Final Report

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Phase 11 & Phase 111
Environmental Investigation and Remediation
Iqaluit Airport
Iqaluit, Nunavut

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November 3, 2014

EXECUTIVE SUMMARY

On July 30, 2014 Mr. Steve Murray, from Transport Canada, contacted Nunatta Environmental Services Inc. in Iqaluit. Mr Murray called to enquire about getting some sampling done at a three cell LTU located on the Iqaluit Airport property.The sampling was required by The Nunavut Water Board to facillitate the decommissioning of the cells. A number of soil samples were required from the soil in each cell. Samples were also required under the liners in cases where the liners had been damaged or removed. Water samples were required in each monitoring well, sump areas and samples from areas of standing water. A site inspection in Auguest 2014 revealed the 3 landfarms had been completely removed and the contaminated soil within the facility had been used for fill material for the Airport expansion project in July 2014.

The sampling results indicated contaminated soil still exists at this location, specifically Ethylbenzene,Xylenes, and and Naphthalene in the soil. One water sample was also obtained that indicated it was also contaminated. Transport Canada contracted Nunatta Environmental and its Sub- Contractor Franz Environmental in September 2014 to complete a Phase Two Environmental Site Assessment(ESA) to determine the location and volume of contaimented soil that exist at the Iqaluit Airport Landfarm.The Environmental Investigation identified two areas of concern. One location contains(estimated) approximately 300 cubic meters of petroleum hydrocarbon(PHC) impacted soil.The second location is estimated to contain 900 cubic meters of PHC impacted soil.(See Environmental Investigation Phase Two Report attached)

The scope of work for the remediation part of this Project only addresses the area containing 300 cubic meters of soil. On October 16, 2014 Nunatta and a Subcontractor, Nunavut Excavating, with three 15 cubic meter Dump Trucks and a large heavy duty Excavator removed 20 truck loads at 15 cubic meters per load(300 cubic meters) of Hydrocarbon Impacted soil from the Iqaluit Airport LTU area. The contaminated soils were hauled to Nunatta's Landfarm for future remediation.

Andrew Keim from AANDC, Inspector for the Nunavut Water Board, was present to witness the Excavation. After the soil had been removed an inspection revealed there was more contamination at this site. The impacted area was deeper than the original estimated in the area where the liner had been damaged and affected area was longer than the estimate.

John Hawkings, Manager of the Iqaluit Airport, arrived at the site. John requested we continued to remove the remaining contaminated soils. John said he would get a Purchase Order for Nunatta to continue excavating the remaining impacted soil. Nunatta's Project Manager, James H. Wilson, said he would have to get permission from Transport Canada prior to starting this work. Jim contacted Anita Gudmundson at Transport Canada. Approximately 2 hours later Transport Canada called back and

granted permission. Nunatta using the Excavator and 3 Dump trucks on site removed another 105 cubic meters of PHC impacted soil.

Andrew Kiem, Inspector for the Nunavut Water Board, requested we take a number of samples to ensure the Berm Area is cleaned up. A total of 17 samples was collected for Laboratory testing. Andrew requested the samples be tested for all the parameters specified in Transport Canada's Maintenance Program for the LTU's. The cost of the Laboratory work was included in the Purchase Order issued by John Hawkins, Manager of the Iqaluit Airport. The results of the Laboratory testing is attached as a separate appendix.

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2.0 INTRODUCTION

The Iqaluit Airport is located adjacent to the City of Iqaluit in the Qikiqtani Region of Nunavut. Transport Canada(TC) engaged a contractor to construct Land Treatment Units(LTU'S) to treat petroleum hydrocarbon(PHC) contaminated soil at the Iqaluit Airport as a result of historical and current activities associated with the airport. The LTUs were completed in the fall of 2006.Early in July 2014, soil from the LTUs was removed and used as fill for the construction of the new Airport. In August 2014 Transport Canada contracted Nunatta Environmental Services to complete a confirmatory sampling program to identify if any cotamination soil remained on site. The Laboratory results indicated contaminated soil still exists at this location specifically Ethylbenzene,Xylenes, and and Naphthalene in the soil. One water sample was also obtained that indicated it was also contaminated.

Transport Canada contracted Nunatta Environmental in September 2014 to complete a Phase Two Environmental Site Assessnent(ESA) to determine the location and volume of contaimented soil that exist at the Iqaluit Airport Landfarm.The Environmental Investigation identified two areas of concern. One location contains(estimated) approximately 300 cubic meters of petroleum hydrocarbon(PHC) impacted soil.The second location is estimated to contain 900 cubic meters of PHC impacted soil.(See Environmental Investigation Phase Two Report attached)

Tranport Canada decided to remove up to 300 cubic meters of PHC impacted soil from pre-determined locations identified in the Phase 11 ESA. The scope of work for this Project only addresses the area containing 300 cubic meters of impacted soil. On October 16, 2014 Nunatta and a Subcontractor Nunavut Excavating with three 15 cubic meter Dump Trucks and and large heavy duty Excavator removed 20 truck loads at 15 cubic meters per load(300 cubic meters) of Hydrocarbon Impacted soil from the Iqaluit Airport LTU area. The contaminated soils were hauled to Nunatta's Landfarm facility for future remediation.

