Stantec

Memo

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File:	Lupin Mine TCA Erosion and Sediment Control	Date:	October 3, 2025

Reference: Lupin Mine TCA Erosion and Sediment Control Memorandum

INTRODUCTION

Lupin Mines Incorporated (LMI), a wholly owned indirect subsidiary of Alkane Resources Ltd (Alkane, or the "Client"), retained Stantec Consulting Ltd. (Stantec) to provide engineering services in support of the ongoing mine closure activities for the Tailings Containment Area (TCA) at the former Lupin Gold Mine.

The Lupin Mine site is located on the western shore of Contwoyto Lake, approximately 400 km northeast of Yellowknife, Northwest Territories, in the Kitikmeot Region of Nunavut. The Lupin Mine operates under the Nunavut Water Licence 2AM-LUP2032 (NWB, 2020), issued to LMI by the Nunavut Water Board (NWB, or the Board).

The Final Closure and Reclamation Plan (FCRP) (Golder, 2020) and closure plan for the TCA (Holubec, 2005) define closure objectives and plans to cover TCA exposed tailings and reclaim the TCA. The approved closure plan includes information on TCA cover, drainage and other design elements but does not describe measures to control erosion and sedimentation. This memorandum includes erosion and sediment design, construction monitoring and mitigation controls.

REGULATORY REQUIREMENTS

The Lupin water license references the Mackenzie Valley Land and Water Board Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories (MVLWB, 2013). These guidelines suggest the following considerations for erosion and sediment control:

- Climate – ensuring that temperature fluctuations over relatively short periods of time and related water runoff do not result in rapid erosion.
- Geotechnical stability – ensuring that no erosion, slumping, or subsidence occur that would cause exposure of potential acid generating material to atmospheric conditions, such as water or oxygen.
- Vegetation – ensuring that enough time has passed for new native or engineered vegetation to develop a cover.
- Hydrology – minimizing sediment transport, protecting surface water quality, and establishing stable landforms capable of supporting long-term ecological functions.
- Permafrost – limiting potential for thawing of permafrost to produce instability due to thaw consolidation or rapid erosion.

To develop erosion and sediment controls, Stantec also used guidance from the Government of the Northwest Territories (GNWT) which outlines good management practices based on site geotechnical, environmental and hydrological conditions. Key conditions at the Lupin Mine TCA include local geology, soil type and properties, infrastructure geometry and related slope stability, surface and groundwater, and vegetation (GNWT, 2013).

Reference: **Lupin Mine TCA Erosion and Sediment Control Memorandum**

SITE CONDITIONS

The TCA lies within the Archean metaturbite sequence of the Contwoyto Formation, which is part of the Yellowknife Supergroup of supracrustal metasedimentary and metavolcanic rocks (Golder, 2020). Bedrock is present on the original ground surface in many areas. Where not present, the ground surface, including the majority of the foundation of the TCA, is composed of glacial till, which is silty sand with gravel and boulders, underlain by low-grade clastic metamorphosed bedrock (Golder, 2020).

The TCA consists of dams and tailings storage cells. The TCA includes perimeter dams 1A, 1B, 1C, 2, 3, 4, 5, and 6, and internal dams 3D, J, K, L, M, N, and the Divider Dykes. These dams contain five tailings cells numbered 1 to 5. Cells 1, 2, 3 and 5 have been covered with a minimum of 1 m of esker material. Containment of the cells is provided by the perimeter and internal dams constructed of esker and rockfill, with frozen tailings in internal dam cores. Dams are designed and constructed of competent materials for local and overall stability.

The facility is in the tundra zone of the Canadian Shield, in an area with continuous permafrost resulting from the semi-arid sub-arctic climate, which includes rapid temperature changes, high winds and distinct seasonal variations in temperature and precipitation (Golder, 2020). Vegetation surrounding the TCA is sparse and includes low-lying shrubs and grasses. Some limited portions of the TCA are partially revegetated including portions of Cells 1 and 2 cover and Dam 3.

