Appendix F3

2017 Landfarm Report

AGNICO EAGLE

MEADOWBANK GOLD PROJECT

2017 Landfarm Report

In Accordance with NIRB Project Certificate No.004
&
NWB License 2AM-MEA1525

Prepared by:
Agnico-Eagle Mines Limited – Meadowbank Division

March, 2018

EXECUTIVE SUMMARY

As per the Landfarm Design and Management Plan (March, 2017), this report has been prepared to provide the following information regarding landfarm activities in 2017:

- volume of material added to and removed from the facility
- disposal or reuse location
- results from laboratory analyses of soil and contact water
- volume and type of nutrient additions
- visual inspection results
- volume of contact water pumped

In addition, this report provides results from a biodegradation feasibility study conducted by the National Research Council of Canada (NRC), on behalf of Agnico Eagle.

Meadowbank's first landfarm (Landfarm 1) is located on the north-west side of the South Tailings Cell (Tailing Storage Facility; TSF). The South Tailings Cell is currently active; tailings are deposited and water is reclaimed from the cell. The tailings and water level in the South Tailings Cell are increasing in elevation over time, and eventually Landfarm 1 will become flooded with reclaim water. For this reason, Agnico decided to find an alternate location for a new landfarm (Landfarm 2), in order to continue the treatment of contaminated soil. Landfarm 2 was constructed in 2016, but no contaminated soil was added until 2017.

It is estimated that between September 2016 and January 2017, 1485 m^3 of soil were added to Landfarm 2 from excavation of spills around the Meadowbank site. In addition, 605 m^3 were relocated to Landfarm 2 from Landfarm 1, leaving 655 m^3 in Landfarm 1. Approximately 175 m^3 of coarse material was removed from Landfarm 2 through screening. Screened coarse material was placed in the Waste Rock Storage Facility, as no hydrocarbon stains or odours were present. No soil sampling for removal of fine soil was conducted in 2017, and no soil was removed.

Visual inspections (27 times) indicated that the landfarm berm and pad appear to be structurally intact, and no maintenance requirements were identified.

Some runoff water was observed within the landfarm, but was insufficient to sample, and was directed towards the adjacent TSF. No seepage outside the landfarm was identified.

NRC conducted chemical and microbiological analyses of soil samples from the landfarm in October, 2017. Results indicated a moderate level of PHC F2 and F3 contamination (i.e. exceedances of CCME guidelines), with no BTEX nor PAHs detected above the RDL. Soil nitrogen and TOC contents were moderate, and the bacterial numbers, both total heterotrophs and diesel degraders, were typical for a soil of this type. Mineralization results

indicated that there was a good indigenous biodegradation activity for both hexadecane and naphthalene, and both of these communities benefited from the addition of a nutrient amendment. Recommendations for enhancing biodegradation rates were made.

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

SECTION 1 • INTRODUCTION

1.1 BACKGROUND

Onsite storage and remediation has been established as the preferred method for treatment of petroleum hydrocarbon-contaminated soil that may be generated at Meadowbank facilities. Specifically, remediation through land farming has been identified as the primary treatment option. The Landfarm Design and Management Plan was updated in March 2017 to describe the operational procedures used onsite in relation to this management strategy. In addition to regular remediation methods, the Plan describes the implementation of a pilot project to enhance rates of bioremediation through addition of a nutrient source.

1.2 OBJECTIVES

Per the Landfarm Design and Management Plan (March, 2017) this report summarizes the following aspects of the Meadowbank landfarm operation in 2017:

- volume of material added to the facility,
- amount of material removed
- disposal or reuse location,
- all analysis results,
- volume and type of nutrient addition,
- visual inspection results
- volume of contact water pumped.

A summary and results of the biodegradation study conducted by the National Research Council of Canada is also provided.

SECTION 2 • PILOT STUDY (2012-2013) & BIODEGRADATION STUDY (2017)

2.1 PILOT STUDY (2012 – 2013)

A number of studies have indicated that amendment with nutrients may increase rates of biodegradation in PHC contaminated soils, but the effectiveness of this practice is not well defined in northern climates. In order to determine effectiveness of nutrient additions at Meadowbank, a pilot project was conducted to examine rates of biodegradation with and without nutrient amendment. For this study, the nutrient addition was treated sewage treatment plant (STP) sludge.

The main objectives of this study were to determine if rates of PHC degradation in soil at the Meadowbank site are sufficiently rapid to achieve remediation within acceptable time frames

(at least prior to closure), and whether additions of sewage sludge significantly impacts degradation rates.

In 2012, three pilot piles in the landfarm facility were treated with 400 gallons of sewage sludge as a nutrient source. Sewage sludge was mixed into the pilot piles on October 8th 2012. Each pile consisted of approximately 140 m^3 of soil. Samples of the nutrient-treated piles were taken in July 2013 (CSP-STP-1, 2, 3) in attempts to determine if this method of nutrient amendment significantly affects rates of PHC degradation.

Representative composite samples of two non-treated piles (CSP-WDP-1, 2) were taken from two locations (0.5 m depth) in October 2012 and again in July 2013 to assess degradation of TPH over this time period without sewage sludge amendment. Samples were sent to an accredited analytical laboratory and analyzed for humidity, BTEX and F1-F4 hydrocarbons.

Overall, rates of PHC degradation were found to be sufficiently rapid to warrant continued use of the landfarm as a viable treatment for spills of the designated materials. Nutrient treatment appeared to generally increase degradation rates, particularly for the F3 fraction. Use of the landfarm with application of sewage sludge as a nutrient treatment has therefore been continued and has become a regular practice at the landfarm.

2.2 BIODEGRADATION FEASIBILITY STUDY (2017)

To confirm the feasibility of continuing to remediate PHC contaminated soils in the Meadowbank landfarm, a biodegradation feasibility study was conducted by the National Research Council of Canada (NRC) in October, 2017. A full report is provided in Appendix A. The goal of the study was to characterize the PHC contamination in the soil (PHC Fractions F1-F4, PAHs, etc.), compare the concentrations of detected PHCs to the Canadian Council of Ministers of the Environment (CCME) guidelines, and perform a feasibility study to examine the potential of the indigenous microbial population to biodegrade the PHC(s) exceeding CCME guidelines. The feasibility study examined several nutrient amendments to identify the most promising approach to augment indigenous PHC biodegradation activities compared to the current PHC biodegradation rates.

Results indicated a moderate level of PHC F2 and F3 contamination (exceedances of CCME guidelines occurred for all samples), with no BTEX nor PAHs detected above the RDL. Soil nitrogen and TOC contents were moderate, and the bacterial numbers, both total heterotrophs and diesel degraders, were typical for a soil of this type. Mineralization results indicated that there was a good indigenous biodegradation activity for both hexadecane and naphthalene, and both of these communities benefited from the addition of a nutrient amendment. Recommendations for enhancing biodegradation rates were made, including use of a specific nutrient amendment, and mixing of the biopiles.

SECTION 3 • LANDFARM ACTIVITIES

3.1 LANDFARM 1

The original landfarm design was submitted by Agnico to the Nunavut Water Board in October 2012 and has been in use for soil decontamination since then. As presented in Figure 1 below, the original landfarm (Landfarm 1) is located on the north-west side of the South Tailings Cell impoundment (Tailing Storage Facility – TSF). The South Tailings Cell is currently active; tailings are deposited and water is reclaimed from the cell. The tailings and water level in the South Tailings Cell are increasing in elevation over time. With the current tailings deposition plan and water balance models, this original landfarm area will eventually become flooded with reclaim water. For this reason, Agnico decided to find an alternate location for a new landfarm in 2017 (Landfarm 2, see below).

In addition, due to operational work required in September 2016 at the buttress of Stormwater Dike, a part of the east section of Landfarm 1 could not be used beyond that date. To ensure sufficient capacity of the landfarm to store contaminated soil and to continue the decontamination process until the new landfarm was constructed & operational, Landfarm 1 was extended on the west side, to a higher elevation.

The Landfarm 1 as-built extension is presented in the updated Landfarm Design and Management Plan (March, 2017). The extension of Landfarm 1 was completed in September 2016 according to the same design criteria as the rest of the landfarm. The landfarm pad includes a layer of compacted till material with a thickness of approximately 2.8 m, with a hydraulic conductivity estimated of $1x10^{-7}$ m/s. The slope of the till pad is 1.0% dipping towards the South Tailings Cell. Berms of 1.2 m are constructed around the extension. With the extension, the total area of Landfarm 1 is 5,247 m^2. Previously, the landfarm area was 3,712 m^2.

In 2017, activities at Landfarm 1 were limited to relocation of contaminated soil (~half the volume) to Landfarm 2. Ultimately the Landfarm 1 pad will be flooded with reclaim water.

Landfarm 1 will continue to be operated as per the Landfarm Design and Management Plan (LDMP) and as per the Water License, Part F, Item 18. The water sampling station ST-14 will remain in use until the Landfarm 1 operations cease.

3.2 LANDFARM 2

The Landfarm 2 facility was constructed in October 2016 in order to provide sufficient area for the ongoing treatment of contaminated soil.

