MEADOWBANK GOLD PROJECT

Landfarm Design and Management Plan

In Accordance with Water License 2AM-MEA1525

Prepared by:
Agnico Eagle Mines Limited – Meadowbank Division

Version 4
March, 2017

EXECUTIVE SUMMARY

General Information

The Landfarm Design and Management Plan (LDMP) describe the design features and operational procedures for the landfarm constructed at the Meadowbank Gold Project site for the storage and treatment of petroleum hydrocarbon contaminated soil.

Annual Review

The LDMP will be reviewed and updated if necessary. Completion of the review of the LDMP will be documented through signatures of the personnel responsible for reviewing, updating and approving the LDMP.

Record of Changes

A record will document all significant changes that have been incorporated in the LDMP subsequent to the latest review. The record will include the names of the persons who made and approved the change, as well as the date of the approval.

Distribution List

Agnico Eagle Mines Limited will maintain a distribution list for the LDMP providing information about all parties that receive the plan including mine personnel, departments, and outside agencies.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEA1525, Part B, Item 11, the proposed implementation schedule for this Plan is effective immediately (February 2017) subject to any modifications proposed by the NWB as a result of the review and approval process.

DISTRIBUTION LIST

Agnico Eagle – Environmental Superintendent
Agnico Eagle – Environmental Senior Coordinator
Agnico Eagle – General Mine Manager
Agnico Eagle – Energy and Infrastructure Superintendent
Agnico Eagle – Field Services Supervisor
Agnico Eagle – Engineering Superintendent

DOCUMENT CONTROL

Version	Date	Section	Page	Revision
1	08/10/08	2		Remediation guidelines used and the parameters measured
		7		Details on storage and treatment options for metals, solvents, glycol and heavy oils; Measures to prevent damage to the liner during mechanical operation
		4		Contingency plans for exceedances in the amounts of contaminated soil and/or snow/ice
		5		Details describing the design components/specifications of the spillway
		8		Contingency planning and monitoring of sump volumes during the snowmelt period
2	12/10/22	All	All	Comprehensive revision to original plan
3	13/02/28	All	All	Further detail and rationale provided
4	17/02/20	All	All	Comprehensive review. Add detail regarding the Landfarm #2

Prepared By: Meadowbank Environment Department

Approved By: Jamie Quesnel
Environmental Superintendent

TABLE OF CONTENTS

1 Introduction ... 6
1.1 Background ... 6
1.2 Objectives ... 6
2 Spill Prevention ... 7
2.1 Spill Management Documentation ... 7
2.2 Spill Severity ... 7
3 Landfarm Design ... 8
3.1 Background ... 8
3.2 Location ... 8
3.2.1 Proximity of Surface Water ... 12
3.2.2 Proximity of Groundwater ... 12
3.3 Design ... 12
3.3.1 Soil Volume Requirements Landfarm 2 ... 12
3.3.2 Design Specifications ... 12
4 Landfarm Operation and Maintenance ... 14
4.1 Management Responsibility ... 14
4.2 Acceptable Materials ... 14
4.2.1 Contaminants ... 14
4.2.2 Grain Size ... 15
4.3 Contaminated Soil Additions ... 15
4.3.1 Spill Excavation ... 15
4.3.2 Placement in the Landfarm ... 15
4.4 Contaminated Snow ... 15
4.5 Remediation ... 15
4.5.1 Absorbent Materials ... 16
4.5.2 Aeration ... 16
4.5.3 Soil Moisture ... 16
4.5.4 Nutrient Amendment ... 16
4.6 Removal of Soil from the Landfarm ... 17
4.6.1 Remediation Guidelines ... 17
4.6.2 Sampling and Analysis ... 18
4.6.3 Soil Removal ... 18

4.7 Water and Snow Management 19
4.7.1 Snow Management 19
4.7.2 Water Management 19
4.8 Landfarm Abandonment 19
4.9 Summary of Activities 20
5 Contingency Options 22
5.1 Large Spill Event 22
5.2 Alternate Treatment Options 22
5.2.1 Soil Amendment 22
5.2.2 Tier 2 – Modified Criteria Approach 22
5.2.3 Thermal Desorption 23
5.2.4 Direct Placement in the TSF or PRSF 23
6 Plan Review and Continual Improvement 24

LIST OF TABLES

Table 1 - Summary of relevant Government of Nunavut Tier 1 soil remediation criteria for surface soil for industrial land uses. 18
Table 2 - Summary of landfarm activities and records to be kept. 21

LIST OF FIGURES

Figure 1. General location of Landfarm 1 and Landfarm 2. 9
Figure 2. Landfarm 1 as-built design 10
Figure 3. Landfarm 2 as-built design 11

1 INTRODUCTION

1.1 Background

In 2008 the Landfarm Design and Management Plan was developed by Agnico Eagle in accordance with Water License 2AM- MEA0815 to describe the handling and remediation of petroleum hydrocarbon (PHC)-contaminated soil at the Meadowbank site. During construction and initial operations (2008-2011, prior to construction of the landfarm facility), soil potentially contaminated with PHCs, as a result of spills was deposited in two quarries (Q5 and Q22) along the All Weather Access Road (AWAR). The majority of this soil was from a transport tanker spill in 2010 and from the contractor camp used for roadway construction in 2007 and 2008. In 2012 the transport of this soil back to the minesite for treatment/storage at the onsite landfarm began. Subsequent landfarm design and management plan modifications (Version 2 and 3) focused on minimizing the waste footprint onsite, and maximizing remediation potential through implementation of a pilot bioremediation project, as well as spill prevention and contingency planning. The current version (Version 4) has been updated to describe construction of an extension to the original landfarm, and construction of a new landfarm facility in 2016.