The hydrology at the site is governed by seasonal precipitation and snowmelt events, with an average annual precipitation of approximately 300 mm (Golder, 2020). The TCA and surrounding area is characterized by limited topographic relief and elevation variation which produces locally small drainages. As a result, the TCA is not subject to significant inflows from upstream areas, with drainage primarily associated with direct precipitation and surface runoff from the immediate catchment area located within the boundaries of the perimeter dams. Surface water typically flows over cover surfaces and/or dams and into the internal ponds. Groundwater occurs at or near the original ground surface including in the tailings cells. Some limited groundwater drainage from covered tailings cells and internal dams is visible in dam faces during summer thawing conditions.

EROSION AND SEDIMENT CONTROLS

The primary erosion risk during active closure is associated with surface runoff across tailings cell covers, on internal and external dam slopes, in drainage channels, spillways and other water management structures and in areas with limited cover, armoring, and/or established vegetation. High-intensity or prolonged precipitation or snowmelt events have the potential to erode materials which in turn may produce downstream sedimentation into the surrounding environment which includes generally unimpacted tundra and lakes. Wind generated wave runup has the potential to erode dam toes which are directly adjacent to ponded water. Windblown sediment has the potential to occur downwind of the limited areas where tailings are not yet covered. The map in Appendix A outlines the potential risk for erosion on TCA tailings cell cover, dam and water management areas.

To reduce the risk of TCA erosion and sediment migration, a combination of design, construction, maintenance and mitigation controls, are being used which are outlined below. Design, construction, monitoring and maintenance controls are developed with consideration of good management practices (GNWT, 2013)

Reference: **Lupin Mine TCA Erosion and Sediment Control Memorandum**

Design Controls

The TCA is currently in the active closure phase, with cover, dam and spillway stabilization measures (including erosion and sediment control) nearing their final configurations. The design controls which are in place for erosion and sediment control of dam crests, slopes, and toes are as follows:

- Dam embankments consist of compacted rock and earth fill surrounding frozen cores, to protect areas of permafrost. Riprap armoring and coarser material is placed in areas with a higher risk of erosion including steeper slopes, drainage features, and dam toes into ponded water.
- Dams are designed to minimal heights (generally less than 10 m high) with slope angles and limited continuous slope distances which are resistant to erosion.
- Dam embankment slopes are confirmed by geotechnical assessment to meet or exceed target factors of safety under static and seismic loading for stability.
- Frozen impervious cores within the dams have been verified to effectively inhibit piping and potential for internal erosion, downstream seepage and related erosion and sedimentation.
- Pond water levels are reduced to, at or below the external dam toe elevations in the closure plans which eliminates the dam function and reduces the consequence of dam slopes erosion. Some internal dam toes are offset from ponded water. Lowered water levels limit the potential for wind driven wave erosion.
- Pond water levels are designed with sufficient freeboard and/or with spillways to limit potential for floods to overtop embankments or overwhelm water management systems.
- Water is designed to be retained in the system behind dams (in and on covers) and when released, to pass through armored spillways.

The design controls which are in place for erosion and sediment control of tailings covers are as follows:

- Tailings are encapsulated beneath covers and are retained as frozen.
- Covers include use of erosion resistant esker material over tailings to limit erosion and mobilization of sediment.
- Covers are designed with limited drainage gradients to reduce runoff velocities.
- Internal drainage channels are designed to intercept and manage surface flows into the ponds. Drainage areas and design floods have been assessed to confirm the adequacy of drainage channels to convey flows while limiting erosion.
- Grading is in place to reduce ponding water and to allow for some limited sheet flow along designed cover surfaces.
- Drainage pathways or swales are included in areas subject to accumulation of high water volumes.
- Armored spillways are included in cover drainage channel discharge areas where higher gradients and flow volumes may occur.
- Riprap armoring is included in areas of higher velocity or higher volume flows.

- Cover materials are selected from local materials to allow for revegetation and erosion protection.

The design controls which are in place for erosion and sediment control of spillways are as follows:

- Spillways and armoring are sized to pass design floods while resisting erosion.
- Gradients are limited to reduce the potential for erosion.
- Spillways are designed with appropriately sized riprap armoring.
- Spillways are constructed in bedrock where feasible.

