GENERAL INFORMATION

The water use license application is being submitted to the NWB on October 9, 2007 for the period of June 2008 to October 2011.

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The specifications for this contract have not yet been awarded. Once the contract is awarded, all contact information will be provided.

TECHNICAL INFORMATION

Site Assessment Considerations

1. Detailed topographic site survey diagrams, maps and aerial photos are provided in the drawing package included with the project description submission.

a. **Soil, fuel and chemical storage locations:** The contractor will store soil, fuel and chemicals, as required to complete the work. The project specifications outline suitable requirements for the storage of these materials, including conformance with all applicable environmental laws, regulations and requirements of Federal, Territorial and other regional authorities.

b. **Soil Landfarm active treatment location:** Shown on the drawings.

c. **Site drainage patterns:** Shown on the drawings.

d. **Adjacent surface water bodies that could be affected by the proposed undertaking:** Shown on the drawings.

e. **Facility site access routes:** Shown on the drawings.

f. **Surface and subsurface environmental monitoring sites;** Locations of proposed monitoring stations are shown on the drawings.

g. **Traditional land use areas:** Traditional land use at the site may include Inuit families residing on the land in tents during the summer months. It is anticipated that the Inuit would engage in traditional activities such as hunting, fishing and gathering. During the site clean up activities, the contractor would be responsible for site security relative to his construction activities.

2. Slope of land underlying the Facility: Measurements taken from the drawings indicate that the approximate slope of the natural ground in the landfarm area is 2% to the west-northwest.

3. Hydrological / Climatic Assessment of the Site:

a. Precipitation and temperature profiles for the area: The climate at FOX-3 includes long cold winters and short mild summers. Average monthly and annual weather data has been measured at the station (Dewar Lakes, Nunavut, 68° 39' N, 71° 10' W, elevation 526.70 m, data from 1971 to 2000, Canadian Climate Normals, Environment Canada) and summarized in the following table.

Table 3: Meteorology: Precipitation and Temperature profiles at FOX-3, Dewar Lakes

Month	Daily Maximum (°C)	Daily Minimum (°C)	Daily Mean (°C)	Extreme Maximum (°C)	Extreme Minimum (°C)	Rainfall (mm)	Snowfall (cm)	Snow at Month-end (cm)
January	-23.4	-30.3	-26.8	22.2*	-49.4	0	5.5	50
February	-25.3	-32	-28.6	0	-50.7	0	4.1	50
March	-23.2	-29.9	-26.6	-2.3	-48.3	0	7.2	52
April	-16.2	-22.9	-19.5	-1.1	-39.8	0	12.4	51
May	-6.7	-12.6	-9.7	9.5	-29.4	0.5	23.9	39
June	2.6	-2.8	-0.1	17.2	-17.2	8.2	12.8	5
July	8.7	2.4	5.6	23.2	-6.3	45.2	3.1	0
August	6.2	0.7	3.4	20.6	-7.5	54.4	9.9	2
September	-0.8	-5	-2.9	11.1	-18	7.4	27.3	15
October	-8.3	-13.8	-11.1	3.3	-33	0	35.6	40
November	-15.6	-21.9	-18.8	-0.6	-40.6	0	17	44
December	-21.7	-28.2	-24.9	0	-45	0	7.3	46

*Although this is the data provided, it is potentially an error.

b.) Details of the local drainage basin: The FOX-3, Dewar Lakes DEW Line site is located in the central area of Baffin Island in the Nunavut Territory. The station area is approximately 6 km northwest of Dewar Lakes, near which the airstrip was built. There is no direct sea access from this site.

The area surrounding the station is characterized by an extensive boulder field featuring poorly developed channels and drainage patterns. Rolling hills separated by broad intervening depressions, which form natural drainage sheds, characterize the landscape between the upper and lower bases.

The upper base facilities occupying the hill crest at approximately 525 masl are drained by a series of culverts and ditches with direct flow toward the surrounding boulder covered terrain. Low lying areas within the station site are often more poorly drained and characterized by standing water or saturated surface materials. Ponding also occurs along the perimeter of the upper base facilities, adjacent to the gravel pad embankments. Natural drainage on the undisturbed terrain occurs in rills or as sheet wash typically below the boulder covered surface.

Drainage from the POL facilities, landfill and pallet areas is controlled largely by the topography which gently slopes away from the facilities toward the surrounding terrain. No channels are developed and flow occurs within rills or as slope wash below the boulder covered surface.