As presented on Figure 1, Landfarm 2 is located on the north east side of the South Tailing Cell, north of the Central Dike. This location was chosen to minimize the waste footprint on site and the transport distance of contaminated material from spill locations. All of the waste generated at Meadowbank in the form of tailings, waste rock and site landfill is in close

proximity. This location will facilitate the landfarm operation at closure. Landfarm 2 is still located within the South Tailings Cell impoundment, providing containment in case of runoff water from the contaminated material.

Landfarm 2 is adjacent to the current South Tailings Cell and is located 900 m west of the nearest water body, Dogleg Lake. Surface drainage in the area of the Landfarm 2 is westerly, towards the South Tailings Cell and away from surface watercourses.

Specifications of the Landfarm 2 design are presented in the LDMP. The Landfarm 2 facility is designed with one soil remediation/storage cell, which is constructed with a 2.5 m high berm and a 0.5 m thick layer of compacted till base with hydraulic conductivity estimated of $1x10^{-7}$ m/s. The slope of the base is 3% towards the East side, leading to a slope of 7% towards the South Tailings Cell. The pad underneath the till layer varies between 6 m and 22.5 m thick, based on elevation of the tundra underneath, which ranges from 151 masl to 134 masl. In the Meadowbank area, the shallow groundwater is estimated to be 1.5 m below surface (active layer of permafrost July to September), at the average depth of thaw. Therefore, no impacts to groundwater are anticipated.

As per the Water License 2AM-MEA1525 Part F, Item 18; “Water accumulating in the landfarm shall be contained within the landfarm and not be discharged to the environment”. The water will be managed and contained within the landfarm, and discharge to the TSF if required. The monitoring station ST-14B was created and will be sampled as per requirement of the Water License.

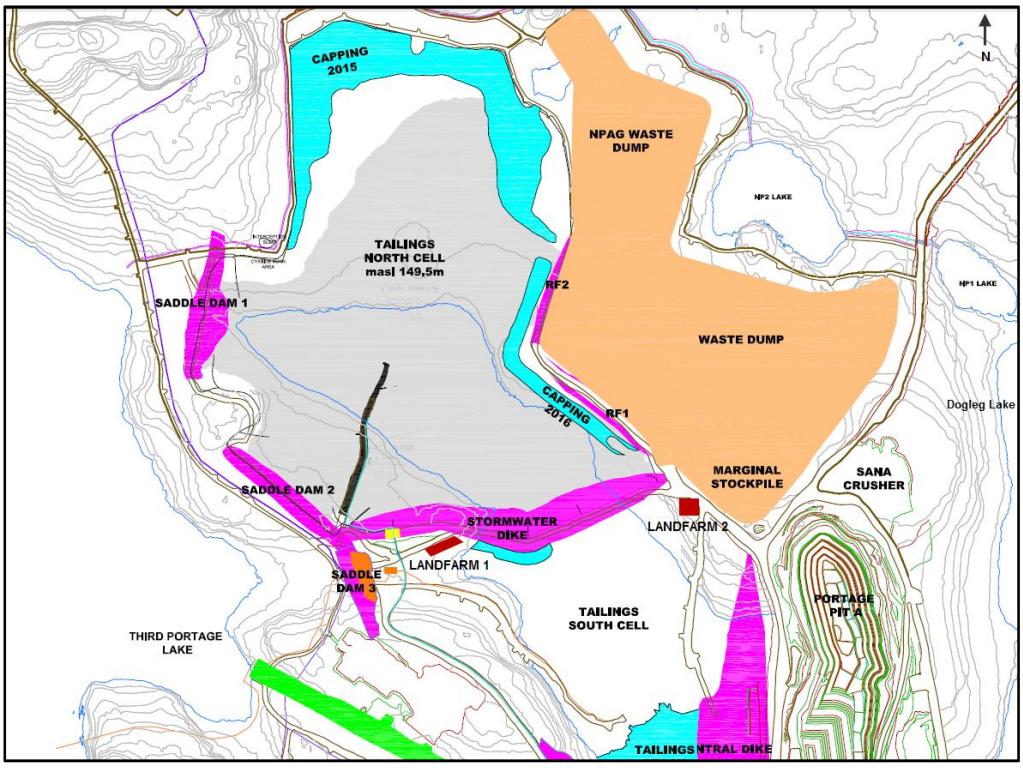

Figure 1. Landfarm 1 and Landfarm 2 General Locations.

3.3 SOIL ADDITION AND REMOVAL

From landfarm survey data, 1485 m^3 of soil were added to Landfarm 2 between September 2016 and January 2017 from excavation of PHC spills around the Meadowbank site. In addition, 605 m^3 were relocated to Landfarm 2 from Landfarm 1, leaving 655 m^3 in Landfarm 1. A summary of spills occurring in 2017 including those sent to the landfarm are provided in Section 8 of the 2017 Annual Report.

3.3.1 Very Coarse Material (>1") Screening

As described in the Landfarm Operations and Management Plan, the use of an Extec screener to separate coarse and fine material was tested in September, 2013, and use was continued annually. Contaminated material was sorted by this method in August and September, 2017 and an estimated 175 m^3 of coarse material was removed from the landfarm during this time. Screened coarse material was placed in the Waste Rock Storage Facility, as no hydrocarbon stains or odours were present.

3.3.2 Remediated Fine Soil Removal

According to the LDMP, in order for landfarmed soil to be considered remediated and removed for use onsite (e.g. road works), samples must meet GN criteria for agricultural/wildlands. Soil meeting industrial criteria may be removed to the waste rock storage facility where it will eventually be capped with up to 2 m of fill, or used as base cover in the TSF where it will eventually be capped with up to 4 m of fill.

No confirmatory sampling of soil for removal from the landfarm was conducted in 2017, and no soil was removed.

3.4 NUTRIENT ADDITIONS AND SOIL AERATION

Sewage sludge was added to all piles as a nutrient amendment on July 1st and 2nd (27 m^3 each date). The sludge was spread across all piles.

Landfarm piles were aerated in July to increase the height of each windrow with a front-end loader or excavator, and again in October to combine all soils.

3.5 REMAINING LANDFARM CAPACITY

For Landfarm 2, the useful area is 3815 m^2, which is similar to the useful area of the Landfarm 1 before the 2016 extension (3712 m^2). It is considered that contaminated material can be stockpiled up to 4 m high. Accounting for a 25% loss of area due to sloping at that windrow height, the landfarm area will allow for the storage of a maximum of 11,445 m^3.

With a current contaminated soil stockpile volume of 2570 m^3 (including remaining soil at Landfarm 1), and conservatively assuming no soil remediation & removal prior to closure, Landfarm 2 will be able to accommodate an additional 8875 m^3 of soil. With an average annual excavated spill volume of 346 m^3 (LDMP), the available landfarm volume will not be exceeded within the expected life of mine.

Thus, ample room will be available to accommodate a designated area for spreading of contaminated coarse-grained material that cannot be bioremediated, and to maintain smaller windrow piles to maximize rates of biodegradation and volatilization.

3.6 WATER MANAGEMENT

Some water runoff was identified at the landfarm in June 2017 but there was not sufficient volume to sample, or to require mitigative action, particularly since the direction of flow was directly towards the adjacent TSF.

No seepage of water outside of the landfarm was identified.

3.7 REQUIRED MAINTENANCE

Visual inspections (see Appendix B) indicated that the landfarm berm and pad appear to be structurally intact; therefore no maintenance requirements were identified.

SECTION 4 • ACTIONS

The following actions were identified for 2017, and Agnico's responses are indicated:

- Steps will be taken to better monitor additions of sewage sludge. Landfarm disposal was added to the log sheet of the truck, and appropriate personnel will be reminded to make use of this logging system prior to the summer months.
    - Completed. Sewage sludge additions were logged.
- Conduct quarterly topographical landfarm surveys (done by Engineering Department) to better evaluate movement of contaminated material.
    - Completed biannually. Landfarm surveys were conducted in August 2017, and January 2018. This frequency was determined to be sufficient.

The following actions are identified for 2018:

- Manage and modify landfarm sloping design to ensure run-off, if any, is contained within the Landfarm area.
- Increase sludge addition during warmer months to maximise remediation efficiencies.

Appendix A

Biodegradation Feasibility Study Report

NRC·CNRC

Meadowbank Mine - PHC Biodegradation Feasibility Study

Date: January 26, 2018
Author: David Juck, PhD.

Energy, Mining and Environment

National Research Council Canada | Conseil national de recherches Canada

Canada

Executive Summary

NRC received samples of petroleum hydrocarbon (PHC) contaminated soils from the Meadowbank mine site. Based on the chemical and microbiological analyses, the following results were observed:

- There was moderate PHC contamination in the soils.
- The numbers of total heterotrophic and diesel degrading bacteria present in the impacted soils were at typical levels.
- The indigenous microbial population was able to effectively mineralize both hexadecane and naphthalene (representative of alkane and aromatic contamination, respectively).
- Addition of the nutrient amendment 20-8-20 or diammonium phosphate, and to a lesser extent monoammonium phosphate, positively stimulated the mineralization of both hexadecane and naphthalene.
- A biopile based bioremediation approach was proposed to address the PHC contaminated soil.

TABLE OF CONTENTS

Introduction

The Meadowbank Mine, owned by Agnico Eagle Mines Limited (AEM), is located approximately 80 km north of Baker Lake and 300 km from Hudson Bay, in the Kivalliq region of Nunavut. The gold mine started commercial production in 2010, with operations to be extended to the end of 2018. Continued use of the mine facilities is expected to occur with the start of production from the Amaruq satellite deposit in late 2019.

