Fingerboards Mineral Sands Project

Inquiry and Advisory Committee

Expert Witness Statement of Hugh MIDDLEMIS (Groundwater Expert)

28th January 2021

1. Introduction

1.1. I, Hugh Middlemis, conducted an independent peer review of the Fingerboards mineral sands project (Project) groundwater impact assessment that was conducted by EMM Consulting and presented as part of Appendix A006 (Groundwater and Surface Water Impact Assessment) to the Environment Effects Statement (EES) for the Project. That peer review report appears as part of Attachment I to the EES (Water Independent Peer Review Report and Proponent Response). The peer review is titled 'Fingerboards Groundwater Modelling Independent Review', dated 25 February 2019 (Groundwater Peer Review Report).

1.2. I have been instructed by White and Case on behalf of Kalbar Operations Pty Ltd (Kalbar) to prepare an expert witness statement relevant to my groundwater expertise, and to present evidence at the Inquiry and Advisory Committee (IAC) hearing to be held in relation to the EES prepared for the Project pursuant to the Environment Effects Act 1978 (Vic), and the draft Planning Scheme Amendment and EPA Works Approval Application. I have been instructed to consider in particular the groundwater elements of key submissions on the EES from the East Gippsland Shire Council, Mine Free Glenaladale and the water authorities.

2. Qualifications and Experience

2.1. I am a civil engineer and hydrogeologist with 40 years' experience across Australia and internationally, working as an independent consultant since 2013. Annexure A contains a statement summarising my qualifications and experience, and the other matters raised by Planning Panels Victoria's Guide to Expert Evidence. My curriculum vitae is provided as Annexure B.

3. Conflict of Interest

3.1. I assert no conflict of interest, but I note the following immediate family or business relationships that could be perceived to have an impact on my duties and responsibilities.

3.2. As mentioned above, I conducted an independent peer review of the Groundwater Assessment for the Fingerboards mineral sands project that was conducted by EMM Consulting on behalf of Kalbar. My Groundwater Peer Review Report is presented as part of Appendix B to Appendix A006 of the Fingerboards EES.

3.3. My son Roger Middlemis has been employed as an environmental engineer at the Adelaide office of EMM Consulting since March 2019, which is after my peer review of the Fingerboards groundwater assessment. I understand that Roger Middlemis has not been involved on tasks relating to the Fingerboards project.

3.4. I was engaged by EMM Consulting to peer review several groundwater assessments:

3.4.1. EM1.3 model (Vic/NSW) for salinity management in Sunraysia region (2019-21); this project also involves consultations with representatives from the Department of Environment, Land, Water and Planning (DELWP).

3.4.2. Snowy 2.0 (NSW) pumped hydro tunnel groundwater model review (2018-19).

3.4.3. Burrawang-Avon Tunnel (NSW) groundwater model review (2020).

3.4.4. McPhillamys Gold Project (NSW) groundwater model review (2019-20).

3.4.5. Chandler Salt Project (NT) groundwater assessment (2016-17).

3.5. I have peer reviewed groundwater investigations conducted by EMM Consulting:

3.5.1. Hume Coal project (NSW) groundwater assessment (2017-19; for NSW Dept. Planning & Environment).

3.6. At various times from 2014 to 2017, I was engaged by the owners of the Stockman base metals mining project near Benambra in the Gippsland highlands to develop groundwater models for groundwater assessments of the mine dewatering and tailings storage facility operations. Those investigations also involved a project team working relationship with Bryan Chadwick, Principal Hydrogeologist at AECOM, who conducted an independent peer review of the Fingerboards groundwater assessment on behalf of the Department of Environment, Land, Water and Planning (DELWP) that is also presented in Attachment I to the Fingerboards EES. The investigations for the Stockman project also involved an independent technical review process and review by DELWP, and a Planning Panels Victoria EES Inquiry Panel hearing in June 2014.

3.7. I was appointed in 2019 by Southern Rural Water (SRW) to the Independent Technical Review Panel (ITRP) that provides SRW with technical advice on the Big Swamp and Boundary Creek and surrounding environment Remediation and Environmental Protection Plan (REPP), and the related investigations being conducted by GHD consultants on behalf of Barwon Water. The ITRP was re-appointed in late 2020, and is continuing to provide advice to SRW in relation to the REPP that is designed to help the groundwater system recover from over-extraction at the Barwon Downs borefield. See also: www.srw.com.au/barwondowns/

4. Peer Review

4.1. The role that I had in preparing the Groundwater Peer Review Report was to conduct the peer review and prepare a report. There were no other contributors to the Review or Report.

4.2. I adopt the Groundwater Peer Review Report, in combination with this statement, as my written expert evidence for the purpose of the Fingerboards mineral sands project IAC procedures into the environmental effects of the Project.