Drainage patterns become better developed with decreasing elevation. The terrain, in turn becomes more rugged, characterized by increasingly steep slopes and steeper channel banks eroding through the mantle of unconsolidated surface materials exposing the underlying bedrock. The channels form a dendritic pattern on the landscape flowing toward the southeast. Small but comparatively deep accumulations of water occur along the drainage courses in parts of the landscape which provide water source for the base. Isolated sumps were noted in parts of the landscape between the upper and lower bases and west of the upper base facility. Drainage channels flow through the dumps exposing their contents.

The lower base facilities are located along an over-bank and channel lag sequence adjacent a large southwest flowing river. Drainage from the lower base facilities, landfills, POL areas and pallet areas, which eventually flows into the river, is improved by ditching and culverts in parts.

c. Likelihood of flood events: The landfarm is located in an area that will not be affected by flood events. It is located out of the flood zone of watercourses.

4. A description of the soil underlying the site:

a. The physical and chemical characteristics of the soil underlying the facility: Three test pits were excavated in the proposed landfarm area. The soils in the area are comprised of sand, gravel, cobbles and silt in varying proportions, with trace boulders.

b. Depth of the permafrost active layer: Frozen ground was encountered between 0.5 m and 0.7 m depth.

c. Permafrost characteristics that may impact the construction and operation of the Facility: Excavation of active layer is to be minimized to reduce the risk of thaw settlement of the underlying ice rich permafrost. The landfarm is constructed primarily above existing grade with only the lowest portion of the collection ditch excavated slightly below existing grade (< 0.3 metres).

5. Municipal Zoning or Land Use Planning Ordinances: The proposed landfarm at FOX-3 is on a DND Reserve on Crown Land.

Soil Storage and Landfarm Treatment Design Considerations

1. Details of Design and Construction of Soil Storage and Landfarm Treatment Facility:

UMA submitted the design for a hydrocarbon soils treatment facility (landfarm) as part of the Project Description for the clean up of the FOX-3 site. The landfarm is located at least 100 metres away from any water body, and in an area free of ponded water; to provide for the convenient access of equipment; at least 300 metres from the construction camp, offices, and laboratory; and in an area that is relatively free of boulders and that is generally level. Development, operation and closure of the landfarm will involve the following work:

- Ground preparation, such as removal of boulders and placement of granular bedding material, to facilitate treatment options, as required;
- Construction and maintenance of roadways required to support treatment operations;

- Construction of exterior berms and drainage ditches;
- Placement of hydrocarbon-contaminated soils in the landfarm;
- Specific activities for landfarming operations, including nutrient application, tilling and moisture conditioning;
- Final grading to promote drainage away from the site and to match the surrounding terrain,
- Supply and installation of temporary groundwater monitoring wells at the perimeter of the landfarm, to be sampled and tested during landfarming operations.
- Closure of the landfarm following confirmation that treatment has remediated the contaminated soil.

Based on the estimated quantities of Type B hydrocarbon soil requiring treatment, the overall landfarm will require a footprint of approximately 4,900 m^2. The landfarm is sized to allow the hydrocarbon soils to be spread out to a maximum thickness of 400 mm to facilitate suitable aeration for treatment. If additional hydrocarbon soils requiring treatment are identified during construction, an additional landfarm cell can be constructed adjacent to the existing landfarm.

a. Retaining Structures; The containment for the landfarm will consist perimeter berms constructed of select borrow material (typically Type 4 granular fill). A granular leveling course will be constructed over the base of the landfarm interior to provide a working surface for treatment activities.

b. Geo-synthetic liners; No geosynthetic liner will be used.

c. Devices used to manage excess runoff water and/or leachate; The landfarm will be graded to drain to a ditch and collect in a sump at the south side of the facility. Excess runoff in the sump will be tested and if it meets the requirements of the wastewater discharge criteria, it will be pumped and discharged appropriately. Landfarm runoff that does not meet the Wastewater Discharge Criteria will be treated or if it cannot be treated, it will be containerized and disposed off-site.

d. Existing and proposed drainage modifications: The landfarm includes the construction of perimeter berms and a leveling course to facilitate a treatment area for the hydrocarbon contaminated soil. Ditches and berms are provided to re-direct drainage and minimize run-on from outside of the landfarm and control runoff from within the landfarm. Diversion ditches will be built outside of the landfarm, if required.

e. Water quality and environmental monitoring stations: Temporary groundwater monitoring wells will be provided to facilitate environmental monitoring during landfarming activities. Four groundwater monitoring wells will be installed around the perimeter of the Landfarm. One well will be located upgradient of the facility and will be used as a background well.

2. Installation of barriers to prevent access to the site: Signage will be erected at access points to the Landfarm Area. Signage will be visible from all sides of the landfarm area. The English version of the sign shall read:

"CAUTION: CONTAMINTATED SOIL LANDFARM AREA
AUTHORIZED PERSONNEL ONLY"

A similar sign in the language of the local dialect will also be posted.

