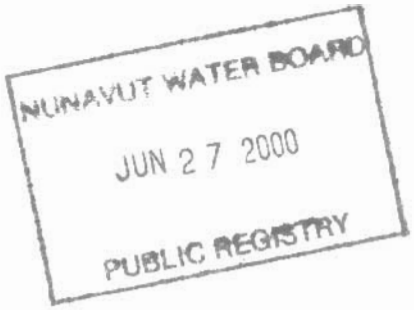
Sanitary Site Environmental Health Risk Assessment & Closure Plan KIMMIRUT, NUNAVUT

Draft Report
April 12, 2000



Sanitary Site -
Environmental Health Risk Assessment & Closure Plan
KIMMIRUT, NUNAVUT

Government of Nunavut
Department of Public Works and Housing

00-7304-2000

Submitted by

Dillon Consulting Limited

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April 12, 2000

DILLON CONSULTING

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Projects Division
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Attention: Mr. Dave Parker
Project Officer

Sanitary Site - Environmental Health Risk Assessment & Closure Plan, Kimmirut, NU.

Dear Mr. Parker;

Please find enclosed five (5) copies of the draft report for the above mentioned project.

We look forward to receiving your comments on this draft report. Should you have any questions regarding this report, please do not hesitate to call.

Yours sincerely,

DILLON CONSULTING LIMITED

Martin Suchy
for
Gary Strong, P.Eng.

Managing Partner

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EXECUTIVE SUMMARY

The Department of Public Works and Housing retained Dillon Consulting Limited (Dillon) to conduct an Environmental Health Risk Assessment and to develop a Closure Plan for the Sanitary Site in Kimmirut. The community has recently expanded as such that new residential housing and recreational developments are required. The Hamlet of Kimmirut wishes to develop the land on which the landfill currently stands for these purposes.

The first section of the report deals with the intrusive investigation, whose purpose was to establish the current environmental condition and identify the presence and extent of contaminants of concern to public health.

Soil and groundwater/surface water samples were collected for subsequent laboratory analysis at Bodycote Technitrol Inc in Pointe Claire Quebec, and compared to existing government guidelines.

Soil and water analyses results are almost entirely below the levels indicated by the selected criteria. Although several samples have some inorganic parameters with concentrations above government guidelines

The closure concept of the sanitary site is the second portion of the report. It was developed based on the regulatory requirements and on the findings of our intrusive investigation. The recommended closure concept, as described in section 5.0, consists of:

- Capping and entombing the solid waste and working face,
- Constructing a drainage ditch around capped area to divert water flow,
- Consolidating the bulky scrap metal and scrap vehicle area into one area,
- Erecting a fence around the scarp metal and capped landfill,
- Providing signs around the site to notify people of the disposal area,
- Monitoring groundwater down gradient of the site on an annual basis,

1.0 INTRODUCTION

1.1 General

The present sanitary landfill site in Kimmirut is located approximately 500 metres south of the community, next to the Petroleum Products Division - Bulk Fuel Storage Facility.

Since 1970, the Hamlet of Kimmirut (previously known as Lake Harbour) has placed waste material in this location. Waste disposal techniques at this landfill site are reported to involve burning, compaction and covering with granular fill materials. The burning has been only partially effective due to limited segregation, while covering is done only occasionally due to limited granular material availability in Kimmirut. Sewage disposal bags (honey bags) and drums containing petroleum hydrocarbons are also reportedly deposited in the landfill. Raw sewage trucked from the community is presently being dumped on site.

The community has recently expanded as such that new residential housing and recreational developments are required. Once the landfill site has been moved to a new location, and abandonment and restoration procedures accomplished, the Hamlet of Kimmirut wishes to develop the land, along with neighbouring properties.

1.2 Objective

The Department of Public Works and Housing (PW&H) - Government of Nunavut, carries as part of it's mandate the planning and implementation of waste disposal facilities in the non tax based communities of Nunavut. It is through this mandate that PW&H retained Dillon Consulting Limited (Dillon) in Iqaluit to complete an Environmental Health Risk Assessment and Closure Plan at the former landfill site. The purpose of the project is to; complete an environmental risk assessment of the site using a soil and water testing program, define the level of existing contamination, identify any evidence of environmental impairment related to the former landfill site, to determine the extent and nature of subsurface contamination, and to develop a conceptual design for the site closure.

This report documents the work under taken in this study, which includes the following:

- compilation and review of historical information related to the landfill site;
- delineation and mapping of the horizontal and vertical extent of the landfill site and characterization of the nature and extent of contaminant releases;
- recovery of representative soil, water, groundwater and leachate samples for laboratory analysis to quantify concentrations of deleterious substances;

- comparison of laboratory analysis results to applicable site assessment and/or remediation criteria;
- completion of an impact assessment to establish potential environmental and human health risks and/or effects;
- in conjunction with appropriate stakeholders, identify potential mitigative, risk management or monitoring options for the site;
- recommendations on the application for the Public Health Act and appropriate setbacks;
- development of a detailed closure plan for the site;
- recommendations with respect to development options for lands within the study area.

2.0 BACKGROUND RESEARCH

2.1 Community and Climate

Kimmirut is a coastal Inuit community with approximately 400 residents. It is located on the south end of Baffin Island situated beside the ocean at the northern extremity of Westbourne Bay within North Bay. See **Figure 1**. The local economy is based on subsistence hunting, trapping, fishing, carving and a growing tourism industry. The development of Katannilik Territorial Park Reserve on the Soper River is expected to increase tourism in the community in the future.

The community has the following services: government offices, school, visitor centre, nursing station, diesel generator plant, airport, Kimik Co-op and Northern Store. Access to Kimmirut is limited to small propeller (Twin Otter) aircraft year round, a snowmobile trail to Iqaluit in winter, and marine sea-lift in the summer.

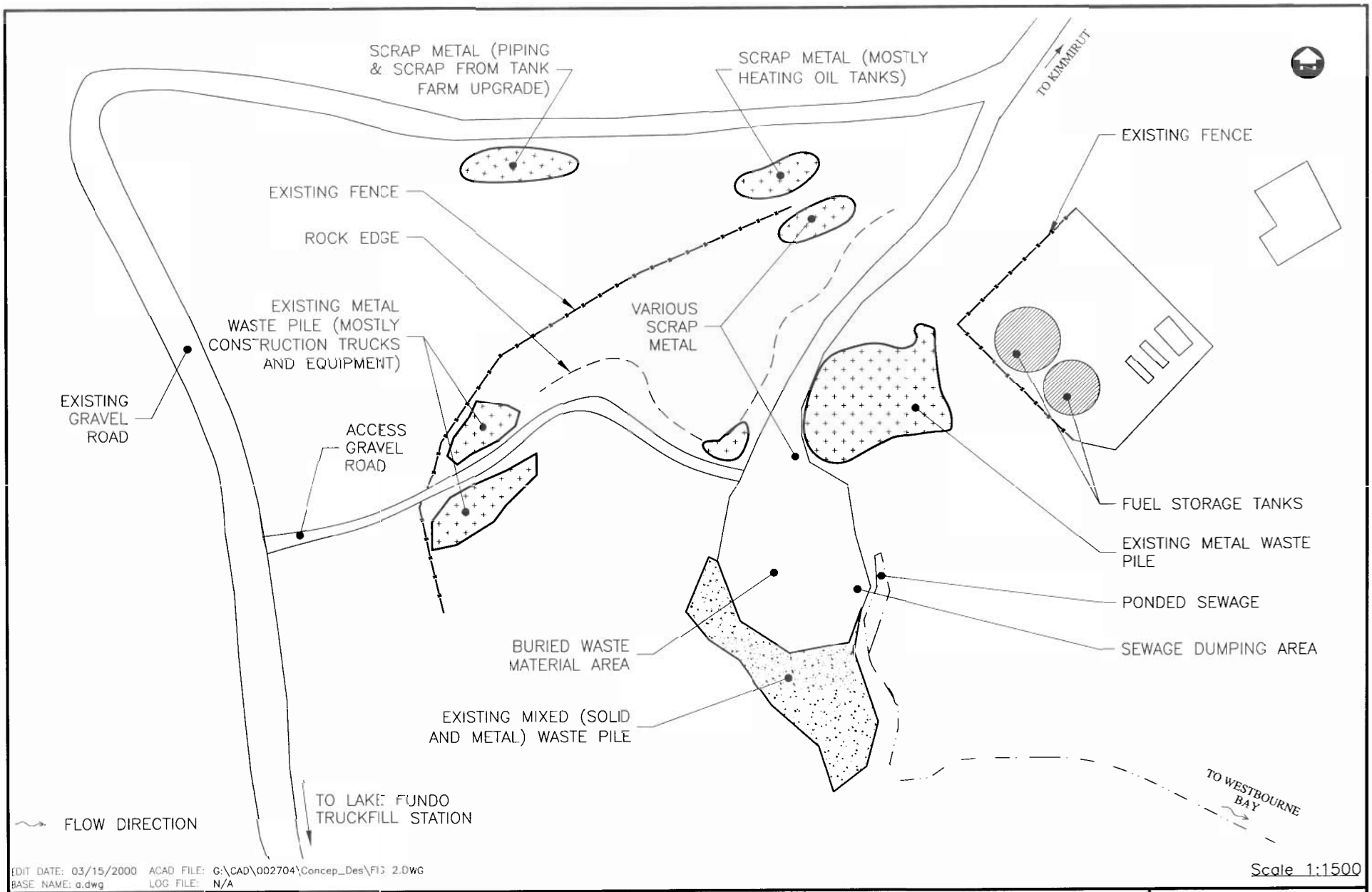
Kimmirut has an arctic climate, although milder than most other communities on Baffin Island. The January and July mean temperatures are -20°C high / -27.2°C low and 12.2°C high / 3.9°C low respectively. The annual precipitation is made up of 20.2 cm of rainfall and 210.1 cm of snowfall for a total of 41.2 cm of precipitation. The prevailing winds are north and south at 9 to 18 knots.

2.2 Existing Site

The existing sanitary site is located next to the Bulk Fuel Storage Facility, along the road leading to the truck-fill station, approximately 500 metres south of the community. The site is in a shallow valley with low rock ridges on three sides (**Photographs 1**). The fourth side to the east drops to a ravine which drains east approximately 400 metres to the harbour (**Photograph 2**). The existing site has been in use since approximately 1970, 10 years longer than typical design life for a small northern community.

The existing sanitation site includes the solid waste disposal area, a trucked sewage dumping area (**Photograph 3**), a scrap vehicle area (**Photograph 4**), and several bulky metals areas (**Photograph 5** and **6**). A litter control fence is present along the northwestern edge of the site. **Figure 2** indicates a plan view of the existing conditions at the landfill site.

The well vegetated path leading to the harbour, in **Photograph 2**, delineates the path taken by the sewage discharged at the sanitary site.



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PROJECT
KIMMIRUT LANDFILL SITE CLOSURE
KIMMIRUT, NUNAVUT

TITLE
LANDFILL SITE – PLAN VIEW
EXISTING CONDITIONS

PROJECT NUMBER
00–7304

DATE
MARCH 2000

FIGURE NUMBER
FIG 2

2.2 Previous Reports

Several previous studies on sanitation and water supply in Kimmirut were identified. Existing reports include:

- Lake Harbour Water, Sewage, and Garbage Pre-design Report, Department of Public Works, Government of Northwest Territories, November, 1974.
- Lake Harbour Water, Sewage , and Garbage Pre-design Report, Department of Public Works, Government of Northwest Territories, April, 1980.
- Lake Harbour Water Supply Evaluation, UMA Engineering Ltd., February 1986.
- General Terms of Reference for a Community Water and Sanitation Service Study, Community Works and Capital Planning Division, Department of Municipal and Community Affairs, Government of Northwest Territories, December 1986.
- Future Development Study for Lake Harbour, Department of Municipal and Community Affairs, Government of Northwest Territories, 1993.
- Sanitation Site Planning Study - Lake Harbour, NWT, M.M. Dillon Limited, December 1994.

3.0 FIELD INVESTIGATIONS

3.1 General

In the fall of 1999, Martin Suchy and Mike Cunningham of Dillon visited the Kimmirut site. The site investigations involved an meeting with Mr. Ken Stewart (SAO), soil and water sample collection, and a topographic survey of the existing sanitary site.

A total of 9 soil and 6 water/groundwater samples were recovered from the site. This includes one soil and water background samples. See **Figure 3** for sample locations.

Target parameters and testing rationale for soil and water samples are identified in **Table 1** on page 8.

The field investigation addresses areas of suspected soil and water contamination. At the Kimmirut Sanitary Site, the most likely locations for contamination are:

- areas surrounding present dumping location.
- area down gradient of dump face.

Sampling priority was assigned by comparing the relative potential for the following in each suspect area:

- impact beyond the immediate source of risk.
- likely extent of contamination.
- proximity to sensitive receptors.
- potential for further contamination.

3.2 Method of Investigation

Field QA/QC programs were implemented for both soil and groundwater sampling. Our approach to the intrusive investigation was as follows:

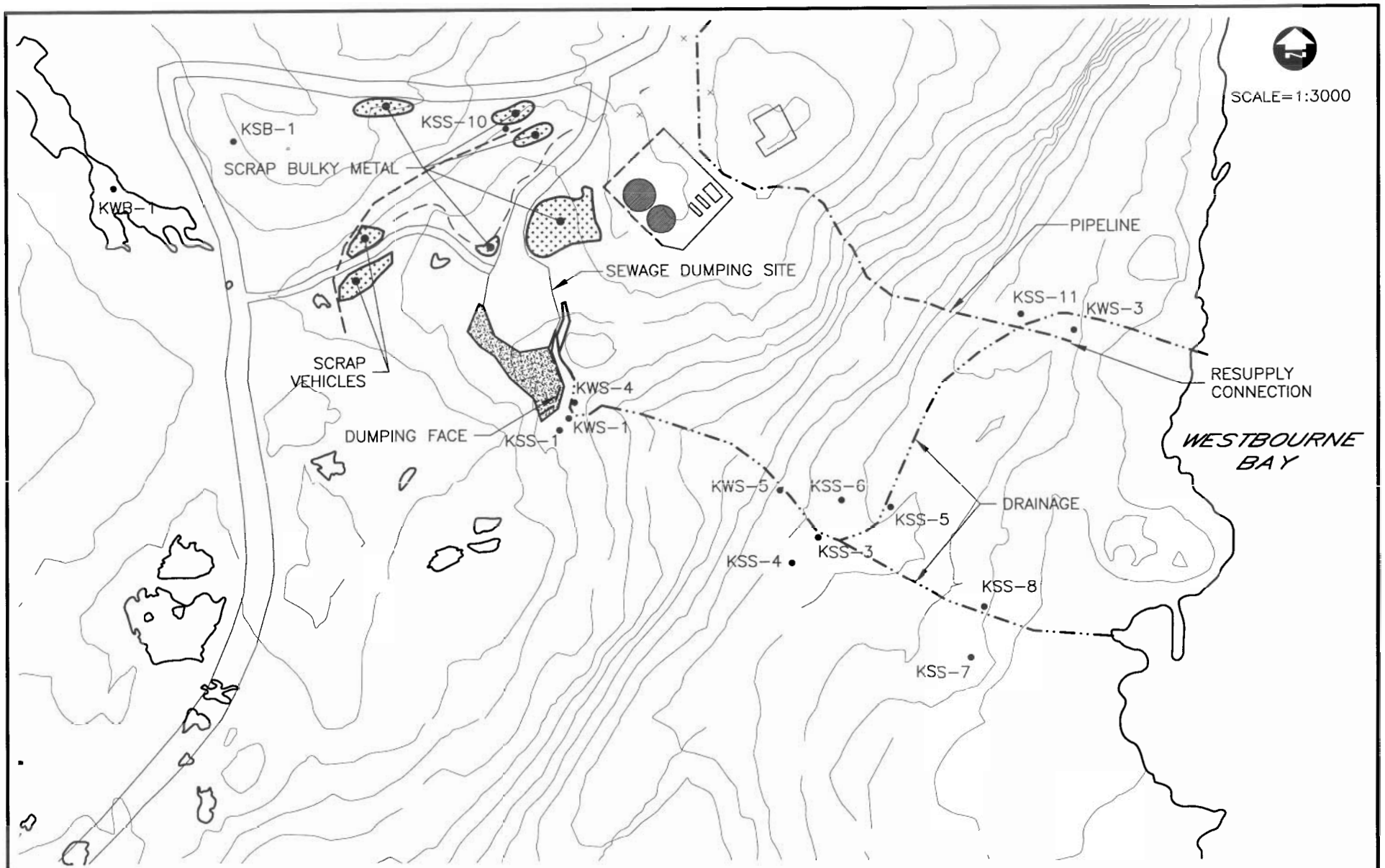
- excavate a series of test pits using hand tools,
- at each test pit location, recover a representative soil sample,
- samples were not to be collected from below the active layer of permafrost,
- recovered soil samples were immediately placed in a laboratory prepared sample jar in accordance with reasonable standard field sampling protocols,
- a set of "background" samples were recovered from test pits in an undisturbed area outside the limits of the suspected area of contamination,
- samples were analysed for selected parameters,

Representative water samples were recovered using dedicated sampling equipment where standing water was located in low-lying areas and where groundwater accumulated in test pits:

- the test pits were purged prior to sampling to ensure the recovery of representative samples,
- recovered water samples were filtered and preserved as required, then placed in laboratory prepared sample jars,

Table 1
Soil an Water Analytical Program

Constituent	Sample Type		Rationale
pH	soil water	yes yes	may identify presence of acids, bases, glycols
Electrical Conductivity	soil water	yes yes	may indicate presence of dissolved ions
Metal scan, including arsenic and mercury	soil water	yes yes	may indicate presence of metal ions
Benzene, Toluene, Ethyl benzene, Xylene (BTEX range)	soil water	yes yes	will indicate presence of petroleum product contaminants
Total Petroleum Hydrocarbons (C_3-C_{32} range)	soil water	yes yes	will indicate presence of petroleum product contaminants
Phenol	soil water	yes yes	screen samples, identify other analysis as required
PAH's	soil water	yes yes	analyse limited number of samples, identify target samples as above and based on staining
Dioxins/Furans	soil water	yes no	screen a limited number of composite samples, analyse additional samples as required
Total Glycols	soil water	yes yes	screen a limited number of composite samples, analyse additional samples as required
PCB's	soil water	yes yes	screen a limited number of composite samples, analyse additional samples as required
VOC Scan	soil water	yes no	screen a limited number of composite samples, analyse additional samples as required



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DILLON CONSULTING

PROJECT
SANITARY SITE
ENVIRONMENTAL HEALTH RISK ASSESSMENT & CLOSURE PLAN

TITLE
KIMMIRUT, NUNAVUT
SAMPLE LOCATIONS

PROJECT NUMBER
00-7304

DATE
MARCH 2000

FIGURE NUMBER
FIG 3

3.3 Analytical Testing

Once extracted from the ground, soil and water samples were transferred to laboratory prepared glass/plastic jars, then refrigerated (kept below 4°C) prior to shipment. Samples were submitted for chemical analysis to Bodycote Technitrol Inc in Pointe Claire Quebec, a 51% Inuit laboratory, which is accredited by the Canadian Association for Environmental Analytical Laboratories (CAEAL).

3.4 Assessment Criteria

In order to determine the significance of the laboratory analysis, the analytical results were compared to existing assessment and/or remediation criteria that are determined by Territorial/Provincial and Federal government agencies. These criteria provide a numerical value to compare with the analytical results. If the analytical results exceed the criteria, significant impacts may be possible to human and environmental health. Assessment criteria considered applicable for comparison with soil and water analytical results from the Kimmirut sanitary site include:

- Canadian Council of Ministers of the Environment (CCME), 1999. Canadian Environmental Guidelines, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health - Industrial, Commercial, Residential/Parkland, and Agricultural criteria, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater Aquatic Life Criteria.

