Submission Cover Sheet

Fingerboards Mineral Sands Project Inquiry and Advisory Committee - EES

423

Request to be heard?: Yes

Full Name: Nicholas John Barton

Organisation:

Affected property:

Attachment 1: EES_-_personal_4.

Attachment 2: Appendix_1.__Kal

Attachment 3:

Comments: see attached submission

Introduction

This Environmental Effects Statement (EES) is an extremely voluminous document which on closer examination is extremely repetitive and carelessly compiled. The structure, Main Report, then Attachments (with appendices), then Appendices (with sub-appendices, and even sub-sub appendices) eg Appendix A002, Appendix D, Appendix D all with common page numbers makes navigating and referencing this document incredibly difficult. This confusion extends to the compilers of the EES, for example section 11.5.4.2 p11-23 refers to the "groundwater and surface water impact assessment prepared by Coffee (Appendix A003) and the Fingerboards Groundwater Modelling Report (EEM 2020b) (appended to Appendix A003)" A search of the EES located these documents as Appendix A006. P 3-31 refers the reader to non-existent sections 9.3.2.2 and 9.3.3.2. In Table 3.1, p 3-3 we are told that the size of the mine void(s) will be 18ha plus 19ha coarse sand tailings and fines tailing cell construction). On page 3.18 they state "The selected mining layout is a series of cells approximately 300m wide by 1000m long. (*Note -This makes 30 ha*) The mine is expected to have two active mining voids of less than 60 ha each at any one time, with an area of 10ha within each void being used for tailings disposal". On page 11-16 we are told that "Two mine voids, of less than 100 ha total, are expected to be active at any one time"

It was surprising to find on p3 of the summary report that Bairnsdale is 20km to the west of the mine site. The dates of floods on the Mitchell (Table 8.23: p8-92) bears no relation to the flow rates given in figure 8.23 and is clearly wrong (Local Flood Guide, Bairnsdale: http://www.eastgippsland.vic.gov.au/files/assets/public/documents/plancom_directorate/emergency/local_flood_guides/bairnsdale_lfg_final.pdf).

However, the sheer size of the document may well have served to obscure important details as readers such as myself, with other commitments, found it impossible to fully analyse the entire document in the time available.

I have elected to concentrate mainly on water and dust, with only passing comments on other aspects of the EES.

The clear impression obtained from this document is that Kalbar had decided that the mine was to proceed and the consultants were given the task of downplaying any risks which may jeopardise this objective.

Unlike other significant zircon resources in Victoria in areas such as the WIM Avonbank resource near Horsham (WIM Resources 2020) (http://www.wimresource.com.au/irm/content/overview.aspx?RID=311&RedirectCount=1), where the topography is flat and overburden shallow the Glenaladale resource is situated on a plateau, intersected with deep gullies and overlying numerous shallow and deeper groundwater systems, with a considerable depth of overburden. It overlooks the Lindenow flats, one of Victoria's premier vegetable growing areas. It is only 300 m from the Heritage Mitchell River, the largest unrestricted river in Victoria, the health of which is vital to the Ramsar Listed Gippsland Lakes. The climate is characterised both by extended dry periods and irregular very heavy rainfall events. This has necessitated complex engineering to attempt to prevent contaminated water or sediment leaving the site, and poses a risk of contaminated water reaching the underlying groundwater.

It is instructive that Rio Tinto Exploration (RTX), the original tenement holder over the Glenaladale Mineral deposit decided to divest the project on the basis that it was unlikely to meet the minimum criteria for a Rio Tinto mining project (Bishop 2013). Oresome Australia Ptd Ltd, a wholly owned subsidiary of Metallica Minerals Ltd entered into a "Right to Explore and Option to Purchase Agreement" with RTX in August 2011. After a Scoping Study Report prepared on their behalf by RJ Robbins and Associates they also decided not to proceed with the purchase of the rights to the tenement.

Key findings from Robbins were that:

- The mine would cost $271 million to establish (2012 costs)
- It would cost $80 million per year to operate exclusive of royalties and taxes
- It would require 4.6GL, and potentially up to 6.2GL per year to operate. This did not include water for dust suppression.
- 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%.

It was considered that sufficient water was unlikely to be available, and on that basis Oresome decided that the project would not be viable and relinquished their rights to the tenement.

So we have a situation where two experienced mining companies independently decided that it was not worth attempting to mine this deposit, whereas Kalbar, a company with no corporate mining experience has decided to try. This would suggest that there is a very high risk of failure of the venture. If the business collapses after excavation of the mine has started the potential for an environmental disaster in a very sensitive environment is extremely high.

Water

The independent peer review report into water by AECOM 2019 (Vol 4, Attachment 1) highlights several deficiencies in the water investigations. They concluded that:

1. There was an absence of information on the design of key engineering structures such as Tailings Storage Facilities (TSF), diversion drains and dams to allow evaluation of the impact of these structures. The proponent's response was that these details were not expected under the scoping requirements. This reaction makes it impossible to determine the safety or otherwise of this engineering. The risk of leakage of water from any of these structures, or of dust from the fine tailings TSF as the tailings dry cannot be evaluated, so therefore cannot be dismissed.
2. The bore field setup that was modelled falls outside the designated bore field. (p10). If Kalbar is unable to source water from the Mitchell and must rely on bores in the designated bore field this could lead to bore interference.
3. Groundwater modelling is considered to be oversimplified, with the possibility of perched aquifers above the base of the mine downplayed. Thus the model may significantly underestimate the impacts of the mine on groundwater mounding and effects on Groundwater Dependent Ecosystems (GDEs). The response from the proponent was to disagree, as many of Kalbar's bores did not strike water. However, Visualising Victoria's

> Groundwater (www.vvg.org.au) shows numerous shallow aquifers along the northern edge of the project area. Local farmers (R Coleman, G Johnson (pers. com) have dams which maintain water levels in the absence of surface run off. The "chain of ponds" characteristic of the significant GDE of Providence Ponds is seen in some of the small streams in the project area. All this would indicate that there are numerous shallow aquifers within the project footprint. The effects of disruption of these on the mine itself, farmers' stock water supply, and GDEs such as Providence Ponds and Saplings Morass are either downplayed or not considered.

Providence Ponds and the Perry River catchment "Chain of Ponds" are considered to be a unique and significant waterway system. 'Chain of Ponds' systems were once common across South-eastern Australia but are now very rare (West Gippsland Catchment Management Authority, 2017). The mine is to impact a significant portion of the catchment of this system. The EES ties itself in knots trying to downplay this inconvenient truth. Firstly, the statement made (Main Report, Table 4.8 p37) that the Boisdale aquifer supports the GDE of Providence Ponds is not supported by reference and is contradicted by the EES itself.

Coffee Appendix A006, p51 further demonstrates the muddled thinking regarding Providence Ponds:

"Providence Ponds is classified as a Type 2 GDE that is highly dependent on the surface expression of groundwater (Richard et al. 2011) and thus can be classified as a Class 1 GDE. This type of GDE relies on groundwater to support aquatic biodiversity by providing habitat and regulation of water chemistry and temperature (Richard et al. 2011) and thus is sensitive to the prevailing groundwater regime.

However, the available information on local groundwater indicate the depth to the regional groundwater system in the area is in the order of 30 m (EMM, 2020b) This suggests that the ponds are not supported by the regional groundwater system. Instead, the likely presence of clayey horizons within the Quaternary sediments form shallow perched systems which support the ponds and the surrounding red gum community."

Instructively Coffee (Appendix A006 p219) states: "Importantly, the Perry River and Providence Ponds are not considered GDE's in the vicinity of the project area as they rely (either completely or partially) on shallow, perched groundwater systems that are disconnected from the more regionally extensive Coongulmerang Formation aquifer".

Is perched groundwater not actually groundwater? Stating that they rely on shallow, perched groundwater systems but are somehow not groundwater dependent ecosystems defies the most elementary logic. The problem for Kalbar is, as pointed out in the peer review, that if the mine goes ahead they cannot avoid disrupting these shallow aquifers.

