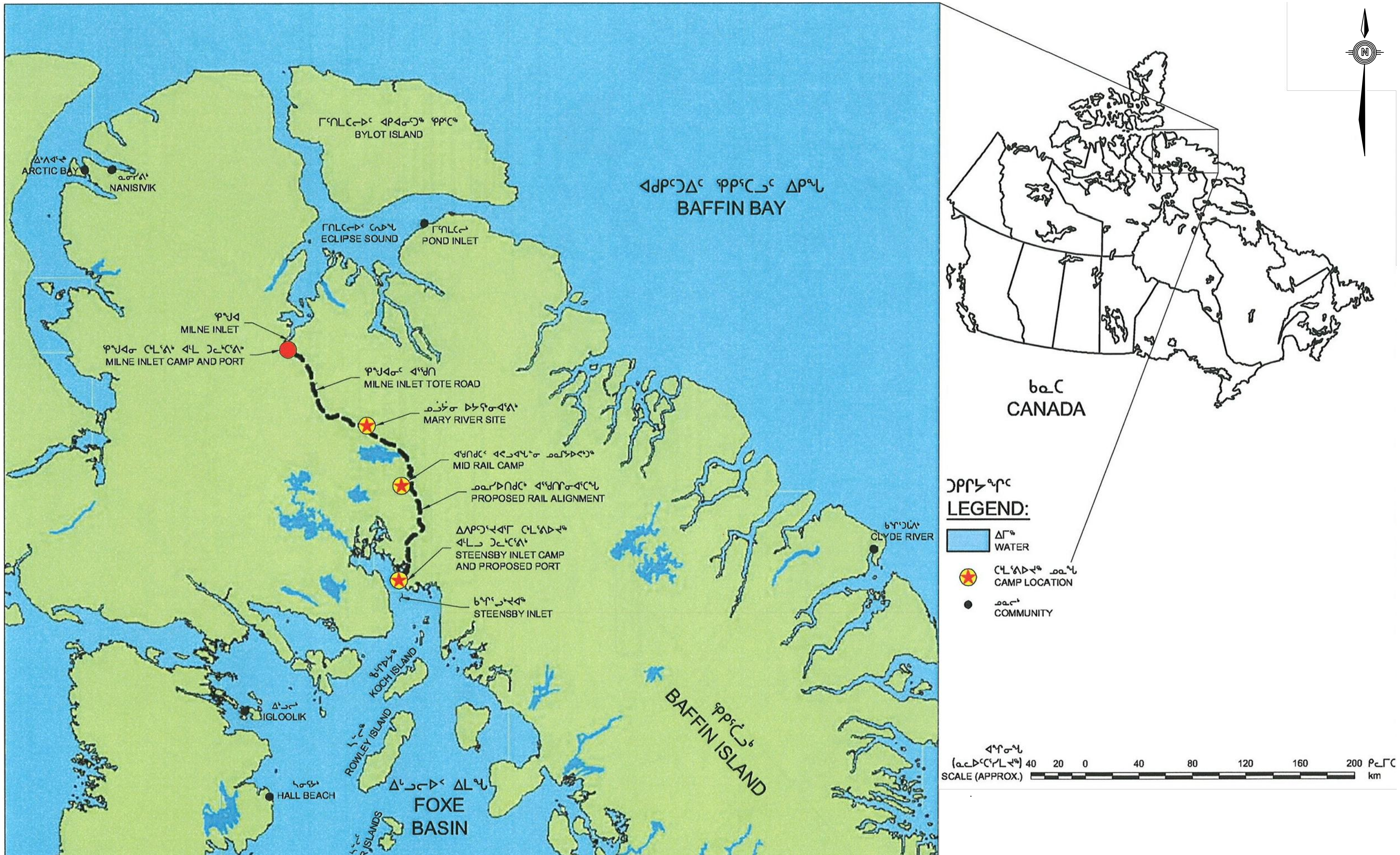
FIGURES

Q:\Edmonton\Drafting\DIVISIONS2007\E141\E14101092\ACAD\E14101092_Fig 1.dwg [FIGURE 1] September 13, 2011 - 3:00:51 pm (BY: MARSH, MAUREEN)