1.2 Objectives

Onsite storage and remediation has been established as the preferred method for treatment of petroleum hydrocarbon-contaminated soil that may be generated on the Meadowbank site, Exploration Camp and Amaruq Road. 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 also described. Alternate contingency options in the event that landfarming is not successful or as efficient as planned are also discussed.

This plan is a component of the Meadowbank Environmental Management System. The objectives of this plan are:

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

2 SPILL PREVENTION

2.1 Spill Management Documentation

Spill prevention is the first stage in contaminated soil management at the Meadowbank site. Three documents describe spill prevention, management and response at this facility: the Spill Contingency Plan, the Emergency Response Plan, and the Oil Pollution Emergency Plan. Specifically, Section 2.1 of the Spill Contingency Plan describes spill prevention measures and can be referred to for further detail. All are updated regularly. General spill prevention methods include:

- Regular inspections of fuel/chemical storage areas for leaks
- Training in safe handling procedures
- Keep containers sealed
- Use methods of secondary containment
- Keep over pack drums nearby to contain leaking drums
- Keep storage area secure from unauthorized access, and protected from weathering and damage
- Segregate incompatible materials
- Regular meetings with site departments

2.2 Spill Severity

In 2011, spills of landfarmable materials (fuel and hydraulic oil) at Meadowbank totaled 5,338 liters. In 2012, Meadowbank Division Environment Department increased delivery of spill prevention programing. This included more departmental information sessions to maintain awareness about spill prevention methods and reporting procedures. In 2012, spills of fuel and hydraulic oil have been reduced to 3,012 liters. In 2013, the Environment Department incorporated a site wide training session for every employee on site. In addition, the Emergency Response Team as well as Environment and Road Maintenance staff had extensive training in spill response by a consultant specializing in spill training (January, 2013). Training pertains to spill response on the tundra as well as surface water. In addition, Agnico has begun use of a new hydraulic fluid (Hydrex™ Extreme; Petro-Canada) that contains no heavy metals and is 40% biodegradable in 28 days. It is therefore estimated that any soil contaminated with the new fluid will be more rapidly remediated in the landfarm than soil contaminated with the previously used fluid. A significant increase of reported spills was noted in 2016 comparing to previous years. The overall changes are a result of different factors, focus on proper spill reporting, equipment wear and increased mining production. An action plan was initiated to address the increase and identify proper improvement channels.

3 LANDFARM DESIGN

3.1 Background

When spills do occur, onsite storage and remediation is the most practical and efficient method of handling contaminated soil, particularly in an isolated location like Meadowbank. For PHC contamination, bioremediation through landfarming has been identified as a viable remedial technique. This method involves spreading, mechanical mixing, and placing the contaminated soil in windrows within a containment area and promoting conditions favorable for the volatilization and aerobic microbial degradation of hydrocarbons. A number of environmental factors and physical properties of the soil affect microbial growth and rates of biodegradation, including temperature, soil moisture, nutrient content, salinity and soil particle size.

Previously, a landfarm options analysis prepared for Agnico by Golder (2007a) identified some of these factors, and presented the following information from the literature on landfarming in the north. Although rates of biodegradation decline with temperature, landfarming is still a feasible technique in arctic climates (Reimer et al. 2005). Microbial activity stops between 0 – -5°C (although volatilization continues at this temperature), so degradation in the north is typically restricted to the months of June – September. Nevertheless, degradation was reported at 70% after one year in a study in Alert, NU (Greer et al. 2007), and 90% over two summers on Resolution Island (Paudyn et al. 2005).

3.2 Location

The overall site plan for the Meadowbank Gold Project and the location of the landfarm facilities are shown in Figure 1. This central 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, wasterock and the site landfill is in close proximity. The location of the original landfarm facility (Landfarm 1) is directly north of the South Cell Tailings Facility. In 2016, Landfarm 1 was extended due to operational work required at the buttress of the Stormwater Dike. The Landfarm 1 extension as-built drawing is presented in Figure 2.

In 2016, a second landfarm facility (Landfarm 2) was constructed in the same general location within the South Cell Tailings impoundment, since the Landfarm 1 facility is planned to be flooded by reclaim water in mid-2017. Landfarm 2 is located on the north east side of the South Tailing Cell, north of the Central Dike. Specifications of the Landfarm 2 design are presented in the as-built drawing, Figure 3. As with the original landfarm, the Landfarm 2 facility is designed with one soil remediation/storage cell.

Landfarm 1 may continue to be used until mid-2017. At that point, any un-remediated soil will be moved to Landfarm 2 as necessary.