Based on personal communications with the Meadowbank Environmental Senior Coordinator (Robin Allard), the landfarm area currently houses soils contaminated during separate spill events with different petroleum products such as diesel fuel and hydraulic oil. The soils are currently arranged into one long pile and there is no delineation between the different contaminant types. The volume of soil was estimated to be between 1600 and 1900 m^3 in January, 2018 (personal communication, Robin Allard).

At the request of AEM, the National Research Council Canada (NRC) performed a feasibility study to determine the potential for biodegradation of the diesel contamination by indigenous microorganisms present in the soil.

Objective

The goal of this proposed work was twofold: 1) characterize the PHC contamination in the soil, e.g. PHC Fractions F1-F4, PAHs, etc., and compare the concentrations of the detected PHCs to the Canadian Council of Ministers of the Environment (CCME) guidelines and 2) perform a feasibility study to determine the number of total heterotrophic and diesel degrading bacteria present in the soils and examine the potential of the indigenous microbial population to biodegrade the PHC(s) exceeding CCME guidelines. The feasibility study examined several nutrient amendments to identify the most promising approach to augment indigenous PHC biodegradation activities compared to the current PHC biodegradation rates.

Activities and Methodologies

Soil Sampling and Transport Protocol

A protocol for the sampling of soils and transport to NRC laboratories in Montreal was developed by NRC and reviewed by AEM Environmental staff at the Meadowbank mine site. The final approved protocol (see Appendix A) was then implemented during a sampling campaign carried out by AEM staff on October 12, 2017, the same day the samples were sent south to AEM facilities. The samples were couriered to the NRC Montreal site and received on October 16, 2017. The samples collected for analytical chemical analysis were separated and collected by AGAT Laboratories on October 17, 2017. The microbiological analyses performed by NRC were started the same week.

Conditions during sampling on October 12, 2017 were estimated to be, based on the Environment and Climate Change Canada data for Baker Lake, as follows: trace amounts of snow, with a temperature of -1˚C to -3˚C and winds of 3 to 17 km/h from the southwest.

A total of 6 samples were collected (Zone 1A, 1B, 2A, 2B, 3A and 3B) for chemical analysis and microbiological/mineralization assays. Figure 1 presents a photo of the landfarm area from a distance with the contaminated soil outlined in orange while Figure 2 presents the locations of each of the sampling zones.

Figure 1. View of the Meadowbank landfarm area, from a distance, with the contaminated soil pile outlined.

Figure 2. Sample zones, as collected by AEM staff.

Due to late season sampling and the site weather conditions, a backhoe was used to facilitate the collection of the contaminated soil samples (personal communication). Based on the approved sampling plan, a total of 5 sub-samples were collected in each zone from a depth greater than approximately 20-30 cm, removing any large rocks and loose material, and then

collecting approximately 400 g of freshly exposed soil which was then placed into a new sealable bag. Once all sub-samples were collected for the zone being sampled (e.g. 1A), the soil was well mixed and then placed into the appropriate sample containers in the following order: BTEX+F1 (120 mL glass jar), PHC F2-F4 and granulometry (250 mL glass jar), microbiology/mineralization assays (700 mL sterile Whirlpak bag). All samples were then immediately placed on ice and kept cold until delivery to the NRC lab in Montreal, with follow-on delivery to AGAT Laboratories in Ville St. Laurent. Fresh gloves were used for each sample zone.

Laboratory Analysis

Soil Samples

Once soils arrived at the NRC labs, the 2 samples from each zone (A and B samples) were combined to create a composite for further microbial analysis (1, 2 and 3). At this point, any remaining rocks were removed and the samples were homogenized. The samples were then divided to start the bacterial count and mineralization assays. The percent humidity for each of the 3 samples was also determined at this point.

Bacterial Counts

Bacterial counts were performed on the initial soils samples using 96 well plates and the Most Probable Number (MPN) statistical analysis. Total heterotrophic bacterial counts (i.e. those which use organic matter as a source of carbon and energy) were performed using the medium YTS_{250} (yeast extract, tryptone and soluble starch, each at 250 mg/L of water) while counting of bacteria able to use diesel as a source of carbon and energy was performed using the medium Minimal Salts Medium (MSM) adjusted to pH 7.0 and supplemented with diesel. A ten-fold dilution series of the soils, using 0.1% sodium pyrophosphate adjusted to pH 7.0, was created for each soil and each dilution was placed into 8 wells of the 96 well plate. Incubation of the plates was performed aerobically (i.e. in the presence of oxygen) at 10˚C, for 14 and 21 days for the total heterotrophs and diesel degraders, respectively.

Mineralization Assays

The capacity of the indigenous microbial population to mineralize compounds representative of the diesel contamination, hexadecane for the alkane component and naphthalene for the aromatic component, was tested in microcosms. The microcosms were prepared in 120 mL serum bottles containing 20 grams of soil. Soils received a mixture of non-radioactive and radiolabeled chemical to a final concentration of 100 ppm for ^{14}C-hexadecane and 10 ppm for ^{14}C-naphthalene. The nutrient amendment conditions tested are outlined in Table 1, and each was prepared in triplicate. The nutrient amendments used were monoammonium phosphate (MAP), diammonium phosphate (DAP) and 20-8-20 (ratio of nitrogen-phosphate-potassium), all commercially available fertilizers.

The sterile control was created using soil 2, which was placed into the microcosms and autoclaved 2 x for 20 minutes, with a period of 24 hours between autoclavings.

The microcosms were incubated at 10°C, and sampled regularly. Mineralization (i.e. the complete breakdown of the compound into CO_2 and H_2O) was measured by liquid scintillation spectrometry (Tri-Carb model 2800, Canberra Packard) and was expressed as the cumulative percentage of evolved $^{14}CO_2$ relative to the initial radioactivity injected into each microcosm.

Table 1. Nutrient amendment conditions examined.

Soil	No Amendment	MAP (150 mg/microcosm)	DAP (150 mg/microcosm)	20-8-20 (150 mg/microcosm)
1	X			
		X		
			X	
				X
2	X			
		X		
			X	
				X
3	X			
		X		
			X	
				X
Sterile Control	X			

Analytical Chemistry

The six samples prepared in the field (1A, 1B, 2A, 2B, 3A and 3B) were sent directly to AGAT Laboratories for the following analyses: Petroleum Hydrocarbon (PHC) Fraction 1 to Fraction 4 (F1-F4), benzene, toluene, ethylbenzene and total xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), total Kjeldahl nitrogen (TKN) and total organic carbon (TOC). The guidelines against which concentrations of PHC F1-F4 and BTEX in the soil were compared against are based on the Department of Environment Government of Nunavut (2014 revision) and the Canadian Council of Ministers of the Environment (CCME) (2008a) and CCME PAH (2010) guidelines.

Sample 2A was also subjected to particle size distribution analysis to determine whether the soil is considered ‘fine’ or ‘coarse’ in the context of the CCCME guidelines for PHC F1-F4 and BTEX contaminated soils (CCME, 2008a). Based on the on-site activities and the site access restrictions, the site is considered industrial (CCME, 2008b).

Results

Chemical Analyses

The results of the PHC F1-F4, BTEX, PAH, TKN and TOC analyses are presented in Table 2 and the certificates of analysis are in Appendix B. The result of the particle size distribution analysis (lab results in Appendix B) revealed that the fraction of the representative sample 2A less than 0.075 mm was 28.1% of the total, which classifies this soil as 'coarse' for the comparison of guideline values (presented in Table 2, 'Guidelines').

Table 2. Results of analytical chemistry analysis for PHCs, BTEX, PAHs, TKN and TOC.

Contaminant	Guidelines (mg/kg)	Sample name/Sampling date (dd/mm/yyyy) (mg/kg)						
	CCME [1]	MD1A	MD1B	MD2A	MD2B	MD3A	MD3B	RDL
		12/10/2017	*12/10/2017*	*12/10/2017*	*12/10/2017*	*12/10/2017*	*12/10/2017*	
F1 Petroleum Hydrocarbons (C6 - C10) [a]	**320**	68	<10.0	<10.0	40.4	30.2	<10.0	10
F2 Petroleum Hydrocarbons (C10 - C16) [a]	**260**	3540	394	351	1260	1260	667	10
F3 Petroleum Hydrocarbons (C16 - C34) [a]	**2,500**	6140	1270	1230	4370	3600	3720	10
F4 Petroleum Hydrocarbons (C34 - C50) [a]	**6,600**	931	207	149	671	525	492	10

NOTES:

1) CCME Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil. Table 1. Revised January

<XX Less than the method detection limit

XX Concentration is over the CCME guideline (2008)

Contaminant	Guidelines (mg/kg)	Sample name/Sampling date (dd/mm/yyyy) (mg/kg)						
	CCME [1]	MD1A	MD1B	MD2A	MD2B	MD3A	MD3B	RDL
		12/10/2017	*12/10/2017*	*12/10/2017*	*12/10/2017*	*12/10/2017*	*12/10/2017*	
Benzene	**0.0068**	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.03
Toluene	**0.08**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Ethylbenzene	**0.018**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05
Total Xylenes	**2.4**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05

NOTES:

1) CCME Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil. Table 1. Revised January 2008

<XX Less than the method detection limit

XX Concentration is over the CCME guideline (2007)

Contaminant	Guidelines (mg/kg)	Sample name/Sampling date (dd/mm/yyyy) (mg/kg)						
	CCME [1]	MD1A	MD1B	MD2A	MD2B	MD3A	MD3B	RDL
		12/10/2017	*12/10/2017*	*12/10/2017*	*12/10/2017*	*12/10/2017*	*12/10/2017*	
Anthracene	**32**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo (a) anthracene	**10**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo (a) pyrene	**72**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo (j) fluoranthene	**10**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo (b) fluoranthene	**10**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Benzo (k) fluoranthene	**10**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Dibenzo (a,h) anthracene	**10**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Fluoranthene	**180**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Indeno (1,2,3-cd) pyrene	**10**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Naphthalene	**22**[2]	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Phenanthrene	**50**[3]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Pyrene	**100**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1

NOTES:

1) CCME Canadian Soils Quality Guidelines for the Protection of Environmental and Human Health Polycyclic Aromatic Hydrocarbons. 2008, revised 2010.