The temporary Tailings Storage Facility (TSF) including the wall covers 90 ha. Internal storage size is 70 ha with a capacity of 6.6 million cubic metres. This corresponds to an average depth of upward 10 metres. The TSF is to be situated on the watershed of the Mitchell and Perry Rivers. Because the base is to be compacted clay it is claimed that there will be no seepage. Sumps and a floating pontoon will be used to harvest water for re-use in ore processing. The upstream slopes will be stabilised with 3% lime (Main Report p3-23) to combat the known dispersive properties of the sodosols on the plateau. These soils are prone to tunnel erosion (Main Report p11-5). On page 3-25 it is stated that an 'east coast low' could deposit around 240 mm of direct rainfall, which they calculate corresponds to 167,670m3 of inflow to the TSF. Process water will be recovered where possible and re-used. Some process water is expected to infiltrate the Boisdale aquifer once tailings are placed in the mine. Except for Al and Cu these are not expected to pose a risk (Coffee 2020 p162). This conclusion is based on the results of analysis of the solubility of metals in the ore using the Australian Standard Leaching Procedure (ASLP). However, these leaching tests generally have very limited application as they only provide information about the leaching potential of solid materials under specific chemical conditions. (Government of Western Australia Department of Environmental Regulation, 2015)

The fine tailings, coarse tailings and mineral ore were chemically analysed by Envirolab, Certificate of Analysis 217289-B (Appendix A002 Appendix D Appendix D). Their analysis of metal concentrations (mg/kg) in the three substrates gave high concentrations of a number of highly toxic elements. Interestingly, Environmental Geochemistry International (EGi) (Appendix A002 Appendix D, 2020 Table 1) omitted to mention a number of these, including gallium, lanthanum, strontium, titanium, vanadium and zirconium The samples were then subject to the ASLP, in neutral water for 24hrs. Most metals were largely insoluble under these conditions, so levels in the leach water were generally low. These results were reported in full by EGi (Table 3), Coffee (Table 7-7) and elsewhere. The reason for the omission of these elements in Table 1 is not spelled out, but appears to be deceptive.

The relevance of the ASLP in determining the composition of the process water and leachate from fine tailings is open to question. Firstly, the process water will be reused as often as possible, which could to lead to a steady increase in dissolved minerals in each cycle. Water in the fine tailings will be in contact with these minerals for weeks or months, giving far more time for minerals to dissolve. The lime added to the upstream slopes is likely to increase the pH of the water in the tailings. Compounds of arsenic, chromium and vanadium, all highly toxic, are markedly more soluble in alkaline solutions than in neutral (Government of Western Australia Department of Environmental Regulation, 2015). Hence the conclusion that drainage from tailings into groundwater is unlikely to be harmful is fraught.

Although Kalbar have claimed that their TSF, freshwater dam and process water dam will be sealed with clay they have not demonstrated that suitable clay will be available. Even if this is the case, they are to construct 19 temporary water management dams (EMM 2020a, Appendix 006, Appendix A, Table 4.2). Some are to contain run-off from undisturbed ground, whilst others will contain water which has been in contact with ore or processed water. They have been designed to contain a maximum of 95mm run-off when empty. Kalbar have allowed for the possibility of up to 240 mm falling during an 'east coast low', (p3-25) so these dams will be unable to contain a rainfall event of anything near this magnitude. Up to 12 dams, with a capacity of 1440 ML will be operational at the peak activity of the mine (Barton 2020a, Kalbar Dams Capacity xlsx, appended). They will rely on spillways to safely release water if capacity is exceeded (EMM 2020a p29) who have conceded that this is possible, and that mine contact water may be released to the environment. The risk of dam failure in dams constructed for a limited life, height to spillway up to 24m, and embankment length up to 830m is also a possibility which cannot be discounted. It is conceded that these dams will leak. EMM (2020a)'s water balance model, (Appendix A006, Appendix A, Figures 8.1 to 8.3 and Figures C1 to C6) allows for up to 14 ML/year of seepage from mine contact water dams and 23 ML/year from undisturbed water dams. Should any of this leaking water find its way into a dispersive sodic clay subsoil the potential for dispersion and tunnelling is very high. A failure of one or more of these dams would lead to a sudden release of potentially contaminated water and sediment into what is likely to be a sensitive environment.

In addition to seepage from dams there will also be seepage from tailings and ore. EEM (2020a) have not included an allowance for water seeping from the mine floor. This seepage is expected to cause groundwater mounding in the vicinity of the mine. Although the process water is expected to contain a number of toxic elements (Coffee p162) they consider that all except aluminium, copper and iron are associated with particles which will be filtered out as the water seeps to the aquifers, and hence are of low risk. The risk to Providence Ponds is rated as low (Main Report p9.77).This is unproven, especially given the potential for failure of a water management dam, or less likely but potentially disastrous, the failure of the TSF.

Water Usage

Kalbar has exhibited considerable uncertainty regarding their ability to access their estimated 3 GL of water required for the project. Pye 2017 (Appendix A008) calculated pipe sizes and pump selection for what he stated would be a maximum flow rate of 25ML/day from the Mitchell River (p20). At this rate it would take 40 days to pump 1GL. However the 350L/s he specified is actually 30ML/day, which would take 106 days to pump 3.2GL

EEM (2020a) Appendix A006, Appendix A, Appendix B in their modelling assumptions used 25 ML/day as the maximum rate of transfer from the Mitchell. However, in describing their model (Appendix A006, Appendix A p75) they have increased the maximum intake to 37.5ML per day as they realised that historically there are many days within the winterfill period from 1st July to 31st October (123 days) when the flow in the Mitchell falls below 1400 ML and winterfill pumping is not permitted. This higher rate will exceed the capacity of the system devised by Pye and will require complete re-design. Analysis of flow rates downloaded from https//data.water.vic.gov.au during the winterfill periods of 2018 and 2019 found that there were only 74 and 81 days respectively on which pumping would have been allowed (Glenaladale daily flow xlsx, Barton 2020b), appended. Kalbar's proposed freshwater storage is 2.2 GL. It is unclear where they intend to store Mitchell water in excess of this quantity.

It should be noted that the water from the Mitchell that Kalbar are proposing to use is additional to that which has been made available to irrigators in the past. An argument could be made that, given time to plan and construct storages, greater employment and value could be created by making this water available to the horticultural industry on the Lindenow flats.

EMM (2020b), Appendix A006 Appendix B p65 checked the potential of the Latrobe Group aquifer to supply Kalbar's water requirements by pumping a test bore at a rate of close to 1 ML/day for 4 days. After an initial rapid drawdown the water level stabilised. It would require 3 such bores pumping continuously year round to obtain 1GL from this aquifer. If the full 3 GL was required from the borefield this would require 8 bores. As pointed out in AECOM peer report this could lead to problems due to bore interference. This aquifer is fully allocated; no further licences for extraction will be issued. It is not known whether Kalbar would be able to purchase licences from existing users to enable them to access this water. This would certainly be a seller's market, and Kalbar may be forced to pay a high price for water from this source.

Some water will also be collected from rainfall in the water management dams, but this will be obtained by intercepting runoff which would normally flow to the Mitchell or Perry River systems. Kalbar have no licence for this water, so have undertaken to return water captured outside the winterfill period to these rivers (Main Report Section 3.7.4.1, p 3.31) Hence this cannot be added to the water available for the mine operation.

Given that Robbins (in Bishop 2013 ibid) decided that far more that 3GL would be required to operate the mine it is worth examining the rationale by which Kalbar decided that only 3GL would be required. Kalbar (p3-28) stated that 300,000 litres per hour will be lost during processing, mostly in pumping coarse and fine tailings Over a 24 hour cycle 365 days per year this equates to about 2.6GL. This contrasts with EEM (2020a),who modelled water usage for years 5, 8 and 15 under a range of conditions (figures 8.1-8.3 and figures C1-C6) They consistently found that around 3050 ML/year was "entrained" in fine and sand tails, and in ore. This equates to 349,000 L/hr. Total usage and losses due to seepage, evaporation and environmental returns in a median year (Figure 8.2) were almost 4GL. The water in excess of 3GL was assumed to come from rainfall and around 600ML of water already present in the ore as it is mined. They have made no allowance for evaporation from the mine void. 12 GL/year (1.37ML/hr) is pumped from the mine to the WCP by the MUPs (Figure 8.2). Therefore, the calculation that only 3 GL/year will be required is heavily dependent on the assumption that nearly 9 GL/year can be recovered from the ore concentrate and tailings storages. If this is overestimated the water requirement would rise dramatically. This may explain why Robbins had a much higher estimate of the water which would be needed.

Kalbar, Main Report, p3-31 have estimated that around 400 ML will be required for dust suppression. However, EEM, (Appendix A006 Appendix A, figures 8.1 – 8.3) calculated that 360-375 ML/year would be needed for dust suppression **on the haul roads alone**. If water recovery is overestimated the mine will run short of water for processing and dust suppression. There will be a strong temptation to use water in the water management dams, rather than returning these to the rivers, and in a dry year they are likely to run out of water.

Dust:

"Construction and operation of the project has the potential to generate significant levels of dust if appropriate mitigation levels are not employed". …… "Dust generation will be appropriately managed through implementing relevant mitigation measures"…. (p 9.47, Main Report)

The conclusion that dust emissions will be within acceptable limits relies on the monitoring and modelling undertaken by Katestone 2020: (Appendix A009). This report is littered with typographical errors and inadequate explanation of some terms used which make it hard to determine the validity of their modelling.

