

Appendix 32-5 : Landfarm Management Plan



AGNICO EAGLE

MELIADINE GOLD MINE

Landfarm Management Plan

**APRIL 2022
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EXECUTIVE SUMMARY

Agnico Eagle Mines Limited (Agnico Eagle) has developed the Meliadine Gold Mine (Mine), located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut. The mine plan includes open pits and underground mining methods for the development of the Tiriganiaq gold deposit, which includes two open pits (Tiriganiaq Pit 1 and Tiriganiaq Pit 2) and one underground mine.

This document presents the Landfarm Management Plan for the Mine and forms a component of the documentation series produced for the Type A Water Licence Application. The Plan describes the design features and operational procedures for the landfarm located at the Mine for the storage and treatment of petroleum hydrocarbon contaminated soils.

On-site storage and remediation has been established as the preferred method for treatment of light petroleum hydrocarbon contaminated soil that may be generated on the proposed mine site. The landfarm is designed to receive soils, rock, snow, and ice contaminated with petroleum hydrocarbons. This will include light hydrocarbons such as diesel and gasoline being treated in the landfarm.

The landfarm is located just off the industrial pad, approximately 200 metres from Collection Pond 1 (CP1) and is shown on Figure 2-1. The central location of the landfarm (Figure 2-1) was chosen to minimize the footprint of the site and the transport distance of contaminated material from potential spill locations. The landfarm is expected to effectively treat up to 5,000 cubic metres of contaminated soil over the construction, operations, and closure of the Mine, and 500 cubic metres of snow and ice annually. Water accumulating in the landfarm is not discharged directly to the receiving environment. It is first sent through an oil/water separator, before being discharged to CP1 for further treatment. The landfarm has an impervious liner and no impacts on shallow groundwater are anticipated.

A report of landfarm activities is prepared annually by Environment Department, indicating the volume of material added to the facility, amount of material removed, disposal or re-use location, analysis results, volume and type of nutrient addition, visual inspection results, and volume of contact water pumped.

Soils contaminated with light end petroleum hydrocarbons are remediated in accordance with the criteria stated in The Government of Nunavut, Environment Department's Environmental Guideline for the Management of Contaminated Sites. When remediated, the soils will be removed from the facility and can be used for construction purposes, such as part of the cover of the Tailings Storage Facility, Landfill or stacked in the Waste Rock Storage Facility. In addition, Agnico Eagle continues remediation of the historical landfarm associated with the Type B Water License – 2BB-MEL1424 that was in use for the former Meliadine Exploration Camp.

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DOCUMENT CONTROL

Version	Date	Section	Page	Revision	Author
1	April 2015			First version of the Landfarm Management Plan	John Witteman, Env. Consultant, Agnico Eagle
2	February 2018	Figure 2-1	5	- "Main Infrastructure for the Meliadine Project, including the Landfarm" - figure added to figure reference	Meliadine Environment Department
		3.1	9	- Antifreeze removed from list of acceptable contaminants for landfarm disposal	
		2.1	3	-Approximate volume of material adjusted to 700 m ³	
		1.3	2	- Updated Oil Pollution Emergency Plan revision date and version	
		All	All	-General review and revision	
3	February 2019	1.1	1	-Estimated quantity of material in Type A landfarm adjusted to 1500 m ³	Sean Arruda
		2.1	3	-Estimated quantity of material in both landfarms adjusted to 3706 m ³ (1500 m ³ in Type A landfarm, 2206 m ³ in Type B landfarm) -Paragraph containing estimated annual inputs to landfarm has been removed - gasoline and light oil added -microbial activity 'slows' (changed from 'stops')	
		2.2.1	4	- 'oil' changed to 'hydrocarbons'	
		Figure 2-1	5	-Site map figure updated.	
		Table 2-2	8	-Sump surface area was a typo (10,040 m ²). Changed to 144 m ²	

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|-------|----|---|
| 3.1.1 | 10 | <p>-‘Aboriginal Affairs and Northern Development Canada’ changed to ‘Crown-Indigenous Relations and Northern Affairs’</p> <p>-Sentence added “If there is uncertainty whether or not the material contains additional, unknown contaminants, the material should be placed in totes/drums until lab results confirm that they can be placed in the landfarm.”</p> |
| 3.3 | 11 | <p>-Contaminated snow is now being sent to the snow cell area</p> |

April 2022	4	All	All	General Update	Agnico Eagle, Environment Department
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ACRONYMS

Agnico Eagle	Agnico Eagle Mines Limited
BTEX	benzene, toluene, ethylbenzene, and xylene
CIRNAC	Crown-Indigenous and Northern Affairs Canada
CP1	Collection Pond 1
GN	Government of Nunavut
IOL	Inuit Owned Land
KivIA	Kivalliq Inuit Association
Mine	Meliadine Gold Mine
NWB	Nunavut Water Board
OPEP/OPPP	Oil Pollution Emergency Plan and Oil Pollution Prevention Plan
PHC	Petroleum hydrocarbons
PID	Photoionization Detector
TSF	Tailings Storage Facility
WRSF	Waste Rock Storage Facility

SECTION 1 • INTRODUCTION

1.1 Project History

Agnico Eagle Mines Limited (Agnico Eagle) is operating the Meliadine Gold Mine (Mine), located approximately 25 kilometres (km) north of Rankin Inlet, and 80 km southwest of Chesterfield Inlet in the Kivalliq Region of Nunavut. Situated on the western shore of Hudson Bay, the Mine site is located on a peninsula between the east, south, and west basins of Meliadine Lake (63°1'23.8" N, 92°13'6.42"W), on Inuit Owned Lands. The Mine is located within the Meliadine Lake watershed of the Wilson Water Management Area (Nunavut Water Regulations Schedule 4).

