Community Supplementary Submission

Centrifuges
in the proposed
Fingerboards mineral sands mine

Auspiced by

Mine-FREE MFG GLENALADALE

PREFACE

We would like to acknowledge the Gunaikurnai people and their elders, past present and emerging as the traditional custodians of the land.

The current situation has generated opportunities for friendships to be developed, knowledge shared and relationships to grow. We trust this will continue into the future and allow more opportunities for people to be “On Country”.

We thank the numerous people who have been involved in the preparation and writing of this supplementary submission. The care, passion and support shown and expressed in so many different ways has been heart-warming and humbling for a community placed under so much unnecessary stress for the past seven years.

Our gratitude goes out to all of you.

Note: Images courtesy of Mine-Free Glenaladale unless otherwise specified

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EXECUTIVE SUMMARY

The proponent advocates their need for the mine on behalf of its shareholders. The wider community views the proposal through the lens of its long-term understanding of the land and its values; from the past, now in the present and also in the future, and is deeply concerned about the potential impacts and the risks they pose.

The use of centrifuges was put forward very late in the assessment process by the proponent following discovery of their fundamental error in estimating the quantity of water required for the proposed Fingerboards project. This “solution” has been poorly considered, with documentation being trickled out, provided late and lacking detail. Some of the documentation is contradictory, with a number of the proponent’s experts appearing confused about the proposal.

The environmental effects relating to the introduction of centrifuges and the associated risks have not been comprehensively presented. Numerous significant areas of risk and impact have been overlooked, understated or ignored.

Many members of the community are concerned that the centrifuge option is uneconomic, and has only been suggested to ease the approval process. Should the project be approved it would be a simple matter to lodge a Work Plan Variation to reinstate the Tailings Storage Facility option instead of the centrifuges. Work Plan Variations are evaluated on the basis of proponent supplied documentation (with no independent scrutiny), are evaluated by ERR (without the requirement for other regulators to be involved) and has no requirement for public exhibition.

Some of the major issues with the centrifuge option include:

- The late inclusion of an option - examined by the proponent in 2018 - has not allowed scrutiny by the Technical Reference Group. No independent oversight by a range of regulators has been undertaken. There has been no independent evaluation of the range of impacts and how they interact.
- The speed at which documentation around the centrifuge option is being generated and posted makes it likely that key issues will be missed or not examined.
- Obligations under the MRSD Act 1990 have not been met in demonstrating that the mining of the mineral resource will be economically viable. No updated economic impact assessment has been presented in light of the significant increase in capital and operating costs with the introduction of centrifuges.
- EES Scoping requirements have not been evaluated nor met.
- Centrifuges have not been used in the mineral sands mining industry before as they are not an economic option. After close scrutiny it is difficult to see how this proposed project could be technically or economically viable.
- The impacts of noise have been gravely understated. Inappropriate test results have been used as the basis for statements by the proponent regarding noise impact. Guidelines and standards appear to have been ignored.

- The impact of the vastly increased quantities of flocculants has not been thoroughly assessed:
    - Research shows the polyacrylamide flocculants can break down into highly toxic acrylamide monomers under anaerobic conditions which has significant implications for human and animal health;
    - Changes to the physical properties of the fine tailings when subjected to the high levels of flocculants, anaerobic conditions and pressure have not been evaluated; and
    - Ecological impacts, especially those relating to aquatic life-forms and groundwater dependent ecosystems have not been considered; and
    - The impact of leaching into ground and surface water has not been fully assessed.
- The process water will have increased levels of contaminants compared to the Tailings Storage Facility (TSF) option. Impacts on seepage into groundwater systems have not been evaluated.
- Centrifuges are associated with major industrial accidents, especially when they “break free”. No accident prevention strategies have been evaluated.
- Impacts from dust have been understated. Dust (with contaminants) will be generated from the stockpiling of the centrifuged tailings and from the traffic and machinery required to transport and work the tailings in the pits.
- Impacts on the dispersive soils within the proposed project area have not been adequately considered:
    - Possible liquefaction of the soil during wet seasons triggered by vibration from the centrifuges;
    - Increases to tunnel erosion from water pooling from the centrifuge housings/foundations; and
    - Centrifuge housing foundations concentrating subsurface water transport and creating flow surfaces.
- The rehabilitation plan originally used fine tailings in the creation of a “manufactured subsoil”. There has been no discussion regarding substitutes for the fine tailings in the rehabilitation process.
- Impacts to existing downstream users, including the crucial horticultural industry from contamination to surface and groundwater through seepage, spills and overflows have not been adequately addressed.
- Increases to greenhouse gas emissions and climate change due to the increased electricity use have not been evaluated.
- Processes and impacts for unexpected or premature closure have not been considered.
- Rehabilitation plans for the centrifuges, their structures and associated plant and infrastructure have not been developed.
- Decreases to the quality of electricity supply, especially on centrifuge start-up, have not been evaluated.

The centrifuge proposal gives the appearance of being hastily put together; somewhat like the biblical house built on sand or the first house of the three little pigs that was built of straw. The proposed Fingerboards project has not been competently considered on a holistic basis, but rather as a series of simplistic pieces that have been cobbled together.

This approach is of grave concern given the highly complex landscape, range and number of impacted businesses and homes, diversity of ecosystems and difficulty of the engineering tasks involved.

The summary of Dr Jasonsmith's Supplementary Expert Witness Statement is to the point:

> "My findings in relation to my review of the Fingerboards Technical Note can be summarised as follows.
>
> i) The Technical Note does not contain a commitment from the proponent to use centrifugation at the Fingerboards site should the project be approved;
>
> ii) The hazards, risks, and consequences presented by the use of flocculants, stockpiling, and other activities related to the use of centrifuges at the proposed Fingerboards mine were not considered;
>
> iii) Evaluation objectives relevant to tailings within the "Scoping requirements for Fingerboards Mineral Sands Project Environment Effects Statement" dated March 2018 (the Scoping Requirements) were not considered; and
>
> iv) The Fingerboards Technical Note is a brief document that does not present an assessment of the potential impacts of the discussed centrifuges and associated tailings on soil, groundwater, or surface water." (Jasonsmith, 2021, p. 2)

Tailings storage facilities are toxic and fail with distressing and disastrous regularity. The Centrifuge option will result in tonnes of polyacrylamides breaking down into toxic acrylamide monomers and thus create other significant issues such as the destruction of the existing agricultural industries, including the multi-million dollar horticultural industry.

In conclusion, the only realistic option is to focus on the existing long-term, sustainable agricultural industries rather than proceeding with the proposed mine project in any form. Many more jobs both direct and indirect would be created if the massive water needs for the proposed Fingerboards project was redirected to the horticultural and agricultural industries.

INTRODUCTION

The proponent publicly introduced the possibility of utilising centrifuges as an alternative to their proposed Tailings Storage Facility - well after the close of the EES public exhibition period. Given that the proponent had clearly investigated the use of centrifuges in 2018 based on the Alfa Laval report (Alfa Laval Australia Pty Ltd, 2018), this late introduction appears to be a ploy to avoid close scrutiny of the option in an effort to keep the proposed project alive.

Alternative Technical Documentation

One of the requirements of the EES Scoping document was to document any technical alternatives, with a discussion as to the reasons for their rejection. The centrifuge option was not documented in the exhibited EES. Reference was made in the Expert Witness Statement by Ivan Saracik to tests conducted by Alfa Laval in 2018 (Alfa Laval Australia Pty Ltd, 2018). Given that the proponent was looking at centrifuges in 2018, why was the centrifuge proposal not discussed as part of the submitted EES?

Incorrect Assumption

It is incredible that after a four year EES preparation period, a basic assumption impacting on the volume of water required has been "discovered" to be so extraordinarily in error; 5.7GL rather than the 2.8GL that was previously specified. What other basic assumptions are also in error? This is a crucial question as the proponent's Expert Witness Statements state they are based on data and assumptions provided by the proponent.

Inadequate Community Consultation & Information Provision

The quantity of water to be used - and its source - has been raised by the community at every community "consultation" event conducted by the proponent. Clearly very little heed has been taken of the results of community "consultation".

The lack of timely provision of detailed information to the public is concerning. There has been plenty of rhetoric, but little actual data provided. This latter includes, for example, the specifications of the centrifuges - which were provided by Alfa Laval to the proponent.

Repeated requests for the specifications from the proponent by community members have resulted in the reluctant provision of mainly brochures containing very little specific and technical information. In addition, these brochures have been drip-fed after repeated requests. This has allowed very little opportunity for scrutiny of the proposed change to centrifuges, and consequently limited evaluation of hazards and risks.

The most recent version of the proponent's draft work plan was released on the afternoon before the close of supplementary submissions. Many people will have already submitted their Supplementary Statements.

Due to the ridiculously short time-frame this imposed on those trying to review the amended proposal, this document has not been able to be considered within this Community Supplementary Submission. The release of critical documentation so late in the process by the proponent indicates a lack of respect for the community, the process and the IAC. Mine-free Glenaladale reserves the right to address issues arising from the revised work plan during the hearings.

Disturbing Statements

There are numerous examples of disturbing statements made throughout the proponent's documentation. One such example from Mr Saracik: *"It is therefore with absolute confidence that I say if the product is safe to be added to the Bairnsdale drinking water, it must be safe too to add to the centrifuge circuit on the Project."* (Saracik, 2021, p. 9).

This statement is astounding. Many compounds are regarded as being safe in extremely low doses/ concentrations (such as that used in Bairnsdale's water supply), but toxic in more concentrated forms. Selenium and other trace elements are used as mineral supplements for people and livestock; safe in tiny doses but toxic at still relatively low doses. Paracetamol is a specific example of a pharmaceutical which in low doses provides effective pain relief, but sadly has been used in large doses for suicides.

Inaccurate and unscientific statements erode credibility and confidence in the "expert", the proponent and in the proposed project.

Complex Process

Many members of the community are struggling with an EES process that has become extremely complicated. Our community's lack of widely available internet and computer access or very slow internet connections that drop out, in combination with the huge number of tabled documents (over 200 so far), changes to timetables and varying forms of "hearings" (directions hearings, public hearings, zoom, face to face) means that members of the public who would like to participate have found it to be just 'too hard'.

It seems extraordinary that our community members have to go to such lengths to defend ourselves from a flawed proposal. The proponent has the luxuries of paid staff, time to prepare the EES document, the financial ability to recruit "experts" to support their viewpoint. They also appear to have the option of suddenly proposing major changes to the project after the EES process has closed for public submissions and shortly before the commencement of the hearings.

Community members are provided with a short period of time in which to review the documentation. They also have to do so within the context of concurrently running their own businesses and lives. Recruitment of independent experts is problematic when the community is not involved in these fields of expertise, has no "connections" and lacks resources.

Many local businesses have suffered financial loss as their managers/owners and operators focus on reviewing documentation and preparing responses, rather than focusing on their business. Our community members are making a huge effort to protect ourselves from a proposal which has been poorly developed and documented, and is financially dubious.

The future of our long-term sustainable agricultural industries, including our essential horticultural industry, relies on the availability of our clean water, uncontaminated soils and our clean, green image. There is far too much at risk for the proponent to use the proposed Fingerboards project as a large-scale experiment.