The Inspector from the Nunavut Water Board, Andrew Kiem,was present to witness the excavation. After the soil had been removed Nunatta's Project Manager, Jim Wilson and Andrew did a thorough inspection of the site.The inspection revealed there was more contamination at this site. The impacted area was deeper than the original estimated in the area where the liner had been damaged and affected area was longer than the estimate.

John Hawkins, Manager of the Iqaluit Airport, arrived at the site. John requested we continued to remove the remaining contaminated soils. John said he would get a Purchase Order for Nunatta to continue excavating the remaining impacted soil. Nunatta's Project Manager, Jim H Wilson, said he would have to get permission from Transport Canada prior to starting this work. Jim contacted Anita Gudmundson at Transport Canada. Approximately 2 hours later Transport Canada called back and

granted permission. Nunatta using the Excavator and 3 Dump trucks on site removed another 105 cubic meters of PHC impacted soil.

Andrew Kiem, Inspector for the Nunavut Water Board, requested we take a number of samples to ensure the LTU site is cleaned up. A total of 17 samples was collected for Laboratory testing. Andrew requested the samples be tested for all the parameters specified in Transport Canada's Maintenance Program for the LTU's. The cost of the Laboratory work was included in the Purchase Order issued by John Hawkins. The results of the Laboratory testing is attached as a separate appendix. (See Airport Final Results)

On Oct 17, 2014 Jim Wilson and Andrew Kiem returned to the Airport LTU site. Stakes were installed at all the sample locations. Using a GPS way points were establised at each sample location. A map showing the sample locations is attached in the appendixes.

3.0 Background

The airport has been in operation since it was originally founded as Frobisher Bay Air base in 1942.The base was closed in 1963 and converted into a civilian airport.TC transferred the Iqaluit Airport to the Government of Northwest Territories(GNWT) in 1995, which has now been transferred to the Government of Nunavut(GN) Airports Division of the Department of Economic Development and Transportation. As a condition of the Arctic "A" transfer agreement of July 1995 between GNWT and TC, the environmental issues that existed prior to the airport transfer must be remediated.

Three (3) Landfarms (90mx40m, 90x10 and 50mx50m) with an oil resistant reinforced polyethylene liner was constructed on site to contain the contaiminated soil. Monitoring wells were installed down gradient of the Landfarm to facilitate future monitoring of these sites.
In July 2014 the 3 Landfarms and contaminated soil within the facility was removed and the impacted soil was used as fill material for the Airport expansion project.
Nunatta Environmental Services, in Iqaluit was contracted to complete a confirmatory sampling program to identify if any contaminated soil remained on site. Laboratory results indicated there was still substantial contaminates on the LTU site.
Transport Canada based on the results of the confirmatory sampling decided to procede with a Phase2 ESA to determine the location and volume of impacted soil. It was further decided to remove up to 300 cubic meters of contaimented soil.

Inspection of the LTU area revealed there was more contaimenated soil on site. John hawkins, Airport Manager authorized a PO to continue removing the remaining impacted soils. A total of 17 confirmatory samples were taken and analysed for all the parameters stated in Transport Canada's Maintenance LTU Program. The results indicated the subject LTU area has been sucessfully remediated.

4.0 REGULATORY GUIDELINES

The *Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil* (CCME, 2008a) presents criteria for petroleum hydrocarbons in soil. These numerical standards are based on the assessment and consistent management of risks posed to humans, plants, animals and environmental processes under four common land uses (agricultural, residential/parkland, commercial and industrial). Under Tier 1 of the CWS, specific numerical levels are presented for the four land uses, two soil textures (coarse and fine) and the four defined petroleum hydrocarbon fractions (F1 (nC6-nC10); F2 (nC10-nC16); F3 (nC16-nC34); F4 (nC34+)).

The standards or guidelines adopted for this evaluation are as follows:

- *Environmental Guideline for Contaminated Site Remediation March 2009 (Revised)* (Government of Nunavut) **and** *Canadian Environmental Quality Guidelines* (CCME, 2007)) for residential/parkland land use ***and*** *Canada-Wide Standards for Petroleum Hydrocarbons (CWS - PHC) in Soil* (CCME, 2008a) - Tier 1 residential land use, coarse-grained soil, non-potable water.