3. Placement of the Facility in relation to water bodies: The site for this landfarm was recommended by EBA Engineering Consultants Ltd. in their geotechnical investigation report for FOX-3. The landfarm site is located

near the station area and is a considerable distance from all waterbodies.

4. Flood risks/maximum probably precipitation events in regards to the Facility placement and design. The landfarm facility is not in the floodplain of any watercourse or waterbody.

5. Alternative methods of soil storage or remediation, in the event that circumstances are not suitable, for example because of environmental constraints, available human resources, etc.: An alternative to Landfarming of hydrocarbon-contaminated soil would be to containerize and provide off-site disposal.

Operations and Maintenance Considerations

1. Procedures to determine if soils may be accepted at the Landfarm:

a. Chemical, physical and biological characterization of the soils and the associated hydrocarbon and metal contaminant concentrations: The FOX-3 landfarm provides a treatment facility for the hydrocarbon contaminated soil, which was investigated and delineated by the Environmental Sciences Group (ESG) in 2006. The soil testing indicated total petroleum hydrocarbon concentrations ranging from <40 to 28,000 ppm.

b. Treatibility studies, to determine the viability of landfarm treatment: Landfarms have been successfully used to treat hydrocarbon contaminated soils at 14 other DND DEW Line sites.

In 2006, the Analytical Services Unit at Queen's University in Kingston, Ontario, prepared a report titled "The Potential for Landfarming of Diesel Contaminated Soil at Ekalugad Fjord", in preparation for the remediation of hydrocarbon contaminated soils at the FOX-C, Ekalugad Fjord site.

The experimental design attempted to simulate a landfarm and examined the contributions of aeration and bioremediation. The addition of fertilizer and the frequency of rotation were varied, as was expected temperature was an important factor with the reactors at 18 °C remediating more diesel that the 8 °C or the 5 °C. However, at colder temperatures the soils were successfully remediated with a rotation frequency of 4 days and the addition of fertilizer. At 5 °C, in particular, aeration improved results and clear evidence of bioremediation was observed. The data from the laboratory experiments indicate that landfarming at Ekalugad Fjord has the potential to successfully remediate the diesel contaminated soils.

c. Sampling frequency and number of samples per volume of soil accepted: The frequency of testing will be determined by the Engineer. A typical testing program for an arctic landfarm includes the following: The landfarm is divided into 10 meter squares for the purpose of sampling. One discrete sample is collected from a random location within each 10 meter square, which corresponds to about 4 cubic meters of hydrocarbon contaminated soil. The sample is collected from the bottom 10 centimeters of soil (approximately 30-40 cm depth).

2. Procedures to be utilized during active landfarming operations in the active treatment cells: The treatment of the hydrocarbon contaminated soils in the landfarm will include the application of nutrients along with tilling and moisture conditioning of the treatment soils. These activities are essential to ensure that adequate conditions for microbial growth are achieved. Granular nutrients will be applied uniformly to the contaminated soils at a rate sufficient to achieve the optimum nitrogen loading, as determined by testing during treatment. Fresh water will be sprayed over the soil to achieve the optimum moisture. Tilling of the contaminated soil is specified to occur at 10 days intervals and at 5 day intervals should periods of warm or dry weather be encountered.

a. **Treatment cell development and material placement therein;** The treatment cell development will consist of the placement of specified granular materials for the perimeter berms and interior leveling course and the excavation of a perimeter ditch and sump in the northwest corner of the facility. Once the landfarm has been constructed, hydrocarbon contaminated soils will be transported to the Landfarm Area such that no soil or liquid will be spilled during transport.

b. Contaminated soil thickness in treatment cells: The Landfarm at FOX-3 is designed to accommodate the hydrocarbon contaminated soil spread to a maximum loose thickness of 400 mm.

c. Method of mechanical aeration in treatment cells; The treatment soils are typically tilled with an earthworks disc unit or rake attachment pulled by a farm tractor or bulldozer.

d. Oversize material management; The intent for oversize material management is to separate the boulders from the contaminated soil during excavation, manually remove organic and contaminated soil and use the boulders as backfill for the excavations. Any boulders observed in the landfarm, which could hinder the tilling operation, will be removed from the treatment area, cleaned and buried on site.