Examples:
P 11"The adopted guideline of 120mg/m^2/ day for monthly maximum dust deposition rates equates to 3.6g/m^2 /day "

They clearly mean m^2 /month

On pp131,132 they refer to:

"EF_{PM19} emission factor for TSP"

It appears that they mean

EF_{PM10} emission factor for PM_{10}

Katestone (2020) did provide a glossary of terms (p vi). However, terms such as VKT and VMT (pp 125-134), critical to understanding the equations that they provided, are not defined.

Katestone, in common with other consultants employed by the mining company, would be under implicit pressure to produce a report which downplays any risk to the community or the environment, or to suggest methods by which any unavoidable risks can be ameliorated.

Nevertheless, the claim (Katestone p133) that if 0.25mm of rain fell on any one day it was assumed that no wind erosion from stockpiles occurred is astounding. Given that evaporation can exceed 10mm/day in summer (Table 4, below) and that cold fronts with accompanying showers may follow days of hot northerly winds with very high evaporation and winds, this defies logic. It is possible, as demonstrated by other typographical errors, that the decimal point is in the wrong place, but even so this exclusion is difficult to justify. It does, however help the model to reduce the estimate of dust which will be produced by the mine.

Evaporation was measured at BoM East Sale Weather Station 85072 until early 2015. Tables 1 – 4 below were derived from these data.

Table 1. Average Daily Evaporation, East Sale Weather Station 85072. 2001-2014													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2001	6.34	5.87	4.89	2.86	1.48	1.33	1.26	2.63	2.47	3.55	4.55	4.46	**3.47**
2002	5.91	4.93	4.59	2.51	1.43	1.99	1.55	1.92	4.08	3.99	6.05	5.94	**3.74**
2003	7.25	5.49	4.41	2.50	1.79	1.97	1.63	2.39	4.15	3.35	5.38	6.38	**3.89**
2004	6.33	5.94	4.85	3.25	1.70	1.74	1.63	2.25	2.48	3.78	5.15	5.12	**3.68**
2005	5.39	5.04	4.34	3.21	1.94	1.25	1.56	2.17	2.52	4.45	5.35	7.16	**3.70**
2006	7.02	5.81	4.95	3.66	1.68	1.05	1.59	2.26	3.55	5.41	6.02	6.79	**4.15**
2007	7.52	7.26	4.54	2.64	2.22	1.69	1.37	2.30	3.11	4.86	4.56	5.86	**3.99**
2008	6.75	5.05	4.70	2.83	1.79	1.47	1.35	1.91	3.90	4.72	5.81	5.43	**3.81**
2009	7.46	6.15	4.78	2.98	1.94	1.07	2.14	3.25	3.45	3.70	6.54	6.15	**4.13**
2010	7.25	5.50	4.47	3.05	1.86	1.27	1.22	2.35	3.08	4.12	5.11	5.18	**3.71**
2011	5.51	5.28	3.79	2.67	1.37	1.49	1.70	1.77	3.41	3.68	4.91	5.57	**3.43**
2012	6.65	4.92	3.35	2.74	1.85	1.09	2.02	2.35	3.66	4.31	5.25	7.15	**3.78**
2013	7.66	6.31	5.21	2.97	1.58	1.13	1.57	2.88	3.19	4.70	4.62	6.39	**4.02**
2014	7.76	6.73	4.77	2.25	1.87	1.16	1.70	1.90	2.78	4.20	5.74	5.35	**3.85**
Average	**6.77**	**5.73**	**4.54**	**2.87**	**1.75**	**1.41**	**1.59**	**2.31**	**3.27**	**4.20**	**5.36**	**5.92**	**3.81**

Table 2. Total Monthly Evaporation, East Sale Weather Station 85072. 2001-2014													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2001	196.6	164.4	151.6	85.7	45.8	40	39	81.4	74.2	110	136.4	138.4	**1263.5**
2002	183.2	138	142.4	75.4	44.2	59.8	48	59.4	122.4	123.8	181.4	184.1	**1362.1**
2003	224.8	153.8	136.8	75	55.6	59.2	50.6	74	124.4	104	161.4	197.8	**1417.4**
2004	196.2	172.2	150.2	97.6	52.6	52.2	50.6	69.6	74.4	117.2	154.6	158.8	**1346.2**
2005	167	141.2	134.4	96.4	60.2	37.6	48.4	67.2	75.6	137.8	160.4	222	**1348.2**
2006	217.6	162.6	153.4	109.8	52.2	31.6	49.2	67.8	106.6	167.8	180.5	210.6	**1509.7**
2007	233.2	196	140.6	79.2	68.8	50.6	42.6	71.2	93.2	150.8	132.2	181.8	**1440.2**
2008	202.6	146.4	145.6	82	55.4	44	41.8	59.2	117	146.4	174.4	168.4	**1383.2**
2009	216.4	172.2	143.4	89.4	60	32	66.2	97.4	103.4	111	189.8	190.6	**1471.8**
2010	224.6	154.1	138.6	91.6	57.8	38.2	37.9	72.8	92.4	127.6	153.2	160.6	**1349.4**
2011	170.8	147.7	117.6	80	42.5	44.6	52.6	55	102.2	114.2	147.2	172.8	**1247.2**
2012	206.2	142.6	103.8	82.2	57.2	31.6	42.4	73	109.7	133.6	157.5	221.7	**1361.5**
2013	237.6	176.7	161.5	89.1	44.2	33.8	48.6	89.2	95.6	145.8	138.6	191.6	**1452.3**
2014	240.6	181.6	147.8	67.6	58	34.8	52.8	59	83.4	130.2	172.2	160.4	**1388.4**
Average	**208.4**	**160.7**	**140.6**	**85.8**	**53.9**	**42.1**	**47.9**	**71.2**	**98.2**	**130.0**	**160.0**	**182.8**	**1381.5**

Table 3. Total Monthly Rain, East Sale Weather Station 85072. 2001-2014													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2001	41.6	25.0	46.8	97.8	32.2	36.2	60.8	65.8	43.6	77.8	76.6	67.2	671.4
2002	29.8	75.6	33.2	100.6	25.2	40.0	20.6	4.2	36.8	28.0	36.6	23.2	453.8
2003	6.4	17.8	27.6	31.0	10.0	43.2	31.2	54.2	32.6	85.6	32.4	34.6	406.6
2004	44.0	32.6	9.2	136.6	33.0	24.6	31.2	40.8	59.2	39.4	75.2	47.0	572.8
2005	33.4	57.4	16.4	25.4	14.2	20.0	76.0	35.0	38.0	22.8	64.0	46.8	449.4
2006	40.8	13.2	12.2	40.6	32.8	12.2	29.8	37.0	39.6	8.6	21.0	13.8	301.6
2007	7.0	109.8	57.0	50.8	15.4	122.2	57.8	31.0	16.4	21.6	113.4	50.4	652.8
2008	58.0	58.4	7.6	15.2	43.8	9.8	33.2	42.2	11.6	7.0	116.6	49.2	452.6
2009	3.2	26.8	19.0	39.0	23.8	15.8	25.6	40.2	63.8	43.8	39.4	37.0	377.4
2010	32.2	70.0	47.2	24.8	42.0	32.2	10.4	40.0	15.6	60.4	64.0	83.0	521.8
2011	39.4	96.8	60.8	50.4	33.4	23.0	70.2	47.8	53.4	54.8	134.8	51.2	716.0
2012	45.4	83.0	96.4	21.8	81.4	90.6	14.0	45.8	41.4	33.2	55.6	32.0	640.6
2013	4.4	56.0	38.6	52.5	12.6	169.4	23.2	38.0	60.0	49.6	37.0	32.0	573.3
2014	22.0	14.2	44.4	62.0	27.6	52.2	24.2	41.6	49.8	57.4	65.6	124.4	585.4
Average	**29.1**	**52.6**	**36.9**	**53.5**	**30.5**	**49.4**	**36.3**	**40.3**	**40.1**	**42.1**	**66.6**	**49.4**	**526.8**
Daily ave	0.94	1.88	1.19	1.78	0.98	1.65	1.17	1.30	1.34	1.36	2.22	1.59	1.44
Evap-rain	5.83	3.85	3.36	1.08	0.76	-0.24	0.42	1.01	1.94	2.84	3.14	4.33	2.36

Table 4. Number of days each month in which evaporation exceeded 10mm, East Sale 2001-2014													
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
2001	3	1	0	0	0	0	0	0	0	0	0	0	**4**
2002	1	1	0	0	0	0	0	0	0	0	1	0	**3**
2003	3	0	0	0	0	0	0	0	0	0	0	2	**5**
2004	0	1	0	0	0	0	0	0	0	0	1	0	**2**
2005	0	1	0	0	0	0	0	0	0	0	0	2	**3**
2006	2	1	0	0	0	0	0	0	0	1	1	2	**7**
2007	3	4	0	0	0	0	0	0	0	0	1	1	**9**
2008	4	1	0	0	0	0	0	0	0	0	2	0	**7**
2009	5	2	1	0	0	0	0	0	0	0	2	0	**10**
2010	2	3	0	0	0	0	0	0	0	0	0	0	**5**
2011	0	2	0	0	0	0	0	0	0	0	0	0	**2**
2012	0	0	0	0	0	0	0	0	0	0	0	0	**0**
2013	7	1	0	0	0	0	0	0	0	1	0	3	**12**
2014	5	4	0	0	0	0	0	0	0	0	0	1	**10**
Total	35	22	1	0	0	0	0	0	0	2	8	11	**79**
Average	**2.5**	**1.6**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.6**	**0.8**	**5.6**

In Katestone (2020) Table 3 there is a requirement to enforce speed limits on haul roads to ensure that vehicles travel at speeds which will not generate excessive dust. Yet equations for dust emitted by scraper in travel mode, bulldozing or wheeled vehicles appear to take neither vehicle speed nor wind speed into account (p131-134). Grading (p133) does consider vehicle speed, and erosion from active stockpiles is dependent on wind speed.