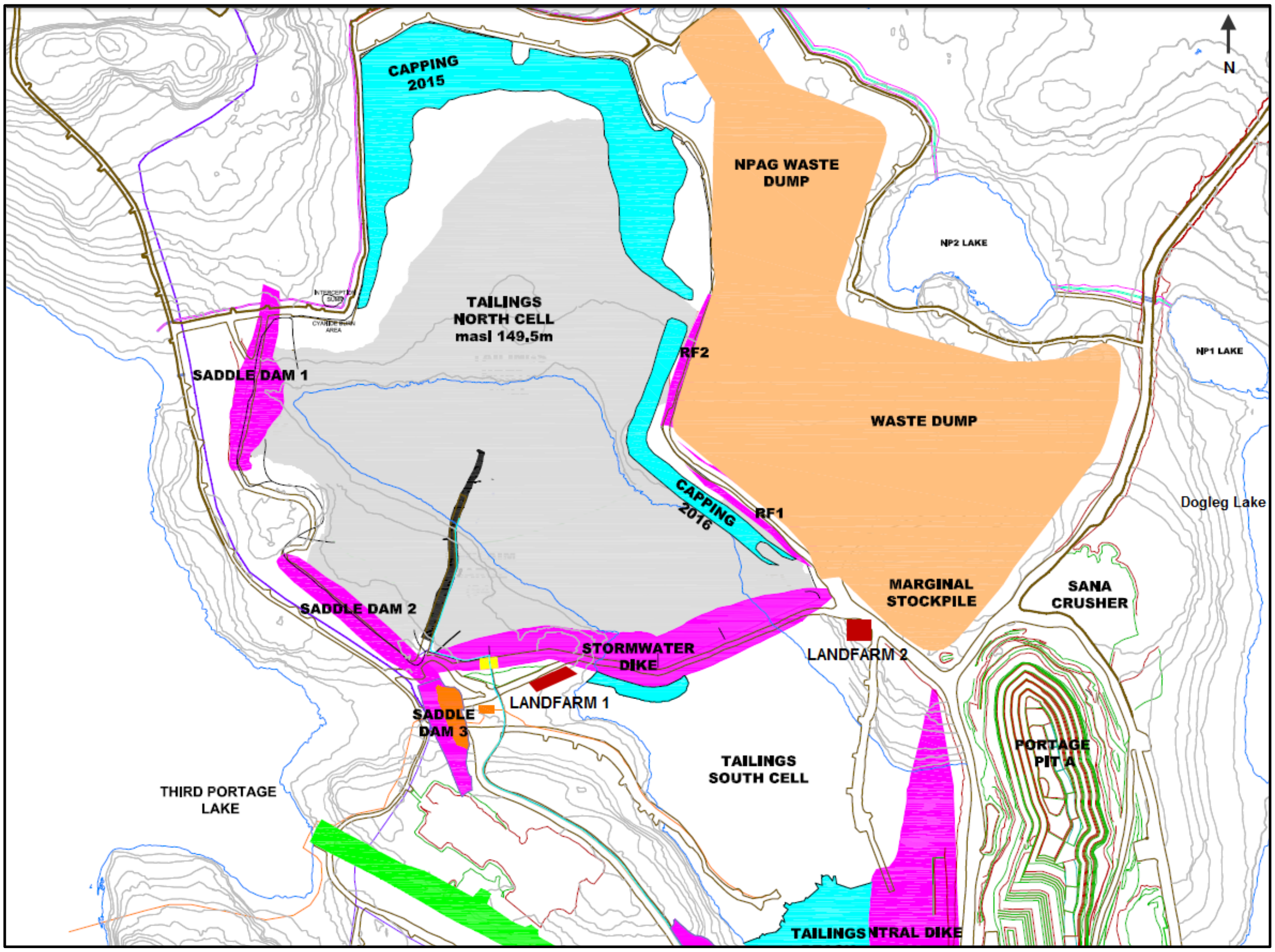


Figure 1. General location of Landfarm 1 and Landfarm 2.