The mine plan proposes open pit and underground mining methods for the development of the Tiriganiaq gold deposit, with two open pits (Tiriganiaq Pit 1 and Tiriganiaq Pit 2) and one underground mine. There are four phases to the development of Tiriganiaq: just over 4 years of construction (Q4 Year -5 to Year -1), 8 years of mine operation (Year 1 to Year 8), 3 years of closure (Year 9 to Year 11), and post-closure (Year 11 forwards).

The Landfarm Management Plan (Plan) focuses on minimizing the waste footprint on-site, and maximizing remediation potential through implementation of bioremediation experience and research carried out at the Agnico Eagle's Meadowbank Gold Mine.

When possible, materials contaminated with heavy hydrocarbons (e.g., hydraulic fluid or grease), are to be segregated, packaged, and shipped south for treatment and/or disposal.

1.2 Objectives

On-site storage and remediation has been established as the preferred method for treatment of light PHC contaminated soil that may be generated at the proposed mine. Specifically, remediation through landfarming has been identified as the primary treatment option and, as such, is the focus of this contaminated soil management plan. A pilot project to enhance rates of bioremediation through addition of a nutrient source is being carried out at Meadowbank and will be employed at the Mine should it prove successful. Alternate contingency options in the event that landfarming is not successful or as efficient as planned are also discussed.

The objectives of this Plan are to:

- provide an overview of contaminated soil management at the Mine;
- describe the physical setting, location, and design criteria of the landfarm;
- define acceptable types of contaminated soils to be placed in the landfarm and conditions for removal of treated soil;
- define operating procedures and monitoring requirements for the landfarm; and
- describe contingency options for alternate treatment/storage of PHC contaminated soil.

1.3 Related Documents

Spill prevention is the first stage in contaminated soil management at the Mine. Documents containing information related to this Plan and submitted as part of the Type A Water Licence Application include:

- Spill Contingency Plan;
- Environmental Management and Protection Plan; and
- Risk Management and Emergency Response Plan.

There is also a related Oil Pollution Emergency Plan and Oil Pollution Prevention Plan (OPEP/OPPP), which is specific to spills at Agnico Eagle's Itivia Oil Handling Facility (OHF) located in Rankin Inlet. The OHF is located on the shore of Melvin Bay, which is part of Hudson Bay. The OPEP/OPPP was prepared as a requirement of the *Canadian Shipping Act* and associated regulations. It is submitted to Transport Canada for approval prior to any shipping related to the Mine.

1.4 Spill Prevention

Similar to the waste management philosophy, plans are to actively work towards minimizing spills through suitable work procedures. Plans developed from the environmental impact study address the management of spills on land, ice, water, and into the marine environment. When spills do occur, the goal is to limit the spread of the spill, and then manage contaminated material resulting from the spill. The Spill Contingency Plan describes spill prevention measures.

SECTION 2 • LANDFARM DESIGN

2.1 Background

In the event of a spill, on-site storage and remediation is the most practical and efficient method in handling contaminated soil, particularly in an isolated location such as the Mine. Any PHC contaminated soils generated during the construction, operation, and closure phases will be adequately managed. Soils contaminated with light PHCs, such as diesel, gasoline, and light oils will be treated on-site in a landfarm. This method involves spreading, mechanical mixing, addition of nutrients and water and placing the contaminated soil in windrows within a containment area, and promoting conditions favorable for the volatilization and aerobic microbial degradation of hydrocarbons. When possible, materials contaminated with heavy hydrocarbons (e.g., hydraulic fluid or grease), are to be segregated, packaged, and shipped south for treatment and/or disposal.

Landfarm option analysis prepared for Agnico Eagle by Golder Associates (2007) identified factors relevant to landfarming in the north. This includes environmental factors and physical properties of the soil that affect microbial growth and rates of biodegradation, including temperature, pH, soil moisture, nutrient content, salinity, and soil particle size.

Although rates of biodegradation decline with temperature, landfarming is still a feasible technique in Arctic climates as demonstrated by the Meadowbank landfarm. Degradation in the north is typically restricted because microbial activity slows between 0 to -5 degrees Celsius (°C) restricting biodegradation to the months of June to September¹. Nevertheless, degradation was reported at 90% over two summers on Resolution Island (Paudyn et al. 2008).

It is estimated that soils contaminated with light end PHCs would require three full summer seasons for complete remediation. When remediated, the soils will be removed from the facility and can be used for construction purposes such as part of the cover of the Tailings Storage Facility (TSF) or stacked in the Waste Rock Storage Facility (WRSF). Based on a remediation period of three seasons, it would be possible to close the landfarm facility on three years after the end of the process plant operation.