NOTES
BASED ON DRAWING PROVIDED BY BAFFINLAND IRON MINES CORPORATION

CLIENT
Baffinland Iron Mines Corporation

eba A TETRA TECH COMPANY

Hydrocarbon Impacted Soils Storage and Landfarm Facility

Site Location Plan

PROJECT NO.	DWN	CKD	REV
E14101092	RH	DF	0
OFFICE	DATE		
EDM	September 13, 2011		

Figure 1

NOTES
BASED ON 2005 AERIAL PHOTOGRAPH

0 250
Scale: 1: 5 000 (metres)

CLIENT
Baffinland Iron Mines Corporation

eba A TETRA TECH COMPANY

Hydrocarbon Impacted Soils Storage and Landfarm Facility

Proposed Landfarm Locations

PROJECT NO.	DWN	CKD	REV
E14101092	RH	DF	0

OFFICE	DATE
EDM	September 13, 2011

Figure 2

APPENDIX A

SOIL SAMPLING RESULTS FROM THE MILNE BLADDER FUEL CONTAINMENT FACILITY

A TETRA TECH COMPANY

November 23, 2012

ISSUED FOR USE
EBA FILE: E14101092
Via Email: Jim.Millard@Baffinland.com

Baffinland Iron Mines Corporation
Mary River Project

Attention: Mr. James Millard, M.Sc., P.Geo., Senior Environmental Superintendent

Subject: Summary Report on Assessment of Hydrocarbon-Impacted Soils within the Bulk Fuel Storage Facility at Milne Inlet, Nunavut

1.0 INTRODUCTION

EBA, A Tetra Tech Company (EBA) is pleased to provide this summary report and work plan to Baffinland Iron Mines Corporation (Baffinland) following completion of fieldwork related to the hydrocarbon-contaminated soil at the Milne Inlet Bulk Fuel Storage Facility in Nunavut. The bladder farm was constructed in 2007 and was intended as a temporary fuel storage facility to serve the bulk sampling program. The facility consists of 76 fuel bladders, each with a capacity of 113,560 litres.

Decommissioning of the bladder farm facility will proceed in the summer of 2012, as outlined in the Action Plan for Decommissioning of Milne Inlet Bulk Fuel Storage Facility and the Construction of New Fuel Tank Storage, Hatch™, report dated June 11, 2011. Some of the bladders were refilled with diesel fuel in September 2011. When the 5 M litre steel tank is commissioned in the spring of 2012, fuel from the bladders will be transferred to the tank

A spill of aviation fuel at the bladder shown as "Jet1" was documented by Baffinland (Figure 1). Also, other minor hydrocarbon spills related to transfer of fuel and leakage of piping fittings and other mechanical components has caused localized soil impairment within the contained facility. The expected contaminants of concern in the facility include Jet A and diesel fuel.

Jet A aviation fuel is a kerosene-type of fuel consisting of a mixture of many different compounds, including hydrocarbons of the paraffin, naphthene, or aromatic classes. The carbon number distribution of this fuel ranges between about eight and 16 carbon numbers (i.e., the F1 to F2 range). The total aromatic content is limited to 25%, and total naphthalene content is limited to 3%. Jet A may also contain biocides to prevent microbial growth in aircraft fuel systems, as well as corrosion-inhibitors, antioxidants, icing inhibitors, metal deactivators and antistatic agents.

The other contaminant of concern, petroleum-derived diesel, is composed of about 75% saturated hydrocarbons, primarily including n-, iso-, and cyclo-paraffins. The remaining 25% consists of aromatic hydrocarbons including naphthalenes and alkylbenzenes. The carbon number distribution ranges between about 10 and 26 carbon numbers (i.e., the F2 to F3 range).