ISSUES OF CONCERN

Timing

The proponent's major modification to its proposal - after the EES had been closed to public comment - has resulted in the community being put under further and unnecessary pressure in many areas. These include the significant additional cost to source, retain and brief expert witnesses - as well as a new barrister - in order to respond to these changes.

The proponent's reasoning for the major modification with the introduction of centrifuges was touted to be in response to community concerns expressed in submissions in relation to the major issues and risks associated with a tailings dam.

The issue of the location and risks associated with a tailings dam (which worryingly grew from sixty to ninety hectares) was raised very early on during community consultations at public meetings run by the proponent. Yet the proponent waited until after the EES documentation was finalised and submitted to suggest a modification that has not been used in mineral sands mining before.

Even with the postponement of the IAC Hearings, adequate opportunity has not been provided to fully and appropriately examine the centrifuge concept. The proponent has not attempted to explain it to the community, short of providing documents which could only be accessed via Engage Victoria's Web Page. The late presentation of this option suggests that this was a ploy to avoid close scrutiny.

In the centrifuge report it mentions that the proponent trialled centrifuges in WA in 2018. The proponent also mentions it in their 2019-2020 Financial Statement. Obviously there were significant limitations to their use; otherwise surely the proponent would have included them in the EES and mentioned their use and benefits to the community at their public meetings? Particularly given that these were where there were so many serious and constantly repeated concerns, complaints and protests about the size, location and treatment of the 90 Ha tailings dam so close to the Perry River and Chain of Ponds.

Document 43 was only made public in mid-January, despite there being evidence that the proponent had been discussing centrifuges with the East Gippsland Shire Council at least a month earlier (Planology, 2021). So the question has to be asked - why was there such a delay in making this information public?

It appears to be another example of the proponent ignoring the community and paying scant regard to their concerns. The hurried changes are neither for the benefit of our community nor for our environment, but simply to gloss over a massive error in order to facilitate approval for their project.

Technology

As centrifuges have not been used in the mineral sands mining environment before, conventional risk frameworks are difficult to apply; the risks, probabilities and/or impacts are unknown. Under the Cynevin Framework (Snowden, 2020), this moves the quadrant for decision making from Complicated (a range of experts/specialists will probably agree as to the best course of action) to Complex (experts/ specialists will have a range of opinions on the best course of action). Within the Complex Quadrant decisions regarding new concepts/technologies are best made following extensive field trials. These have not been undertaken.

The EES proposes one wet concentrator plant (WCP), to which slurried ore from the two mining unit plants is pumped for separation. Fine tailings (slimes) are to be treated with flocculant, and then thickened in a large tank called a "thickener". If centrifuges are to be used, thickened slimes will be treated with flocculant and then centrifuged to remove excess water and in theory produce a stackable "cake" containing 65-70% solids.

Technical Note 01 appears to completely misunderstand this process. Section 6 states that:

> "As the project entails two mining unit plants (MUP) in two separate areas, two centrifuge plants would also be required." (Kalbar Operations Pty Ltd, 2021c, p. 7)

It goes on to state:

> "The centrifuge plants would be located in close proximity to the mining area in order to reduce the overland haul distance of the centrifuge cake back to the mining void, and thereby minimise noise and dust generation. Based on the preliminary mine planning it is anticipated that each centrifuge plant would be relocated to a new position every four to five years" (Kalbar Operations Pty Ltd, 2021c, p. 7).

Relocation is an incredibly expensive exercise given the massive concrete foundations and tremendously deep pylons needed because of the 'weakness' of the Coongulmerang Formation.

Given the proponent's fundamental misunderstanding of where centrifuges fit into the processing procedure, it appears that there isn't much that is really technical in the inappropriately named Technical Note 01.

Saracik in his expert review of the technical note makes no comment that the centrifuges follow the WCP rather than the MUPs during processing, casting doubt on the thoroughness of this review (Saracik, 2021).

It would of course be possible to pump the thickened slimes slurry from the WCP to centrifuges located near the mining voids. This would necessitate the construction of additional pipelines, additional pumps and more electricity to power them. It would reduce the haul distance needed to truck the fine tailings "cake" to the mine void. Offsetting this would be the fact that slurry would no longer be pumped to the TSF.

Neither Saracik nor Technical Note 01 documents make any estimate of the electricity required to run the centrifuges. However, Welchman (Katestone, 2021, p. para 45) was advised that they would require approx. 10,194 MWh per annum which equates to 10,400t CO_2 equivalent.

The MUPs require electricity for a vibrating screen and for water and slurry pumps. The WCP requires electricity for multiple pumps for water and slurry, and possibly screens and magnets. Welchman (Katestone, 2021, p. 5) estimated the electricity requirements of these to generate 500,000 t CO_2 equivalent over the life of the project.

Using the power/CO_2 ratio of the centrifuges, this totals 490,000 MWh. Using the centrifuges for fifteen years will increase total electricity consumption requirements by about 24% over the project lifespan.

Section 7 of TN01 (Kalbar Operations Pty Ltd, 2021c, p. 7) does state that a review of the modelling used to estimate the recovery of water from the Temporary Tailings Facility (TSF) using amphirols was markedly over estimated. It is unclear what gave rise to the original estimate, but flocculant manufacturer Nalco (Nalco, 2015, p. 3) in promoting their "WATERSHED" tailings treatment claim that water usage for the project could be reduced from 5.7 to 2.8 GL/year.

As it is now recognised that this estimate was flawed, some doubts must be raised about Nalco's other claims regarding flocculant use for the thickener and centrifuges. Details of the revised modelling are not provided, but the original flawed model was accepted both by the proponent and the original suite of expert witnesses. It seems inconceivable that during the four years preparation of the EES that such a major error could have been undetected - until after publication of the EES.

In both the technical note and its review, it is accepted without question that the thickener will remove supernatant water and thicken the slimes slurry to 30-35% solids. Given the comments above, this may not be the case.

According to the draft work plan (Kalbar Operations, 2021a, p. Fig 5.1), 5,747 m^3 (5.747ML) of water will flow into the thickener each hour, of which nearly 88% is expected to flow through, with 700m^3 remaining in the slurry. There has been a range of slimes content as a percent of ore given: 21% (Kalbar Operations Pty Ltd, 2021c), 23% (Kalbar Operations, 2021a) and 25.1% (Kalbar Operations, 2021a).

At a process rate of 1,500 tonnes of ore per hour (Kalbar Operations, 2021a, p. 5.2) these equate to 315, 345 or 376.5 tonnes of slimes per hour. Mixed with 5.47 m^3 of water they come to 5.2%, 5.7% or 6.1% respectively entering the thickener.

Nalco (Nalco, 2015, pp. 4-5) undertook settling rate trials in the laboratory using a range of flocculants. They determined that Nalco 83384 was the most economical of the anionic polyacrylamide flocculants tried, giving a settling rate of 10m/hr at 130 g/t under ideal calm conditions.

They added the proviso that it was very important to dilute the slurry as thickener feed to less than 3% w/w. This condition is not met for material leaving the WCP.

Nalco did provide a conceptual design for a thickener. However their assumptions for the characteristics of the input material do not match those provided by the proponent, so it is uncertain whether their design has been adopted.

The proponent does not appear to have provided the design of the thickener they intend to adopt. It is uncertain whether it will perform as hoped with the flocculant concentration intended. Rather than undisturbed settling within a laboratory situation, there will be rapid water movement with likely turbulent flow in the thickener.

Alfa Laval (Alfa Laval Australia Pty Ltd, 2018, pp. 1-9) confirmed that a 25% suspension (w:w) of slimes, with 340g/tonne solids of flocculant added, could be successfully concentrated to 70% solids in a laboratory bench top centrifuge. The addition of flocculant was essential for separation. They believed that dewatering decanter centrifuges could be used successfully to dewater the fine tailings.

However, it must be noted that any laboratory tests which:

- Do not describe the machine used for testing, nor state whether it was a commercial machine or a scaled down model;
- Do not provide a report on the quality of the separated fluids;
- Do not give any indication of the amount of tailings fed into the system, the length of time it was fed in for or the rate of feed;
- Do not have a chain of custody for samples - *"the age and origin of the sample is unknown to Alfa Laval"* (Alfa Laval Australia Pty Ltd, 2018, p. 3) and
- Do not process a number of samples from across the proposed mine site, given the project intends to cover 1,675 hectares

…cannot be used to justify that this is an acceptable and workable alternative, and therefore renders risk assessment impossible.

Technical Note 01 (Kalbar Operations Pty Ltd, 2021c, p. 6) states that centrifuges would have a throughput rate of around 55 t/hr solids. If this throughput is correct, 6 operating centrifuges would be able to process 330 t/hr, which would be sufficient to cope with the 315 tonnes throughput projected provided the ore contains 21% fines. This rate would however be insufficient if the 23% or 25.1% figures are correct. Technical Note 14 (Kalbar Operations Pty Ltd, 2021d, p. 3) settles on an average of 321 t/hr.

The centrifuge modification has never been considered by the Technical Reference Group as were other major concerns which led to Peer Reviews.

The successful use of this method in Oil Sands and Coal Tailings (which has a far lower percentage of tailings from their processing) does not mean that it will be successful in mineral sands tailings. The proponent has not produced any evidence to show the similarity between these tailings types.

This demands that:

- There should be further investigation into this process;
- It should not be taken at face value based on the proponent's "say so"; and
- That it must be proven to be viable, practical and effective.

Serious consideration MUST be given to the premise that if a centrifuge system that has been "tested" only under laboratory conditions is to fail, then what is the alternative? The pros and cons of tailings dams cannot be so readily dismissed by the proponent and still require comprehensive assessment.

Further water loss/Seepage

The tests say a 67% solid cake could be produced that is transportable/ spadeable. However no testing has been done to show what happens when that cake is deposited in the mine pit.

Engineers suggest that for the cake to be worked (moved around and positioned by machines working in the pit) the water content should be only about 15%. Therefore more drying will be required in the pit. The pits will act as concentrators for rainfall. Major rainfall events, such as those associated with East Coast Lows, will further saturate the cake, slow drying times, reduce work-ability, and increase issues with seepage, spillage and overflow.

This is unlikely to occur as the depth of the pit means the cake is not exposed to PAN evaporation (wind) forces or sun that promote evaporation of moisture. The only option is seepage through the pit floor.

No testing has been done on cake flocculated at those rates to show if that is likely to happen. It is not known if the flocculant will permanently bind the cake and prevent seepage - in which case it will impact on natural lateral and vertical water movement underground. There are too many unknowns and the risks and consequences are too great for the proposed Fingerboards area to be treated as an experimental site.

The proponent has said they will use pipes at the bottom of the pits. Implementation of this technology at the MCG (and the proposed mining pits are far bigger than the MCG) costs millions. The proposed pipes would need to be spaced about 1-2 metres apart at the bottom of pits and then covered with gravel/rocks. Collected water would be taken to the surface through a sump pump.

What happens to the pipes when the mines are rehabilitated? What are the chances of water seeping through to adjoining pits? Do the Fingerboards lose their capacity to act as a gravel recharge aquifer?

