# Plan of Operations

# To Accompany
# Red Dog Mine Millsite Lease Application

Teck

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Alaska Department of Natural Resources

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# Table of Contents



**LIST OF FIGURES**

# 1.0 INTRODUCTION

This document is being submitted by Teck Alaska Incorporated, Red Dog Mine (TAK) to the Alaska Department of Natural Resources (ADNR) for approval to conduct surface activities on lands recently included in an application for a Millsite Lease (Figure 1). This Plan of Operations (PoO) is being submitted at this time so it can be reviewed and approved by ADNR at the same time the Millsite Lease application is reviewed and approved. Under this coordinated review TAK understands the PoO and Millsite Lease will be jointly published for public review and comment and, if approved, the approvals will follow simultaneously.

The Red Dog Mine is located nearly entirely on NANA lands. However the boundary between State and NANA lands is being encroached upon as the mine tailings storage facility (TSF) expands as a result of rising tailings and water levels. The permits for the TSF expansion are in hand for all of the activities that will occur on NANA land. However, a Millsite Lease is required to authorize the use of State surface lands for the purpose of tailings management. TAK submitted an application for a Millsite Lease on Dec 30, 2019. As soon as the Millsite Lease is issued and this PoO is approved, TAK will take steps to begin placing mine tailings on lands within the proposed Millsite Lease boundary as described in this PoO.

Additional future activities on the proposed Millsite Lease lands could include construction of an emergency spillway for the TSF. Detailed engineering and construction of the spillway are at least two years in the future and will be addressed in a future update to this PoO.

This Plan of Operations describes:

- Proposed tailings management operations on Millsite Lease lands,
- Reclamation of proposed Millsite Lease lands,
- Concurrently active material sale activities within the boundary of the proposed Millsite Lease.