Construction Controls

During closure construction, the following erosion and sediment control measures are used:

- Construction activities include daily inspections of the construction and surrounding area for erosion and sedimentation. Eroded areas are identified, filled and compacted with competent material. The source is identified and mitigated.
- Esker, riprap and other construction materials are selected and verified to provide suitable cover which is resistant to erosion.
- Construction activities occur during favorable weather conditions and avoid wet weather periods.
- Traffic during construction is limited to durable surfaces which are resistant to erosion. Where construction impacts to areas which are sensitive to erosion are observed, additional mitigation is carried out.
- Construction areas are monitored and maintained to limit areas of ponded water and generation of concentrated flows.
- Dams and spillways are constructed during periods of low water to reduce potential for shoreline erosion and sedimentation into ponds.
- Accumulated sediment is removed and restored to source locations with additional protection.
- Placement areas and access roads are contoured and re-graded. Roadway berms are removed and/or breached at intervals to limit ponding water and concentrated flows.
- Spillways, ditches and other water management systems are visually inspected to confirm that they are free of debris or sediment to avoid damming, allow for water to flow and to reduce potential downstream sedimentation.
- Riprap is placed at abutments, inlets, outlets, and exposed dam toes at closure water elevations, to minimize exposed soils. Temporary riprap is used in construction areas where needed, for example, when constructing temporary construction access roads.
- Riprap is also placed in discharge areas where pond drawdown pumping is occurring.

- Tailings pipelines and culverts used to transport tailings are removed, and openings are filled, compacted and re-sloped for drainage and to minimize erosion.

Monitoring and Maintenance

Monitoring of erosion and sedimentation is expected to continue during active closure and into the early stages of passive closure. Erosion and sediment control monitoring and maintenance activities include:

- Annual inspections are carried out by the EOR of all dam toes, crests, and slopes, cover areas, spillways and other water management systems for signs of erosion or sediment buildup.
- Regular inspections are carried out of TCA construction areas and dam toes, crests, slopes, covers, spillways and water management systems during the construction season.
- Eroded areas and areas of accumulated sediment are photographed, surveyed, documented and are reported for mitigation.
- Eroded areas are filled and compacted with erosion resistant material. Sources of erosion (ponded water in low lying areas, concentrated flows) are identified and additional mitigation is completed which may include grading, diversion, or armoring, etc.
- Accumulated sediment is removed from inlet and outlet structures and other areas to restore flow.
- As part of annual water quality testing, water samples are collected from TCA ponds and are tested for suspended solids.
- Maintenance activities are documented and reported.

REFERENCES

GNWT. (2013). *Erosion and Sediment Control Manual.* Government of the Northwest Territories (GNWT) - Department of Transportation.

