Fingerboards Mineral Sands Project Inquiry and Advisory Committee
Technical note

TN No: TN 006
Date: 8 February 2021
Subject: Response to IAC Request for Information – Sections 2.4-2.5, questions 8, 10, 11, 12.

INTRODUCTION

The IAC's request relevantly provides:

> **2.4 Design details of infrastructure**
>
> **(i) Reference**
>
> Several submissions and the 'Water Independent Peer Review and Proponent Response' (Attachment I) mention the absence of design engineering structures and information to allow evaluation of infrastructure and associated impacts..
>
> **(ii) Request**
>
> The Proponent should provide:
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> 7. …
>
> 8. Concept design of key engineering structures such as Tailings Storage Facilities (TSF), diversion drains and dams.
>
> **2.5 Dams and tailings storage facility**
>
> **(i) Reference**
>
> Dams and the proposed TSF, both temporary and permanent, may pose risks to the local environment in the event of failure or overflow.
>
> Several submissions have sought further information on the dam construction and operational requirements to understand the proposal and associated impacts.
>
> **(ii) Request**
>
> The Proponent should:
>
> 9. …
> 10. Provide information on the justification for not lining the temporary TSF to prevent leachate entering the ground and surface water system.
> 11. Provide information on the operational requirements, dam and TSF safety obligations (including the allowance for the potential of cascading dam failures should upstream dams fail, impacting on downstream dams which also contain mine site sediments), and management of instream environmental and biodiversity impacts.
>
> 12. Clarify dam and TSF capacity and the point at which mine contact water would spill from dams.

RESPONSE

Question 8

The concept design for the TSF presented in the EES is in EES Attachment B at section 8.5.2 and Figures 8-2 and 8-3.

There are several catchment dams proposed to be constructed at different times over the life of the Project. Perry Gully catchment dam will be constructed first and accordingly has been selected for preliminary engineering design. All subsequent catchment dams will be designed to a similar engineering basis and construction standard.

The preliminary designs are described in the 4567-30-RPT-GE-00011 – Fingerboards Bankable Feasibility Study (Section 11 – Tailings Management) and the following conceptual design drawings:

- 4567-40-DWG-CI-31101 – Tailings storage facility & freshwater dam general arrangement
- 4567-40-DWG-CI-31102 – Tailings storage facility typical sections & details
- 4567-40-DWG-CI-32001 – Perry Gulley TSF catchment dam general arrangement
- 4567-40-DWG-CI-32002 – Perry Gulley TSF catchment dam typical sections & details
- 4567-40-DWG-CI-32003 – Perry Gulley TSF catchment dam typical spillway details
- 4567-40-DWG-CI-32004 – Perry Gulley TSF sand stacking area - drainage and flood protection berm details

The diversion drains proposed for the Project will be designed in accordance with the relevant drainage standards and site management plans. In particular, the Erosion and Sediment Control Plan for the Project and the relevant engineering design guidelines, most notably, Australian Rainfall and Runoff (ARR 2019).

Question 10

As part of the preliminary design of the TSF, consideration was given to the following aspects of the TSF in relation to lining:

- The nature of potential leachate;
- The permeability of the stored tailings;
- The nature of the founding material beneath the facility.

Each of these matters is considered below.

Nature of the Possible Leachate

In the mineral processing used to generate the fines waste to be stored in the TSF, no potentially harmful chemicals are added to the process stream. The only addition to the tailings, apart from fresh water, is a flocculant used to aid the thickening process prior to discharge. This flocculant is not regarded as being potentially harmful to the environment – see expert witness statements of Ivan Seracik and Robert Loch.

Permeability of the Stored Tailings

There has not been any direct measurement of permeability of the fine tailings, although a Rowe cell test was completed on a sand/fines mix. This test incorporated measurement of permeability at the end of each loading stage. For combined sand/fines slurries of the mix proportion tested, the permeability measured relates directly to the properties of the contained fines slurry.

At the end of the Rowe cell test (under maximum pressure), the effective density of the contained fines and water in the mix was significantly lower than the anticipated density of the fine tailings at the base of the facility (1 00 t/m^3 c.f. 1.43 t/m^3) - the permeability measured was 4 x 10^{-9} m/sec.

There are also empirical equations by Hazen, Alyamani and Sen and Sherard which estimate permeability from grain size analysis. Application of these equation estimated the permeability of the fine tailings to be in the order of 5 x 10^{-9} m/s to 1 x 10^{-9} m/s.

Engineered liners for waste storage facilities typically provide for a similar level of permeability, so it was concluded that inclusion of a liner would not enhance the security of the facility.