Katestone have relied heavily on their onsite monitoring station, plus modelling to determine wind speeds. According to local landholders the location at which this monitor is situated is not fully exposed to winds (R Coleman, G Johnson, pers comm). The maximum wind speed recorded by Katestone (p13) over a 1 hour average was 11.5 m/s (41 km/hr).

They found that dust deposition at sensitive receptors (houses) in the vicinity of the proposed mine was within acceptable limits. This is unsurprising, as their observations were undertaken in the absence of the mine.

Bureau of Meteorology (BoM) look to mention raised dust in forecasts when it has been dry for a lengthy period and they expect average winds of around 35+km/hr (which would generally mean wind gusts of around 55+ km/hr. (Steven McGibbony, Severe Weather Manager, BoM, email dated 2 October 2019).

Analysis of wind speeds recorded by the BoM at Bairnsdale for the 12 months from 1st October 2018 to 30th September 2019 revealed 66 days (roughly 1 day in 6) when maximum wind gusts exceeded the 55 km/hr threshold at which dust may be raised. On 10 of these days peak wind gusts exceeded 75 km/hr (Table 5 below). Typically the direction of the peak gusts was southwesterly, which would propel dust raised in the direction of the vegetable areas of the Lindenow flats. Although it cannot be concluded that the winds at Glenaladale are identical to those at Bairnsdale airport, these strong winds are usually associated with cold fronts which have a widespread impact. This does cast doubt on the velocity of the winds recorded by Katestone. The mine site is elevated, and in the absence of screening the mine area will be subjected to strong winds.

The potential for large bare areas to generate dust is well recognised. Agriculture Victoria (2018) promotes the use of stock containment areas to, among other purposes, “reduce soil erosion or damage to paddocks during a drought or dry conditions”

https://agriculture.vic.gov.au/__data/assets/pdf_file/0008/537578/Stock-containment-areas.pdf

Cropping paddocks are likewise prone to wind erosion.

Figures for evaporation at East Sale (Tables1 and 2, above) are broadly in line with the figures given in the EES (Coffee 2020 Table 3.1). There was an average of 5.6 days each year where evaporation exceeded 10mm per day (Table 4). Average daily evaporation minus rainfall for January was nearly 6mm/day (Table 3). Although the ore body will be wet when first exposed, drying will be rapid under these conditions.

Table 5: High wind days at Bairnsdale Oct -Sep 2018/19					
Date	Max Wind Gust (km/hr)	Direction	Date	Max Wind Gust (km/hr)	Direction
27/10/2018	65	WSW	30/05/2019	57	W
2/11/2018	74	NNW	31/05/2019	57	WSW
3/11/2018	67	WSW	3/06/2019	57	S
5/11/2018	59	NNW	12/06/2019	59	NNW
22/11/2018	56	WSW	29/06/2019	61	NNW
23/11/2018	72	WSW	30/06/2019	57	WNW
2/12/2018	70	SW	11/07/2019	65	W
3/12/2018	76	WSW	12/07/2019	61	WSW
28/12/2018	56	S	13/07/2019	61	W
4/01/2019	81	SW	14/07/2019	74	WNW
13/01/2019	59	E	15/07/2019	61	W
18/01/2019	59	SW	16/07/2019	70	WSW
25/01/2019	59	NNW	18/07/2019	57	WSW
30/01/2019	56	NNW	23/07/2019	57	SW
5/02/2019	57	E	3/08/2019	56	WSW
6/02/2019	56	E	9/08/2019	78	W
9/02/2019	70	W	10/08/2019	65	WNW
12/02/2019	80	WSW	16/08/2019	56	NNW
13/02/2019	59	WSW	18/08/2019	59	NW
6/03/2019	76	WSW	19/08/2019	65	W
12/03/2019	67	SW	20/08/2019	65	WNW
16/03/2019	57	E	21/08/2019	81	W
25/03/2019	76	W	22/08/2019	80	W
26/03/2019	61	W	24/08/2019	70	WSW
29/03/2019	65	NNE	28/08/2019	56	SW
30/03/2019	65	WSW	1/09/2019	74	WSW
31/03/2019	57	WSW	7/09/2019	85	W
18/04/2019	65	WSW	8/09/2019	57	WSW
26/04/2019	74	WSW	9/09/2019	61	SW
28/04/2019	65	WSW	12/09/2019	72	W
8/05/2019	57	WSW	13/09/2019	61	WSW
27/05/2019	72	W	21/09/2019	67	WNW
29/05/2019	59	WNW	27/09/2019	81	WSW

Apart from underestimating the likely wind speeds at the mine, Katestone's conclusion that their modelling of potential dust raised from the mine will be within acceptable limits rely heavily on the adoption of dust mitigation measures described in Table 17 of their report. These include the continuous use of water while scrapers are operating, the watering of transport routes, the necessity to keep dozer travel routes and materials moist, and the application of water and/ or suppressants during haulage and grading.

Elsewhere, on p3-31 of the main report it is stated that "water trucks will routinely spray water onto exposed areas, roads and within the mine void to suppress fugitive dust created by mobile plant and equipment movements. An estimated 400 megalitres (ML) of water per year will be used for dust suppression."

EEM (2020a) Appendix 006, Appendix A p47, in their modelling of water requirements for the project, calculated that around 375ML/year is required solely for watering the haul roads. This leaves 25ML/year for water for dust suppression in all other situations. In the Main Report, Table 3.1 “Estimate of area of disturbance in project area at any point of time” gives 35 ha in the topsoil, strip, 23 ha in the overburden strip, 18 ha in the ore and mine void floor, 19 ha for tailing cells construction in the mine void and another 40 ha for topsoil and overburden placement.. There are also large areas in the TSF and topsoil stockpiles.

Reading on, on page P 3-18, bottom paragraph we find that: “The selected mining layout is a series of cells approximately 300m wide by 1000 m long. The mine is expected to have two active mining voids of less than 60 ha each at any one time, with an area of 10 ha within each void being used for tailings”. This is hard to reconcile with the 18ha for ore and mine void floor given in Table 3.1

EEM (2020a) p47 allowed 3 mm/day in excess of evaporation for the fact that water output cannot be so precise as to exactly match evaporation. Including this factor, on days of evaporation ranging from 5-10 mm, 1ML would cover from 12.5 to 7.7 ha. If this was sprayed over just the 60 ha of active exposed mine floor, the 25ML would last between 3 and 5 days. Kalbar are proposing to purchase 2 water trucks to suppress dust both on haul roads and disturbed areas. These are to be either 45000L or 75000L capacity. These would require 22 or 13 trips respectively to put out 1ML, with associated filling and spraying times. It is obviously completely absurd to suggest that they could be used for widespread dust mitigation. It therefore follows that the dust mitigation factors essential to Katestones’s conclusions that dust emissions will be acceptable cannot be met. Therefore Katestone’s conclusions are invalid, and dust emissions from the mine will exceed acceptable limits.

Dust exceedances during mining are extremely common eg Moranbah, Queensland (ABC 2019) (https://www.abc.net.au/news/2019-08-26/elevated-dust-levels) and Newman, Western Australia where emissions exceeded allowable levels on 45 occasions during a 12 month period.(ABC 2020) (https://www.abc.net.au/news/2020-10-12/dust-levels-bhp-newman-iron-ore-mine-exceed-licence-limit/12732272). This has not resulted in cessation of mining activities.

Similarly, if the Fingerboard Mine is approved, and dust emissions exceed those modelled in the EES, the community will be forced to endure the consequences.

This brings us to the composition of the dust. The ore contains between 20 and 25% fines (particles smaller than 38µm) (Main report p3-18), much of which will be susceptible to wind. Some of the lower grade ore is to be included in the overburden. On p 3.20 of the main report it was stated that around 1% of the ore will be in material greater than 300 mm which will be screened prior to pumping and used as a road base and for other construction purposes. Pounding by heavy vehicles is likely to reduce this material to dust.