The proponent claims that:

> "Any risk of seepage from fine tailings is removed as this material is fully dewatered to a state that will only retain capillary moisture that cannot seep to the environment" (White & Case, 2021, p. 5).

However, where is the recognition of the ‘hydraulic’ effect? That is, the effect of the weight of materials compacting others and pushing the water out?

Seepage will still occur as the tailings become saturated from water infiltrating from the surface. What are the impacts of seepage water which has been in contact with the toxic tailings and potentially toxic flocculant break-down products?

Flocculants

The additional flocculant use resulting from the centrifuge option will be immense. According to Technical Note 14:

> "The flocculant will be used at a dosing rate of approximately 370 g/tonne of dry solids reporting to the centrifuge. This translates to a nominal (average or usual) dose rate of around 118 kg of flocculant every hour," (Kalbar Operations Pty Ltd, 2021d, pp. 3-40).

At 130g/t in the thickener and 370 g/t in the centrifuge (Kalbar Operations Pty Ltd, 2021d, pp. 3-40) this works out at 3.85 tonnes per day for 321 tonnes slimes/hr - 1400 tonnes per year. At 55c for 130 g (Nalco 2013 price for their WATERSHED flocculant (Nalco, 2015, p. 10)) this comes to $6 million per year. Around $4.4 million is ascribed to flocculant intended for use solely by the centrifuges.

In addition it is proposed to use extra flocculant for dust suppression on bare areas and coagulants as well as flocculants in the DAF. Other compounds are touted to reduce dust on roads. Chemicals will be a major budget item.

TN 14 (Kalbar Operations Pty Ltd, 2021d, p. 39) states that 370g flocculant/tonne x 321 tonnes solids per hour through the centrifuges results in 118 kg/hour flocculant being used. It follows that as the centrifuges will be running continuously, this is 2.83 t flocculant/day or nearly 88 t over a 31 day month. Bulk density of Nalco Optimer 83384 (BASF, 2017, p. 29) is 0.72, which comes to 120 cu m/month.

TN14 (Kalbar Operations Pty Ltd, 2021d, p. 3) also states that a 50 cu m silo will hold enough flocculant for a month. This is clearly incorrect. At the rate proposed it will last barely 13 days.

McAlister (Kalbar Operations Pty Ltd, 2021d, p. 39) maintains that 5 bags of flocculant would be enough for 10 days. Bulka bags normally hold 1 tonne to allow handling by normal forklifts (this would be about 1.4 cu m). Five bags wouldn't even last for 2 days.

In summary, one can have very little confidence in documents that contain such errors.

Impact on horticulture

The increase in the amount of flocculants used will pose significant environmental risks for a number of reasons. These risks arise from the sheer volume of flocculants that need to be frequently delivered and stored on site, the potential for an accident or spill to occur (refer to the Safety Data Sheets for impacts) and risks from leaching into the soil and aquifers/waterways.

Should a spill or a flooding event occur, there is a foreseeable risk of leaching of the flocculant into the local aquifers, spring fed dams, dams and waterways. This would have major negative consequences for users of ground and surface water with risks of contamination. Environmental risks associated with the use of flocculants under the centrifuge option have not been properly assessed nor addressed.

In her second supplementary expert witness statement for Mine-Free Glenaladale, Dr Jasonsmith states:

> "The potential hazard to human health and the environment presented by the use of polyacrylamide [flocculants] depends on a number of factors, including its concentration, and how it will behave and be changed in the environment. Demonstration that polyacrylamide will present an acceptable risk to the environment, at the concentrations used and conditions to which it will be subject at the proposed Fingerboards mine, has not been demonstrated in the Fingerboards EES or associated technical notes." (Jasonsmith, 2021, p. 6).

The horticulture industry, which is as close as 500 metres from the boundary of the proposed project, relies on both ground and surface water to:

- Irrigate the vegetable crops;
- Make ice for transporting them; and
- Wash produce that is washed before packing.

Most of the industry's irrigation water is sourced from the Mitchell River, which flows below the mine site. Should the Mitchell River become unsuitable for irrigation users due to contamination, this would have a major impact on the viability of this major pre-existing Food Bowl industry with concerns such as:

- Loss of food production capability;
- Loss of certification of the horticulture businesses;
- Damage to the reputation of the area for its quality produce;
- Financial losses to the local and State economy;
- Loss of both direct and indirect jobs from the horticulture industry;
- Loss to local businesses for the services they provide to the horticulture industry;
- Interruption and potential permanent damage to the supply chain for local, regional, national and international recipients of the produce; and
- Costs to landholders in legal fees, time and lost production.

Flocculant quantity and impacts to the surrounding environment.

Dr Robert Loch states that he is:

> "...not aware of any information on the long-term mobility, persistence, or breakdown products from such compounds if placed at significant depth in the soil." (Loch, 2021, p. 2) [Underlining added]

He then continues that:

> "...the placement of dried tailings from the centrifuge would deliver considerably less polyacrylamide into the pit than would be the case with wet fine tailings being placed into a TSF." (Loch, 2021, p. 2)

Yet, this clearly contradicts with TN014 page 13:

> "The introduction of centrifuges will mean that additional flocculant will be used for the Project." (Kalbar Operations Pty Ltd, 2021d, p. 13).

Clearly Dr Loch has not researched this topic as extensively as Dr Jasonsmith (see below) and thus is not in a position to make such statements.

If the dosing rate is 118 kg of flocculant every hour for every 321 tonnes per hour of solids, this equates to around 1,000 tons annually mixing with coarse sands forming the base settlement zone at least 20 metres in depth.

The risk of degradation and release of the neurotoxic and carcinogenic acrylamide monomer, particularly in anaerobic environments with high iron content such as the Fingerboards, is very real (Xiong, et al., 2018, pp. 4-6) . Currently, there is little research on the degradability of the flocculant at depth and its impact on the environment.

Nonetheless, the proponent attempts to compare flocculant use in agriculture and other applications. The proponent fails to highlight that the vast majority of its use in the agricultural sector is related to aerobic surface application where it is exposed to sunlight, oxygen & microbial actions. This is totally different to a flocculant as part of a solid cake, being used in the filling process to consolidate an anaerobic subsoil settlement zone at depth.

> "The centrifuge cake will be primarily composed of fine quartz and clays, which are naturally occurring. This will make up 70% of the mass. The remaining 30% of the mass is water, which is retained in the cake. Initially, the concentration of PAM in the centrifuge cake will be around 333 ppm. In the mining void, the centrifuge cake will be placed as backfill, along with overburden, on top of the coarse tailings. In total, the centrifuge cake will represent only 7% - 8% of the total overburden backfill volume. After backfilling, the concentration of PAM is diluted to 13.6mg/kg. PAM will then continue to degrade until it is nearly undetectable after 48 hours and will eventually degrade completely." (Kalbar Operations Pty Ltd, 2021d, p. 5) [Underlining added]

The proponent then contradicts this in the Groundwater Impact in TN 014, p8 by stating that the majority of flocculant adheres to the fine tailings cake; not the process water, but with the residual flocculant degrading in the mine void and potentially seeping into the groundwater.

> "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." (Kalbar Operations Pty Ltd, 2021d, p. 8) [Underlining added]

Additionally, the complication continues for surface water interactions due to the use of centrifuges and less project water requirements:

> "...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." (Kalbar Operations Pty Ltd, 2021d, p. 10) [Underlining added]

In TN 014, the proponent attempts to qualify the

> "...inclusion of centrifuges will have a positive or neutral impact on the environment effects of the Project. Where there is potential for negative environment effects, the negative effect is expected to be slight and manageable." (Kalbar Operations Pty Ltd, 2021d, p. 1)

The addition of approximately 20,000 tons of anionic polyacrylamide (PAM) over the proposed mine life, which will become part of the solid waste returned as anaerobic fill to the mine void for rehabilitation, cannot be deemed slight and manageable as the degradation is unknown. This same concern is relevant to the decommissioning of centrifuge infrastructure; how does one vegetate concrete?

Toxicity of flocculants

Scientific knowledge about flocculants is limited. The proponent glosses over the potential effects of flocculants on human, animal and aquatic health, claiming low toxicity. However "*the dose makes the poison: a chemical in very small doses may not be harmful but deadly in large quantities*." (Paracelsis, 1538).

The quantity of flocculant the proponent intends to use are both concentrated over a smaller area and are far higher application rates than that used by East Gippsland Water in the Woodglen Water Treatment Plant. Each mining pit will end up with thousands of tonnes of flocculant.

We do not know what will happen over time if the polymer softens/liquefies and seeps into groundwater and waterways.

PAM and Human Health

Dr Jasonsmith in her Supplementary Witness Statement quotes research which completely contradicts the benign statements made by the proponent.

> "It has been shown that anaerobic digestion of polyacrylamide by a mixed population of microbes results in accumulation of significant amounts of the acrylamide monomer." (Jasonsmith, 2021, p. 7)

> "Although the acrylamide monomer is a known neurotoxic substance (Erkekglu and Maydar, 2014), polyacrylamide itself is considered to be nontoxic to plants and animals (Seybold, 1994)." (Jasonsmith, 2021, p. 7)

> "The placement of clay-rich and moist tailings directly into the mining void without aeration has the potential to create the anaerobic environment that has been found to drive the conversion of polyacrylamide to acrylamide." (Jasonsmith, 2021, p. 8)

Other relevant research also points to the hazards of the proponent's proposal:

> "Although PAM is relatively nontoxic to humans, animals, fish, or plants, the acrylamide monomer can be absorbed via dermal exposure and inhalation, and it is a known neurotoxin and a potential carcinogen: it is immediately dangerous at concentrations of 0.06 mg/L and is lethal (LD50) at 150–200 mg/kg body weight. A 13-week exposure to acrylamide in drinking water at a concentration above 1 mg/kg/day leads to peripheral nerve alterations as observed under electron microscopy." (Xiong, et al., 2018, p. 6)

> "The potential risks on environment and health are thus linked to the spreading of acrylamide and polyacrylamide degradation products in the natural environment… residual monomers remain dissolved in the water and may spread in surface and ground waters." (Guzzo & Guezennec, 2015, p. 6387).

> [Because] "the acrylamide is considered as a carcinogenic molecule, mutagen and reprotoxic (Molak, 1991), all polyacrylamides (PAMs) used within the European Union are required to contain less than 0.1 % (w/w) of residual acrylamide (AMD) (European Parliament 1999) unless they are classified and labelled as a category 2 carcinogen (European Parliament 2006)." (Guzzo & Guezennec, 2015, p. 6387)

> "The flocculant will be used at a dosing rate of approximately 370 g/tonne of dry solids reporting to the centrifuge. This translates to a nominal (average or usual) dose rate of around 118 kg of flocculant every hour as the centrifuge units nominally receive around 321 tph of solids, noting that the percentage of fines tailings is variable due to natural variations in the deposit geology" (Kalbar Operations Pty Ltd, 2021d, p. 3/40).