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2.0 SCOPE OF WORK

The scope of work, as provided in the proposal submitted to Baffinland dated August 30, 2011, was as follows:

- Use a combination of photoionization detector (PID) and analytical tests to characterize the soils within the lined bladder farm facility;
- Perform surface observations and ground truth previously-selected potential landfarm locations based on aerial photographs, and collect samples of potential borrow source material to verify suitability for construction of the berms and landfarm liner protective layer; and
- Prepare a summary report of the soils results and provide a work plan to finalize the landfarm design and operation manual.

The investigation work was conducted between September 5 and September 9, 2011 by Ms. Daniela Felske, P.Eng., of EBA's Edmonton office. A total of twenty-two samples were collected from the lined bladder farm facility for submission to Baffinland's designated laboratory, Exova (Guelph, Ontario). Samples were analyzed for CCME petroleum hydrocarbon fractions F1 to F4, CCME metals, salinity, total organic carbon, pH, soil texture, and field capacity of the soil. EBA collected four aggregate samples and Milne Inlet and submitted these to EBA's materials testing laboratory in Yellowknife, NT. Samples were submitted for grain size analysis and pH. Two samples were analyzed for porewater salinity. At the request of the Client, one additional sample was collected at the borrow pit used for the construction of the landfill at Mary River Camp.

3.0 RESULTS

3.1 Bladder Farm Soil Sampling

A total of 23 sample locations were dug by hand to the geofabric/geomebrane liner. Locations of the sampling points are shown on Figure 1. Soils in the bladder farm mainly consisted of medium- to coarse-grained sands with five to ten percent gravel and few fines. Cobble-sized rocks were also encountered in some locations. In the context of the Canadian Council of Ministers of the Environment (CCME) environmental guidelines, the soils are coarse-grained. Coarse-grained soils are those which contain greater than 50% by mass particles greater than 75 µm mean diameter (D50 > 75µm).

A 500 g sample of soil from each sample location was collected in a plastic bag and sealed for the purpose of soil screening. A MiniRAE 2000 photoionization detector (PID) calibrated with isobutylene was used to record organic vapour emission (OVE) measurements in the headspace above the soils. Ionization potential of the soil was recorded in ppm. PID readings are a screening tool and do not provide a quantitative measurement of the level of hydrocarbon contamination in soil samples, as readings are affected by soil temperature, type and moisture content. Maximum PID measurements from each of screening locations are provided in the table on Figure 1. Photos showing the localized soil staining are attached. Petroleum hydrocarbon soil staining is predominantly associated with small leaks originating from the camlock hose couplings.

The depth of soil cover over the liner system ranged from 18 cm to 33 cm. Some of the contained areas were fully saturated, with free-standing water at the surface. Using an average depth of 25 cm, the total soil volume within the bladder farm is approximately 2,700 m^3. Approximately 100 m^3 of soil on the inner side of the berm has been stained by the rise of petroleum-hydrocarbon impacted within the containment area in the spring.

Samples were shipped to Baffinland's designated laboratory, Exova Accutest in Ottawa, Ontario. Analytical results for F2 and F3 hydrocarbon fractions in the soil sampled on September 7, 2011 are summarized on Figure 1. The laboratory-issued report is attached as an appendix. BTEX and the F1 and F4 hydrocarbon fractions were not included in the table because the concentrations were low or less than the laboratory detection method limit. The landfarm remediation strategy for the current soils pertains to the F2 and F3 hydrocarbon fractions.