Nature of Founding Materials Beneath the TSF

Preliminary geotechnical investigation has shown the TSF will be founded on the upper clay unit of the Haunted Hills Formation which has been shown to be stiff to hard with moderate plasticity. It is anticipated that this will be of low permeability, although a complete geotechnical assessment of the TSF incorporating physical properties of foundation material would need to be conducted as part of detailed design.

<u>Question 11</u>

TSF Construction

The TSF would consist of four cells constructed in two stages, with the raise for the second stage constructed by downstream raising of the perimeter walls. Preliminary details of the construction are included in Section 8.5.2 and 8.5.3 of the draft Work Plan at EES Attachment B.

No spillways are to be installed in the initial stage of construction for so long as the available storm storage capacity above the tailings exceeds the volume which would be required to contain a 1 in 10,000 ARI storm event. Construction of the second stage of the TSF would be timed so the construction is completed prior to the available storm storage falling below this requirement.

In constructing the second stage of the TSF, a spillway on the dividing wall between Compartment 3 and Compartment 1 would be constructed, and for Compartments 1, 2 and 4, spillways through natural ground to north would spill to a flume along the north directing flow to the north-east corner of the TSF for discharge to Perry Gully, the mining void or Long Marsh Gully. Please refer to Figure 8-2 in EES Appendix B which depicts the location of the compartments

Tailings Deposition

Fine tailings as the thickener underflow would be delivered in rotation to the cells to a depth if 1 m in each rotation. In each cell, the tailings would be subjected to a period of quiescent consolidation and evaporative drying before commencement of accelerated mechanical consolidation (AMC) (Mud Farming). The AMC will allow the tailings to increase in density.

Tailings would be deposited via a ring main around each cell with discharge from multiple spigots, with management maintained to ensure flow of surface water (decant and rainwater) towards the decant collection.

Deposited Tailing Properties

It is anticipated that after AMC and ongoing self-weight consolidation the average density of the stored tailings will be in excess of 1.4 t/m3. No rheological testing has been completed on the fine tailings slurry but rheological testing of a slurry of sand and fines has been completed which provides guidance. It is estimated the solids concentration of the fines/water component would be 55% (w/w), with a shear strength of about 50 Pa. Extrapolation of these data to the anticipated solids concentration of 70% after AMC in the TSF indicates that the shear strength of the fines may be around 200 Pa.

Decant & Stormwater Management

Decant facilities would be included in each cell of the TSF to optimise the recovery of decant and storm water to maximise water recovery and promote evaporative drying and operation of AMC.

Safety requirements

The design and operation of the TSF would be in accordance with best practice with minimum obligations as established by appropriate regulatory and practice guidelines including the following:

- ANCOLD 'Guidelines on Tailings Dams, Planning, Design, Construction and Closure – Revision 1' (July 2019); and
- Victoria State Government (Department of Economic Development, Jobs, Transport and Resources), 'Technical Guideline – Design and Management of Tailings Storage Facilities', (April 2017).

<u>Question 12</u>

TSF Capacity

The TSF capacity is described in Table 8-1 of EES Appendix B and reproduced below:

Fines TSF Storage Characteristics

Stage	**Top of Embankment**	**Storage Volume (Mm^3)**	**Cumulative Storage Volume (Mm^3)**
Stage 1	RL 128.5	4.2	4.2
Stage 2	RL 133.0	2.6	6.8
Total		**6.8**	

Note that Section 8.5.1 of the draft work plan at EES Attachment B refers to the total capacity of the TSF being 9.17Mm^3. This volume was under consideration during the early design phase of the project, but as the Project design evolved the capacity was reduced to 6.82Mm^3. The reference to 9.17Mm3 is an error, and was presumably missed during the editorial review of the draft work plan.

Mine Contact Water Discharge

Surface water modelling has been undertaken for the site and is provided in the EES technical reports (EES Appendix 006 and its appendices prepared by Water Tech). Preliminary designs have been prepared for the first catchment dam in Perry Gully, as that is the commencement stage dam (see response to RFI #8). However, the same design principles will apply to all the catchment dams.

The Perry Gully dam has a capacity of 375,000m^3 based on the 1:100 yr 72hr design event for a 280ha catchment. The embankment design is for the top crest level at RL 66.5, the full storage capacity for the 1:100 AEP rainfall event at RL 63.5, and the spillway overflow at RL 64.5. The spillway design capacity is for a 1:2,000 Annual Exceedance Probability (AEP) Critical Rainfall event of 285 mm over a 24-hour period, with an estimated peak discharge capacity over the spillway of 20.8 m3/s.