2) Due to the contaminment of the system and no direct impact on surface waters, the guideline value used is the 'Provisional SQG_E(CCME 1997)'

3) Due to the contaminment of the system and no direct impact on surface waters, the guideline value used is the 'Interim Soil Quality Criteria (CCME 1991)'

<XX Less than the method detection limit

XX Concentration is over the CCME guideline (2007)

Parameter	Units	Sample name/Sampling date (dd/mm/yyyy) (mg/kg)						
	CCME [1]	MD1A	MD1B	MD2A	MD2B	MD3A	MD3B	RDL
		12/10/2017	*12/10/2017*	*12/10/2017*	*12/10/2017*	*12/10/2017*	*12/10/2017*	
Total Kjeldahl Nitrogen	**mg/kg - N**	219	246	237	199	253	243	90
Total Organic Carbon	**%**	2.1	0.9	1	1.7	1.3	1.4	0.3

The analytical chemistry results demonstrate, on average, a moderate level of PHC F2 and F3 contamination above CCME guidelines, apart from 1B and 2A which were below guidelines for PHC F3. This is consistent with the presence of diesel fuel and lubricating oil. Concentrations of PHC F2 and F3 were highest in sample 1A, lowest in samples 1B and 2A, and moderate in samples 2B, 3A and 3B. The average PHC F2 and F3 concentrations for the system as a whole were 1,245 mg/kg and 3,388 mg/kg, respectively, while the average concentration of Total PHCs was 5,152 mg/kg.

Concentrations of F1 and F4, below CCME guidelines, were detected in 3 and 6 samples, respectively. For the BTEX analysis, no samples had concentrations above the RDL. The PAHs presented in Table 2 are those for which CCME guideline values have been developed. Additional PAHs were analysed for (see Appendix B) but will not be discussed in the context of this project. No PAHs were detected above the RDL in any of the soils samples.

The TKN results revealed similar TKN concentrations for all samples (range of 199 to 253 mg/kg) with an average TKN concentration for the system as a whole at 233 mg/kg, which is approximately 19%, 7% and 5% of the PHC F2, F3 and Total PHC concentrations, respectively.

TOC analysis revealed an average concentration of organic carbon at 1.4%, which could be considered moderate.

Bacterial Counts

Bacterial counts for the total heterotrophic population and the diesel degrading population are presented in Table 3. The number of cells /g soil dry weight for both of the populations examined are consistent with those observed at other similar sites and represent a typical dynamic bacterial population.

Table 3. MPN bacterial counts for zones 1, 2 and 3.

	MPN (# of cells/g soil dry weight)	
Sample	Total Heterotrophs	Diesel Degraders
MB1	1.69E+07	4.13E+05
MB2	1.68E+07	8.37E+04
MB3	3.33E+07	4.55E+05

Mineralization

The goal of the mineralization assays was two-fold: to determine what the mineralization potential was of the indigenous microbial population without any nutrient amendments and to determine which nutrient amendment had the most positive impact on the mineralization (i.e. complete biodegradation of the contaminant into CO_2 and H_2O) of a representative alkane (hexadecane) and an aromatic (naphthalene).

The nutrient amendments under examination were monoammonium phosphate (MAP), diammonium phosphate (DAP) and 20-8-20 (ration of N-P-K). These commercially available fertilizers provide an additional source of nitrogen and phosphorus to the indigenous microbial community as nitrogen, and to a lesser degree phosphorus, are typically very quickly consumed by PHC degrading bacteria and become one of the major limiting parameters in the complete biodegradation of the PHC contamination.

The results of the mineralization assays for hexadecane and naphthalene are presented in Figure 3. For hexadecane, the total level of mineralization in the un-amended microcosms for the three zones was from 1-4%. With amendment, the range of mineralization was from 17.5 to 33% after 49 days of incubation at 10˚C. While this level of mineralization is slightly lower than might be expected, it indicates that nitrogen (and possibly phosphorus) was limiting the biodegradation of hexadecane. For the three zones, 20-8-20 appeared to have the most positive impact on overall level of mineralization (from 19.5 to 33%), although DAP was close behind (from 19 to 27.5%). MAP had the least positive impact on overall hexadecane mineralization (from 17.5 to 25.5%).

For the mineralization of naphthalene, there was less of a difference between the un-amended and amended microcosm; the range of mineralization for the un-amended microcosms was 40-45% while the amended microcosms ranged from 45.5 to 49% mineralization. These results are in line with what could be expected in this type of a soil and the concentration of TKN present. Despite this similarity between the un-amended and amended microcosms, for all zones, all three nutrient amendments had a positive impact on the overall level of mineralization observed as compared to the un-amended soils. In contrast to the hexadecane assays, there was no clear preferred amendment for the naphthalene biodegrading microbial populations.

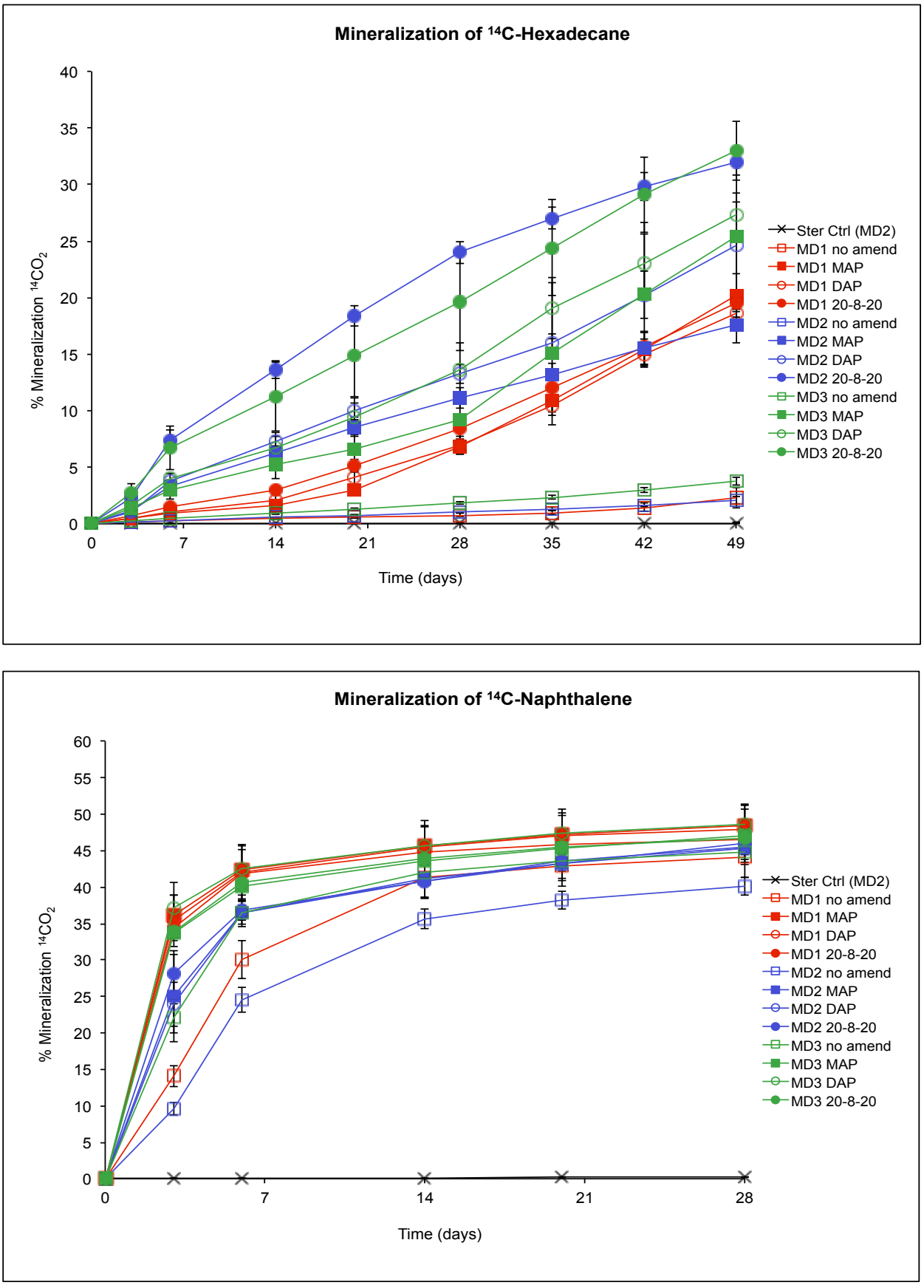

Figure 3. Mineralization results for hexadecane (upper panel) and naphthalene (lower panel).