The soil analytical results indicated the following:

- Approximately 800 to 900 m^3 plus the 100 m^3 from the sides of the berm (for a total of approximately 1,000 m3) of soils require no treatment other than stockpiling and confirmatory sampling to achieve the most stringent Government of Nunavut Tier 1 remediation criteria for petroleum hydrocarbons;
- Approximately 500 m^3 to 600 m^3 of soils are co-contaminated with F2 and F3 petroleum hydrocarbon fractions and should be segregated at the landfarm for separate treatment owing to the longer treatment times typically required to bioremediate the F3 fraction (see hatched area on Figure 1); and
- The remainder of the soils within the berm, between 1,100 m^3 to1,200 m^3 requires landfarming to achieve the applicable Government of Nunavut guidelines. Using a weighted average approach, the approximate resulting concentration of a well-mixed soil was estimated to be between 800 and 900 mg/kg F2 fraction.

A past spill of Jet A at location "Jet1" coincides with the F2/F3 co-contaminated soils shown on Figure 1, and also with the most highly-impacted soils. The pattern of hydrocarbon impacts also conforms to the design slope and grading of the facility, with hydrocarbons migrating from the origin of the spill to the south and east, to the sump. However, the isolated high F3 hydrocarbon fraction concentrations (highest value of F3 equal to 4,200 mg/kg) are not characteristic of Jet A.

3.2 Aggregate Analyses

Aggregate samples were collected at four locations near Milne Inlet including Alternative Landfarm Site A (about 3 km along the tote road), Alternative Landfarm Site B (plateau about 1 km along the tote road and east of the road), a pit at kilometre 2 along tote road, and a pit at kilometre 4 along the tote road. See Figure 2 for sample locations and the attached photos. Particle Size analyses were conducted at EBA's Yellowknife materials laboratory, in accordance with ASTM standards C136 and C117. Results of the sieve analyses and other parameters are included in the appendices and summarized below.

- Site A: Gravelly sand, poorly graded, with some cobble, trace fines;
- Site B: Sandy gravel, poorly graded, trace fines;
- Pit@km 2: Poorly graded sand with some gravel, trace fines; and

- Pit@km 4: Sandy gravel, well graded, trace fines.

At the request of the client, one additional sample was collected at the pit used for the construction of the landfill at Mary River Site A, at approximately km 104 along the tote road.

- Pit@km 104: Sand and cobble with some gravel, poorly graded, trace fines.

4.0 CLOSURE

We trust this summary report and work plan meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Sincerely,
EBA Engineering Consultants Ltd.

REGISTERED PROFESSIONAL ENGINEER
W. T. HORNE
LICENSEE
Nov 23, 2012
N.W.T.

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date Nov. 23, 2012
PERMIT NUMBER: P 018
NWT/NU Association of Professional Engineers and Geoscientists

Bill Horne, P.Eng.
Principal Consultant, Arctic Region
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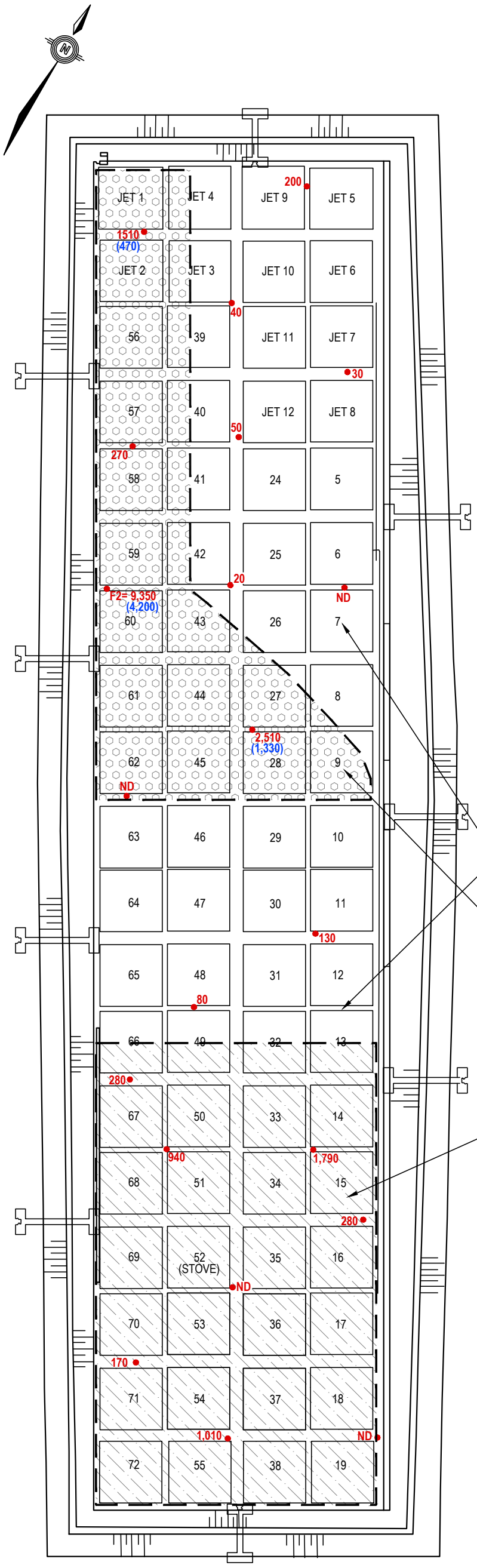
Attachments: Figures (2)
Photos (8)
Report of Analysis, Exova Accutest
Aggregate Analysis – Particle Size
Aggregate Analysis – Salinity
Aggregate Analysis – pH
General Conditions – Environmental Report