The mineral composition of the fine tailings, coarse tailings and mineral ore were chemically analysed by Envirolab, (Certificate of Analysis 217289-B, Appendix A002 Appendix D Appendix D). Their analysis of metal concentrations (mg/kg) in the three substrates, and particularly the ore and fine tailings gave high concentrations of a number of elements. These included arsenic, chromium, thorium, uranium and a number of others: aluminium, barium, gallium, lanthanum, strontium, titanium, vanadium and zirconium which Environmental Geochemistry International (EGi) (2020)

Appendix A002 Appendix D, omitted to mention. Vanadium, in particular, is extremely toxic when airborne. The EGi and Envirolab tables are reproduced below: Kalbar give no indication why these elements have been omitted from this table.

Table 6 below, extracted from Tables constructed by the ATSDR – the United States *Agency for Toxic Substances and Disease Registry* shows the minimum risk levels for a number of the elements detected by Envirolab in the ore and tailings. The high levels of chromium found have been downplayed by Kalbar who have claimed that it is predominately present as the trivalent, not the toxic hexavalent form. However, ATSDR make it obvious that CrIII in dust is also highly toxic. The MRL table does not consider carcinogenicity but the California Office of Environmental Health Hazard Assessment (OEHHA) lists arsenic, both valencies of chromium, uranium and respirable titanium dioxide on their table of carcinogens https://www.p65warnings.ca.gov/chemicals.

EGi Table 1. Reproduced in Appendix D of both Appendices A002 and A006, as Table 5-5 in the Draft Work Plan (Attachment B) and elsewhere.

***TABLE 1:** Elemental compositions of tailings, heavy mineral concentrate and overburden samples*

Element	Material type	10t Bulk Sample *			Overburden **	
	Sample Description	10t Bulk Fine Tailings	10t Bulk Sand Tailings	Heavy Mineral Concentrate	Overburden Gravelly Clay	Overburden Sandy Clay
Antimony (Sb)	mg/kg	<0.5	<0.5	0.5	<0.5	<0.5
Arsenic (As)	mg/kg	37	4	11	3	6
Bimuth (Bi)	mg/kg	<1	<1	<1	<1	<1
Cadmium (Cd)	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium (Cr)	mg/kg	86	10	58	10	12
Cobalt (Co)	mg/kg	2	<0.5	<1	4	2
Copper (Cu)	mg/kg	18	2	12	3	5
Lead (Pb)	mg/kg	11	1.9	18	5	7
Manganese (Mn)	mg/kg	24	6	44	21	5
Mercury (Hg)	mg/kg	0.02	<0.01	<0.01	0.02	0.02
Molybdenum (Mo)	mg/kg	1	<0.5	1	<0.5	<0.5
Nickel (Ni)	mg/kg	5	0.7	3	5	3
Selenium (Se)	mg/kg	0.3	<0.1	0.4	0.1	0.2
Silver (Ag)	mg/kg	0.1	<0.1	<0.2	<0.1	<0.1
Sulfur (S)	%	0.01	<0.01	<0.01	<0.01	<0.01
Thorium (Th)	mg/kg	11	1	120	3	3
Tin (Sn)	mg/kg	2	<0.5	2	<0.5	<0.5
Uranium (U)	mg/kg	4	0.4	9	0.9	1
Zinc (Zn)	mg/kg	17	2	11	14	8

* Envirolab Services (WA) Pty Lrd (MPA Laboratories), Cerificate of Analysis 217289-B - See Appendix D

** Envirolab Services (WA) Pty Lrd (MPA Laboratories), Cerificate of Analysis 217492-B - See Appendix D

From Envirolab report 217289-B

Metals - soil				
Our Reference		217289-B-1	217289-B-2	217289-B-3
YourReference	UNITS	Leach FT	Leach CT	Leach HM
Type of sample		Sludge	Soil	Soil
Date digested	-	13/11/2018	13/11/2018	13/11/2018
Date analysed	-	14/11/2018	14/11/2018	14/11/2018
Calcium	mg/kg	380	44	170
Potassium	mg/kg	770	180	84
Sodium	mg/kg	120	16	20,000
Magnesium	mg/kg	490	40	59
Phosphorus	mg/kg	110	20	240
Silicon	mg/kg	370	170	160
Silver	mg/kg	0.1	<0.1	<0.2
Aluminium	mg/kg	4,500	260	260
Arsenic	mg/kg	35	4.4	11
Boron	mg/kg	<1	<1	11
Barium	mg/kg	28	5.8	32
Beryllium	mg/kg	<0.5	<0.5	<1
Bismuth	mg/kg	<1	<1	<1
Cadmium	mg/kg	<0.1	<0.1	<0.1
Cobalt	mg/kg	1.7	<0.5	<1
Chromium	mg/kg	81	10	58
Copper	mg/kg	17	1.8	12
Iron	mg/kg	12,000	1,300	5,000
Gallium*	mg/kg	6.6	1.1	23
Mercury	mg/kg	0.02	<0.01	<0.01
Lanthanum	mg/kg	49	11	300
Lithium	mg/kg	2	<1	<1
Manganese	mg/kg	23	6	44
Molybdenum	mg/kg	1.2	<0.5	1.2
Nickel	mg/kg	4.0	0.7	3.1
Lead	mg/kg	10	1.9	18
Antimony	mg/kg	<0.5	<0.5	0.5
Selenium	mg/kg	0.3	<0.1	0.4
Tin	mg/kg	1.7	<0.5	1.7
Strontium	mg/kg	8	1	4
Thorium	mg/kg	9.8	1	120
Titanium	mg/kg	230	100	350
Thallium	mg/kg	<0.5	<0.5	<0.5
Uranium	mg/kg	3	0.4	9
Vanadium	mg/kg	130	17	83
Tungsten	mg/kg	<1	<1	<1

Metals - soil				
Our Reference		217289-B-1	217289-B-2	217289-B-3
YourReference	UNITS	Leach FT	Leach CT	Leach HM
Type of sample		Sludge	Soil	Soil
Zinc	mg/kg	16	2.3	11
Zirconium	mg/kg	14	2	2

Table 6. Agency for Toxic Substances and Disease Registry Minimum Risk Levels for Selected Elements					
Element	Route	Duration	MRL	Unit	Endpoint
Aluminium	Oral	Int	1000	µg/kg/day	Neurol
	Oral	Chronic	1000	µg/kg/day	Neurol
Arsenic	Oral	Acute	5	µg/kg/day	Gastro
	Oral	Chronic	0.3	µg/kg/day	Dermal
Chromium (III)					
Soluble Particulate	Inhaled	Int	0.1	µg/m^3	Resp
Insoluble Particulate	Inhaled	Int	5	µg/m^3	Resp
Chromium (VI)	Oral	Int	5	µg/kg/day	Haemato
	Oral	Chronic	0.9	µg/kg/day	Gastro
Aerosol	Inhaled	Int	0.005	µg/m^3	Resp
	Inhaled	Chronic	0.005	µg/m^3	Resp
Particulate	Inhaled		0.3	µg/m^3	Resp
Strontium	Oral	Int	2000	µg/kg/day	Musculo
Uranium					
Soluble	Inhaled	Int	2	µg/m^3	Renal
	Inhaled	Chronic	0.8	µg/m^3	Renal
	Oral	Acute	2	µg/kg/day	Devel
	Oral	Int	0.2	µg/kg/day	Renal
Insoluble	Inhaled	Int	2	µg/m^3	Renal
	Inhaled	Chronic	0.8	µg/m^3	Resp
Vanadium	Inhaled	Acute	0.8	µg/m^3	Resp
	Inhaled	Chronic	0.1	µg/m^3	Resp
	Oral	Int	10	µg/kg/day	Heamato
Duration					
Acute	1 to 14 days				
Intermediate	15 to 364 days				
Chronic	1 year or longer				

Apart from the elements listed, the minerals in which they occur may themselves be hazardous. The rare earths are found in the minerals monazite and xenotime (Appendix A002 p21) Both commonly contain the radioactive elements thorium and uranium, which have been detected in the assay. Xenotime crystals are brittle (Wikipedia) and hence likely to fracture during mining and hence contribute to the dust. Monazite is extremely toxic if inhaled or ingested

The New Brunswick Laboratory Safety Data Sheet for monazite sand ore materials states:

"OSHA HAZARDS: Highly toxic by inhalation. Highly toxic by ingestion.