Conclusions

The soil chemistry results indicated a moderate level of PHC F2 and F3 contamination, with no BTEX nor PAHs detected above the RDL. Soil nitrogen and TOC contents were moderate, and the bacterial numbers, both total heterotrophs and diesel degraders, were typical for a soil of this type.

Mineralization results indicated that there was a good indigenous biodegradation activity for both hexadecane and naphthalene, and both of these communities benefited from the addition of a nutrient amendment, with 20-8-20 being the most promising, followed closely by DAP.

Recommendations

Based on the mineralization results, a biopile bioremediation approach to address the PHC contaminated soils is recommended. The bioremediation of these soils should be carried out as follows:

- A nutrient amendment (slow release granular 20-8-20 or DAP) should be added to the soil each spring at an annual rate of approximately 0.1 g/kg soil. This equals approximately 250 kg per year for the current estimated volume of contaminated soil of 1750 m^3.
- The soil should be arranged in windrows no more than 1.5 m in height and no more than 1.5 m wide.
- Immediately after even broadcasting of the nutrient amendment, the windrows should be turned to incorporate the nutrient amendment and aerate the soils.
- If possible, the windrows should be positioned in the landfarm area so that they are not within pools of standing water where they will be water saturated. Water saturation of the soils will reduce the amount of aeration in these areas and reduce the rate of biodegradation of the PHCs.
- Any meltwater/leachates that do accumulate within the landfarm/biopile area can be used to wet the biopiles later in the summer/early autumn, to ensure that adequate moisture levels are maintained.
- Annual sampling of the biopiles (e.g. 6 sampling zones composed of sub-sample composites from each zone) should be performed at the end of each autumn, with analytical chemistry analysis for PHCs, BTEX and TKN performed to follow the progress of the bioremediation system and ensure that nitrogen levels do not significantly increase.

The approach proposed by NRC in no way guarantees the complete remediation of PHC contamination of these soils. This remains the sole responsibility of AEM and/or the firms contracted to perform this work.

References

Department of Environment Government of Nunavut 2014. Environmental Guideline for the Management of Contaminated Sites. 2014 revision.

CCME 2008a. Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil. Table 1 Revised January 2008.

CCME 2008b. Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil. Technical Supplement. January 2008.

CCME 2010. Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, Polycyclic Aromatic Hydrocarbons. 2008, revised 2010.

Appendix A

SOIL SAMPLING AND TRANSPORT PROTOCOL

The contaminated soil area should be divided into 3 paired areas for a total of 6 sampling zones (e.g. 1A, 1B, 2A, 2B, 3A, 3B). The paired areas should be similar with respect to soil type, contamination, contamination event (if relevant), etc. Composite samples from each of the 6 areas will be collected as follows:

- For each zone: 5 equal sized sub-samples to be collected.
- For each sub-sample, a hole of ca. 15-20 cm needs to be dug, removing any surface material from the hole.
- Using a fresh pair of disposable gloves (one pair per zone, not per sub-sample) ca. 2-3 handfuls of soil to be collected.
- Rocks, large gravel, debris, large chunks of organic matter, etc, should be removed from the samples.
- Sub-samples to be placed into the labeled Zip-lock bags, with a final goal of filling the bag ¾ full (with all 5 sub-samples).
- Once all of the sub-samples have been collected, the soil needs to be well mixed removing any large materials (rocks, peat material, etc) and then sampled directly into glass jars for analytical chemistry.
- The glass jars (1x 250 mL, 1x 120 mL) need to be filled right to the top and tightly closed.
- The remainder of the sample will be placed in the labeled sterile Whirl-pak bags for MPN and microcosm analysis. The Whirl-pak bags should be filled close to the top, leaving ca. 3-4 cm clear to be able to fold the top down 2-3 times and closing with the integrated twist-tie.
- If there is any soil remaining in the Zip-lock bags, this can be returned to the contaminated soil pile. The disposable gloves can then be removed and a new pair used for the next zone.
- Date of sampling needs to be written on the bottles and Whirl-pak bags, and a wrap of packing tape put around the labels on the bottles to ensure that the labels do not come off or are damaged during transit.
- All samples will be transported back to NRC labs in an insulated shipping container containing ice packs.
- Samples should be delivered as soon as possible to the NRC Royalmount facilities.

List of material to be sent:

- Medium sized cooler
- 6x 250 mL pre-labeled bottles
- 6x 120 mL pre-labeled bottles
- 6x pre-labeled Zip-lock bags
- 6x pre-labeled Whirl-pak bags
- disposable gloves
- packing tape
- shipping labels
- ice packs

Appendix B

ANALYTICAL CHEMISTRY CERTIFICATES OF ANALYSIS

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CLIENT NAME: **NATIONAL RESEARCH COUNCIL**
6100 ROYALMOUNT
MONTREAL, QC H4P2R2
(514) 496-7250

ATTENTION TO: **David Juck**

PROJECT: **Meadowbank**

AGAT WORK ORDER: **17M274098**

SOIL ANALYSIS REVIEWED BY: **Rémi Briant, chimiste**

TRACE ORGANICS REVIEWED BY: **Robert Roch, Chimiste**

DATE REPORTED: **2017-11-03**

VERSION*: **2**

PAGES (INCLUDING COVER): **14**

Should you require any information regarding this analysis please contact your client services representative at (514) 337-1000

NOTES
VERSION 2:2017-11-03 - Results added

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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Certificate of Analysis

AGAT WORK ORDER: 17M274098
PROJECT: Meadowbank

CLIENT NAME: NATIONAL RESEARCH COUNCIL
ATTENTION TO: David Juck
SAMPLED BY:
SAMPLING SITE:

Granulometry/Sedimentometry

DATE RECEIVED: 2017-10-17 **DATE REPORTED: 2017-11-03**

		SAMPLE DESCRIPTION:		MD2A
		SAMPLE TYPE:		Soil
		DATE SAMPLED:		2017-10-12
Parameter	Unit	G / S	RDL	8835232
Granulometry (Wentworth)	NA		NA	Annexe

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:

CHIMISTE Rémi Briant 2012-104 QUÉBEC

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Certificate of Analysis

AGAT WORK ORDER: 17M274098

PROJECT: Meadowbank

CLIENT NAME: NATIONAL RESEARCH COUNCIL

ATTENTION TO: David Juck

SAMPLED BY:

SAMPLING SITE:

Inorganic Analysis (Soil)

DATE RECEIVED: 2017-10-17

DATE REPORTED: 2017-11-03

Parameter	Unit	G / S: A	G / S: B	G / S: C	G / S: D	RDL	MD1A Soil 2017-10-12 8835229	MD1B Soil 2017-10-12 8835230	MD2A Soil 2017-10-12 8835232	MD2B Soil 2017-10-12 8835233	MD3A Soil 2017-10-12 8835234
Total Kjeldahl Nitrogen	mg/kg - N					90	219	246	237	199	253
Total Organic Carbon	%					0.3	2.1	0.9	1.0	1.7	1.3

Parameter	Unit	G / S: A	G / S: B	G / S: C	G / S: D	RDL	MD3B Soil 2017-10-12 8835235
Total Kjeldahl Nitrogen	mg/kg - N					90	243
Total Organic Carbon	%					0.3	1.4

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to QC PTC 2016 A, B Refers to QC PTC 2016 B, C Refers to QC PTC 2016 C, D Refers to QC RESC (Annex 1)
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Certified By:

CHIMISTE Rémi Briant 2012-104 QUÉBEC

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AGAT WORK ORDER: 17M274098

PROJECT: Meadowbank

CLIENT NAME: NATIONAL RESEARCH COUNCIL

ATTENTION TO: David Juck

SAMPLED BY:

SAMPLING SITE:

PAHs (soil)

DATE RECEIVED: 2017-10-17

DATE REPORTED: 2017-11-03

						SAMPLE DESCRIPTION:	MD1A Soil	MD1B Soil	MD2A Soil	MD2B Soil	MD3A Soil
						SAMPLE TYPE:					
						DATE SAMPLED:	2017-10-12	2017-10-12	2017-10-12	2017-10-12	2017-10-12
Parameter	Unit	G / S: A	G / S: B	G / S: C	G / S: D	RDL	8835229	8835230	8835232	8835233	8835234
Acenaphtene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Acenaphtylene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Anthracene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Benzo (a) anthracene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Benzo (a) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Benzo (b) fluoranthene	mg/kg	0.1	1	10	136	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Benzo (j) fluoranthene	mg/kg	0.1	1	10	136	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Benzo (k) fluoranthene	mg/kg	0.1	1	10	136	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Benzo (c) phenanthrene	mg/kg	0.1	1	10	56	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Benzo (g,h,i) perylene	mg/kg	0.1	1	10	18	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Chrysene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Dibenzo (a,h) anthracene	mg/kg	0.1	1	10	82	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Dibenzo (a,i) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Dibenzo (a,h) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Dibenzo (a,l) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Dimethyl-7,12 benzo (a) anthracene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Fluoranthene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Fluorene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Indeno (1,2,3-cd) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Methyl-3 cholanthrene	mg/kg	0.1	1	10	150	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Naphtalene	mg/kg	0.1	5	50	56	0.1	0.4[A-B]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Phenanthrene	mg/kg	0.1	5	50	56	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Pyrene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Methyl-1 naphtalene	mg/kg	0.1	1	10	56	0.1	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Methyl-2 naphtalene	mg/kg	0.1	1	10	56	0.1	0.2[A-B]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Dimethyl-1,3 naphtalene	mg/kg	0.1	1	10	56	0.1	0.6[A-B]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Trimethyl-2,3,5 naphtalene	mg/kg	0.1	1	10	56	0.1	0.2[A-B]	<0.1[<A]	<0.1[<A]	<0.1[<A]	<0.1[<A]
Moisture	%					0.1	9.9	7.8	11.1	7.5	8.1

