Report to:

GOVERNMENT OF NUNAVUT - DEPARTMENT OF COMMUNITY AND GOVERNMENT SERVICES

Interim Abandonment and Reclamation Plan Kugaaruk Soil Landfarm

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WARDROP

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INTERIM ABANDONMENT AND RECLAMATION PLAN KUGAARUK SOIL LANDFARM

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Prepared by	D Ediger	Date	Feb 23/10
	David Ediger		
Reviewed by		Date	Feb 23/10
	Shauna Zahariuk, , B.Env.Sc., CEPIT		
Authorized by		Date	FEB 23/10
pp	Lorne Stone, Project Manager		

WARDROP

400-386 Broadway, Winnipeg, Manitoba R3C 4M8
Phone: 204-956-0980 Fax: 204-957-5389 E-mail: winnipeg@wardrop.com

TABLE OF CONTENTS

1.0 BACKGROUND 1

2.0 CLOSURE PROCEDURE 2

2.1 SOIL QUALITY MONITORING 2
2.2 SOIL REMOVAL 2
2.3 RESIDUAL SOIL SAMPLING 3
2.4 WATER REMOVAL 4
2.5 GROUNDWATER MONITORING 4

3.0 CONTINGENCY FOR FURTHER TREATMENT 5

3.1 RETENTION CELL 5
3.2 MONITORING WELLS 5
3.3 RESIDUAL SOIL COVER 5

4.0 FINAL SITE MODIFICATIONS 6

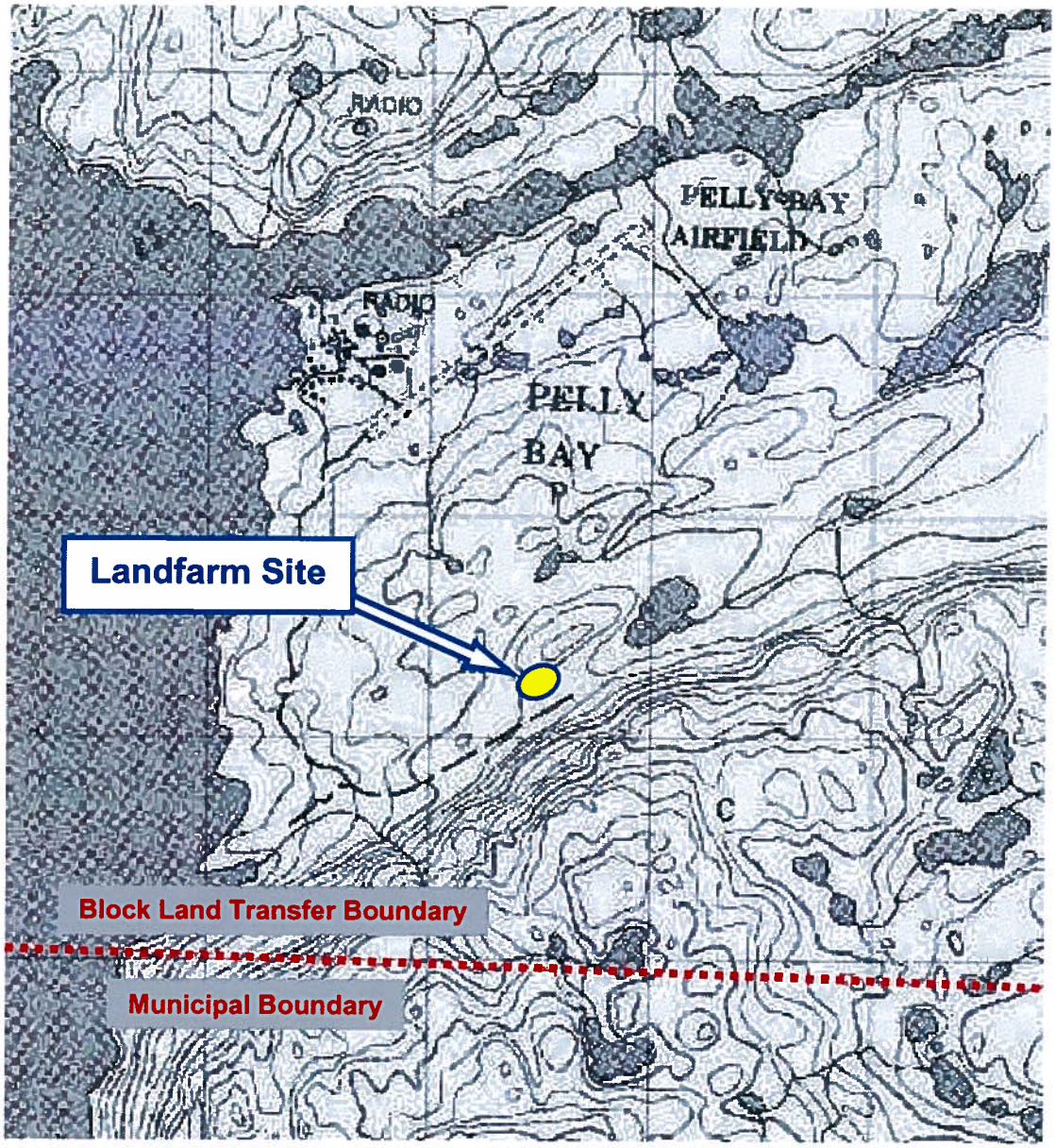
5.0 RESIDUAL ENVIRONMENTAL EFFECTS 7

1.0 BACKGROUND

During 2006, the Nunavut Department of Community and Government Services constructed a landfarm in the vicinity of the Hamlet of Kugaaruk to treat petroleum impacted soil which was to be excavated following removal of two large storage tanks in the community. The landfarm consists of a soil treatment cell and a water retention cell. The cells are surrounded by a berm constructed of local granular material, with an interior berm separating the two cells. The base and interior walls of each cell are lined with an impermeable petroleum resistant liner. The water retention cell is designed to hold precipitation and melt water that has been in contact with the impacted soil in the treatment cell. Water which accumulates in the soil treatment cell flows downgradient through culverts in the interior berm into the water retention cell.

In July 2007, approximately 2200 m^3 of hydrocarbon impacted soil was excavated from the former tank site and placed in the treatment cell of the landfarm. The contamination was determined to be primarily in the diesel fuel range of petroleum hydrocarbons. The soil is turned periodically to enhance aeration and natural biodegradation of the hydrocarbon contaminants. Once completion of treatment has been confirmed through laboratory analyses and any required regulatory authorizations are received, the soil will be removed from the landfarm and transported to an approved location. The Nunavut Department of Community and Government Services is proposing to leave the landfarm berms and liners in place for possible future use. The location of the landfarm is shown on Figure 1.

