TETRA TECH

Design Report for Landfarm, Meliadine Gold Project

PRESENTED TO

Agnico Eagle Mines Limited

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EXECUTIVE SUMMARY

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Gold Project (the project). The mine is located approximately 25 km north from Rankin Inlet, Nunavut. Agnico Eagle retained Tetra Tech Canada Inc. (Tetra Tech) to conduct a detail design of a landfarm for the Project.

This report summarizes the site conditions, design basis, considerations, and criteria and presents the detailed design of the landfarm, including construction drawings and material quantities. Key considerations for the landfarm operation and monitoring are also discussed in this report.

The project site is located within the Southern Arctic terrestrial eco-zone in a zone of continuous permafrost. Continuous permafrost to depths between 360 m to 495 m are expected at this site. Typical permafrost ground temperatures at the depths of zero annual amplitude (typically at a depth below 15 m) are in the range of -5.0°C to -7.5°C in the areas away from lakes and streams.

On-site storage and remediation has been established as the preferred method for treatment of light petroleum hydrocarbon contaminated (PHC) soils and snow/ice that may be generated at the site during pre-production construction and operation of the proposed Meliadine mine. The landfarm is designed to receive soils, rock, snow, and ice contaminated with petroleum hydrocarbons and antifreeze. This will include light hydrocarbons such as diesel and gasoline, and also antifreeze, being treated in the landfarm.

The original ground in the proposed landfarm location has a gentle slope of approximately 3%, is well drained, and has a small local catchment area, which is within the overall catchment area of the main water collection pond (CP1) at the site. This location is suitable for the proposed landfarm.

The landfarm is designed to have an engineered rockfill pad and perimeter berms with a geomembrane liner system. A sump area is designated for internal water management of the landfarm. The sump area will temporarily store the runoff water from snowmelt and rainfall events before the water is pumped to an oil separator for removal of excess oil. The treated water from the oil separator will be pumped to CP1.

A PHC snow/ice storage area is designated in the landfarm basin to temporarily store PHC snow/ice collected in each winter season. The snow/ice will thaw in the following spring and summer each year.

The maximum design treatment/remediation time for the PHC soils to meet the treatment criteria is assumed to be three years. The soils that have been temporarily stored at the site before the start of the landfarm operation will be placed in the initial PHC soil placement zone covering the majority of the inside landfarm basin, except for the sump area. This layer will serve as a base and may remain in the landfarm until the late stages of the landfarm operation. The new annual PHC soils after 2017 will be placed in one of three soil treatment zones (A, B, and C) over the initial PHC soil placement zone. The maximum soil lift thickness in each of the three soil treatment zones will be approximately 0.5 m.

Regular soil testing and sampling of the landfarmed soils will be conducted to monitor the remediation conditions and verify that the soils meet remediation objectives during and at the end of the working season. The environmental staff will advise of the remedial action for the landfarm if the remediation conditions need to be improved.

A quality control/quality assurance (QA/QC) program is required during construction of the landfarm to ensure that construction-sensitive features of the design are achieved. The landfarm geotechnical performance should be regularly monitored during the landfarm operation with an annual geotechnical site inspection by the Designer or a qualified geotechnical engineer.

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Agnico Eagle Mines Limited and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Agnico Eagle Mines Limited, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech Canada Inc.'s Services Agreement. Tetra Tech's General Conditions are provided in Appendix C of this report.

1.0 INTRODUCTION

Agnico Eagle Mines Limited (Agnico Eagle) is developing the Meliadine Gold Project (the project). The mine is located approximately 25 km north from Rankin Inlet, Nunavut. Situated on the western shore of Hudson Bay, the proposed project site is located on the peninsula between the east, south, and west basins of Meliadine Lake (63°01'23.8"N, 92°13'6.42"W). A general location plan for the project is shown on Drawing 65-696-230-200 in Appendix A.

The current project focuses on the development of the Tiriganiaq gold deposit which will be mined using conventional open-pit and underground mining operations. A new Type “A” Water Licence (No. 2AM-MEL1631) was awarded in 2016 to Agnico Eagle for the development of the project.

Agnico Eagle retained Tetra Tech Canada Inc. (Tetra Tech) to undertake the following tasks associated with the landfarm:

- Conduct the detailed design of the landfarm to produce construction drawings; and
- Prepare the design report for the landfarm, in accordance with the requirements in Part D of the Type “A” Water Licence (No. 2AM-MEL1631).

This report summarizes the site conditions, design basis, considerations, and criteria, and presents the detailed design of the landfarm. In addition, construction related items including construction drawings for the landfarm are presented. Key considerations for landfarm operation and monitoring are also discussed in this report.

This report is prepared to meet the requirements in the Type “A” Water Licence No. 2AM-MEL1631 – Agnico Eagle Mines Limited for the Meliadine Gold Project (Part D, item 2).

2.0 GENERAL SITE CONDITIONS

2.1 Climate and Meteorology

The project site lies within the Southern Arctic Climatic Region where daylight reaches a minimum of 4 hours per day in winter and a maximum of 20 hours per day in summer. The nearest weather station is Rankin Inlet A (Station 2303401), located approximately 25 km south of the project site. The closest long-term regional evaporation station operated by Environment Canada is in Churchill, Manitoba. The monthly mean air temperature is typically above 0°C for the months of June to September, and is below 0°C between October and May. July is typically the warmest month and January the coldest. Winters are typically long and cold, while summers are short and cool. Spring and autumn are short. The mean annual temperature for the period of record from 1981 to 2009 was -10.4°C.

The total annual average precipitation at the project site is 405 mm/year, presents almost equally as snow and rainfall (Golder 2013). Average annual evaporation for small waterbodies in the project area is estimated to be 323 mm between June and September. The average annual loss of snowpack to sublimation and snow redistribution is estimated to vary between 46% and 52% of the total precipitation for the winter period and occurs between October and May (Golder 2013).

The region is known for high winds, which are due in part to the broad, flat, uninterrupted landscape offered to moving air masses. The wind blows from the north and north-northwest direction more than 30% of the time. The mean values for wind speed show that the north-northwest, together with north and northwest winds, have the highest speeds and tend to be the strongest. Mean monthly wind speeds are typically between 19 km/hour and 27 km/hour.

The climate in the project region is projected to be warmer for the 2020s, 2050s, and 2080s time horizons when compared to the observed historic values (Agnico Eagle and Golder 2014). Precipitation shows an increase compared to historical values, but the majority of projections are not significantly different from the annual recorded precipitation values.

2.2 Topography and Lakes

The dominant terrain in the project area comprises glacial landforms such as drumlins (glacial till), eskers (gravel and sand), and lakes. A series of low relief ridges are composed of glacial deposits, oriented in a northwest-southeast direction, which control the regional surface drainage patterns. The property is about 60 metres above sea level (masl) in low-lying topography with numerous lakes. Surface waters are usually frozen by early October and remain frozen until early June.

The surveyed lake surface elevations in the project area range from about 51 masl at Meliadine Lake to about 74 masl for local small perched lakes. Lakes formed by glaciofluvial processes or glacial processes, are common throughout the project area. Most of the perched lakes at the project site are relatively shallow (less than 2 m water depth). Late-winter ice thicknesses on freshwater lakes in the project area range between 1.0 m and 2.3 m with an average thickness of 1.7 m. Ice cover usually appears by the end of October and is completely formed in early November. The spring freshet typically begins in mid-June and is complete by early July (Golder 2012a).