Petroleum Hydrocarbon Results for Milne Inlet Bladder Farm
September 7, 2011

Bladder	PID reading (ppm)	Depth of Soil (cm above liner)	Depth of Water (cm above liner)	F2 Hydro-carbon Fraction (mg/kg)	F3 Hydro-carbon Fraction (mg/kg)	Land use
Government of Nunavut Environmental Guideline for Contaminated Site Remediation (2009), Coarse-Grained Soils				260	1,700	Industrial
				150	300	Wildland
Jet 1	685	18	0	**1,510**	470	
Jet 3	122	26	2	40	50	
Jet 5	3.2	29	0	200	200	
Jet 7	15	23	0	30	80	
Jet 12	179	18	0	50	70	
6	93	30	1	ND	ND	
8	225	24	10	10	20	
11	63	27	27	130	30	
14	116	23	7	**1,790**	60	
15	122	23	8	**280**	60	
18	16	26	9	ND	ND	
27	366	23	18	**2,510**	1,330	
42	4.7	33	7	20	ND	
47	225	25	17	80	40	
50	11.5	25	8	**940**	240	
52	1.2	33	13	ND	ND	
54	314	32	14	**1,010**	130	
57	25	20	0	**270**	230	
59	20	23	0	**9,350**	**4,200**	
62	310	24	17	10	20	
66	35	19	12	**280**	70	
70	8	24	11	170	200	

PID = Photoionization Detector
ND = concentration less than the laboratory detection method limit
All samples collected on September 7, 2011
Bold and underlined = concentrations higher than the Government of Nunavut Tier 1 PHC guidelines for coarse-grained soils, industrial land use (Guideline for Contaminated Site Remediation, 2009)

NOTES
BASED ON DRAWING PROVIDED BY B.H. MARTIN CONSULTANTS LTD.

LEGEND:
- ● - VALUES IN mg/kg
- ND - NON - DETECT
- (XXX) - F3 VALUES IN mg/kg, ONLY LOCATIONS WITH CONCENTRATIONS EXCEEDING THE GN GUIDELINES ARE SHOWN (TIER 1, AGRICULTURAL/WILDLAND, COARSE GRAINED SOILS)

0 25
Scale: 1: 750 (metres)

CLIENT
Baffinland Iron Mines Corporation

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SITE EVALUATION FOR LANDFARM AT MILNE INLET, NU
MILNE INLET, NUNAVUT

PETROLEUM HYDROCARBON SOIL RESULTS AND DEPTH OF SOIL COVER OVER LINER, SEPTEMBER 2011

PROJECT NO.	DWN	CKD	REV	
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OFFICE	DATE			
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