Once the soil remediation process is completed, the procedure outlined in this document will be implemented. This interim plan has been developed in conformance with the Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories (September 1990) as required by Nunavut Water Board Licence No. 8BR-KRK0609. Based on the classification system for abandoned tailings disposal areas included in the 1990 guideline, the Kugaaruk landfarm would be considered as a "low impact" site. The proposed closure procedure for the landfarm would fall within the definition of a long term shutdown. All costs associated with the closure of the landfarm will be borne by the Nunavut Department of Community and Government Services.



Reproduced from a geo-referenced digital topographic map (057A10), CanMatrix, Natural Resources Canada, 2002.

Note: Drawing is not to scale.

CLIENT

Government of Nunavut

DWG DESCRIPTION

SOIL LANDFARM LOCATION, KUGAARUK, NUNAVUT

WARDROP | Engineering Inc.

DESIGNED BY: P.R.S.	DRAWN BY: P.R.S.	DWG NO.
CHECKED BY: B.K.H.	DATE: 04.04.15	022288-08-05 FIG. 1

2.0 CLOSURE PROCEDURE

2.1 SOIL QUALITY MONITORING

The impacted soil contained within the treatment cell is sampled annually to determine the concentration of hydrocarbon contaminants. A grid pattern is established across the soil pile and a series of samples were taken at the grid points. A total of six composite samples are prepared with a minimum of four discrete soil samples from each grid line being used to make up one composite. The samples are submitted to an accredited laboratory to be analyzed for benzene, toluene, ethylbenzene and xylene (BTEX) and F1 to F4 Petroleum Hydrocarbons. The annual sampling is typically completed near the end of the treatment season.

The analytical results are compared to the applicable CCME Environmental Quality Guidelines and the Canada Wide Standards for coarse grained surface soil on industrial sites. When the analytical results from a sampling event confirm that the contaminant concentrations in all samples all below guideline levels for the intended end use of the soil, remediation activities will be suspended.

2.2 SOIL REMOVAL

Upon receiving all required regulatory approvals, a schedule will be developed for excavation and removal of the remediated soil from the treatment cell. Rubber tired excavation equipment will be used to excavate the soil pile and place the material into trucks for removal from the site. Caution will be exercised to ensure that the cell liner is not damaged during the excavation. An employee will be assigned to monitor the soil removal visually and direct the excavator to ensure that all treated soil and the uppermost portion of the underlying layer of granular material are removed.

Upon completion of the soil removal, the cell will be inspected and any areas where the impermeable liner is exposed will be covered after a visual examination for damage to the liner. Areas where a breach of the liner may have occurred will be marked for subsequent investigation and repair by a qualified contractor. The surface profile will be established to minimize water ponding within the cell, and to ensure that any impounded water flows toward the drains leading to the retention cell.