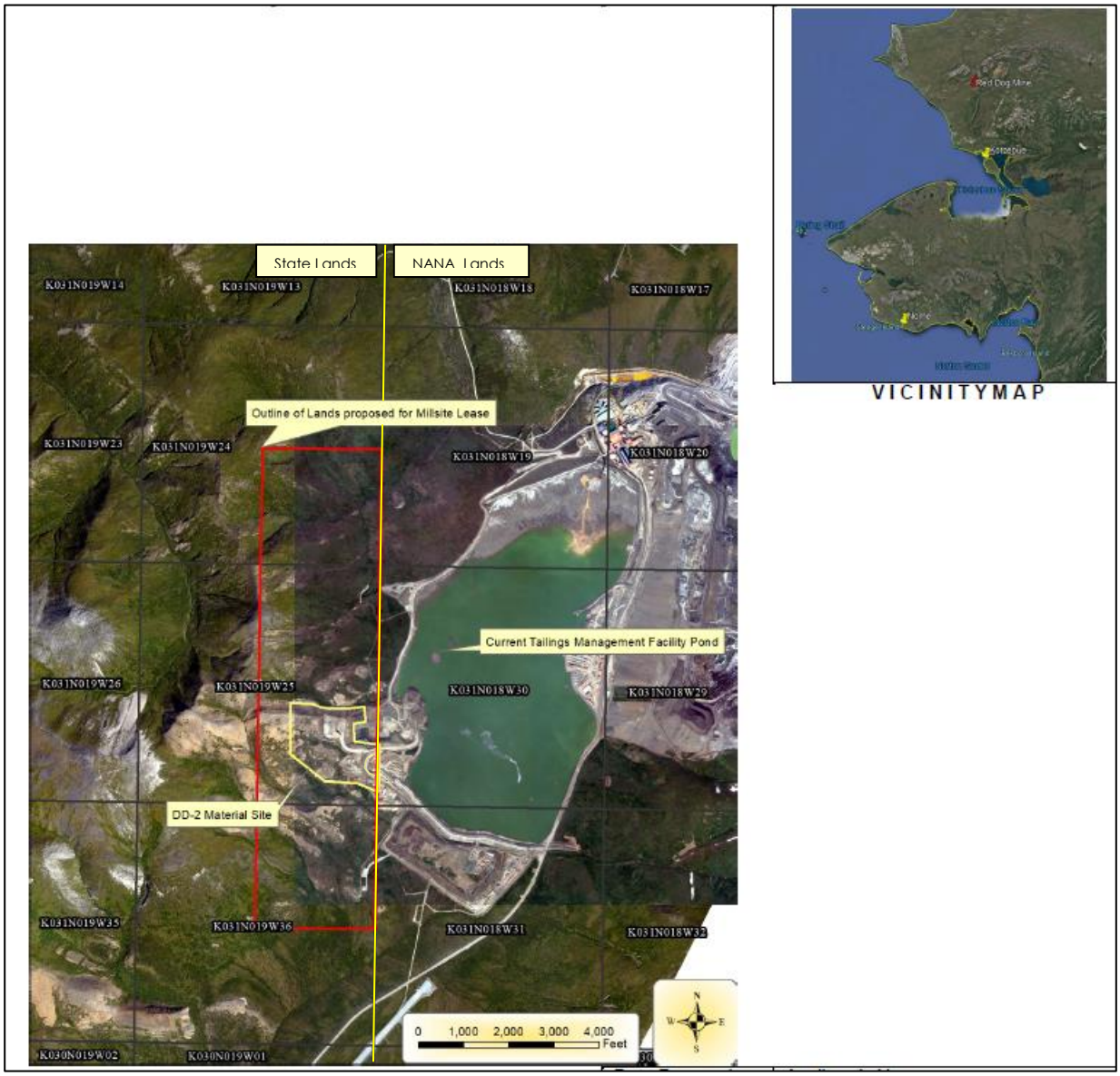


**Figure 1. Location Map**

## 2.0 PROPOSED ACTIVITIES ON MILLSITE LEASE LANDS

At the present time TAK is proposing to use Millsite Lease lands for the purpose of disposal of mine tailings from the Red Dog Mine. The mine TSF lies almost entirely on NANA lands as illustrated in Figure 1. However the TSF has been gradually expanded through a series of tailings dam raises since 1988 that will likely end with the final Stage XII dam raise in 2028. A small portion of the expanding TSF is close to impinging on state land. This is State land where TAK has also been excavating construction material from a permitted material site (DD-2) which

has created a depression TAK plans to use for tailings disposal. The tailings disposal and final reclamation of the area are discussed below.

## 2.1 Tailings Disposal Operations

Shortly after the Millsite Lease is approved, TAK proposes to place tailings into the large excavation created in the DD-2 material site, for permanent storage. This area is illustrated in Figure 2. The western half of this area falls inside the boundary of the proposed Millsite Lease, the remainder is on NANA land.

At the time of this writing, the floor of this excavation has an elevation of approximately 970 ft above mean sea level (msl); the driving surface of the causeway separating it from the active TSF has an elevation ranging from 995 ft to 1000 ft msl; the culvert base below the road causeway is at an elevation of approximately 981 ft msl and the surface water elevation in the TSF is at approximately 981 ft msl.

This DD-2 excavation area would be filled by diverting tailings slurry from the existing tailings slurry pipeline situated along the west side of the TSF. Tailings slurry will be diverted by a 26 inch pipe and conveyed to the excavation area, initially close to the highwall at the western-most part of the excavation as shown in Figures 3 and 4. The tailings slurry is composed of about 22% solids, 78% water. As the area begins to fill and tailings solids settle, excess water will flow toward the current TSF and through the coarse road causeway fill or the existing culvert. As tailings accumulate and start to inundate the discharge end of the slurry pipeline, the pipe will be broken farther back and the slurry will be allowed to continue filling the area. In this way the excavated area will be systematically filled from the base of the highwall and then progressively toward the road and existing TSF.

The operation will continue and be monitored until the settled tailings at the toe closest to the existing road/causeway culvert have an elevation of approximately 981 ft. One objective is to insure that tailings are able to naturally dewater and the water gradient is always toward the road culvert/TSF pond.

### 2.1.1 Tailings Physical Properties

The tailings consist of the solid wastes from the Red Dog mill consisting of crushed ore material rejected by the various concentrating processes in the mill. Metal recoveries in the mill do not recover 100% of the ore metals and the tailings still contain some concentrations of metals as described in more detail below. The specific gravity of tailings solids ranges from 2.87 to 3.18, based on composite samples from Main, Aqqaluk, and Qanaiyaq Pit ore; target grind size is 80% passing 60 microns (230 mesh).

