Fingerboards Mineral Sands Project Inquiry and Advisory Committee
Direction 59(c) of 29 January 2021 - Impacts of the use of centrifuges on EES study areas

Study area	Impact	Cross-reference
Biodiversity	• Inclusion of centrifuges will slightly reduce the water requirement assessed in the EES from 3 GL/year to around 2.9 GL/year, which will result in a slight reduction in potential impact to aquatic environments, including the Mitchell River. This is a neutral or slightly positive change. • Elimination of the temporary TSF will reduce truck haul distances within the Project area during the first years of mining. This reduction will potentially reduce potential impacts to ecological values associated with vehicular collision (fauna road mortality), noise and dust. This is a positive change. • Otherwise, the centrifuges are not anticipated to alter the results of the ecological impact assessment.	Refer to section 1.2 of the supplementary witness statement of Aaron Organ dated 8 February 2021.
Groundwater	• Inclusion of centrifuges will slightly reduce the water requirement assessed in the EES from 3 GL/year to around 2.9 GL/year, which will result in a slight reduction to the amount of borefield make up water required. This is a neutral or slightly positive change. • Centrifuges improve the reliability of the water balance given they involve a controlled, mechanical process that is not affected by weather, evaporation rates or slurry tailings deposition methods. This is not a change to the environment effects per se, but enhances confidence in the estimated water required from surface and groundwater resources, and the associated impacts of water extraction and water use. • Centrifuges would process a proportion of the sand tailings stream (due to a large cut off particle size), reducing the slurry volume directed to the sand stackers, which discharges directly into the pit voids. This reduces the amount of seepage from coarse sandy tailings to the water table from 1.7 GL/year to 1.15 GL/year, a reduction of 32%. This would result in a significant reduction in	Refer to paragraphs 2.1 and 2.2 of the supplementary witness statement of Hugh Middlemis dated 5 February 2021. Refer to section 4 of the supplementary witness statement of Joel Georgiou dated 7 February 2021. Refer to section 5.2 of the supplementary witness statement of John Sweeney dated 8 February 2021.

	the modelled groundwater mounding presented in the EES. This is a positive change.
	
	• Elimination of the TSF eliminates the potential for seepage from the TSF to:
	  o contribute to raised water groundwater levels; and
	  o negatively impact groundwater quality.
	
	This is a positive change.
	
	• Elimination of the TSF also eliminates potential for TSF seepage impacting on any spring fed dam located within the same catchment as the TSF. This is a positive change.
	
	• Flocculant used in the centrifuges will be used sparingly and the majority of it will adhere to the fine tailings cake, not the process water. The flocculant to be used is polyacrylamide (**PAM**), which degrades to form nitrogen, ammonia, carbon dioxide and water. It is not considered harmful to aquatic organisms and does not cause long-term adverse effects in the environment. Further work is recommended during detailed design to determine the concentrations and flux of total nitrogen and ammonia that might be generated if residual PAM degrades in the mine void and seeps into groundwater. The initial assessment is that potential impacts of these compounds on groundwater is likely to be very low and therefore, this is expected to be a neutral change.	

Surface water	• Centrifuges significantly improve water efficiency and results in a slight reduction in the amount of water required for the project. This is a slightly positive change. • The elimination of the temporary TSF will eliminate the risk of dam failure and contamination in downstream waterways. This is a positive change. • The elimination of the temporary and in-pit TSFs allow for quicker rehabilitation time, both of which reduce the overall area of disturbance at any given time. With the smaller disturbance footprint, and the highly controlled nature and quality of centrate produced by the centrifuges, the overall water quality	Refer to section 3.3 and page 10 of Appendix A of the supplementary witness statement of Jarrah Muller dated 8 February 2021. Refer to section 2 of the supplementary witness statement of Tony McAlister dated 8 February 2021. Refer to section 2 of the supplementary witness statement of James Weidmann dated 7 February 2021.