5. Summary of key risk issues, opinions and recommendations

5.1. It is my professional opinion that the Fingerboards project groundwater assessment (EMM 2019, Appendix B to EES Appendix A006) was conducted consistent with best practice methods. The best practice principles and procedures of the Australian Groundwater Modelling Guideline (‘AGMG’; Barnett et al. 2012) were applied to conduct the review, as there are no standard procedures for peer reviews of groundwater investigations and impact assessments as such. The Fingerboards groundwater assessment provides clear information on the project impacts in terms of the spatial and temporal distributions of key criteria of groundwater levels, drawdown/mounding, and flux exchanges between the various elements of the groundwater and connected surface water system including groundwater dependent ecosystems (GDEs). The groundwater assessment included a sensitivity analysis of the groundwater model calibration history match to identify the key sensitive parameters, which was input to the deterministic predictive scenario uncertainty assessment, consistent with best practice guidance. The calibration and prediction scenarios also considered short term and long term wet and dry climatic variability during mining and post-mining, including the effect of climate change consistent with DELWP (2016) guidelines.

5.2. In summary, the key groundwater issues/risks related to the project arise from changes to groundwater levels due to either groundwater extraction (dewatering), injection (managed aquifer recharge or MAR), or water table mounding due to seepage from tailings storages during mining operations. The predicted groundwater level changes set the context for changes to groundwater flux exchanges with surface water features including rivers, creeks

and wetlands such as the Gippsland Lakes, as well as depth-dependent evapotranspiration processes representing terrestrial vegetation. The key hydrogeological and hydrological elements of these interactive processes were all carefully considered in the groundwater modelling and related assessment that supports the EES.

5.3. The integrated groundwater and ecological assessment approach applied to the EES was input to the Environmental Management Framework (EMF) (EES Chapter 12) that is designed to minimise, manage and/or mitigate potentially adverse environmental impacts during the design, construction and operational stages.

6. Further work since preparation of the Groundwater Peer Review Report

6.1. Since the Groundwater Peer Review Report was finalised, I have undertaken further work in relation to:

6.1.1. Providing informal advice via an email on 19 March 2019 to the senior hydrogeologist at EMM Consulting, relating to the draft version of the AECOM 'Independent Review of Water Related Studies' dated 6 March 2019 (the final version in EES Attachment I is dated 2 July 2019). I understand that my informal review comments on that draft report were considered in relation to the presentation that was prepared and delivered by EMM on groundwater matters at the Technical Reference Group meeting number 12 on 20 February 2019. I did not directly prepare the EMM presentation material, nor did I attend the TRG meeting.

6.1.2. Providing informal advice via an email on 5 July 2019 to the senior hydrogeologist at EMM Consulting, relating to my opinion that the Fingerboards groundwater model is nominally fit for purpose for particle tracking investigations.

6.2. This further work has not caused me to change my opinion as expressed in the Groundwater Peer Review Report.

7. Submissions

7.1. On instruction from White and Case, I have reviewed selected submissions to the EES, draft planning scheme amendment and works approval application that are relevant to my area of expertise in groundwater. These submissions and the concerns or issues raised are summarised in Table 1 below, along with my comments and response to the issues raised.

Table 1 – Summary of groundwater-related issues raised in selected written submissions.

Item	Groundwater-related Concerns, Comments and/or Issues	Submission#	Response by Groundwater Expert Mr Hugh Middlemis
1	Submission 291 is from one of the members of the Technical Reference Group convened by DEWLP to provide guidance to Kalbar during the EES preparation and its supporting technical studies. Submission 291 indicates that the EES investigations and documentation has contributed significantly to the technical understanding of groundwater systems and the potential mining-related impacts. **Submission 291 also indicates that additional information will be required in due course from Kalbar to support licensing requirements**, including further detail on the potential impacts on groundwater beneficial uses of proposed groundwater extraction and injection borefields, as well as seepage from proposed dams including the TSF.	291	Licensing requirements are acknowledged in the EES Chapter 5, which also outlines that it is usual practice for specific licensing matters to be addressed once the primary approvals process is completed (ie. mining licence and work plan). The EES Chapter 9 provides detailed information on water licensing matters, including references to the detailed Groundwater Impact Assessment (Appendix B of EES Appendix A006) which provides information on the predicted changes to the availability of groundwater for beneficial and licensed users. The Fingerboards groundwater model that was used for the impact assessment predictions and uncertainty analysis has been assessed as consistent with best practice principles and fit for the purpose of investigative scenario modelling of the effects of mining activities (Groundwater Peer Review Report; part of EES Attachment I). The model is assessed as suitable for use in supporting impact assessment investigations and informing management and mitigation strategies, which would include licensing requirements once the primary approvals process is completed. Some field investigations may also be required to support the ongoing modelling investigations, to augment the integrated and multi-disciplinary investigations already completed for the EES studies, as documented in the EES reports.