- Government of the Northwest Territories, Department of Renewable Resources, Wildlife and Economic Development (GNWT), 1998. Environmental Guidelines for Site Remediation - Both Commercial/Industrial Criteria and Residential criteria are shown.

The above mentioned guidelines have been adopted by the Government of Nunavut, Department of Sustainable Development.

3.5 Results

3.5.1 Soil Analyses

Soil analyses results are provided in **Table 2**, on pages 12 to 14. Analyses results revealed that all but one sample, including the background sample (KSB-1) collected off-site, contain elevated concentrations of titanium. Sample KSS-10 (**Photograph 6**), collected near scrap heating oil tanks contained nickel concentrations above criteria (122 ppm compared to industrial criteria of 50 ppm). Sample KSS-3 (**Photograph 7**), collected 160 metres down gradient of the dump face, exhibited Antimony concentrations of 30 ppm. This value lies between the parkland/residential and industrial

criteria levels of 20 and 40 ppm, respectively. Otherwise, no samples had any elevated concentrations of organic parameters.

3.5.2 Water Analyses

Four inorganic parameters; aluminium, copper, iron and zinc exhibit concentrations above Canadian Freshwater Aquatic Life criteria in 5 of 6 samples. Elevated iron concentrations (360 ppm), slightly above selected criteria (300 ppm), were also present in the background sample KWB-1. All analyses results from inorganic parameters such as; Phenols, Glycols, PCB's, and all Hydrocarbons, did not exhibit any elevated concentrations. A further selection of photographs showing sample locations are provided in **Appendix A**. Detailed water analyses results are provided in **Table 3** on pages 15 to 16. Original Laboratory Certificates are provided in **Appendix B**.

TABLE 2: Soil Analyses Results
Kimmirut Sanitary Site
concentrations are mg/kg (ppm) unless otherwise noted

constituents	year revised	parkland/ residential	industrial	KSB-1 background	KSS-1 dump face	KSS-3 midway	KSS-4 midway	KSS-5 midway	KSS-6 midway	KSS-7 shore	KSS-8 shore	KSS-10 scrap metal	KSS-11 shore
General Parameters													
Conductivity (µmhoms/cm)			4	12	190	120	190	67	79	31	67	75	160
pH		6 to 8	6 to 8	7.2	7.3	8.1	7.5	7.2	7.2	7.2	7.2	7.7	7.8
Inorganic Parameters													
Aluminum	-	NS	NS	11200	6250	4320	5000	3100	3830	4700	3400	6380	3030
Antimony	1991	20	40	20	<10	<10	**30**	10	<10	<10	<10	10	30
Silver	1991	20	40	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Arsenic	1997	12	50	<0.5	<0.5	1	0.8	<0.5	<0.05	<0.05	<0.5	1.8	0.7
Barium	1999	500	2000	257	29	24	40	66	29	28	34	54	38
Berylium	1991	4	8	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Boron	-	NS	NS	2	8	43	28	7	5	6	7	2	34
Bismuth	-	NS	NS	<20	<10	<10	<10	<10	<10	<10	<10	<20	<10
Cadmium	1999	10	27	**<1**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Calcium	-	NS	NS	1800	7320	78000	53000	45800	9060	3040	8980	5830	52000
Chromium (total)	1997	64	87	40	15	5	7	7	7	12	8	11	6
Cobalt	1991	50	300	8	14	3	3	4	10	5	6	15	5
Copper	1999	63	91	23	19	5	9	50	15	15	29	18	15
Tin	1991	50	300	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Iron	-	NS	NS	31000	14000	5600	9900	20000	9900	14000	9400	35000	8700
Lithium	-	NS	NS	39	6	2	3	3	4	4	3	8	2
Magnesium	-	NS	NS	17000	3400	120000	69000	13000	7800	11000	8300	11000	71000
Manganese	-	NS	NS	84	241	764	469	112	255	248	362	186	583
Mercury	1999	6.6	50	<0.03	<0.03	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	0.03	0.06
Molybdenum	1991	10	40	4	4	<2	<2	<2	<2	<2	<2	5	<2
Nickel	1991	50	50	25	27	7	8	16	31	10	13	**122**	18
Lead	1999	140	600	<10	<10	20	10	20	<10	<10	<10	<10	<10
Potassium	-	NS	NS	6560	590	350	525	570	580	510	570	520	410
Selenium	-	NS	NS	0.7	3.3	0.9	1.1	0.8	1.1	0.6	1.5	1.3	1
Silicium	-	NS	NS	343	640	373	547	643	506	522	769	627	302
Sodium	-	NS	NS	133	170	96	80	105	80	75	110	130	125
Titanium	1997	130	130	**2600**	**668**	123	**263**	**215**	**221**	**357**	**254**	**553**	**200**
Vanadium	1999	200	360	73	22	8	13	7	10	21	13	16	9
Zinc	-	NS	NS	22	93	55	64	108	38	64	30	89	97
Total Phosporous				120	980	145	670	3460	430	430	670	420	810

TABLE 2: Soil Analyses Results (continued)
Kimmirut Sanitary Site
concentrations are mg/kg (ppm) unless otherwise noted

constituents	year revised	parkland/ residential	industrial	KSB-1 background	KSS-1 dump face	KSS-3 midway	KSS-4 midway	KSS-5 midway	KSS-6 midway	KSS-7 shore	KSS-8 shore	KSS-10 scrap metal	KSS-11 shore
Monocyclic Aromatic Hydrocarbons													
Benzene	1997	0.5	5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Toluene	1997	0.8	0.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	1997	1.2	20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Xylene	1997	1	20	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorobenzene	1991	1	10	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Styrene	1991	5	50	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,2-Dichlorobenzene	1991	1	10	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,3-Dichlorobenzene	1991	1	10	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,4-Dichlorobenzene	1991	1	10	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Total				NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Extractable & Purgeable Hydrocarbons													
C_6 to C_{10}	-	NS	NS	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
C_{11} to C_{22}	-	NS	NS	<50	<50	<50	<50	<50	<50	<50	<50	<50	54
C_{23} to C_{32}	-	NS	NS	<50	<50	<50	<50	310	55	<50	<50	<50	100
Total Petroleum Hydrocarbons (TPH)*	1998	NS	2500*	ND	ND	ND	ND	310	55	ND	ND	ND	154
Phenolic Compounds													
Phenols (colorimetry)	1997	3.8	3.8 (4AAP)	NT	0.48	NT	0.33	NT	NT	NT	0.11	NT	NT
Glycols													
Glycol-diethylene	1991	-	-	NT	<5	NT	<5	NT	NT	NT	NT	NT	NT
Glycol-ethylene	1991	-	-	NT	<5	NT	<5	NT	NT	NT	NT	NT	NT
Glycol-propylene	1991	-	-	NT	<5	NT	<5	NT	NT	NT	NT	NT	NT
Polychlorinated biphenyls (PCB's)													
Aroclore 1242	-	NS	-	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Aroclore 1248	-	NS	-	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Aroclore 1254	-	NS	-	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Aroclore 1260	-	NS	-	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Total PCB	1999	1.3	33	NT	ND	NT	ND	NT	NT	NT	NT	NT	NT
Chlorinated Hydrocarbons				NT	<0.6	NT	<0.6	NT	NT	NT	NT	NT	NT
Chloroform	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,1-Dichloroethane	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,1-Dichloroethene	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,1-Dichloroethene	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT

TABLE 2: Soil Analyses Results (continued)
Kimmirut Sanitary Site
concentrations are mg/kg (ppm) unless otherwise noted

constituents	year revised	parkland/ residential	industrial	KSB-1 background	KSS-1 dump face	KSS-3 midway	KSS-4 midway	KSS-5 midway	KSS-6 midway	KSS-7 shore	KSS-8 shore	KSS-10 scrap metal	KSS-11 shore
Chlorinated Hydrocarbons (continued)													
1,2-Dichloroethene (t+c)	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,2-Dichloropropane	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,3-Dichloropropane (t+c)	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Dichloromethane	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,1,2,2-Terachloroethane	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Tetrachloroethene	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Carbon tetrachloride	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
1,1,1-Trichloroethane	-	NS	NS	NT	<0.1	NT	<0.1	NT	NT	NT	NT	NT	NT
Trichloroethane	-	NS	NS	NT	ND	NT	ND	NT	NT	NT	NT	NT	NT
Total	-	NS	NS	NT	ND	ND	ND	NT	NT	NT	NT	NT	NT
PCDDs and PCDFs (dioxins and furans)	1991	1000 µg/g	NS	NT	98 µg/g	NT	ND	NT	NT	NT	NT	NT	NT
Polycyclic Aromatic Hydrocarbons (PAH's)													
Benzo(a)anthracene	1991	1	10	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Benzo(b,j,k)fluoranthene	1991	1	10	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Benzo(a)pyrene	1997	0.7	0.7	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
3-Methylcholanthrene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Indeno(1,2,3-cd)pyrene	1991	1	10	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Dibenzo(a,h)anthracene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Dibenzo(a,l)pyrene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Dibenzo(a,i)pyrene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Dibenzo(a,h)pyrene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Pyrene	1991	10	100	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Naphthalene	1997	0.6	22	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Phenanthrene	1991	5	50	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Acenaphthene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Anthracene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Chrysene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Fluoranthene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Fluorene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Benzo(g,h,i)perylene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Benzo(c)phenanthene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
Acenaphthylene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT
7,12-Dimethylbenzoanthracene	-	NS	NS	NT	<0.2	<0.1	<0.1	NT	NT	NT	NT	NT	NT

NOTES: NT - Not Tested; NS - Not Specified; **BOLD** - values exceed criteria

ND - Not Detected; * GNWT Environmental Guidelines for Site Remediation

TABLE 3: Water Analyses Results
Kimmirut Sanitary Site
concentrations are (µg/L) (ppb) unless otherwise noted

constituents	year revised	Freshwater Aqautic Life	KWB-1 background	KWS-1 leachate	KWS-2 shore	KWS-3 shore	KWS-4 effluent	KWS-5 midway
General Parameters								
Conductivity	-	NS	600	1140	900	670	970	930
pH	1987	6.5 to 9	8	7.5	7.6	7.2	7.4	7.6
Inorganic Parameters								
Aluminum	1987	5 to 100	20	20	50	10	**3300**	**110**
Antimony	-	NS	2	4	1	1	1	1
Silver	1987	0.1	<1	<1	<1	<1	<1	<1
Arsenic	1997	5	<1	<1	<1	<1	<1	<1
Barium	-	NS	30	30	10	20	10	10
Berylium	-	NS	<10	<10	<10	<10	<10	<10
Boron	-	NS	20	180	140	50	190	160
Bismuth	-	NS	<100	<100	<100	<100	<100	<100
Cadmium	1996	0.017	<1	<1	<1	<1	<1	<1
Calcium	-	NS	88000	102000	46000	71000	23000	84000
Chromium	-	NS	4	7	5	4	6	24
Cobalst	-	NS	<1	8	2	<1	<1	4
Copper	1987	2 to 4	4	**5**	1.4	2	**37**	8
Tin	-	NS	<10	10	<10	<10	<10	<10
Iron	1987	300	**360**	**20000**	**2800**	280	**1700**	**4800**
Lithium	-	NS	<20	<20	<20	<20	<20	<20
Magnesium	-	NS	18000	17000	9200	27000	6200	15000
Manganese	-	NS	10	1100	260	8	70	530
Mercury	1987	0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum	1999	73	3	5	1	2	<1	1
Nickel	1987	25 to 150	4	26	12	3	6	21
Lead	1987	1 to 7	<1	2	4	<1	**17**	2
Potassium	-	NS	800	12000	14000	3000	17000	12000
Silicium	-	NS	820	3500	3300	6900	6100	3700
Sodium	-	NS	11000	40000	50000	32000	67000	44000
Titanium	-	NS	<10	<10	<10	<10	<10	<10
Vanadium	-	NS	<30	<30	<30	<30	<30	<30
Zinc	1987	30	10	**40**	**50**	20	**120**	20
Monocyclic Aromatic Hydrocarbons								
Benzene	1999	370	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	1996	2.0	<0.1	<0.1	<0.1	<0.1	0.8	<0.1
Ethylbenzene	1996	90	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Xylene	-	NS	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Extractable & Purgeable Hydrocarbons								
C_6 to C_{10}	-	NS	<25	<25	<25	<25	<25	<25
C_{11} to C_{22}	-	NS	<50	69	51	<50	740	68
C_{23} to C_{32}	-	NS	<50	91	100	<50	2300	270
Total Petroleum Hydrocarbons (TPH)	-	NS	ND	160	151	ND	3040	338
Phenol								
Phenols (colorimetry)	not compatible		21	14	22	9	170	24
CCME criteria for Phenols (mono- & dihydric)	1999	4	NT	NT	NT	NT	NT	NT
Glycols								
Glycol-diethylene	-	NS	NT	<5	<5	<5	NT	NT
Glycol-ethylene	1997	192000	NT	<5	<5	<5	NT	NT
Glycol-propylene	1997	500000	NT	<5	<5	<5	NT	NT

TABLE 3: Water Analyses Results (continued)
Kimmirut Sanitary Site
concentrations are (µg/L) (ppb) unless otherwise noted

constituents	year revised	Freshwater Aqautic Life	KWB-1 background	KWS-1 leachate	KWS-2 shore	KWS-3 shore	KWS-4 effluent	KWS-5 midway
Polychlorinated biphenyls (PCB's)								
Aroclore 1242	-	NS	NT	<0.1	<0.1	<0.1	NT	NT
Aroclore 1248	-	NS	NT	<0.1	<0.1	<0.1	NT	NT
Aroclore 1254	-	NS	NT	<0.1	<0.1	<0.1	NT	NT
Aroclore 1260	-	NS	NT	<0.1	<0.1	<0.1	NT	NT
Total PCB	1987	0.001	NT	ND	ND	ND	NT	NT
Polycyclic Aromatic Hydrocarbons (PAHs)								
Acenaphthene	1999	5.8	NT	<0.3	<1.6	<0.1	NT	NT
Anthracene	1999	0.012	NT	<0.3	<1.6	<0.1	NT	NT
Chrysene	1999	NS	NT	<0.3	<1.6	<0.1	NT	NT
Fluoranthene	1999	0.04	NT	<0.3	<1.6	<0.1	NT	NT
Fluorene	1999	3	NT	<0.3	<1.6	<0.1	NT	NT
Naphthalene	1999	1.1	NT	<0.3	<1.6	<0.1	NT	NT
Phenanthrene	1999	0.4	NT	<0.3	<1.6	<0.1	NT	NT
Pyrene	1999	0.025	NT	<0.3	<1.6	<0.1	NT	NT
Acenaphthylene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Dibenzo(a,h)anthracene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
7,12-Diimethylbenzoanthracene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Benzo(g,h,i)perylene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Benzo(c)phenanthrene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Benzo(a)anthracene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Benzo(b,j,k)fluoranthene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Benzo(a)pyrene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
3-Methylcholanthrene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Indeno(1,2,3-cd)pyrene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Dibenzo(a,l)pyrene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Dibenzo(a,i)pyrene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Dibenzo(a,h)pyrene	-	NS	NT	<0.3	<1.6	<0.1	NT	NT
Total	-	NS	NT	ND	ND	ND	NT	NT

NOTES:

NT - Not Tested
ND - Not Detected
NS - Not Specified
BOLD - values exceed criteria

4.0 STAKEHOLDERS

4.1 Background

The need for a risk assessment was partially initiated by the Department of Health, Government of Nunavut. Their concern relates to the Health Act requirement for a 450 metre set back from a waste disposal facility to any building used for human habitation. In particular the "General Sanitation Regulations, Public Health Act" P-16 item 8 states:

> "No building used for human habitation shall be:
>
> - nearer than 450 m to a waste disposal ground; or
> - on any site, the soil of which has been made up of any refuse, unless the refuse has been removed from the site or has been consolidated or the site has been disinfected in every case and the site has been approved by a health officer.

The Hamlet of Kimmirut has a desire to develop the area of land within the 450m setback from the landfill site for residential and recreational purposes. **Figure 4** illustrates the range of the 450 m "buffer zone" and the overlap with the proposed southern community expansion. However, due to the concern related to the landfill, permission for development may not be granted. This may come in the form of denial of a land lease or restrictions placed by the Department of Health. Based on this history there are a number of stakeholders:

- Department of Health, Baffin Region, Bonnie Segal
- Department of Community Government & Transportation, Baffin Region, Doug Sitland
- Department of Public Works and Housing, Baffin Region, Dave Parker
- INAC, Baffin Region, Phillip Lavalee
- Environment Canada, Francois Rainville
- Department of Fisheries and Oceans, Julie Dahl
- Department of Sustainable Development, Earl Bubbaloo
- The Hamlet of Kimmirut
- The Nunavut Water Board, Dione Filliatrult, P. Eng.
- The Nunavut Impact Review Board, Jayda Edwards
- Hunters and Trappers Organization

Under an agreement with Public Works and Housing, interviews will not be held with the stakeholders. Instead, the stakeholders will receive a draft report, and will be asked to comment on proposals brought forward, indicating whether the requirements would satisfy their needs, and to contribute any new suggestions and/or ideas. Furthermore, stakeholder debriefings from a similar study performed upon the closure of the Pond Inlet Sanitary Site were considered.

The Department of Health's closure requirements would require at a minimum of the following:

- Consolidation of the waste,
- The issues of long term exposure and chronic effects be addressed
- Proper capping material is placed over the waste,
- Monitoring of the site is completed,
- The site is used for appropriate land use,
- The site needs to be delineated on community mapping to indicate that the site was a former waste site, and the community plan needs to respect the restrictions that may be placed on the future development of the site by the Health Department.

The Department of Health will be the key regulator for the closure of the site. The process for the site to be deregulated and allow for the development within the 450m setback is as follows:

- The proponent (PW&H) makes an application to the Chief Medical Health Officer, Dr. A. Roberts. The Application is to include the reasons for the request. It was stressed that the reasons need to be clear.