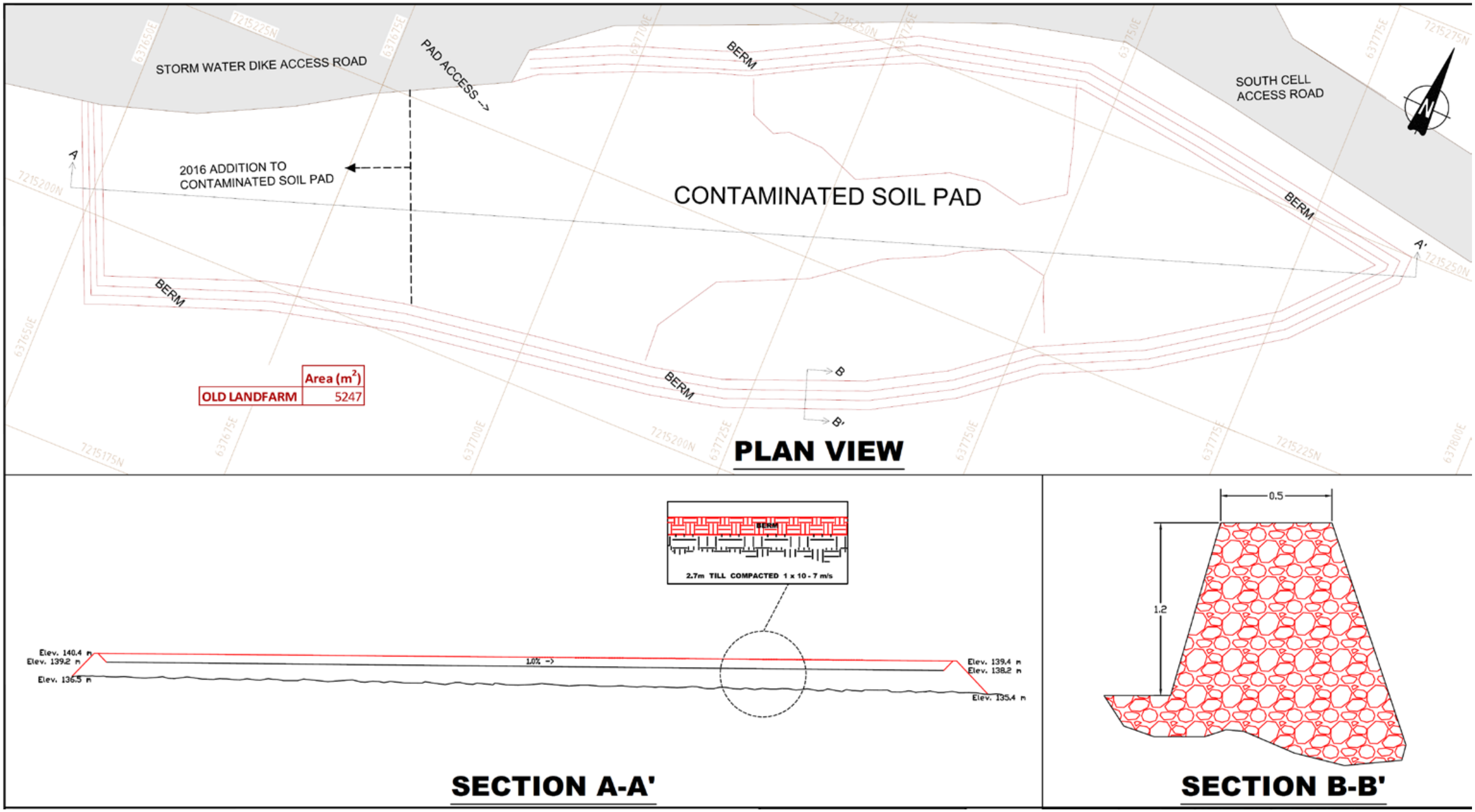
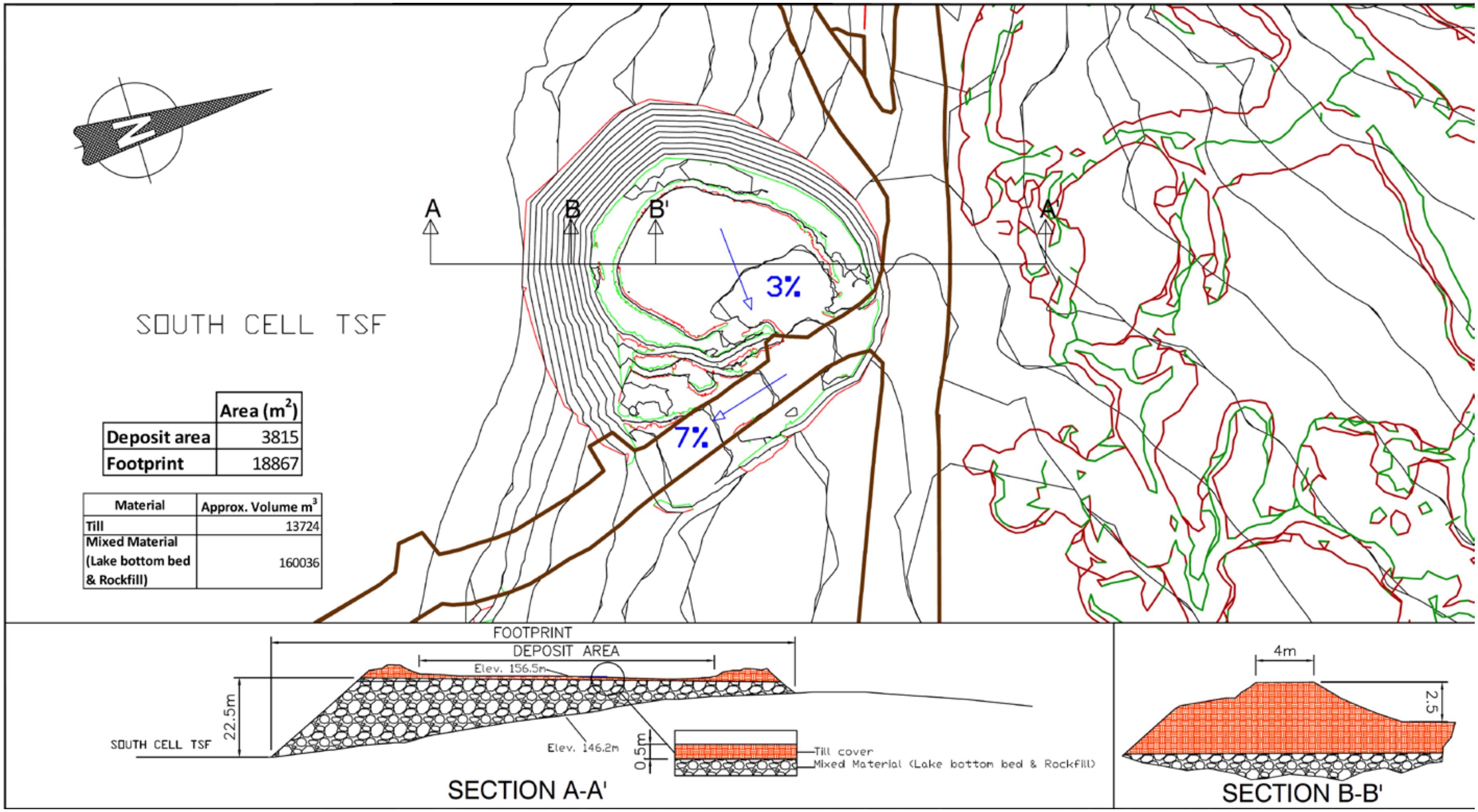