2.2 Location

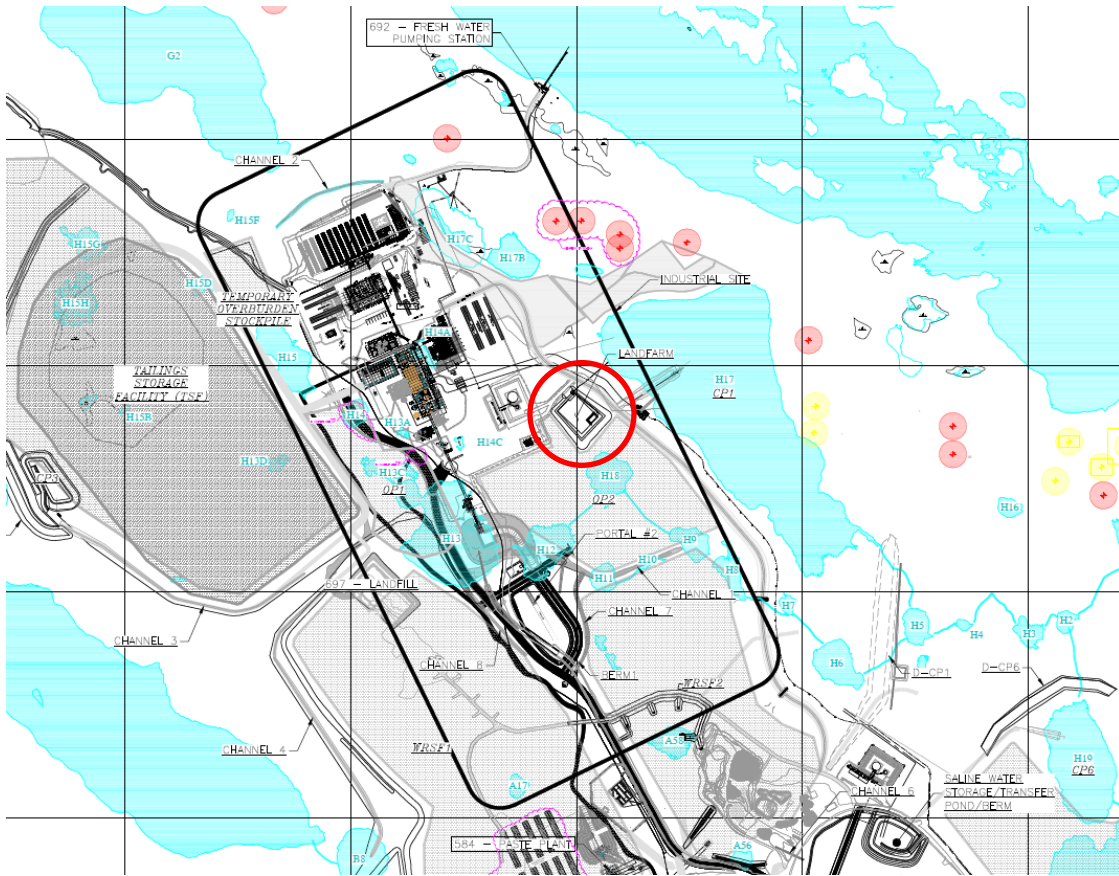
The overall site plan showing the main infrastructure for the Mine, including the landfarm, is shown in Figure 2-1. The area has no exposed bedrock and up to 20 metres (m) of glacial-fluvial till that has little ground ice and shows no permafrost degradation. The central location of the landfarm was chosen to minimize the footprint of the site and the transport distance of contaminated material from potential spill locations. The management of all waste generated at the Mine in the form of dry stack tailings, waste rock, incinerator, and landfill waste are located in close proximity to the main infrastructure.

¹ Even though bioremediation ceases below -5°C, volatilization of the PHCs does continue but at a much slower rate.

2.2.1 Proximity of Surface Water

The landfarm is located adjacent to the infrastructure pad, approximately 200 m from Collection Pond 1 (CP1). The landfarm is located on land that slopes towards the southwest corner, which results in any rainwater or snowmelt draining to temporary water storage having the capacity to store a 1:100 wet year spring freshet plus 500 m³ of water from melting of contaminated snow/ice. Drainage from the landfarm may be used as water in the turning of the windrows during the remediation process. Excess water is collected within a sump inside the landfarm and will be pumped to an oil pre-treatment plant to remove any hydrocarbons. The treated water will then be discharged into the CP1. Discharge from CP1, is controlled by a dike, which stops direct flow to Meliadine Lake. Meliadine Lake is the source of freshwater for the site and is used by Inuit for traditional pursuits. If water is to be discharged from CP1 to Meliadine Lake, it is treated to meet compliance criteria. Except for a short duration during the spring freshet or a heavy rainfall, water ponding will be eliminated in the landfarm by the end of the summer such that a sufficient storage capacity is available for the upcoming spring freshet.

Figure 2-1 Landfarm Site Location Plan



2.2.2 Proximity of Groundwater

In the Mine area, the groundwater within the active layer is estimated to reach 1.5 m in October. The active layer begins to form in July when temperatures largely remain above 0°C, and deepens to a maximum in October. Shallow groundwater flow in the area of the landfarm is towards the industrial site.

To prevent movement of contaminants from the landfarm facility into groundwater and the surrounding environment, Environment Canada (SAIC 2006) recommends implementation of a barrier with 10^{-7} centimetres per second hydraulic conductivity at a thickness of 0.6 m. The Meliadine landfarm has an impervious liner and no impacts on shallow groundwater are anticipated.

2.3 Design

The landfarm is designed to receive soils, rock, snow, and ice contaminated with petroleum hydrocarbons. This will include light hydrocarbons such as diesel and gasoline. The design volume of the landfarm is based on allowances for the materials being treated at Meadowbank.

The average floor slope is 3.1% going in the designed direction of northwest to southeast, matching the natural ground slope. This slope is still adequate allowing leachate/drainage from the PHC soils and internal runoff to gradually seep through the filter berm into the sump area. The water collected in the sump will be pumped to the oil separator for oil removal before being discharge into CP1. The sump area was built as per design capacity.