Certified By:

Robert Roch

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Certificate of Analysis

AGAT WORK ORDER: 17M274098

PROJECT: Meadowbank

CLIENT NAME: NATIONAL RESEARCH COUNCIL

ATTENTION TO: David Juck

SAMPLED BY:

SAMPLING SITE:

PAHs (soil)

DATE RECEIVED: 2017-10-17

DATE REPORTED: 2017-11-03

			SAMPLE DESCRIPTION:	MD1A	MD1B	MD2A	MD2B	MD3A
			SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil
			DATE SAMPLED:	2017-10-12	2017-10-12	2017-10-12	2017-10-12	2017-10-12
Surrogate	Unit	Acceptable Limits		8835229	8835230	8835232	8835233	8835234
Acenaphtene-D10	%	40-140		114	104	98	102	111
Fluoranthene-D10	%	40-140		117	100	100	110	102
Perylene-D12	%	40-140		81	86	85	81	78

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PROJECT: Meadowbank

CLIENT NAME: NATIONAL RESEARCH COUNCIL

ATTENTION TO: David Juck

SAMPLED BY:

SAMPLING SITE:

PAHs (soil)

DATE RECEIVED: 2017-10-17

DATE REPORTED: 2017-11-03

					SAMPLE DESCRIPTION:		MD3B
					SAMPLE TYPE:		Soil
					DATE SAMPLED:		2017-10-12
Parameter	Unit	G / S: A	G / S: B	G / S: C	G / S: D	RDL	8835235
Acenaphtene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]
Acenaphtylene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]
Anthracene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]
Benzo (a) anthracene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]
Benzo (a) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]
Benzo (b) fluoranthene	mg/kg	0.1	1	10	136	0.1	<0.1[<A]
Benzo (j) fluoranthene	mg/kg	0.1	1	10	136	0.1	<0.1[<A]
Benzo (k) fluoranthene	mg/kg	0.1	1	10	136	0.1	<0.1[<A]
Benzo (c) phenanthrene	mg/kg	0.1	1	10	56	0.1	<0.1[<A]
Benzo (g,h,i) perylene	mg/kg	0.1	1	10	18	0.1	<0.1[<A]
Chrysene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]
Dibenzo (a,h) anthracene	mg/kg	0.1	1	10	82	0.1	<0.1[<A]
Dibenzo (a,i) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]
Dibenzo (a,h) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]
Dibenzo (a,l) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]
Dimethyl-7,12 benzo (a) anthracene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]
Fluoranthene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]
Fluorene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]
Indeno (1,2,3-cd) pyrene	mg/kg	0.1	1	10	34	0.1	<0.1[<A]
Methyl-3 cholanthrene	mg/kg	0.1	1	10	150	0.1	<0.1[<A]
Naphtalene	mg/kg	0.1	5	50	56	0.1	<0.1[<A]
Phenanthrene	mg/kg	0.1	5	50	56	0.1	<0.1[<A]
Pyrene	mg/kg	0.1	10	100	100	0.1	<0.1[<A]
Methyl-1 naphtalene	mg/kg	0.1	1	10	56	0.1	<0.1[<A]
Methyl-2 naphtalene	mg/kg	0.1	1	10	56	0.1	<0.1[<A]
Dimethyl-1,3 naphtalene	mg/kg	0.1	1	10	56	0.1	<0.1[<A]
Trimethyl-2,3,5 naphtalene	mg/kg	0.1	1	10	56	0.1	<0.1[<A]
Moisture	%					0.1	6.2

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 17M274098
PROJECT: Meadowbank

CLIENT NAME: NATIONAL RESEARCH COUNCIL
SAMPLED BY:

ATTENTION TO: David Juck
SAMPLING SITE:

PAHs (soil)

DATE RECEIVED: 2017-10-17 **DATE REPORTED: 2017-11-03**

			SAMPLE DESCRIPTION:	MD3B
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2017-10-12
Surrogate	Unit	Acceptable Limits		8835235
Acenaphtene-D10	%	40-140		101
Fluoranthene-D10	%	40-140		109
Perylene-D12	%	40-140		77

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to QC PTC 2016 A, B Refers to QC PTC 2016 B, C Refers to QC PTC 2016 C, D Refers to QC RESC (Annex 1)
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

Certified By: Robert Roch

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Certificate of Analysis

AGAT WORK ORDER: 17M274098

PROJECT: Meadowbank

CLIENT NAME: NATIONAL RESEARCH COUNCIL

ATTENTION TO: David Juck

SAMPLED BY:

SAMPLING SITE:

Petroleum hydrocarbons TPH F1-F4 (- BTEX)

DATE RECEIVED: 2017-10-17

DATE REPORTED: 2017-11-03

		SAMPLE DESCRIPTION:		MD1A	MD1B	MD2A	MD2B	MD3A	MD3B
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2017-10-12	2017-10-12	2017-10-12	2017-10-12	2017-10-12	2017-10-12
Parameter	**Unit**	**G / S**	**RDL**	**8835229**	**8835230**	**8835232**	**8835233**	**8835234**	**8835235**
Benzene	mg/kg		0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Toluene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Xylenes	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
C6-C10 (F1)	mg/kg		10.0	68.0	<10.0	<10.0	40.4	30.2	<10.0
C6-C10 (F1-BTEX)	mg/kg		10.0	68.0	<10.0	<10.0	40.4	30.2	<10.0
C>10-C16 (F2)	mg/kg		10.0	3540	394	351	1260	1260	667
C>16-C34 (F3)	mg/kg		10.0	6140	1270	1230	4370	3600	3720
C>34-C50 (F4)	mg/kg		10.0	931	207	149	671	525	492
Heavy Hydrocarbons by gravimetry (F4G-sg)	mg/kg		300	NA	NA	NA	NA	NA	NA
% Moisture	%		0.2	10.4	9.6	8.7	8.7	8.9	7.8
Surrogate	**Unit**	**Acceptable Limits**							
Rec. Fluorobenzène (BTEX F-1)	%	40-140		95	95	94	91	92	94
Rec. Nonane (F2-F4)	%	40-140		125	120	119	117	119	118

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8835229-8835235 Resuls are express on a dry basic.
Fraction F1-BTEX prsents results after substraction of BTEX.
Fraction F1 is quantified in function of the response factor of toluene. Response factors of alcanes nC6 and nC10 don't exceed 30% between Toluene.
Fractions F2, F3 et F4 are quantified in function of the response factor medium of alcanes nC10, nC16 et nC34. The response factor of alcane nC50 don't exceed 30% from the response factor average of the alcanes nC10, nC16 et nC34. Responses factor of the alcanes nC10, nC16 et nC34 don't vary more than 10 % between each other.
Linearity domain respect a maximum difference of 15%.
The chromatogramm line come back to base line before the retention time of the alcane nC50. If not, the analysis ot the fraction F4G is done. Fraction F4G-sg represent the heavy hydrocarbons analysis by gravimetry after a silicium gel treatment. Results of F4G cannot be add to hydrocarbons C6 to C50. Quality control results are available in the section Quality control of the certificate of analysis. The holding time for the analysis and the extraction have been respected.