Figure 2. Landfarm 1 as-built design



	Area (m^2)
Deposit area	3815
Footprint	18867

Material	Approx. Volume m^3
Till	13724
Mixed Material (Lake bottom bed & Rockfill)	160036

Figure 3. Landfarm 2 as-built design

3.2.1 Proximity of Surface Water

Landfarm 1 is located 300 m from the nearest water body, Third Portage Lake (TPL) and immediately adjacent to the North Cell Tailings Storage Facility (TSF). Surface drainage in this area is easterly, towards the TSF and away from TPL.

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

3.2.2 Proximity of Groundwater

In the Meadowbank area, the shallow groundwater is estimated to be 1.5 m below surface (active layer July – October), at the average depth of thaw. In order to prevent movement of contaminants from the landfarm facility into groundwater, Environment Canada (SAIC, 2006) recommends implementation of a barrier with 10^{-7} m/s hydraulic conductivity at a thickness of 0.6 m. The Meadowbank Landfarm 1 facility pad is constructed of 2.7 m of compacted till with a hydraulic conductivity of 10^{-7} m/s. The Landfarm 2 cell is constructed with a 0.5 m thick layer of compacted till base with hydraulic conductivity estimated of 10^{-7} m/s, over a constructed pad which varies between 6 m and 22.5 m in thickness. Therefore, no impacts to groundwater are anticipated.

3.3 Design

The landfarm facilities are designed with one soil remediation/storage cell. The design volumes of the cells are based on allowances for the materials to be treated. This calculation is described in the following section.

3.3.1 Soil Volume Requirements Landfarm 2

In September 2016, Landfarm 1 held a total of 1,258 m^3 of contaminated soil, based on survey results. Currently production will continue through 2018 for an expected additional required landfarm capacity of 692 m^3 (2 years x 346 m^3/year; average yearly amount of contaminated soil, from LDMP (Agnico, 2013)). With an additional 30% for contingency, and conservatively assuming that no soil will be remediated in Landfarm 1 in 2017 and before closure, the total estimated required capacity for landfarm 2 is 2,535 m^3.

3.3.2 Design Specifications

Specifications of the landfarm designs are shown in Figure 2 and 3. Landfarm 1 is constructed with a 1.5 m high berm and a 2.7 m deep compacted till base with hydraulic conductivity of 1×10^{-7} m/s. The slope of the base is 1.5%.

Landfarm 2 is constructed with a 2.5 m high berm and a 0.5 m thick compacted till base with hydraulic conductivity estimated of 10^{-7} m/s. The slope of the base is 3% towards the east side, and 7% towards the South Tailings Cell. The pad under the till layer on top of the tundra varies from 6 – 22.5 m thick.

For Landfarm 1, the useful landfarm area is 5,247 m^2, with the extension. The area of Landfarm 2 is 3,815 m^2. Based on landfarm specifications of other northern mines (Ekati Diamond Mine – in Golder, 2007a), 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. This will readily accommodate the estimated total of 2,535 m^3 of contaminated soil, should all of it need to be stored until closure. In addition, ample room will be available to accommodate a designated area for spreading of contaminated coarse-grained material that cannot be bioremediated (see Section 4.2.2).

Based on the available area, maximum windrow size will be 15 m wide at base x 4 m high x 50 m long, but smaller piles will be used as space allows maximizing rates of biodegradation and volatilization.

4 LANDFARM OPERATION AND MAINTENANCE

The following presents the operational procedures that apply to each landfarm facility.

4.1 Management Responsibility

Agnico Eagle will be responsible for managing and implementing the operation plan. Operation and monitoring of the facility will come under the responsibility of the Environment Superintendent. Designation of training requirements is the responsibility of Meadowbank Environment Department.