2.3 Permafrost

The project site is located within the Southern Arctic terrestrial eco-zone, one of the coldest and driest regions of Canada, in a zone of continuous permafrost. Continuous permafrost to depths of between 360 m to 495 m is expected based on historical and recent ground temperature data from thermistors installed near Tiriganiaq, F-Zone, and Discovery deposits (Golder 2012b). The measured ground temperature data indicates that the active layer is 1.0 m to 3.0 m in areas of shallow soils and areas away from the influence of lakes. It is anticipated that the active layer adjacent to lakes or below a body of moving water such as a stream could be deeper. The typical permafrost ground temperatures at the depths of zero annual amplitude (typically at a depth of below 15 m) are in the range of -5.0°C to -7.5°C in the areas away from lakes and streams. The geothermal gradient ranges from 0.012 C°/m to 0.02 C°/m (Golder 2012b).

2.4 Groundwater

In areas of continuous permafrost, there are generally two groundwater flow regimes: a shallow groundwater flow regime located in the active layer near the ground surface, and a deep groundwater flow regime located beneath permafrost. From late spring to early autumn, when temperatures are above 0˚C, the active layer thaws. Within the active layer, the water table is expected to be a subdued replica of topography, and is expected to parallel the topographic surface. The project area groundwater in the active layer flows to local depressions and ponds that drain to larger lakes.

The permafrost in the rock in the project area is generally assumed to be impermeable to groundwater flow. The shallow groundwater flow regime, therefore, has little to no hydraulic connection with the deep groundwater regime.

2.5 Subsurface Conditions

A number of site investigation programs were carried out at the project site in 1998, 1999, 2007, 2009, 2011, 2012, 2013, 2014, 2015, and 2016.

In general, the near surface stratigraphy comprises a veneer of organic material, underlain by non-cohesive soils (i.e. silty sand and sandy silt) with cobbles and boulders. The overburden thickness ranges between 1.5 m and 17.8 m and is underlain by greywacke, medium to strong with some fracturing and frost jacking of the upper bedrock surface. A layer of ice-rich overburden (silt or sand) has been observed in some of the drilled boreholes. Overburden soils with excess ice (Vc, Vs, Vx, and Vr) were observed in most of the boreholes. Massive icy beds up to 1.25 m thick were also encountered. The estimated percentage (by volume) of the excess visible ice ranged from 2% to more than 50% in the overburden soils. Limited soil porewater salinity tests (EBA 2013) indicated that the overburden soils may have a porewater salinity of up to 4 parts per thousand (ppt) for shallow sandy soils, up to 7 ppt for shallow silty soils, and up to 12 ppt for deep silty soils.

2.6 Seismic Zone

The project site is situated in an area of low seismic risk. The peak ground acceleration (PGA) for the area was estimated from the 2015 National Building Code of Canada seismic hazard website (http://earthquakesscanada.nrcan.gc.ca). The estimated PGA is 0.022 g for a 5% in 50-year probability of exceedance (0.001 per annum or 1 in 1,000 year return) and 0.037 g for a 2% in 50-year probability of exceedance (0.000404 per annum or 1 in 2,475 year return) for the area.

2.7 Other Relevant Data

The raw land survey data, a 1-m contour digital map of the ground surface and 0.5 m contour lake bathymetric data for selected lakes at the project site were provided to Tetra Tech by Agnico Eagle. Survey data for selected areas were recently provided to Tetra Tech and were incorporated into the original digital map for the design in this Project.

3.0 DESIGN BASIS

3.1 Landfarm Management Plan

Agnico Eagle (2015b) presented the landfarm management plan for the Meliadine Project and it formed a component of the documentation series produced for the Type "A" Water Licence application. The plan described the preliminary design basis and operational procedures for the landfarm to be constructed for the storage and treatment of petroleum hydrocarbon contaminated (PHC) soils and snow/ice.

Landfarming is a bioremediation process that uses naturally-occurring microorganisms, predominantly aerobic microbes, to metabolize (breakdown) petroleum hydrocarbons in the PHC soils in aerobic conditions. End products of bioremediation are microorganism protein, carbon dioxide, and water. Stimulation of microbial growth and activity for hydrocarbon removal is accomplished primarily through the addition of air through tilling and addition of nutrients.

Although rates of biodegradation decline with temperature, landfarming is still a feasible technique in Arctic climates as demonstrated by the Meadowbank landfarm (Agnico Eagle 2015b). Although a few petroleum hydrocarbon-degradable micro-organisms have been found to be active at temperatures below 0°C, most biodegradation occurs above freezing. Research has shown appreciable biodegradation may occur after one summer season, additional biodegradation over a second season is usually required. Biodegradation in the north is typically restricted to the relatively warmer months of June to September (even though bioremediation nearly ceases below -5°C, volatilization of the petroleum hydrocarbons does continue but at a slower rate). Nevertheless, degradation was reported at 90% over two summers on Resolution Island (Paudyn et al. 2008).

On-site storage and remediation has been established as the preferred method for treatment of light PHC soils and snow/ice that may be generated on the site during pre-production construction and operation of the proposed Meliadine mine. The landfarm is designed to receive soils, rock, snow, and ice contaminated with petroleum hydrocarbons and antifreeze. This will include light hydrocarbons such as diesel and gasoline, and also antifreeze (Agnico Eagle 2015b).

3.2 Estimated Volume of Materials to be Treated in the Landfarm

The estimated volumes of the PHC soils and snow/ice to be treated in the landfarm are as the following:

- The volume of the existing PHC soils stored at the site was approximately 1,100 m^3 by June 2017 (provided by Agnico Eagle on June 19, 2017). The stored PHC soils will be transferred to the landfarm upon its completion and commissioning.
- The estimated annual volume of the PHC soils is up to 350 m^3 (Agnico Eagle 2015b).
- The estimated annual volume of PHC snow/ice is up to 500 m^3 (Agnico Eagle 2015b).

It is expected that the PHC soils at the Project site will generally include sandy silt, silty sand, sand/gravel with trace to some silts, and rockfill.

3.3 Location of Proposed Landfarm

The preliminary landfarm location that was initially proposed in Agnico Eagle (2015b) was located just to the east of the Industrial Site pad, approximately 250 metres from Collection Pond 1 (CP1).

With the progress of detail design and construction of the Industrial Site pad in 2016, it was found that the original landfarm location would conflict with the expanded Industrial Site pad. As a result, Agnico Eagle decided to relocate the landfarm to a new location, as shown on Drawing 65-696-230-200 in Appendix A. The new location is approximately 280 m southeast of the original one and is closer to CP1.