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Quality Assurance

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PROJECT: Meadowbank

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SAMPLING SITE:

Soil Analysis

RPT Date: 2017-11-03			DUPLICATE			REFERENCE MATERIAL				METHOD BLANK			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Analysis (Soil)															
Total Kjeldahl Nitrogen	1	NA	NA	NA	0.0%	< 90	103%	80%	120%	101%	80%	120%	87%	80%	120%
Total Organic Carbon	8835229		2.13	2.08	2.4%	< 0.3	95%	80%	120%	NA	80%	120%	NA	80%	120%

Certified By:

CHIMISTE Rémi Briant 2012-104 QUÉBEC

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Quality Assurance

CLIENT NAME: NATIONAL RESEARCH COUNCIL

AGAT WORK ORDER: 17M274098

PROJECT: Meadowbank

ATTENTION TO: David Juck

SAMPLED BY:

SAMPLING SITE:

Trace Organics Analysis

RPT Date: 2017-11-03			DUPLICATE			REFERENCE MATERIAL				METHOD BLANK			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
PAHs (soil)															
Acenaphtene		NA	NA	NA	0.0%	< 0.1	94%	70%	130%	NA	70%	130%	98%	70%	130%
Acenaphtylene		NA	NA	NA	0.0%	< 0.1	81%	70%	130%	NA	70%	130%	81%	70%	130%
Anthracene		NA	NA	NA	0.0%	< 0.1	91%	70%	130%	NA	70%	130%	101%	70%	130%
Benzo (a) anthracene		NA	NA	NA	0.0%	< 0.1	85%	70%	130%	NA	70%	130%	102%	70%	130%
Benzo (a) pyrene		NA	NA	NA	0.0%	< 0.1	84%	70%	130%	NA	70%	130%	101%	70%	130%
Benzo (b) fluoranthene		NA	NA	NA	0.0%	< 0.1	90%	70%	130%	NA	70%	130%	104%	70%	130%
Benzo (j) fluoranthene		NA	NA	NA	0.0%	< 0.1	88%	70%	130%	NA	70%	130%	94%	70%	130%
Benzo (k) fluoranthene		NA	NA	NA	0.0%	< 0.1	85%	70%	130%	NA	70%	130%	91%	70%	130%
Benzo (c) phenanthrene		NA	NA	NA	0.0%	< 0.1	87%	70%	130%	NA	70%	130%	88%	70%	130%
Benzo (g,h,i) perylene		NA	NA	NA	0.0%	< 0.1	92%	70%	130%	NA	70%	130%	98%	70%	130%
Chrysene		NA	NA	NA	0.0%	< 0.1	97%	70%	130%	NA	70%	130%	124%	70%	130%
Dibenzo (a,h) anthracene		NA	NA	NA	0.0%	< 0.1	80%	70%	130%	NA	70%	130%	79%	70%	130%
Dibenzo (a,i) pyrene		NA	NA	NA	0.0%	< 0.1	86%	70%	130%	NA	70%	130%	85%	70%	130%
Dibenzo (a,h) pyrene		NA	NA	NA	0.0%	< 0.1	76%	70%	130%	NA	70%	130%	80%	70%	130%
Dibenzo (a,l) pyrene		NA	NA	NA	0.0%	< 0.1	81%	70%	130%	NA	70%	130%	81%	70%	130%
Dimethyl-7,12 benzo (a) anthracene		NA	NA	NA	0.0%	< 0.1	85%	70%	130%	NA	70%	130%	86%	70%	130%
Fluoranthene		NA	NA	NA	0.0%	< 0.1	94%	70%	130%	NA	70%	130%	144%	70%	130%
Fluorene		NA	NA	NA	0.0%	< 0.1	97%	70%	130%	NA	70%	130%	104%	70%	130%
Indeno (1,2,3-cd) pyrene		NA	NA	NA	0.0%	< 0.1	92%	70%	130%	NA	70%	130%	96%	70%	130%
Methyl-3 cholanthrene		NA	NA	NA	0.0%	< 0.1	58%	70%	130%	NA	70%	130%	73%	70%	130%
Naphtalene		NA	NA	NA	0.0%	< 0.1	89%	70%	130%	NA	70%	130%	90%	70%	130%
Phenanthrene		NA	NA	NA	0.0%	< 0.1	99%	70%	130%	NA	70%	130%	129%	70%	130%
Pyrene		NA	NA	NA	0.0%	< 0.1	95%	70%	130%	NA	70%	130%	135%	70%	130%
Methyl-1 naphtalene		NA	NA	NA	0.0%	< 0.1	88%	70%	130%	NA	70%	130%	91%	70%	130%
Methyl-2 naphtalene		NA	NA	NA	0.0%	< 0.1	88%	70%	130%	NA	70%	130%	90%	70%	130%
Dimethyl-1,3 naphtalene		NA	NA	NA	0.0%	< 0.1	91%	70%	130%	NA	70%	130%	96%	70%	130%
Trimethyl-2,3,5 naphtalene		NA	NA	NA	0.0%	< 0.1	84%	70%	130%	NA	70%	130%	78%	70%	130%
Petroleum hydrocarbons TPH F1-F4 (- BTEX)															
Benzene	1	8835230	< 0.03	< 0.03	0.0%	< 0.03	99%	80%	120%	NA	100%	100%	94%	70%	130%
Toluene	1	8835230	< 0.05	< 0.05	0.0%	< 0.05	104%	80%	120%	NA	100%	100%	98%	70%	130%
Ethylbenzene	1	8835230	< 0.05	< 0.05	0.0%	< 0.05	109%	80%	120%	NA	100%	100%	102%	70%	130%
Xylenes	1	8835230	< 0.05	< 0.05	0.0%	0.06	111%	80%	120%	NA	100%	100%	102%	70%	130%
Rec. Fluorobenzène (BTEX F-1)	1	8835230	95	96	1.0%	95	88%	40%	140%	NA	100%	100%	92%	40%	140%
C6-C10 (F1)	1	8835230	< 10.0	< 10.0	0.0%	< 10.0	76%	70%	130%	NA	100%	100%	72%	60%	140%
C>10-C16 (F2)	1	8835232	351	344	2.0%	< 10.0	104%	70%	130%	NA	100%	100%	95%	60%	140%
C>16-C34 (F3)	1	8835232	1230	1190	3.3%	< 10.0	105%	70%	130%	NA	100%	100%	96%	60%	140%
C>34-C50 (F4)	1	8835232	149	147	1.4%	< 10.0	99%	70%	130%	NA	100%	100%	98%	60%	140%
Rec. Nonane (F2-F4)	1	8835232	119	118	0.8%	115	139%	40%	140%	NA	100%	100%	134%	40%	140%
% Moisture	8835229	8835229	10.4	10.8	3.2%	< 0.2	98%	80%	120%	NA	100%	100%	NA	100%	100%

Comments: TPH CCME F1-F4 analysis is not controled under MDELCC regulation.

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Quality Assurance

CLIENT NAME: NATIONAL RESEARCH COUNCIL
AGAT WORK ORDER: 17M274098
PROJECT: Meadowbank
ATTENTION TO: David Juck
SAMPLED BY:
SAMPLING SITE:

Trace Organics Analysis (Continued)

RPT Date: 2017-11-03			DUPLICATE			REFERENCE MATERIAL				METHOD BLANK			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper

Certified By:

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Method Summary

CLIENT NAME: NATIONAL RESEARCH COUNCIL

AGAT WORK ORDER: 17M274098

PROJECT: Meadowbank

ATTENTION TO: David Juck

SAMPLED BY:

SAMPLING SITE:

PARAMETER	DATE PREPARED	DATE ANALYZED	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis					
Granulometry (Wentworth)	2017-11-01	2017-11-01	INOR-161-6031F, unaccredited by MDDELCC	MA. 100 - Gran. 2.0	SIEVING
Total Kjeldahl Nitrogen	2017-10-26	2017-10-27	INOR-101-6048F	MA.300-NTPT 2.0	COLORIMETRY
Total Organic Carbon	2017-10-21	2017-10-21	INOR-101-6057F	MA. 405-C 1.1	TITRATION

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Method Summary

CLIENT NAME: NATIONAL RESEARCH COUNCIL **AGAT WORK ORDER: 17M274098**

PROJECT: Meadowbank **ATTENTION TO: David Juck**

SAMPLED BY: **SAMPLING SITE:**

PARAMETER	DATE PREPARED	DATE ANALYZED	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis					
Acenaphtene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Acenaphtylene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Anthracene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Benzo (a) anthracene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Benzo (a) pyrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Benzo (b) fluoranthene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Benzo (j) fluoranthene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Benzo (k) fluoranthene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Benzo (c) phenanthrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Benzo (g,h,i) perylene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Chrysene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Dibenzo (a,h) anthracene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Dibenzo (a,i) pyrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Dibenzo (a,h) pyrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Dibenzo (a,l) pyrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Dimethyl-7,12 benzo (a) anthracene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Fluoranthene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Fluorene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Indeno (1,2,3-cd) pyrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Methyl-3 cholanthrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Naphtalene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Phenanthrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Pyrene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Methyl-1 naphtalene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Methyl-2 naphtalene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Dimethyl-1,3 naphtalene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Trimethyl-2,3,5 naphtalene	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Acenaphtene-D10	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Fluoranthene-D10	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Perylene-D12	2017-10-20	2017-10-20	ORG-100-5102F	MA.400-HAP 1.1	GC/MS
Moisture			LAB-111-4040F	MA.100-ST 1.1	SCALE
Benzene	2017-10-23	2017-10-23	VOL-160-5002F	MA. 400 - COV. 2.0	(P&T)GC/MS
Toluene	2017-10-23	2017-10-23	VOL-160-5002F	MA. 400 - COV. 2.0	(P&T)GC/MS
Ethylbenzene	2017-10-23	2017-10-23	VOL-160-5002F	MA. 400 - COV. 2.0	(P&T)GC/MS
Xylenes	2017-10-23	2017-10-23	VOL-160-5002F	MA. 400 - COV. 2.0	(P&T)GC/MS
Rec. Fluorobenzène (BTEX F-1)	2017-10-23	2017-10-23	VOL-160-5002F	MA. 400 - COV. 2.0	GC/MS
C6-C10 (F1)	2017-10-23	2017-10-23	ORG-160-5110F	CCME Method 1st section	GC-FID
C6-C10 (F1-BTEX)	2017-10-23	2017-10-23	ORG-160-5110F	CCME Method 1st section	GC-FID
C>10-C16 (F2)	2017-10-23	2017-10-23	ORG-160-5110F	CCME Method 1st section	GC-FID
C>16-C34 (F3)	2017-10-23	2017-10-23	ORG-160-5110F	CCME Method 1st section	GC-FID
C>34-C50 (F4)	2017-10-23	2017-10-23	ORG-160-5110F	CCME Method 1st section	GC-FID
Heavy Hydrocarbons by gravimetry (F4G-sg)	2017-10-23	2017-10-23	ORG-160-5110F	CCME Method 1st section	GRAVIMETRY
Rec. Nonane (F2-F4)	2017-10-23	2017-10-23	ORG-160-5110F	CCME Method 1st section	GC-FID
% Moisture	2017-10-23	2017-10-23	INOR-161-6006F	MA. 100 - S.T. 1.0	SCALE