Compared to the thousands of tonnes of flocculant the proponent will use over the 15-20 year mine life, the amount of flocculant used in agricultural and water treatment industries is relatively minuscule (Guzzo & Guezennec, 2015, pp. 6387-6389). PAM exposed to sunlight degrades to ammonia, carbon dioxide and water.

A basic principle of toxicology is that the dose makes the poison; a chemical in very small doses may not be harmful but can be deadly in large quantities (Paracelsis, 1538).

There are thousands of examples where this principle applies. To cite just two: sodium chloride (table salt) is essential for human health, but in large amounts can lead to high blood pressure, strokes or heart disease. In small doses, Paracetamol is used to reduce pain and fever. In larger doses it causes liver damage and even death.

All chemicals, from whatever source – manufactured or natural – are potentially toxic at some dose. The claim by the proponent that using their proposed chemical/s is "safe" is not based on accepted scientific evidence. As such, the risks cannot be assessed.

Economics

The Mineral Resources (Sustainable Development) Act, 1990 (MRSDA) states:

> **Purpose**
> The purpose of this Act is to encourage economically viable mining and extractive industries which make the best use of resources in a way that is compatible with the economic, **social and environmental objectives of the State**. [Emphasis added]
>
> **2A Principles of sustainable development**
>
> (2) For the purposes of this Act, the principles of sustainable development are—
> (a) community wellbeing and welfare should be enhanced by following a path of economic development that **safeguards the welfare of future generations;**
> **(f) both long and short term economic, environmental, social and equity considerations should be effectively integrated into decision-making;** [emphasis added]
>
> **15 Application for a licence**
> "(6B) Without limiting subsection (6), an applicant for a mining licence (other than an infrastructure mining licence) or a retention licence **must satisfy the Minister that there is a reasonable prospect that the mining of the mineral resource described in the application will be economically viable.**" (Parliament of Victoria, 2017) [Emphasis added]

The use of centrifuges must be considered in the economic context of the proposed project. By the proponent's own admission, it will greatly increase capital costs along with operational costs.

The proponent needs to prove the economic viability of this project to gain the necessary approvals. The viability of the proposed project has already been questioned, with the proponent's consultants BAEconomics found lacking in providing a realistic breakdown of costs and revenue by The Australia Institute. The Australia Institute further suggests that BAEconomics report overstates the benefits and understates the costs.

The additional costs, not only of purchase but of maintenance and running six centrifuges, makes this new concept far from convincing. The fact that no other mineral sands mining company employs this method due to "cost considerations" throws further doubt on the proposed project's feasibility.

TN14 states that it would cost $3.50 –$4.00 per tonne for tailings processed and hauled to the pit for backfill (Kalbar Operations Pty Ltd, 2021d, p. 3). This could well be conservative. At 55c/130g, 370g/t would add up to $1.56 per tonne for flocculant. Centrifuges are estimated to take 17000 MWhr/year to run; at 2.8 million tonnes of tailings this equates to 6 kWhr/tonne.

It is unknown how much the proponent will pay for power, but at the current price of 34c/kWhr this comes to $2.00. Thus we have $3.50 per tonne to stockpile at the centrifuge, not counting labour or the cost of cartage to the mine void, or of depreciation and maintenance of the centrifuges. Power costs are likely to escalate significantly over the projected lifetime of the proposed project.

Robbins stated of the Fingerboards ore quality:

> "Although they would still be saleable, chromium and magnesium content would downgrade most titanium products, causing price reductions in the vicinity of 30%.
>
> Uranium and thorium content would cause the downgrade of zircon produced, potentially by up to 20%." (R.J. Robbins & Associates, 2012, pp. 44-45).

It is quite possible that the additional cost involved in the centrifuges will render an economically marginal project unviable.

If the centrifuge system is accepted and fails, the project would become financially insecure resulting in a strong possibility that the mine may be abandoned. An abandoned mine of this size will create a huge cost to a community which extends much further than just East Gippsland.

Given the technical issues with dispersive soils, toxic tailings and an unforgiving terrain, it is unlikely the costs of rehabilitation would be adequately covered by the proponent's bond.

Number of jobs per mega litre (ML) of water used

In the horticulture impact supplementary Expert witness statement for the proponent, authored by Dr Blaesing, the only area of comment in relation to the introduction of centrifuges was about the number of jobs created per mega litre of water used (RMCG, 2021b, p. 1). The EES stated that 200 jobs would be created based on 3 GL of water. So contrary to what is stated by Dr Blaesing, there is no change in the proportion of jobs to mega litres of water used with the introduction of centrifuges.

Should the use of centrifuges not be viable for technical or financial reasons, the proponent would require 5 GL or 5,000 mega litres of water annually (Coffey Services Australia, 2021b, p. 4). Based on its current irrigation water usage, the horticulture industry could create 5 times more jobs than the mine with that quantity of water. Furthermore, every job in agriculture creates over 4 times more indirect jobs than mining (National Farmers Federation, 2017, p. 10).

As one of the marketing arguments used by the proponent to justify the need for the project concerns the number of jobs that would be created, many more jobs could be created by redirecting water required by the proposed project, whether that be 3 GL or 5 GL, to support and expand the horticulture industry. Therefore, arguments around job creation to justify the need for the Project are misguided.

The horticulture industry is a long-term sustainable contributor to the local, state and national economies that would create many more direct and indirect jobs than the Project if the horticulture industry was given access to that water. This would provide greater economic support to the region on a long-term basis.

Viability

As stated in Submission 813, the economic viability of the proposed mine is questionable. The proponent has not described or evaluated the business or financial risks, including full capital and rehabilitation costs and market prospects given the uncertainties in the rare earths industry.

The latter is critical as the submission shows that the project is relying on end processing of rare earths to cover costs. In effect the company is attempting to mine fine grain WIM mineral sands that pose significantly greater challenges than the coarser strandline mineral sands being mined elsewhere in Australia. In addition, with the complexities of the topography, watercourses and soil types, they are attempting to mine those sands in a far more challenging landscape.

Information from the Draft Work Plan and Investor Presentations on the proponent's website indicates that the project will only receive around $5.90 per tonne of overburden and ore disturbed. That $5.90 per tonne must cover:

- Capital costs of establishing the mine;
- Land purchase/lease agreements;
- Building of dams;
- Administration of the mine;
- Diversion of roads;
- Excavation and management of overburden and ore;
- Processing of the ore;
- Management of tailings;
- Road and sea transport to buyers; and
- Rehabilitation and closure of the mine.

In short, it is impossible for the mine to be any more than a loss-making exercise and the introduction of the concept of centrifuges only adds to the economic burden. Information in TN 14 states that the use of centrifuges doubles the operating costs associated with treatment of fine tailings from $1.50-$2.00 per tonne to $3.50 - $4.00 per tonne.

In addition, the inherent problems with the ore body that were recognised by previous licence holders remain the same; the centrifuge option does nothing to address these.

Some of these issues include, but are not limited to:

- Depth of ore;
- Inability to produce clean titanium dioxide; and
- High slimes and high iron oxide contents, etc. (R.J. Robbins & Associates, 2012).

The capital costs proposed originally have expanded significantly since the proponent first touted the mine. There has been no disclosure of the extent of that expansion. Centrifuges add to the operating costs and will cost many millions of dollars to purchase the equipment, and many millions more to establish foundations and housing for them.

Revenue/tonne

Kalbar anticipate $455/tonne HMC from the site (export price) (Investor presentation 2018 from Kalbar website). However they are also saying only 1.3% of the material disturbed (overburden and ore) is going to be transported in the ore. (Kalbar Operations, 2021a). That means for 1.3 tonnes of ore transported, 98.7 tonnes remain on site and has to be rehabilitated or whatever they intend to do with it.

For every 100 tonnes disturbed there are 1.3 tonnes of HMC and 98.7 tonnes of overburden and tailings. Revenue for every 100 tonnes disturbed is $591.5 ($455*1.3 = $591.5). This works out at $5.92/tonne disturbed.

How is the proponent going to pay for excavation, admin staff, transport to port, shipping, rehabilitation, land purchases, road diversions and so on out of that $5.92 per tonne? Even if they can double the final revenue from processing in China they will still not cover costs.

In addition the proponent now has to fund the extra cost of using centrifuges, which for operating alone is double that of a Tailings Storage Facility (TSF).

"Local" policy

Alfa Laval is an overseas company. The proponent is substituting "local" jobs in the earthmoving industry for the purchase of equipment from overseas. One of the proponent's purported major economic "benefits" is the supplier benefit; this would result in minimal benefits to the Australian economy by purchasing off-shore. The proponent is already ignoring its local purchasing policy. For example, Siebtechnik Tema's facility in Revesby, Sydney, manufactures centrifuges for the mining industry, and there are other Australian manufacturers.

Capital and operating costs

Power

With the proposed centrifuges powered by electricity, the question has to be asked as to the source. Will it be from diesel powered generators which would be noisy and produce greenhouse gases? Or will it be from the grid? If it is from the latter, what impact will this have on existing electricity customers already within the system?

The extra demand for electricity to run these centrifuges will be far from minimal. The proponent's own estimation is that electricity demand will increase by 55% from 9,000 kVA to 14,000 kVA.

The proponent claims the total power per centrifuge is 360kW, and that the average load during operations is 220kW, with annual consumption for 6 units of 10.2MWh. 220kW x 6 units x 24 hours per day x 365 days per year = 11.5MWh per annum.

This figure excludes the significantly higher power use during centrifuge start up. The minimum figure of 11.5MWh is higher than the proponent's quoted figure of 10.2MWh per annum. The proponent's figure appears to be optimistic.

Cost of treating tailings

Information in TN 14 states that the use of centrifuges doubles the operating costs associated with treatment of fine tailings from $1.50-$2.00 per tonne to $3.50 - $4.00 per tonne. Assuming this only relates to fine tailings, the annual operating costs for treating tailings could cost more than $11 million.

				Current low	Current high	Centrifuge low	Centrifuge high
t/h	hours	days	t/annum	$1.50	$2.00	$3.50	$4.00
321	24	365	2,811,960	$4,217,940.00	$5,623,920.00	$9,841,860.00	$11,247,840.00

Flocculant costs

In addition to the flocculant used in processing, according to the technical notes, the centrifuge option requires 370g flocculant/tonne * 321 tonnes solid per hour. That works out at 2.83 tonnes per day, 88 tonnes a month or 1033 tonnes per year.

Despite the claims in TN14 (Kalbar Operations Pty Ltd, 2021d, p. 3), because of the bulk density of the flocculant, the silo the proponent proposes to use will only hold enough flocculant for 13 days. It is highly likely that the proponent will need to treble the number of holding silos to ensure a month's centrifuging capacity. These figures are based on the proponent's best option for fines; this figure will increase significantly should the percentages rise to the 23% or 25% quoted elsewhere in the EES documentation.

The alternative to bulk delivery is delivery in bulka bags, which is more expensive. The costs of flocculants and storage have not been considered in the documentation; this omission will considerably increase ongoing operational costs.

Cost to transport cake

Centrifuges remove the opportunity to transport through slurry pipelines as the material is not able to be pumped. There is an increased need for trucks and handling equipment to transport the cake to the pits.