4.2 Acceptable Materials

4.2.1 Contaminants

The landfarm facility will only treat and/or store petroleum hydrocarbon contaminated soils that have been generated through mine-related activities at the Meadowbank Gold, Project Meadowbank exploration camp and the Amaruq Road. Material from other sites will not be accepted without approval from the Nunavut Water Board, AANDC Water Resources Officers and the Kivalliq Inuit Association.

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

In the event that the contaminant source is unknown, soil samples will be analyzed for petroleum hydrocarbons 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. Concentrations of contaminants will be compared to the site background values (for metals) and/or criteria in the GN Guidelines for Contaminated Site Remediation (March, 2009). If this analysis indicates soil contamination above background or GN guidelines with any substances not described in Section 4.2.1 (i.e. non-PHC contaminants), it will not be placed in the landfarm facility. This is to ensure PHC contaminated soil is not contaminated with other products.

Spills of > 100 L of non-PHC material (e.g. solvents, glycol) will be placed in drums and stored in the site Hazmat area for shipment south to approved facilities during barge season. Spills of non-PHC material < 100 L will be placed in the TSF.

4.2.2 Grain Size

While very coarse-grained larger soil material does not readily retain moisture and nutrients, inhibiting bioremediation, 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:surface area ratio, and can typically be screened out prior to landfarming (SAIC, 2006). A 2010 study at Meadowbank (Qikiqtaaluk Environmental, 2010) indicated increasing concentrations of PHC with decreasing grain size in one group of samples with soil fractions of 0.5, 0.5-1 and >1" (two other groups sampled were below detection at all grain sizes) (see Section 4.3.1).

4.3 Contaminated Soil Additions

4.3.1 Spill Excavation

Soil contaminated with the above-described petroleum hydrocarbon materials will be excavated from the source and transported to the landfarm facility in dump trucks or by roll- off containers. Care will be exercised to ensure that the entire spill is excavated (verified by visual assessment, by using a PID meter or sampling if necessary) and that none of the contaminated material is lost during transport.

4.3.2 Placement in the Landfarm

All material collected (coarse and fine) from spill locations will be deposited at the landfarm to be remediated.

A mechanical screener, used to separate coarse and fine material, will be operated to segregate material once in landfarm when conditions permit it.

4.4 Contaminated Snow

For spills < 100 L, PHC-contaminated snow will be placed in a designated area of the landfarm and treated as contact water after snowmelt.

For spills > 100 L, PHC-contaminated snow will be excavated and stored in labeled drums. After snow melt, the contaminated water will be pumped through the site's oil-water separator (carbon filter) to remove PHC residue. The treated water will be sampled per Part F, Item 7 of the Water License, and discharged to the Stormwater Management Pond if criteria are met. If criteria are not met, water will be treated as hazardous material and shipped south. Also, after snowmelt, visible product will be cleaned up with absorbent pads or booms.

4.5 Remediation

Remediation of fine-grained PHC-contaminated soil in landfarms occurs naturally through volatilization and aerobic microbial degradation. Soil aeration and nutrient amendment are recognized as methods of improving rates of remediation. To this end, remedial operations at the Meadowbank site include soil mixing (aeration) and a pilot project utilizing onsite nutrient additions. While it is recognized that pH, salinity, moisture content and microbial population density also contribute to rates of degradation, these factors will not be explicitly investigated or managed unless remediation rates are too slow to meet the site closure time period (see Section 5.2).

4.5.1 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. Used absorbent materials will be incinerated.

4.5.2 Aeration

In order to promote aerobic conditions throughout the windrows, soil will be mixed mechanically with earth-moving equipment. This turnover of soil piles will occur at least once per year, during the summer months. The presence of coarse material also helps creating gaps within the piles which will increase aeration and help degradation of PHC.

4.5.3 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 dry, 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, a freshwater supply will be used. If the windrows are saturated, aeration will be conducted at a later date.

4.5.4 Nutrient Amendment

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. For example, in a Resolution Island study by Paudyn et al. (2008), aeration alone reduced concentrations of diesel fuel by 80% over three summers, almost entirely due to volatilization (not biodegradation). One-time amendment with nutrients (C:N:P of 100:7.5:0.5) in combination with aeration resulted in 90% reduction of TPH concentrations over this time, with significant (but undefined) contributions from microbial degradation.

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. Attempts to sample all piles again in the fall of 2013 were unsuccessful because of frozen ground.

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 will be continued. Based on these results, the pilot project (comparison of treated and untreated piles) was completed and the addition of sewage sludge as a nutrient source to enhance bioremediation was implemented as an operational practice in 2014. Sewage sludge was incorporated into all contaminated soil since 2014.

The use of sewage sludge as a nutrient amendment has precedent in the north. This method has been used at Diavik Diamond Mine, as reported in the BSc thesis of Brenda Lee Bailey, Carleton University (in Golder, 2007). It was found in this study that with sewage sludge amendment (12.6 gallons on a 6 m^3 soil pile), aeration by perforated pipe and clear polyethylene covers to retain heat and moisture, TPH concentrations declined from 15,000 mg/kg to less than 2,000 mg/kg in 88 days. 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 adds organic matter to help retain moisture, and is a source of microorganisms. Furthermore, the re-use of this material produced onsite helps to reduce the waste footprint of the mine by re-directing this material from disposal facilities and avoiding the import of chemical fertilizer.