	management regime at the site will be easier to control, test and operate. This is a positive change. • Additional use of flocculant may change the pH of the centrate and/or introduce other sources or compounds of additional concern into the centrate (e.g. dissolved aluminum), depending on the flocculant used. However, these concerns are readily manageable, especially given the localised and controlled manner by which centrate will be produced. With management, this is a neutral change. • The use of centrifuges in combination with flocculant is likely to reduce the concentration of metals in the returned process water following a single pass through the processing circuit. The effects of the improved water efficiency and closed loop system are likely to cause increased concentration of solutes over time. During detailed design, further investigation will be undertaken to predict long term average process water quality for total and dissolved metals, as well as other water quality parameters such as total dissolved solids, nutrients and other solutes that may concentrate over time. This may require management, but is not expected to have any impact on surface water. • Fine tailings cake from the centrifuges may accumulate in a temporary stockpile of up to 3,600m^3 before being hauled to the mine void for disposal. The stockpile presents a water quality hazard if run off does not report to the water management dams – this should be required as part of the detailed design of the Project. With management, this is a neutral change. • The inclusion of centrifuges will affect elements of the hydraulic assessment, but not the overall outcomes or recommendations. In particular: o The hydraulic modelling included the TSFs in the design surfaces. Elimination of the TSFs reduces the storage available for rain capture. However, this is unlikely to adversely affect flooding given the elimination of the TSFs also reduces the disturbance footprint at any point in time.	Refer to section 5.2 of the supplementary witness statement of John Sweeney dated 8 February 2021. Refer to section 2 of the supplementary witness statement of Michael Cheetham dated 8 February 2021.

	o A reduction in the pre-mining disturbance footprint allows existing landforms and catchment boundaries to be more readily maintained, which is a key to flood mitigation. o Water extracted from fine tailings via the centrifuges will be returned to the process water dam. Centrifuges will not impact the operation of the water management dams which, when drawn down, provide freeboard and act as a buffer to attenuate flood impacts. This is a neutral change. • Centrifuges reduce the Project water requirements due to reduced water losses to tails. This will result in lower utilization of the freshwater dam and higher volumes of water stored in the freshwater dam for longer periods. If the freshwater dam is full, it will not be possible to operate the DAF plant to treat mine contact water as it will not be able to be stored in the fresh water dam. This increases the probability of the dams spilling and filling. Mine year 8 has the highest probability of spill, with 3.4% spill probability from dams in the Mitchell River catchment, 0.9% in the Perry River catchment. Over the life of the mine, the average annual probability of a spill in the Mitchell River catchment is around 1.4%, and around 0.5% in the Perry River catchment. With management, this is a neutral change.	
Air quality	• Broadly, modelling of dust emission rates with centrifuges included in the Project, shows little change to the EES modelling. By using centrifuges, dust emissions from overburden haulage and vehicle exhaust emissions are reduced due to shorter haulage distances. However, the additional haulage of cake from the centrifuges to the mining void is a new dust source, which increases dust associated with tailings management. o In year 5 operations, use of centrifuges reduces the total estimated emission rate of TSP and PM10 but the total emission rate of PM2.5 increases by 1%. o In year 8 operations, use of centrifuges increases the total estimated emission rate of TSP by 1% and PM10 by 2%, with no change to the emission rate of PM2.5.	Refer to section 4 of the supplementary witness statement of Simon Welchman dated 9 February 2021.

	o In year 12 operations, use of centrifuges reduces the total estimated emission rate of TSP and PM10, with no change to the emission rate of PM2.5. On balance, this is a neutral change, with slight positive and slight negative changes, depending on the mine year. • Dust dispersion modelling indicates that standard and additional mitigation measures are required to achieve air quality criteria for 24hr average concentrations of PM10 at all receptors with or without centrifuges. However, in the centrifuge scenario, there will be fewer exceedances using just standard mitigation than in the EES scenario. This is a slightly positive change. • Modelling indicates that by adopting specified mitigation measures, the Project using centrifuges would comply with the SEPP AAQ environmental quality objectives for PM10. This is a neutral change.	
Greenhouse gas (**GHG**)	• Inclusion of centrifuges would use approximately 10,194 MWh of electricity per year in total, which will have associated GHG emissions of approximately 10,400 $tCO_{2\text{-}e}$ per year. This would represent a 15% increase in GHG emissions if no other changes to the Project were made. • However, using centrifuges means that amphirols are no longer required to dewater fine tailings, which eliminates their associated GHG emissions. Also, given the reduced haul distances, GHG emissions associated with diesel fuel use are reduced. While a complete GHG inventory for the Project with centrifuges has not yet been prepared, it is expected that total GHG emissions with centrifuges will not be significantly different from the estimates in the EES and will therefore be a neutral to slightly negative change.	Refer to section 4.5 of the supplementary witness statement of Simon Welchman dated 9 February 2021.
Noise and vibration	• Centrifuges eliminate the need to construct the temporary TSF and the in-pit TSFs, and the need for amphirol plant, which are the primary noise sources associated with the TSF. The predicted noise levels for the centrifuge based option are below the recommended levels in EPA Publication 1411 *Noise from Industry in Regional Victoria* for the day, evening and night periods. These levels are generally comparable to the TSF based option, with increases of up to 2dB (typically 1dB),	Refer to page 3 of the supplementary witness statement of Christophe Delaire dated 8 February 2021.