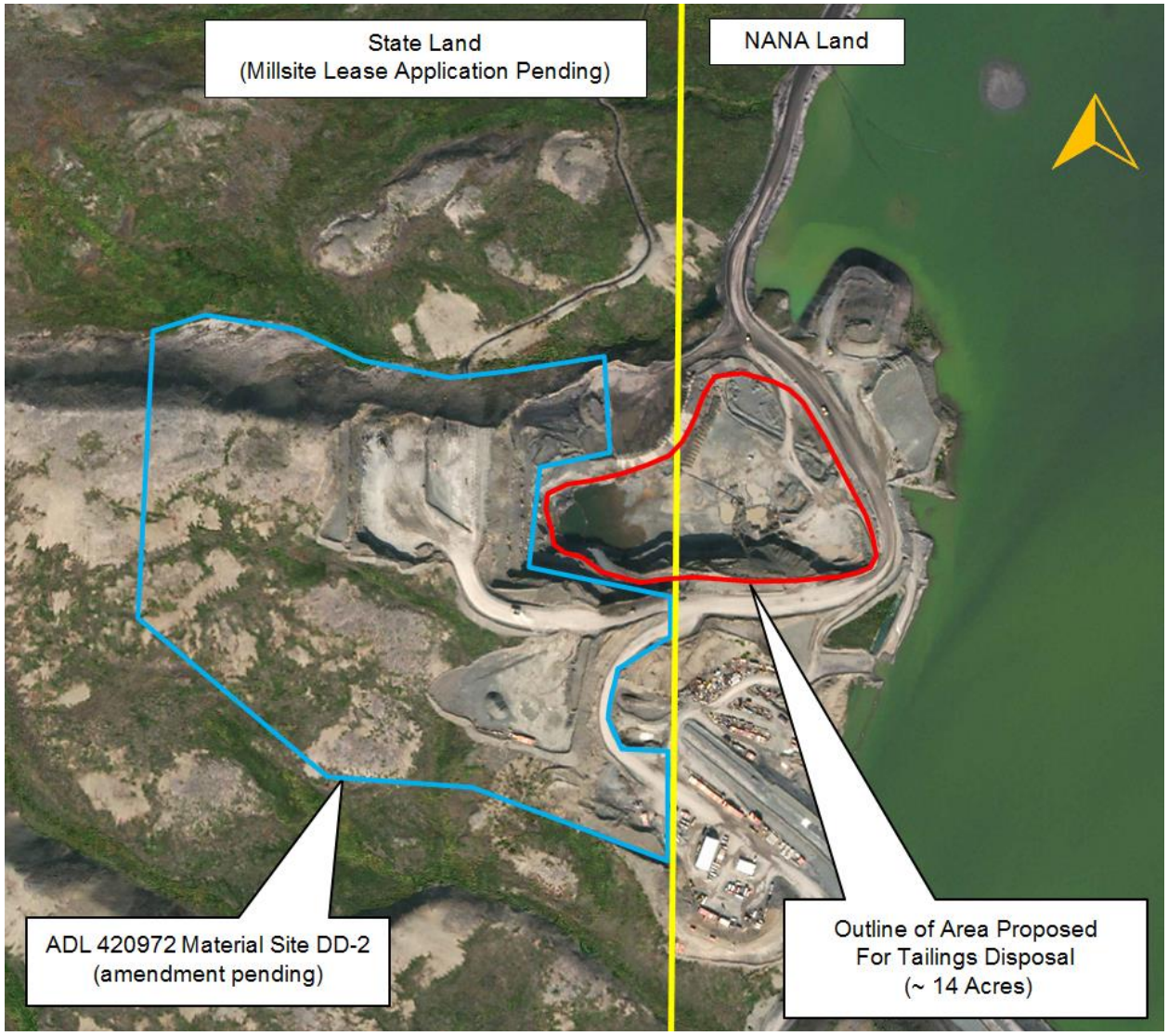


Figure 2. Detailed Location Map of Proposed Tailings Disposal Area and Existing Material Site

### 2.1.2 Tailings Geochemistry

The following are key aspects of the tailings geochemistry based on previous studies completed by, and for, the Red Dog Mine.

- Zinc concentrations in tailings range from 2.4 to 6.2 weight percent, 1.2 to 2.8 weight percent for lead, and 4.6 to 11.4 weight percent for iron.
- Total sulfur content ranges from 9.65% to 16% (as S). Soluble sulfate, barite ($BaSO_4$) and galena (PbS) and anglesite ($PbS\text{-}SO_4$) account for roughly one-quarter of the sulfur.