The claim that distances travelled are reduced does not hold weight. For practical and financial purposes the centrifuges must be permanently stationed near the WCP, which is at some distance from the pits.

Centrifuge housing

The structures to house the banks of centrifuges will need to be enormous. The proponent mentions the use of "a basic lightweight enclosure with acoustically designed penetrations" (Kalbar Operations Pty Ltd, 2021b, p. 11).

Realistically this would not be feasible. The foundations and structures required to safely and completely stabilise six 20 tonne machines rotating at 1800 rpm with 55 tonne loads would be astronomical.

Adding to the complexity of the centrifuge foundation and structure design task is the fragile dispersive soils found throughout the proposed project area. The GHD study mentions the 'weakness' of the Coongulmerang Formation and the effect of saturation of the dispersive sub-soils. Major concrete foundations, probably with extremely deep piers, would be required to ensure the centrifuge bases are stable.

The impacts should a centrifuge break-free and not be contained would be devastating - as experienced elsewhere in the world. The capital and design costs of these structures would be significant, and severely impact the proposed budget.

The proponent rather naively discusses relocating the centrifuge complexes several times during the proposed project lifetime. The construction costs alone associated with such relocations would make this an uneconomic option.

Decommissioning and rehabilitating

A fundamental and significant additional cost not mentioned in the proponent's documentation is that of decommissioning and rehabilitating the centrifuges and their sites.

Experience from the Douglas Mine in Western Victoria suggests that long term exposure to the tailings causes the associated plant to become radioactive. Decommissioning of the centrifuges and their structures would therefore become a major and very expensive waste disposal project.

What are the implications with the centrifuge option in the event of the proposed mine closing prematurely or unexpectedly?

Tailings Disposal

Tailings disposal is a significant cost that is not directly income generating; it is effectively a 'waste disposal' cost. It is possible that the proponent will agree to a range of measures in order to gain approval for the proposed project, with a view to 'cost cutting' measures being implemented later. Any cost cutting would compromise the effectiveness of possible mitigation measures to the detriment of the community, landscape and the environment.

Water

The high level of interaction between groundwater systems and the Mitchell and Perry Rivers is well documented and was commented on extensively in MFG's original EES submission document (#813). However it is unclear from the proponent's documentation the extent of the impacts on both the groundwater and surface water systems (and their beneficial users) from the altered disposal of the fine tailings and increased deposition of flocculants.

Groundwater

Interaction of the groundwater systems with the complex network of dams and process water storage facilities is likely to result in seepage from the storage facilities into the groundwater systems. In the case of the process water storage facility, this seepage would contain high levels of unacceptable contaminants.

The re-use of the water would continuously increase the percentage of dissolved minerals. Use of the centrifuge may increase the level of contamination of the process water and hence the risk of contamination of the groundwater systems.

The dumping of fine tailings treated with high levels of flocculants into the mine void where they would then be subjected to anaerobic conditions and high constant pressure (from the replaced overburden, subsoil, topsoil …), takes us into unknown territory. Dr Jasonsmith's Supplementary Expert Witness Statement makes it very clear that there is the potential for high levels of neuro-toxins to be generated from the breakdown of the PAM in the monomers (Jasonsmith, 2021, pp. 7-8).

What are the transport paths of these toxic acrylamide monomers? Will other surface or groundwater users suffer from exposure to them? The numerous examples of Groundwater Dependent Ecosystems within the project area would certainly be impacted detrimentally from these compounds.

In addition to the concerns about the chemical impacts of the high level of flocculants are the changes to the physical properties of the fine tailings:

- Will the high level of flocculants in the fine tailings cause them to continue to aggregate - and then set like concrete?
    - In this scenario erosion would be significantly increased by the creation of a hard impermeable layer across which infiltrated water would flow, taking the dispersive soil with it.
- Will the treated tailings absorb and tie-up water?
    - This would have impacts on the availability of water to the groundwater systems and groundwater dependent ecosystems
- Where is the experimental data to indicate likely impacts?

Management of mine contact water dams and process dam

Use of the centrifuge option leads to:

- Reduced need for replenishing process water; and
- Increases spillages and releases.

There are so many issues with this that numerous questions must be asked, including:

- What management provisions are made for these?
- Where does the tainted water go?
    - As the mine water catchment dams are in gullies, what happens to downstream users? and
- Who will issue the waste disposal licence for the tainted water released?

The proponent states that spillage from the mine contact water dams will increase threefold. Yet it appears that they have no intention of re-designing those dams to control the release of turbid and/or otherwise unsuitable water, including but not limited to that from contact with:

- Mine voids and other disturbed areas;
- Infrastructure areas; and
- Mining contractor's facilities, such as sewerage and other waste.

8-3 of the Workplan says Mine contact water has the potential to contain higher concentrations of suspended solids, nutrients and elements. The proponent acknowledges there will be more spills, and have committed to making sure that this happens towards the Mitchell rather than the Perry River.

Impact on horticulture

There are a number of issues that impact the horticulture industry in relation to the amount of water required by the Project. This means that under either of the tailings management options (centrifuge or tailings dam), the scoping requirements for the EES are not met as the project will be competing with pre-existing industries for access to the same source of water. Potential contamination of water sources is also a continued concern.

Competition for water fails to meet EES scoping requirements

In tabled document 42 on the IAC website, Mr Power, the proponent's legal representative from White & Case lawyers, stated the following:

> "It has become evident that one of the assumptions that underpins the Project water balance in EES Appendix A006 (Appendix A) - the water recovery rate from fine tailings – is incorrect." (White & Case, 2021, p. 2).

In response to the revelation of this significant error in the EES, in an Expert witness statement (tabled document 81), Mr Sweeney from Coffey Services, the consultancy company engaged by the proponent, stated the following:

> "When applying the corrected water recovery rate, the corresponding water supply requirement for the project when using amphirols alone would be in the range of 4 to 5 GL/year." (Coffey Services Australia, 2021a, p. 7).

In the event that the tailings storage facility, as documented in the EES remains an option proposed for managing tailings waste, 5 GL of water could be required by the Project. This means an additional 2 GL of water would be required on an annual basis for the life of the Project - in addition to the 3 GL stated in the EES.

This will have a significant impact on other ground and surface water users, with the horticulture industry in the Lindenow Valley potentially seriously impacted. Any expansion plans by the horticulture industry would be threatened due to an even larger water consumption amount required by the proposed project.

As indicated by Southern Rural Water (tabled document 38), only 2 GL of the 6 GL of winter-fill water available through the Gippsland Regional Sustainable Water Strategy is potentially unallocated (Southern Rural Water, 2021, p. 3). Should the proposed project require 5 GL of water, at least 3 GL would need to be identified from groundwater licences which are fully allocated (Southern Rural Water, 2021, p. 4).

The increased water needs of the project, identified as a result of the water recovery error, will further exacerbate water security concerns for the horticulture industry. The proposed project would be competing with pre-existing users for even more water, which means that the EES scoping requirements are not met.

Detrimental financial impacts would be expected for the horticulture business owners with impacts on their farm production and livelihoods. Without sufficient clean water, their businesses cannot operate.

In considering the use of centrifuges, the amount of water required by the proposed project remains approximately the same as originally specified in the exhibited EES which is nearly 3 GL. Therefore, the arguments and issues presented in Chapter 7 (Horticulture) of EES Submission #813 apply to the use of centrifuges (refer to section 3 'Impact on Water' on pages 316 to 320). The centrifuge option for tailings management does not reduce the environmental impacts of the proposed project on the horticulture industry.

EES scoping requirements are not met in relation to both the tailings dam and centrifuge options.

Impact of reduced water availability

Under both of the tailings management options (centrifuge or tailings dam), the requirement for water by the proposed project is greater than the water available (Southern Rural Water, 2021, p. 3). Given the projected 15-20-year life of the proposed project, water resources are expected to diminish during that time due to climate change impacts.

Whether the centrifuge option is adopted or the original TSF, the proposed project would require unacceptable volumes of water to the detriment of existing local industries. No definitive or secured sources for the water have been identified. What compromises would be made should sufficient water become unavailable, or reduced water supplies become the norm?

Should the specified amount of water not be available - or need to be increased due to drier conditions necessitating more dust mitigation - this could have major environmental consequences. Mr Muller in an addendum to his Expert witness statement for the Proponent (tabled document 132) stated:

> "During drought, winter fill volumes may not be fully allocated, and there is a possibility the site may not have access to river water. This means that the site may need to rely almost entirely on groundwater in drought conditions, or potentially adjust the rate of mining to adapt to the constrained water supply," (EMM Consulting, 2021, p. 7).

As stated by Southern Rural Water in tabled document 38, groundwater licences are fully allocated, so this may not be possible (Southern Rural Water, 2021, p. 4).

Mr Sweeney in his supplementary Expert witness statement for the Proponent (tabled document 135) went further in saying:

> "Sustained periods of reduced water supply might threaten the commercial viability of the mine and potentially leave the mine unrehabilitated," (Coffey Services Australia, 2021b, p. 6).

If the proposed mine is abandoned, dust from an un-rehabilitated mine site risks contaminating the vegetable crops and soils in which they grow, impacting on vegetable certification and productivity of the horticulture industry as well as all the businesses and employees that rely on that industry. The reputation of the horticulture industry would also be at risk.

Most significantly, if the proposed mine was abandoned and left un-rehabilitated, the proposed mitigation measures would fail. This would have severe consequences for the horticulture businesses.

This very point was made by Dr Blaesing in her Expert witness statement (tabled document 73) where she said:

> "Failure to implement, maintain, review and, if required improve mitigation measures can, in my view have impacts on horticulture producers," (RMCG, 2021a, p. 4).

Contamination of water sources

In addition to the risks of contamination from the significant increase in the use of flocculants, the risks of contamination in relation to erosion and run-off from the proposed project area with the removal of the tailings storage facility is cited in Technical Note 14 from the Proponent (Tabled Document 194):

> "On first principles, the removal of the TSF will reduce the overall storage available for rain capture, and therefore increase the potential for run off from the Project area. Again on first principles, this could have the potential to result in increased erosion and impacts to the quality of receiving waters if the proposed water management dams are not appropriately sized or positioned," (Kalbar, 2021; p 2).

No hydrological modelling has been done on the water capture dams. In the event of catastrophic failure, the risks of sediment and contaminated water entering the Mitchell River (the source of irrigation water for the horticulture industry), is an unacceptable and foreseeable risk that threatens the viability of that industry.

The fate of the highly contaminated process water following closure of the proposed project has not been addressed. How will the proponent manage 3,000 Ml of highly contaminated water at the end of the project and restore it to the state it was provided, i.e. drinking water quality? What will be done with the contaminated process water in the event of premature or unexpected closure?

Soils & Rehabilitation

It's imperative to focus on the existing landscape environment in terms of pre and post proposed mining activities. The landscape is agricultural and has been so sustainably since 1850. Post-mining it must function properly as agricultural land. Not just be returned to something that looks like, and only purports to be agricultural land. A complex, inter-related myriad of factors must be fully considered.