TARGET ORGANS: Kidney, liver, lungs, brain

Fatal if swallowed or inhaled
May cause cancer
May cause damage to organs through prolonged or repeated exposure
Causes skin irritation

Cancer hazard (may cause lung cancer in humans if inhaled). Risk of cancer depends on duration and level of exposure. May damage the lungs. May be irritating to skin and eyes. May affect the heart. May cause blood disorders. May cause convulsions. May affect the central nervous system. May cause adverse reproductive effects. May cause eye damage. Do not breathe dust. Do not get in eyes, on skin, or on clothing.

Thus, if the mine proceeds, we have a situation where the systems proposed for dust mitigation cannot possibly be effective. Apart from radioactive minerals such as monazite and xenotime, the raised dust will contain toxic elements such as chromium and vanadium which are toxic if inhaled at $\mu g/m^3$ levels. They, with titanium dioxide and arsenic are listed as carcinogenic. Vanadium, chromium vi (if present) and arsenic are also oral toxins. All these will contaminate the rainwater tanks of houses in the vicinity, and possibly even the Woodglen reservoir which supplies drinking water to the major population centres in East Gippsland Shire. In downplaying this risk Coffee (2020b) p80 first uses the Katestone (2020) figures for dust deposition which, as shown above, use conservative figures for wind speeds and rely on mitigation measures which cannot possibly be effectively implemented. Coffee also show a staggering misunderstanding of the analyses done for the project. They state" "The maximum concentrations of metals in fine and coarse tailings and the maximum leachability results for tailings, heavy mineral concentrate and overburden (based on Australian Standard Leaching Procedure AS 4439.2) reported by EGi (2020) were used to estimate the concentration of metals that may dissolve into the tank water. The measured concentrations in leachate are considered to be very conservative given the pH of the tank water would be considerably less acidic than that adopted in the leaching test." The leaching test (Envirolab, Certificate of Analysis 217289-B Appendix A002 Appendix D Appendix D) was done using de-ionised water for 24 hours, pH of final leachate was 7.5 for fine tailings and 7.0 for mineral concentrate. It is obvious that the Coffee (2020b) conclusion that there will be little risk to household water supplies cannot be relied upon. Dust deposition will almost certainly be much higher than modelled by Katestone, and that, combined with the presence of numerous toxic elements and compounds, will pose an unacceptable risk to household water supplies for properties adjacent to the mine.

As PM10 and PM2.5 particles can travel many kilometres people and properties further afield may also be impacted. Although the impact will reduce as distance from the mine increases, it is not possible to determine how far the danger zone will extend. Vegetable crops are also likely to be affected. Any actual of perceived contamination of crops intended for human consumption would place the entire Lindenow valley vegetable industry at risk. Were this to occur the losses would far outweigh any financial benefits from the mine. Apart from humans, pastures, and hence grazing animals may also be at risk; meat contamination can cause major problems for exporters.

The workforce at the mine will be exposed not only to these elements but also respirable αquartz, a listed carcinogen. The Lindenow vegetable industry employs large numbers of staff, many of whom work in the fields. The local residents and employees will be directly exposed to dust emissions from the mine, with associated health risks. Children, being smaller and liable to play in, and ingest dirt, are at particular risk.

There is also the risk that Kalbar could run out of water or that due to future trade or economic conditions the mine becomes unviable. Their entire business model is predicated on transporting heavy mineral concentrate to China for further processing. Given the presence of impurities detected by Robbins (Bishop 2013) this may be the only viable business model. The world political situation has shifted dramatically since Kalbar devised their business plan. Should relationships with China deteriorate further export to China may not be possible.

Kalbar do consider the risk of unplanned temporary or permanent closure in Chapter 11 of the EES. Most risks, except those caused by ground movement, are considered to be low or very low. (Table 11.9) They do not appear to have considered the possibility of ongoing dust from the mine site impacting neighbouring houses and crops. Kalbar will be required to lodge a bond prior to commencing mining. This needs to be substantial. Should mining cease with the TSF still in existence the costs of mechanically transporting the huge amount of material in the TSF to the mine void will be astronomical. If the bond is insufficient this will remain as a source of pollution for many years. The Iluka mine at Douglas in western Victoria has never been fully rehabilitated. If the Fingerboards mine was abandoned this would put the health of the community and the viability of the neighbouring horticultural industry in jeopardy.

Even if the mine is rehabilitated it is unlikely to become the parklike vista envisaged by its proponents. Disruption of soils which have developed over millennia will result in soil swelling (p11.36) with only partial consolidation during rehabilitation. As fine tailings , whose settling characteristics differ from coarse sands and overburden, are to be placed in only one third of the mine void this creates an obvious problem which Kalbar propose to overcome by mixing coarser sands in with the fines before covering with overburden. There are also differences where roads and other structures have been situated. It is forecast that soils will have increased in volume by 8% even after consolidation.

Clearly, ongoing settling will continue for many years, and with the differential underlying material base this will occur unevenly. This will lead to the potential for water pooling. Although the proposed addition of gypsum will reduce the dispersive nature of the clay materials, the risk of future erosion cannot be discounted.

The claimed economic benefits of this mine come with the potential for even greater costs should mining not proceed as planned, or if (when) the mitigation measures proposed to combat problems such as dust emissions prove to be inadequate.

The mine should not be permitted to proceed.

Appendices

Barton, NJ (2020a). Appendix 1. Kalbar Dams Capacity.xlsx

Barton, NJ (2020b). Appendix 2. Glenaladale Daily Flow.xlsx

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Appendix 2 . Glenaladale Daily Flow, Winterfill Period 2018
Pumping allowed on days when minimum flow exceeded 1400 ML
Quality Codes (QC)2 Good quality data
Site 224203 MITCHELL RIVER @ GLENALADALE Lat:-37.76358991 Long:147.3747776 Elev:0
Sourced from https//data.water.vic.gov.au

Date	Discharge (Ml/d)	QC	Discharge (Ml/d)	QC	Discharge (Ml/d)	QC	Pumping Allowed?
	Mean		Minimum		Maximum		
1/07/2018	690.48	2	673.92	2	705.61	2	0
2/07/2018	707.02	2	671.33	2	738.37	2	0
3/07/2018	704.23	2	687	2	724.59	2	0
4/07/2018	681.1	2	658.47	2	702.93	2	0
5/07/2018	647.48	2	625.87	2	666.17	2	0
6/07/2018	631.45	2	620.96	2	640.77	2	0
7/07/2018	750.32	2	630.81	2	1554.31	2	0
8/07/2018	2017.98	2	1554.31	2	2201.38	2	1
9/07/2018	2147	2	2044.34	2	2222.23	2	1
10/07/2018	2012.23	2	1928.32	2	2054.23	2	1
11/07/2018	1834.5	2	1741.03	2	1928.32	2	1
12/07/2018	1651.53	2	1566.58	2	1741.03	2	1
13/07/2018	1493.33	2	1423.31	2	1566.58	2	1
14/07/2018	1352.36	2	1289.19	2	1423.31	2	0
15/07/2018	1228.36	2	1174.1	2	1289.19	2	0
16/07/2018	1128.51	2	1078.8	2	1184.26	2	0
17/07/2018	1043.55	2	1007.51	2	1078.8	2	0
18/07/2018	974.35	2	942.59	2	1007.51	2	0
19/07/2018	949.27	2	924.59	2	979.32	2	0
20/07/2018	973.22	2	957.78	2	991.78	2	0
21/07/2018	1611.54	2	991.78	2	2264.32	2	0
22/07/2018	2030.85	2	1886.08	2	2185.83	2	1
23/07/2018	1778.64	2	1658.62	2	1886.08	2	1
24/07/2018	1601.24	2	1538.05	2	1675.75	2	1
25/07/2018	1520.3	2	1489.84	2	1546.16	2	1
26/07/2018	1830.71	2	1505.79	2	2165.22	2	1
27/07/2018	2103.04	2	2034.48	2	2134.55	2	1
28/07/2018	1999.72	2	1947.29	2	2034.48	2	1
29/07/2018	1922.57	2	1862.89	2	1952.06	2	1
30/07/2018	2091.96	2	1844.48	2	2674.55	2	1
31/07/2018	2636.77	2	2521.39	2	2713.79	2	1
1/08/2018	2499.56	2	2460.54	2	2526.76	2	1
2/08/2018	2832.3	2	2471.77	2	3029.39	2	1
3/08/2018	2968.49	2	2862.86	2	3005.22	2	1
4/08/2018	2948.32	2	2764.79	2	4482.2	2	1