3.4 Geotechnical Conditions in the Proposed Landfarm Area

The nearest borehole to the proposed landfarm location is GT14-29, which was drilled during the 2014 site investigation (Tetra Tech EBA 2014), is approximately 70 m from the nearest edge of the proposed landfarm. The location of GT14-29 is presented in Drawing 65-696-230-201 in Appendix A. The borehole logs indicate that the overburden thickness was 9.6 m with 0.3 m peat, 3.9 m silty sand, and 5.3 m silt and sand followed by strong greywacke bedrock. The upper (up to 1.2 m below the ground surface) overburden soils below the peat layer were generally ice-poor to slightly ice-rich with an excess ice content (by volume) of up to 10% and a moisture content of 16%. The silty sand around the depth of 1.5 m below the ground surface has an excess ice content (by volume) of up to 20% and a moisture content of 36%. The soils below the depth of 3 m from the ground surface were generally well-ice-bonded without excess ice.

3.5 Parameters for Precipitation and Surface Runoff

Various parameters for surface runoff estimation used in the landfarm design are presented in Table 3.1. These parameters are adopted from Appendix B of the Water Management Plan (Agnico Eagle 2015a).

Table 3.1: Various Parameters for Surface Runoff Estimation

Item	Value
Estimated snow melt water equivalent during a 1 in 2 return (mean) spring freshet	103 mm
Annual net runoff on disturbed land surface for a mean (1 in 2 return) precipitation year	251 mm (133 mm in June, 36 mm in July, 43 mm in August, 31 mm in September, and 8 mm in October)
Estimated snow melt water equivalent during a 1 in 100 return wet year spring freshet	171 mm
Annual net runoff on disturbed land surface for a 1 in 100 return wet precipitation year	466 mm (219 mm in June, 69 mm in July, 91 mm in August, 68 mm in September, and 19 mm in October)
Precipitation for a mean (1 in 2 return) 24-hour duration rainfall event	33 mm
Precipitation for a 1 in 100 return wet 24-hour duration extreme rainfall event	65 mm

3.6 Construction and Operation Schedules and Assumptions

The following construction and operation schedules are assumed for the design of the landfarm:

- Start construction in mid-August 2017;
- Complete the liner installation by the end of November 2017;
- Complete the remaining fill placement by mid-December 2017;
- Start operation by the end of 2017; and
- Decommission and close the landfarm, when it is no longer needed.

The primary activities at the landfarm during the period of operation will include the following:

- Receive and treat the soils/rock and snow/ice that are contaminated with petroleum hydrocarbons and antifreeze during pre-production and mine operation;
- Regularly remove the treated soils/rock from the landfarm and place them into the operation landfill as an interim cover or into waste rock storage facilities; and
- On an as-needed basis, regularly pump the runoff water collected in the landfarm sump to the landfarm oil separator for oil removal before the water is discharged to CP1.

3.7 Construction Materials

The construction materials for the landfarm will include the following:

- Run-of-mine Rockfill (sourced from the waste rock from mine development);

- Transition Rockfill (processed from the waste rock from mine development);
- Granular Fill (processed from the waste rock from mine development or natural eskers);
- Geotextile; and
- Geomembrane Liner.

A baseline geochemical characterization program for the project was initiated in 2008 and consisted of static and kinetic testing methods to assess the chemical composition of the mine waste and overburden, its potential to generate acid rock drainage and its potential for metal leaching (ML) upon exposure to ambient conditions.

Golder (2012c) documented the waste geochemical characterization programs carried out from 1998 to 2011 for the project. The key findings included the following:

- The waste rock from the Tiriganiaq deposit area is considered to be non-potentially acid generating (NAG) and has a low potential for ML. Kinetic tests at various scales indicate that drainage water quality will meet Metal Mining Effluent Regulations (MMER) monthly mean effluent limits.
- The overburden at the site will be NAG, and that leachate concentrations are generally lower than waste rock and will meet MMER monthly mean effluent limits. Waste rock and overburden have compatible geochemical characteristics such that these materials can be managed together in the same disposal facilities.

Therefore, the waste rock from the mine development, fill materials sourced from the rock, and overburden materials will be NAG and have low potential of ML.

4.0 DESIGN OF LANDFARM

4.1 Key Design Considerations

The landfarm is designed based on the following key considerations:

- The landfarm will have a raised base with perimeter containment berms, constructed over the original ground with no or minimum excavation to avoid disturbing the permafrost foundation. Removal of surficial organics/peat layer is only required to reduce potential excess thaw settlement if the organics/peat layer is frozen when the overlying fill is placed during construction.
- A geomembrane liner system will be enclosed in the landfarm base and perimeter berms to contain drainage/ leachate and runoff water from the PHC soils and thawing snow/ice in the landfarm.
- The landfarm base will have a gentle slope, generally parallel to the original ground surface, which has a slope of approximately 3%. This will lessen construction material volumes and promote natural drainage towards the lower portion of the landfarm.
- A sump area will be located in the lower portion of the landfarm to temporarily collect the drainage/leachate and runoff water. A low filter berm around the sump area will be constructed to help reduce soil particles in the water flowing into the sump area.
- A pumping station with an oil separator will be installed on a pad close to the landfarm. The water in the landfarm sump will be pumped to the oil separator, on an as needed basis, to remove the oil products in the water. The treated water will then be pumped to CP1. The landfarm sump will be emptied by the end of each pumping season before winter shut-down.

- A dedicated zone for temporary storage of the PHC snow/ice during each winter period will be located in the lower portion of the landfarm close to the sump area, without blocking the natural drainage within the landfarm.
- A pad around the entrance to the landfarm will serve as an unloading zone for the PHC soils and snow/ice to avoid heavy equipment traffic over the area with the geomembrane liner system. A shovel or dozer (like a Komatsu 300 or CAT D8) with relatively low ground pressure will move the materials from the unloading area into the landfarm.
- Upon landfarm start-up, all PHC soils that are temporarily stored at the site will be transferred and uniformly spread over the majority of the inside base of the landfarm, except for the sump and nearby areas. This initial layer of PHC soils will serve as a base for future lifts of incoming PHC soils. The initial layer could remain in the landfarm for more than three years until the soils meet the treatment requirements for removal.
- The PHC soils/rock will be typically treated for three years in the landfarm. After three years, the treated soils/rock will meet the treatment criteria and can be removed from the landfarm to provide space for the PHC soils/rock for a future year. The remediation/treatment rate of the PHC soils/rock can be adjusted during the landfarm operation to meet the targeted three-year treatment schedule.
- Three soil treatment zones (A, B, and C) will be identified in the landfarm. Each treatment zone will store and treat the PHC soils that are received for a given year. The soils in each of the zones will remain in the landfarm for up to three treatment years, after which the soil should meet the treatment criteria and will be removed at the start of the fourth year. This also permits additional PHC soils to be placed in the landfarm for treatment on a yearly basis. This cycle repeats until no PHC soils need to be treated in the landfarm.

4.2 Plan Layout, Sections, and Key Parameters

The Landfarm design drawings are presented in Appendix A. Drawings 65-696-230-200 and 65-696-230-201 show the landfarm location and layout plans. Drawings 65-696-230-202 to 205 present the landfarm typical design section and six sections through the landfarm. Table 4.1 summarizes the key design parameters for the landfarm.

