Appendix 27

Meadowbank 2018 Landfarm Report

AGNICO EAGLE

MEADOWBANK GOLD PROJECT

2018 Landfarm Report

In Accordance with NIRB Project Certificate No.004
&
NWB License 2AM-MEA1526

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

March, 2019

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 2018:

- 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

Meadowbank's first landfarm (Landfarm 1) was 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, and contaminated soil was added in 2017 and 2018.

It is estimated that between January 5, 2018 and January 1, 2019, 986 m^3 of soil were added to Landfarm 2 from excavation of spills around the Meadowbank and Whale Tail sites. No additional soil was relocated to Landfarm 2 from Landfarm 1 in 2018, leaving an estimated 655 m^3 in Landfarm 1. No soil sampling was conducted in 2018, and no material was removed from the landfarm.

Visual inspections (34 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 in June only, 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. Recommendations for enhancing biodegradation rates were made (specific nutrient amendment) which are planned for 2019.

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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.

1.2 OBJECTIVES

Per the Landfarm Design and Management Plan (March, 2017) this report summarizes the following aspects of the Meadowbank landfarm operation in 2018:

- 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 of pilot and supporting studies on biodegradation rates in the Meadowbank landfarm in 2012/2013 and 2017 are 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 the 2017 Landfarm Report. 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 was in use until 2017. As presented in Figure 1 below, the original landfarm (Landfarm 1) was located on the north-west side of the South Tailings Cell impoundment (Tailing Storage Facility – TSF). Landfarm 1 is no longer operational, as the area has been in-filled with tailings material.

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-MEA1526 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.

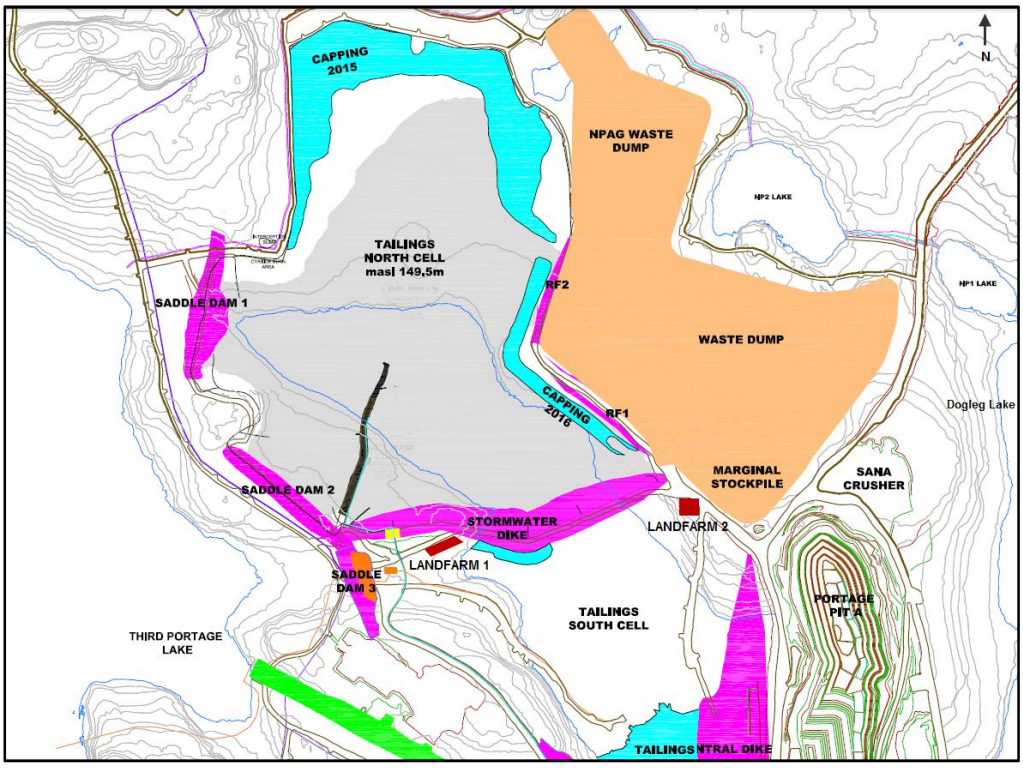

Figure 1. Landfarm 1 and Landfarm 2 locations.

3.3 SOIL ADDITION AND REMOVAL

From landfarm survey data, 986 m^3 of soil were added to Landfarm 2 between January 2018 and January 2019 from excavation of PHC spills around the Meadowbank and Whale Tail sites. A summary of spills occurring in 2018 including those sent to the landfarm are provided in Section 7 of the 2018 Annual Report.