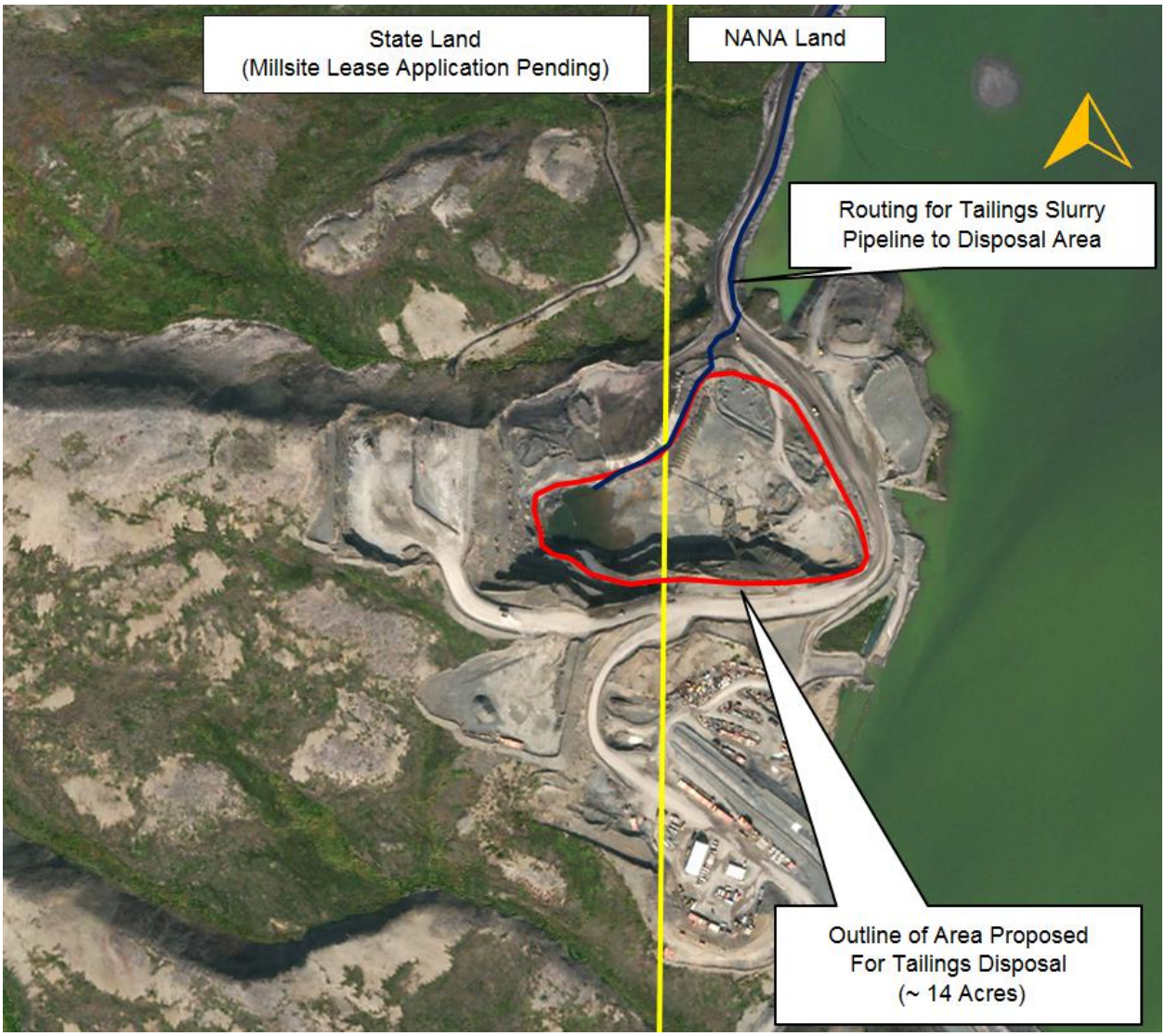


**Figure 3. Routing of Tailings Slurry Pipeline to Tailings Disposal Area**

- Sphalerite (Zn, Fe) S accounts for roughly another quarter and pyrite ($FeS_2$) accounts for the remainder.
- Comparison of acid generation and neutralization potentials indicate the tailings are acid generating. The acid generation potential is between 155 and 240 kg $CaCO_3$/tonne. The neutralization potential ranges from 0.4 to 9.4 kg $CaCO_3$/tonne.
- Ongoing monitoring and sampling results of tailings solids and decant solution are reported quarterly (to ADEC) and there is no indication of any significant variations in the geochemical characterization of the tailings.