Table 4.1: Key Design Parameters for Landfarm

Parameter	Value
Side Slopes of Perimeter Berms	2.5(H):1(V)
Typical Berm Crest Width	4 m
Berm Height	2.1 m (min.) to 7.2 m (max.)
Berm Crest Elevation	75.15 m
Geomembrane Liner Crest Elevation	74.85 m
Inside Base Surface Slope	3%
Minimum Fill Thickness above Original Ground for Inside Base	1.75 m (with 1.60 m for the sump bottom area)
Inside Base Surface Area including Sump Area	3,870 m^2
Sump Surface Area	200 m^2
Landfarm Footprint Area	10,150 m^2

4.3 Sump Design for Water Management

The sump area is designed to collect leachate/drainage and runoff from the PHC soils during landfarm operation. The water collected in the sump will be regularly pumped to the oil separator for oil removal before being discharged into CP1. During annual spring freshet or a heavy rainfall event, the water level in the landfarm could temporarily rise to a water elevation higher than the top elevation of the filter berm surrounding the sump area. This is allowed to avoid over-design of the sump. Under unfavorable operation conditions when no water is pumped out of the sump area during a spring freshet, the estimated maximum water elevation in the landfarm sump area is 73.82 m during a mean spring freshet and 74.05 m during a 1 in 100 return wet spring freshet. These water elevations are below the ultimate design water elevation of 74.35 m, which is 0.5 m lower than the geomembrane liner crest design elevation of 74.85 m. The key parameters for the landfarm internal water management are summarized in Table 4.2.

Table 4.2: Key Design Parameters for Landfarm Internal Water Management

Parameter	Value
Landfarm Internal Catchment Area	5,570 m^2
Designed Maximum Temporary Water Elevation in Landfarm during Spring Freshet or a Heavy Rainfall Event	74.35 m
Net Water Storage Capacity in Landfarm at Water Elevation of 74.35 m (with full placement of PHC soils)	2,144 m^3
Typical Operating Water Elevation in Sump	72.78 m
Net Water Storage Capacity in Landfarm at Water Elevation of 72.78 m	102 m^3
Crest Elevation of Filter Berm Surrounding Sump	73.35 m
Net Water Storage Capacity in Landfarm at Water Elevation of 73.35 m	474 m^3
Estimated Total Volume of Runoff Water in Landfarm during a Mean Spring Freshet (including 500 m^3 of water from melting PHC snow/ice in each winter)	1,074 m^3
Estimated Total Volume of Runoff Water in Landfarm during a 1 in 100 Return Wet Spring Freshet (including 500 m^3 of water from melting PHC snow/ice in each winter)	1,452 m^3
Estimated Total Volume of Runoff Water in Landfarm during a 1 in 100 Return Wet Extreme 24-hour Rainfall Event	362 m^3
Estimated Total Volume of Runoff Water in Landfarm during a Mean (1 in 2 Return) 24-hour Rainfall Event	184 m^3
Design Pump Rate for Pumping Water from Landfarm Sump Area to Oil Separator	136 m^3/day

4.4 Thermal Evaluation

Permafrost is expected to exist beneath the footprint of the landfarm. The thermal design intent for the landfarm is to maintain the active layer (annual thawing and freezing layer) within the top portion (approximately 1.2 m) of the original ground active layer, where overburden soils are generally ice poor, for the footprint area beneath the landfarm geomembrane liner system.

A simple one-dimensional thermal analysis was conducted to estimate the maximum thaw depth below the original ground surface into the overburden soils during the landfarm operation. Both mean climatic conditions and extreme warm years (1 in 100 return event) were evaluated. The potential air temperature increase due to climate change was not evaluated due to the relatively short period of landfarm operation. Past thermal analyses that were conducted for other earth structures at the Meliadine Project indicated that the estimated air temperatures for a 1 in 100 return warm year are warmer than those incorporating climate change scenarios for a short operation life. The thermal analysis results indicate the following key findings:

- The unfrozen overburden soils within the original active layer will freeze back in the winter period following the landfarm construction in late 2017;
- The estimated thaw depth below the original ground surface for the landfarm footprint area beneath the geomembrane liner system is no greater than 0.7 m under mean climatic conditions during normal landfarm operation; and
- The estimated thaw depth below the original ground surface is no greater than 0.9 m under two consecutive 1 in 100 warm years.

The findings suggest that the landfarm thermal design intent can be met.

4.5 Stability Evaluation

The side slopes of 2.5(H):1(V) for the landfarm perimeter berms were adopted based on past experience and supported by preliminary limit equilibrium slope stability analyses on a typical section. The analyses evaluated several scenarios including short-term construction and long-term operation (both static and seismic loading conditions).

To ensure reasonable safety of earthworks, a safety factor is usually introduced in geotechnical stability analyses. Generally, the selection of a design factor of safety for an earth structure depends on the importance of the structure, potential failure consequences, and uncertainties involved in design loads and soil parameters. The minimum design factors of safety adopted for the landfarm are presented in Table 4.3.

Table 4.3: Design Minimum Factors of Safety for Landfarm

Loading Conditions	Minimum Factor of Safety
Static loading, short-term, end of construction	1.3
Static loading, long-term, normal operating	1.3 for shallow slip; 1.5 for deep-seated slip
Seismic loading (pseudo-static), long-term, normal operating	1.1

The calculated minimum factors of safety for the landfarm perimeter berms meet or exceed the adopted minimum factors of safety.

4.6 Seepage Evaluation

Potential leakage through the geomembrane liner, in the event of damage including small holes in parts of the liner, was estimated based on some literature publications. The leakage rate through the liner will depend on how many holes exist in the liner, damaged area per hole, water head, and bedding material hydraulic conductivities. Based on typical ranges of these parameters assumed for a properly installed liner system with a quality control and quality assurance program, the calculated potential leakage rate through the liner system in the landfarm ranges from 0.5 m^3/day (at a water elevation of 72.5 m in the sump or an average water depth of approximately 0.2 m in the sump) and 3 m^3/day (at the ultimate design water elevation of 74.35 m in the lower portion of the landfarm inside basin). Since the water in the sump will be regularly pumped to the oil separator for treatment, the water elevation will be low during the majority of the sump operation in summer. It is expected that no leakage will occur during the winter period when the sump is empty and soils above the liner are frozen. Therefore, the overall quantity of the potential leakage through the liner system will be low.

Any potential leakage from the landfarm will naturally flow into CP1 since the landfarm is within the natural catchment boundary of CP1. If the leakage water is noticeable and collectable during landfarm operation, when required after water quality assessment, the leakage water can be collected and either pumped back to the landfarm sump or to the oil-separator directly for oil removal.

4.7 Deformation Considerations

The majority of potential deformations of the rockfill used for landfarm construction are expected to occur during the construction stage. The landfarm will be constructed in late summer and fall 2017 when the foundation soils in the annual active layer are unfrozen. With placement of the overlying rockfill, the majority of deformations in the unfrozen foundation soils will occur during the construction stage.

During landfarm operation, the maximum thaw depth into the top original foundation soils for the footprint area beneath the geomembrane liner system has been estimated to be between 0.3 m and 0.9 m, which is less than the 1.2 m thickness of the surface overburden soils that are generally ice-poor. Therefore, thaw-induced settlement of the original foundation soils will be minimal.

The original foundation soils at depths from 1.5 m to 3.0 m could be ice-rich. Creep-induced deformations may occur in the ice-rich soils under shear loading. Based on the site conditions and landfarm design geometry, it is expected that limited creep-induced deformations may occur in the outside slopes of the landfarm perimeter berms, which are away from the internal geomembrane liner system. Therefore, the deformations would have little detrimental effects on the geomembrane liner system.