2.3 RESIDUAL SOIL SAMPLING

After the soil removal is complete, a series of samples will be taken from the layer of granular material remaining over the synthetic liner. The grid pattern that was established for the soil sampling during the treatment operation will be used for this purpose. Six composite samples will be submitted for analysis of BTEX and F1 to F4 Petroleum Hydrocarbons. The purpose of the sampling will be to confirm that no residual contaminants in excess of the levels shown in Table 2.1 are left within the treatment cell.

TABLE 2.1
Residual Soil Quality Criteria

Parameter	Maximum Concentration (mg/kg)
BTEX[1]	
Benzene	180
Toluene	250
Ethylbenzene	300
Xylenes	350
Petroleum Hydrocarbons[2]	
Fraction 1 (C_6 to C_{10})	320
Fraction 2 (C_{10} to C_{16})	1000[3]
Fraction 3 (C_{16} to C_{34})	1700
Fraction 4 (>C_{34})	3300

Notes:

[1]CCME, Canadian Environmental Quality Guidelines, 2007 (coarse-grained surface soils, eco-soil contact pathway).

[2]Canadian Council of Ministers of the Environment (CCME), Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil, May 2008 (for Fraction 1 to 4 values for eco-soil contact with surface, coarse-grained soils).

[3]Revison of F2 fraction from 260 mg/kg to 1000 mg/kg approved by Nunavut Department of Environment, Jan. 28, 2010, based on soil being used as landfill cover material.

2.4 WATER REMOVAL

Immediately following the soil removal, the water in the retention cell will be sampled and analyzed for BTEX and F1 to F4 Petroleum Hydrocarbons. Subject to approval of the regulator, the water will then be discharged. It is assumed that the scheduling of the soil removal will permit the sampling and discharge of the retention cell to be completed in the same year.

In the year following the soil removal and water discharge, the retention cell will be sampled again and discharged, subject to required approvals.

2.5 GROUNDWATER MONITORING

Water samples will be taken from the five monitoring wells annually for two successive years following the removal of soil from the treatment cell. Samples will be analyzed for the parameters specified in Section I2 of Water Licence No. 8BR-KRK0609. Results will be compared to applicable CCME surface water quality guidelines and to Alberta Environment groundwater remediation guidelines.

3.0 CONTINGENCY FOR FURTHER TREATMENT

In the event that any of the final sampling procedures described in Section 2 reveal contaminants in soil or water exceeding applicable criteria, further remedial action may be required prior to the final closure of the landfarm.

3.1 RETENTION CELL

If the water sample taken in the year following the removal of the treated soil reveals that contaminants are present in excess of applicable guidelines, the activated carbon water treatment system will be deployed. During the set up and testing of the system, any treated discharged water will be directed back into the retention cell. When it is confirmed that the treated discharge will meet applicable limits, the cell will be pumped out using the same procedure as in previous years of the landfarm operation.

3.2 MONITORING WELLS

If contaminant concentrations exceeding the guideline limits are found in the monitoring well samples, a plan will be developed for delineation of any downgradient contaminant migration and for identification of the source of the groundwater impact. The details of the plan will be based on the pattern of exceedances found in the well sampling program.

3.3 RESIDUAL SOIL COVER

If a portion of the residual cover material remaining in the treatment cell is found to be impacted in excess of guideline limits, the area of impact will be delineated and this material will be removed to the depth of the upper geotextile liner. Some of this work will require removal by hand to minimize the potential for physical damage to the liner. Depending on the volume of material removed, the impacted soil will be either be placed in containers for further biotreatment, or a fully enclosed biocell will be constructed within the current treatment cell. The option of leaving the residual soil spread in the cell to allow further natural biodegradation will also be considered.

4.0 FINAL SITE MODIFICATIONS

It is proposed that the landfarm berms, access road and splash pad be left in place for possible future use. There are no other structures associated with the landfarm.

To alleviate the potential for excessive water accumulation within the landfarm berms, the downstream corner of the retention cell will be opened to allow the unimpeded outflow of water. The berm material will be carefully removed to expose the synthetic liner. The liner will then be folded down inside the cell and covered with suitable granular material. The area where the berm is removed will be excavated to facilitate the flow of water with minimal erosion of the exposed sides of the remaining berm. Rip rap will be used as required for this purpose.

No other modifications to the landfarm structure are proposed.

5.0 RESIDUAL ENVIRONMENTAL EFFECTS

Following the treatment and removal of all impacted soil and water from the landfarm, there will be no further potential for chemical contamination of the surrounding environment as result of the presence of the landfarm.

The berms and access road will continue to result in minor deviations the local drainage pattern across the area. Since the construction of the landfarm, there has been no indication that the presence of the landfarm has resulted in increased flooding or erosion; therefore, the environmental effects associated with these minor alterations to the natural drainage pattern are not considered to be significant.