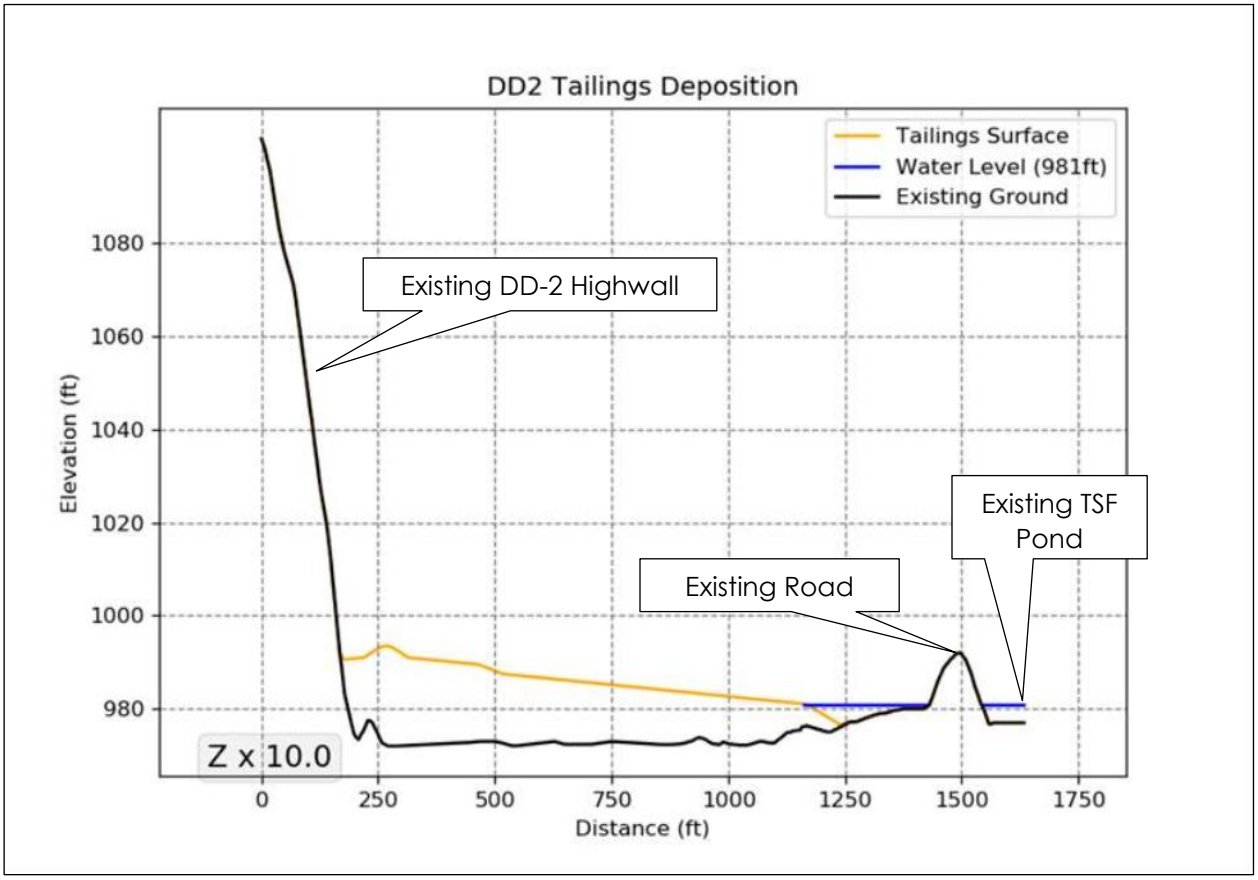


**Figure 4. Idealized Cross Section of Final Configuration of DD-2 Tailings Disposal Area – View Looking North**

## 2.2 Reclamation of Tailings Disposal Area Including Millsite Lands

The tailings disposal area within the DD-2 excavation will require reclamation in the future. After the tailings are deposited in the DD-2 excavation, they will settle over time and any free water will flow toward the larger TSF facility. The result will be a relatively dry stable surface with a gentle slope toward the TSF, covering an area of approximately 14 acres. The NANA/State land boundary passes through this area, so approximately half of this area is on the proposed Millsite Lease lands.

Under the current Red Dog Mine Reclamation Plan Approval (F20169958), the TSF will receive a “wet” closure. The tailings in the TSF will remain covered with at least two feet of water cover and that water pond will be maintained in perpetuity. The water cover is expected to reduce oxygen availability to the tailings and slow their oxidation. However, the elevation of the final

tailings water will not cover the tailings sufficiently to assure a permanent water cover over the tailings that are deposited within the DD-2 excavation.