4.6 Removal of Soil from the Landfarm

When PHC vapors are no longer detected, coarse-grained material will be removed to the site waste rock disposal area and disposed of as potentially acid generating (PAG) material. PAG will be covered with a minimum of 2 m of non-potentially acid generating (NPAG) material to closure, such that freeze-back occurs and any potentially remaining contaminants are not mobile in the environment.

Prior to removal of the finer grained soil from the landfarm, soil samples will be analyzed to ensure they meet Government of Nunavut guidelines, as described below.

4.6.1 Remediation Guidelines

In assessing the remediation success of PHC contaminated soils being treated in the landfarm facility, Agnico Eagle will use the Government of Nunavut (GN) Department of Environment, Environmental Guidelines for Site Remediation (March, 2009) to determine if the soil has been suitably treated.

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

- Benzene, toluene, ethylbenzene and xylene (BTEX)
- Petroleum hydrocarbon fractions 1 - 4

GN remediation criteria are characterized for agricultural/wildland, residential/parkland, commercial and industrial land uses. At the Meadowbank site, remediation to agricultural/wildland criteria is targeted. However, if these criteria cannot be met efficiently, industrial criteria will be followed and soil disposed of accordingly (see Section 4.6.3). Remediation criteria for coarse-grained (>75 um) soils will be applied. Table 1 presents the applicable Tier 1 criteria for coarse-grained soil, assuming agricultural/wildland or industrial land uses. For contaminated sites, a Tier 1 analysis involves the most conservative criteria, and may be applied when the proponent does not wish to establish site-specific criteria.

Table 1 - Summary of relevant Government of Nunavut Tier 1 soil remediation criteria for surface soil for industrial land uses.

Parameter	Criteria (mg/kg)
Benzene	0.03
Toluene	0.37
Ethylbenzene	0.082
Xylene	11
PHC Fraction 1	320
PHC Fraction 2	260
PHC Fraction 3	1700
PHC Fraction 4	3300

4.6.2 Sampling and Analysis

Landfarm windrows will be sampled annually 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.

Degradation rates are assessed regularly to estimate the total remediation time required for PHC-contaminated soil under these conditions. If remediation to GN guidelines is feasible within the timeframe, landfarm operations will continue, with aeration and nutrient amendments as described above. If rates of TPH degradation are not sufficient through this method, alternate options will be further investigated (see Section 5).

4.6.3 Soil Removal

Coarse-grained material will be assessed after segregation from mechanical screening has been started, by Environment Department technicians for PHC product and odors. A PID monitor may be employed to assist in petroleum-hydrocarbon based vapor detection. When PHC vapors are no longer detected, this material will be removed to the Portage Rock Storage Facility (PRSF) and disposed of as PAG material.

When sample analysis of fine-grained material indicates that concentrations of contaminants are below Government of Nunavut 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 head-space with a portable instrument (e.g. flame ionization detector), but samples will be confirmed by an accredited laboratory prior to soil removal.

Soil remediated to agricultural/wildland criteria will be appropriately delineated by Environment Department staff, and stockpiled outside the landfarm for use in site works or reclamation activities.

Soil remediated to industrial-use criteria will be removed from the landfarm and placed in the (PRSF) as PAG material. This material will be capped with a minimum of 2 m of NPAG at closure, allowing freeze-back and permanent encapsulation to occur.

4.7 Water and Snow Management

Since the landfarm facility is uncovered to facilitate natural weathering, water accumulating inside the bermed area may come into contact with contaminated material. The management plan for handling this potentially contaminated water is described below.

4.7.1 Snow Management

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 (no less than 10 cm) in place. After 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 snow melt to minimize migration into the facility substrate.

4.7.2 Water Management

Monitoring will be conducted for seepage of contact water through the perimeter berm, or accumulation of water within the containment berm through visual inspection by the Environment Department. This will be conducted on a weekly basis, after freshet, from July through October when water is likely to be present. In the event of water accumulation or seepage, the ponded water will be analyzed for Group 4 monitoring parameters, as described in Table 2 – Monitoring programs of the Water License prior to discharge to the adjacent Tailings Storage Facility (monitoring stations ST-14 and ST-14b). Alternatively, ponded water will be sprayed on the windrows to increase moisture content, as required. Water accumulating in the landfarm will not be discharged to the environment as per Part F, Item 18 of the water license.

4.8 Landfarm Abandonment

After removal of all remediated soil and prior to abandonment/closure of the landfarm, the berm and base will be sampled on a 10 m grid, including at a depth of 1 m in representative locations, to determine if these soils are free from PHC contamination. Results of this analysis will be compared to GN criteria. Since this area will form part of the TSF at closure, no excavation is necessary if industrial criteria are not met. Agnico Eagle's Closure Plan notes that the tailings facilities will be capped with at least 2 m of NPAG to ensure freeze-back encapsulation. Monitoring of tailings freeze-back is ongoing at the site, and to date the results indicate that tailings are already freezing as planned.