5.0 CONSTRUCTION OF LANDFARM

5.1 Construction Materials and Estimated Quantities

The landfarm drawings for construction are presented in Appendix A. The general considerations of the construction materials for the landfarm are presented in Section 3.7 of this report.

Table 5.1 presents the estimated in-place quantities of the construction materials for the landfarm.

Table 5.1: Estimated In-Place Material Quantities for Construction of Landfarm

Item	Estimated In-Place Quantity after Compaction and Installation	Material Source and Key Specifications
Type A: Run-of-Mine Rockfill (600 mm minus)	19,078 m^3 (see Note 1) or 19,966 m^3(see Note 2)	To be sourced from run-of-mine rock stockpiles or mine operation; maximum particle size of 600 mm.

Table 5.1: Estimated In-Place Material Quantities for Construction of Landfarm

Item	Estimated In-Place Quantity after Compaction and Installation	Material Source and Key Specifications
Type B: Transition Rockfill (150 mm minus)	3,580 m^3	To be processed from the rock stockpiles or other sources approved by the Design Engineer and the Owner; maximum particle size of 150 mm.
Type C: Granular Fill or Esker Sand (20 mm minus)	2,696 m^3	To be processed from the rock stockpiles or other sources approved by the Design Engineer and the Owner; maximum particle size of 20 mm; fines (<0.08 mm) content of 4 to 10%.
HDPE Geomembrane Liner	5,808 m^2	Double sided textured HDPE with a minimum average thickness of 1.5 mm; to be ordered by Agnico Eagle.
Nonwoven Geotextile	11,616 m^2	Needle punch polypropylene nonwoven geotextile with a typical unit weight of 540 g/m^2; to be ordered by Agnico Eagle.
Organics/Peat Layer Excavation (if frozen during construction)	1,775 m^3 (see Note 2)	Frozen organics or peat material.

Note 1: Type A material is assumed to be directly placed over unfrozen organics/peat layer with an assumed settlement of approximately 0.15 m; and

Note 2: Type A material is assumed to be placed after excavation and removal of frozen organics/peat layer with an assumed average thickness of 0.3 m.

It should be noted that the actual quantities could be different from those estimated due to the following reasons:

- The actual settlement of the unfrozen organics/peat layer could be different than assumed;
- The actual thickness of the frozen organics/peat layer could be different than assumed; and
- Field observations during construction may lead to design and construction related modifications, which may in turn affect the quantities.

5.2 Water Management and Erosion Control during Construction

Based on the current landfarm construction schedule, the landfarm fill materials will be placed in later summer or early fall when the surficial organics/peat layer is unfrozen. Under this condition, no foundation excavation is required for landfarm construction. Foundation excavation (removal of surficial organics/peat layer) over the landfarm footprint is only required if the surficial organics/peat layer is frozen during fill placement for landfarm construction. Therefore, there will be no or minimal requirement for seepage and erosion control during removal of frozen organics/peat layer (if needed).

Runoff water from the rockfill materials during landfarm construction is expected under a rainfall event. The runoff will naturally flow into CP1. As a result, a separate water collection system is not required.

5.3 Quality Control and Quality Assurance

A quality control/quality assurance (QA/QC) program is required during construction of the landfarm to ensure that construction-sensitive features of the design are achieved.

As part of the field QA/QC program, daily field reports should be prepared by the on-site construction QA/QC team to document the construction activities associated with landfarm construction. The daily report will include, but not be limited to the following:

- Up to date information of daily construction activities including a list of equipment on-site and weather conditions;
- A summary of visual inspections and observations;
- Records of any construction deficiency and appropriate actions taken, if any;
- Records of QA/QC testing results and monitoring data; and
- Report on construction and design changes made during construction.

Upon the completion of the construction activities, an as-built construction report will be prepared and submitted to the regulators within 90 days after construction is completed. The report should provide all relevant supporting documentation compiled during implementation of the QA/QC plan. The construction report will include, but not be limited to the following:

- Construction drawings based on the as-built survey information of the surface of all materials placed;
- Actual construction quantities;
- Liner system installation details;
- All testing records, a summary of all test sample locations, collection methods, and test results;
- Summary of the construction issues and resolution applied;
- Report on construction and design changes made during construction; and
- Installation details of any required instrumentation or monitoring devices, if any.

5.4 Surveying Requirements

A Survey Contractor should be retained to carry out as-built surveying and documentation to verify quantities and produce as-built drawings.

The Survey Contractor should carry out, as a minimum, the following tasks:

- Survey original ground within the landfarm footprint prior to the commencement of construction.
- During and after construction, the following tasks should be performed:
  - Provide staking to guide construction;
  - Survey the as-built conditions of excavations and fills including different material boundaries as required;
  - Survey any measurement for payment items;

  - Provide quantities of excavations and fill materials on critical stages or as required;
  - Provide AutoCAD drawings showing three-dimensional (3D) lines and surfaces of the excavations and fill materials at critical stages of construction or as required; and
  - Provide the as-built AutoCAD drawings showing 3D lines and surfaces of the excavations and fill materials after the completion of each structure.
- During the operation of the landfarm, the water elevation in the sump should be regularly surveyed and documented.

6.0 OPERATION AND MONITORING OF LANDFARM

6.1 Landfarm Operation Management

The operation of the landfarm needs to be managed to produce effective and consistent results. The operation and maintenance of the landfarm is the responsibility of the Site Services department, with the support of the site Environmental department, and includes the following components:

- Safety and environmental protection measures;
- Soil acceptance procedures including oversize boulders/rocks handling;
- Day-to-day landfarm operation procedures, including initial soil handling, tilling and moisture conditioning, addition of nutrients, and removal of treated soils;
- Operation of snow/ice storage area;
- Managing internal contact water, including operation and maintenance of the sump pumping system and oil separator;
- Sampling and quality control of remediated soils;
- Leakage and seepage (if any) monitoring; and
- Reporting.

6.2 Placement and Removal Plan for PHC Soils and Snow/Ice in Landfarm

Drawing 65-696-230-206 in Appendix B shows the location plan for placement of the proposed PHC soils and snow/ice. Drawings 65-696-230-207 to 209 in Appendix B present six sections throughout the landfarm showing the proposed placement of the PHC soils and snow/ice.

The PHC snow/ice collected in each winter will be stored in the PHC snow/ice storage area in the landfarm. The snow/ice will naturally thaw in the following spring and early summer and the resulting water will flow into the sump, from where the water will be pumped to the oil separator for oil removal before being discharged into CP1.

The proposed placement and removal plan for the PHC soils is summarized in Table 6.1. The design maximum treatment/remediation time for the PHC soils to meet the treatment criteria is three years. The estimated total volume of the PHC soils that are/will be temporarily stored at the site before the start of the landfarm operation is approximately 1,275 m^3. At the start of the landfarm operation by the end of 2017, the soils will be placed in the initial PHC soil placement zone with a layer thickness of approximately 0.36 m. This layer will cover the majority of the inside of the landfarm basin, except for the sump area. This layer will serve as a base and may remain in the landfarm for more than three years or until the late stages of the landfarm operation. PHC soils generated annually after 2017 will be placed in one of three soil treatment zones (A, B, and C) over the initial PHC soil placement zone. The maximum soil lift thickness in each of the three soil treatment zones is approximately 0.5 m.