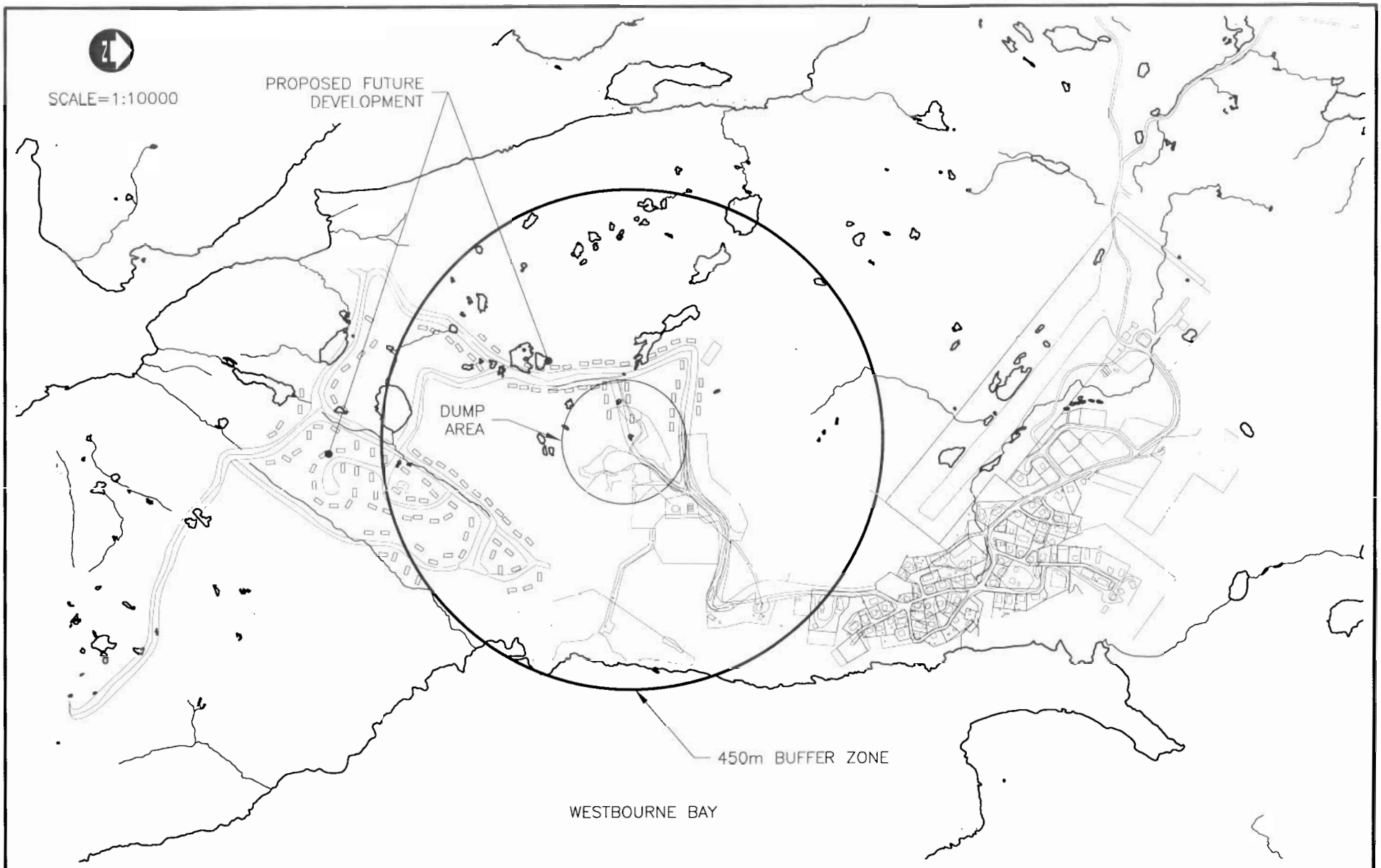
- The Chief Medical Health Officer can reject the application, request more information, or accept the application. If the Chief Medical Health Officer agrees with the application, she will forward the application with her recommendation to the Deputy Minister of Health.

- The Deputy Minister of Health can reject the application, request further information, or forward the application to the Deputy Minister of Justice.

- The Deputy Minister of Justice reviews the application, and if he agrees with it, forwards it to the Commissioner.

- Once the commissioner has reviewed the application, if he agrees with the application, it is signed, and the exemption to the Public Health Act for the site is placed in the Consolidation of General Sanitation Exemption Regulations.

At the successful conclusion of the above process, the site would not require a set back with respect to the Public Health Act. The site may have future land use restrictions. These could restrict future land use to passive development such as a baseball park that does not use the site for building development.



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DILLON CONSULTING

PROJECT
SANITARY SITE
ENVIRONMENTAL HEALTH RISK ASSESSMENT & CLOSURE PLAN

TITLE
KIMMIRUT, NUNAVUT
BUFFER ZONE

PROJECT NUMBER
00-7304

DATE
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FIGURE NUMBER
FIG 4

5.0 CLOSURE PLAN

5.1 Introduction

The presence of a contaminant alone does not in itself constitute chronic risk to human health or the environment. For risk to exist there is a requisite for three key elements to be present: a source; receptors; and pathways. The management of risk is focussed on the control (or elimination) of one or more of the elements.

From the earlier described investigation the landfill can be characterized as a low source of potential contamination to local receptors (the public and the environment). The contaminants appear to be contained with the landfill with minimal evidence of migration through shallow soil or ground water. As a result the only apparent chronic exposure scenarios are through direct contact with the contaminants within the landfill waste material or through wind entrainment of the contaminants followed by inhalation or ingestion offsite. Since elimination of either the source or the receptors is not feasible, consideration should be given to isolation of the contaminants through engineered covers.

5.2 Land Use and Receptor Characterization

The current land use of the site is a landfill. It is possible that the site will be used at some future date for passive or active recreation use, and/or other development for other site development activities. For the purpose of this assessment it has been assumed that the landfill area will be used for an active recreation site. It is noted that this land use provides the greatest access to the site by potential receptors, and is therefore the most conservative approach for the health assessment.

5.3 Exposure Pathways Screening

The use of the site as a park area indicates that there will be human exposure to soils and surficial water located on or flowing through the site. It will be likely that members of the community will routinely use the site. Therefore a risk assessment of a person using the site will be required.

The land directly adjacent (up-gradient) to the landfill site is proposed to be developed into residential housing units. It is recognized that a person would have opportunity to access the areas around the site, even in the event that the landfill proper is not used as a future recreational area. Therefore a risk assessment of a person using an adjacent area will be required.

Based on the results of the intrusive investigation, there are small amounts of contaminants of concern leaving the landfill area through migration in the soils and/or ground water. From this, it can be assumed that direct contact, either through ingestion or dermal contact is unlikely outside the land fill

area. This relates to the direct contact of soils and surficial water located on site, but not to up-gradient adjacent lands.

There are contaminants of concern within the landfill proper. Though these have not been specifically delineated with respect to contaminant volumes or soil and ground water concentrations, it is reasonable to assume that there are contaminants of concern related to metals, hydrocarbons, and organics. Exposure pathways for these contaminants would be through direct ingestion and/or dermal contact with the soils or surficial water located on the site.

Ingestion of the ground water (not related to surficial site ponding) is not an issue for this site as the ground water is not used for potable water, irrigation, or other use. There is no expected use of the ground water in the future. Therefore a risk assessment of the ground water is not required for this site. It should be noted that even though there is no use of the ground water, the samples recovered from the intrusive investigation indicated that there were a few minor elevated levels of contaminants above background levels in the water samples, and therefore risk to human health from this pathway is unlikely.

The last area of risk to human health is direct physical hazards that are created by the exposed waste on the landfill site. The presence of barrels, scrap metal, construction waste and other materials presents a physical hazard to a person that may traverse the site. Small children on the site are exposed to the physical hazards that may cause personal injury. Due to the nature and location of the site this is a likely risk to human health.

5.4 Exposure Pathways Mitigation

The risks identified above are a result of the presence of the physical debris at the site and the contaminated soils at the site being exposed to direct human contact. Mitigating measures require that the pathway between the issues of concern (contaminants of concern and the physical hazards) and human receptors be eliminated. Two approaches are typically used for landfills throughout Canada. These are:

- The installation of an engineered cover over the landfill. This normally includes fill material to a depth that can range from 0.5m to 2.0m. In some cases the use of impermeable or semi-permeable barriers are used in conjunction with the cover material. The barriers can be synthetic or natural materials.

- The installation of a physical barrier to enclose the site from access. This is typically a chain link fence. Signs around the site are placed to deter unauthorized entrance to the area.

The above measures are used separately, or in combination, dependant on the expected future use of the site.

Engineered Cover

The principals of using an engineered cover are to provide a physical barrier to the entombed material. The cover can also provide a means to reduce the generation of leachate, and the subsequent migration of leachate from the waste mass. At the Kimmirut site this has not been demonstrated to be of concern, however, proper site management would suggest that reducing future leachate would be prudent.

The final contouring of the site is developed in a manner that provides for positive drainage of snow-melt and runoff from the centre of the area to the periphery of the site to reduce the infiltration of the water into the waste mass. Because of the topography in which the Kimmirut site lies, drainage from the surrounding rock ridges cannot be diverted off site. Instead, drainage will be kept away from the entombed material through the use of perimeter ditches and berms. The perimeter ditching will also remove runoff from the waste mass proper.

At locations were there is a concern with the generation of leachate that may carry contaminants of concern, a leachate collection system is installed. This is typically a pond with an impermeable barrier installed to retain all site ground water and surface water to one area. The water collected can be treated and the effluent released, or the water is pumped back into the waste mass. Testing in Kimmirut on September 22 1999 indicates that water leaving the site does not contain contaminants of concern above the criteria guidelines, and that the installation of a leachate collection system at this time is not required.

Fencing

Fencing the site will remove the pathway for human exposure to the waste mass and the contaminants of concern. For the fence to be effective, all waste must be enclosed by the fence, and the waste must be prevented from migrating off site. Waste migration may be caused by wind scatter, the mobility of waste through run-off, and the scavenging of waste by residents of the community. Effectively this would require the consolidation and cover of the waste as described above. However, through the installation of a perimeter fence, the bulky metal waste would not require any cover. This is cost effective especially in Kimmirut, where there is a limited supply of granular material.

The fence height should be selected to provide a physical barrier to children in the winter and summer months. Snow accumulation at the site will be accentuated by the fence. Further work on this matter is required to determine the appropriate fence height.

Signs are required around the fenced enclosure to indicate the hazards of the site, and to deter unauthorized access to the site. The signs are to be installed in both Inuktituk and English.

5.5 Conceptual Design

The site closure for the Kimmirut sanitary site would have the following components:

1. The waste should be consolidated and graded prior to the placement of cover over the waste mass. Consolidation of the waste includes the collection of barrels, construction waste and any other debris in the area to a central waste area. The waste mass is to be compacted and contoured. The contours of the waste mass are to reflect the final contours of the site to promote positive drainage.

2. Approximately 0.6 metres of cover material over the waste mass. To ensure that the site does not present any hazards, all waste should have a minimum of the 0.6 metres of cover.

3. Contour the site to a minimum of 4% slope. Side slopes of the cover should have a slope of 6:1 to prevent erosion.

4. Install perimeter ditches and berms to remove the runoff water from the site.

5. Re-vegetate the cover material to prevent wind and water erosion of the cover material. If re-vegetation is not possible or required, the installation of course granular material should be completed to prevent erosion.

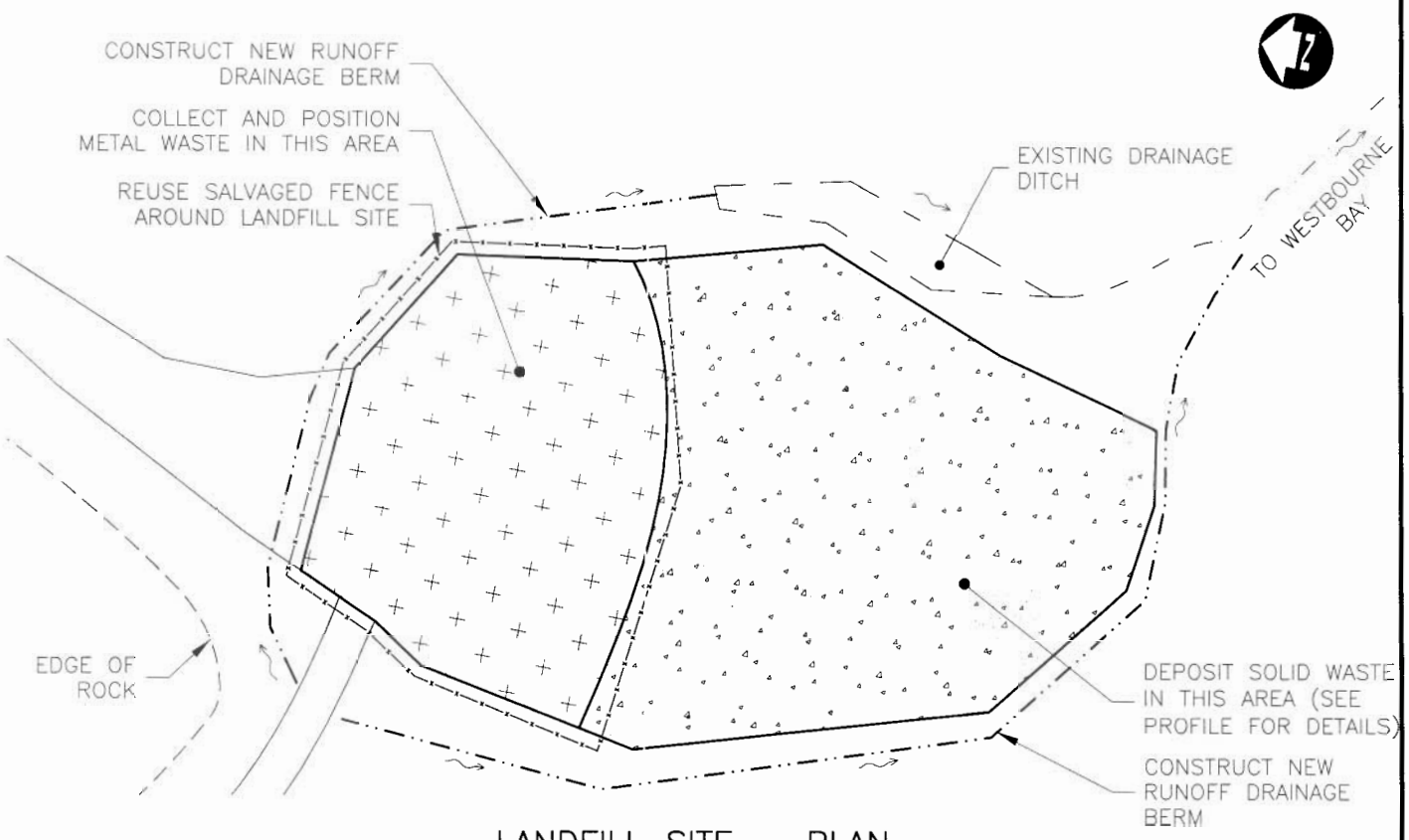
6. Consolidation of scrap metal and scrap vehicles from separate areas (see **Figure 2**) into one pile atop the covered solid waste mass.

7. Enclose the scrap metal with a chain link fence. The present fence used to contain wind blown debris can re-used and modified if necessary.

The use of granular material or vegetative cover for the final layer of the closure will be dependant on the proposed land use of the site. **Figures 5** and **6** on pages 24 and 25 illustrate the components of the conceptual design.

5.6 Site Monitoring

The closure of the site as described in the previous sections is intended to mitigate against human health concerns. These concerns were raised by the Department of Health, Government of Nunavut. To demonstrate that the closure methods have been successful, and to provide a means of monitoring the site, the following monitoring program is recommended. It is suggested that the monitoring program be established in the first year using a qualified sampling and testing firm, and that the first year is also used to train the Hamlet staff to complete the subsequent years of sampling. The program is set up to establish the first few years of data to compliment the work that was completed in this study. After the



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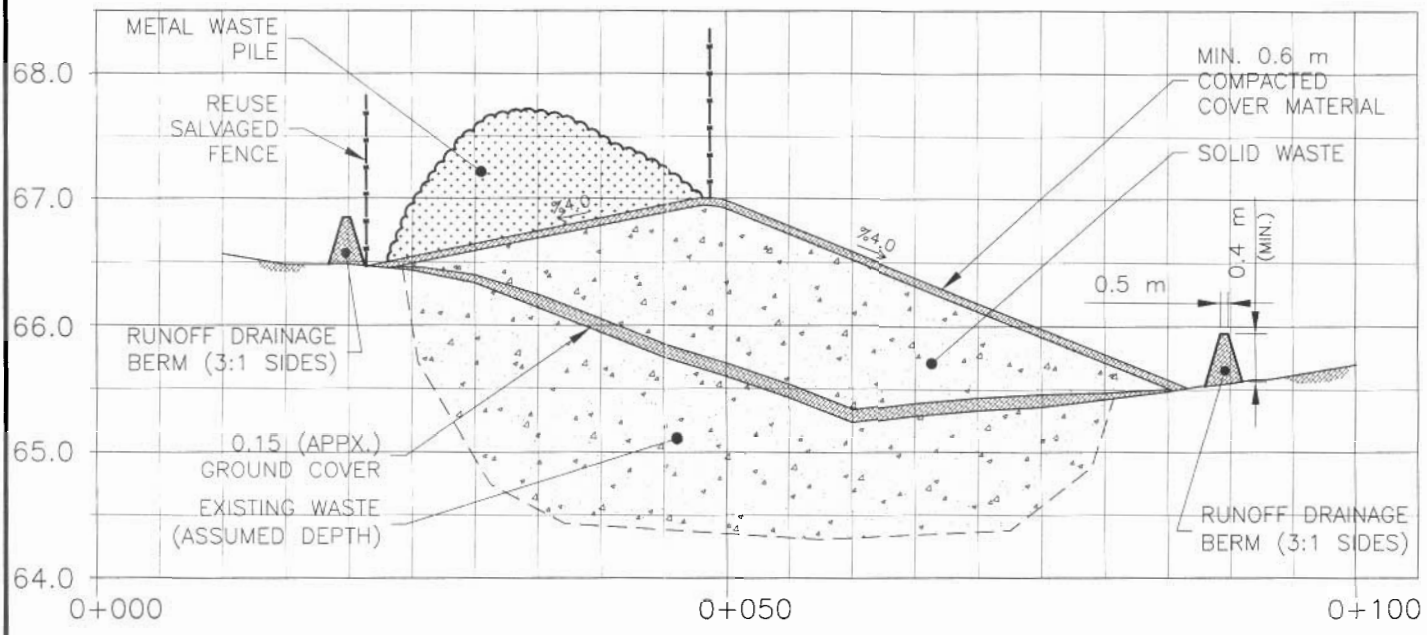

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RUNOFF FLOW DIRECTION

DILLON CONSULTING

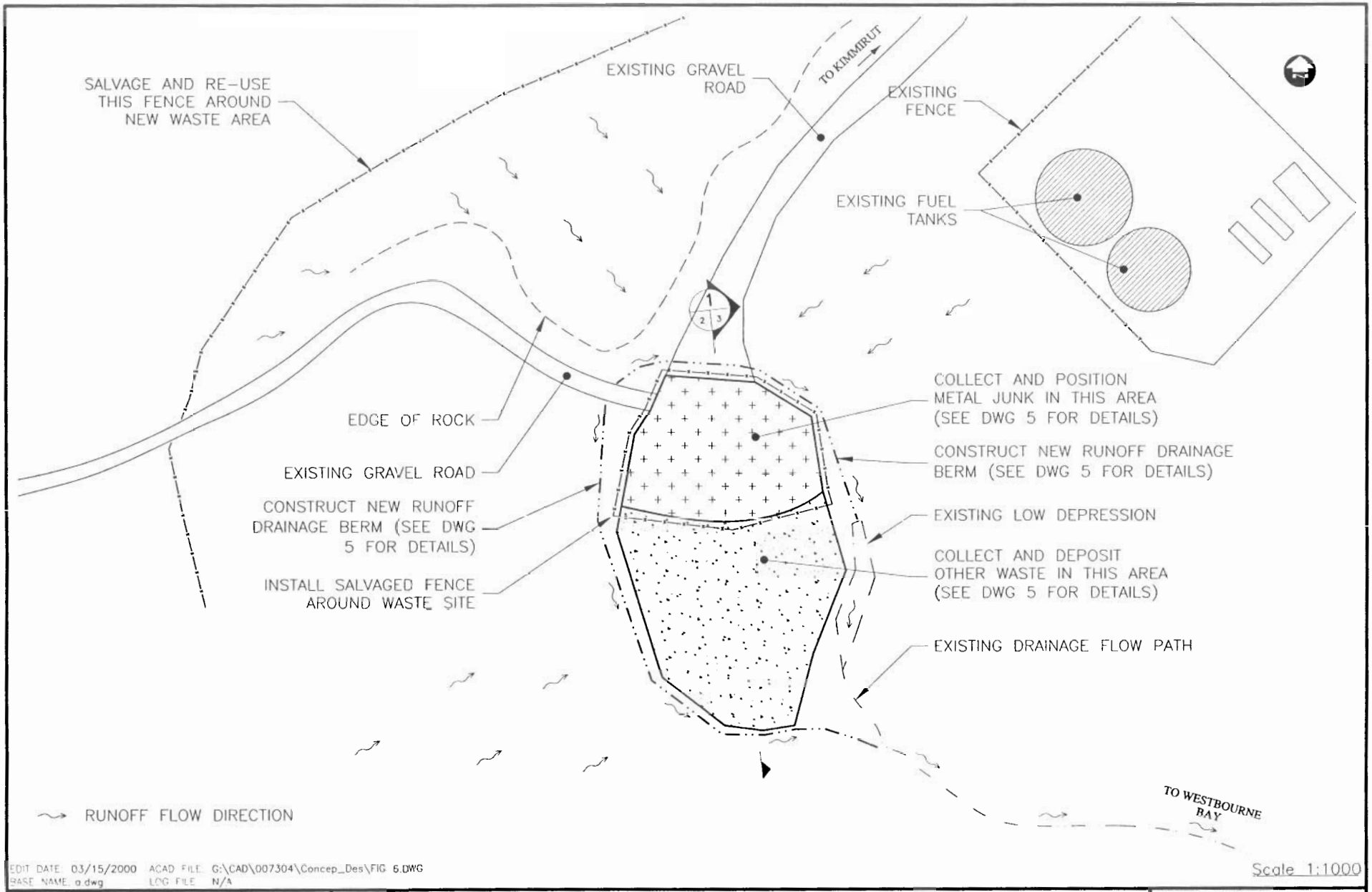
KIMMIRUT LANDFILL SITE CLOUSER
KIMMIRUT, NUNAVUT

CONCEPTUAL DESIGN OF LANDFILL SITE
PLAN AND PROFILE

PROJECT NUMBER: 00-7304

MARCH 2000

FIGURE NUMBER: FIG 5



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DILLON CONSULTING

PROJECT
KIMMIRUT LANDFILL SITE CLOSURE
KIMMIRUT, NUNAVUT

TITLE
LANDFILL SITE CLOSURE
CONCEPTUAL DESIGN

PROJECT NUMBER
00-7304

DATE
MARCH 2000

FIGURE NUMBER
FIG 6

initial two years, the sampling program can be reduced provided that the sample results indicate the closure is preventing the generation and migration of the contaminants of concern.

Year 1 Program

Establish monitoring station for surficial (active layer) ground water collection. Complete sampling 3 times over the summer months, late June, mid August, late September. Water samples to be analysed the for pH, conductivity, metals (including hydride metals), benzene, toluene, ethyl benzene, xylene (BTEX), total petroleum hydrocarbons (C_3-C_{32} range), phenol, PAH's, and PCB'S. Assess results of the program and adjust the following years program accordingly.

Year 2 Program

Complete sampling 3 times over the summer months, late June, mid August, late September. Water samples to be analysed for pH, conductivity, metals (including hydride metals), benzene, toluene, ethyl benzene, xylene (BTEX), total purgeable hydrocarbons (C_3-C_{10} range), total extractable hydrocarbons (C_{10}-C_{32} range), and PAH's. Assess the results of the program and adjust the following years program accordingly.

Year 3 Program

Complete sampling 3 times over the summer months, late June, mid August, late September. Water samples to be analysed for pH, conductivity, benzene, toluene, ethyl benzene, xylene (BTEX), total purgeable hydrocarbons (C_3-C_{10} range), total extractable hydrocarbons (C_{10}-C_{32} range). Assess the results of the program and adjust the following years program accordingly.

Year 5, 10 and 20 Program

Complete sampling 3 times over the summer months, late June, mid August, late September. Water samples to be analysed for pH, conductivity, metals (including hydride metals), benzene, toluene, ethyl benzene, xylene (BTEX), total purgeable hydrocarbons (C_3-C_{10} range), total extractable hydrocarbons (C_{10}-C_{32} range). Assess the results of the program and adjust the following years program accordingly.

6.0 SUMMARY

The Hamlet of Kimmirut has placed waste material into the present landfill located south of the community for approximately 30 years. Typical design life-spans for solid waste facilities in northern communities is 20 years. Waste disposal techniques at this landfill site are reported to involve burning, compaction and covering with granular fill materials.

The community has recently expanded as such that new residential housing and recreational developments are required. The Hamlet of Kimmirut wishes to develop the land on which the landfill currently stands for these purposes. Dillon was retained to complete an Environmental Health Risk Assessment and Closure Plan for the landfill site.

An intrusive investigation of the site was completed to identify the presence and extent of contaminants of concern to public health. Test holes were advanced around the landfill, soil and water samples were collected for subsequent laboratory analysis. In order to determine the significance of the laboratory analysis, the analytical results were compared to existing assessment and/or remediation criteria that are determined by Territorial/Provincial and Federal Government agencies. These criteria provide a numerical value to compare with the analytical results.

When compared to the above noted criteria, soil analyses results are almost entirely below the levels indicated by the selected criteria. In soil samples, one inorganic parameter, titanium, exhibited elevated concentrations in 9 of 10 samples, including the background sample collected 50 metres up-gradient of the sanitary site boundary. Nickel is also above criteria concentrations in one soil sample.

Aluminum, copper, iron and zinc exhibit concentrations above selected criteria in several water samples. These values may have been augmented because sewage effluent is being dumped into the sanitary site, thereby increasing through-flow and leachate generation. Sample KWS-1 (leachate/surface water), indicates copper and zinc concentrations slightly above Canadian Freshwater Aquatic Life criteria. Although iron concentrations were above criteria in most samples, especially KWS-1, this can be accounted for by metals oxidation.

The analytical test results indicate that the landfill is not generating significant quantities of leachate. Contaminant migration is therefore not of concern to environmental receptors or human health.

The need for a risk assessment was partially initiated by the Department of Health, Government of Nunavut. Their concern relates to the Health Act requirement for a 450m set back from a waste disposal facility to any building used for human habitation. In particular the "General Sanitation Regulations, Public Health Act" P-16 item 8. The Hamlet of Kimmirut wishes to develop the land within the 450m setback for both residential and recreational use. However, due to concern related to the landfill, permission for occupancy may not be granted. This may come in the form of denial of the land lease or restrictions placed by the Department of Health.

To develop a closure plan that would address the concerns of the Department of Health and other agencies, several stakeholders will be asked for input on this draft report.

The Department of Health's closure requirements would require at a minimum of the following:

- The issues of long term exposure and chronic effects be addressed,
- Consolidation of the waste,
- Proper capping material be placed over the waste,
- Monitoring of the site is completed,
- The site is used for appropriate land use,
- The site needs to be delineated on community mapping to indicate that the site was a former waste site, and the community plan needs to respect the restrictions that may be placed on the future development of the site by the Health Department.

The closure of the sanitary site is intended to mitigate against human health concerns. To demonstrate that the closure methods have been successful, and to provide a means of monitoring the site, a monitoring program is recommended. The program is set up to establish the first few years of data to compliment the work that was completed in this study. After the initial three years, the sampling program can be reduced provided that the sample results indicate the closure is preventing the generation and migration of contaminants.

The closure concept is developed, based on the regulatory requirements and on the findings of our investigation. The recommended closure concept, as described in section 5.0, consists of:

- Collect and entomb wind blown litter,
- Cap and entomb the waste mass and working face,
- Install perimeter ditches and berms to re-direct runoff water,
- Consolidate the bulky scrap metal and scrap vehicle area into one area above waste mass,
- Fence the bulky metals, and provide signs around the site to notify people of the disposal area,
- Monitor groundwater down gradient of the site on an annual basis. Samples are to be forwarded to a respectable laboratory,

The conceptual closure plan, and the future land use plan for the site must be submitted to the Department of Health, Chief Medical Officer with an application to deregulate the site. The application must indicate the reasons that PW&H is requesting the deregulation. The Chief Medical Officer may request additional information. Once satisfied, the Chief Medical Officer will forward the application up through the process. At the successful conclusion of the process, the site would not require a set back with respect to the Public Health Act. The site may have future land use restrictions. These could restrict future land use to passive development such as a recreational park that does not use the site for building development.

7.0 DISCLAIMER

This report was prepared exclusively for the purposes, project and site location outlined in the report. The report is based on information provided to or obtained by Dillon Consulting Limited (Dillon) as indicated in the report, and applies solely to site conditions existing at the time of the site investigations. Although a reasonable investigation was conducted by Dillon, it was by no means exhaustive and can not be construed as a certification of the absence of any contaminants from the site. Rather, Dillon's report represents a reasonable review of available information within an agreed work scope, schedule, and budget. It is therefore possible that currently unrecognized contamination or potentially hazardous materials may exist at the site. Further review and updating of the report may be required as local and site conditions, and the regulatory and planning frameworks, change over time.

This report was prepared by Dillon for the benefit of the Department of Public Works and Housing, Government of Nunavut, and for the review by stakeholders mentioned in the report. It is not to be relied upon by any other party without Dillon's express written consent. The material in it reflects Dillon's best judgement in light of the information available to it at the time of preparation. Any use which a third part makes of this report, or any reliance on or decisions made based on it are the sole responsibility of such third parties. Dillon accepts no responsibilities for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

APPENDIX A
Site Photographs

Photograph 1: View looking north into bowl shaped solid waste facility. The current dump face is in the foreground. The area is surrounded by rocky topography.

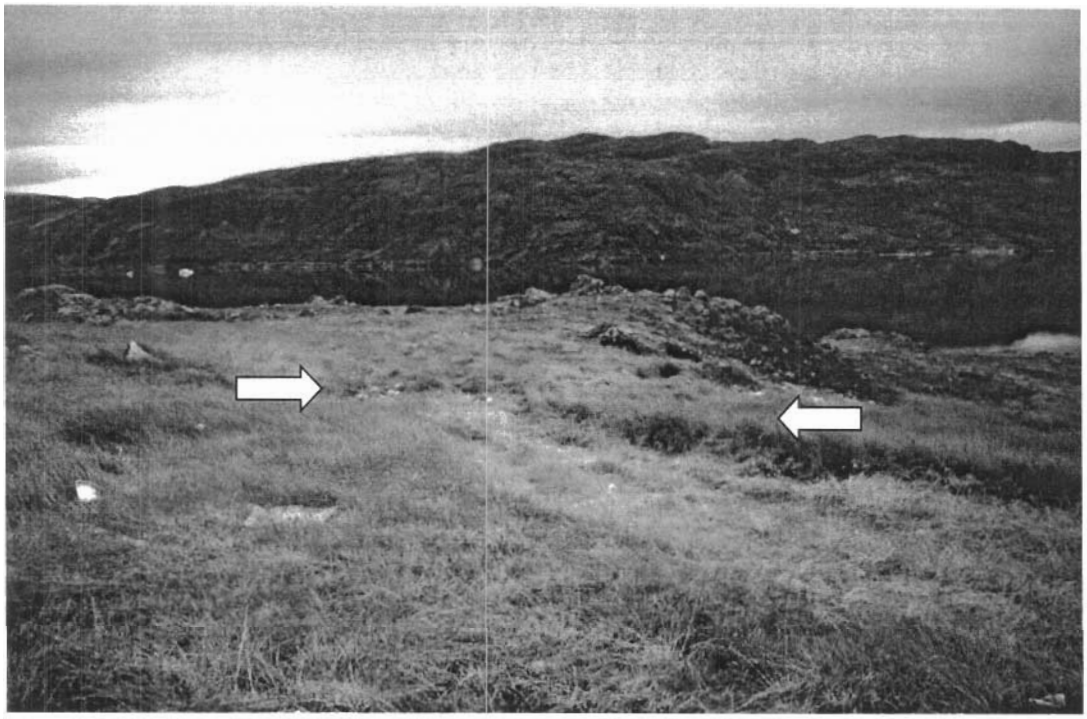
Photograph 2: View looking southeast to Westbourne Bay, approximately 400 metres away. Lush vegetation follows the sewage drainage path.

Photograph 3: Sewage truck discharging waste at the sanitary site. Waste water flows down the drainage channel/wetlands until it reaches the shoreline approximately 400 metres away.

Photograph 4: General refuse area and truck turn around. Scrap vehicles are visible in the background near the chain link fence designed to contain windblown debris.

Photograph 5: General refuse area in the foreground, sewage truck dumping site at barrels, and one of several bulky metals area at centre.

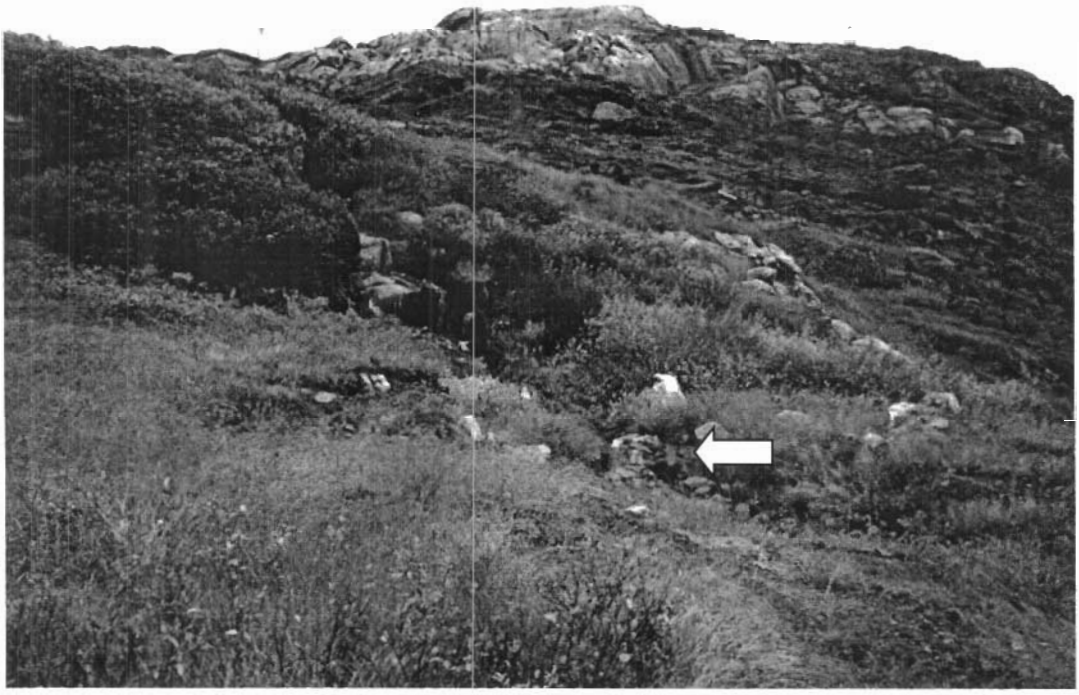
Photograph 6: Sample location of KSS-10 at flag. Segregated area for used heating oil storage tanks. Scrap piping from the PPD Tank Farm Upgrade is visible in the upper left.



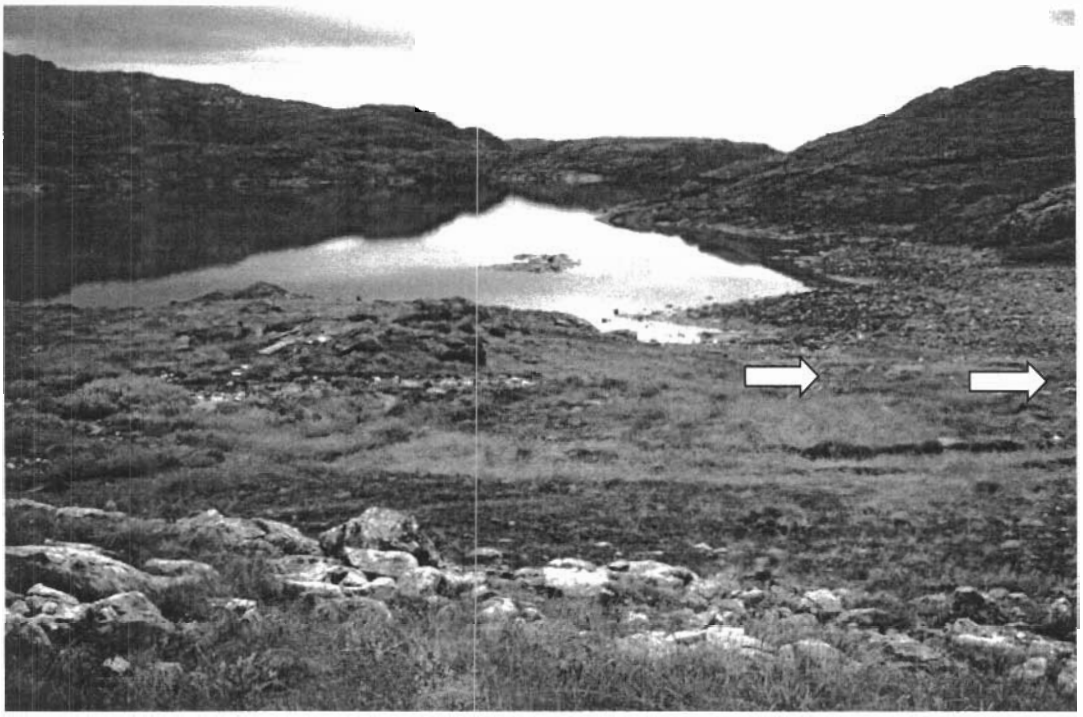
Photograph 7: Soil samples KSS-3 and KSS-4, on the left and right respectively. Sample KSS-3 is situated along the main drainage channel.

Photograph 8: Bottom of the present dumping face. Samples KSS-1 and KWS-1 were collected at the flag.

Photograph 9: Northeast view of the present dumping face.



Photograph 10: Sample location of KWS-5, near the main drainage channel from the sanitary site, approximately 150 metres up gradient.



Photograph 11: Samples KSS-7 and KSS-8 on the right and left respectively.

Photograph 12: Samples KWS-3 and KSS-11 on the left and right respectively. These are located near the PPD pipeline fuel re-supply connection.

APPENDIX B
Laboratory Certificates

DIOXIN/FURAN ANALYSIS REPORT

ENVIRO-TEST LABORATORIES

TRACE ORGANICS DIVISION

PROJECT :	BODYCOTE TECHNITROL INC.	GC COLUMN :	J&W DB-5, 60m x 0.32mm
MATRIX :	SOIL	INSTRUMENT :	KRATOS CONCEPT IS32 HRMS
SAMPLE # :	E9-09-F58-01A	ANAL. DATE :	01-Nov-99
SAMPLE ID :	KSS-1 09/22/99		
SAMPLE SIZE :	9.6 g (Dry Weight)	ORIGINAL SAMPLE MOISTURE:	43 %
SAMPLING TYPE :	Single Sample Aliquot		

PCDD/F Congener	Concentration (pg/g)	DL (pg/g)	I-TEF (NATO)	TEQ (ND=0) (pg/g)	TEQ (ND=0.5DL) (pg/g)	PCDD/F Homologues	Concentration (pg/g)	DL (pg/g)	NP
2378-TCDD	ND	0.5	1	ND	0.23	TCDD	ND	0.5	0
* 12378-PeCDD	ND	0.5	0.5	ND	0.13	PeCDD	ND	0.5	0
* 123478-HxCDD	ND	0.6	0.1	ND	0.032	HxCDD	2.3	0.6	2
* 123678-HxCDD	ND	0.6	0.1	ND	0.028	HpCDD	4.5	1.9	1
* 123789-HxCDD	ND	0.6	0.1	ND	0.030				
1234678-HpCDD	5.7	1.9	0.01	0.057	0.057	Total	6.8		3
OCDD	41	2.9	0.001	0.041	0.041	Homologues			
* 2378-TCDF	ND	1.0	0.1	ND	0.049	TCDF	6.9	1.0	3
* 12378-PeCDF	ND	0.9	0.05	ND	0.022	PeCDF	3.0	0.8	2
* 23478-PeCDF	ND	0.7	0.5	ND	0.22	HxCDF	ND	0.9	0
* 123478-HxCDF	ND	0.8	0.1	ND	0.040	HpCDF	1.6	2.5	1
* 123678-HxCDF	ND	0.8	0.1	ND	0.038				
* 234678-HxCDF	ND	0.9	0.1	ND	0.045	Total	12		6
* 123789-HxCDF	ND	1.1	0.1	ND	0.055	Homologues			
1234678-HpCDF	ND	2.2	0.01	ND	0.011				
1234789-HpCDF	ND	2.9	0.01	ND	0.014				
OCDF	ND	2.1	0.001	ND	0.0010				
			Total TEQ =	0.098	1.0				

PCDD/F Surrogate	Amount added (ng)	Recovery
13C12-2378-TCDD	1	76%
13C12-2378-TCDF	1	69%
13C12-12378-PeCDD	1	60%
13C12-12378-PeCDF	1	67%
13C12-23478-PeCDF	1	68%
13C12-123478-HxCDD	1	67%
13C12-123678-HxCDD	1	66%
13C12-123478-HxCDF	1	64%
13C12-123678-HxCDF	1	68%
13C12-234678-HxCDF	1	75%
13C12-123789-HxCDF	1	79%
13C12-1234678-HpCDD	1	76%
13C12-1234678-HpCDF	1	62%
13C12-1234789-HpCDF	1	70%
13C12-OCDD	2	38%

Notes:

1.- Results are corrected for surrogate recovery.

2.- PCDD/F Homologues results do NOT include the 2,3,7,8-congeners.

* Value represents a maximum possible amount. This congener might co-elute with other congener(s).

The following abbreviations are used:

DL = Detection Limit.

ND = Not Detected.

TEQ = 2,3,7,8-TCDD Toxic Equivalency

NDR = Not Detected due to incorrect isotope Ratio.

PCDD/F = Polychlorinated dibenzo-p-dioxin/Polychlorinated dibenzofuran

N/A = Not Applicable.

NP = Number of Analyte Peaks.

DPE = Chlorinated DiPhenylEther Interference.

I-TEF = International Toxic Equivalency Factor.

DIOXIN/FURAN ANALYSIS REPORT

ENVIRO-TEST LABORATORIES

TRACE ORGANICS DIVISION

PROJECT :	BODYCOTE TECHNITROL INC.	GC COLUMN :	J&W DB-5, 60m x 0.32mm
MATRIX :	SODIUM SULFATE	INSTRUMENT :	KRATOS CONCEPT IS32 HRMS
SAMPLE # :	E9-09-F58-MB	ANAL. DATE :	01-Nov-99
SAMPLE ID :	METHOD BLANK		
SAMPLE SIZE :	10 g (Dry Weight)		
SAMPLING TYPE :	Single Sample Aliquot		

PCDD/F Congener	Concentration (pg/g)	DL (pg/g)	I-TEF (NATO)	TEQ (ND=0) (pg/g)	TEQ (ND=0.5DL) (pg/g)	PCDD/F Homologues	Concentration (pg/g)	DL (pg/g)	NP
2378-TCDD	ND	0.1	1	ND	0.033	TCDD	ND	0.1	0
* 12378-PeCDD	ND	0.1	0.5	ND	0.016	PeCDD	ND	0.1	0
* 123478-HxCDD	ND	0.1	0.1	ND	0.0066	HxCDD	ND	0.1	0
* 123678-HxCDD	ND	0.1	0.1	ND	0.0059	HpCDD	ND	0.2	0
* 123789-HxCDD	ND	0.1	0.1	ND	0.0062				
1234678-HpCDD	ND	0.2	0.01	ND	0.0012	Total Homologues	ND		0
OCDD	ND	2.5	0.001	ND	0.0012				
* 2378-TCDF	ND	0.2	0.1	ND	0.011	TCDF	ND	0.2	0
* 12378-PeCDF	ND	0.1	0.05	ND	0.0025	PeCDF	ND	0.1	0
* 23478-PeCDF	ND	0.1	0.5	ND	0.025	HxCDF	ND	0.1	0
* 123478-HxCDF	ND	0.1	0.1	ND	0.0046	HpCDF	ND	0.5	0
* 123678-HxCDF	ND	0.1	0.1	ND	0.0043				
* 234678-HxCDF	ND	0.1	0.1	ND	0.0050	Total Homologues	ND		0
* 123789-HxCDF	ND	0.1	0.1	ND	0.0066				
1234678-HpCDF	ND	0.4	0.01	ND	0.0022				
1234789-HpCDF	ND	0.7	0.01	ND	0.0033				
OCDF	ND	0.3	0.001	ND	0.000152				
			Total TEQ =	ND	0.14				

PCDD/F Surrogate	Amount added (ng)	Recovery
13C12-2378-TCDD	1	76%
13C12-2378-TCDF	1	67%
13C12-12378-PeCDD	1	75%
13C12-12378-PeCDF	1	78%
13C12-23478-PeCDF	1	90%
13C12-123478-HxCDD	1	71%
13C12-123678-HxCDD	1	70%
13C12-123478-HxCDF	1	72%
13C12-123678-HxCDF	1	76%
13C12-234678-HxCDF	1	84%
13C12-123789-HxCDF	1	86%
13C12-1234678-HpCDD	1	81%
13C12-1234678-HpCDF	1	62%
13C12-1234789-HpCDF	1	65%
13C12-OCDD	2	40%

Notes:

1.- Results are corrected for surrogate recovery.

2.- PCDD/F Homologues results do NOT include the 2,3,7,8-congeners

* Value represents a maximum possible amount. This congener might co-elute with other congener(s).

The following abbreviations are used:

DL = Detection Limit.

ND = Not Detected.

TEQ = 2,3,7,8-TCDD Toxic Equivalency

NDR = Not Detected due to incorrect isotope Ratio.

PCDD/F = Polychlorinated dibenzo-p-dioxin/Polychlorinated dibenzofuran

N/A = Not Applicable.

NP = Number of Analyte Peaks.

DPE = Chlorinated DiPhenylEther Interference.

I-TEF = International Toxic Equivalency Factor.

ENVIRO-TEST CHEMICAL ANALYSIS REPORT

LAB ID	SAMPLE ID	TEST DESCRIPTION	RESULT	D.L.	UNITS	EXTRACTED	ANALYZED	BY
E909F58-01	KSS-1							
Sample Type:SOL								
Collected:09/22/99								
		Dioxin/Furan in Sediment	ATTACHED				11/04/99	ESB
		Moisture Contents	ATTACHED				11/04/99	ESB

N.D. - NOT DETECTED, LESS THAN THE DETECTION LIMIT

THIS IS THE FINAL PAGE OF THE REPORT

Le Groupe S.M.

Laboratoire d'environnement S.M. inc.

2111, boul. Fernand-Lafontaine, Longueuil (Québec) J4G 2J4
Téléphone: (450) 651-4855 - Télécopieur: (450) 651-9542

No de rapport : 18564

Rapport d'analyse

99-10-22 (A/M/J)

Votre no. de bon de commande : CT-05648

Client: BODYCOTE TECHNITROL-ECO
M. Benoît Saumure
121, boulevard Hymus
Pointe-Claire, Québec
H9R1E6 **Tél :** 1.(514) 697-3400 **Ext :** **Fax :** 1.(514) 697-2090

No de client: 261
No de projet: 1249

Date de prélèvement: 99-09-22 (A/M/J)
Date de réception: 99-09-30 (A/M/J)

Prélevé par:
Nature de l'échantillon: Sol

Description :

Analyse d'eau et de sols - 1999

No ECH	Identification Client	Analyse	Résultat	Dupl.	% Rec.	Unité	Date d'analyse	Note
65588	68050-305947 (KSS-1)	Glycol - diéthylène glycol	<5			mg/kg	99-10-01	
		Glycol - éthylène glycol	<5			mg/kg	99-10-01	
		Glycol - propylène glycol	<5			mg/kg	99-10-01	
65589	68050-305948 (KSS-4)	Glycol - diéthylène glycol	<5			mg/kg	99-10-01	
		Glycol - éthylène glycol	<5			mg/kg	99-10-01	
		Glycol - propylène glycol	<5			mg/kg	99-10-01	

Note :

Louis Bilodeau, Chimiste, B.Sc.

CHIMISTE
Louis Bilodeau
90-133
QUÉBEC

Réjean Beauchemin , Chimiste, B.Sc.

Le Groupe S.M.

Laboratoire d'environnement S.M. inc.

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Téléphone: (450) 651-4855 - Télécopieur: (450) 651-9542

No de rapport : 18564

Rapport d'analyse

99-10-22 (A/M/J)

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Client: BODYCOTE TECHNITROL-ECO
M. Benoît Saumure
121, boulevard Hymus
Pointe-Claire, Québec
H9R1E6 **Tél :** 1.(514) 697-3400 **Ext :** **Fax :** 1.(514) 697-2090

No de client: 261
No de projet: 1249

Analyse	Méthode analytique	No d'instruction de travail
Glycol - diéthylène glycol	GC-FID	ILCE-027
Glycol - éthylène glycol	GC-FID	ILCE-027
Glycol - propylène glycol	GC-FID	ILCE-027

- **Les échantillons sont conservés pour une période de 60 jours après la date de réception ou pour le délai de conservation maximum spécifique à chaque analyse. À moins d'indication contraire, nous disposerons donc des échantillons après ces délais.**
- **Ce rapport ne doit pas être reproduit sinon en entier, sans l'autorisation écrite du Laboratoire d'environnement S.M. Inc..**

Louis Bilodeau, Chimiste, B.Sc.

CHIMISTE Louis Bilodeau 90-133 QUÉBEC

Réjean Beauchemin , Chimiste, B.Sc.

Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
121, BOUL. HYMUS, POINTE-CLAIRE, QUÉBEC H9R 1E6
TÉL.: (514) 697-3273 • FAX: (514) 697-2090

Certificat d'analyse • Certificate of Analysis

Attention: Martin Suchy
Client: Dillon Consulting
P.O.Box 978
Iqualuit, Nunavut
X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kss-1 Kimmirut	Kss-4 Kimmirut
Reference	Soilide Waste Closure Plan	Soilide Waste Closure Plan
Matrix	Soil	Soil
Date sampled	99-09-22	99-09-22
Sampling Location	NA	NA
Sampled by	M.Suchy	M.Suchy
Laboratory No.	305947	305948
Date prepared	99-09-28	99-09-28
Date analyzed	99-09-29	99-09-29
BPC-A-S-13	mg/kg	mg/kg
Aroclor 1242	< 0.1	< 0.1
Aroclor 1248	< 0.1	< 0.1
Aroclor 1254	< 0.1	< 0.1
Aroclor 1260	< 0.1	< 0.1
Total	ND	ND
% Recovery		
Decachlorobiphenyle	100	100

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist
Yves Moras

CHIMISTE
Yves Moras
94-006
QUÉBEC

Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
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Certificat d'analyse • Certificate of Analysis

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P.O.Box 978
Iqualuit, Nunavut
X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	306787	305947	306790	306788	
Control Type	Blank	Sample	Duplicate	Reference materials	
Matrix	Soil	Soil	Soil		
Date Sampled		99-09-22	99-09-22		
Sampling Location		NA	NA		
Sampled by		M.Suchy	M.Suchy		
Reference				Obtained	Range
Date Prepared	99-09-28	99-09-28	99-09-28	99-09-28	
Date Analyzed	99-09-29	99-09-29	99-09-29	99-09-29	
BPC-A-S-13	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aroclor 1242	< 0.1	< 0.1	< 0.1	(-)	(-)
Aroclor 1248	< 0.1	< 0.1	< 0.1	(-)	(-)
Aroclor 1254	< 0.1	< 0.1	< 0.1	9.8	(5.3 - 15.3)
Aroclor 1260	< 0.1	< 0.1	< 0.1	(-)	(-)
Total	ND	ND	ND		
%Recovery					
Decachlorobiphenyle	115	100	103	113	

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

CHIMISTE
Yves Moras
94-006
QUÉBEC

Yves Moras

Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
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Certificat d'analyse • Certificate of Analysis

Attention Martin Suchy
Client DILLON CONSULTING (IQALUIT)
PO. Box 978
Iqaluit, T.N.
X0A 0H0

Report number 99-68050
Date reported 99-10-04
Date received 99-09-27
Project **
Purchase order N.W.T.

Identification		KSS-1	KSS-4	KSS-8	KSS-3
Identification (cont'd)		---	---	---	---
Matrix		soil	soil	soil	soil
Date collected		99-09-22	99-09-22	99-09-22	99-09-22
Location sampled		---	---	---	---
Collected by		Martin Suchy	Martin Suchy	Martin Suchy	Martin Suchy
Laboratory number		305947	305948	305954	305955
Parameters	Date prepared/analysed	Results (mg/kg)*	Results (mg/kg)*	Results (mg/kg)*	Results (mg/kg)*
Phenols (colorimetry)	99-09-29	0.48	0.33	0.11	---
Conductivity in µmhos/cm	99-10-01	190	190	67	120
pH (pH Units)	99-10-01	7.3	7.5	7.2	8.1
Aluminium	99-09-30	6250	5000	3400	4320
Antimony	99-09-30	<10	30	<10	<10
Silver	99-09-29	<2	<2	<2	<2
Arsenic	99-09-29	<0.5	0.8	<0.5	1
Barium	99-09-29	29	40	34	24
Berylium	99-09-30	<1	<1	<1	<1
Boron	99-09-29	8	28	7	43
Bismuth	99-09-30	<10	<10	<10	<10
Cadmium	99-09-29	<1	<1	<1	<1
Calcium	99-09-30	7320	53000	8980	78000
Chromium	99-09-29	15	7	8	5
Cobalt	99-09-29	14	3	6	3
Copper	99-09-29	19	9	29	5
Tin	99-09-30	<5	<5	<5	<5
Iron	99-09-30	14000	9900	9400	5600
Lithium	99-09-30	6	3	3	2
Magnesium	99-09-30	3400	69000	8300	120000
Manganse	99-09-29	241	469	362	764
Mercury	99-09-30	<0.03	<0.03	<0.03	<0.03

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

*Unless stated otherwise

Chemist Micheline Godin

Micheline Godin 84-032 QUÉBEC

Note : Analytical Results relate only to the samples analysed

Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
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TÉL.: (514) 697-3273 • FAX: (514) 697-2090

Certificat d'analyse • Certificate of Analysis

Attention Martin Suchy
Client DILLON CONSULTING (IQALUIT)
PO. Box 978
Iqaluit, T.N.
X0A 0H0

Report number 99-68050
Date reported 99-10-04
Date received 99-09-27
Project **
Purchase order N.W.T.

Identification		KSS-1	KSS-4	KSS-8	KSS-3
Identification (cont'd)		---	---	---	---
Matrix		soil	soil	soil	soil
Date collected		99-09-22	99-09-22	99-09-22	99-09-22
Location sampled		---	---	---	---
Collected by		Martin Suchy	Martin Suchy	Martin Suchy	Martin Suchy
Laboratory number		305947	305948	305954	305955
Parameters	Date prepared/analysed	Results (mg/kg)*	Results (mg/kg)*	Results (mg/kg)*	Results (mg/kg)*
Molybdenum	99-09-29	4	<2	<2	<2
Nickel	99-09-29	27	8	13	7
Lead	99-09-29	<10	10	<10	20
Potassium	99-09-30	590	525	570	350
Selenium	99-09-30	3.3	1.1	1.5	0.9
Silicium	99-09-30	640	547	769	373
Sodium	99-09-30	170	80	110	96
Titanium	99-09-30	658	263	254	123
Vanadium	99-09-30	22	13	13	8
Zinc	99-09-29	93	64	30	55
Total phosphorus as P	99-09-30	980	670	670	145

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

***Unless stated otherwise**

CHIMISTE Michelline Godin 84-032 QUÉBEC

Chemist _____
Micheline Godin

Note : Analytical Results relate only to the samples analysed

Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
121, BOUL. HYMUS, POINTE-CLAIRE, QUÉBEC H9R 1E6
TÉL.: (514) 697-3273 • FAX: (514) 697-2090

Certificat d'analyse • Certificate of Analysis

Attention Martin Suchy
Client DILLON CONSULTING (IQALUIT)
PO. Box 978
Iqaluit, T.N.
X0A 0H0

Report number 99-68050
Date reported 04-10-99
Date received 99-09-27
Project **
Purchase order N.W.T.

Identification		KSS-5	KSS-6	KSS-7	KSS-10
Identification (cont'd)		---	---	---	---
Matrix		soil	soil	soil	soil
Date collected		99-09-22	99-09-22	99-09-22	99-09-22
Location sampled		---	---	---	---
Collected by		Martin Suchy	Martin Suchy	Martin Suchy	Martin Suchy
Laboratory number		305956	305960	305961	305963
Parameters	Date prepared/analysed	Results (mg/kg) *	Results (mg/kg) *	Results (mg/kg) *	Results (mg/kg) *
Phenols (colorimetry)	99-09-29	---	---	---	---
Conductivity in µmhos/cm	99-10-01	67	79	31	75
pH (pH Units)	99-10-01	7.2	7.2	7.2	7.7
Aluminium	99-09-30	3100	3830	4700	6380
Antimony	99-09-30	10	<10	<10	10
Silver	99-09-29	<2	<2	<2	<2
Arsenic	99-09-29	<0.5	<0.5	<0.5	1.8
Barium	99-09-29	66	29	28	54
Berylium	99-09-30	<1	<1	<1	<1
Boron	99-09-29	7	5	6	2
Bismuth	99-09-30	<10	<10	<10	<20
Cadmium	99-09-29	<1	<1	<1	<1
Calcium	99-09-30	15800	9060	3040	5830
Chromium	99-09-29	7	7	12	11
Cobalt	99-09-29	4	10	5	15
Copper	99-09-29	50	15	15	18
Tin	99-09-30	<5	<5	<5	<5
Iron	99-09-30	20000	9900	14000	35000
Lithium	99-09-30	3	4	4	8
Magnesium	99-09-30	13000	7800	11000	11000
Manganse	99-09-29	112	255	248	186
Mercury	99-09-30	0.05	<0.03	<0.03	0.03

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

*Unless stated otherwise

CHIMISTE Micheline Godin 84-032 QUÉBEC

Chemist _____
Micheline Godin

Note : Analytical Results relate only to the samples analysed

Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
121, BOUL. HYMUS, POINTE-CLAIRE, QUÉBEC H9R 1E6
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Certificat d'analyse • Certificate of Analysis

À l'attention de Martin Suchy
Client DILLON CONSULTING (IQALUIT)
P.O. Box 978
Iqaluit, T.N.
X0A 0H0

No de certificat 99-68050
Date d'émission 99-10-04
Date de réception 99-09-27
No. projet **
Bon de commande N.W.T.

Identification		KSS-5	KSS-6	KSS-7	KSS-10
Identification (suite)		---	---	---	---
Matrice		soil	soil	soil	soil
Date de prélèvement		99-09-22	99-09-22	99-09-22	99-09-22
Lieu du prélèvement		---	---	---	---
Prélevé par		Martin Suchy	Martin Suchy	Martin Suchy	Martin Suchy
No de laboratoire		305956	305960	305961	305963
Paramètres	Date préparation / d'analyse	Results (mg/kg)*	Results (mg/kg)*	Results (mg/kg)*	Results (mg/kg)*
Molybdenum	99-09-29	<2	<2	<2	5
Nickel	99-09-29	16	31	10	122
Lead	99-09-29	20	<10	<10	<10
Potassium	99-09-30	570	580	510	520
Selenium	99-09-30	0.8	1.1	0.6	1.3
Silicium	99-09-30	643	506	522	627
Sodium	99-09-30	105	80	75	130
Titanium	99-09-30	215	221	357	553
Vanadium	99-09-30	7	10	21	16
Zinc	99-09-29	108	38	64	89
Total phosphorus as P	99-09-30	3460	430	430	420

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

*Unless stated otherwise

Chemist _____
Micheline Godin

CHIMISTE (I) Micheline Godin 84-032 QUÉBEC

Note : Analytical Results relate only to the samples analysed

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Iqaluit, T.N.
X0A 0H0

No de certificat	99-68050
Date d'émission	04-10-99
Date de réception	99-09-27
No. projet	**
Bon de commande	N.W.T.

Identification		KSS-11	KSB-1
Identification (suite)		---	---
Matrice		soil	soil
Date de prélèvement		99-09-22	99-09-22
Lieu du prélèvement		---	---
Prélevé par		Martin Suchy	Martin Suchy
No de laboratoire		305968	305972
Paramètres	Date préparation / d'analyse	Results (mg/kg)*	Results (mg/kg)*
Phenols (colorimetry)	99-09-29	---	---
Conductivity in µmhos/cm	99-10-01	160	12
pH (pH Units)	99-10-01	7.8	7.2
Aluminium	99-09-30	3030	11200
Antimony	99-09-30	30	20
Silver	99-09-29	<2	<2
Arsenic	99-09-29	0.7	<0.5
Barium	99-09-29	38	257
Berylium	99-09-30	<1	<1
Boron	99-09-29	34	2
Bismuth	99-09-30	<10	<20
Cadmium	99-09-29	<1	<1
Calcium	99-09-30	52000	1800
Chromium	99-09-29	6	40
Cobalt	99-09-29	5	8
Copper	99-09-29	15	23
Tin	99-09-30	<5	<5
Iron	99-09-30	8700	31000
Lithium	99-09-30	2	39
Magnesium	99-09-30	71000	17000
Manganse	99-09-29	583	84
Mercury	99-09-30	0.06	<0.03

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

*Unless stated otherwise

Chemist _____ Micheline Godin

CHIMISTE Micheline Godin 84-032 QUÉBEC

Note : Analytical Results relate only to the samples analysed

Bodycote TECHNITROL • ECO

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No de certificat 99-68050
Date d'émission 04-10-99
Date de réception 99-09-27
No. projet **
Bon de commande N.W.T.

Identification		KSS-11	KSB-1
Identification (suite)		---	---
Matrice		soil	soil
Date de prélèvement		99-09-22	99-09-22
Lieu du prélèvement		---	---
Prélevé par		Martin Suchy	Martin Suchy
No de laboratoire		305968	305972
Paramètres	Date préparation / d'analyse	Results (mg/kg)*	Results (mg/kg)*
Molybdenum	99-09-29	<2	4
Nickel	99-09-29	18	25
Lead	99-09-29	<10	<10
Potassium	99-09-30	410	6560
Selenium	99-09-30	1	0.7
Silicium	99-09-30	302	343
Sodium	99-09-30	125	133
Titanium	99-09-30	200	2600
Vanadium	99-09-30	9	73
Zinc	99-09-29	97	22
Total phosphorus as P	99-09-30	810	120

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

*Unless stated otherwise

Chemist

CHIMISTE
Micheline Godin
QUÉBEC

Micheline Godin

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Iqaluit, T.N.
X0A 0H0

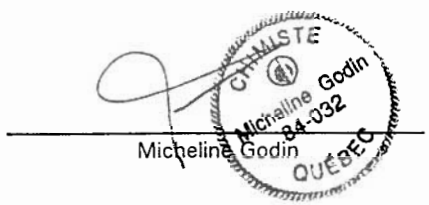
Report number 99-68050
Date reported 04-10-99
Date received 99-09-27
Project **
Purchase order N.W.T.

Appendix II-Quality Control

						Certified Reference Material (CRM)		
	Blank	Duplicate			CRM	CRM	CRM	Fortified sample
			Value 1	Value 2	Indenti-	Target	Result	
					fication	(Range)		%
Parameters	mg/kg*	# Lab	mg/kg*	mg/kg*	mg/kg*	mg/kg*	mg/kg*	Recovery
Phenols (colorimetry)	<0.01***	---	---	---	ERA 9983	0.09(0.065-0.107)***	0.08***	---
Conductivity in µmhos/cm	<1	---	---	---	ERA 9982 1/5	143(121-164)	136	---
pH (pH Units)	---	---	---	---	ERA9982	9.12(8.92-9.32)	9.10	---
Aluminium	< 10	305947	6250	6100	CLP-241 -Al	5300(3140-7360)	3580	---
Antimony	< 10	305947	<10	<10	CLP-241 -Sb	33(6-60)	42	---
Silver	< 2	---	---	---	CLP-241 -Ag	87(65-109)	89	---
Arsenic	< 0.1	---	---	---	CLP-241 -As	94(70-118)	96	---
Barium	< 1	305947	27	29	CLP-241 -Ba	330(254-405)	348	---
Berylium	< 1	305947	<1	<1	CLP-241 -Be	43(34-52)	44	---
Boron	< 2	305947	8	8	CLP-241 -B	72(45-99)	48	---
Bismuth	< 0.1***	---	---	---	INTERNE -Bi	1.0 (0.80-1.20)***	0.97***	---
Cadmium	< 1	305947	<1	<1	CLP-241 -Cd	97(75-120)	93	---
Calcium	< 1	305947	7320	7110	CLP-241 -Ca	1300(990-1650)	1295	---
Chromium	< 1	305947	14	15	CLP-241 -Cr	46(36-57)	40	---
Cobalt	< 1	---	---	---	CLP-241 -Co	120(96-145)	108	---
Copper	< 1	305947	18	19	CLP-241 -Cu	147(121-174)	135	---
Tin	< 5	305947	<5	<5	CLP-241 -Sn	140(83-197)	121	---
Iron	< 1	305947	13000	14000	CLP-241 -Fe	10200(5900-14500)	8100	---
Lithium	< 0.02***	---	---	---	INTERNE -Li	1.0 (0.85-1.15)***	0.94***	---
Magnesium	< 1	305947	3400	3300	CLP-241 -Mg	2340(1890-2790)	2200	---
Manganse	< 2	---	---	---	CLP-241 -Mn	166(127-205)	148	---
Mercury	<0.03	---	---	---	CLP-241	2.20 (1.05-2.86)	2.03	---

*Unless stated otherwise

Chemist



Micheline Godin

Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
121, BOUL. HYMUS, POINTE-CLAIRE, QUÉBEC H9R 1E6
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Certificat d'analyse • Certificate of Analysis

À l'attention de Martin Suchy
Client DILLON CONSULTING (IQALUIT)
PO. Box 978
Iqaluit, T.N.
X0A 0H0

No de certificat 99-68050
Date d'émission 04-10-99
Date de réception 99-09-27
No. projet **
Bon de commande N.W.T.

Appendix II-Quality Control

	Blank	Duplicate			Certified Reference Material (CRM)			Fortified sample
			Value 1	Value 2	CRM Indenti-fication	CRM Target (Range)	CRM Result	%
Parameters	mg/kg*	# Lab	mg/kg*	mg/kg*	mg/kg*	mg/kg*	mg/kg*	Recovery
Molybdenum	< 2	---	---	---	CLP-241 -Mo	40(31-50)	37	---
Nickel	< 1	---	---	---	CLP-241 -Ni	138(108-168)	119	---
Lead	< 10	---	---	---	CLP-241 -Pb	135(103-167)	123	---
Potassium	< 50	305947	590	585	CLP-241 -K	1480(1100-1950)	1260	---
Selenium	,0.1	---	---	---	CLP-241 -Se	96(71-121)	94	---
Silicium	< 0.02***	---	---	---	INTERNE -Si	1.0(0.85-1.15)***	1***	---
Sodium	< 10	305947	170	170	CLP-241 -Na	845(531-1160)	735	---
Titanium	< 1	305947	634	658	CLP-241 -Ti	319(179-460)	258	---
Vanadium	< 3	305947	21	22	CLP-241 -V	65(44-86)	56	---
Zinc	< 1	305947	81	93	CLP-241 -Zn	75(58-92)	70	---
Total phosphorus as P	< 10	305947	980	900	MR-102-98-2 -	13200(9200-17000)	12700	---

***Unless stated otherwise**

Chemist

CHIMISTE Micheline Godin 98-032 QUÉBEC

Micheline Godin

Bodycote TECHNITROL • ECO

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TÉL.: (514) 697-3273 • FAX: (514) 697-2090

Certificat d'analyse • Certificate of Analysis

Attention: Martin Suchy
Client: Dillon Consulting
P.O.Box 978
Iqualuit, Nunavut
X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kss-1 Kimmirut Soilide Waste Closure Plan	Kss-4 Kimmirut Soilide Waste Closure Plan	Kss-8 Kimmirut Soilide Waste Closure Plan	Kss-3 Kimmirut Soilide Waste Closure Plan	Kss-5 Kimmirut Soilide Waste Closure Plan
Reference					
Matrix	Soil	Soil	Soil	Soil	Soil
Date sampled	99-09-22	99-09-22	99-09-22	99-09-22	99-09-22
Sampling Location	NA	NA	NA	NA	NA
Sampled by	M.Suchy	M.Suchy	M.Suchy	M.Suchy	M.Suchy
Laboratory No.	305947	305948	305954	305955	305956
Date prepared	99-09-28	99-09-30	99-09-30	99-09-30	99-09-30
Date analyzed	99-09-28	99-09-30	99-09-30	99-09-30	99-09-30
BTEX-S-13	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes	< 0.1	< 0.1	< 0.1	< 0.1	0.1
Total	ND	ND	ND	ND	0.1
% Recovery					
Dibromofluoromethane	118	97	97	78	114
D8-Toluene	113	75	87	75	86
1-Bromo-4-fluorobenzene	128	112	122	106	139

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist
Yves Moras

CHIMISTE
Yves Moras
94-006
QUÉBEC

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X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kss-6 Kimmirut Soilide Waste Closure Plan	Kss-7 Kimmirut Soilide Waste Closure Plan	Kss-10 Kimmirut Soilide Waste Closure Plan	Kss-11 Kimmirut Soilide Waste Closure Plan	Ksb-1 Kimmirut Soilide Waste Closure Plan
Reference					
Matrix	Soil	Soil	Soil	Soil	Soil
Date sampled	99-09-22	99-09-22	99-09-22	99-09-22	99-09-22
Sampling Location	NA	NA	NA	NA	NA
Sampled by	M.Suchy	M.Suchy	M.Suchy	M.Suchy	M.Suchy
Laboratory No.	305960	305961	305963	305968	305972
Date prepared	99-09-30	99-09-30	99-09-30	99-09-30	99-09-30
Date analyzed	99-09-30	99-09-30	99-09-30	99-09-30	99-09-30
BTEX-S-13	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total	ND	ND	ND	ND	ND
% Recovery					
Dibromofluoromethane	105	105	96	100	110
D8-Toluene	83	78	81	69	80
1-Bromo-4-fluorobenzene	114	114	111	122	111

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist _____
Yves Moras

CHIMISTE
Yves Moras
94-006
QUÉBEC

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Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	306575	305948	307306	306577	
Control Type	Blank	Sample	Duplicate	Reference materials	
Matrix	Soil	Soil	Soil		
Date Sampled		99-09-22	99-09-22		
Sampling Location		NA	NA		
Sampled by		M.Suchy	M.Suchy		
Reference				Obtained	Range
Date Prepared	99-09-28	99-09-30	99-09-30	99-09-28	
Date Analyzed	99-09-28	99-09-30	99-09-30	99-09-28	
BTEX-S-13	mg/kg	mg/kg	mg/kg	ng	ng
Benzene	< 0.05	< 0.05	< 0.05	280	(199 - 380)
Toluene	< 0.1	< 0.1	< 0.1	960	(685 - 1250)
Ethylbenzene	< 0.1	< 0.1	< 0.1	1100	(765 - 1395)
Xylenes	< 0.1	< 0.1	< 0.1	2700	(2036 - 3596)
Total	ND	ND	ND		
%Recovery					
Dibromofluoromethane	85	97	95	100	
D8-Toluene	85	75	75	100	
1-Bromo-4-fluorobenzene	101	112	118	120	

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

CHIMISTE
Yves Moras
94-006
QUÉBEC

Yves Moras

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X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	307304	307305	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-30	99-09-30	
Date Analyzed	99-09-30	99-09-30	
BTEX-S-13	mg/kg	ng	ng
Benzene	< 0.05	250	(199 - 380)
Toluene	< 0.1	730	(685 - 1250)
Ethylbenzene	< 0.1	900	(765 - 1395)
Xylenes	< 0.1	2100	(2036 - 3596)
Total	ND		
%Recovery			
Dibromofluoromethane	63	87	
D8-Toluene	74	103	
1-Bromo-4-fluorobenzene	99	149	

Non-conformities:
Comments:
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CHIMISTE
Yves Moras
94-006
QUÉBEC

Yves Moras

Bodycote TECHNITROL • ECO

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Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kss-1 Kimmirut Soilide Waste Closure Plan	Kss-4 Kimmirut Soilide Waste Closure Plan	Kss-8 Kimmirut Soilide Waste Closure Plan	Kss-3 Kimmirut Soilide Waste Closure Plan	Kss-5 Kimmirut Soilide Waste Closure Plan
Reference					
Matrix	Soil	Soil	Soil	Soil	Soil
Date sampled	99-09-22	99-09-22	99-09-22	99-09-22	99-09-22
Sampling Location	NA	NA	NA	NA	NA
Sampled by	M.Suchy	M.Suchy	M.Suchy	M.Suchy	M.Suchy
Laboratory No.	305947	305948	305954	305955	305956
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date prepared	99-09-28	99-09-30	99-09-30	99-09-30	99-09-30
Date analyzed	99-09-28	99-09-30	99-09-30	99-09-30	99-09-30
C6 @ C10 Hydrocarbons	<10	<10	<10	<10	<10
Date prepared	99-10-01	99-10-01	99-10-01	99-10-01	99-10-01
Date analyzed	99-10-02	99-10-02	99-10-02	99-10-02	99-10-02
C11 @ C22 Hydrocarbons	< 50	< 50	< 50	< 50	< 50
Date prepared	99-10-01	99-10-01	99-10-01	99-10-01	99-10-01
Date analyzed	99-10-02	99-10-02	99-10-02	99-10-02	99-10-02
C23 @ C32 Hydrocarbons	< 50	< 50	< 50	< 50	310
Total	ND	ND	ND	ND	310
Comments	---	---	---	---	Heavy hydrocarbons
% Recovery					

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist Yves Moras

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Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
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TÉL.: (514) 697-3273 • FAX: (514) 697-2090

Certificat d'analyse • Certificate of Analysis

Attention: Martin Suchy
Client: Dillon Consulting
P.O.Box 978
Iqualuit, Nunavut
X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kss-6 Kimmirut Soilide Waste Closure Plan	Kss-7 Kimmirut Soilide Waste Closure Plan	Kss-10 Kimmirut Soilide Waste Closure Plan	Kss-11 Kimmirut Soilide Waste Closure Plan	Ksb-1 Kimmirut Soilide Waste Closure Plan
Reference					
Matrix	Soil	Soil	Soil	Soil	Soil
Date sampled	99-09-22	99-09-22	99-09-22	99-09-22	99-09-22
Sampling Location	NA	NA	NA	NA	NA
Sampled by	M.Suchy	M.Suchy	M.Suchy	M.Suchy	M.Suchy
Laboratory No.	305960	305961	305963	305968	305972
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date prepared	99-09-30	99-09-30	99-09-30	99-09-30	99-09-30
Date analyzed	99-09-30	99-09-30	99-09-30	99-09-30	99-09-30
C6 @ C10 Hydrocarbons	<10	<10	<10	<10	<10
Date prepared	99-10-01	99-10-01	99-10-01	99-10-01	99-10-01
Date analyzed	99-10-02	99-10-02	99-10-02	99-10-02	99-10-02
C11 @ C22 Hydrocarbons	< 50	< 50	< 50	54	< 50
Date prepared	99-10-01	99-10-01	99-10-01	99-10-01	99-10-01
Date analyzed	99-10-02	99-10-02	99-10-02	99-10-02	99-10-02
C23 @ C32 Hydrocarbons	55	< 50	< 50	100	< 50
Total	55	ND	ND	154	ND
Comments	Trace of heavy hydrocarbons	---	---	Trace of hydrocarbons in diesel range and heavy hydrocarbons	---
% Recovery					

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist _____
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X0A 0H0

Certificate No.: 13967-99
Date revised: 99-10-06
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	306581	305948	307307	306582	
Control Type	Blank	Sample	Duplicate	Reference materials	
Matrix	Soil	Soil	Soil		
Date Sampled		99-09-22	99-09-22		
Sampling Location		NA	NA		
Sampled by		M.Suchy	M.Suchy		
Reference				Obtained	Range
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date prepared	99-09-28	99-09-30	99-09-30	99-09-28	
Date analyzed	99-09-28	99-09-30	99-09-30	99-09-28	
C6 @ C10 Hydrocarbons	<10	<10	<10	46	(35 - 65)
Date prepared	99-10-01	99-10-01		99-10-01	
Date analyzed	99-10-01	99-10-02		99-10-01	
C11 @ C22 Hydrocarbons	< 50	< 50	(*)	2670	(1200 - 3250)
Date prepared	99-10-01	99-10-01			
Date analyzed	99-10-01	99-10-02			
C23 @ C32 Hydrocarbons	< 50	< 50	(*)		
Total	ND	ND			
Comments			(*) No duplicate		
%Recovery					

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

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X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	307311	307313	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-30	99-09-30	
Date Analyzed	99-09-30	99-09-30	
HYD-C6C10-S-13	mg/kg	mg/kg	mg/kg
C6 @ C10 Hydrocarbons	<10	44	(35 - 65)
%Recovery			

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

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Certificat d'analyse • Certificate of Analysis

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Iqualuit, Nunavut
X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kss-1 Kimmirut Soilide Waste	Kss-4 Kimmirut Soilide Waste
Reference	Closure Plan	Closure Plan
Matrix	Soil	Soil
Date sampled	99-09-22	99-09-22
Sampling Location	NA	NA
Sampled by	M.Suchy	M.Suchy
Laboratory No.	305947	305948
Date prepared	99-09-28	99-09-28
Date analyzed	99-09-28	99-09-28
HHT-T-S-13	mg/kg	mg/kg
Chloroform	< 0.1	< 0.1
1,1-Dichloroethane	< 0.1	< 0.1
1,1-Dichloroethene	< 0.1	< 0.1
1,2-Dichloroethane	< 0.1	< 0.1
1,2-Dichloroethene (t+c)	< 0.1	< 0.1
1,2-Dichloropropane	< 0.1	< 0.1
1,3-Dichloropropene (t+c)	< 0.1	< 0.1
Dichloromethane	< 0.6	< 0.6
1,1,2,2-Tetrachloroethane	< 0.1	< 0.1
Tetrachloroethene	< 0.1	< 0.1
Carbon tetrachloride	< 0.1	< 0.1
1,1,1-Trichloroethane	< 0.1	< 0.1
1,1,2-Trichloroethane	< 0.1	< 0.1
Trichloroethene	< 0.1	< 0.1
Total	ND	ND
% Recovery		
Dibromofluoromethane	82	96
D8-Toluene	83	92
1-Bromo-4-fluorobenzene	80	85