Therefore, TAK proposes constructing an engineered cover over the entire 14 acres of tailings within the DD-2 excavation. TAK has been testing engineered covers on the mine waste dumps with positive results that indicate more than 97% of precipitation is diverted off of the dumps. This has nearly eliminated infiltration of surface water into the sulfide-bearing mine wastes with the likely long-term benefits of reducing oxidation and the generation of acid drainage. The design of the engineered cover is illustrated in Figure 5 and consists of an impermeable geomembrane sandwiched between a prepared subgrade and cover material.

TAK proposed constructing that engineered cover as soon as practical after the tailings have settled and dewatered to a point where they can be safely accessed by equipment and personnel, likely during the 2021 construction season. Until then, TAK will implement dust suppression as required to mitigate any fugitive dust associated with the tailings.

The reclamation of the tailings in the DD-2 excavation area will be included in the forthcoming update of the Red Dog Mine Reclamation Plan, which is under development at this time. The cost estimate for procurement and installation of the engineered cover for the DD-2 area tailings will also be included in that Reclamation Plan update.

# 3.0 EXISTING ACTIVITIES ON MILLSITE LEASE LANDS

TAK is actively excavating construction materials within the boundary of the proposed Millsite Lease. The material site is authorized under a material sales contract between TAK and ADNR (ADL 419715) and the site is referred to as the DD-2 Material Site. The sale contract authorizes TAK to remove up to 1.5 million cubic yards of crushed and screened shale and chert through 6/3/2023. Likely the contract will be renewed. Exploitation of the materials at this site to date has resulted in the excavation proposed as the site for tailings deposition in this PoO. TAK will continue to excavate material from the DD-2 site, but to the west of the excavated area proposed for tailings deposition, and the ongoing material site development will not interfere with TAK's plan to deposit, manage and reclaim the tailings.

TAK has submitted a written request to ADNR Lands, Northern Region, to amend the DD-2 material site boundary to exclude the excavation where TAK plans to deposit mine tailings under this PoO. This has also been coordinated with the ADNR Mining Section. The boundary amendment is pending at this time of writing.

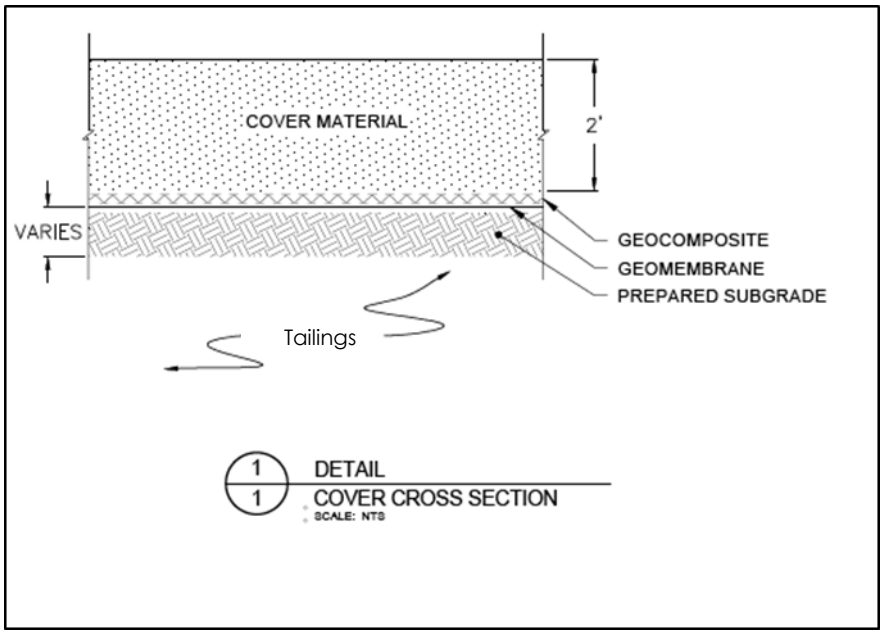


Figure 5 Crossection of Engineered Cover Design

## 4.0 MONITORING

TAK will perform sufficient visual monitoring of the proposed tailings deposition activities to assure the tailings are deposited as described in this PoO. Monitoring of reclamation activities and post closure monitoring are discussed more fully in the Red Dog Mine Reclamation Plan. The Reclamation Plan is presently being updated and will address reclamation of the DD-2 tailings deposition site specifically. The updated reclamation plan will be submitted to ADNR and ADEC in September 2020 for review.