To return the mined-out void back to an agriculture standard the fill used to consolidate the base subsoil is crucial. It must be remembered that the current landform has demonstrated it can successfully sustain high levels of agricultural production for over 150 years. The proponent's rehabilitation plans have no such track record.

Overburden and tailings (non-economic sand, silts and clay) will be returned to mine voids as part of the rehabilitation process. These will be covered with topsoil to establish a post mining soil profile. The fine tailings would be returned to the mine void as fine tailings, PLUS considerably more polymer than originally envisaged with TSFs.

Under the proponent's initial rehabilitation plan (Landloch, April, 2020) there is a process by which rehabilitation may occur. With the use of centrifuges this process now requires change, as the solid cake (comprised mainly of fine tailings) would be used to continuously backfill the void at depth.

The proponent has claimed that it is unlikely the solid cake will be used in manufacturing subsoils for rehabilitation (Kalbar Operations Pty Ltd, 2021d). Rather an aggregate material of course sands and solid cake fine tailings will provide the base at depth. No information has been provided as to the revised components of the "manufactured subsoil".

In addition to concerns regarding the toxic nature of breakdown by-products from the polyacrymalide, it is unknown what the physical characteristics of the flocculant treated fine tailings will be when subjected to an anaerobic environment and high pressure. One possibility is that the treated fine tailings could create an impermeable layer across which infiltrated water would flow, exacerbating tunnel erosion in the dispersive soils.

Alternatively, the flocculants could form a water repellent layer preventing the filtration of water to the lower aquifer layers below the void, below the project area and hence all receiving water systems including creeks, streams, rivers, and lakes. The mine voids could in effect become vast tailings dams.

Nothing is known as to the behaviour of the treated fine tailings under these circumstances. The centrifuge technology has not previously been utilised in a mineral sands mine.

Complicating the rehabilitation integrity of the subsurface is the placement of concrete pads for the centrifuge plants. Each centrifuge plant is proposed to be relocated to a new position every four to five years. Whilst the centrifuges are designed to be mobile, concrete is not.

These concrete foundations will be of significant size to accommodate the centrifuge units in an enclosed building that is approximately 23.5m long and 13.5m wide. There could be approximately 8 concrete sites across the mine site that potentially will remain in situ as mining progresses. The proponent states:

> "The rehabilitation surface on top of the cake/overburden backfill will be identical to the method proposed in the EES, consisting of a manufactured subsoil, followed by topsoil and revegetation." (Kalbar Operations Pty Ltd, 2021c, p. 9)

But how will rehabilitation of the site, littered with concrete infrastructure, be attempted? Will the concrete pads be decommissioned to compliment rehabilitation in preparation for topsoil and revegetation?

Should the concrete foundations remain, they would provide an ongoing menace to those attempting to farm the area. You cannot farm concrete. Some of the many significant issues would be:

- Injuries to animals;
- Tillage;
- Damaged machinery and vehicles;
- Inability to grow crops and/or grass;
- Reduction of productive area; and
- Increased risk of erosion.

The large concrete foundations would significantly increase the probability of tunnel erosion. The impermeable pads would act as water catchment areas causing considerable infiltration of water around the edges of the foundations. The concrete foundations would also act as concentration points for water transporting through the soil profile, and as flow surfaces for the infiltrated and concentrated water.

Once water becomes concentrated within the dispersive soil and begins to flow, it starts to transport the dispersed soil particles. The minimisation of water infiltration and avoidance of concentration surfaces are two of the keys to managing dispersive soils to minimise tunnel erosion.

The possible liquefaction of dispersive soils during wet seasons in the presence of vibration from the centrifuges has not been considered or addressed. Soils within the proposed project area are known to liquefy simply from having heavy machinery operating.

The soil has been observed to "wobble" underfoot merely after a truck passed through a gateway several times. The vibratory impacts from six centrifuges, each weighing 70 tonnes when loaded, would be significantly higher. The extensive foundations of the centrifuges would closely couple the centrifuges with the subsoil, increasing vibration transmission.

Possible impacts from the soil liquefying could include:

- Disruption of the centrifuge foundations;
- Increased tunnel erosion;
- Liquid flows of subsoil into the mining pit (and possible burying of plant and operators);
- Collapse of native fauna burrows and destruction of their occupiers; and
- Increased bogging of machinery on nearby farms.

Foundations & Safety

Geotechnical risks not considered

GHD made a number of observations and recommendations in EES document App A004, Glenaladale Starter Pit Prelim Geotech Investigation. They noted the very limited geotechnical investigations that were conducted and consequently disclaimed liability if any of the provided information was incorrect.

Their tests included the geotechnical strength characteristics of subsurface formation. The report was based on information provided by the proponent and others; this information was not verified (GHD, 2020).

A number of issues in relation to the plasticity of the soils and shrink/swell potential of clayey soils, variation in strength at different levels and the highly dispersive nature of the material were noted. They also commented on the loss of strength to the Coongulmerang Formation on saturation. This must be considered in the release or discharge of water. GHD recommended a test starter pit be excavated to gauge the impacts of that Formation.

They also raised the challenges of construction on the dispersive soils found throughout the project area, including the likelihood of increased erosion caused by runoff from storm water and other sources. In addition they noted the unsuitability of most of the materials that could be sourced on site for such things as fill, construction embankment and dam walls and liners, without additional treatments.

Mining One, in their Geotechnical Assessment (Appendix 003) took a much more cavalier approach to the risks associated with the geotechnical challenges of the proposed mine. They considered that because people assume certain risks in going about their daily life, it should be acceptable for the proposed mine to add to those risks (Mining One Consultants, 2020)

This is an unacceptable approach to risk. The risks assumed to conduct daily life are unavoidable; the unnecessary risks imposed by this ill-considered mine proposal are of a much higher magnitude and should not be imposed on the community and its environs.

It appears that neither GHD nor Mining One have been required by the proponent to comment on the geotechnical risks associated with the use of centrifuges. This is both disappointing and surprising as according to the definitions of Geotechnical Risk Zones put forward by Mining One, centrifuges should be assessed in terms of geotechnical risks.

These include, but are not limited to the location of the centrifuges, the strength of the foundations needed, the impacts on their stability from constant vibration... No assessments have been undertaken on the potential impacts to human health that might be created by the physical positioning and use of centrifuges; including their potential to break free from foundations due to, amongst other things, inadequate strength and stability in those foundations or impacts on the surrounding soils (liquefaction) of constant vibration.

Geotechnical assessments by independent consultants (who are not bound by the lowest price) should be conducted and results made known. These should be performed before any decisions are made about centrifuges, and those who are going to have to endure the burden of those risks need to be fully informed.

No assessment has been made regarding the "rehabilitation" of the concrete foundations of the centrifuge structures, especially as multiple foundations will be created if the centrifuges are to be moved, as proposed by the proponent.

Liquefaction potential

It is possible for the dispersive soils and sub soils within the project area to liquefy if wet and subjected to vibration. This has already been clearly demonstrated on one property during the proponent's exploratory drilling programme. The movement of the drilling rig through a gateway caused the subsoil to liquefy to the extent that the ground 'wobbled' when walked on.

The centrifuges will be closely coupled to the dispersive subsoil through their mountings and concrete foundations. As this will generate significant vibration, design of the foundations to safely stabilise the centrifuges will need to consider and cater for vibration from several sources, including:

- The centrifuges;
- The mining operations; and
- Seismic activity.

Movement of the foundations from these sources and/or from liquefaction of the subsoil could pose a hazard to life and property. Cost-cutting in the installation of the centrifuges is a dangerous and unacceptable option.

Safety

The safety data sheets for the preferred flocculant show there will be an increased risk of fire and explosion if the utmost care is not taken in ensuring dust does not accumulate (Kalbar Operations Pty Ltd, 2021d). Risk treatment and fire management plans will need to be updated to reflect those risks; sufficient establishment and ongoing costs to ensure proper storage and handling must be proven.

East Gippsland is one of the most bushfire prone areas in the world. Large quantities of flocculant which is explosive in the powdered form are proposed to be stored on-site – these represent a major hazard to the public and fire-fighters in the event of a fire.

The proponent will be unable to rely on the local CFA brigades should explosions occur. They are not equipped to handle, nor trained to manage fires that involve HAZMAT chemical substances such as ammonia or oxides of carbon and nitrogen. The nearest brigades with gas-tight suits are located in Lakes Entrance (approximately 80km) and Traralgon (approximately 100km).

No consideration has been made by the proponent of the impacts of chemical spills, either on-site or in the transport of the flocculants. The proponent's estimate of the size of the silos required has been shown to be totally inadequate; the quantities of chemical being transported and stored are large.

Spills represent significant explosion risks as well as contamination impacts to waterways, household's potable water supplies (through dust; most households in the area rely on the catchment of rainwater) and soil contamination.

In addition, as pointed out by the Expert Witness Dr O'Loughlin, there is no indication of planning to develop containment sheds to restrict the movement of the centrifuge should it escape its mountings (O'Loughlin, 2021). This has happened with dire consequences in other mines.

Simplistic calculations on the rotational kinetic energy of 70 tonnes of plant and tailings (assuming an average diameter of 1 metre) rotating at 1800 rpm come to approximately 310MJ. This is roughly equivalent to the energy contained in 75kg of explosive.

The human health and environmental impacts of machinery and tailings with that much energy catapulting from a second storey of a building would be catastrophic and totally unacceptable.

Particularly worrying is the opinion of the proponent's health expert, Karen Teague, in her witness report that it is sufficient for the proponent to provide training, updates and PPE if required for farmers faced with the risks of working near the mine (Teague, Expert Witness Statement, 2021, p. 11).

Sadly the required level of PPE is clearly misunderstood and under-estimated. On another level it is disturbing as the proponent has claimed they can co-manage or co-exist with their agricultural neighbours; the neighbours do not share this view.

Biosecurity

Livestock producers are required to operate their businesses in compliance with the industry developed Quality Assurance scheme LPA (Livestock Production Assurance). Under the LPA producers must maintain bio-security controls and certify that their livestock for sale are outside the with-holding period of any chemicals to which they have been exposed.

How can nearby livestock producers certify their stock as "safe" when there is the risk of exposure through infiltration into groundwater systems, spillage or above ground seepage? Have the flocculants been evaluated by APVMA to determine appropriate with-holding and export slaughter interval periods?

The biosecurity of any property on which the proposed project operates will be severely compromised through the uncontrolled traffic between properties and the random relocation of top-soil to properties. Currently disease free properties could well end up with biologically contaminated soil from other properties, e.g. Johnnes Disease, Pestivirus and Vibriosis.

Air quality/particulates

The evidence regarding reduced particulates is unconvincing as:

- The risk of cake drying is quite high
    - Particularly over summer with the weekly stockpiling of 3,600 tonnes of cake (due to no trucking on Saturday afternoon and Sundays);
- The cake contains very fine particles which are prone to dispersion on even mildly windy days; and
- Additional truck movements will be required to transport the cake, resulting in additional emissions and particulates and increased dust from the traffic.

Does the revised water budget/balance include the water required for dust suppression on the new roads required to transport the “cake” to the void?

Health

The impacts from the centrifuge option on health have been treated superficially. There are a number of areas where health considerations have either been ignored or glossed over.

Dust

The incorporation of centrifuges into the mining process will not reduce the volume of dust that will emanate from the project area: across adjoining agricultural land, residents' households, recreational areas including rivers, parks, forests, and natural landscapes. Rather, it will require an increase in the movements of dump trucks, loaders, transit vehicles, and machinery movements; all producing and propelling copious quantities of dust into the environment.

Wildlife, livestock, and food producing areas will be fouled and impacted. How can the residents, animals and flora of Glenaladale be assured that this volume of dust will not create health issues, impact their water and food supplies and diminish the amenity of the area in which they live?

Maintenance

Planned maintenance is an essential component of any operating plant, but breakdowns also occur. The plan to have a "spare" centrifuge for every set of three operating centrifuges indicates that maintenance and breakdowns will be common.

How is a 55 tonne load of toxic tailings to be safely removed from a broken down centrifuge? Does a mine-worker crawl into the one metre diameter opening to shovel them out by hand? What PPE would be effective in such a confined, difficult space? What happens to the tailings once removed from the broken-down centrifuge?

Break-Free

Dr O'Loughlin's Expert Witness Statement expresses concern regarding the proposed design of both the centrifuge sheds and the lack of containment facilities. Experience overseas has shown that when centrifuges break-free from their bearings, the results can be catastrophic.

Using some simplistic calculations, the rotational kinetic energy of 70 tonnes of plant and tailings (assuming an average diameter of 1 metre) rotating at 1800 rpm is approximately 310MJ. This is roughly equivalent to the energy contained in 75kg of explosive.

The human health and environmental impacts of machinery and tailings with that much energy catapulting from the second storey of a building are too horrendous to contemplate.

Karen Teague's Human Health Supplementary

Karen Teague's Human Health Supplementary Expert Witness Statement assumes there will be a positive impact on the release of impacted water to groundwater and subsequent discharges to surface water, generation of dust and its subsequent migration to off-site receptors compared with the use of the TSF (Teague, Supplemental Statement of Karen Teague, 2021, p. 1). These are completely unjustified assumptions, particularly in relation to the release of impacted water.

The proponent has already stated there will be less ability to fill the process water dams from the DAF water. This will result in substantial increases in the number of times the mine and process water dams will overflow due to the reduced ability of the process water dams to hold the treated tailings water.

Such 'releases/spills/overflows' will cause increased sedimentation across the 'receiving environment'. That is, almost every gully, creek and stream around the mining area, thus contaminating the water relied upon by downstream users.

In the case of the Heritage-listed Mitchell River, all the horticulturalists rely on its water for purposes of irrigation and ice-making. Turbid, contaminated water will cause multiple problems with irrigation equipment and create numerous issues with produce.

The Woodglen Water Storage Facility serves numerous townships. However, there are many other users along the Mitchell River who rely on the river for domestic and stock water. To make a statement that the centrifuges will have a positive impact is not only reckless, but demonstrates complete ignorance of the realities of water use in and around the project area.

As with the original HHIA, the consultant completely overlooks the effect of noise on receptors; even though it arguably has one of the most immediate and damaging consequences on those receptors. MFG's submission (813) showed that the proposed project already exceeds WHO guidelines for noise.

In addition it outlined some of the problems associated with noise from the negative impacts on animal husbandry. Background noise from the mine will mask the sounds that signal the need to check stock (such as fox calls), create sleep deprivation and all of the mental and physical health issues arising from that. The centrifuges will add considerably to the already massive noise burden the proposed project will impose on significant numbers 'sensitive receptors'.

Noise

Background information

The noise component of our community submission on the centrifuge option uses information sourced from data sheets provided by Alfa Laval. This includes broad specifications and a noise test for the P3-10070 decanter centrifuge. The proponent states they are proposing to use this model in place of the tailings storage facility to increase the solid component of fine tailings before returning them to the mine voids.

The proponent states they will use 8 centrifuges in total; three working and one on standby at two sites in the project area. Information provided by the proponent about noise indicates the working centrifuges will be positioned at about 10 metres above ground. This is to enable trucks to drive underneath for filling with the cake.

The picture below indicates the type of structure required to support such a set up, and illustrates the need for elevation of the centrifuges. It is inconceivable that the proponent will attempt to build a shed - or any other structure to reduce the noise levels from the centrifuge – particularly given the comments by their experts that indicate a 'practical' approach to noise management rather than an attempt to meet the noise guidelines is to be pursued.

The three operating centrifuges will require many extra truck movements per day to transport the 'cake' to pits. Whether those trucks are normal tip trucks or massive mine trucks, there will be intrusive noise as they descend the pit to release their load and as they emerge from the pit empty. That noise has not been considered in the documentation.

The proponent claims that they will cease such truck movements overnight and allow stockpiles of cake to form. There is neither no indication of the machinery to be used to load the stockpiles into the trucks at the start of each day; nor any indication of how the system will deal with the cake stockpiled overnight (front-end loaders to trucks?) while the cake continues to be churned out by the centrifuges. The centrifuges are intended to operate 24 hours a day.

Marshall Day Acoustics' assumption that haul trucks would travel continuously allowed them to avoid considering the effects of constant stopping and starting that add to noise stress. Furthermore, their assumption that it would only take 30 seconds for a truck to be loaded appears intended to try to avoid allowing for the extended time such additional noise will be affecting receptors. (Marshall Day Acoustics, 2020, p. 126). The noise level data they provided in octave band levels - with no conversion to decibels to make them comprehensible to the average reader.

Centrifuge noise levels understated

In addition to the experts failing to mention the environmental noise from an actual working mine in the EES and witness statements, they have not questioned the noise data supplied by the proponent in relation to the noise produced by centrifuges. Investigations into these show that they have drastically understated the noise from the working centrifuges which will have a constant flow of slurry in and water and cake out.

The proponent's experts claim that the noise produced from each centrifuge is 'only' 85dB and that claim is based on noise data supplied by Alfa Laval. However, that data is seriously flawed and significantly understates the noise to be expected from a working centrifuge.

The noise was assessed when:

- The machine was operating at less than full speed;
- The inlet and outlet pipes have been sealed; and
- It was likely that there was no load of tailings within the centrifuge, possibly not even water.

The noise of a centrifuge operated at full speed loaded with tailings and attached to piping is going to be much higher than 85dB – possibly up to 30dB higher. This means the noise per centrifuge could be around 115dB with that level rising by 3dB for each of the two extra centrifuges per shed.

The video produced by Alfa Laval illustrates the operation of the centrifuge https://youtu.be/cT8qn8Hreg4. It is clear that many extra truck movements will be required daily to manage the output from the centrifuges. Those trucks are, due to the nature of the internal roads, unlikely to be able to carry much more than 30 tonnes per load.

How many extra movements will be required to manage the centrifuge output? Where is that noise factored in? In particular the noise from starting, loading up the trucks, moving to pit, tipping the tailings out and returning to the centrifuge.

Overview of sound

Sound is measured in decibels (dB). A whisper is about **30 dB**, normal conversation is about **60 dB**, and a motorcycle engine running is about **95 dB**. Noise above **70 dB** over a prolonged period of time may start to damage your hearing. Loud noise above **120 dB** can cause immediate harm to your ears.

There are dozens of pieces of machinery operating 24 hours a day on the mine site that emit more than 70dB in noise. The centrifuge option adds to that noise, not only in absolute terms with its operation, but in terms of the number of trucks needed to cart the dewatered cake to the pits.

Despite the proponent's assertion that it removes the use of amphirols given evaporation is not an option (and therefore the noise associated with them), the proponent has not given any information as to how the fine and coarse tailings are going to be dewatered further when in the pit, to get them to the ~85% solids needed to work up for rehabilitation or the type of equipment that will be used for 'mixing' tailings to meet the stated rehabilitation goals.

Environmental Noise Standards

In the Douglas Mine EES it was stated that noise from new industries should effectively be unobtrusive.

> "Appropriate noise limits determined for a new industry in an established area will result from consideration of the existing acoustic environment and the limits will enable the noise emissions from the new industry to become part of the existing environment without dominating it." (Watson Moss Growcott Acoustics pty Ltd, 2001, p. 126).

In its original community submission (#813), MFG referred to the WHO guidelines on night noise (World Health Organisation, 2009). Those guidelines reiterated the extensive medical evidence on the relationship between sleep and health. Sleep is a biological necessity and disturbed sleep is associated with a number of health problems.

WHO guidelines list many of the well known problems associated with exposure to excess or prolonged noise, including sleep deprivation and sleep disorders. Chronic exposure to noise leads to such conditions as heightened stress, impaired cognition, hypertension, cardiovascular disease and mental health issues (including sleep deprivation induced psychoses).

The use of centrifuges will add to the environmental noise pollution residents are already facing as a result of the proposed mine operations both during the day and at night. The proponent's contention that they have a negligible effect is not credible.

While the WHO guidelines aren't legally binding, they do set a standard for decency that states companies and individuals should aspire to prevent the harmful effects of night noise. People should have a fundamental right to enjoy the highest attainable standard of health and no other person or company should have the right to impose on that standard.

As stated in the MFG community submission, the proponent will add unacceptable risks from environmental noise pollution to all receptors within a few kilometres of the mine site.

Victoria's EPA has had interim guidelines for noise levels from industry in rural areas for many years (EPA Victoria, 1989). Most companies would at least consider them. It is difficult to know why the proponent thinks it is appropriate not to.

It has referred to the NSW noise standards for industry (NSW EPA, 2017), but appears to have been quite relaxed in its application; for example, incorrectly likening the Bairnsdale-Dargo Road to an arterial road in built up areas. The proponent has also used octave band frequencies throughout their documentation without converting them to decibels. It appears this was done to make them less understandable to the lay person so it is impossible to work out just how 'noisy' all the equipment and machinery will be.

Notwithstanding, the NSW regulations classify intrusive noise as anything that adds 5dB to background noise and sets limits that should be met by industry. There is guidance as to the circumstances under which those limits might be exceeded, but they do not give industries carte blanche to impose excessive noise on receptors.

> "The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15- minute period, does not exceed the background noise level by more than 5dB when beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment." (NSW EPA, 2017, p. 9)

The proponent has indicated that people will have to endure night-time noise of up to 65dB or more outside their bedrooms. This is 33dB higher than the Victorian guidelines for night noise in rural areas. Those noises will destroy the amenity of the area, and the WHO has clearly shown that noise levels over 40dB can have adverse physiological and mental health affects and over 55dB can be dangerous (World Health Organisation, 2009, p. 108).

Effects of different levels of night noise on the population's health[2]

Average night noise level over a year $L_{night,outside}$	Health effects observed in the population
Up to 30 dB	Although individual sensitivities and circumstances may differ, it appears that up to this level no substantial biological effects are observed. $L_{night,outside}$ of 30 dB is equivalent to the NOEL for night noise.
30 to 40 dB	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest. $L_{night,outside}$ of 40 dB is equivalent to the LOAEL for night noise.
40 to 55 dB	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.
Above 55 dB	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

Despite the known amenity and serious health implications of the noise from the proposed mine, made even worse with centrifuges, the proponent's documentation gives little comfort to those who will be affected as it:

- Gives no indication of the actual location of the centrifuges (likely to be at opposite ends of the mine site and closer to residences than the TSF);
- Gives no real information about any proposed enclosures (Kalbar Operations Pty Ltd, 2021b, p. 11) (and given the size of the enclosure needed probably unlikely to ever be built); and
- Fails to identify any avenue or action for following up on noise complaints beyond the inadequate noting that they exist (Kalbar Operations Pty Ltd, 2021b, p. 13).