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist _____ Yves Moras

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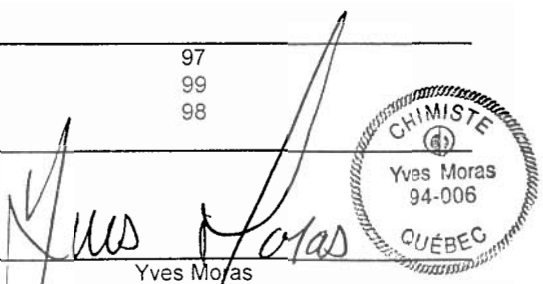
X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	306406	306408	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-28	99-09-28	
Date Analyzed	99-09-28	99-09-28	
HHT-T-S-13	mg/kg	ng	ng
Chloroform	< 0.1	190	(140 - 260)
1,1-Dichloroethane	< 0.1	200	(140 - 260)
1,1-Dichloroethene	< 0.1	190	(140 - 260)
1,2-Dichloroethane	< 0.1	180	(140 - 260)
1,2-Dichloroethene (t+c)	< 0.1	390	(280 - 520)
1,2-Dichloropropane	< 0.1	180	(140 - 260)
1,3-Dichloropropene (t+c)	< 0.1	350	(280 - 520)
Dichloromethane	< 0.1	180	(140 - 260)
1,1,2,2-Tetrachloroethane	< 0.1	180	(140 - 260)
Tetrachloroethene	< 0.1	190	(140 - 260)
Carbon tetrachloride	< 0.1	200	(140 - 260)
1,1,1-Trichloroethane	< 0.1	200	(140 - 260)
1,1,2-Trichloroethane	< 0.1	170	(140 - 260)
Trichloroethene	< 0.1	190	(140 - 260)
Total	ND		
%Recovery			
Dibromofluoromethane	102	97	
D8-Toluene	111	99	
1-Bromo-4-fluorobenzene	104	98	

Non-conformities:
Comments:
Note: These results only apply to the samples submitted



Yves Moras

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X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kss-1	Kss-4
	Kimmirut	Kimmirut
	Soilide Waste	Soilide Waste
Reference	Closure Plan	Closure Plan
Matrix	Soil	Soil
Date sampled	99-09-22	99-09-22
Sampling Location	NA	NA
Sampled by	M.Suchy	M.Suchy
Laboratory No.	305947	305948
Date prepared	99-09-28	99-09-28
Date analyzed	99-09-28	99-09-28
HMA-T-S-13	mg/kg	mg/kg
Benzene	< 0.1	< 0.1
Ethylbenzene	< 0.1	< 0.1
Chlorobenzene	< 0.1	< 0.1
Toluene	< 0.1	< 0.1
Xylenes	< 0.1	< 0.1
Styrene	< 0.1	< 0.1
1,2-Dichlorobenzene	< 0.1	< 0.1
1,3-Dichlorobenzene	< 0.1	< 0.1
1,4-Dichlorobenzene	< 0.1	< 0.1
Total	ND	ND
% Recovery		
Dibromofluoromethane	82	96
D8-Toluene	83	92
1-Bromo-4-fluorobenzene	80	85

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist _____
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Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	306409	306410	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-28	99-09-28	
Date Analyzed	99-09-28	99-09-28	
HMA-T-S-13	mg/kg	ng	ng
Benzene	< 0.1	190	(140 - 260)
Ethylbenzene	< 0.1	200	(140 - 260)
Chlorobenzene	< 0.1	190	(140 - 260)
Toluene	< 0.1	190	(140 - 260)
Xylenes	< 0.1	600	(420 - 780)
Styrene	< 0.1	190	(140 - 260)
1,2-Dichlorobenzene	< 0.1	180	(140 - 260)
1,3-Dichlorobenzene	< 0.1	180	(140 - 260)
1,4-Dichlorobenzene	< 0.1	180	(140 - 260)
Total	ND		
%Recovery			
Dibromofluoromethane	102	97	
D8-Toluene	111	99	
1-Bromo-4-fluorobenzene	104	98	

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

CHIMISTE
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X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kss-1 Kimmirut Soilide Waste	Kss-4 Kimmirut Soilide Waste	Kss-8 Kimmirut Soilide Waste
Reference	Closure Plan	Closure Plan	Closure Plan
Matrix	Soil	Soil	Soil
Date sampled	99-09-22	99-09-22	99-09-22
Sampling Location	NA	NA	NA
Sampled by	M.Suchy	M.Suchy	M.Suchy
Laboratory No.	305947	305948	305954
Date prepared	99-09-28	99-09-28	99-09-28
Date analyzed	99-09-28	99-09-28	99-09-28
HAP-T-S-13	mg/kg	mg/kg	mg/kg
Naphthalene	< 0.2	< 0.1	< 0.1
Methyl-2-Naphthalene	< 0.2	< 0.1	< 0.1
Methyl-1-Naphthalene	< 0.2	< 0.1	< 0.1
Dimethyl-1,3,Naphthalene	< 0.2	< 0.1	< 0.1
Acenaphthylene	< 0.2	< 0.1	< 0.1
Acenaphthene	< 0.2	< 0.1	< 0.1
Trimethyl-2,3,5,Naphthalene	< 0.2	< 0.1	< 0.1
Fluorene	< 0.2	< 0.1	< 0.1
Phenanthrene	< 0.2	< 0.1	< 0.1
Anthracene	< 0.2	< 0.1	< 0.1
Fluoranthene	< 0.2	< 0.1	< 0.1
Pyrene	< 0.2	< 0.1	< 0.1
7,12-Dimethylbenzoanthracene	< 0.2	< 0.1	< 0.1
Benzo(g,h,i)perylene	< 0.2	< 0.1	< 0.1
Benzo(c)phenanthrene	< 0.2	< 0.1	< 0.1
Chrysene	< 0.2	< 0.1	< 0.1
Benzo(a)anthracene	< 0.2	< 0.1	< 0.1
Benzo(b,j,k)fluoranthene	< 0.2	< 0.1	< 0.1
Benzo(a)pyrene	< 0.2	< 0.1	< 0.1
3-Methylcholanthrene	< 0.2	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	< 0.2	< 0.1	< 0.1
Dibenzo(a,h)anthracene	< 0.2	< 0.1	< 0.1
Dibenzo(a,l)pyrene	< 0.2	< 0.1	< 0.1
Dibenzo(a,i)pyrene	< 0.2	< 0.1	< 0.1
Dibenzo(a,h)pyrene	< 0.2	< 0.1	< 0.1
Total	ND	ND	ND
% Recovery			
D10-Fluorene	100	104	100
D10-pyrene	15	116	115
D12-Benzo[a]pyrene	92	88	91

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist Yves Moras

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X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	306586	306587	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-28	99-09-28	
Date Analyzed	99-09-28	99-09-28	
HAP-T-S-13	mg/kg	mg/kg	mg/kg
Naphthalene	< 0.1	3.8	(0.6 - 4)
Methyl-2-Naphthalene	< 0.1	(-)	(-)
Methyl-1-Naphthalene	< 0.1	(-)	(-)
Dimethyl-1,3,Naphthalene	< 0.1	(-)	(-)
Acenaphthylene	< 0.1	0.8	(0.6 - 1.5)
Acenaphthene	< 0.1	(-)	(-)
Trimethyl-2,3,5,Naphthalene	< 0.1	(-)	(-)
Fluorene	< 0.1	(-)	(-)
Phenanthrene	< 0.1	(-)	(-)
Anthracene	< 0.1	4.2	(1.1 - 6.2)
Fluoranthene	< 0.1	(-)	(-)
Pyrene	< 0.1	1.4	(0.5 - 1.8)
7,12-Dimethylbenzoanthracene	< 0.1	(-)	(-)
Benzo(g,h,i)perylene	< 0.1	(-)	(-)
Benzo(c)phenanthrene	< 0.1	(-)	(-)
Chrysene	< 0.1	1.1	(0.4 - 1.1)
Benzo(a)anthracene	< 0.1	2.4	(0.8 - 2.6)
Benzo(b,j,k)fluoranthene	< 0.1	(-)	(-)
Benzo(a)pyrene	< 0.1	(-)	(-)
3-Methylcholanthrene	< 0.1	(-)	(-)
Indeno(1,2,3-cd)pyrene	< 0.1	(-)	(-)
Dibenzo(a,h)anthracene	< 0.1	(-)	(-)
Dibenzo(a,l)pyrene	< 0.1	(-)	(-)
Dibenzo(a,i)pyrene	< 0.1	(-)	(-)
Dibenzo(a,h)pyrene	< 0.1	(-)	(-)
Total	ND		
%Recovery			
D10-Fluorene	102	95	
D10-pyrene	118	115	
D12-Benzo[a]pyrene	98	81	

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

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Yves Moras

Le Groupe S.M.

Laboratoire d'environnement S.M. inc.

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Téléphone: (450) 651-4855 - Télécopieur: (450) 651-9542

No de rapport : 18565

Rapport d'analyse

99-10-22 (A/M/J)

Votre no. de bon de commande : CT-05648

Client: BODYCOTE TECHNITROL-ECO
M. Benoît Saumure
121, boulevard Hymus
Pointe-Claire, Québec
H9R1E6 **Tél :** 1.(514) 697-3400 **Ext :** **Fax :** 1.(514) 697-2090

No de client: 261
No de projet: 1249

Date de prélèvement: 99-09-22 (A/M/J)
Date de réception: 99-09-30 (A/M/J)

Prélevé par:
Nature de l'échantillon: Liquide

Description :

Analyse d'eau et de sols - 1999

No ECH	Identification Client	Analyse	Résultat	Dupl.	% Rec.	Unité	Date d'analyse	Note
65590	68050-305994 (KWS-1)	Glycol - diéthylène glycol	<5			mg/L	99-10-05	
		Glycol - éthylène glycol	<5			mg/L	99-10-05	
		Glycol - propylène glycol	<5			mg/L	99-10-05	
65591	68050-306002 (KWS-2)	Glycol - diéthylène glycol	<5			mg/L	99-10-01	
		Glycol - éthylène glycol	<5			mg/L	99-10-01	
		Glycol - propylène glycol	<5			mg/L	99-10-01	
65592	68050-306007 (KWS-3)	Glycol - diéthylène glycol	<5			mg/L	99-10-01	
		Glycol - éthylène glycol	<5			mg/L	99-10-01	
		Glycol - propylène glycol	<5			mg/L	99-10-01	

Note :

Louis Bilodeau, Chimiste, B.Sc.

CHIMISTE
Louis Bilodeau
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Réjean Beauchemin , Chimiste, B.Sc.

Le Groupe S.M.

Laboratoire d'environnement S.M. inc.

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No de rapport : 18565

Rapport d'analyse

99-10-22 (A/M/J)

Votre no. de bon de commande : CT-05648

Client: BODYCOTE TECHNITROL-ECO
M. Benoît Saumure
121, boulevard Hymus
Pointe-Claire, Québec
H9R1E6 **Tél :** 1.(514) 697-3400 **Ext :** **Fax :** 1.(514) 697-2090

No de client: 261
No de projet: 1249

Analyse	Méthode analytique	No d'instruction de travail
Glycol - diéthylène glycol	GC-FID	ILCE-027
Glycol - éthylène glycol	GC-FID	ILCE-027
Glycol - propylène glycol	GC-FID	ILCE-027

- **Les échantillons sont conservés pour une période de 60 jours après la date de réception ou pour le délai de conservation maximum spécifique à chaque analyse. À moins d'indication contraire, nous disposerons donc des échantillons après ces délais.**
- **Ce rapport ne doit pas être reproduit sinon en entier, sans l'autorisation écrite du Laboratoire d'environnement S.M. Inc..**

Louis Bilodeau, Chimiste, B.Sc.

CHIMISTE
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90-133
QUÉBEC

Réjean Beauchemin , Chimiste, B.Sc.

Bodycote TECHNITROL • ECO

BODYCOTE TECHNITROL INC.
121, BOUL. HYMUS, POINTE-CLAIRE, QUÉBEC H9R 1E6
TÉL.: (514) 697-3273 • FAX: (514) 697-2090

Certificat d'analyse • Certificate of Analysis

Attention: Martin Suchy
Client: Dillon Consulting
P.O.Box 978
Iqualuit, Nunavut
X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kws-1 Kimmirut Soilide Waste	Kws-2 Kimmirut Soilide Waste	Kws-3 Kimmirut Soilide Waste
Reference	Closure Plan	Closure Plan	Closure Plan
Matrix	Water	Water	Water
Date sampled	99-09-22	99-09-22	99-09-22
Sampling Location	NA	NA	NA
Sampled by	M.Suchy	M.Suchy	M.Suchy
Laboratory No.	305994	306002	306007
Date prepared	99-09-30	99-09-30	99-09-30
Date analyzed	99-09-30	99-09-30	99-09-30
BPC-A-L-13	µg/L	µg/L	µg/L
Aroclor 1242	< 0.1	< 0.1	< 0.1
Aroclor 1248	< 0.1	< 0.1	< 0.1
Aroclor 1254	< 0.1	< 0.1	< 0.1
Aroclor 1260	< 0.1	< 0.1	< 0.1
Total	ND	ND	ND
% Recovery			
Decachlorobiphenyle	101	84	102

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist Yves Moras

CHIMISTE
Yves Moras
94-006
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Report number 99-68050
Date reported 99-10-04
Date received 99-09-27
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Identification		KWB-1	KWS-1	KWS-2	KWS-3
Identification (cont'd)		---	---	---	---
Matrix		water	water	water	water
Date collected		99-09-22	99-09-22	99-09-22	99-09-22
Location sampled		---	---	---	---
Collected by		Martin Suchy	Martin Suchy	Martin Suchy	Martin Suchy
Laboratory number		305990	305994	306002	306007
Parameters	Date prepared/analysed	Results (mg/L)*	Results (mg/L)*	Results (mg/L)*	Results (mg/L)*
Aluminum	99-09-29	0.02	0.02	0.5	0.01
Antimony	99-09-29	0.002	0.004	0.001	0.001
Silver	99-09-29	<0.001	<0.001	<0.001	<0.001
Arsenic	99-09-29	<0.001	0.001	<0.001	<0.001
Barium	99-09-29	0.03	0.03	0.01	0.02
Beryllium	99-09-30	<0.01	<0.01	<0.01	<0.01
Boron	99-09-29	0.02	0.18	0.14	0.05
Bismuth	99-09-30	<0.1	<0.1	<0.1	<0.1
Cadmium	99-09-29	<0.001	<0.001	<0.001	<0.001
Calcium	99-09-30	88	102	46	71
Chromium	99-09-29	0.004	0.007	0.005	0.004
Cobalt	99-09-29	<0.001	0.008	0.002	<0.001
Copper	99-09-29	0.004	0.005	0.014	0.002
Tin	99-09-29	<0.01	0.01	<0.01	<0.01
Iron	99-09-29	0.35	20	2.8	0.28
Lithium	99-09-30	<0.02	<0.02	<0.02	<0.02
Magnesium	99-09-30	16	17	9.2	27
Manganese	99-09-29	0.01	1.1	0.26	0.008
Mercury	99-09-30	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	99-09-29	0.003	0.005	0.001	0.002
Nickel	99-09-29	0.004	0.026	0.012	0.003
Lead	99-09-29	<0.001	0.002	0.004	<0.001

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

*Unless stated otherwise

Chemist _____
Micheline Godin

CHIMISTE Micheline Godin 84-032 QUÉBEC

Note : Analytical Results relate only to the samples analysed

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Identification		KWB-1	KWS-1	KWS-2	KWS-3
Identification (cont'd)		---	---	---	---
Matrix		water	water	water	water
Date collected		99-09-22	99-09-22	99-09-22	99-09-22
Location sampled		---	---	---	---
Collected by		Martin Suchy	Martin Suchy	Martin Suchy	Martin Suchy
Laboratory number		305990	305994	306002	306007
Parameters	Date prepared/analysed	Results (mg/L)*	Results (mg/L)*	Results (mg/L)*	Results (mg/L)*
Potassium	99-09-30	0.8	12	14	3.0
Silicon	99-09-30	0.82	3.5	3.3	6.9
Sodium	99-09-30	11	40	50	32
Titanium	99-09-30	<0.01	<0.01	<0.01	<0.01
Vanadium	99-09-30	<0.03	<0.03	<0.03	<0.03
Zinc	99-09-29	0.01	0.04	0.05	0.02
Phenols (Colorimetry)	99-09-28	0.021	0.014	0.022	0.009
Conductivity in µmhos/cm	99-09-28	600	1140	900	670
pH (pH Units)	99-09-28	8.0	7.5	7.6	7.2

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

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Identification		KWS-4	KWS-5
Identification (cont'd)		---	---
Matrix		water	water
Date collected		99-09-22	99-09-22
Location sampled		---	---
Collected by		Martin Suchy	Martin Suchy
Laboratory number		306064	306065
Parameters	Date prepared/analysed	Results (mg/L)*	Results (mg/L)*
Aluminum	99-09-29	3.3	0.11
Antimony	99-09-29	0.001	0.001
Silver	99-09-29	<0.001	<0.001
Arsenic	99-09-29	0.001	<0.001
Barium	99-09-29	0.01	0.01
Beryllium	99-09-30	<0.01	<0.01
Boron	99-09-29	0.19	0.16
Bismuth	99-09-30	<0.1	<0.1
Cadmium	99-09-29	<0.001	<0.001
Calcium	99-09-30	23	84
Chromium	99-09-29	0.006	0.024
Cobalt	99-09-29	<0.001	0.004
Copper	99-09-29	0.037	0.008
Tin	99-09-29	<0.01	<0.01
Iron	99-09-29	1.7	4.8
Lithium	99-09-30	<0.02	<0.02
Magnesium	99-09-30	6.2	15
Manganese	99-09-29	0.07	0.53
Mercury	99-09-30	<0.0002	<0.0002
Molybdenum	99-09-29	<0.001	0.001
Nickel	99-09-29	0.006	0.021
Lead	99-09-29	0.017	0.002

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

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CHIMISTE Micheline Godin 04-032 QUÉBEC

Note : Analytical Results relate only to the samples analysed

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Identification		KWS-4	KWS-5
Identification (cont'd)		---	---
Matrix		water	water
Date collected		99-09-22	99-09-22
Location sampled		---	---
Collected by		Martin Suchy	Martin Suchy
Laboratory number		306064	306065
Parameters	Date prepared/analysed	Results (mg/L)*	Results (mg/L)*
Potassium	99-09-30	17	12
Silicon	99-09-30	6.1	3.7
Sodium	99-09-30	67	44
Titanium	99-09-30	<0.01	<0.01
Vanadium	99-09-30	<0.03	<0.03
Zinc	99-09-29	0.12	0.02
Phenols (Colorimetry)	99-09-28	0.17	0.024
Conductivity in µmhos/cm	99-09-28	970	930
pH (pH Units)	99-09-28	7.4	7.6

Sample non-conformities:
Comments : ** Kimmirut Solide Waste Closure Plan.

Analytical Methods : Appendix I
Quality Control: Appendix II

*Unless stated otherwise

CHIMISTE (41) Micheline Godin 84-032 QUÉBEC

Chemist _____ Micheline Godin

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Appendix I-Analytical Methods

Parameters	Method number or reference	Intrument or analytical method
Aluminum	12-072-98	ICP-MS
Antimony	12-072-98	ICP-MS
Silver	12-072-98	ICP-MS
Arsenic	12-072-98	ICP-MS
Barium	12-072-98	ICP-MS
Beryllium	12-063-97	Inductively coupled plasma
Boron	12-072-98	ICP-MS
Bismuth	12-063-97	Inductively coupled plasma
Cadmium	12-072-98	ICP-MS
Calcium	12-063-97	Inductively coupled plasma
Chromium	12-072-98	ICP-MS
Cobalt	12-072-98	ICP-MS
Copper	12-072-98	ICP-MS
Tin	12-072-98	ICP-MS
Iron	12-072-98	ICP-MS
Lithium	12-063-97	Inductively coupled plasma
Magnesium	12-063-97	Inductively coupled plasma
Manganese	12-072-98	ICP-MS
Mercury	12-041-95	Col vapor atomic absoption spectrometry
Molybdenum	12-072-98	ICP-MS
Nickel	12-072-98	ICP-MS
Lead	12-072-98	ICP-MS

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	Iqaluit, T.N.	**Project**	**
	X0A 0H0	**Purchase order**	N.W.T.