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Laboratory Use Only
AGAT Work Order: 17M274098
No. of Coolers:
Arrival Temperature: 4,8 °C
Custody Seal Intact?: ☐ Yes ☐ No ☐ N/A

Chain of Custody - Environmental Chemistry

Client Information
Company: NRC
Address: 6100 Royalmount Ave
Montreal, QC, H4P 2R2
Phone: 514-496-5297 Fax.:
Project No: Meadowbank
Sample Location:
Sampled By:

Report Sent To
1. Name: David Juck
Email: david.juck@cnrc-nrc.gc.ca
2. Name:
Email:

Guideline Criteria
☐ PRTC ABC ☐ RESC
☑ CCME Other:
☐ Eau consommation
☐ Eau résurg. Surface
☐ Eau résurg. Salée
CMM Sanitary ☐ Storm ☐

Turn Around Time Required (Business Days)
Environmental: Regular: ☑ 5 to 7 days; Rush: ☐ < 12 hours ☐ 24 hours ☐ 48 hours ☐ 72 hours
Ultra Trace: Regular: ☐ 10 to 15 days; Rush: ☐ < 10 days
Date Required:

Report Format
☐ **Portrait** (sample/page) ☐ **Landscape** (multi sample/page)

SAMPLES RECEIVED AFTER 4 PM WILL BE RECORDED AS RECEIVED ON NEXT BUSINESS DAY

Invoice To Same Address: ☑ Yes ☐ No
Company:
Contact:
Email:
Address:
PO No: to follow Quote No:

Comments: English Report

Matrix (legend)
S Soil; B Sludge; SL Solid; EU Wastewater; EP Drinking Water (MDDEDEC Form); SE Sediment; EF Effluent; ES Surface Water; ST Groundwater; AF Affluent; A Air

Analyses listed: BTEX ☐ MAH ☐ VOC: THH-MAH ☐ THM ☐; PAH; Petroleum Hydrocabons C10-C50; RFA ☐ Chlorobenzenes ☐ Phthalates ☐; PCB: Congeners ☐ Aroclor ☐; Ethylene glycol ☐ Glycols (Scan) ☐; Formaldehyde; Mineral Oil & Grease ☐ Total Oil & Grease ☐; Pesticides (specify):; Phenols (GC-MS) ☐ Phenolic Compunds (4AAP) ☐; 6 Metals (Cd, Cr, Cu, Ni, Pb, Zn); 13 Metals TC - Soil ☐ 17 Metals TC - Water ☐; Metals (specify):; Mercury ☐ Selenium - Soil ☐ Total Hardness ☐; Alkalinity ☐ Bicarbonate ☐ Conductivity ☐; Chloride ☐ Fluoride ☐ Sulphate ☐ Bromide ☐; Cyanide : Total ☐ Available ☐ Oxidizable ☐; COD ☐ P total ☐ TOC ☑; NH_3 ☐ TKN ☑ $NO_2 + NO_3$ ☐; Solides : Total ☐ Dissolved ☐ TSS ☐ VSS ☐; Sulphide - Water ☐ Total Sulphur - Soil ☐; Dissolved Metals filtered by Laboratory :; SHORT HOLD TIME: pH ☐ NO_2 ☐ NO_3 ☐ o-PO4 ☐; Absorbance ☐ Colour ☐ Turbidity ☐; BOD_5 ☐ $CBOD_5$ ☐ Hexavalent Chromium ☐; Coliforms : Total ☐ Fecal ☐ E.coli ☐; Microbiology (other) :; HR/MS : PCDD/PCDF ☐ PAH ☐ PCB ☐; CMM 2008-47 : Sanitary ☐ Storm ☐; RMD ☐ REIMR art. ☐; CCME F1-F4

SAMPLE IDENTIFICATION	SAMPLE DATE: DATE (DD/MM/YY)	TIME	MATRIX	No. OF CONTAINERS	PAH	COD / P total / TOC	NH_3 / TKN / $NO_2 + NO_3$	CCME F1-F4	
MD1A	12/10/2017		S	2	✓	✓	✓	✓	
MD1B	12/10/2017		S	2	✓	✓	✓	✓	
MD2A	12/10/2017		S	2	✓	✓	✓	✓	✓
MD2B	12/10/2017		S	2	✓	✓	✓	✓	
MD3A	12/10/2017		S	2	✓	✓	✓	✓	
MD3B	12/10/2017		S	2	✓	✓	✓	✓	

Samples Released by (Print and Sign): David Juck [signature] — Date (DD/MM/YY): 16/10/17 — Time:
Samples Received by (Print and Sign): MA — Date (DD/MM/YY): 17/10/17 — Time: 13h00
Samples Released by (Print and Sign): — Date (DD/MM/YY): — Time:
Samples Received by (Print and Sign): — Date (DD/MM/YY): — Time:

Page 1 of 1
Nº:

Copies: Red - Client Yellow - AGAT White - AGAT

Page 14 of 14

AGAT Laboratoires
350, rue Franquet
Québec, Québec, G1P 4P3
Tél. (418) 266-5511

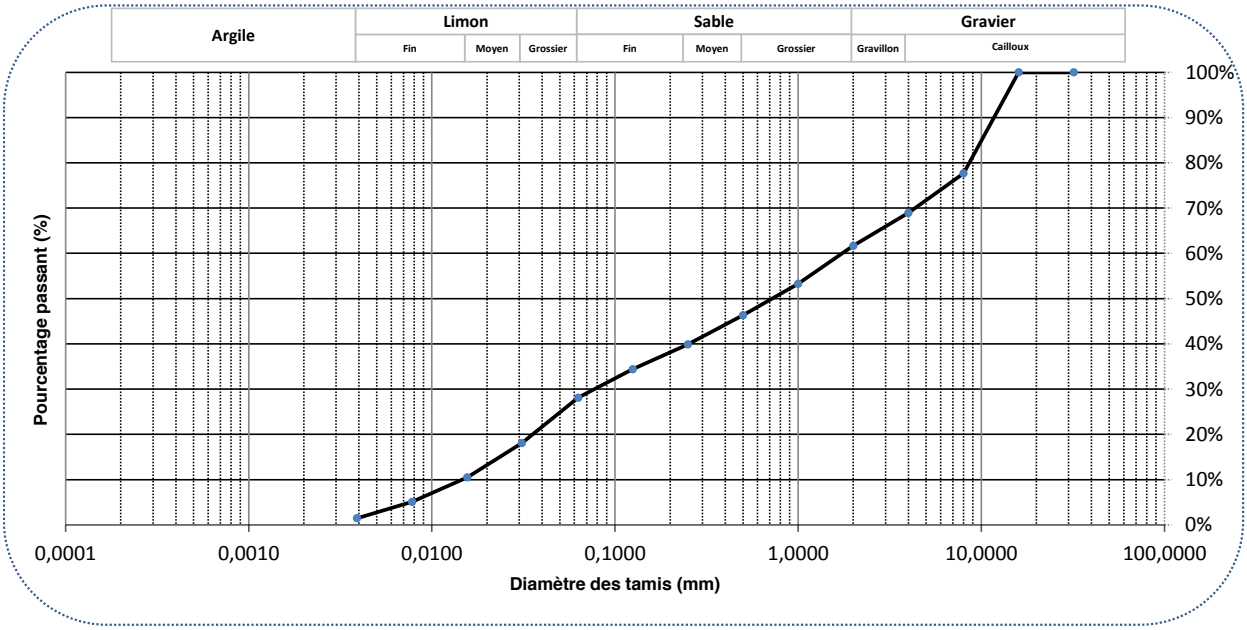
GRANULOMÉTRIE - SÉDIMENTOMÉTRIE

Classification Wentworth

No bon de travail :	17M274098	Client :	NRC
No échantillon :	8835232	Votre référence :	MD2A
Version du certificat :			

Granulométrie Tamis (mm)	Pourcentage Passant (%)
32	100,0%
16	100,0%
8	77,7%
4	68,9%
2	61,6%
1	53,3%
0,500	46,3%
0,250	39,9%
0,125	34,4%
0,063	28,1%

Sédimentométrie Diamètre équivalent (µm)	Pourcentage Passant (%)
31,0	18,1%
15,6	10,5%
7,8	5,1%
3,9	1,5%



Commentaires :

Gravier (2-32mm) : 38,35%
Sable (0.063-<2mm) : 33,55%
Limon,Argile (<63um) 26,61%
Argile (<3.9µm) : 1,49%

Date : 2017-11-02

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Document: INOR-161-6686F.002
Date: 2014-11-13

Appendix B

Landfarm Inspection Forms