Table 6.1: Proposed Placement and Removal Plan for PHC Soils in Landfarm

Mine Year	Estimated Volume of PHC Soils Produced (m^3)	Placement Location in Landfarm for Remediation	Estimated Volume of Treated PHC Soils Removed from Landfarm (m^3)	Removal of Treated PHC Soils	Maximum Accumulated PHC Soils in Landfarm (m^3)
Up to June 2017 (Year -3)	1,100	Temporarily stored at the site			
June to December 2017 (Year -3)	175	Temporarily stored at the site			
Start of Landfarm Operation (end of Year -3)		Up to 1,275 m^3 of temporarily stored PHC soils in the initial layer of PHC soil placement zone			1,275
-2	350	Year -2 PHC soils in Soil Treatment Zone A			1,625
-1	350	Year -1 PHC soils in Soil Treatment Zone B			1,975
1	350	Year 1 PHC soils in Soil Treatment Zone C			2,325
2	350	Year 2 PHC soils in Soil Treatment Zone A	350	Year -2 PHC soils in Soil Treatment Zone A	2,325
3	350	Year 3 PHC soils in Soil Treatment Zone B	350	Year -1 PHC soils in Soil Treatment Zone B	2,325
4	350	Year 4 PHC soils in Soil Treatment Zone C	350	Year 1 PHC soils in Soil Treatment Zone C	2,325
5	350	Year 5 PHC soils in Soil Treatment Zone A	350	Year 2 PHC soils in Soil Treatment Zone A	2,325
6	350	Year 6 PHC soils in Soil Treatment Zone B	350	Year 3 PHC soils in Soil Treatment Zone B	2,325
7	350	Year 7 PHC soils in Soil Treatment Zone C	350	Year 4 PHC soils in Soil Treatment Zone C	2,325
8	350	Year 8 PHC soils in Soil Treatment Zone A	350+315	Year 5 PHC soils in Soil Treatment Zone A; soils in initial layer in the base below the snow/ice storage area	2,010

Table 6.1: Proposed Placement and Removal Plan for PHC Soils in Landfarm

Mine Year	Estimated Volume of PHC Soils Produced (m^3)	Placement Location in Landfarm for Remediation	Estimated Volume of Treated PHC Soils Removed from Landfarm (m^3)	Removal of Treated PHC Soils	Maximum Accumulated PHC Soils in Landfarm (m^3)
9 (interim closure)	0		350+320	Year 6 PHC soils in Soil Treatment Zone B; soils in initial layer in the base below Soil Treatment Zone B	1,340
10 (interim closure)	0		350+320	Year 7 PHC soils in Soil Treatment Zone C; soils in initial layer in the base below Soil Treatment Zone C	670
11 (interim closure)	0		350+320	Year 8 PHC soils in Soil Treatment Zone A; soils in initial layer in the base below Soil Treatment Zone A	0

6.3 Landfarm Internal Water Management

The landfarm has been designed to temporarily store the runoff rainwater or snowmelt water collected within its perimeter by draining to the lower portion of the landfarm into a sump area. During the landfarming process, contact water that accumulates in the sump may be recycled as irrigation water, to add nutrient amendments, or to supress dust within the landfarm area during dry periods. Excess water from the landfarm will be pumped to an oil separator to remove any excess oil. The treated water will then be discharged into CP1. CP1 is retained by a dike with a geomembrane liner system keyed into the permafrost foundation, stopping direct water flow to the downstream environment. The water in CP1 will be treated in a water treatment plant and be discharged to Meliadine Lake through a pipeline and a diffuser after the water quality meets discharge criteria.

The water in the sump area will be regularly pumped to the oil separator for treatment during each open water season. Except for a short duration during the spring freshet or a heavy rainfall, water ponding in the landfarm will be minimized during the majority of the landfarm operation. The sump should be completely empty by the end of the pumping season before winter shut-down such that a sufficient storage capacity is available for the next upcoming spring freshet.

6.4 Key Considerations in Landfarm Operation and Monitoring

Detailed landfarm operation and monitoring procedures are not described in this report. Key considerations in landfarm operation and monitoring include, but not limited to, the following:

- Proper signage should be placed at the landfarm entrance and other critical locations to facilitate daily operation and reduce risks of improper or incorrect activities;

- Heavy equipment including hauling trucks shall not travel into the landfarm where the geomembrane liner system is installed; the PHC soils and snow/ice shall be unloaded at the unloading area of the landfarm entrance and transferred into the designated zones inside of the landfarm by equipment with a relatively low ground pressure to avoid damage to the geomembrane liner system;
- The equipment used inside the landfarm should have a ground contact pressure less than 110 kPa and shall avoid excess rutting, sharp turning, sudden stops, and acceleration;
- Staff (including equipment operators) working in the landfarm must be trained for safety, environmental protection, operation procedures, and monitoring procedures;
- Soil acceptance procedures should be established before landfarm operation to avoid placing non-acceptable materials (e.g., soils with heavy petroleum-based products) into the landfarm;
- PHC soils should be mixed as they are placed and spread; the soil layer thickness should not exceed 0.5 m; soil placement should maintain a minimum 1.5 m offset from the inside berm toe;
- If required, PHC soils can be temporarily stockpiled within the landfarm but the height of such a stockpile should not exceed 2.0 m;
- The placement and removal of the PHC soils and snow/ice together with internal water management should follow the general plans described in the above sections;
- Tilling and moisture conditioning procedures should be established before landfarm operation and be adjusted when required during operation to optimize the aerobic environment and moisture conditions for enhancing biodegradation and remediation;
- The PHC soils in the landfarm can be amended to optimize the remediation conditions by the addition of nutrients; details of nutrient application should be determined by the environmental personnel based on soil testing and monitoring results;
- PHC snow/ice collected in each winter should be placed in the designated snow/ice storage area in the landfarm; the snow/ice should not block the natural drainage pathway to the sump and should not be piled directly against the surrounding berms to avoid damage to the berms and the liner system; the maximum pile height should be less than 2.0 m;
- Soil testing and sampling procedures should be established before the start of landfarm operation; the landfarmed soils should be sampled and tested to monitor the remediation conditions and verify that the soils meet remediation objectives during and at the end of the summer treatment season. The environmental staff shall advise the remedial action for the landfarm if the remediation conditions needs to be improved;
- Contact water quality may be tested, when required, including both the raw water pumped to the oil separator and the treated water pumped from the oil separator;
- Leakage/seepage from the landfarm should be regularly monitored during the life of landfarm operation. If the leakage water is noticeable and collectable during landfarm operation, depending on the water quality assessment, the leakage water can be collected and either pumped back to the landfarm sump or to the oil-separator directly for oil removal; and
- The geotechnical performance of the landfarm should be regularly monitored during the landfarm operation; an annual geotechnical site inspection by the Designer or a qualified geotechnical engineer should be conducted to inspect/document the landfarm performance and identify any remedial measures that need to be taken.

7.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

REGISTERED PROFESSIONAL ENGINEER
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LICENSEE
June 23, 2017
NWT/NU

REGISTERED PROFESSIONAL ENGINEER
KEVIN W. JONES
JUNE 23, 2017
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PERMIT TO PRACTICE
TETRA TECH CANADA INC.

Signature ____________________

Date JUNE 23, 2017

PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

REFERENCES

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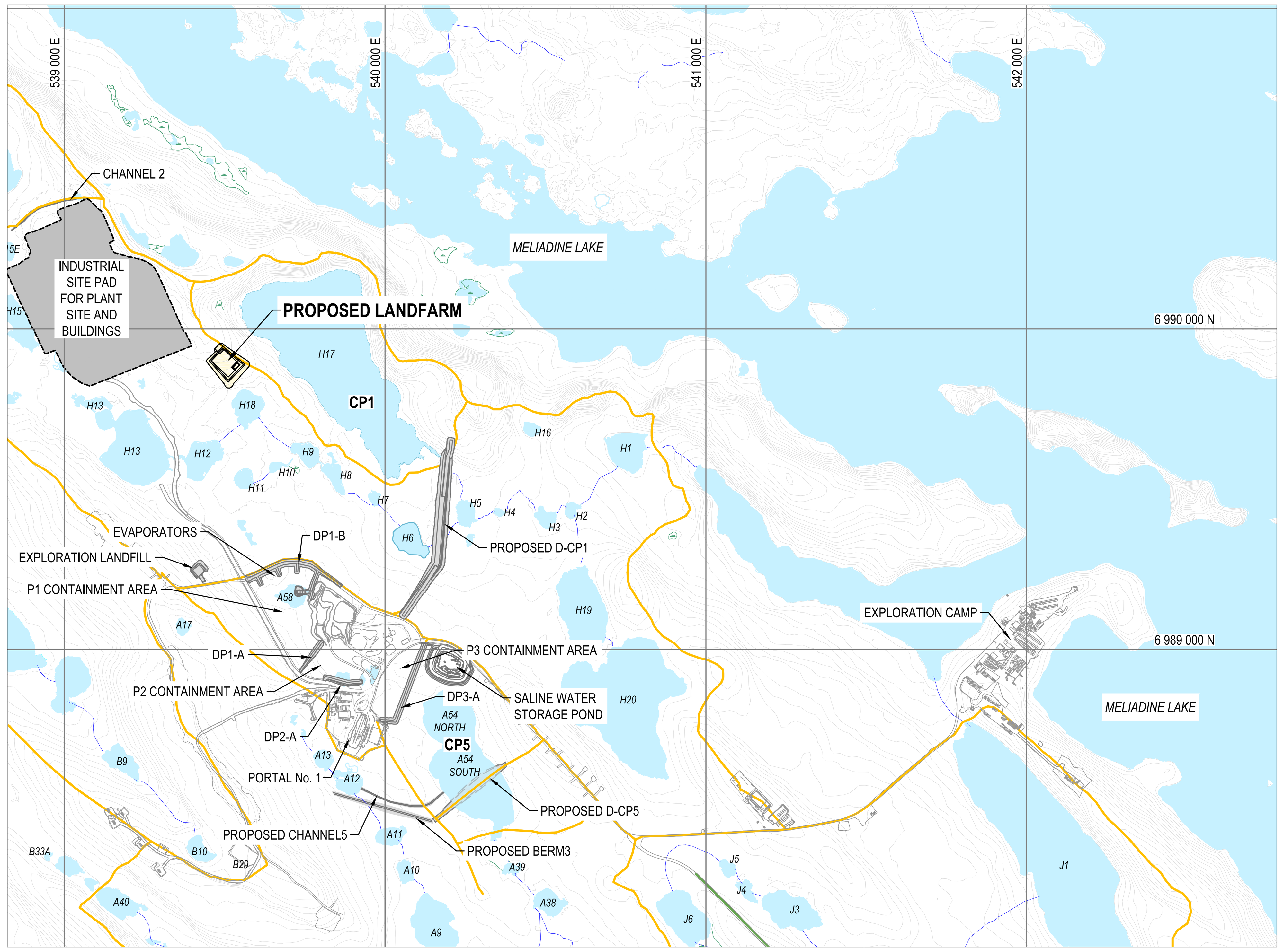
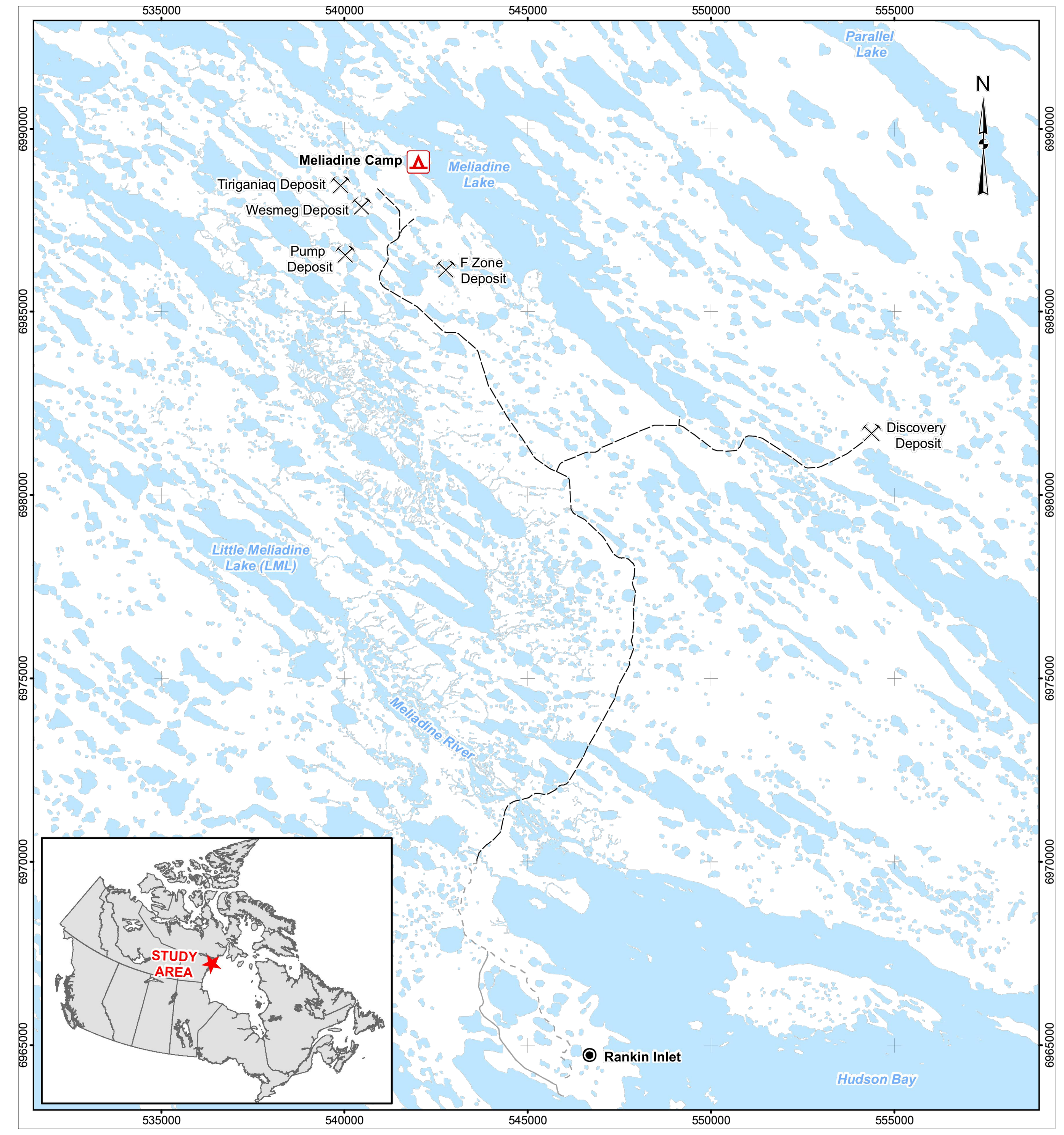
APPENDIX A