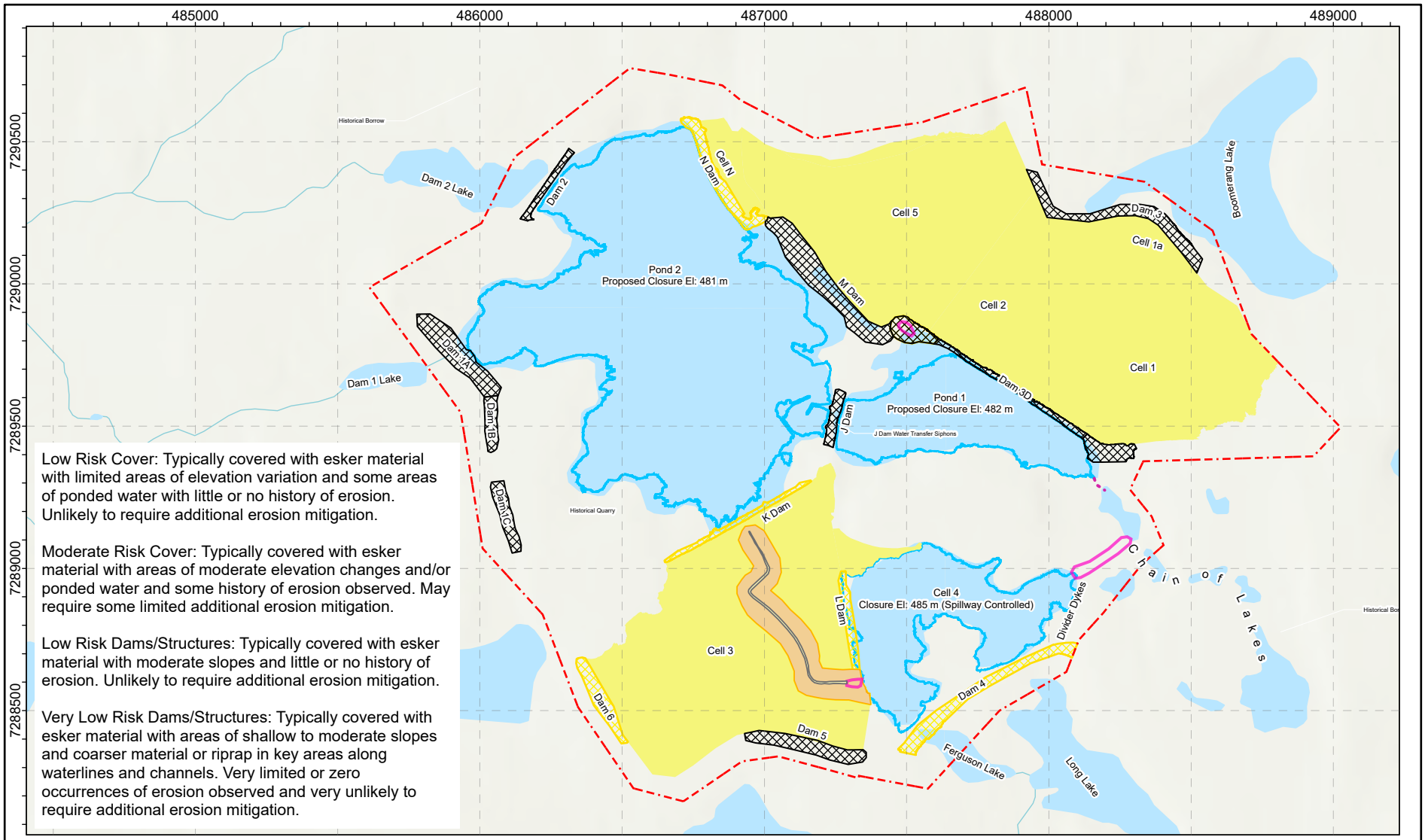
Golder, A. (2020). *Lupin Mine Site, Final Closure and Reclamation Plan. Report submitted to the Nunavut Water Board. July 2018.*

Holubec. (2005). *Closure Plan for Tailings Containment Area - Lupin Operation. Holubec Consulting Inc.*

MVLWB. (2013). *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites in the Northwest Territories.* Mackenzie Valley Land and Water Board.

NWB. (2020). *Nunavut Water License 2AM-LUP2032, Issued to Lupin Mines Incorporated. Nunavut Water Board (NWB). February 2020.*

Stantec. (2020). *2 AM-LUP2032 Technical Memorandum on Exposed Tailings Preliminary Cover Design.*



Low Risk Cover: Typically covered with esker material with limited areas of elevation variation and some areas of ponded water with little or no history of erosion. Unlikely to require additional erosion mitigation.

Moderate Risk Cover: Typically covered with esker material with areas of moderate elevation changes and/or ponded water and some history of erosion observed. May require some limited additional erosion mitigation.

Low Risk Dams/Structures: Typically covered with esker material with moderate slopes and little or no history of erosion. Unlikely to require additional erosion mitigation.

Very Low Risk Dams/Structures: Typically covered with esker material with areas of shallow to moderate slopes and coarser material or riprap in key areas along waterlines and channels. Very limited or zero occurrences of erosion observed and very unlikely to require additional erosion mitigation.

Legend
- Pond and Cell Closure Shorelines
- Low Risk Cover
- Moderate Risk Cover
- Very Low Risk Dams/Structures
- Low Risk Dams/Structures
- Pond 1 Natural Inflow
- Spillway and Outfall Footprints - Completed

Notes
1. Coordinate System: NAD 1983 UTM Zone 12N
2. Units: all units are in metres unless otherwise noted.
3. Topography (DEM): 20 cm resolution; collected/processed by Stantec Geomatics Group on August 21, 2021.

0 200 400 600 800 1,000 Meters
(At original document size of 8.5x11)
20,000

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Project Location
Lupin Mine
Kitikmeot, Nunavut, Canada

Prepared by F. Sawyer on 9/29/2025
TR by S. Leggett on 9/29/2025
IR by P. Brown on 9/29/2025

Client/Project *169525614*
Client: Lupin Mines Incorporated
Project: Lupin Mine Site Closure
Report: Lupin Erosion & Sediment Control Plan

Figure No.
1

Title
Erosion Plan Map