3.3.1 Very Coarse Material (>1") Screening

As described in the Landfarm Design 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. No screening occurred in 2018, and no coarse material was removed from the landfarm during this time.

3.3.2 Remediated Fine Soil Removal

According to the Landfarm Design and Management Plan, 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 2018, and no soil was removed.

A summary of historical sample results for years in which sampling was conducted (2014 – 2016) is provided in Table 1. Since landfarm additions and removals occurred each year, piles were mixed, and sampling locations are not consistent, year-over-year trends were not assessed.

Table 1. Government of Nunavut soil quality criteria for agricultural/wildlands and industrial areas, and results of landfarm soil analyses. *Sample locations do not necessarily correspond year-over-year. Samples exceeding GN Agricultural/Wildland criteria are shaded grey.

Year	Sample Name*	Parameter							
		Benzene	Toluene	Ethylbenzene	Xylene	F1	F2	F3	F4
Agricultural/ Wildland (mg/kg)>		**0.03**	**0.37**	**0.082**	**11**	**30**	**150**	**300**	**2800**
Industrial (mg/kg) >		**0.03**	**0.37**	**0.082**	**11**	**320**	**260**	**1700**	**3300**
2014	CSP-1A	-	-	-	-	<0.06	900	3500	650
	CSP-1B	-	-	-	-	<0.06	380	2200	460
	CSP-STP-2A	-	-	-	-	<0.06	590	2200	6400
	CSP-STP-2B	-	-	-	-	<0.06	450	2300	6600
	CSP-3	-	-	-	-	<0.06	25	110	<50
	CSP-4A	-	-	-	-	<0.06	480	3300	520
	CSP-4B	-	-	-	-	<0.06	51	1100	210
	CSP-5A	-	-	-	-	<0.06	51	2500	550
	CSP-5B	-	-	-	-	<0.06	460	5100	1000
	CSP-5C	-	-	-	-	<0.06	130	2100	540
	CSP-5D	-	-	-	-	<0.06	38	1400	360
	CSP-5E	-	-	-	-	<0.06	61	1900	450
	CSP-6	-	-	-	-	0.22	2300	610	57
	Average						**455**	**2178**	**1483**
2015	CSP-1a	<0.03	<0.06	<0.06	<0.06	<0.3	600	3200	490
	CSP-1b	<0.03	<0.06	<0.06	<0.06	<0.3	350	2300	380
	CSP-2a	<0.03	<0.06	<0.06	<0.06	<0.3	810	6200	2400
	CSP-2b	<0.03	<0.06	<0.06	<0.06	<0.3	5600	20000	3100

Year	Sample Name*	Parameter							
		Benzene	**Toluene**	**Ethylbenzene**	**Xylene**	**F1**	**F2**	**F3**	**F4**
	CSP-3a	<0.03	<0.06	<0.06	<0.06	<0.3	670	4200	490
	CSP-3b	<0.03	<0.06	<0.06	<0.06	<0.3	920	3500	530
	CSP-4	<0.03	<0.06	<0.06	<0.06	<0.3	840	320	<50
	CSP-5a	<0.03	<0.06	<0.06	<0.06	<0.3	260	5200	720
	CSP-5b	<0.03	<0.06	<0.06	<0.06	<0.3	2000	13000	1600
	CSP-5c	<0.03	<0.06	<0.06	<0.06	<0.3	38	1500	350
	CSP-5d	<0.03	<0.06	<0.06	<0.06	<0.3	640	7300	1600
	CSP-6a	<0.03	<0.06	<0.06	<0.06	<0.3	<10	620	79
	CSP-6b	<0.03	<0.06	<0.06	<0.06	<0.3	200	1200	200
	Average						**1052**	**5496**	**1057**
2016	CSP-1a	<0.03	<0.06	<0.06	<0.06	<0.3	350	3000	530
	CSP-1b	<0.03	<0.06	<0.06	<0.06	<0.3	240	2400	490
	CSP-1c	<0.03	<0.06	<0.06	<0.06	<0.3	840	5400	930
	CSP-2a	<0.03	<0.06	<0.06	<0.06	<0.3	470	3000	560
	CSP-2b	<0.03	<0.06	<0.06	<0.06	<0.3	560	5800	1200
	CSP-2c	<0.03	<0.06	<0.06	<0.06	<0.3	240	2200	400
	Average						**450**	**3633**	**685**

3.4 NUTRIENT ADDITIONS AND SOIL AERATION

No nutrient additions or soil aeration occurred in 2018. Recommendations made in the 2017 NRC study (Section 2) for addition of a specific nutrient amendment are planned to be implemented in 2019.