LANDFARM DRAWINGS FOR CONSTRUCTION

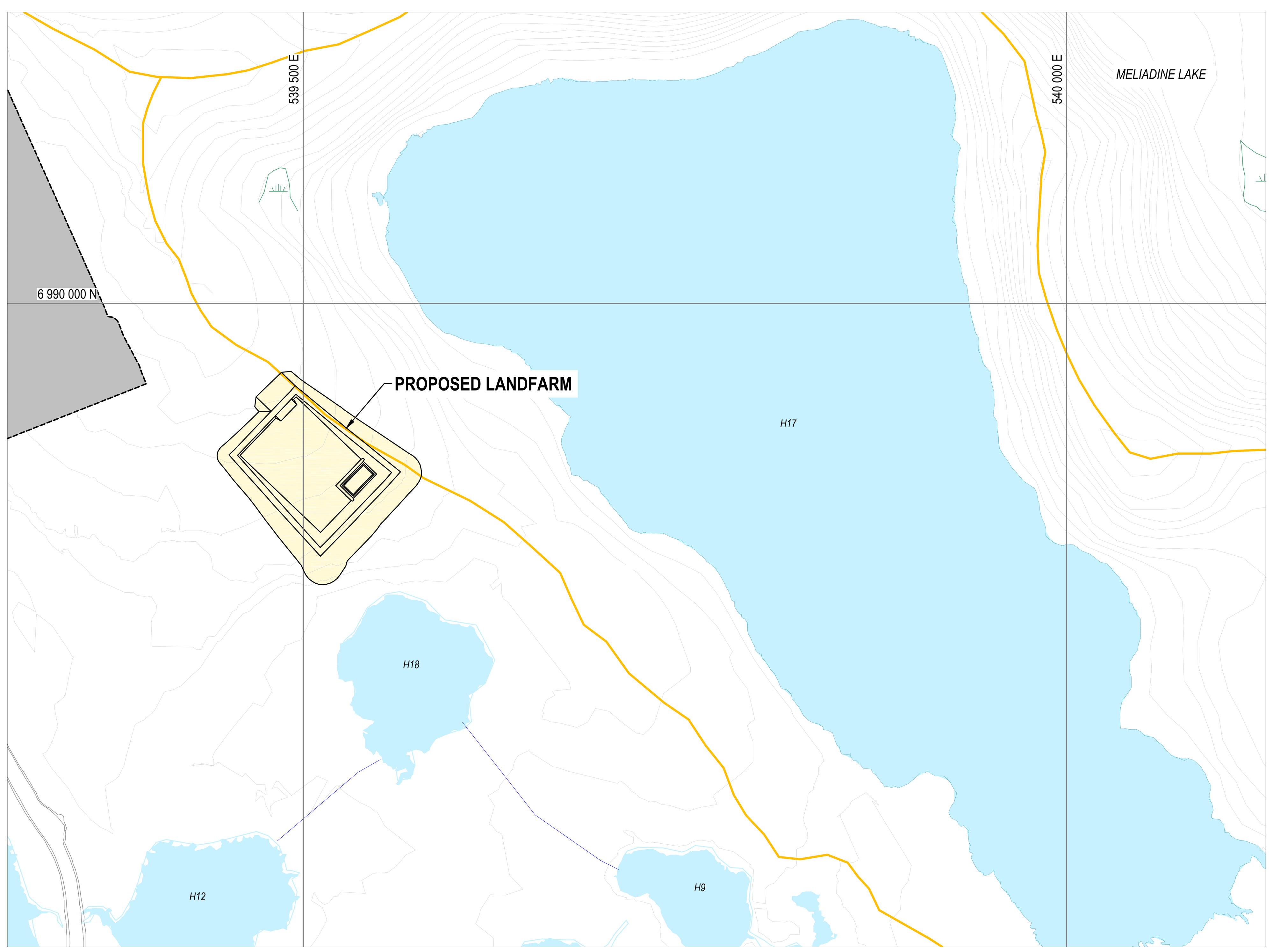
NO. DESSIN DRAWING NO. 65-696-230-200



GENERAL SITE LOCATION
SCALE: 1:12,000



LOCATION MAP
SCALE: N.T.S.



LANDFARM SITE LOCATION
SCALE: 1:2,500

LANDFARM CONSTRUCTION DRAWING INDEX

DRAWING NUMBER	REV.	DRAWING TITLE
65-696-230-200	1	LANDFARM GENERAL LOCATION PLAN
65-696-230-201	1	LANDFARM LAYOUT PLAN
65-696-230-202	1	LANDFARM TYPICAL DESIGN SECTION, DETAILS, AND QUANTITIES
65-696-230-203	1	LANDFARM SECTIONS A-A AND B-B
65-696-230-204	1	LANDFARM SECTIONS C-C AND D-D
65-696-230-205	1	LANDFARM SECTIONS E-E AND F-F

TETRA TECH EBA

NOTES GÉNÉRALES / GENERAL NOTES

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
Signature
Date June 1, 2017
PERMIT NUMBER: P 018
NT/NU Association of Professional Engineers and Geoscientists

POUR CONSTRUCTION
FOR CONSTRUCTION
DATE : 2017-06-01
AGNICO EAGLE

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS

TITRE / TITLE	# DWG
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AGNICO EAGLE

REV.	DATE	DESCRIPTION	PAR/BY	APP.	CLIENT
1	2017-06-01	RE-ISSUED FOR CONSTRUCTION	EL	GZ	
0	2017-02-08	ISSUED FOR CONSTRUCTION	EP	GZ	
A	2017-01-16	ISSUED FOR REVIEW	EP	GZ	

REVISIONS

REGISTERED PROFESSIONAL ENGINEER G. ZHANG LICENSEE NWT/NU
REGISTERED PROFESSIONAL ENGINEER KEVIN W. JONES LICENSEE NWT/NU

TITRE / TITLE
AGNICO EAGLE MELIADINE GOLD PROJECT

LANDFARM
GENERAL LOCATION PLAN

DESSINÉ PAR DRAWN BY	EP	DATE	2017-01-16
VERIFIÉ PAR CHECKED BY	GZ		2017-01-16
APPROUVÉ PAR APPROVED BY			
ÉCHELLE SCALE	AS SHOWN	DATE	2017-01-16
NO. DESSIN DRAWING NO.	65-696-230-200		
NO. PROJET PROJECT NO.	6515	REVISION 1	FEUILLE / SHT 1 / 6

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