4.9 Summary of Activities

A summary of landfarm activities including monitoring of the physical condition and potential environmental impacts of the landfarm facility is provided in Table 2. A report will be prepared annually, indicating the volume of material added to the facility, amount of material removed and 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 Annual Report to the NWB.

Table 2 - Summary of landfarm activities and records to be kept.

Activity	Analysis	Frequency	Record
Excavation of spill and transport of contaminated material	If unsure of full excavation - F1-F4, BTEX	As needed	Date and time of excavation; estimated quantity of excavated soil; storage/disposal location of excavated soil, if applicable; any evidence of remaining product
Contaminated soil additions to landfarm	If contaminant source unknown, F1-F4, BTEX, metals, oil and grease, VOCs (at discretion of Environment Department)	Prior to soil addition at facility	Date and time; quantity of soil; original location; landfarm location; spill/excavation record # or storage container label
Soil aeration	N/A	Min. once during summer	Date and time; location; soil condition (moisture, odour, 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; location in landfarm
Ponded contact water	BTEX, oil and grease, lead – as per Part F, Item 6 of Water License	Prior to any dewatering; if re-used in landfarm, no sampling necessary	Date and time, location, laboratory report, Annual Report
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	N/A	Date and time; location; quantity of soil removed; final location
Identification of maintenance requirements	Visual inspection of facility	Twice annually during summer	Inspected areas; condition of berm and base; previously unidentified safety concerns

5 CONTINGENCY OPTIONS

The following sections describe the contaminated soil management plan, should a large spill event occur, and if landfarm treatment is not successful.

5.1 Large Spill Event

Considering that the landfarm is built to hold nearly 5x as much contaminated soil as is expected to be produced, a large spill event producing a quantity of soil that cannot be contained in the landfarm is unlikely. Nevertheless, in this event, soils will be placed in a temporary storage area. A temporary stockpile area would be set up in the PRSF or at another location as approved by the NWB and AANDC. The soil would then be placed in the landfarm as soon as practical. Through extensive spill prevention measures discussed earlier in this Plan Agnico Eagle is minimizing the probability of this scenario occurring.

5.2 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 period (to 2025) 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.

5.2.1 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 (see SAIC, 2006). In addition, the height of soil windrows could be reduced to maximize air exposure if space in the facility allows.

5.2.2 Tier 2 – Modified Criteria Approach

According to the Government of Nunavut Environmental Guideline for Contaminated Site Remediation (Appendix A), 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. In the case of the Meadowbank site, landfarmed soils are to be encapsulated in the PRSF 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.

5.2.3 Thermal Desorption

In the thermal desorption process, excavated soils are heated in a chamber to rapidly volatilize PHCs. Gases produced are consumed in an oxidation unit, and particulate matter removed (baghouse). Soil, free of any contamination, can then be replaced, or used in site reclamation or construction processes. The other advantage of this approach is that this equipment is mobile and could be brought to any spill site for remediation activities (e.g. spills along the AWAR). This method is described by Environment Canada (2002). The purchase or rental of a portable thermal desorber unit is under consideration by Agnico Eagle as a contingency option.

5.2.4 Direct Placement in the TSF or PRSF

Another option for management of contaminated soil would be the direct placement of this material in the Tailings Storage Facility or Waste Rock Storage Facility, if bioremediation is not effective or for operational reasons. Although the consumption of space in these storage areas is not optimal, the quantity of PHC-contaminated soil created onsite is small in comparison to the quantity of tailings or waste rock. 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. The final cover with NPAG will be a minimum of 2 m deep (current closure plan is 4 m of NPAG cover). Total 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 Meadowbank Closure Plan.

6 PLAN REVIEW AND CONTINUAL IMPROVEMENT

The Landfarm Design and Management Plan will be reviewed regularly by the Meadowbank Environmental Superintendent, and updated, when needed.

REFERENCES

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.

Environment Canada. 2002. Technical Assistance Bulletin 13: Soil Remediation: Low Temperature Thermal Desorption Available at: http://www.on.ec.gc.ca/pollution/ecnpd/tabs/tab13-e.html

Environment Canada. 2007. Part 4 screening for Land Farm, Hamlet of Pond Inlet – NIRB 07UN061. Technical advice. Available at: http://ftp.nirb.ca/01-SCREENINGS/COMPLETED%20SCREENINGS/2007/07UN061-GN-CGS%20-%20Pond%20Inlet%20Quarry/02-DISTRIBUTION/COMMENTS/070829-07UN061-EC%20Comment-IEAE.pdf

Golder (Golder Associates Ltd). 2007a. Technical Memorandum: Landfarm Option Analysis, Meadowbank Gold Project, Nunavut. Prepared for: Agnico-Eagle Mines Ltd. August 23, 2007.

Golder (Golder Associates Ltd.), 2007b. Final Report on Pit Slope Design Criteria for Portage and Goose Island Deposits, Meadowbank Gold Project Nunavut, Project 06-1413-089/5000, Doc. No. 449, Revision 0, submitted to Meadowbank Mining Corporation, dated April 5, 2007.

MMC (Meadowbank Mining Corporation), 2007. Meadowbank Gold Project Mine Waste and Water Management. August 2007.

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 #: