

Submission Cover Sheet

Fingerboards Mineral Sands Project Inquiry and Advisory
Committee - EES

429

Request to be heard?: Yes

Full Name: Ian Magee

Organisation: Bendigo District Environment Council

Affected property:

Attachment 1: BDEC_Submission.

Attachment 2:

Attachment 3:

Comments: Please refer to attached PDF.

Introduction

The Fingerboards project is highly unlikely to provide a sustainable positive return for investors. The inhibitors acting against a positive return include -

- The cost of construction.

Most mineral sands mining activity shares characteristics which are similar to those of a quarry or a farming operation and so has a cost of construction which is modest compared to hard rock mining, but conversely has a high day to day operating cost because of the vast volume of ore to be handled and processed. The excavations are usually relatively shallow, and mining is conducted on a flat or gentle landscape, using common infrastructure such as farm dam type constructions, may be scaled to the available water reticulation and can use the natural climate to condition sand to be returned to mine pits.

Kalbar have chosen a novel mine design with relatively deep pits, to be developed on difficult topography with highly erosive soils and requiring the construction of substantial civil assets on an adventurous scale. Kalbar have nominated a capital cost for the construction activity as \$190 million, or ~ 3% of the value that will be derived from sale of HMC over 15 years. This cost of construction is a fraction of that which would usually be associated with a complex mine development and this cost should be considered with caution unless Kalbar can provide an independently generated business case.

- Energy balance and water use.

A mine development of this scale has a day to day operating cost in which the primary influence is the energy cost relating to such activities as the removal and handling of overburden, developing mine pits at depth, the hydraulic transport of viscous sand slurry, the operation of thickeners and cyclones and the transport of HMC to a port facility.

If a lower rate of recovery of mine water from pits and tailings dams can be accepted some reduction of electrical energy for the operation of thickeners and other conditioning plant can be achieved but that will be traded against the purchase of more make up water and an extended period, perhaps years, before mine pits can be rehabilitated. The day to day operating cost would be highly susceptible to fluctuations in the purchase price of grid electricity and diesel fuel.

- Exposure to market.

Kalbar have chosen a plant design to provide a high rate of production of HMC but without the capacity to process and recover rare earths. Kalbar have then locked their production and marketing to a limited range of product which is dependent on primarily a narrow segment of an Asian market.

- Exposure to competitors.

Competitors are likely to be based in the Wimmera with a simpler production process, access to Murray - Darling basin water, a lower cost of production and access to standard gauge rail transport and bulk handling port facilities.

The following submission provides reasoning and evidence for the rejection of the granting of an EES to the Fingerboards project.

This submission has the following sections:

1. The Risk that the Project is abandoned due to the Failure of the Economic Model.
2. Rehabilitation of mine project area. Rehabilitation of public and private lands impacted by mining activity. Lodging of bond.
3. Risk of Loss of Life and Income Withdrawal from Catastrophic Failure of Tailings and Water Management dams and Mine Pits
4. Sourcing of water and volumes required
5. Loss to the Ecological Value of the Gippsland Lakes RAMSAR Wetland, Lakes National Park and Corner Inlet RAMSAR Site
6. Loss of Native Vegetation and Ecological Connectivity.

Section 1

The Risk that the Project is abandoned due to the Failure of the Economic Model.

Kalbar have provided extensive documentation in their EES application, and also in marketing bulletins, wherein they forecast the economic contribution of the project to the local community and also to the State of Victoria.

With respect to the mines operation the company provides an estimated or inferred value for the ore body and nominates a capital cost to construct the project in Years -2 and -1. The company forecasts a per tonne cost for the recovery and processing of ore and projects an expected financial rate of return for the project. The EES application does not include an economic model, or a business case, which details the establishment cost of the project. The establishment cost would include the purchase of mine plant, civil construction activity, the connection of services, the cost of construction labour etc. The company have not provided a case which details the annual operating cost. This would include the cost of labour, the cost of energy, the cost of maintenance of equipment and the expected contact costs of shipping of the product (HMC) etc.

The company could reasonably consider that an economic model might include information which is commercially sensitive. However, the Victorian mining Act, the MDRS(Act), requires that a proponent satisfies certain conditions for the granting of a mining licence. These conditions include clauses that require that the holder of the licence “ be a fit and proper person”, that the proponent demonstrate that the licence area holds “ an accessible, economically viable body of ore” and that the proponent is able to finance the development and operation of the mine and also lodge the declared rehabilitation bond.

The local community as neighbours, or perhaps engaged as potential providers of services, need comfort that the project is able to be developed and operated in the long term rather than it be abandoned during the construction phase or that it becomes unsustainable during operation.

Rio Tinto produced a report in 2012, Exploration Report 29569, which for the purposes of their company considered the potential development of the Fingerboards site. This report provided a plant layout for the site using “ unremarkable, standard mineral sand mining equipment “ and included a cost structure for the development of the site. The report assessed the capital development cost of the project as \$271 million. If this cost is reassessed in terms of a project scaled to the production rate of the Kalbar project and reformatted for the additional compliance activity now considered in the EES application, the calculated cost would be in the order of \$550 million. Neither of these estimates include the amount to establish a rehabilitation bond.

If the Rio Tinto report is considered further and those elements that were costed from desk top sources were re-assessed to current circumstances or known site conditions a more accurate estimate could be prepared

for the capital cost of construction and for the annual cost of operation.

The following details some of the circumstances of the Kalbar project that have changed compared to the Rio Tinto Report and where an estimate can be improved from a desk top source to the known field condition.

1 (a) Knowledge of the location of the ore body and the rate of mineral return.

- this refers to the annual cost of operation.

Kalbar have carried out only a limited amount of physical exploration above that available as the of legacy Rio Tinto's activity. Drill core samples have limitations where the core may lack structural integrity due to discontinuities where layers include sand and gravel or those sections of the sample with a high moisture content. For a project with such a significant investment that has been projected over a timeline of many years it would be expected that a further amount of research would have been undertaken to better define and prove the ore body.

Traditionally this investigation of a site could be carried out by the development of one or more costeans (trenches) to gain access to the soil stratigraphy or by recovery and processing of ore from a bulk sampling pit. A current option is the placement of a HD camera into a reamed bore. Kalbar have provided as a reference document A003, the GHD Starter Pit Report. The activity carried out by GHD, who are a significant consultant to the industry, included the drilling of several shallow bores in the vicinity of the proposed pit but did not include the excavation of the pit. The subsequent report by GHD included their recommendation that Kalbar proceed with the development of the pit as it would provide valuable information that would help interpret the volume and quality of materials that might be won from the site and used in construction activities and that the prospective return from the ore body might be further assessed. Kalbar have at this time not proceeded with the development of the pit. It may be reasonable that the company intends to develop a less intrusive or more economic strategy to further explore the ore body, or it could also be that the company were concerned that a less than optimum report following the development of the pit could affect the companies capacity to raise capital.

A failure to accurately define the ore body and the degree of mineralisation must represent a significant risk.

1 (b) Shipping of product (HMC). -

- this refers both to the cost of construction and the annual operating cost.

Since 2018 Kalbar have published marketing bulletins with alternating narratives for the shipping of product. The current EES application describes the road transport of product (HMC) by B double to Port Anthony which is situated in Corner Inlet. It does not indicate if the product will be handled in bulk, if it might be containerised or there might be use of an alternative such as Cube containers. Corner inlet is a shallow

water body with a significant tidal influence and is a RAMSAR wetland. The Port Anthony facility services shallow draft vessels typically used for coastal services and with capacities to about 10,000 tonnes. There are no facilities for bulk handling or storage of bulk product (HMC)at the port. Shipping from Port Anthony would require availability of a vessel about each four days. The use of Port Anthony would impose a competitive disadvantage against the Kalbar operation compared to companies who utilise the efficiencies of bulk carriers that have a capacity ten or more times greater. An option available to the company would be to road transport standard sealed 6m shipping containers to the Port of Melbourne where the handling of 80 containers a day would only contribute around 1% to the Port traffic and access would be available to international bulk container vessels. The cost of road transport and port handling for this option, using accepted contract transport rates, would contribute around \$110/tonne to the cost of production.

1 (c) Additional conditioning of coarse and fine sands to a moisture content that will allow filling of the mine voids and the replacement of overburden to the time schedule as proposed by Kalbar. - referring to the capital cost and the annual production cost.

The draft EES lacks detail to describe the process of returning sand to the mine voids. Kalbar have separately made reference to the process in an undated bulletin they released in 2019 re the collapse of a tailings dam at a BHP mine facility in Brazil. This bulletin suggests that sand will be conditioned to 65% solid, before being placed in a successive one metre layer each month to the ultimate depth required to accept the return of overburden. The described process suggests the hydraulic placement of sand. This would limit the opportunity to further reduce the water content of the sand, other than the long term natural processes of seepage to the lower sands (pit base) and evaporation and also limit the amount of water available for recovery and recycling.

Notwithstanding a further description by the company, a considerable additional amount of energy would be needed to condition the sand to the moisture content where it could be mechanically returned to the pit and wherein it would be capable of supporting the loading of successive sand layers and the ultimate timely placement of overburden.

1 (d) Cost of water. - this refers to the annual operating cost.

The Rio Tinto report lists a minimal cost for water. This may have been calculated as the cost to extract from the local aquifer. The volumes of water required will be very much determined by the energy cost that the company is prepared to pay for the conditioning of sand returned to the mine voids and the corresponding amount of water that can be recovered and recycled. There will also be a considerable amount of water that will be required for dust mitigation and civil construction activity. The most likely circumstance that can be envisaged for those operations would require 6 to 10 Gigalitres each year, dependent on the climatic conditions.

1(e) Cost of dams for management of surface water, storage of winter flows and the cost of a water treatment plant. - this refers to the capital cost and also the operating cost.

Kalbar have nominated the construction, and in some cases the removal and re-siting, of many significant dams for a number of uses. Several of these dams are of such a significance that they are required to be established under ANCOLD criteria.

Kalbar have quoted their intent to source material for dam building on site from the Haunted Hills formation. The 2015 GHD Starter Pit Report introduces significant doubt that adequate quantities or quality of materials can be won from the site for dam construction. Some million of tonnes of material will be required to be sourced, conditioned and compacted as the fill for the various gravity walls. An option canvassed by GHD is the importing of non-dispersing clay. That clay would be used as the lining for the dam wall and also for lining of the gully walls. The comment is included that “ the liner thickness is generally significantly thicker (up to 1.5 metres) to accomodate the settlements without compromising the integrity of the liner. “ Such clay would be be sourced remote from the site and transported at significant cost. The draft EES reference documents report that test boreholes across the project at this time have not extended to bedrock. Kalbar have nominated that a specialist company will be engaged in the design and construction of those dams that will be required to satisfy ANCOLD criteria. At this time there is no indication from Kalbar as to the form the design of these dams might take or the cost of construction. The construction of such significant dams, where local construction materials have an inherently limited structural integrity and high permeability must be seen as problematic, and indeed if possible, likely to involve novel designs incorporating expensive membranes, geotextile fabrics and imported clay. It seems unusual that such a significant mining proposal would have advanced to the engagement with an EES process without a more sufficient understanding of the most significant engineered structures in the proposal. There remains considerable uncertainty as to the costing of all dam structures.

1 (f) Payments to VicRoads for maintenance of those public roads under their jurisdiction. Maintenance of local roads. - this refers to the annual cost of production.

The longer section of the route used for transport of product (HMC) utilises sections of the Princess and South Gippsland highways. The company will be required to lodge documentation with VicRoads seeking a

permit to use this route and will need to pay an annual road maintenance fee along with a contribution towards the cost of any road upgrade activity deemed necessary.

Sections of the route using minor roads under the jurisdiction of Local government may be heavily impacted by shoulder failure from the loading of B doubles. It is not unusual in this circumstance for Local governments to allow sections of road to revert to unsealed surfaces and subsequently be reconstructed at the cessation of mine activity. Local governments will provide cost estimates and may offer contracts to the company relative to the circumstance of Council.

1 (g) Purchase of farmland within the project area. Compensation for loss of horticulture crops. - this refers to the capital cost and the cost of production.

There are sufficient examples of current mining operations in Central Victoria to demonstrate that a mining project based on the Kalbar model could not co-exist with agricultural grazing activity or the occupancy of residences within the mine footprint. Some, but not all, of the influences that contribute to non cohabitation are -

- i. the removal of personal amenity by dust, noise and light pollution.
- ii. the inability of residents to gain sleep.
- iii. the loss or pollution of potable water.
- iv. the loss of agricultural income, a restricted access to properties and the inability to secure private property.
- v. Stress and negative health outcomes.

During the last three decades five mining companies developed new mine sites, or extended the footprint of existing mine sites, at Kangaroo Flat, Eaglehawk, Stawell, Fosterville and Costerfield. These developments incorporated the acquisition of approximately 55 homes and in several cases this included farmland. These transactions are usually conducted privately and often under considerable duress from the company. They are likely to include non-disclosure clauses so it is difficult to establish accurate records. The anecdotal record is that mining companies are successful in between 80% to 90% of the attempted acquisitions and that the prices paid are somewhat above market land value but may not account for the loss of an associated business .

It would be unremarkable if Kalbar have not made a contingency allowance of up to \$10 million for the purchase of the properties on the mine footprint and possibly other strategic properties for the storage of tailings. Most of the key properties in Central Victoria sought by companies were purchased during the first two years of the construction period.

There are very few records of agricultural producers such as horticulturalists successfully litigating in Court, for example in the case of dust deposition on leafy vegetables, as the attention of the action is likely to cause the withdrawal of prospective food buyers from the market.

1 (h) Construction of a 66kv electrical feeder and associated switchgear and substation. - refers to the capital cost and also the annual cost of operation.

Kalbar have proposed that the long term provision of electrical energy be sourced from a local 22kv power route. The power load has been nominated as 9000Kva. This proposal appears to have prepared from a desktop examination of the network distribution plans of the energy provider, Ausnet Services. An understanding of the power distribution network and a field observation would have determined that the selected local route is a 12.7kv SWER route intended only for provision to an individual domestic customer and rated at approximately 10kva. The Rio Tinto proposal nominated the construction of a 66kv power line to a point on the Fernybank road where it intersected an existing 66kv route, one of three routes that parallel the Princes highway and supply energy to Bairnsdale and consumers to the east. The Rio Tinto proposal was

for construction of a route rated at approximately 13000kva and was costed in 2012 at \$14.7million. The Rio Tinto proposal notes that the energy provider may not accept the loading of a route that supplies energy to Bairnsdale mid route, that is, the network implication if there were load fluctuations on the spur route to the mine site. In fact it is most likely that Ausnet Services would seek to upgrade its current distribution network from Bairnsdale so that it has the security of load sharing over the three 66kv routes that currently switch at Bairnsdale. Provision of a new route from Bairnsdale might likely be programmed on a three or five year construction program and dependent on the organisations cost sharing philosophy would likely be costed above \$30million.

Kalbar have suggested that they will initially use diesel generator sets during the construction period. If on site generation of electrical power was to be considered and these generators were to be configured for the early production period it may be that two parallel gas fired turbines each rated at 10,000kva, housed in a suitable building for noise mitigation, might be the preferred solution.

1 (i) Purchase of electrical energy. - this refers to the annual operating cost.

Kalbar's mining program requires that coarse and fine sand are to be conditioned to a moisture level that allows their placement in mine voids in a timely manner so that overburden can be replaced and rehabilitation activity commence on each pit.

A timely process of pit rehabilitation will require electrical energy (for mechanical equipment) beyond that nominated by Kalbar. If an energy consumption of 18,000kw is accepted, dependent on commercial contracts, the annual electrical energy consumption could be estimated as costing \$35million. The cost of establishment of on-site generation capability and the purchase of diesel or gas fuel for the construction period is affected by many variables but could reasonably be seen to be comparable with the preceding estimate of the annual cost for electrical energy.

1 (j) Lodgement of rehabilitation bond monies. - this refers to the capital cost.

The MDRS(Act) requires that a rehabilitation bond be lodged prior to commencement of activity on the site. The Act and associated regulations require that the bond be assessed as that amount required for rehabilitation at the point in time of maximum disturbance and that the bond be assessed by the lodgement of ERR bond spreadsheets, or otherwise, as may be required by the Minister for Resources.

In practice the point in time of maximum disturbance usually corresponds with the time when the mining operation ceases or is abandoned. There is no evidence to support a claim that any significant mining operation in Victoria in the last five decades has been successfully rehabilitated. In only several cases is there evidence of significant rehabilitation during the period of the mine's operation. The VAGO report currently before the Victorian parliament provides evidence of the complete failure of the rehabilitation bond process as administered by ERR.

If an EES is approved for a mining project and subsequently a related mining licence is issued, there is evidence that the regulator, ERR, may provide approvals, or give agreement to, activity beyond the original project boundary or original timeline as was agreed to in the EES, without further referral to a formal planning process, for example a supplementary EES.

This project as envisaged by Kalbar is novel and of a significant complexity with substantial civil infrastructure and land disturbance. It is requested that the Panel seek that the Minister uses the discretion available under the Act to establish a bond amount that is a minimum of 5% of the projected value of the project, and that this bond would be required to be lodged in full as a cash amount, that is not a bank guarantee, prior to commencement of any project.

1 (k) Purchase or rental of private land adjacent the project area for mine support infrastructure and storage. - this refers to the capital cost and the annual operating cost.

It is a common practice that mining companies require access to private land beyond the nominated project boundary. This land is required for multiple purposes, for example, private haul roads or service corridors, plant service and storage etc.

It is also common practice that, to avoid double handling of materials such as overburden or soil, companies will store materials on private land adjacent the mine perimeter. Local government usually permits this activity outside the MDRS(Act). Most legacy mine sites in Victoria will provide evidence of this storage, including placement of tailings outside the area of the approved Work Plan.

1 (l) Relocation of public roadways. - this refers to the capital cost.

Kalbar have nominated the requirement for the relocation and subsequent reconstruction of a public road and the company will need to seek a contract with VicRoads for this work. For a section of minor road that is under the jurisdiction of Local government, Council is required to provide estimates and recover the charges for the activity they or their contractors perform. Council are also required to establish a bond process to cover restitution for road damage and re-establishment of road function at the cessation of the mine's activity. Failure of this bond process in the past has required Local government to reconstruct roads, drainage and other infrastructure, after the abandonment of a mining project, at ratepayer expense.

1 (m) Provision of real-time air monitoring installations and associated compliance activity. - this refers to capital cost and the cost of operation.

Kalbar will be required to provide several real-time air monitoring installations and access contractor services for sample analysis and to carry out other compliance activity.

1 (n) Plant availability and service cycle - this refers to annual opening cost.

Kalbar have noted that redundancy will be available in several items of plant. The capital cost to establish the mine site, as estimated by Kalbar, suggests that significant advantage may be made of recovered plant and mobile equipment. Maintenance downtime, failure of energy supplies, weather events and civil disruption inevitably cause disruption to production cycles. This becomes more problematic when plant is required to run on a continuous cycle without scheduled maintenance periods. Mine sites where product circulates on complex paths through multiple plant elements are usually managed based on a production cycle of about 85 % plant availability.

It appears Kalbar's economic model may have been predicated on 91% plant availability, if that is the case there is a high risk of failure of the economic model.

1 (o) Market acceptance of product (HMC). - this refers to cost of production.

The Rio Tinto (Oresome) report places considerable emphasis on the category that the HMC, the ilmenite and the rare earth components may be placed in by prospective Asian purchasers. See page 9 of Oresome report in appendix.

The report notes that contaminant levels in the HMC are likely to place the Zircon in a category where it will only be accepted for a limited range of production purposes and the ilmenite component will not be suitable for base metal production. It is quite likely that purchase of Kalbar HMC will be at price discounted below that figure appearing in trading commodity price reports. It is noted that Kalbar have placed an economic value against several of the rare earths that are present in the HMC and note that these rare earths trade at a premium per kilogram price. However it may be that the purchaser of the HMC is of the view that these rare earths exist at the level where they are seen as a contaminant rather than a value added product that would become available after a further refining stage.

The HMC product as produced by Kalbar would seem to be at considerable risk of becoming a downgraded product as standards are re-assessed by developing countries.

Section 2

Rehabilitation of mine project area. Rehabilitation of public and private lands impacted by mining activity. Lodging of bond.

The Victorian mining Act, the MDRS (Act) 1990, requires that mining companies rehabilitate their projects (Section 78 a) and that a bond be established to provide funding if the company is unable to carry out this activity. (Section 80). The opportunity for the Glenaladale community to experience rehabilitation of their farmland disturbed by the mine footprint, and for the wider community to experience rehabilitation of Crown and public lands outside the mine footprint, under the current process as administered by the regulatory agencies in Victoria, ERR and EPA, is negligible. The likelihood that a rehabilitation bond, funded by the mining company and recovered by a regulatory agency, is used to conduct the required works is minimal. The Victorian Auditor Generals Office in August 2020 reported on the failure of EER to manage mine rehabilitation. They provided extensive negative commentary on the matter of EER's capacity to regulate mining operations. The VAGO was critical of the lack of transparency, reporting and compliance activity conducted by EER.

VAGO report a shortfall of bond monies, as held against Victorian mine sites, of more than \$500 million. The bond amounts as originally listed by ERR were derived from self assessments prepared by the mining companies, or their agents, and use historical work cost units that have little relationship with current cost structures.

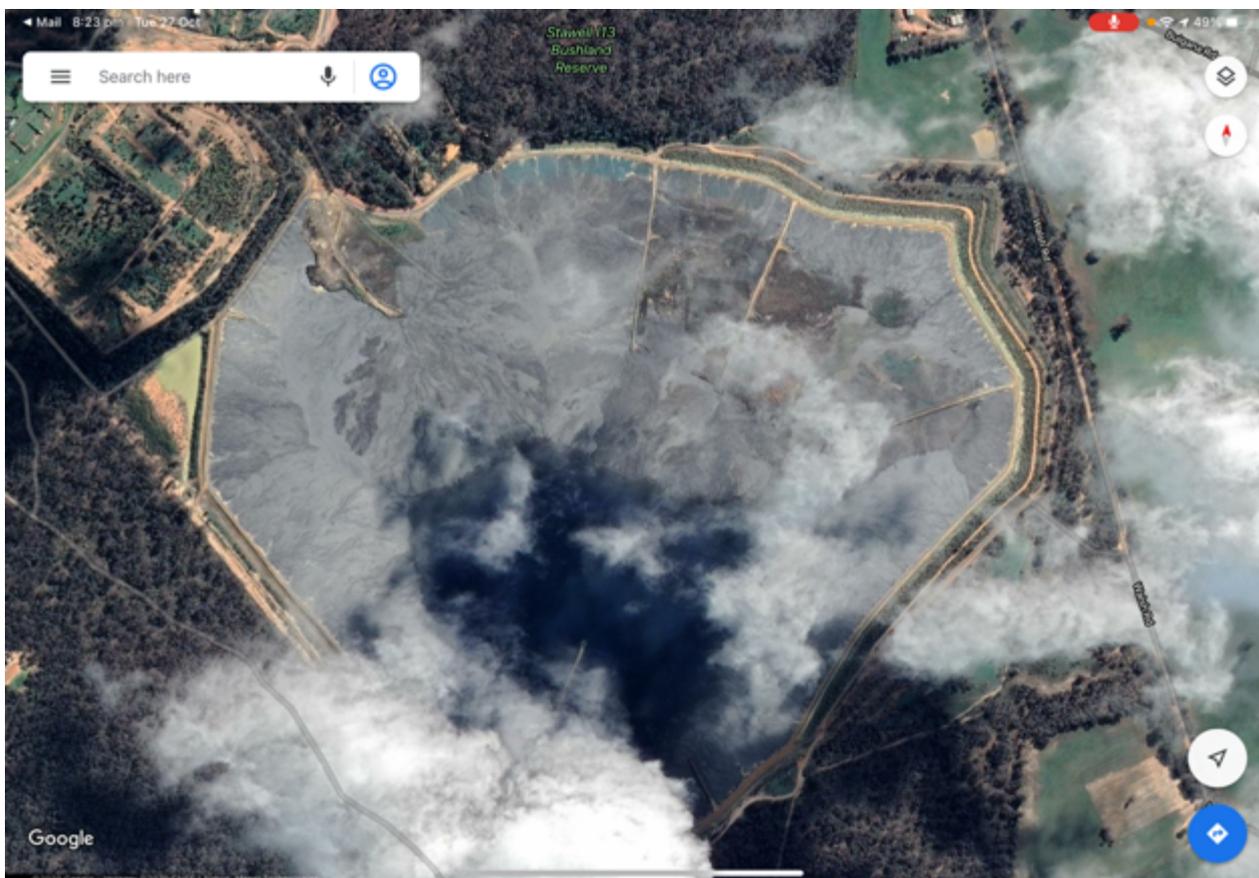
If mining companies were to perform rehabilitation activities they would be acting directly against the financial goals of their own board of directors. The quantum of any rehabilitation bond is invariably no more than a superficial amount so it will always be in the interest of a company to withdraw from any rehabilitation responsibility and sacrifice the loss of that minimal bond.

If mining companies cause disturbance or pollute land beyond the mine boundary, in general it is incumbent on the manager of the disturbed land to seek restoration by litigation. Mining companies, for reasons of operational convenience, frequently transport and store tailings beyond the mine licence boundary. In this circumstance the mining act requires the tailings are associated with the mining licence and remain so until removed or made safe.

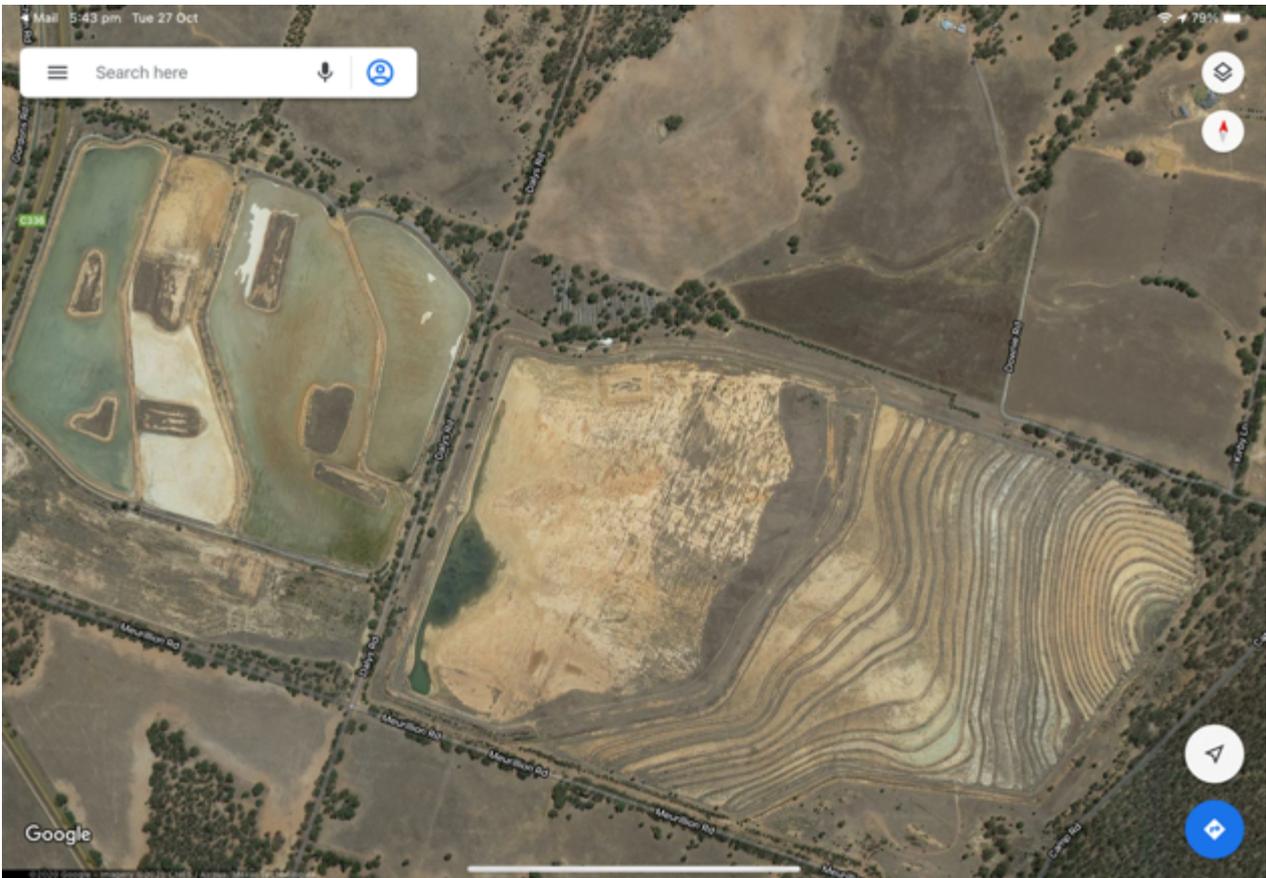
The attached images, Ref: 2.1-12 are of 12 larger gold, copper, mineral sands and coal mining projects initiated in Victoria during the last five decades. The current circumstances of these sites varies through from abandoned, to care and maintenance, operational, or in other circumstances such as waiting legal definition. The images indicate that none of these sites are fully rehabilitated. Images of three of these sites suggest that some rehabilitation activity has occurred and images of nine suggest there may have been no rehabilitation other than for the purpose of amenity. All the significant tailing(s) dams on each site are, in general, still exposed.

The gold mining operation developed on four sites in Bendigo since 1995, under various company structures, has now been abandoned. The bond nominated for these sites is currently ~ \$12million, comprising a cash component of ~ \$6million and a value garnered from recovery of plant left in situ of ~ \$6million. The cash bond amount, as a portion of the project expenditure, expressed as NPV, is 0.3%. Reference to this cash amount is made in statements reported to the ASX by Bendigo, Unity and GBM mining companies during the period 2002-2019. A decade after the cessation of mining activity the sites have deteriorated in condition and no significant rehabilitation has occurred. ERR have not recovered the cash bond monies and it is understood the last site operator has removed the high value components of the " in situ " plant. The human health risk of the extensive tailings dams at Woodvale has been assessed in an EPA approved 53V Audit but the mitigation activities required by that Audit have not been undertaken by the company or ERR.

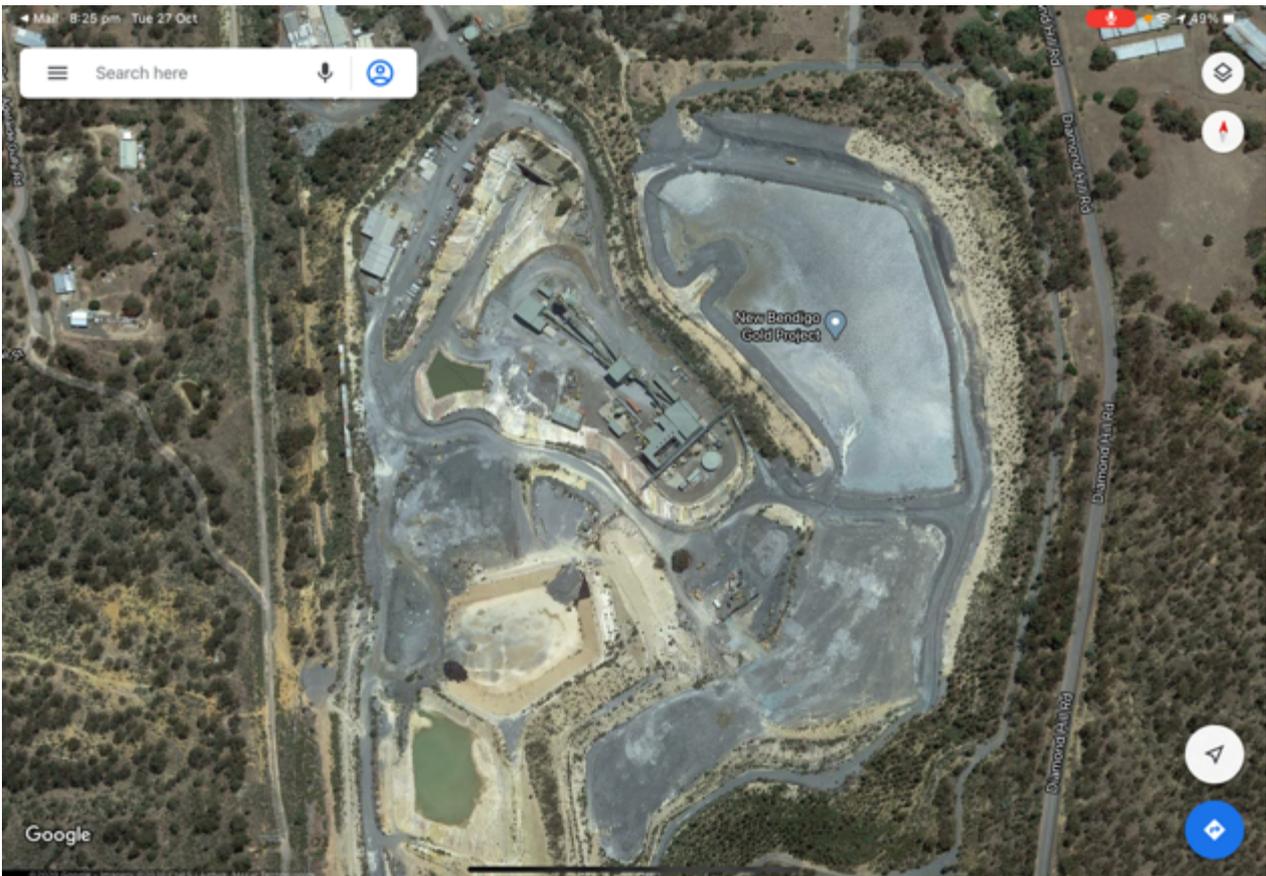
Mining regulations require that the bond amount be determined at that point in time when the maximum disturbance occurs. Most of the significant infrastructure development and the disturbance of the Kalbar project, which is the removal of the landscape surface and the construction of dams and other civil structures is proposed during the two year construction period. The possibility for misadventure affecting assets beyond the project area commences with the initiation of the project. If a mining licence was to be considered it is requested that a project bond be established that is, at a minimum, 5 % of the project market value and that it be lodged prior to any site disturbance.



2.1. Sat. image Stawell tailings dam



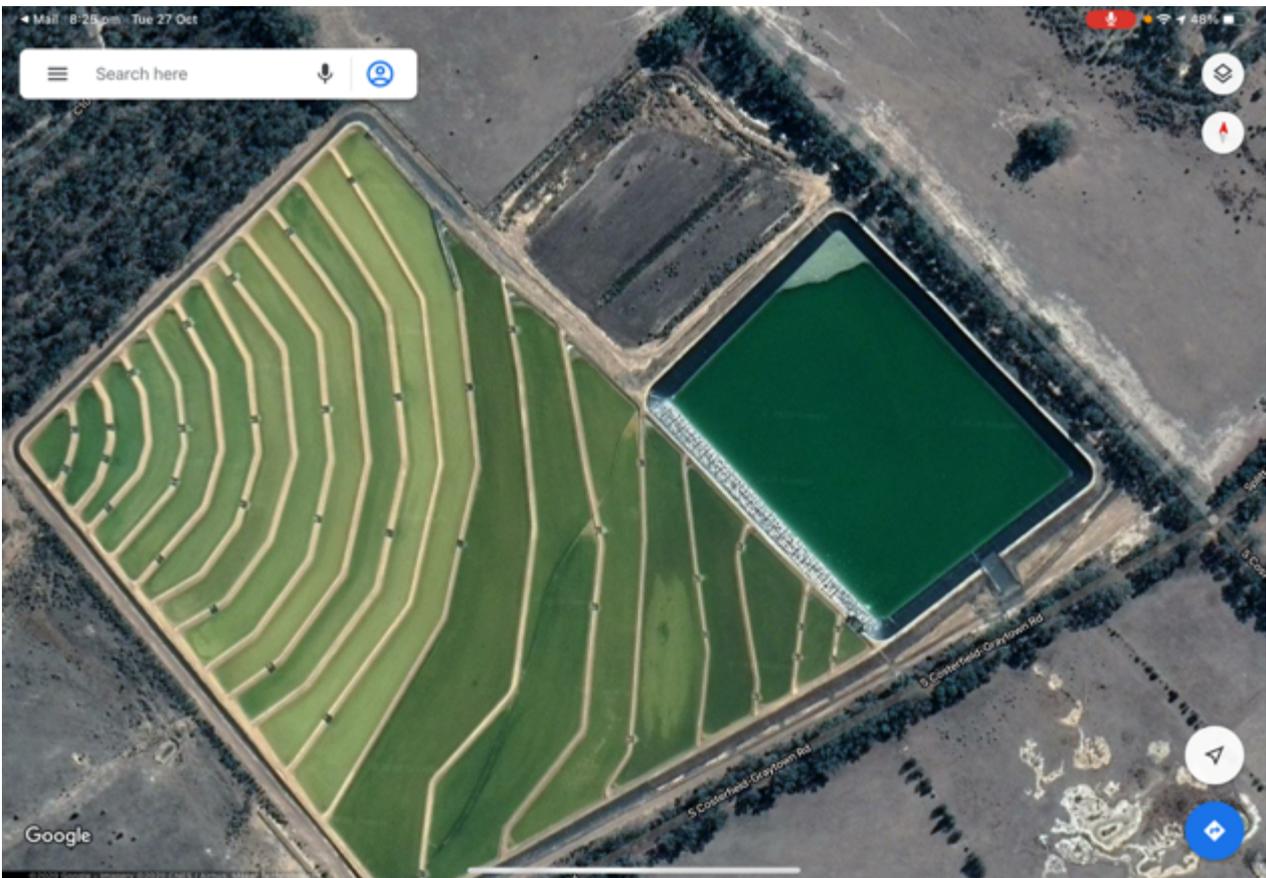
2.2. Sat. image Woodvale tailings dam



2.3 Sat. image Kangaroo Flat mine site



2.4 Sat. image Maldon mine site



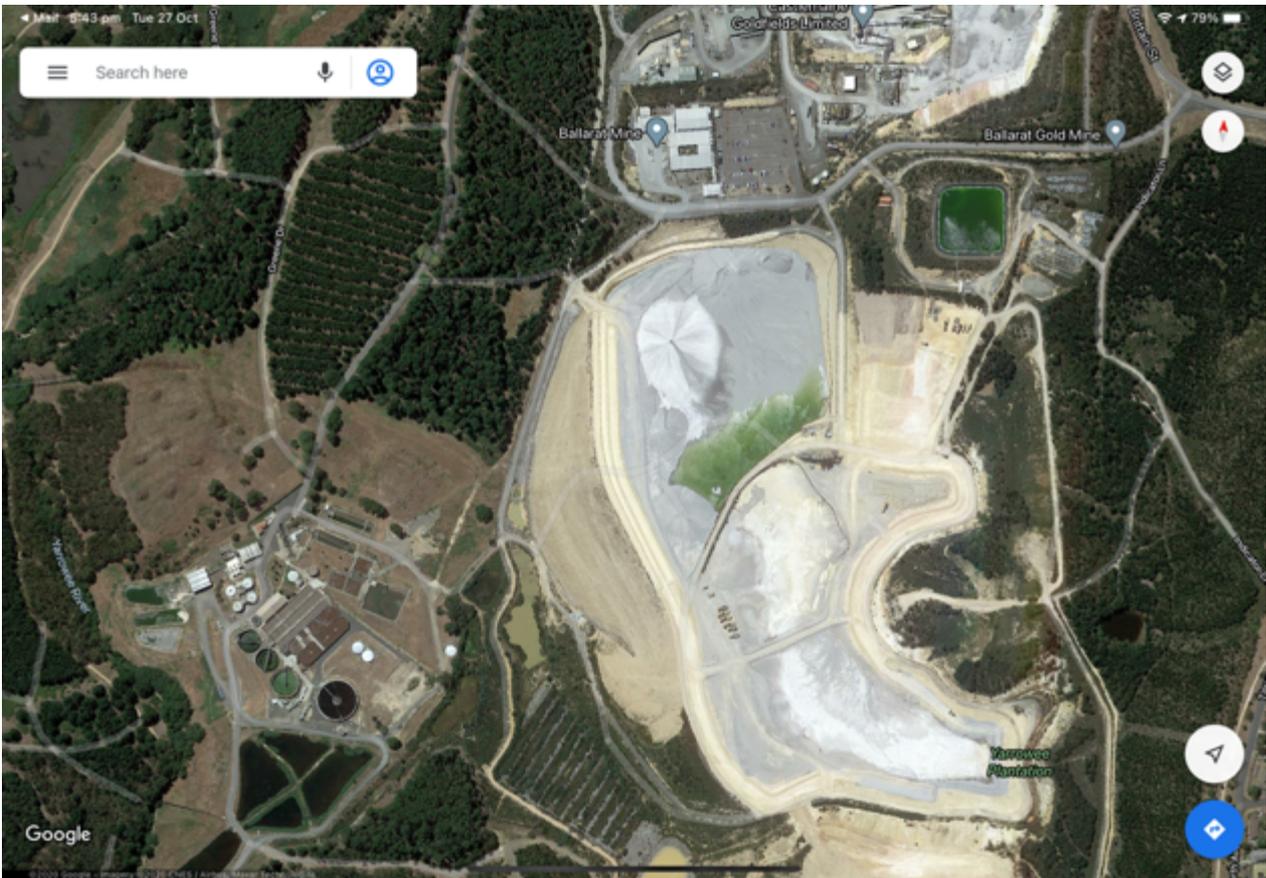
2.5. Sat. image Costerfield mine site



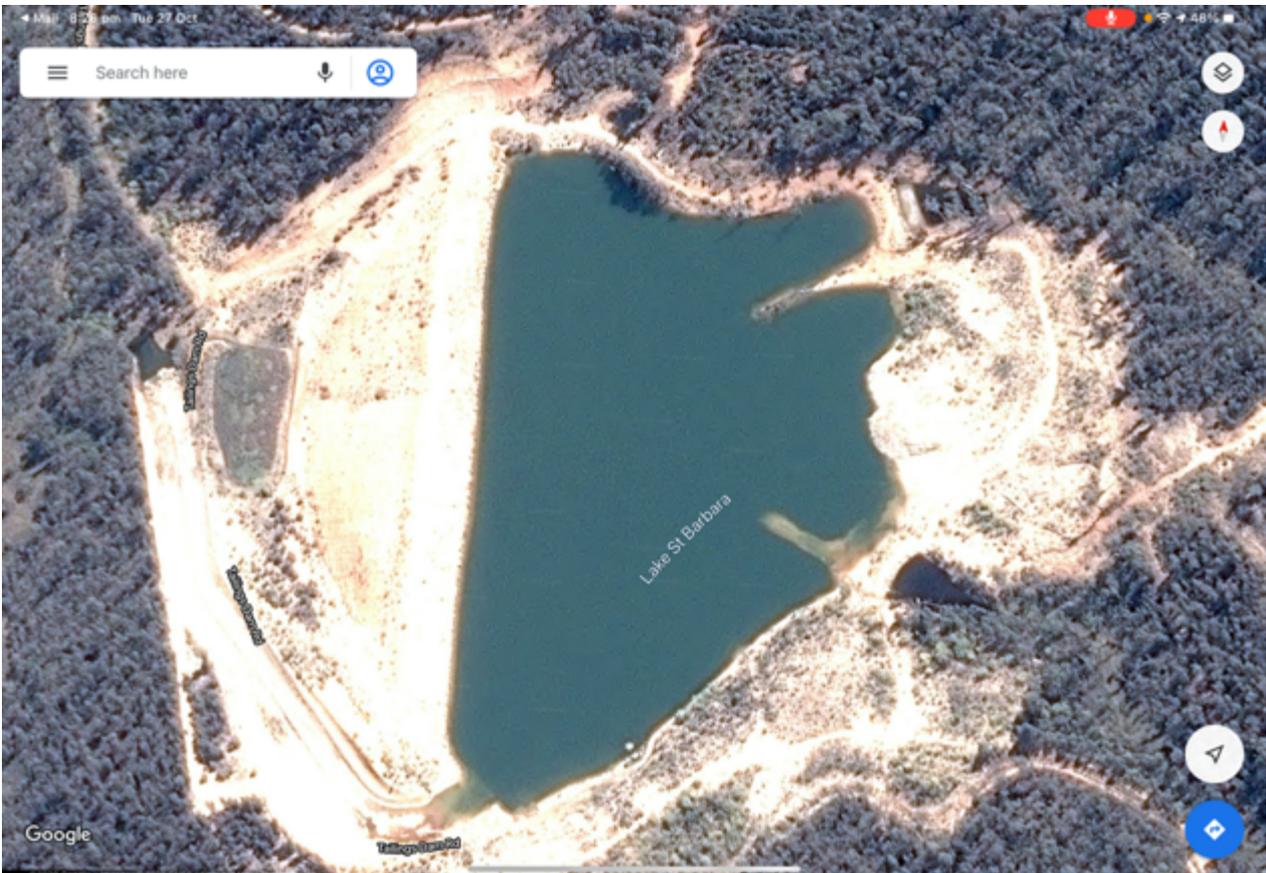
2.6. Sat. image. Costerfield tailings dam



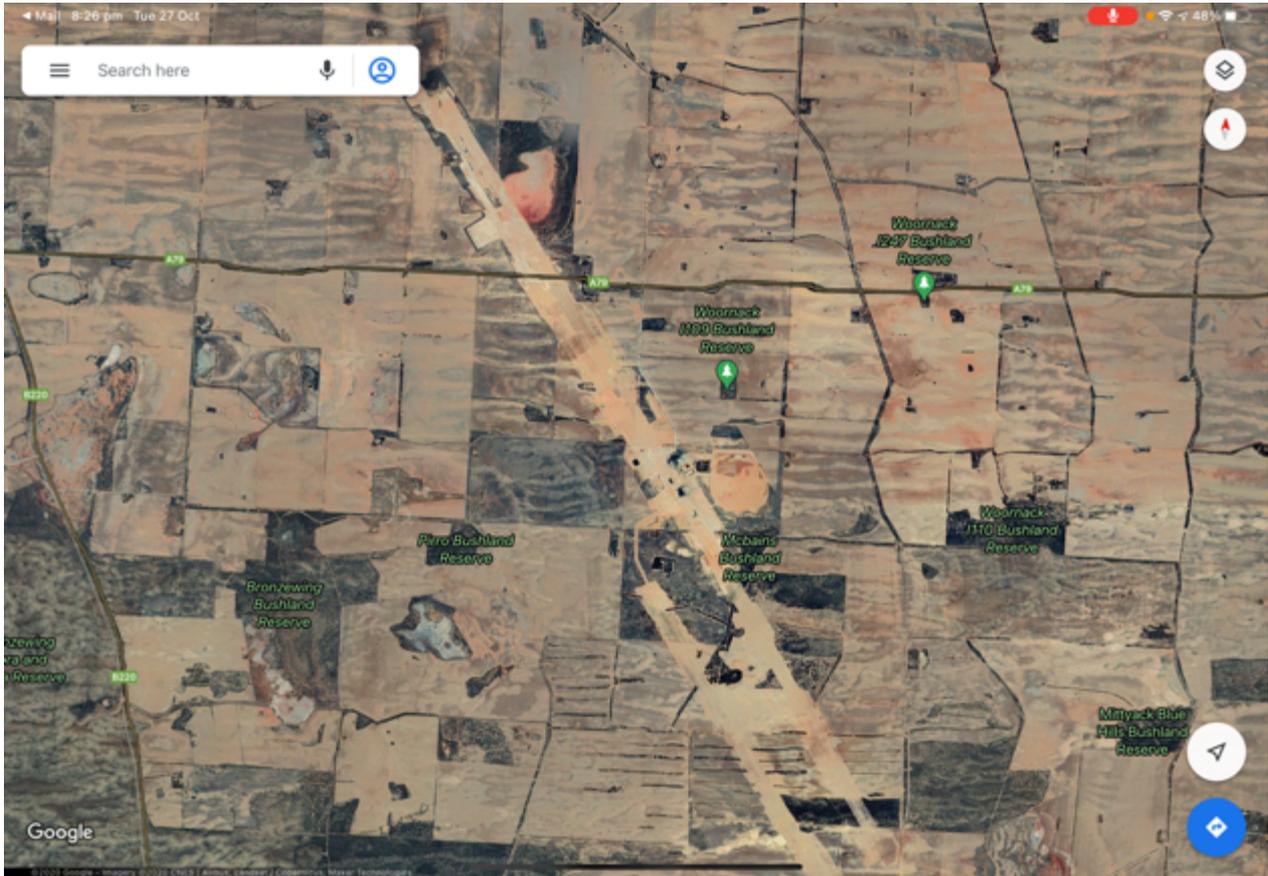
2.7. Sat. image Fosterville mine site



2.8. Sat. image Ballarat mine site



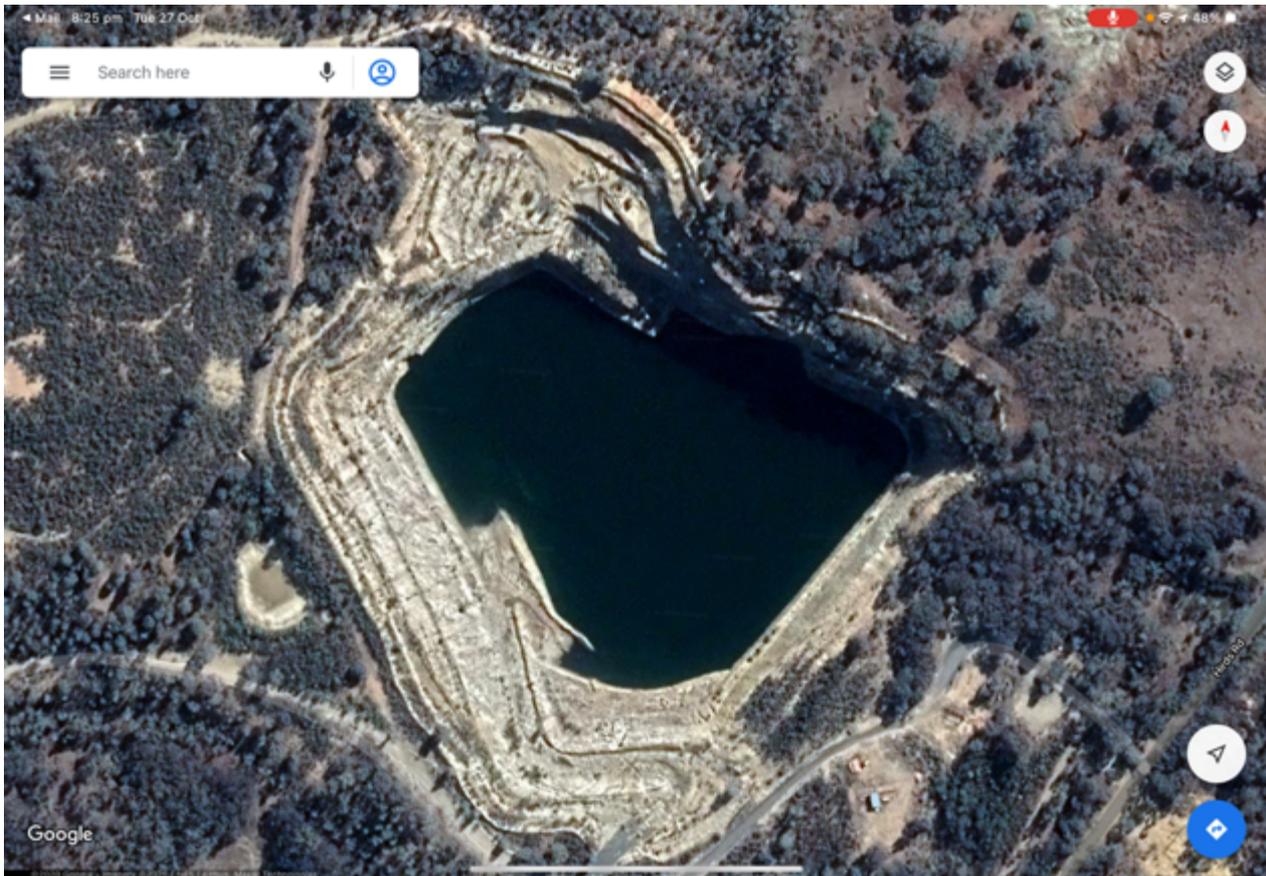
2.9. Sat. image St. Barbara tailings dam



2.10. Sat. image Ouyen mineral sands mine



2.11. Sat. image Horsham mine site



2.12. Sat. image Heathcote tailings dam

Section 3

Risk of Loss of Life and Income Withdrawal from Catastrophic Failure of Tailings and Water Management dams and Mine Pits

In the EES Draft Kalbar have nominated the construction, in some cases the relocation, and then the eventual decommissioning of some twenty dams. These dams serve various functions such as tailings storage, freshwater capture and management and are also incorporated in the processing circuit. The company have nominated a similar number of mine voids or pits, which also include as a function the storage or recycling of mine water.

Those structures which have been classified as dams will range in their method of construction and in their statutory classification dependent on their scale and intended use. Some dams will be intended to securely retain their contents with an overflow facility that will only function in an emergency whereas some dams used for water management will have an overflow facility designed to progressively release the water they have captured during a storm.

Some of these dams where tailings, usually incorporating fine or coarse sand, are placed hydraulically from a spigot will share some similarities with upstream tailings lift dams. Upstream tailings lift dams are commonly considered as those wherein the upstream hydraulic placement of tailings, which are subsequently allowed to dry, form a part of the structure of the wall. Kalbar dams in some cases will share a similarity in that the placement of tailings, which are subsequently allowed to dry, will form part of the structural strength of a dam wall, and, or, in some cases these dried tailings will form a hard cap over sections of the dam which will modify the structural or hydraulic behaviour of the dam. Kalbar mine pits will have walls wherein the crest may be raised or the wall otherwise modified in its structural behaviour by the placement and subsequent drying of tailings.

The GHD 2015 Starter Pit report describes the difficulties that Kalbar will face in designing and constructing dams in an environment which includes dispersive soils and with the lack of materials suitable

for dam construction that can be won from the project area. Other than dams where the natural features of the topography are incorporated into the construction of the dam, most walls will be of gravity fill construction. If these dam walls fail due to an inadequate structural strength, or fail from erosion due to the mis-operation of a spillway, and the fill material is exposed, there is the opportunity for up to several tens of thousands of tonnes of fill material to be discharged, along with the dam contents, into the downstream environment. In the case of mine voids, dependent on the moisture contents of the tailings, failure of a mine void wall could result in the discharge of some millions of tonnes of tailings.

The company have nominated that the flow of a tributary of the Honeysuckle creek, which has a significant catchment upstream of the mine site, will be diverted around the project area. This would require the construction of an alternate hardened channel.

Two or more of the project dams, due to their scale, will fall under the statutory classification of ANCOLD Large Storage dams. This classification places technical requirements on the design and operation of such dams, in part due to the risk that is placed on down stream parties if there is structural failure or mis-operation of such a dam.

Kalbar have not established a sufficient narrative in the draft EES for the management of surface water flows or the management of mine water. Specifically, there is insufficient information on the design or intended operation of the mine pits and on the design of the ANCOLD category dams. The companies technical reference documents do not contain a realistic process to assess the risk to health or infrastructure in the downstream Perry or Mitchell river environments following the catastrophic failure of a dam.

Omissions in the narrative and gaps in the data sets include but are not limited to -

- The ANCOLD dams are the most significant and expensive civil structures required for the project. By their admission Kalbar have not engaged the services of consultants to consider the philosophy of the design of these dams and for advice as to if it is economically feasible to construct these dams in such a difficult soil structure.

Kalbar have not conducted test bores to a depth which might establish the bedrock conditions on which the dam designs might be based.

- The predicted extreme precipitation event, or events, in the catchment of a dam is a critical factor in determining the intended design capacity of that dam and also the flow capacity of the spillway structure. Neither of the consultants engaged by Kalbar to consider water management have applied due diligence to the assessment of extreme precipitation events or to the prediction of stream flows. Their assessment could have been better refined by interpolation of the available local weather recordings including local newspaper reports. It is now accepted that climate change needs to be included in the assessment of extreme precipitation events. In Victoria this has led to a lowering of the mean annual precipitation but has also led to an increase in the level of an extreme precipitation event. DELWP have recently provided a guideline to determine the variation which can be attributed to climate change.

- The consideration of mitigation activity if there is the release of fill material from a dam wall when a weather event strikes during the construction, or the attempted dismantling, of a dam structure.

- The mitigation activity that would be required if a dam structure is made ineffective due to tunnel erosion.

- The installation of an emergency warning system and the promulgation of an evacuation procedure for protection of downstream residents in the event of a catastrophic failure of a dam wall.

The failure of mine tailings dams, particularly those that rely in part on the placement and hardening of tailings for their structural strength, are still reoccurring events in the Victorian and National mining industry. One of the most recent and potentially dangerous events in the failure of upstream lift tailings dams was in NSW and is recorded in this media coverage -

<https://www.smh.com.au/business/companies/newcrest-warned-gold-mine-dam-walls-at-risk-20190430-p51imn.html>

After several mine tailing dam discharge events in Australia and an event in Brazil, BHP and the Australian Minerals Council in 2018 described a process for the risk assessment of tailings dams at major mine locations in Australia and a strategy for the replacement of those deemed to be of high or extreme risk and described the strategy in the following bulletin.

https://www.bhp.com/-/media/documents/media/reports-and-presentations/2019/190607_esgbriefingtailingsdams.pdf?la=en

The following images and description refer to an ANCOLD category dam which is the primary operational tailing storage facility at a gold mining site at Stawell, Victoria. This dam is similar in scale to a proposed Kalbar ANCOLD category dam or a Kalbar mine pit, being approximately 70 hectares in area with a major wall crest height of 26 metres and a current loading of 26 million tonnes of fine sand tailings. National Pollution Inventory data describe that the dam contents include more than ten thousand tonnes of arsenic and also include the bi-products from the use of cyanide in the processing plant. The company has informed the ERC that 60% of the contents of the dam are considered as mobile. Processing water is decanted for recycling from the depression towards the centre of the dam surface. EPA have issued a series of notices against the company for discharges of tailings water beyond the dam wall and there is currently a system of interception bores and associated pumps in operation. Some forty residences situated along a creek flat, between the tailings dam and the Wimmera river, could be seen as of risk from a surge of tailings water if there was a structural failure of the dam. The companies advice to the ERC is that they do not utilise the services of the significant consultancies within Australia that would usually be engaged on the annual or bi-annual inspections of ANCOLD classified dams. The most recent report on the function of the dam, prepared by a consultancy significantly as a desk top review, was by SKM in 2008. The mining company has been unable to provide a record that indicates the dam at any time has undergone a stress test, a common precautionary procedure for earthen dams. The company has advised the ERC that the Work Plan requires that it prepares an evacuation procedure and that this procedure has been promulgated to emergency services staff. Members of the public have not been provided with an emergency evacuation document and are unaware of any early warning devices or the manner of their operation.

This tailings dam would fall under the BHP classification as of extreme risk, not because of the inadequacy or otherwise of it's construction or operation, but because of the risk to life if the dam structure was to fail. BHP would have de-commissioned this dam.

This current ongoing example of the near complete failure of the regulators, ERR and EPA, to manage the protection of health and infrastructure under the MDRS (Act) and SEPP guidelines should preclude the incorporation of dams of the scale of the ANCOLD category from Work Plans until the community can regain comfort in the operational capability of these regulators.



Drone image of the Stawell tailings dam

The consultant Water Technology has provided technical reference documents to the Kalbar draft EES and “ worked in close co-operation “ with another contributor, the consultancy EEM. Water Technology have provided the technical reference document, Surface Water Assessment Site Study. Appendix A006. On page 2 of this document the consultant states -

“ The prime purpose of this report is to outline the potential for adverse affects on nearby and downstream water environments (including the Mitchell and Perry rivers, King and Wellington Lakes, and Gippsland Lakes RAMSAR wetland of international importance overall) due to changed water quality, flow regimes or waterway conditions during construction, operations, rehabilitation, decommissioning and post closure.”(sic)

Based on the consultant’s description of the purpose of the report it is reasonable to consider that the most significant disturbances amongst those likely to influence the downstream water environment, both in order of scale and severity and perhaps in their likelihood of occurrence, are -

wall collapse of one or more mine voids and the potential to release, dependent on the mobility of the contents, several million tonnes of mine tailings into the Mitchell or Perry river courses.

wall collapse of one or more cells of the tailing storage facility and the potential release of several million tonnes of fine sand tailings (including the flocculant component) into the Perry river course.

wall collapse of the ANCOLD category freshwater dam. This would have the potential to release, along with several gigalitres of water, tailings from a mine void or sediments from other dams in the path of the discharge along with fill from the freshwater dam wall. Dependent on the character of the failure it may be possible than the discharge could access the Perry or Mitchell river course.

wall collapse of other mine water or freshwater dams. The potential for erosion of local watercourses and

the deposition of silt. This could include the deposition of silt into the Perry chain of ponds.

Water Technology have not provided hydrological models for any of these events.

Some events need to consider the cascading failure of structures and the models need to include alternate flow regimes, i.e. high or low flow rates, in the receiving streams, the Mitchell river, Honeysuckle creek and the Perry river.

As access to this modelling is critical for the assessment of risk to life, risk to loss of structures and for the assessment of environmental risk to a RAMSAR site, it is requested that the Panel not proceed to a final assessment of the EES until the proponent has been able to place this modelling, prepared by an informed consultant, before the community and that this include a suitable period to review and present argument before the Panel.

Section 4

Water Requirement and Sourcing

Southern Rural Water have developed a history of sustainable water allocation for agriculture and the environment. The requirement of this project, to substantially increase the current extraction rate from the Mitchell river and/or the **Latrobe Group** aquifer, is in direct conflict with sustainable allocation. The conflict derives from the risk of over allocation, the risk of withdrawal of allocations from existing producers, the inherent demand for a constant volume of water to be present within the processing circuit of the mine, the risks to water quality (turbidity and altered chemistry) and the long term risk to the future beneficial use of a ground water resource.

Kalbar and their consultants, EEM and Coffey, have presented a flawed, conflicting and incomplete narrative for the sourcing of water and for their estimation of the volume required for the mines operation.

The Fingerboard project presents a complex scenario of sourcing water from stream and groundwater allocations, the diversion and regeneration of surface flows, of on-site water harvesting and the recovery and treatment of mine water.

The civil structures are likely to include more than twenty significant dams (including two or more dams likely to be categorised as ANCOLD dams). These dams are variously purposed as fresh water storage dams, process water dams, tailings dams, surface water or mine water collection dams, mine pits (which include dam wall structures) and various overflow or silt retention dams. Surface water flows within the site or at the perimeter are managed by structures which include dams, but also include modified or natural gullies, embankments, diversion drains or pipes and bund walls. Many of these structures are to be de-commissioned and re-commissioned as mine voids are progressively excavated or refilled across the site.

Kalbar have nominated the requirement for a water allocation from external sources as ~ 3Gl per year. The primary consultants, Coffey and **EMM** management, appear to have accepted this nomination and also appear to have accepted further advice from Kalbar, such as the capacity of the various structures and plant to recover water for recycling, for instance, from mine voids and tailings dams. Kalbar have not provided sufficient background to their sources of information for other values they have placed with their consultants, for instance, that coarse sand can be de-watered to 65% solids prior to placement in the mine voids. The consultants have not applied sufficient rigour to establish baseline values prior to their creation of a conceptual model for water management, but have provided a general disclaimer of the risks inherent in their acceptance of information from Kalbar and therefore the reliability (or lack thereof) of their reports.

Four significant mechanisms of water loss during the mines operation are -

- the losses when sands are hydraulically returned to mine voids and tailings dams.
 - water that is used for dust suppression on areas currently actively mined or not yet rehabilitated, on the maintenance of mine haul roads, for dust suppression on overburden and soil stockpiles, on the maintenance of public roads outside the mine footprint which, because of heavy vehicle loadings, local government has chosen to operate as unsealed roads until the cessation of mine haulage.
 - water used for conditioning during construction of private and public roads and for conditioning of fill and clay used in the construction of dams, bund walls etc.
- evaporation from dam structures.

The overburden, upper sands and marker sands typically share a makeup where more than 20% of particles are less than 20 microns in size. Some additional contribution of particles less than 20 microns will occur from the shearing of larger particles under the action of mining excavation equipment. Sub 20 micron particles have the capacity to generate significant quantities of airborne dust during periods of low soil moisture and will require the use of substantial quantities of water as dust suppressant during extended dry periods. The science of negative health outcomes from exposure to small particle silica present in these dust loads is well described. A constant conversation at

Environment Review Committee meetings at all active mining projects in central Victoria is in regard to the inability of the company to source water for dust suppression, and the withdrawal of ERR and EPA from compliance activity on dust exceedance events.

Prior to the sale of this project by Rio Tinto to Kalbar, Rio Tinto commissioned a feasibility study into the development of a mineral sand mining operation. This operation is similar, but with a somewhat lower scale of production, to the Kalbar proposal. The Rio Tinto Exploration Report 29569 of 2012, provides a detailed model of a mining operation using “ordinary mineral sand mining techniques”. Section 7.2 of this report indicates a requirement for 4.66 Gl/annum of make up water and Section 8.2 discusses the risk in obtaining a 6.2 Gl/annum water supply. From the discussion in this report it is considered this water requirement relates primarily to the operation of plant used for processing ore, and for the hydraulic transport of ore and the transport and placement of coarse sand and tailings, rather than for dust mitigation or rehabilitation activity.

A critical examination of the water losses that would occur includes -

- losses at the mine pits and tailings dams from seepage and evaporation.
- losses from seepage and evaporation at dams for water capture or storage of fresh or process water.
- the water that is required for dust suppression.
- the water that is required for irrigation to establish pasture or vegetation for control of erosion on reconstructed gully slopes and swales.

If these losses were summated a more credible estimate, for a project of the scale envisaged by Kalbar, might be 8 Gl/annum, varying on a seasonable basis.

The Rio Tinto report concludes that this project, as described, does not suit their company model for investment due primarily to the risk inherent in securing a reliable water supply.

Section 5

Loss to the Ecological Value of the Gippsland Lakes RAMSAR Wetland, Lakes National Park and Corner Inlet RAMSAR Site.

The Gippsland Lakes are an extensive system of saline, brackish and freshwater lakes, billabongs, swamps and river outfalls. The Lakes National Park hosts unique habitat on the fringing ocean dunes. Two significant waterways, Lakes King and Victoria, are fed by several river systems, including the heritage listed Mitchell river which has it's headwaters in the Victorian alps. The Lakes, due to

their scale, and the complex range of habitats which have been formed from the interplay between the marine environment and the freshwater rivers systems are well placed to retain ecological functionality during a period of climate change. The capacity for resilience of the Lakes is in contrast to RAMSAR wetlands such as Lake Albacutya in northern Victoria where the single water source ,the Wimmera river, is now unreliable and increasingly saline.

The Gippsland Lakes would be impacted by the dust loading that the Kalbar project would place on the lower Mitchell river catchment, by an increase in water turbidity and by a change in water chemistry. The Lakes ecology would be affected by increased extraction from the Mitchell river or from the aquifers interconnected with the Lakes and possibly by unseasonal water release from dams on the project site.

The risk of structural failure of the more than twenty tailing dams, mine pits or water holding dams that would be constructed, or deconstructed, during the period of the mine project would be an immediate threat to the lakes.

Some individual dams would have a holding capacity greater than several Gigalitres. Failure of a dam of this scale could release several Gigalitres of mine water and mobilise several hundred thousand tonnes of material from the dam wall fill along with residual silt from the dam bed. If a mine pit was to structurally fail there would be the capacity for up to several million tonnes of tailings to flow through the Chain of Ponds on the Perry river and into the Lakes. The effect on the Lakes from structural failure of a large dam or mine pit would be extensive ecological damage to aquatic plants and molluscs and in the short term a reduction in fish stocks. Several Kalbar dams will be categorised as Large dams under the ANCOLD criteria. These dams are not precluded from failure which may occur due to lack of maintenance or from misadventure in operation. Dams satisfying ANCOLD criteria or of a similar construction standard and used as town water supplies, for irrigation, or for mining operations have failed in all States of Australia. If a national analysis of dam failure, or unintended discharge, was used to apply risk to the Kalbar site it would possibly indicate multiple dam failures during the life of the project.

Communities in central Victoria have extensive experience with fugitive emissions of dust and mine tailings from gold mining sites. Some examples have been described in the local media and further in these reports -

- The Golder Report 1 and 2. 2015. Mandalay mine. Costerfield.
- GHD report on environmental monitoring. 2016. SGM. Stawell.
(critical of monitoring of the ANCOLD categorised tailing dam).
- EPA approved 53V Audit. 2017 . GBM. Health risk of Woodvale complex of tailings dams.

The Corner Inlet RAMSAR site is about 670 square kilometres in area and is a submerged plain covered with mud flats and sand and also features sand islands.

There are significant areas of sea grass supported by tidal movement. The Inlet is recognised for it's bird life, marine species and for it's tourism and recreational values.

Port Anthony, in Corner Inlet, has been nominated by Kalbar for the handling and shipping of ore. Vessels using Port Anthony are limited to approximately 10,000 tonnes due to the shallow shipping channel and vessel movements are further limited by the tidal influence. Kalbar would require vessel movements on an average of each four days to satisfy the production volume they have nominated for their mine. There are currently no facilities to store or handle bulk HMC at Port Anthony.

The following document from the Australian Government's Department of Agriculture, Water and the Environment provides an ecological character description of the Corner Inlet RAMSAR site in Chapter 1 and describes the acceptable limits of change in chapter 4.

<https://www.environment.gov.au/water/wetlands/publications/corner-inlet-ramsar-site-ecological-character-description>

The level of disturbance / activity projected by Kalbar to occur within the Corner Inlet RAMSAR site exceed the limits of change described in this document.

The use of an economic model to place a financial value against an individual ecological asset is difficult and the resultant value is open to interpretation. Kalbar have predicted a financial rate of return for their project. Simply, this rate of return is dwarfed by the ongoing financial return that the State of Victoria derives from only two aspects of the Gippsland Lakes and Corner Inlet, that is the return from tourism and the return from the recreation industry. The return derived from tourism and the recreational industry is in turn reliant on the ecological quality of the two assets.

Section 6

Loss of Native Vegetation and Ecological Connectivity.

Kalbar engaged Ecology and Heritage Partners to prepare a detailed Ecological Assessment - Appendix A005. The assessment was managed and reviewed by the companies two senior ecologists. E & H Partners stated “ field methods were used to assess environmental conditions and identify key ecological values”. On page 7

E & H Partners identified seven key threatening processes, these typically include processes such as direct fauna mortality and dust, noise and light.

E & H Partners failed. They did not provide an ecological assessment, rather simply an incomplete list of biota that was not science motivated or based on evidence. This report is in the most part a desk based collation of flora and fauna species likely to be present in the area and was not significantly advanced by the less than robust field observations. The E & H document includes a considerable expenditure of effort to establish vegetation offsets that could be used under the Commonwealth EPBC Act or State native vegetation legislation to buy “ credits “ for the ecological damage E & H consider will be generated from the proponents project.

E & H , either as a condition of their engagement or for other reasons, have sought to diminish or minimise the environmental circumstances they have found or reported on. An example is the prominent listing of pest weed and feral animal species supported by poor quality b & w images. These observations would be unremarkable in almost all Victorian grazing land. Of more ecological significance would have been coloured images of the pre-european heavily canopied Gippsland red gums. These red gums typically feature multiple nesting hollows which are visited by a continuous movement of galahs and colourful parrots. Or perhaps an image of a platypus working a gravel bar in the crystal clear water of the Mitchell river, or a sea eagle standing sentinel atop a prominent tree on the bank?



Some of the processes or evaluations which should have been present, or have been provided with suitable recognition, in an ecological assessment would include -

- # The capacity of the project area to provide climate services (moderation of weather, reduction of wind speeds and temperature).
- # Pollination services and a seed bank for regeneration of locally adapted vegetation.
- # Beneficial biota (seeds and insects) as food to the river systems and the Lakes.
- # Suitable amenity for human habitation.
- # Recognition that grazing land that is not regularly cultivated and which provides refuge for protection of fauna and small bird species in deep vegetated gullies can highly advantage birds of prey such as eagles, hawks and falcons.



That in a modified environment the stewardship of graziers as land managers provides a service in the removal of pest weed and animal species and management of wildfire.

Climate Change. Roadside vegetation and deep gullies provide continuous corridors of vegetation for the movement of flora and fauna across the landscape as the climate changes.(biolinks). In particular remnant native vegetation in or near the riparian zone can provide temporary refuge to fauna stressed by drought and may be critical in the adaptation of some species to climate change.

Food production including shelter belts for the grazing of stock.

E & H Partners failed to recognise the most significant threatening processes -

That in Victoria there is minimal regulation of mining projects. Farmland modified by a mining process will usually be abandoned by the miner and the State and will remain in the landscape as an unlicensed waste or tailings storage facility. This risk is self evident from the VAGO report of August 2020.



Drone image of Woodvale tailing dams

That farm soil as re-constructed by Kalbar may not withstand natural erosion processes and is not capable of food production.

That the collapse of a Kalbar mine pit has the capacity to place several millions of tonnes of tailings into the Perry river system chain of ponds and continue intrusion in to the Lakes System. This risk is most easily established by a search of media reports of failure of tailings dams in legacy mine sites in all States of Australia. This search would provide a more sound evidence base of risk rather than consultant reports which have been generated for and paid for by a mine proponent and seek to suggest low risk.

That the collapse of a tailing storage facility or water storage dam has the capacity to place up to several thousand of tonnes of tailings, mine water or water into the Mitchell river and continue intrusion in to the Lakes.

That Kalbar have incorrectly assessed, or mis-stated, their requirement for water by underestimating the requirement of water for dust suppression or overestimating the amount of water that can be recovered and recycled from mine pits or tailings dams. If Kalbar were to make purchases of water in an open market of up to 20 Gigalitres /year as an expedient to maintain production this increase in extraction would affect the availability of environmental water.

The risk to the RAMSAR site, Corner Inlet, if Kalbar finds it uneconomic to ship ore when that requires a ship movement every 4 days. Kalbar may seek a Port upgrade and a channel dredging process to enable the movement of bulk carrier scale ships.

The pollution of aquifers by the annual leaching of many tonnes of flocculants.

The fugitive release of dust to the environment if water for dust suppression cannot be sourced during a drought. Exposed sand tailings have the capacity to generate hundreds of tonnes of airborne contaminant per hectare in a single storm event. (~ 200 tonnes/hectare from each centimetre of the surface eroded by wind).

The concept that native vegetation can be “offset“ under a Commonwealth or State offset formula to compensate for the disturbance caused by mining activity is not realistic. Those existing mature trees, possibly featuring nesting hollows, lose their ecological function on the day of their removal. If offset land is purchased and planted with native vegetation it may be a hundred years before the ecological function is available. If offset land is purchased that holds mature trees that ecological service is already existing and under native vegetation legislation those trees cannot be removed by the land manager. There is therefore no opportunity for gain or loss at the offset site. The failure of this offset process was highlighted in a Senate Select Committee investigation of the performance of the EPBC act and referred to in the following article in The Guardian.

<https://www.theguardian.com/environment/2020/jun/27/morrison-government-urged-to-fix-flawed-environmental-offsets-leaving-threatened-species-at-risk>

E & H Partners conduct significant business activity as traders in native vegetation offset credits. This is a conflict of interest in their engagement as the principal party to prepare an ecological assessment. If E & H Partners reach a conclusion that particular native vegetation is not essential and can be removed and that this removal can be managed by the native vegetation offset process they would then be advantaged as a trader of credits.

To satisfy the EES process, Kalbar must source an ecological assessment from one of the many ecology consultants who are suitably experienced and will inform the EES process with a science based ecological assessment.

Table 3.2: Glenaladale Main Produced Products

	TiO ₂	Fe ₂ O ₃	SiO ₂	Al ₂ O ₃	ZrO ₂ +HfO ₂	U XRF	Th XRF
Primary Zircon	0.14	0.05	32.7	0.1	65.5	391	222
Secondary Zircon	0.79	0.07	31.2	0.1	62.5	448	279

	TiO ₂	Fe ₂ O ₃	SiO ₂	Al ₂ O ₃	Cr ₂ O ₃	ZrO ₂ +HfO ₂	U XRF	Th XRF
HiTi 70	80.9	7.4	6.3	1.8	0.6	0.2	36	123
HiTi 80	83.7	7.0	1.9	1.1	3.6	0.1	16	74
Primary Ilmenite	48.4	46.4	0.8	0.8	0.8	0.1	0.0	36.8

Table 3.3: Mossiface Produced Products

	TiO ₂	Fe ₂ O ₃	SiO ₂	Al ₂ O ₃	ZrO ₂ +HfO ₂	U XRF	Th XRF
Primary Zircon	0.10	0.03	33.80	0.31	63.00	415	217
Secondary Zircon	0.73	0.04	32.60	0.24	65.20	514	269

	TiO ₂	Fe ₂ O ₃	SiO ₂	Al ₂ O ₃	Cr ₂ O ₃	ZrO ₂ +HfO ₂	U XRF	Th XRF
HiTi 70	-	-	-	-	-	-	-	-
HiTi 80	-	-	-	-	-	-	-	-
Primary Ilmenite	57.0	36.8	0.8	0.5	0.6	0.1	27	102

Produced primary zircon product is of typical premium zircon quality with the exception of the Uranium (U) and Thorium (Th) levels exceeding typical requirements of <500ppm.

Secondary zircon product is of typical special/chemical grade quality containing <1.0% TiO₂ and <1,000ppm U+Th.

Potential HiTi products were only produced for Glenaladale Main as insufficient sample was available for further testing of Mossiface material, with chemical analyses of Glenaladale Main produced products, HiTi 70 and HiTi 80 indicating products to contain elevated levels of SiO₂.

Primary ilmenite products produced contain different levels of TiO₂, but similar levels of ilmenite as identified optically, thereby suggesting varying ilmenite species with varying titanium levels. Confirmation of this would require further detailed mineralogical analyses.

Further to the above the primary ilmenite product produced, contain elevated levels of Cr₂O₃ calculated at 0.8% for Glenaladale Main and 0.6% for Mossiface. Given the TiO₂ levels and fine size range, material would be best suited as titanium smelter feed material and/or direct titanium dioxide pigment manufacture. For this to occur Cr₂O₃ levels are required to be <0.1%.

3.2.2 Ilmenite Product Test Work

A representative sample produced from the Glenaladale Main potential ilmenite was submitted for sulphuric acid solubility test work with CSIRO, detailed QEMSCAN analyses with Amdel – Bureau Veritas and an undisclosed titanium smelter operator to determine Cr₂O₃ solubility, free chromite and potential titanium slag quality respectively.

Cr₂O₃ Solubility

Sulphuric acid solubility test work completed under standard CSIRO conditions indicated that the produced Glenaladale Main ilmenite had a TiO₂ solubility of 89.4%, with soluble Cr₂O₃ content of 0.20 wt%. For material to be suitable as a feedstock for sulphuric acid titanium dioxide production soluble Cr₂O₃ levels are required to be <0.1%, with data suggesting overall Cr₂O₃ levels will need to be reduced to <0.4%, so as to meet this specification.