5/08/2018	5730.16	2	4482.2	2	5964.73	2	1
6/08/2018	5379.57	2	4958.29	2	5799.23	2	1
7/08/2018	4778.63	2	4702.56	2	4965.51	2	1
8/08/2018	4466.68	2	4189.76	2	4744.6	2	1
9/08/2018	4450.27	2	4157.29	2	4751.63	2	1
10/08/2018	4533.06	2	4274.9	2	4723.55	2	1
11/08/2018	4086.73	2	3959.46	2	4294.7	2	1
12/08/2018	4066.05	2	3940.63	2	4248.59	2	1
13/08/2018	4029.25	2	3865.86	2	4202.79	2	1
14/08/2018	3742.6	2	3608.05	2	3872.05	2	1
15/08/2018	3500.27	2	3394.58	2	3655.9	2	1
16/08/2018	3683.41	2	3401.12	2	4516.2	2	1
17/08/2018	4838.71	2	4516.2	2	4929.46	2	1
18/08/2018	4656.42	2	4441.61	2	4879.27	2	1
19/08/2018	4519.7	2	4387.83	2	4619.16	2	1
20/08/2018	4416.88	2	4367.77	2	4468.64	2	1
21/08/2018	4113.01	2	3896.91	2	4367.77	2	1
22/08/2018	3774.08	2	3649.04	2	3903.13	2	1
23/08/2018	3517.27	2	3381.52	2	3655.9	2	1
24/08/2018	3245.83	2	3096.53	2	3388.04	2	1
25/08/2018	2964.54	2	2833.78	2	3096.53	2	1
26/08/2018	2733.22	2	2630.18	2	2839.58	2	1
27/08/2018	2569.75	2	2477.4	2	2635.7	2	1
28/08/2018	2439.43	2	2339.3	2	2483.04	2	1
29/08/2018	2285.37	2	2227.46	2	2344.72	2	1
30/08/2018	2159.04	2	2099.15	2	2227.46	2	1
31/08/2018	2037.56	2	1971.2	2	2099.15	2	1
1/09/2018	1981.43	2	1923.59	2	2222.23	2	1
2/09/2018	2172.59	2	2094.13	2	2280.25	2	1
3/09/2018	2141.88	2	2099.15	2	2170.36	2	1
4/09/2018	2089.22	2	2034.48	2	2129.47	2	1
5/09/2018	2008.54	2	1933.05	2	2039.4	2	1
6/09/2018	1926.46	2	1881.43	2	1947.29	2	1
7/09/2018	2022.91	2	1881.43	2	2301.61	2	1
8/09/2018	4051.1	2	2301.61	2	4488.99	2	1
9/09/2018	4129.21	2	3915.61	2	4394.53	2	1
10/09/2018	3727.99	2	3553.87	2	3928.11	2	1
11/09/2018	3457.38	2	3355.51	2	3560.61	2	1
12/09/2018	3360.55	2	3284.67	2	3466.98	2	1
13/09/2018	3729.24	2	3466.98	2	3810.36	2	1
14/09/2018	3517.12	2	3265.52	2	3773.63	2	1
15/09/2018	3115.66	2	2963.22	2	3265.52	2	1
16/09/2018	2907.92	2	2822.2	2	2975.18	2	1
17/09/2018	2654.5	2	2471.77	2	2822.2	2	1
18/09/2018	2354.64	2	2191.01	2	2471.77	2	1

19/09/2018	2120.59	2	2000.22	2	2201.38	2	1
20/09/2018	2004.21	2	1956.83	2	2054.23	2	1
21/09/2018	1893.94	2	1781.03	2	1961.61	2	1
22/09/2018	1737.06	2	1662.89	2	1785.51	2	1
23/09/2018	1655.96	2	1595.48	2	1684.35	2	1
24/09/2018	1592.49	2	1562.48	2	1620.54	2	1
25/09/2018	1564.18	2	1538.05	2	1587.19	2	1
26/09/2018	1534.37	2	1509.8	2	1558.39	2	1
27/09/2018	1501.64	2	1446.55	2	1525.9	2	1
28/09/2018	1422.68	2	1396.52	2	1446.55	2	0
29/09/2018	1410.06	2	1377.59	2	1438.77	2	0
30/09/2018	1387.22	2	1358.84	2	1404.14	2	0
1/10/2018	1325.97	2	1285.6	2	1358.84	2	0
2/10/2018	1247.03	2	1218.56	2	1285.6	2	0
3/10/2018	1190.13	2	1167.36	2	1218.56	2	0
4/10/2018	1173.13	2	1143.14	2	1204.76	2	0
5/10/2018	1257.78	2	1170.73	2	1329.21	2	0
6/10/2018	1321.57	2	1289.19	2	1340.27	2	0
7/10/2018	1252.84	2	1204.76	2	1292.8	2	0
8/10/2018	1172.33	2	1136.24	2	1208.2	2	0
9/10/2018	1107.04	2	1085.45	2	1136.24	2	0
10/10/2018	1122.55	2	1102.2	2	1139.69	2	0
11/10/2018	1192.08	2	1125.96	2	1271.28	2	0
12/10/2018	1249.55	2	1197.9	2	1307.28	2	0
13/10/2018	1128.99	2	1049.23	2	1201.33	2	0
14/10/2018	1015.83	2	976.22	2	1052.48	2	0
15/10/2018	937.03	2	895.13	2	979.32	2	0
16/10/2018	877.04	2	854.99	2	895.13	2	0
17/10/2018	851.23	2	828.06	2	869.18	2	0
18/10/2018	888.29	2	834.11	2	939.58	2	0
19/10/2018	981.44	2	909.78	2	1036.26	2	0
20/10/2018	955.96	2	927.58	2	982.42	2	0
21/10/2018	934.4	2	903.9	2	960.83	2	0
22/10/2018	1041.86	2	921.62	2	1132.81	2	0
23/10/2018	977.78	2	909.78	2	1052.48	2	0
24/10/2018	852.32	2	792.46	2	909.78	2	0
25/10/2018	764.78	2	724.59	2	792.46	2	0
26/10/2018	709.59	2	676.52	2	732.83	2	0
27/10/2018	659.08	2	638.27	2	679.13	2	0
28/10/2018	614.53	2	577.72	2	638.27	2	0
29/10/2018	574.76	2	538.51	2	592.04	2	0
30/10/2018	527.78	2	509.87	2	540.77	2	0
31/10/2018	500.5	2	484.43	2	516.38	2	0
Days on which pumping available							74
Maximum Volume at 25ML/day							1850

Appendix 2 . Glenaladale Daily Flow, Winterfill Period 2019
Pumping allowed on days when minimum flow exceeded 1400 ML
Quality Codes (QC)2: Good quality data, 15: Minor Editing
Site 224203 MITCHELL RIVER @ GLENALADALE Lat:-37.76358991 Long:147.3747776 Elev:0
Sourced from https//data.water.vic.gov.au

Datetime	Discharge (Ml/d)	QC	Discharge (Ml/d)	QC	Discharge (Ml/d)	QC	Pumping Allowed?
	Mean		Minimum		Maximum		
1/07/2019	2780.53	2	860.65	2	3574.12	2	0
2/07/2019	2823.02	2	2542.91	2	3102.69	2	1
3/07/2019	2378.35	2	2170.36	2	2542.91	2	1
4/07/2019	2074.71	2	1923.59	2	2175.51	2	1
5/07/2019	1828.01	2	1706	2	1923.59	2	1
6/07/2019	1632.14	2	1538.05	2	1706	2	1
7/07/2019	1485.42	2	1404.14	2	1538.05	2	1
8/07/2019	1376.03	2	1310.92	2	1407.96	2	0
9/07/2019	1311.34	2	1271.28	2	1385.14	2	0
10/07/2019	1342.29	2	1246.49	2	1381.36	2	0
11/07/2019	1267.34	2	1242.97	2	1289.19	2	0
12/07/2019	1636.38	2	1253.54	2	2139.64	2	0
13/07/2019	3697.47	2	2139.64	2	7547.98	2	1
14/07/2019	7308.17	2	6438.84	2	7852.87	2	1
15/07/2019	5768.63	2	5329.67	2	6438.84	2	1
16/07/2019	5047.28	2	4681.62	2	5329.67	2	1
17/07/2019	4359.54	2	4028.98	2	4681.62	2	1
18/07/2019	3810.42	2	3621.68	2	4028.98	2	1
19/07/2019	3441.8	2	3189.68	2	3635.34	2	1
20/07/2019	3044.43	2	2857.03	2	3202.24	2	1
21/07/2019	2728.84	2	2559.12	2	2862.86	2	1
22/07/2019	2463.02	2	2333.89	2	2559.12	2	1
23/07/2019	2267.07	2	2149.85	2	2339.3	2	1
24/07/2019	2133.2	2	2099.15	2	2196.19	2	1
25/07/2019	2718.35	2	2191.01	2	2927.54	2	1
26/07/2019	2667.86	2	2569.97	2	2736.38	2	1
27/07/2019	2518.64	2	2410.44	2	2580.85	2	1
28/07/2019	2368.57	2	2269.62	2	2415.97	2	1
29/07/2019	2218.13	2	2119.33	2	2269.62	2	1
30/07/2019	2106.62	2	2084.1	2	2124.4	2	1
31/07/2019	2056.61	2	1966.4	2	2094.13	2	1
1/08/2019	1911.74	2	1849.07	2	1966.4	2	1
2/08/2019	1786.03	2	1697.32	2	1853.67	2	1
3/08/2019	1645.56	2	1566.58	2	1697.32	2	1
4/08/2019	1529.07	2	1462.19	2	1566.58	2	1