e. Surface water management, leachate containment and/or treatment, and site grade planning; During periods of wet weather, tilling will be delayed until the treatment soils have adequately dried out. The landfarm is graded to drain and collect excess runoff in a sump at the low end of the facility. The runoff that collects in the landfarm sump is considered contact water, and can only be discharged if it is tested to have maximum concentration of 5 mg/L of oil and grease. The storage in the sump is limited and the contractor is required to make provisions for testing, treatment (as required), and controlled discharge of the contact water. If the contact water does not meet the criteria for oil and grease as indicated previously, the contractor must treat the water to meet the criteria or containerize it as hazardous waste for off-site disposal.

f. Process water management and treatment prior to discharge; All surface water and runoff that collects in the landfarm sump is considered contact water and can only be discharged if it is tested to meet the requirements of the oil and grease discharge criteria as noted above. The storage in the sump is limited and the contractor is required to make provisions for testing, treatment (as required) and controlled discharge of the contact water. If the contact water does not meet the discharge criteria, the Contractor must treat the water to meet the criteria or containerize it off-site disposal.

h. Dust control programs; The suppression of dust generated during landfarm operations will be done with a water spray. The use of oil for dust control is prohibited.

i. Staff operational training programs: All activities involving the handling and treatment of hydrocarbon contaminated soil, shall be directly supervised by Construction Contractor's personnel who have successfully completed a 40 hour training course for Hazardous Waste Activities in compliance with OSHA 29 CFR 1910.120 or other approved equivalent training courses such as the Canadian Hazardous Waste Workers Program. It is the responsibility of the Contractor to provide suitable training for operational staff.

3. Soil Quality Remediation Objective:

The Soil Quality Remediation Objectives are provided in the DND-NTI Cooperation Agreement, Environmental Provisions, dated September 1998. The remediation objectives include the treatment of hydrocarbon contaminated soils by landfarming to meet the criteria of 2500 ppm for Total Petroleum Hydrocarbons (TPH). If

these levels are met, the contaminated soils are considered remediated and can be left in place. It the criteria is not met, further tilling and confirmatory sampling is necessary.

4. Conceptual Decommissioning and Reclamation plan:

a. Details regarding the ultimate deposition of any treated soils; When the hydrocarbon contaminated soils at the FOX-3 landfarm have been tested to show that the remediation objectives have been met, the following tasks are specified to close the landfarm:

- All granular fill is to be compacted to 95% Maximum Dry Density;
- Consolidate the treated contaminated soil within the Landfarm to a maximum depth of 1.0 metre. Grade this consolidation area allow a final slope of 2 to 4%.
- Excavate granular material from the perimeter berms outside the consolidation area and place this material, as cover to a minimum depth of 30 centimetres, over the consolidated treated soil area.
- Decommission the groundwater monitoring wells, including backfilling with appropriate grout, removal of the protective casing, lockable cap and well pipe to within 300 mm from the ground surface, and backfill and compact all voids with granular fill material.

The contractor is required to complete the cleanup and remediate all of the areas in which their activities took place, as described in the Project Description.

b. Disposal plan for soils contaminated with bioremediation-unsuitable compounds, or for soils that do not respond well to the proposed landfarming treatment: All soils contaminated with bioremediation-unsuitable compounds, or soils that do not respond well to the proposed landfarming treatment will be containerized and disposed of off-site.

Surface and Groundwater Monitoring Programs

1. Locations of all proposed Monitoring Stations; The proposed locations of the four temporary monitoring wells are shown on the drawings. All locations are to be field confirmed by the Engineer. The monitoring wells will be surveyed after installation.

2. Chemical, physical and biological parameters to be monitored; A typical groundwater monitoring program for a temporary landfarm would include accredited lab testing for Total Petroleum Hydrocarbons and field testing for pH, turbidity, temperature, conductivity and visual observations for a hydrocarbon sheen.

3. Sampling frequency; A typical groundwater monitoring program would include annual sampling and testing of water from temporary monitoring wells. The samples would be taken at maximum thaw (Late August or September) during active soil treatment operations.

4. Baseline Monitoring Programs: Geotechnical and environmental investigations of the proposed landfarm location were conducted in 2006 to determine if the site was suitable. The results of the environmental investigation found no elevated concentrations of inorganic elements, PCBs or total petroleum hydrocarbons in the area. Suitable landfarm areas from a geotechnical perspective should be located away from significant water bodies or other potential receptors and in an area that is level, has low overland flow and is free of ponded water. Both the environmental and geotechnical investigation found the proposed site to be suitable for development of a landfarm.

5. QA/QC Programs to be implemented as part of the Monitoring Program: Construction monitoring and quality control is required to ensure satisfactory performance of the landfarm at FOX-3. DCC provides qualified engineering staff, with support from the Environmental Sciences Group for environmental issues, to ensure that the design intent, including all requirements of the specification, is suitably met.