The geomembrane liner crest elevation was installed at an elevation of 74.80 m, it does allow for 0.45 m of freeboard before reaching the geomembrane liner crest elevation.

2.3.1 Soil Volume Requirements

The landfarm was built with the expectation of effectively treating up to 5,000 m³ of contaminated soil over the construction, operations, closure of the Mine, and 500 m³ of snow and ice annually. Based on the experience at Meadowbank, the volume of PHC would be approximately 350 m³ per year during construction, operation, and closure phases. Table 2-1 outlines the estimated volumes of contaminated soils and rock, and contaminated snow and ice expected during each phase of the mine.

Table 2-1 Estimated Volume of Petroleum Hydrocarbon Contaminated Soil and Ice/Snow to be Managed

Project Phase	Volume of PHC Soil/Rock (m ³)	Annual PHC Snow/Ice (m ³)
Advanced exploration	2,209 (volume in exploration landfarm to date) ^(a)	
Predevelopment (2 years)	350 (175 per year)	
Construction (3 years)	1,050 (350 per year)	500 per year
Operations (7 years)	2,450 (350 per year)	
Closure & Reclamation (2 years)	700 (350 per year)	
Total	4,970	

^(a) The contaminated soil in the advanced exploration landfarm will be transferred to the mine landfarm upon its completion and commissioning.

As described in the Landfarm Design & Management Plan (Agnico Eagle 2008), it is estimated that soils contaminated with light end PHCs would require three full summer seasons for complete remediation. When remediated, the soils will be removed from the landfarm and used on-site, placed in a WRSF or used as cover at the TSF.

2.3.2 Design Specifications

The design criteria for the landfarm is outlined in Table 2-2. Its footprint is approximately 11,000 square metres (m²), with a perimeter berm that is approximately 2.0 m high over the landfarm surface. The geometry and characteristics of the landfarm are shown in Table 2.2.

Table 2-2 Geometry and Characteristics of the Landfarm

Item	Actual
Dimensions of Perimeter Berm Crest Exterior (avg.)	86.8 m x 68.4 m
Dimensions of Perimeter Berm Crest Interior (avg.)	74.4 m x 53.3 m
Side Slopes of Perimeter Berm (avg.)	1V:2.5H (40%)
Perimeter Berm Crest Width (avg.)	3.5 m
Perimeter Berm Height (Min. to Max.)	1.4 m to 5.2 m
Perimeter Berm Crest Elevation (avg.)	75.25 m
Dimensions of Filter Berm Crest Interior (avg.)	19.0 m x 12.0 m
Side Slopes of Filter Berm (avg.)	1V:1.5H (67%)
Filter Berm Crest Width (avg.)	1.0 m
Geomembrane Liner Crest Elevation	74.80 m
Interior Floor Slope (avg.)	-3.1% (NW to SE)
Fill Thickness Above Original Ground for Inside Base/ Sump Area (Min.)	1.52 / 1.48 m
Fill Thickness Above Liner	0.5 m
Inside Base Surface area Including Sump Area	3,794 m ²
Sump Surface Area	144 m ²

Table 2-3 indicates the growth and stabilization of the volume of PHC considering remediation over three years and the maximum volume of contaminated material that is anticipated to be stored over a period of 13 years.

The size of the landfarm is based on the design criteria (Table 2-2), the estimated volume of material (Table 2-3), and the requirement to turn over the surface of the piles during the summer months. The designed footprint of the landfarm is 11,000 m² with a useful landfarm surface of 3,650 m². Contaminated material is piled 1.5 m so that the material is below the crest height of the perimeter berm. At the maximum estimated capacity of the facility, three windrows having each 890 m³ of PHC will cover 1,800 m² allowing 1,850 m² for turnover and water management.

Table 2-3 Volume of Petroleum Hydrocarbon Contaminated Material in the Landfarm

Mine Year	Estimated PHC Produced (m ³)	Accumulated PHC in Landfarm for Remediation (m ³)	Treated PHC Removed from Landfarm (m ³)	Hydrocarbon Contaminated Snow or Ice to Landfarm (m ³)	Maximum Accumulated PHC in Landfarm (m ³)
Before -6	420			0	0
-6 and -5	350			0	0
-4	350			0	0
-3	350	1,470		500	1,970
-2	350	1,820		500	2,320
-1	350	2,170		500	2,670
1	350	1,400	1,120	500	1,900
2	350	1,400	350	500	1,900
3	350	1,400	350	500	1,900
4	350	1,400	350	500	1,900
5	350	1,400	350	500	1,900
6	350	1,400	350	500	1,900
7	350	1,400	350	500	1,900
8	350	1,400	350	500	1,900
9	0	1,050	350	0	1,050
10	0	525	525	0	525
11	0	0	525	0	0

SECTION 3 • LANDFARM OPERATION AND MANAGEMENT

Agnico Eagle is responsible for managing and implementing the landfarm operation plan. Operation and monitoring of the landfarm as well as designation of training requirements will be the responsibility of the Environment General Supervisor, Coordinators or designate.

3.1 Acceptable Landfarm Material

3.1.1 Contaminants

The landfarm facility will only treat and/or store light PHC contaminated soils that have been generated through mine related activities at the Mine and which have been transferred from the Mine's advanced exploration camp landfarm upon closure. Material from the Hamlet of Rankin Inlet or other sites will not be accepted without approval from the NWB, Crown-Indigenous Relations and Northern Affairs (CIRNAC), Water Resources Inspectors, and the Kivalliq Inuit Association (KivIA).