5/08/2019	1429.88	2	1373.83	2	1466.12	2	0
6/08/2019	1342.26	2	1289.19	2	1373.83	2	0
7/08/2019	1260.31	2	1208.2	2	1303.65	2	0
8/08/2019	1197.5	2	1160.5	2	1218.56	2	0
9/08/2019	1502.99	2	1160.5	2	2079.1	2	0
10/08/2019	2698.22	2	2079.1	2	3059.79	2	1
11/08/2019	2846.1	2	2702.54	2	2999.19	2	1
12/08/2019	2589.26	2	2432.62	2	2708.16	2	1
13/08/2019	2318.36	2	2175.51	2	2432.62	2	1
14/08/2019	2147.33	2	2069.13	2	2180.67	2	1
15/08/2019	2049.11	2	1985.66	2	2089.11	2	1
16/08/2019	1998.68	2	1952.06	2	2044.34	2	1
17/08/2019	1997.19	2	1947.29	2	2054.23	2	1
18/08/2019	2175.53	2	2049.28	2	2227.46	2	1
19/08/2019	2339.22	2	2191.01	2	2586.3	2	1
20/08/2019	3151.09	2	2586.3	2	3297.47	2	1
21/08/2019	3171.86	2	3102.69	2	3221.14	2	1
22/08/2019	3337.71	2	3096.53	2	3594.45	2	1
23/08/2019	3778	2	3594.45	2	3859.67	2	1
24/08/2019	3642.32	2	3414.22	2	3785.85	2	1
25/08/2019	3287.57	2	3090.39	2	3466.98	2	1
26/08/2019	2974.55	2	2787.66	2	3102.69	2	1
27/08/2019	2667.18	2	2510.68	2	2787.66	2	1
28/08/2019	2409.83	2	2269.62	2	2510.68	2	1
29/08/2019	2200.49	2	2089.11	2	2274.93	2	1
30/08/2019	2044.93	2	1933.05	2	2094.13	2	1
31/08/2019	1870.81	2	1772.08	2	1933.05	2	1
1/09/2019	1725.78	2	1658.62	2	1772.08	2	1
2/09/2019	1660.29	2	1628.95	2	1680.04	2	1
3/09/2019	1665.54	2	1603.8	2	1714.71	2	1
4/09/2019	1595.8	2	1558.39	2	1624.74	2	1
5/09/2019	1578.5	2	1542.1	2	1607.97	2	1
6/09/2019	1582.74	2	1538.05	2	1616.34	2	1
7/09/2019	1672.45	2	1562.48	2	1928.32	2	1
8/09/2019	2037.6	2	1928.32	2	2089.11	2	1
9/09/2019	1954.42	2	1849.07	2	2005.09	2	1
10/09/2019	1893.57	2	1844.48	2	1937.79	2	1
11/09/2019	1824.58	2	1749.87	2	1881.43	2	1
12/09/2019	1747.04	2	1680.04	2	1799	2	1
13/09/2019	1699.32	2	1662.89	2	1732.23	2	1
14/09/2019	1707.73	2	1667.17	2	1745.44	2	1
15/09/2019	1655.67	2	1599.64	2	1688.67	2	1
16/09/2019	1653.88	2	1587.19	2	1710.35	2	1
17/09/2019	2679.58	2	1688.67	2	3859.67	2	1
18/09/2019	3262.1	2	2939.4	2	3621.68	2	1

19/09/2019	2772.06	2	2569.97	2	2945.34	2	1
20/09/2019	2466.78	2	2333.89	2	2580.85	2	1
21/09/2019	2335.44	2	2285.58	2	2377.43	2	1
22/09/2019	2822.82	2	2371.95	2	3642.19	2	1
23/09/2019	3207.26	2	2827.99	2	3621.68	2	1
24/09/2019	2665.98	2	2516.03	2	2827.99	2	1
25/09/2019	2379.4	2	2196.19	2	2516.03	2	1
26/09/2019	2103.72	2	1971.2	2	2196.19	2	1
27/09/2019	1909.56	2	1821.64	2	1971.2	2	1
28/09/2019	1751.63	2	1671.45	2	1826.2	2	1
29/09/2019	1627.12	2	1574.8	2	1671.45	2	1
30/09/2019	1521.45	2	1442.66	2	1574.8	2	1
1/10/2019	1409.07	15	1347.68	15	1442.66	15	0
2/10/2019	1316.2	15	1260.61	15	1347.68	15	0
3/10/2019	1223.72	15	1170.73	15	1264.16	15	0
4/10/2019	1147.24	15	1105.57	15	1170.73	15	0
5/10/2019	1102.11	15	1082.12	15	1119.13	15	0
6/10/2019	1097.85	15	1068.88	15	1136.24	15	0
7/10/2019	1060.48	15	1026.62	15	1078.8	15	0
8/10/2019	1023.41	15	1001.2	15	1045.98	15	0
9/10/2019	981.87	15	948.65	15	1007.51	15	0
10/10/2019	944.69	15	918.65	15	957.78	15	0
11/10/2019	889.42	15	860.65	15	918.65	15	0
12/10/2019	831.48	15	813.09	15	860.65	15	0
13/10/2019	830.11	15	789.54	15	846.29	15	0
14/10/2019	801.36	15	783.73	15	816.07	15	0
15/10/2019	766.43	15	721.86	15	810.12	15	0
16/10/2019	703.8	15	689.64	15	721.86	15	0
17/10/2019	683.21	15	666.17	15	700.26	15	0
18/10/2019	664.53	15	655.92	15	692.28	15	0
19/10/2019	719.85	15	692.28	15	746.73	15	0
20/10/2019	677.97	15	638.27	15	727.33	15	0
21/10/2019	625.84	15	606.4	15	643.28	15	0
22/10/2019	587.56	15	565.98	15	606.4	15	0
23/10/2019	549.25	15	525.15	15	568.31	15	0
24/10/2019	514.55	15	497.03	15	527.36	15	0
25/10/2019	485.77	15	463.95	15	503.42	15	0
26/10/2019	454.9	15	442.15	15	472.06	15	0
27/10/2019	440.47	15	424.88	15	465.97	15	0
28/10/2019	478.16	15	463.95	15	497.03	15	0
29/10/2019	495.28	15	472.06	15	509.87	15	0
30/10/2019	450.08	15	428.68	15	472.06	15	0
31/10/2019	410.13	15	383.86	15	430.58	15	0
Days available for winterfill							81
Maximum Volume at 25ML/day							2025

Appendix 1. Kalbar Dams Capacity. From EEM A006 A Table 4-2 p 30 NJ Barton

Water Management Dams				Capacity Each Year(ML)														
Dam ID	Catchment	Capacity	Runoff to	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	ha	ML	fill (mm)															
2	132	125	95	0	0	0	0	125	125	125	125	125	125	125	125	125	125	125
3	61	57	93	57	57	57	0	0	0	0	0	0	0	0	0	0	0	0
4	15	15	100	0	0	15	15	0	0	0	0	0	0	0	0	0	0	0
5	13	13	100	0	0	13	13	0	0	0	0	0	0	0	0	0	0	0
6	7	7	100	0	0	7	7	0	0	0	0	0	0	0	0	0	0	0
7	222	211	95	211	211	211	211	211	211	211	211	211	211	0	0	0	0	0
8	24	23	96	0	0	0	23	23	23	0	0	0	0	0	0	0	0	0
9	128	122	95	0	0	0	122	122	122	122	122	122	122	0	0	0	0	0
10	134	127	95	0	0	0	127	127	127	127	127	127	127	0	0	0	0	0
11	41	39	95	0	0	0	0	0	0	39	39	39	39	0	0	0	0	0
12	22	21	95	0	0	0	0	0	0	21	21	21	21	0	0	0	0	0
13	135	128	95	0	0	0	0	0	0	128	128	128	128	0	0	0	0	0
14	76	72	95	0	0	0	0	0	0	72	72	72	72	0	0	0	0	0
15	42	40	95	0	0	0	0	0	0	40	40	40	40	0	0	0	0	0
16	280	266	95	0	0	0	0	0	0	266	266	266	266	266	266	266	266	266
17	101	96	95	0	0	0	96	96	96	96	96	96	96	96	96	96	96	96
18	207	197	95	0	0	0	197	197	197	197	197	197	197	197	197	197	197	197
19	230	219	95	0	0	0	0	0	0	0	0	0	0	219	219	219	219	219
20	175	166	95				0											
Totals	2045	1944		268	268	303	811	901	901	1444	1444	1444	1444	903	903	903	903	903