It is difficult to know how the proponent's consultant was able to compare noise levels from the TSF and centrifuge when no map has ever been shown to identify where the centrifuges are to be located. In addition, and as with the Noise section in the original EES, the consultant has expressed noise levels as octave bands and has failed to translate those to decibels to make those understandable to the lay person.

Experience at other sites

As noted in the MFG main report (Submission #813), the EES used the MZI Keysbrook mineral sands mine to claim that dust would not be a problem with the Fingerboards mine. [1] The Keysbrook mine uses far less machinery than the Fingerboards mineral sands mine is expected to (Environmental, 2006). Despite less machinery and equipment, noise has been an ongoing problem at Keysbrook with a litany of complaints leading to a review of the mine's operations by the Western Australian EPA. The resulting report forced a number of changes to MZI operations in an attempt to ensure that noise is appropriately regulated and managed. These included changes to timing of operations and distances from receptors (Environmental Protection Authority Western Australia, 2018).

The WA Keysbrook experience illustrates the type of problems experienced by 'neighbours' of mine sites around the country as well as the difficulties with relying on mines to manage environmental noise. There are many similar examples in Victoria but it appears that the Victorian EPA is more reluctant to step in to protect communities from obtrusive noise.

The proponent's noise consultant admits to not knowing about the effects of noise on the health and wellbeing of humans (Delaire, Fingerboards Mineral Sands Project Environment Effects Statement Statement of evidence, 2021a, p. 13). However he appears willing to sacrifice the health and well-being of the people of Glenaladale and surrounds and also to deny them the protections afforded by the recently released Victorian EPA Noise Control Guidelines (EPA Victoria, 2020), claiming they would curtail night-time operations (Delaire, Fingerboards Mineral Sands Project Environment Effects Statement Statement of evidence, 2021a, p. 11).

[1] The Fingerboards EES neglected to mention that unlike the Fingerboards mine's massive overburden the Keysbrook mine is a 'dunal deposit with **no overburden, mineralization only 2-5 metres beneath the surface.** (https://www.mindat.org/loc-272629.html)

The expert's push for a more 'pragmatic' approach reflects the dismissive and cavalier approach to the community throughout the process. It creates and builds an understandable fear of what people will be exposed to should the project proceed.

The recommendation to ignore Victoria's new standards is at odds with the proponent's response to residents' concerns about noise that:

> "The applicable regulations and standards used to define noise criteria for the Project have been developed by the relevant authorities to protect the amenity of residents in the vicinity of the Project." (Delaire, Fingerboards Mineral Sands Project Environment Effects Statement Statement of evidence, 2021a, p. 50)

However that report finally shows the community something of the decibel levels of the machinery to be used on the mine site – and they are frightening. Dozens of them are all over 100dB. Unfortunately there is no justification provided for adjustments to sound levels claimed – apart from claiming they are going to buy some proprietary mitigation packages.

The centrifuge option will add to that list of noise sources. The use of centrifuges will require dozens of extra truck movements per day as well as additional in-pit machines to mix the tailings. Unless the proponent's consultant has any knowledge of a working mine, it is difficult to understand why he would claim there will be a neutral effect on noise levels.

Electricity

The introduction of centrifuges will necessitate increased use of power either through diesel generators or mains power. The carbon footprint of this proposal is unjustified. We should be looking at economic developments that use less fossil fuel and create less carbon emissions, not marginal projects which increase our demand on the already stressed State's power production.

Local demand on electricity is already impacted when the town water pumps operate, causing irrigation pumps to turn off from the drop in voltage. Household electricity supplies are similarly regularly compromised.

In Tabled Document 194 (p5/40) the proponent states it has engaged AusNet Services to undertake a feasibility study:

> "…to determine the scope and cost of works required to connect the Project to the existing 66kV network, including any necessary upgrade works." (Kalbar Operations Pty Ltd, 2021d, p. 5)

This proposed feasibility study is far too late in the process. It is also appears to be based on preliminary data supplied by the proponent, and as such needs to be treated with caution, particularly given that the mathematics provided do not add-up.

For example from TD 194 the initial average electricity demand was stated as 6,400kW for a total demand of 54,000MWh. However 6400kW x 24 hours per day x 365 days per year is 56,000MWh.

According to TD 194 the demand at peak production will be 12,100kW for a total demand of 104,300MWh. Yet 12,100kW x 24 hours per day x 365 days per year gives 106,000MWh. These errors, resulting in under estimations, are not attributable to rounding or truncating.

There will be issues with onsite and offsite power supply as a result of the centrifuges. There will not be an even continuous draw of power; start up, slowing such large mechanical machines down and stopping them all take a significant amount of power. This will affect other parts of the mine that also rely on power.

The company will no doubt have some backup generators for such instances? However such back up options are not available to all the other users of electricity who will be affected by increased brownouts or blackouts.

Have the consequences of the Fingerboards mine causing blackouts or otherwise disrupting supply to other users been modelled? Is every business in Bairnsdale, Lindenow, Dargo, etc. willing to take the risk and pay the price of the power needs of the Fingerboards mine?

Impact on horticulture

According to the amended Draft Work Plan (tabled document 197) with the introduction of centrifuges the power demand for the Project has increased from 9kVa to 14,000 kVA, (Kalbar Operations, 2021a, pp. 6-7).

Should there be quality issues, power surges or interruption of service with the electricity supply, concerns are raised about the impact this could have on the horticulture businesses. Of particular concern is the potential for burnout of large and very expensive irrigation pumps through “brown-outs” which could be caused during centrifuge start-up.

Not being able to irrigate the crops when required could result in loss of production. The cost of replacing pumps and delays in harvest will have financial implications for the horticulture business owners.

Impacts on health

The company must present a realistic and practical appraisal of the predictable outcomes and the effects on other users of the system.

- How prepared are hospitals, aged-care homes, supermarkets, etc. for more frequent interruptions to power supply?
- What insurance has been considered to compensate people for loss and injury as a result of those outages?
- What consideration has been given to the stress on power supply in hot weather?

Climate change

The introduction of centrifuges increases the impacts of the project on climate change by a staggering 56%.

Mine-Free Glenaladale's original community submission (#813) pointed out that the mine as originally proposed exacerbates climate change, and in particular produces changes to micro-climates in Glenaladale and surrounds. It is not possible to denude the landscape and divert all the water that normally flows via the gullies and the gravel aquifer system at the Fingerboards - without affecting large areas in, around and downstream.

MFG illustrated that as the proponent has failed to include a number of sources of Green House Gases (GHG) in its reports on climate change, it has grossly under estimated the effect of the project on CO_2 emissions. The proponent's choice not to include Scope 3 emissions (presumably trucking contractors, transport operators, carriers, etc.) is completely unjustified given that the emissions from transporting and shipping the product would not occur if this unnecessary and unviable project did not proceed.

Even with all the serious 'omissions of emissions' the project as originally proposed would account for 0.07% of Victoria's total emissions. MFG has already illustrated that that 'contribution' would be significantly higher; that is, if the proponent's calculations of emissions had fairly reflected their occurrence by giving proper consideration to the effects of land clearing and a more realistic picture of rehabilitation.

The centrifuge option will increase the GHG emissions by more than 55%, in the main due to the increased power needs of the centrifuges. This will take the proposed project's burden on Victoria's emissions to more than 0.11%; an amount that far exceeds any purported benefit from the project.

In addition, any supposed savings in truck movements from removing the TSF are more than outweighed by the additional movements required to transport the centrifuge cake to pit, and in combination with the additional machine work required to mix the fine and coarse tailings. That is, should these ever reach the solid volumes where that is even possible.

The production of centrifuge cake (at each centrifuge station) at the expected rate will require a 'conga line' of trucks to transport the cake to pit during non-night time working hours. On top of that, additional machinery (e.g. two front end loaders) will be required to transfer the cake stockpiled overnight to the trucks. Even more heavy equipment will be needed should the centrifuge cake ever become dry enough to be mixed with the sand tailings (~15% solids).

None of these additional contributions to greenhouse gas emissions have been considered in the centrifuge proposal.

Ecology

Noise & Vibration

The proponent's evaluation of the use of centrifuges ignores and/or dismisses their likely impacts on the local environment. One obvious result will be the increased and excessive noise levels affecting both farm animals and wildlife.

For example, the mating rituals of the many birds and numerous other animals dependent upon aural signalling for this purpose will be disrupted. So will the use of vocal sounds from agricultural animals (such as cattle and sheep) and other wildlife for locating their young/ mother/ the rest of the herd/flock and signalling distress and other purposes of aural communication.

As the centrifuges will be closely coupled with the subsoil, noise and vibration will be conducted through the ground far more effectively than through the air. Underground dwelling creatures in particular will be disturbed, as will invertebrates and snakes.

The proposed project area is populated by wombats. These are now on the protected list in the Fingerboards area.

It is of grave concern that Platypus, (a listed species), are known to have burrows in the banks of the Mitchell River, within 350m of the proposed project area. These are an especially shy species and hence will be prone to any form of disturbance from the proposed project.

Liquefaction of the dispersive subsoil during wet seasons in the presence of high levels of vibration could cause collapse of burrowing animals' homes and the deaths of the occupants.

Toxicity

Flocculants are known to be toxic to aquatic life-forms:

> "This product is toxic to fish. It should not be directly discharged into lakes, ponds, streams, waterways or public water supplies." (BASF, 2017, p. 26).

The high level of flocculant use proposed makes contamination by these - and their neuro-toxin breakdown products - into the groundwater systems inevitable. These compounds would have devastating impacts on the life-forms dependent on the Ground Water Dependent Ecosystems (GDEs).

The impact on (GDEs) is problematic. There are a range of GDEs throughout and adjoining the proposed project area, the largest of which is the Perry River (and its tributaries) Chain of Ponds systems. Many of these GDEs have not been identified by the proponent.

Soil life and fauna will be affected by the increased concentration of toxic substances and flocculants in reclaimed water when leaching occurs. Technical data sheets on the flocculants to be used have stated that they are toxic to aquatic life. This has implications on species in creeks, dams, rivers, the Gippsland Lakes as well as the GDEs.

Increased levels of these toxic substances in the soil have the potential to affect rehabilitation of both the site and plant growth.

Water

Rainfall over the centrifuged product will affect the consolidation process as the mine void has the potential to fill with water. Any degree of water fill will increase the impacts from seepage and spillage, and interfere with the drying process.

Due to increased toxicity in the reclaimed water, the process water storages must be treated as tailings dams. Leaching from these has the potential to affect waterways.

Any breach or failure of the process storage dams has the potential to contaminate and destroy rivers, farmland and its associated industries and also the Gippsland Lakes.

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