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 2901 m^3, and conservatively assuming no soil remediation & removal prior to closure, Landfarm 2 will be able to accommodate an additional 8544 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 2018 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 template, Appendix A) 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 2018, and Agnico's responses are indicated:

- Manage and modify landfarm sloping design to ensure run-off, if any, is contained within the landfarm area.

    - In 2018 the north (entrance) section of the Landfam was re-sloped in August to keep any potential run-off from leaving the bermed area and ease off-loading of contaminated material from hauling equipment.

- Increase sludge addition during warmer months to maximize remediation efficiencies.

    - The NRC-recommended specific nutrient amendment is planned to be added in 2019.

The following actions are identified for 2019:

- Investigate and if feasible, apply the nutrient amendment recommended in the 2017 study by NRC

Appendix A

Landfarm Inspection Template

Environmental Inspection Report for the Meadowbank Landfarm

Date: **Inspected By:**

Location: **Weekly Inspection**

In Compliance with	Subject	Conform	Non-conform	N/A	Comments
NWB Part B Item 10	Sign posted to inform of a waste disposal facility in English, French, and Inuktitut.				
NWB Part D Item 29 MBK SCP NIRB Condition 26	Are there any visual spills that can enter any water body?				
NWB Part F Item 6 and Item 8	Does the water need to be pumped? If yes, estimated volume in m^3, analyse water and 10 days notification give to NWB?				
NWB Part F Item 9 NIRB Condition 12	Discharge of water >30m from ordinary high water mark				
NWB Part F Item 9 NIRB Condition 12	Discharge of water not causing erosion				
NWB Part F Item 9 NIRB Condition 12	Discharge of water not directly flowing to water body				
NWB Part F Item 19 NIRB Condition 12	Waste disposal area >30 m from high water mark				
NWB Part I Item 9	Monitoring signs are posted in English, French, and Inuktitut.				
NWB Part F Item 14 NIRB Condition 27	No hazardous waste present - All Hazardous waste generated is sent off site to an approved disposal facility (except contaminated soil)				
NIRB Condition 26	Ensure that spills, if any, are cleaned up				

	immediately and that the site is kept clean of debris, including wind-blown debris.				
NWB Part I Item 10 and 15	Visual sign of runoff or seepage. If so, record and report the observation and the flow.				
NWB Part I Item 12	Annual Geotechnical inspection completed. Date?				
Landfarm Design and Management Plan	Maximum windrow size was 15 m wide at base x 4 m high x 50 m long				
Landfarm Design and Management Plan	Larger coarse material (> 1") was separated from the finer material				
Landfarm Design and Management Plan	A record is kept for the amount of contaminated soil placed in the landfarm and the location of each load within the facility.				
Landfarm Design and Management Plan	Does new contaminated soil was bringing to Landfarm without authorization? If so, estimated quantity.				
Landfarm Design and Management Plan	A record is kept for the amount of remediated contaminated soil, disposal location and usage.				
Landfarm Design and Management Plan	Does some pile are remediated and ready to remove from landfarm (respect GN guideline)?				
Landfarm Design and Management Plan	Soil mixed mechanically with earth-moving equipment (2-4 times per year, during the summer months). Date?				
Landfarm Design and Management Plan	Does the windrow are dry prior to turning? If yes, we need to moisture the pile.				
Landfarm Design and Management Plan	Soil treatment with sewage sludge as nutrient supplement, at least once during summer on selected windrows.				

Landfarm Design and Management Plan	Windrows sampled annually at the end of the summer season. See section 4.6.2 for sampling procedure.				
Landfarm Design and Management Plan	Coarse-grained material assessed near the end of the summer season for PHC product and odour. PHC odours are no longer detected? If yes, removed to the PRSF and disposed of as PAG material.				
Landfarm Design and Management Plan	Does non-contaminated snow need to be removed?				
Landfarm Design and Management Plan	Inspected areas; condition of berm and base; previously unidentified safety concerns, Twice annually during Summer. Date?				
BMP	Are there any additional environmental hazards/potential impacts that require attention?				
MINE ACT	Are there any Health and Safety issues that should be addressed to prevent injury to workers?				

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Contaminated Soil Acceptable at Landfarm

Only soil contaminated with the following products may be treated in the landfarm if used onsite and spilled on soil:

- Diesel fuel
- Gasoline
- Aviation fuel (Jet A)
- Hydraulic oil
- Other light oil e.g. engine oil, lubricating oil

Comments/Recommendations:

Environmental Personnel Name: _____

Signature: _____

Actions Corrected:

_____

_____

_____

_____

Site Service Supervisor Name: _____

Signature: _____