Appendix I-Analytical Methods

Parameters	Method number or reference	Intrument or analytical method
Potassium	12-063-97	Inductively coupled plasma
Silicon	12-063-97	Inductively coupled plasma
Sodium	12-063-97	Inductively coupled plasma
Titanium	12-063-97	Inductively coupled plasma
Vanadium	12-063-97	Inductively coupled plasma
Zinc	12-072-98	ICP-MS
Phenols (Colorimetry)	12-027-95	Colorimetric with UV-Visible HP
Conductivity in µmhos/cm	12-052-95	Conductivimetry
pH (pH Units)	12-028-95	pH-meter

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Appendix II-Quality Control

	Blank	Duplicate			Certified Reference Material (CRM)			Fortified sample
			Value 1	Value 2	CRM Indenti-fication	CRM Target (Range)	CRM Result	%
Parameters	mg/L*	# Lab	mg/L*	mg/L*	mg/L*	mg/L*	mg/L*	Recovery
Aluminum	< 0.01	---	---	---	ERA 9977 -Al	0.41(0.33-0.48)	0.42	---
Antimony	< 0.001	---	---	---	ERA 9977 -Sb	0.23(0.17-0.28)	0.260	---
Silver	< 0.001	---	---	---	ERA 9977 -Ag	0.102(0.084-0.12)	0.100	---
Arsenic	< 0.001	---	---	---	ERA 9977 -As	0.2(0.15-0.24)	0.210	---
Barium	< 0.01	---	---	---	ERA 9977 -Ba	0.67(0.55-0.79)	0.67	---
Beryllium	< 0.01	---	---	---	ERA 9978 -Be	0.14(0.12-0.17)	0.14	---
Boron	< 0.02	---	---	---	ERA 9977 -B	0.32(0.26-0.39)	0.33	---
Bismuth	< 0.1	---	---	---	INTERNE -Bi	1.0 (0.80-1.20)	0.9	---
Cadmium	< 0.001	---	---	---	ERA 9977 -Cd	0.12(0.098-0.14)	0.120	---
Calcium	< 0.01	---	---	---	ERA-425 -Ca	171(145-197)	181	---
Chromium	< 0.001	---	---	---	ERA 9977 -Cr	0.41(0.34-0.49)	0.410	---
Cobalt	< 0.001	---	---	---	ERA 9977 -Co	0.66(0.54-0.78)	0.650	---
Copper	< 0.001	---	---	---	ERA 9977 -Cu	0.45(0.37-0.53)	0.430	---
Tin	< 0.01	---	---	---	INTERNE15 -Sn	1.0 (0.85-1.15)	1.10	---
Iron	< 0.01	---	---	---	ERA 9977 -Fe	0.67(0.55-0.79)	0.69	---
Lithium	< 0.02	---	---	---	INTERNE -Li	1.0 (0.85-1.15)	0.95	---
Magnesium	< 0.01	---	---	---	ERA-425 -Mg	30(26-35)	31	---
Manganese	< 0.001	---	---	---	ERA 9977 -Mn	0.1(0.082-0.12)	0.100	---
Mercury	<0.000	---	---	---	INT 0,003	0,0030(0,0027-0,00330)	0.0031	---
Molybdenum	< 0.001	---	---	---	ERA 9977 -Mo	0.23(0.19-0.27)	0.210	---
Nickel	< 0.001	---	---	---	ERA 9977 -Ni	0.57(0.47-0.67)	0.560	---
Lead	< 0.001	---	---	---	ERA 9977 -Pb	0.66(0.54-0.79)	0.650	---

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Chemist

Michelline Godin

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Appendix II-Quality Control

	Blank	Duplicate			Certified Reference Material (CRM)			Fortified sample
			Value 1	Value 2	CRM Indenti-fication	CRM Target (Range)	CRM Result	%
Parameters	mg/L*	# Lab	mg/L*	mg/L*	mg/L*	mg/L*	mg/L*	Recovery
Potassium	< 0.5	---	---	---	ERA-425 -K	82(69-94)	81	---
Silicon	< 0.02	---	---	---	INTERNE -Si	1.0(0.85-1.15)	0.99	---
Sodium	< 0.1	---	---	---	ERA-425 -Na	101(86-116)	100	---
Titanium	< 0.01	---	---	---	INTERNE -Ti	1.0(0.85-1.15)	0.98	---
Vanadium	< 0.03	---	---	---	ERA 9978 -V	0.36(0.30-0.43)	0.37	---
Zinc	< 0.01	---	---	---	ERA 9977 -Zn	0.34(0.28-0.40)	0.34	---
Phenols (Colorimetry)	<0.01	---	---	---	ERA 9966	0.15 (0.11-0.19)	0.14	---
Conductivity in µmhos/cm	<1	---	---	---	ERA 9982 1/5	143(121-164)	136	---
pH (pH Units)	---	---	---	---	ERA9982	9.12(8.92-9.32)	9.0	---

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Parameters	Method number or reference	Intrument or analytical method
Aluminum	12-063-97	Inductively coupled plasma
Antimony	12-072-98	ICP-MS
Silver	12-072-98	ICP-MS
Arsenic	12-072-98	ICP-MS
Barium	12-072-98	ICP-MS
Beryllium	12-063-97	Inductively coupled plasma
Boron	12-072-98	ICP-MS
Bismuth	12-063-97	Inductively coupled plasma
Cadmium	12-072-98	ICP-MS
Calcium	12-063-97	Inductively coupled plasma
Chromium	12-072-98	ICP-MS
Cobalt	12-072-98	ICP-MS
Copper	12-072-98	ICP-MS
Tin	12-072-98	ICP-MS
Iron	12-072-98	ICP-MS
Lithium	12-063-97	Inductively coupled plasma
Magnesium	12-063-97	Inductively coupled plasma
Manganese	12-072-98	ICP-MS
Mercury	12-041-95	Col vapor atomic absoption spectrometry
Molybdenum	12-072-98	ICP-MS
Nickel	12-072-98	ICP-MS
Lead	12-072-98	ICP-MS

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Parameters	Method number or reference	Intrument or analytical method
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Titanium	12-063-97	Inductively coupled plasma
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Zinc	12-072-98	ICP-MS
Phenols (Colorimetry)	12-027-95	Colorimetric with UV-Visible HP
Conductivity in µmhos/cm	12-052-95	Conductivimetry
pH (pH Units)	12-028-95	pH-meter

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Reference					
Matrix	Water	Water	Water	Water	Water
Date sampled	99-09-22	99-09-22	99-09-22	99-09-22	99-09-22
Sampling Location	NA	NA	NA	NA	NA
Sampled by	M.Suchy	M.Suchy	M.Suchy	M.Suchy	M.Suchy
Laboratory No.	305990	305994	306002	306007	306064
Date prepared	99-09-29	99-09-29	99-09-29	99-09-29	99-09-30
Date analyzed	99-09-29	99-09-29	99-09-29	99-09-29	99-09-30
BTEX-L-13	µg/L	µg/L	µg/L	µg/L	µg/L
Benzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	< 0.1	< 0.1	< 0.1	< 0.1	0.8
Ethylbenzene	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total	ND	ND	ND	ND	0.8
% Recovery					
Dibromofluoromethane	87	89	93	94	95
D8-Toluene	101	97	66	95	98
1-Bromo-4-fluorobenzene	98	98	98	98	100

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

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BODYCOTE TECHNITROL INC.
121, BOUL. HYMUS, POINTE-CLAIRE, QUÉBEC H9R 1E6
TÉL.: (514) 697-3273 • FAX: (514) 697-2090

Certificat d'analyse • Certificate of Analysis

Attention: Martin Suchy
Client: Dillon Consulting
P.O.Box 978
Iqualuit, Nunavut
X0A 0H0

Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kws-5 Kimmirut Soilide Waste
Reference	Closure Plan
Matrix	Water
Date sampled	99-09-22
Sampling Location	NA
Sampled by	M.Suchy
Laboratory No.	306065
Date prepared	99-09-29
Date analyzed	99-09-29
BTEX-L-13	µg/L
Benzene	< 0.1
Toluene	< 0.1
Ethylbenzene	< 0.1
Xylenes	< 0.1
Total	ND
% Recovery	
Dibromofluoromethane	89
D8-Toluene	89
1-Bromo-4-fluorobenzene	98

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

Chemist Yves Moras

CHIMISTE Yves Moras 94-006 QUÉBEC

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Laboratory No.	306933	306007	306402	306934	
Control Type	Blank	Sample	Duplicate	Reference materials	
Matrix	Water	Water	Water		
Date Sampled		99-09-22	99-09-22		
Sampling Location		NA	NA		
Sampled by		M.Suchy	M.Suchy		
Reference				Obtained	Range
Date Prepared	99-09-29	99-09-29	99-09-29	99-09-29	
Date Analyzed	99-09-29	99-09-29	99-09-29	99-09-29	
BTEX-L-13	µg/L	µg/L	µg/L	µg/L	µg/L
Benzene	< 0.1	< 0.1	< 0.1	43	(38.7 - 62.3)
Toluene	< 0.1	< 0.1	< 0.1	52	(48.4 - 75.8)
Ethylbenzene	< 0.1	< 0.1	< 0.1	12	(11.4 - 17.9)
Xylenes	< 0.1	< 0.1	< 0.1	30	(23.7 - 46.1)
Total	ND	ND	ND		
%Recovery					
Dibromofluoromethane	90	94	89	92	
D8-Toluene	97	95	97	100	
1-Bromo-4-fluorobenzene	96	98	97	97	

Non-conformities:
Comments:
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Laboratory No.	307378	307380	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-30	99-09-30	
Date Analyzed	99-09-30	99-09-30	
BTEX-L-13	µg/L	µg/L	µg/L
Benzene	< 0.1	41	(38.7 - 62.3)
Toluene	< 0.1	50	(48.4 - 75.8)
Ethylbenzene	< 0.1	12	(11.4 - 17.9)
Xylenes	< 0.1	28	(23.7 - 46.1)
Total	ND		
%Recovery			
Dibromofluoromethane	90	91	
D8-Toluene	98	94	
1-Bromo-4-fluorobenzene	96	92	

Non-conformities:
Comments:
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Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Identification	Kws-5 Kimmirut Soilide Waste
Reference	Closure Plan
Matrix	Water
Date sampled	99-09-22
Sampling Location	NA
Sampled by	M.Suchy
Laboratory No.	306065
Units	µg/L
Date prepared	99-09-29
Date analyzed	99-09-29
C6 @ C10 Hydrocarbons	<25
Date prepared	99-10-01
Date analyzed	99-10-02
C11 @ C22 Hydrocarbons	68
Date prepared	99-10-01
Date analyzed	99-10-02
C23 @ C32 Hydrocarbons	270
Total	338
Comments	Trace of hydrocarbons in diesel range and heavy hydrocarbons
% Recovery	

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

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Chemist _____
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Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68060
Purchase Order No.: N.W.T.

Identification	Kwb-1 Kimmirut Soilide Waste Closure Plan	Kws-1 Kimmirut Soilide Waste Closure Plan	Kws-2 Kimmirut Soilide Waste Closure Plan	Kws-3 Kimmirut Soilide Waste Closure Plan	Kws-4 Kimmirut Soilide Waste Closure Plan
Reference					
Matrix	Water	Water	Water	Water	Water
Date sampled	99-09-22	99-09-22	99-09-22	99-09-22	99-09-22
Sampling Location	NA	NA	NA	NA	NA
Sampled by	M.Suchy	M.Suchy	M.Suchy	M.Suchy	M.Suchy
Laboratory No.	305990	305994	306002	306007	306064
Units	µg/L	µg/L	µg/L	µg/L	µg/L
Date prepared	99-09-28	99-09-29	99-09-29	99-09-29	99-09-30
Date analyzed	99-09-28	99-09-29	99-09-29	99-09-29	99-09-30
C6 @ C10 Hydrocarbons	<25	<25	<25	<25	<25
Date prepared	99-10-01	99-10-01	99-10-01	99-10-01	99-10-01
Date analyzed	99-10-01	99-10-02	99-10-02	99-10-02	99-10-01
C11 @ C22 Hydrocarbons	< 50	69	51	< 50	740
Date prepared	99-10-01	99-10-01	99-10-01	99-10-01	99-10-01
Date analyzed	99-10-01	99-10-02	99-10-02	99-10-02	99-10-02
C23 @ C32 Hydrocarbons	< 50	91	100	< 50	2300
Total	ND	160	151	ND	3040
Comments	---	Hydrocarbons in diesel range	Trace of hydrocarbons in diesel range and heavy hydrocarbons	---	Hydrocarbons in diesel range and heavy hydrocarbons
% Recovery					

Non-conformities:
Comments:
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Certificate No.: 13967-99
Date revised: 99-10-06
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	306403	306007	306405	306404	
Control Type	Blank	Sample	Duplicate	Reference materials	
Matrix	Water	Water	Water		
Date Sampled		99-09-22	99-09-22		
Sampling Location		NA	NA		
Sampled by		M.Suchy	M.Suchy		
Reference				Obtained	Range
Units	µg/L	µg/L	µg/L	µg/L	µg/L
Date prepared	99-09-28	99-09-29	99-09-29	99-09-28	
Date analyzed	99-09-28	99-09-29	99-09-29	99-09-28	
C6 @ C10 Hydrocarbons	<25	<25	<25	4000	(3500 - 6500)
Date prepared	99-10-01	99-10-01		99-10-01	
Date analyzed	99-10-01	99-10-02		99-10-01	
C11 @ C22 Hydrocarbons	< 50	< 50	(*)	2000	(1100 - 2800)
Date prepared	99-10-01	99-10-01			
Date analyzed	99-10-01	99-10-02			
C23 @ C32 Hydrocarbons	< 50	< 50	(*)		
Total	ND	ND			
Comments			(*) No duplicate		
%Recovery					

Non-conformities:
Comments:
Note: These results only apply to the samples submitted

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Certificate No.: 13967-99
Date Printed: 99-10-04
Date Received: 99-09-27
Work Order No.: 99-68050
Purchase Order No.: N.W.T.

Laboratory No.	306936	306937	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-29	99-09-29	
Date Analyzed	99-09-29	99-09-29	
HYD-C6C10-L-13	µg/L	µg/L	µg/L
C6 @ C10 Hydrocarbons	<25	4100	(3500 - 6500)
%Recovery			

Non-conformities:
Comments:
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Laboratory No.	307390	307391	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-30	99-09-30	
Date Analyzed	99-09-30	99-09-30	
HYD-C6C10-L-13	µg/L	µg/L	µg/L
C6 @ C10 Hydrocarbons	<25	5500	(3500 - 6500)
%Recovery			

Non-conformities:
Comments:
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Purchase Order No.: N.W.T.

Laboratory No.	307444	306007	307446	307445	
Control Type	Blank	Sample	Duplicate	Reference materials	
Matrix	Water	Water	Water		
Date Sampled		99-09-22	99-09-22		
Sampling Location		NA	NA		
Sampled by		M.Suchy	M.Suchy		
Reference				Obtained	Range
Date Prepared	99-09-30	99-09-30	99-09-30	99-09-30	
Date Analyzed	99-09-30	99-09-30	99-09-30	99-09-30	
BPC-A-L-13	µg/L	µg/L	µg/L	µg/L	µg/L
Aroclor 1242	< 0.1	< 0.1	< 0.1	(-)	(-)
Aroclor 1248	< 0.1	< 0.1	< 0.1	(-)	(-)
Aroclor 1254	< 0.1	< 0.1	< 0.1	1.0	(0.75 - 1.5)
Aroclor 1260	< 0.1	< 0.1	< 0.1	(-)	(-)
Total	ND	ND	ND		
%Recovery					
Decachlorobiphenyle	106	102	97	95	

Non-conformities:
Comments:
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Purchase Order No.: N.W.T.

Laboratory No.	306674	306675	
Control Type	Blank	Reference materials	
Matrix			
Date Sampled			
Sampling Location			
Sampled by			
Reference		Obtained	Range
Date Prepared	99-09-29	99-09-29	
Date Analyzed	99-09-29	99-09-29	
HAP-T-L-13	µg/L	µg/L	µg/L
Naphthalene	< 0.1	2.2	(1.05 - 2.2)
Acenaphthylene	< 0.1	(-)	(-)
Acenaphthene	< 0.1	2.5	(2.1 - 3.6)
Fluorene	< 0.1	2.7	(1.9 - 3.5)
Dibenzo(a,h)anthracene	< 0.1	(-)	(-)
Phenanthrene	< 0.1	3.5	(2.5 - 4.5)
Anthracene	< 0.1	3.1	(2.6 - 3.8)
Fluoranthene	< 0.1	2.3	(1.6 - 3.1)
Pyrene	< 0.1	(-)	(-)
7,12-Dimethylbenzoanthracene	< 0.1	(-)	(-)
Benzo(g,h,i)perylene	< 0.1	(-)	(-)
Benzo(c)phenanthrene	< 0.1	(-)	(-)
Chrysene	< 0.1	(-)	(-)
Benzo(a)anthracene	< 0.1	(-)	(-)
Benzo(b,j,k)fluoranthene	< 0.1	(-)	(-)
Benzo(a)pyrene	< 0.1	(-)	(-)
3-Methylcholanthrene	< 0.1	(-)	(-)
Indeno (1,2,3-cd) pyrene	< 0.1	(-)	(-)
Dibenzo(a,l)pyrene	< 0.1	(-)	(-)
Dibenzo(a,i)pyrene	< 0.1	(-)	(-)
Dibenzo(a,h)pyrene	< 0.1	(-)	(-)
Total	ND		
%Recovery			
D10-Fluorene	100	92	
D10-pyrene	97	105	
D12-Benzo[a]pyrene	81	68	

Non-conformities:
Comments:
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Identification	Kws-1 Kimmirut Soilide Waste Closure Plan	Kws-2 Kimmirut Soilide Waste Closure Plan	Kws-3 Kimmirut Soilide Waste Closure Plan
Reference	Water	Water	Water
Matrix	99-09-22	99-09-22	99-09-22
Date sampled	NA	NA	NA
Sampling Location	M.Suchy	M.Suchy	M.Suchy
Sampled by	305994	306002	306007
Laboratory No.	99-09-29	99-09-29	99-09-29
Date prepared	99-09-29	99-09-29	99-09-29
Date analyzed			
HAP-T-L-13	µg/L	µg/L	µg/L
Naphthalene	< 0.3	< 1.6	< 0.1
Acenaphthylene	< 0.3	< 1.6	< 0.1
Acenaphthene	< 0.3	< 1.6	< 0.1
Fluorene	< 0.3	< 1.6	< 0.1
Dibenzo(a,h)anthracene	< 0.3	< 1.6	< 0.1
Phenanthrene	< 0.3	< 1.6	< 0.1
Anthracene	< 0.3	< 1.6	< 0.1
Fluoranthene	< 0.3	< 1.6	< 0.1
Pyrene	< 0.3	< 1.6	< 0.1
7,12-Dimethylbenzoanthracene	< 0.3	< 1.6	< 0.1
Benzo(g,h,i)perylene	< 0.3	< 1.6	< 0.1
Benzo(c)phenanthrene	< 0.3	< 1.6	< 0.1
Chrysene	< 0.3	< 1.6	< 0.1
Benzo(a)anthracene	< 0.3	< 1.6	< 0.1
Benzo(b,j,k)fluoranthene	< 0.3	< 1.6	< 0.1
Benzo(a)pyrene	< 0.3	< 1.6	< 0.1
3-Methylcholanthrene	< 0.3	< 1.6	< 0.1
Indeno (1,2,3-cd) pyrene	< 0.3	< 1.6	< 0.1
Dibenzo(a,l)pyrene	< 0.3	< 1.6	< 0.1
Dibenzo(a,i)pyrene	< 0.3	< 1.6	< 0.1
Dibenzo(a,h)pyrene	< 0.3	< 1.6	< 0.1
Total	ND	ND	ND
% Recovery			
D10-Fluorene	75	88	77
D10-pyrene	108	110	110
D12-Benzo[a]pyrene	80	75	91

Non-conformities:
Comments:
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