	and reductions of up to 4dB (typically 1dB), depending on the receptor. On balance, this is a neutral change, with slight positive and slight negative changes, depending on the receptor and the mine year.	
Radiation	No impact.	Refer to section 3.4 of the supplementary witness statement of Darren Billingsley dated 8 February 2021.
Roads, traffic and transport	• Elimination of the temporary TSF reduces internal haul distances during the first years of mining as trucks hauling overburden will no longer need to travel around the TSF. This is a positive change. • Impacts from a roads, traffic and transport perspective on the public transport are expected to be minor and do not require additional mitigation measures. o The construction of the centrifuge buildings will result in few additional construction vehicle movements – less than 5 return trips per day over a 2-3 month period. This is expected to be a combination of light and heavy vehicles and is unlikely to require over-dimensional loads. o During operations, use of the centrifuges may require some additional internal hauling activities – likely to require 3 additional operations staff which will generate 3 additional light vehicle return trips per day. This is a neutral or slightly negative change.	Refer to TN01 and section 4 of the supplementary witness statement of Paul Carter dated 8 February 2021.
Land use and planning	No impact.	Refer to section 2 of the supplementary witness statement of John Glossop dated 8 February 2021.
Landscape and visual	To be confirmed.	Additional photomontages are being prepared by Urbis and will be provided as soon as possible.
Agriculture and horticulture	Inclusion of centrifuges means the ratio of jobs created per ML of water used by the Project improves. Otherwise, no impact.	Refer to the supplementary witness statement of Doris Blaesing dated 8 February 2021.

Cultural heritage	No impact – the centrifuges will be located within the same Project footprint as the TSF option and impacts on cultural heritage will be managed in accordance with the approved cultural heritage management plan.	See Figure 8 in TN 01 and TN 008.
Socioeconomic	Many submitters raise concerns about the temporary TSF. Inclusion of the centrifuges removes the need for the TSF and any risk associated with it, which in turn is expected to allay some concerns of submitters. While some submitters may also be concerned about the use of centrifuges, the impacts of the centrifuge will typically be neutral or less than the TSF.	See for example, section 2.19 of Tabled Document 107.
Human health	No impact.	Refer to section 3 of the supplementary witness statement of Karen Teague dated 8 February 2021.
Rehabilitation and closure	• Elimination of the TSFs will eliminate the delay required for each TSF to be filled and dried, which allows for continuous backfilling of voids and earlier commencement of rehabilitation. This is a positive change • Earlier commencement of rehabilitation may reduce the area of land disturbed at any one time and the amount of topsoil required to be stockpiled during the first years of mining. • Earlier commencement of revegetation will reduce post closure monitoring duration. This is not a change to the environment effects per se, but it is a positive change for the Project. • The dry fine tailings from the centrifuge will be placed in mine voids, and are unlikely to be used in manufacturing subsoils for rehabilitation. Nevertheless, if this was proposed then a procedure will need to be developed for breaking any dried lumps of fine tailings to a finer particle size so they can be mixed with sand tailings. It is likely that the mixing of fine dry tailings of a suitable particle size (probably in the order of <5mm) with sand tailings could be mixed thoroughly and evenly. This is a neutral change.	Refer to section 2 of the supplementary witness statement of Michael Cheetham dated 8 February 2021. Refer to paragraphs 9-13 of the supplementary witness statement of Robert Loch dated 6 February 2021.