The following products are acceptable for treatment in the landfarm if generated on-site and spilled on soil:

- diesel fuel;
- gasoline;
- hydraulic oil
- aviation fuel (Jet A);
- other light oil (e.g., engine oil, lubricating oil);

In the event that the contaminant source is unknown, soil samples will be analyzed for PHCs and possibly additional contaminants prior to placement in the landfarm. These additional parameters could include total metals, oil and grease, and volatile organic compounds. Analysis for additional compounds will be determined by the Environment Department on a case-by-case basis. If there is uncertainty whether or not the material contains additional, unknown contaminants, the material should be placed in totes/drums until lab results confirm that they can be placed in the landfarm.

Concentrations of contaminants will be compared to the site background values (for metals) and/or criteria in the Government of Nunavut (GN) *Guidelines for Contaminated Site Remediation* (GN 2009). If this analysis indicates soil contamination above background or GN guidelines for any substance not approved for landfarming (i.e., non-PHC contaminants), the spill material will not be placed in the landfarm. This is to ensure that PHC contaminated soils are not contaminated with other products.

Spills of non-PHC material (e.g., solvents) will be placed in drums and stored on-site for shipment to approved facilities during shipping season.

3.1.2 Grain Size

Bioremediation of very coarse-grained, larger soil material, is inhibited as it does not readily retain moisture. However, volatilization will occur more rapidly (SAIC 2006). It has been noted that this material likely contains lower concentrations of contaminants due to a lower volume-to-surface area ratio, and can typically be screened out prior to landfarming (SAIC 2006). As a result, soils and rock material with grain size less than 2.5 centimetres (cm) will be separated from larger-grained material, where possible. This will occur at the spill location or in the landfarm using a screen sieve, should it prove necessary. The two soil fractions will be treated separately in the landfarm.

3.2 Contaminated Soil Additions

3.2.1 Spill Excavation

Soil contaminated with the above-described petroleum hydrocarbon materials will be excavated and transported to the landfarm facility in dump trucks or other approved methods. Care will be exercised to ensure that the entire spill is excavated (verified by olfactory and visual assessment, or sampling if necessary) and that none of the contaminated material is lost during transport.

3.2.2 Placement in the Landfarm

As described above, larger coarse material (rocks) will be separated from the finer material (sand and gravel) in the landfarm and assessed visually for PHC staining and product. If the material is saturated it will be spread to allow volatilization in the designated area of the landfarm.

Materials identified as acceptable in the landfarm will be placed in windrows with dimensions about 18 m wide at base x 1.5 m high x 34 m long. Windrows may be piled wider, higher, or longer as space permits. A record will be kept by the on-site Environmental Coordinator or designate of the amount of contaminated soil placed in the landfarm and the location of each load within it.

3.2.3 Decontamination of Soil Movement Equipment

The decontamination of soil movement equipment is outlined in the Landfarm Soil Movement Procedure, included as the Appendix A to this Management Plan.

3.3 Contaminated Snow

Petroleum hydrocarbon contaminated snow and ice will be placed in a designated snow-cell area and treated as contact water after snowmelt. After snowmelt, the contaminated water will be pumped through the site's oil-water separator to remove PHC residue. The treated water will be discharged to the CP1.

Snow accumulation in the Landfarm will be allowed to melt and accumulate in the Landfarm sump where it will be treated through the oil-water separator as needed upon melt or used in the bioremediation process for the contaminated soil. Any excess snow accumulation in the Landfarm will be moved to the snowcell.

3.4 Remediation

Remediation of fine grained PHC contaminated soil in the landfarms occurs naturally through volatilization and aerobic microbial degradation. Soil aeration, nutrient amendment and water addition, are recognized as methods for improving rates of remediation. Agnico Eagle commissioned the National Research Council Canada to undertake the bioremediation research study to optimize the biodegradation process. Agnico Eagle will look at increasing biodegradation rates through potential opportunities such as nutrient amendment.

3.4.1 Absorbent Materials

Coarse-grained soils are not readily bio-remediated, but concentrations of PHC contaminants may still be reduced through volatilization. Oil absorbent pads will be used to help remove visible product from coarse-grained material.

3.4.2 Aeration

To promote aerobic conditions throughout the windrows, soil will be mixed mechanically with earth-moving equipment. This turnover of soil piles will occur approximately two to four times per year, during the summer months.

3.4.3 Soil Moisture

Prior to turning, site personnel will ensure that soil is not so dry as to generate significant dust, nor overly saturated. If soil is too dry, non-contaminated water from within the landfarm containment area will be used as a moisture source and sprayed on the piles. If no accumulated water is available, water from CP1 or freshwater will be used. If the windrows are saturated, aeration will be delayed until the moisture content is reduced.

3.4.4 Nutrient Amendment

The use of sewage sludge as a nutrient amendment has precedent in the north. Sewage sludge as a nutrient source has also been proposed for the Milne Inlet Mary River Project (EBA 2010). This material not only provides the benefit of nutrients, but also adds organic matter to help retain moisture and microorganisms. Furthermore, the use of sewage sludge produced on-site helps to reduce the waste footprint of the mine by re-directing this material from disposal facilities and avoids needing to import a chemical fertilizer. The use of sewage sludge or another recommended nutrient amendment will be considered for optimization of biodegradation.

3.5 Removal of Soil From the Landfarm

3.5.1 Government of Nunavut Remediation Guidelines

The following parameters will be measured and compared with the GN industrial remediation criteria to determine whether PHC contaminated soil has been adequately remediated:

- benzene, toluene, ethylbenzene and xylene (BTEX); and
- petroleum hydrocarbon fractions 1 - 4.

The GN remediation criteria are characterized for agricultural/wildlife, residential/parkland, commercial, and industrial land uses. At the Mine, remediation to agricultural/wildlife criteria is targeted; however, if these criteria cannot be met, industrial criteria will be followed.

The GN remediation criteria for coarse-grained soils will be applied. Table 3-1 presents the applicable Tier 1 criteria for coarse-grained soil, assuming agricultural/wildlife or industrial land uses.

Table 3-1 Summary of Relevant GN Tier 1 Soil Remediation Criteria for Surface Soil (mg/kg)

	Land Use Criteria (mg/kg)	
	Agricultural/Wildlife	Industrial
Benzene	0.03	0.03
Toluene	0.37	0.37
Ethylbenzene	0.082	0.082
Xylene	11	11
PHC Fraction 1	30	320
PHC Fraction 2	150	260
PHC Fraction 3	300	1,700
PHC Fraction 4	2,800	3,300

mg/kg = milligram per kilogram

3.5.2 Sampling and Analysis

Landfarm windrows will be sampled annually at the end of the summer season to determine if remediation objectives have been met. Representative composite samples will be taken of each windrow to estimate remaining PHC concentrations. For each 10 m of windrow length, one composite sample will be collected, each consisting of three surface sub-samples and three sub-samples at 1 m depth. Sub-samples will be taken approximately 3.3 m apart, and will be taken from both sides of the windrow. Sampling QA/QC measures will include collection of 1 duplicate per 10 samples.

After two seasons of treatment in the landfarm, degradation rates will be assessed to estimate the total remediation time required for PHC contaminated soil under these conditions. If remediation to GN guidelines is feasible within the life-of-mine timeframe, landfarm operations will continue, with aeration and possible nutrient amendments as described above. If rates of degradation are not sufficient through this method, alternate options will be further investigated as described in Section 4.2.

3.5.3 Soil Removal

Coarse-grained soils will be assessed near the end of the summer season by Environment Department technicians for PHC product and odour. Based on the experience learned at Meadowbank, Agnico

Eagle is confident that confirmatory sampling and laboratory analysis is not required prior to removing coarse-grained soil from the Landfarm. Observations show that volatilization of PHCs from coarse-grained soil occurs more rapidly than biodegradation. It has been noted that this material likely contains lower concentrations of contaminations due to a lower volume-to surface area ratio, and can typically be screened out prior to landfarming. Thus, the use of a photoionization detector (PID) is sufficient to confirm material is in a suitable state to be removed from the landfarm. When PHC odours are no longer detected, the material will be removed to waste rock storage facility or at the TSF to be used as cover material.

When sample analysis of fine-grained material at the end of a season indicates that concentrations of contaminants are below GN guidelines, a soil pile or the appropriate section of a pile will be deemed acceptable for removal from the facility. Interim monitoring may be conducted through measurements of headspace with a portable instrument (e.g., flame ionization detector), but samples will be confirmed by an accredited laboratory prior to soil removal.

When remediated, the soils will be removed from the facility and can be used for construction purpose such as normal overburden (i.e., part of the cover of the TSF) or stacked in the WRSF. Based on a remediation period of three seasons, it would be possible to close the landfarm facility three years after the end of the process plant operation.

3.6 Water Management

Since the landfarm facility is uncovered to facilitate natural weathering, water accumulating inside the bermed area may come into contact with contaminated material.

While the landfarm has an impermeable liner, visual inspections by the Environment Department will be conducted for seepage of contact water coming through the perimeter berm, or the accumulation of water within the containment berm. This will be conducted on a weekly basis starting after freshet and continuing until October when water is likely to be present. In the event of water accumulation or seepage, the ponded water will be pumped through the site's oil-water separator to remove PHC residue and will be analyzed for BTEX, lead, and oil and grease prior to discharge to CP1 or used on the windrows to increase moisture content, as required. Water accumulating in the landfarm will not be discharged directly to the receiving environment.

3.7 Winter landfarm management

Uncontaminated snow will be removed as much as possible during winter to minimize the quantity of spring melt water inside the berm. Care will be taken to ensure contaminated snow/soil is not disturbed by leaving a base layer of snow of no less than 10 cm in place. Following snowmelt, any contaminated product left from winter spill clean-up operations will be padded up. The base soil in these areas will be excavated and added to existing remediation windrows as soon as possible after snowmelt to minimize migration into the facility substrate.

3.8 Landfarm Closure and Reclamation

After removal of all remediated soil and prior to closure and reclamation of the landfarm, the berm and base will be sampled on a 10 m grid, to determine if these soils are free from PHC contamination. Results of this analysis will be compared to GN criteria set out in Table 3-1. No excavation will be necessary if agricultural/wildlife criteria are met. If industrial criteria are used, the landfarm will be covered with 2 m of waste rock or other material used for reclamation. The surrounding berm will be breached to avoid water accumulation on the landfarm.

3.9 Summary of Activities

A summary of landfarm activities including monitoring of the physical condition and potential environmental impacts of the landfarm is provided in Table 3-2. An annual report will be prepared indicating the 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, and volume of contact water pumped. This information will be appended to Agnico Eagle's NWB Annual Report.

Table 3-2 Summary of Landfarm Activities, Analyses, and Records

Activity	Analysis	Frequency of Analysis	Record
Excavation of spill and transport of contaminated material to landfarm.	If unsure of full excavation - F1-F4, BTEX If contaminant source unknown, F1-F4, BTEX, metals, oil and grease, VOCs	As needed	Date, time and location of spill and excavation; estimated volume of spill; estimated quantity of excavated soil; storage/disposal location of excavated soil, if applicable. Any evidence of remaining product
Soil aeration	NA	Two to four times over the summer	Date and time of the aeration; location; soil condition (moisture, odour, granulometrie, etc.)
Soil treatment with sewage sludge as nutrient supplement.	Visual inspection to ensure proper incorporation	At least once during summer on selected windrows	Date and time; type of treatment (aeration or nutrient amendment); location in landfarm; any odour noticed during aeration
Sampling for progress of remediation	Hydrocarbon vapour in headspace (by PID); F1-F4, BTEX (laboratory)	Vapour – as needed; Laboratory - annually	Date and time; location; odour; laboratory report
Soil removal from landfarm	Removal subject to meeting GN criteria	Once GN criteria are met	Date and time; location; quantity of soil removed; final location
Ponded contact water	BTEX, oil and grease, lead – as specified in Water Licence	Prior to any dewatering; if re-used in landfarm, no sampling necessary	Date and time, location, laboratory report, in Annual Report
Seepage	Visual inspection; BTEX, oil and grease, lead – as specified in Water License	Weekly during summer	Location, extent, approximate depth, evidence of seepage
Identification of maintenance requirements	Visual inspection of landfarm	Twice over the summer	Inspected areas; condition of berm and base; previously unidentified safety concerns

SECTION 4 • CONTINGENCY OPTIONS

This section describes the contaminated soil management plan, should a large spill event occur, and if landfarm treatment prove not successful.

4.1 Large Spill Event

A large spill event producing a quantity of soil that cannot be contained in the landfarm is unlikely because the landfarm is designed to hold nearly two times as much contaminated soil as is expected to be produced. Nevertheless, in this event, soils will be placed in a temporary storage area. A temporary stockpile area would be set up on an emergency basis, such as in the Waste Rock Storage Facility (WRSF) or the Tailings Storage Facility (TSF). As space becomes available, the soil would be added to the landfarm. Through spill prevention measures discussed earlier in this Plan, Agnico Eagle is minimizing the probability of this scenario occurring.

4.2 Alternate Treatment Options

Should landfarm treatment not perform as anticipated and it is evident that rates of degradation are not sufficient to meet GN Tier 1 criteria within the life-of-mine and the anticipated closure, the following alternative treatment options will be considered. Implementation will be after development of a more detailed protocol and approval of a revised plan by the NWB.

4.2.1 Soil Amendment

Since pH, salinity, moisture content, and microbial population density all affect rates of biodegradation by microbes, these factors may be monitored and adjusted through soil amendments if they are not found to be optimal (SAIC 2006). In addition, the height of soil windrows could be reduced to maximize air exposure if space in the landfarm allows.

4.2.2 Tier 2 – Modified-Criteria Approach

According to the GN *Environmental Guideline for Contaminated Site Remediation* (GN 2009), in cases where site conditions, land uses, receptors, or exposure pathways are different from those assumed in the development of the Tier 1 criteria, modified criteria may be permitted. This process requires the collection of site-specific information on exposure and risk estimates and is subject to GN approval. For this Mine, landfarmed soils are to be encapsulated in a WRSF rather than used in surface applications, as assumed in Tier 1, reducing the likelihood of exposure to any remaining contamination. Therefore, the Tier 2 approach could be warranted if Tier 1 criteria cannot be met. Any consideration for this approach would be based on soil sampling results and science based information.

4.2.3 Direct Placement in Waste Rock Storage Facility or on Tailings Storage Facility

Another option for management of contaminated soil if bioremediation proves not effective would be the direct placement of this material in a WRSF or on the TSF. Although the use of PHC contaminated soils in these storage areas is not optimal, the quantity generated on-site is small in comparison to the quantity of waste rock and cover on the TSF. While this method would not result in the treatment of soil, it is a viable contingency option because it would allow for the safe disposal of the contaminated material. Encapsulation and freeze-back would occur, eliminating any movement of contaminants. Over time, this material would undergo natural degradation. Consideration of this option would also include a suitable monitoring program for PHCs, which would be incorporated into the Closure and Reclamation Plan.

SECTION 5 • ASSESSMENT AND REPORTING

5.1 Feasibility

After two seasons of treatment in the landfarm, degradation rates of PHC contaminants are assessed to estimate the total remediation time required under these conditions. If remediation to GN guidelines is feasible within the life-of-mine timeframe, landfarm operations will continue, with aeration and possible nutrient amendments as described above. If rates of degradation are not sufficient through this method, alternate options will be further investigated (Section 4).

5.2 Reporting

Reporting of landfarm activities is submitted annually by the Environment Department, indicating the volume of material added to the facility, amount of material removed and disposed or the re-use location, and confirmatory analysis results. This information will be appended to Agnico Eagle's NWB Annual Report.

5.3 Plan Review and Continual Improvement

The Landfarm Management Plan is reviewed annually by the Meliadine Environmental Department, and, if necessary, updated at least every two years of operation.

REFERENCES

- Agnico Eagle (Agnico Eagle Mines Limited). 2008. Landfarm Design and Management Plan In Accordance with Water License 2AM-MEA0815, Meadowbank Gold Project, 20 p. + Figures and Appendix. October 2008.
- Agnico Eagle. 2017. Version 1.1, Supporting Document 8-2 Oil Pollution Emergency Plan, Final Environmental Impact Statement, Meliadine Gold Project, Nunavut. Submitted to the Nunavut Impact Review Board. September 2017.
- EBA. 2010. Hydrocarbon Impacted Soils Storage and Landfarm Facility Operations, Maintenance and Monitoring Plan, Milne Inlet, Mary River Project, Nunavut. Prepared for: Baffinland Iron Mines Corporation. Issued for Review. December 2010.
- Golder (Golder Associates Ltd). 2007. Technical Memorandum: Landfarm Option Analysis, Meadowbank Gold Project, Nunavut. Prepared for: Agnico-Eagle Mines Ltd. August 23, 2007.
- Government of Nunavut, March 2009. Environmental Guideline for Contaminated Site Remediation <http://env.gov.nu.ca/sites/default/files/Guideline%20Contaminated%20Site%20Remediation.pdf>
- Paudyn, K. et al, 2008. Remediation of hydrocarbon contaminated soils in the Canadian Arctic by landfarming. Cold Regions Science and Technology, v53, p 102-114, n 1 June 2008
- SAIC (Science Applications International Corporation), 2006. Federal Guidelines for Landfarming Petroleum Hydrocarbon Contaminated Soils. Final report presented to: Contaminated Sites Division and Emergencies Engineering Technologies Office (EETO), Environmental Technology Centre, Environment Canada. SAIC Canada Project #: 11953.B.S08. CM #: 001659. March 31, 2006.
- TetraTech EBA. 2014. Tailings, Waste And Water Management For Feasibility Level Study Meliadine Project, Nunavut, FILE: E14103188-01, AEM Report Number: 6509-REP-05, 145 p. + Appendix.

APPENDIX A

DOCUMENT ID: MEL-ENV-0029 Permanent Landfarm & Soil Sampling

People concerned: Agnico Eagle employees, contractors, visitors on the Meliadine site

Effective Date: 2018-03-10

This procedure corresponds to the required minimum standard. Each and everyone also have to comply with the rules and regulations of the Nunavut Government in terms of health and safety at work.

Rev #	Date	Description	Initiator
1	2018-03-10	Change to intellex template	Alexandre Gauthier
2	2018-03-27	Review	Matt Gillman

Objective:

- To establish inspections that fulfil the Nunavut Impact Review Board (NIRB) PROJECT CERTIFICATE NIRB [NO.: 006], Nunavut Water Board (NWB) WATER LICENCE NO: 2AM-MEL1631, and any commitments made in the existing management plans for the Meliadine Gold Project.

Definitions (If applicable):

- None

Tool/Equipment Required	PPE Required
<ul style="list-style-type: none"> As required 	<ul style="list-style-type: none"> Standard PPE

Specific Training Requirements
<ul style="list-style-type: none"> None

<p>1. All contaminated soils are to be sent to the Landfarm.</p> <p>Every reported spills contaminated soil must be stored separately, identified, sampled and localized so it can be managed regarding its origin and contamination level. Environmental department also needs to keep track of the amount of soil moved from the spill to the Landfarm.</p> <p>2. Landfarm will be gated and locked to prevent unapproved dumping of contaminated material.</p> <p>Site Services and Environment will be the departments with keys to the gate system. All other departments and contractors will need to contact SS or Environment to open the gate to allow access.</p> <p>3. All Contaminated soil is to be placed in rows and marked separately</p> <p>Once the cleanup is done, mark off the soil with red flag to avoid having soil from another spill</p>

with different contaminant or concentration mix. (See picture #1)



Figure 1 – soil marked separately for each spill

4. Identification

Once marked off with flagging tape, the contaminated soil needs to be identified. The easiest way to do so is to use the date of the reported spill as the name for the location and also for the samples. If the material comes from an unknown place or from an unreported spill, an appropriate identification must be given (i.e.: Maintenance green tank) (See pictures #2 and 3)



Figure 2- Identification from a reported spill



Figure 3- Identification from an unreported spill (MNTCE G T for maintenance green tank)

5. Sampling Contaminated Soil

Once stored and identified, the soil now needs to be sampled for analyses. To do so, we need to send four 250 ml glass bottles with aluminum paper in the cover and ask the lab to do a composite. Each bottle will also be a composite sample (Take soil from different spots, put it in a plastic bag, mix it and then put it in the bottle). All four samples will be identified with the same name as the soil location, the date of the spill for reported spill and an appropriate identification for unreported spill (See picture #4 and 5).



Figure 4- identification of the samples



Figure 5- Sampling

6. Location

Once everything is done, take the GPS coordinates for every separated spill (in the middle of the piles) so we can put it on a plan, take a picture and put these coordinates in the contaminated soil file.
<\\Camefs02\groups\Environment\SAMPLING\LandFarm>

NOTE: Depending of the results received from the lab, Site Services will need to be advised what needs to be done with the contaminated soil. Environmental supervision is important to avoid confusion between samples.

Related Documentation (If applicable):

- Landfarm Management Plan

References (If applicable):

- None

Appendix (If applicable):

- None

Authorization (Print Name)

Approved: _____ <div style="text-align: center;">Name JOHSC Worker Rep.</div>	Date: _____
Approved: _____ <div style="text-align: center;">Name Department Superintendent / Delegate</div>	Date: _____
Approved: _____ <div style="text-align: center;">Name Health & Safety Superintendent / Delegate</div>	Date: _____