Table 4.1 Canadian Wide Standards

Land Use	Soil Texture	Fraction 1	Fraction 2	Fraction 3	Fraction 4
Agriculture	Coarse-grained soil	30b	150	300	2800
Residential /	Coarse-grained soil	30b	150	300	2800
Parkland	grained soil				
Commercial	Coarse-grained soil	320 (240a)	260	1700	3300
Industrial	Coarse-grained soil	320 (170a)	260	1700	3300

5.0 Investigation Methology(For the Phase 11 Environmental Investigation)

5.1 Intrusive Field Investigation and Sampling

The proposed field program will involve excavating test pits with a mechanical excavator. Up to 20 test pits will be excavated to assess for the presence or absence of contamination and to provide an assessment of the horizontal and vertical extent of any contamination in the soil in the LTU area.

Test pitting will be completed using a backhoe owned and operated by a local contractor. It is planned that up to three soil samples will be collected from each test pit from the backhoe bucket: one representing the upper 1.5 m (surface soil), one from below 1.5 m (subsurface soil) and one from a depth expected to be clean to provide vertical delineation (one sample will be placed on hold depending on the olfactory and visual observations).

Soil descriptions including approximate grain size, colour, moisture content, stratigraphy, and nature and extent of apparent contamination will be recorded by the field technician.

Nunatta and FRANZ will conduct jar headspace analysis using a combustible gas detector with methane elimination (e.g., Gastechtor) to detect petroleum hydrocarbon vapours. Immediately after retrieval, samples will be placed into the jars for headspace analysis and also into laboratory bottles. This will allow for submission of the selected samples for detailed chemical analysis.

In general, only the contaminants of concern will be tested for, unless there is reason to suspect that other contaminants might be present. Contaminant analysis programs will be site specific. The chemical parameters for this project include:

- Petroleum hydrocarbon fractions F1-F4 [for all samples]
- Benzene, toluene, ethylbenzene and xylenes [for all samples]
- Polycyclic aromatic hydrocarbons [one sample per test pit]
- Metals [one sample per test pit]

Nunatta and FRANZ realize that groundwater or melt water may be present in some of the test pits. Two infiltration water samples are included in the work plan. The purpose of infiltration water sampling is to obtain information that can be used to determine the presence and possible extent of groundwater impacts and determine the potential for trans-boundary migration of contaminants. Water samples will be collected from pooled water in test pits. Sampling in such a manner may result in false negatives or non-detection of potential contaminants of concern in groundwater. Since there is a chance groundwater may not be present and the installation of wells may not be required (depending on the nature and location of soil impacts with respect to

the water table / active layer), the risk of false negatives is considered to be acceptable provided the sample results are not being used for regulatory purposes.

Laboratory Analysis

All chemical analysis will be completed by Maxxam Analytical Services (Maxxam) in Ottawa, Ontario or Mississauga, Ontario. Maxxam is certified by the Canadian Association for Laboratory Accreditation Inc. (CALA). The proposed laboratory program will include verification that the selected analytical methods will have minimum detection limits which are less than the applicable environmental quality criteria or standard on which the numerical comparison will be based.

Quality Assurance/Quality Control and Chemical Analyses

The field QA/QC program will consist of the following elements:

- Proper documentation of all aspects of the sampling program, which could potentially cause sampling bias. The documentation will include daily field summary sheets, separate filing of field notes, chain-of-custody forms and memos written when any major deviation from ideal protocol occurs (e.g., an ice-pack melts, a bottle is broken, etc.).
- Decontamination of sampling equipment in soil. All re-usable soil sampling apparatus such as hand augers will be successively washed with tri-sodium phosphate (TSP), rinsed with distilled water, rinsed with methanol and rinsed with distilled water.
- A minimum of 10% collected soil samples submitted to the laboratory will be blind field duplicates. These duplicates are in addition to any duplicates and replicates analyzed as part of the standard lab QA/QC procedures.
- Nunatta and FRANZ are aware of the sample holding time requirements. Samples will be delivered to the laboratory as soon as possible following the sampling, either directly by our personnel or by courier. Samples will be immediately transferred and stored in coolers with ice packs to hold the sample temperature at approximately 4 -10°C, as required by most laboratory protocols.

Site Survey

All sampling locations will be surveyed using a differential global positioning system. This will provide sufficient accuracy for any future excavation and disposal of impacts.

Data Analysis and Interpretation

Once the fieldwork is completed the data reduction and interpretation will begin.Stratigraphy will be analyzed to develop geological and hydrogeological models of the site. Soil properties and the results from the laboratory analysis will be used to evaluate the horizontal and vertical contamination of the site.

Field measurements, together with the results of the chemical analyses, will be used to characterize the soil conditions through comparison to background levels and applicable

standards. The volume of contaminated soil and groundwater (as applicable) on the airport property will be calculated where sufficient information exists; the likelihood of offsite contamination will also be evaluated.

An assessment of the site remediation and/or risk management requirements will be made in the context of the existing regulations and guidelines currently in force for both Nunavut and the Government of Canada (through the Contaminated Sites Management 10-step process).Impacted media will be delineated to develop volume estimates of contaminated media exceeding applicable guidelines and standards.

Reporting

A preliminary field report will be provided to TC after the analytical results of the field program are received. This report will include figures, tables, and a brief discussion of the results in a short letter. Preparing drawings for the report on this schedule will be possible only if TC can provide base drawings in AutoCAD-compatible format of the LTF area before the field program.

After the preliminary field report is submitted, draft report on the investigation will be prepared. The report will clearly identify areas of actual contamination in the areas investigated and the basis for all findings. Applicable federal, provincial, local legislation and published guidelines used as a basis for findings or conclusions respecting the determination of contamination will be referenced. Nunatta and FRANZ will also indicate the relative degree of uncertainty associated with evidence of potential contamination.

Nunatta and FRANZ will submit two digital copies of the draft and three paper copies and three digital copies of the final report.

6.0 INVESTIGATION RESULTS
(see Phase 11 Environmental Report Sent Previously)

7.0 Quality Assurance and Quality Control

Field personnel ensured NUNATTA'S Assurance/Quality Control (QA/QC) protocols, including appropriate techniques for soil sampling, sample storage, shipping and handling, as well as collection of duplicates

Soil samples collected for laboratory analysis were placed in laboratory prepared 250 ml glass jars fitted with screw-tight Teflon-lined lids. Sample numbers were clearly marked on the containers. The soil jars were filled to capacity with minimum headspace and stored in coolers with cold packs to moderate temperature fluctuations during transport to the laboratory. To prevent cross contamination, samples were collected with fresh nitrile gloves.

The samples were transported to the project laboratory, Maxxam Labs in Ottawa, ON, accompanied by a Chain of Custody form.

7.1 Laboratory Analytical Program

Maxxam Laboratory Inc. of Ottawa, Ontario was selected to complete the analytical testing for this project. Maxxam is certified by the Canadian Association for Laboratory Accreditation Inc. (CALA), and follows strict internal quality assurance/quality control (QA/QC) protocols. Its quality control program includes replicate analysis, blank spikes, matrix spikes, instrument calibration, internal standards, method blanks, and internal QC checks.

The laboratory QA/QC documentation is provided with the analytical report and it was reviewed by NUNATTA as part of the QA/QC protocol (see Appendix A)

8.0 Discussion

Based on the results of the 17 samples collected on October 16, 2014 from the excavated area. The contamination has been removed. None of the samples collected, post excavation, exhibited any concentrations above the Canadian Wide Standards. The verification sampling indicates that the excavation and remedial work was successful in removing the contaminated soil.

9.0 Conclusion

Based on the Laboratory Analysis, the results of the 17 samples collected in the berm area proved the remediation was sucessful.Some test locations in Cell C and A also exhibited elevated levels of Hydrocarbon Impacted contamination. See Laboratory results in The Phase 11 Report. These cells were not remediated. The scope of work for this project was limited to the berm area. A total of 405 cubic meters of contaminated soil was removed and transported to Nunatta's Landfarm for future remediation.

10.0 LIMITATIONS

This report has been prepared exclusively for Transport Canada. Any other person or entity may not rely upon without the express written consent from Nunatta Environmental Inc. and Transport canada..

Any use, which a third party makes of this report, or any reliance on decisions made based on it, is the responsibility of such third parties. Nunatta Environmental Services Inc. accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

Some of the information presented in this report was provided through existing documents. Nunatta Environmental Services, Inc. in certain instances, have been required to assume that the information provided is accurate.

The conclusion presented represents the best judgment of these circumstances of the assessors based on the site conditions observed during the period of August 8 and 9th.

Should additional information become available, Nunatta Environmental Services, Inc. request that this information be brought to our attention so that we may re-assess the conclusions presented herein.

There is no warranty, expressed or implied that the work reported has uncovered all potential environmental liabilities, nor does the report preclude the possibility of contamination outside the areas of investigation. The findings of this report were developed in a manner consistent with a level of care and skill normally exercised by members of the engineering profession currently practicing under similar conditions in the area.

A potential remains for the presence of unknown, unidentified, or unforeseen surface and sub-surface contamination. Any evidence of such potential site contamination would require appropriate surface and sub-surface exploration and testing. If new information is developed in future work (which may include excavations, borings, or other studies), Nunatta Environmental, Inc. should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

8.0 CLOSURE

We trust that this information is satisfactory for your requirements. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Yours truly,

James H Wilson
General Manager &
VP of Operations
Nunatta Environmental Services

Axel D Have P Eng.
Chairperson
Nunatta Environmental Services