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2	Submission 514 is from one of the members of the Technical Reference Group convened by DEWLP to provide guidance to Kalbar during the EES preparation and its supporting technical studies. Submission 514 lists key recommendations in relation to groundwater matters as: a) the **Environmental Management Framework** (EMF), Work Plan and plans under the Incorporated Document should be updated within 12 months of commencement of the New Environment Protection Act, and including addressing the new requirements of the new general environmental duty (GED); b) the Proponent should provide more specific information in the **Works Approval Application** about the off-site groundwater discharges, notably in relation to whether the 'capture and re-use of process water' from the tailings disposal process 'may cause increases in the concentration of leachable analytes over time' and thus change the 'potential for the quality of water seeping from the tailings to increase above background levels over time, thereby posing a changing risk profile to protected beneficial uses as the Project progresses'; further information is likely to be requested 'in response to a formal section 22 notice which will be issued in due course'; c) there should be appropriate monitoring of dust, noise, surface water and groundwater impacts to ensure early, proactive management can occur, and the assessment criteria for dust, noise, surface water and groundwater impacts as detailed in the relevant Risk Treatment Plans should be amended.	514	I concur with the monitoring recommendations and note the following on the other key recommendations of Submission 514: a) Kalbar has committed to project design, construction, operation and closure in accordance with the agreed environmental management framework (EES Chapter 12), and to implementing practices that prevent, minimise, mitigate or remediate potential effects of the project on the environment. The EES process and documentation provides a tangible demonstration of that commitment in terms of consultation with stakeholders and preparation of draft versions of the key EMF documents: draft Work Plan, draft Planning Scheme Amendment, draft Works Approval Application. b) It is understood that further consultations on the EMF and related documents will be required once the primary approvals process is completed. c) The recommendations in regard to monitoring and related amendments to the Water Quality and Hydrology Risk Treatment Plan and the EMF are supported in terms of: o including a new monitoring program of water draining from the tailings prior to their placement in the mine void. o including corrective actions that would be implemented should the results of this monitoring exceed specified risk-based trigger levels. o including acceptance criteria for groundwater in accordance with SEPP (Waters) and to make it clear that the background level (as defined in SEPP (Waters)) will become the objective where it is better than the environmental quality objective.

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3	Submission 692 is from one of the members of the Technical Reference Group convened by DEWLP to provide guidance to Kalbar during the EES preparation and its supporting technical studies. Submission 692 reiterates the importance of ongoing **engagement between Kalbar and East Gippsland Water**, which provides drinking water supplies to about 20,000 customers, to ensure that risks to the EGW Mitchell River pumping station at Glenaladale and the Woodglen aquifer storage and recovery (ASR) borefield are managed should the mine proceed. Submission 692 lists the following potential groundwater-related risks in relation to EGW interests: a) Reduced groundwater yield from EGW Woodglen borefield (due to groundwater pumping). b) Increased groundwater levels in EGW Woodglen borefield (due to potential seepage from tailings and water storages). c) Adverse impacts to groundwater quality in EGW Woodglen borefield (due to potential seepage from tailings dams). d) Reduced surface water availability from the Mitchell River (due to surface water extraction activity).	692	I note that the issues raised in Submission 692 were also addressed in the Coffey response (with which I concur) to the AECOM peer review, which are both presented in Attachment I to the EES. My response to Submission 692 is summarised below: a) The Groundwater Assessment report (EMM 2019; Appendix B to EES Appendix A006) discusses drawdown effects at third party bores in section 7.10 and shows at Figure 7.39 that there is no material drawdown effect predicted at the Woodglen borefield (ie. less than 0.5m), which means there would be no material reduction in groundwater yield at the Woodglen bores. b) Similarly, the Groundwater Assessment report shows that there is no material increase in groundwater levels predicted at the Woodglen borefield due to seepage from the tailings storages and related mounding. Further, the uncertainty analysis (section 8) and climate change assessment (section 8.5) and Figures 8.1 to 8.20 demonstrate that there is no material drawdown or mounding effect predicted at the Woodglen borefield. c) The Groundwater Assessment report (section 7.8.1) conducted particle tracking simulations that demonstrated that there are no flow paths from the mine site to the Woodglen borefield, although some particles are captured by the Mitchell River alluvium (Figures 7.25 and 7.26). This was also the case for the no mining scenario, and also for an alternative hydrogeological conceptualisation of a more extensive Seaspray Group. Therefore there would be no adverse impacts on Woodglen borefield groundwater quality. d) Although it is not strictly a groundwater issue, for completeness, my response at item 5 below includes some comments on the potential impacts on Mitchell River surface water availability due to proposed winterfill surface water extractions.

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4	Submission 716 is from one of the members of the Technical Reference Group convened by DEWLP to provide guidance to Kalbar during the EES preparation and its supporting technical studies. Submission 716 is supported by a **'targeted technical review' that was conducted by SLR Consulting (2020)** into the Fingerboards EES. In summary terms, Submission 716 requests additional information be provided in relation to groundwater modelling predictions and implications for groundwater availability and quality, including all potentially impacted groundwater users, and also regarding the potential impact in terms of geothermal properties and of an increased introduction of saline intrusion into the Latrobe Group aquifer. SLR (2020) presents an outline of groundwater-related issues at Table 5, while the 'key matters' are presented as a summary table at Attachment 2 to SLR (2020), and the latter issues are listed below. a) The groundwater risk assessment (EES Appendix A006 Table 8-8) has more detail and identified risks than presented in the Attachment F risk report. The additional risks and items requiring more thorough consideration (listed below) should be addressed in the EES risk report, and EPRs developed.	716	Some of the groundwater-related issues of Submission 716 are derivative of the content in the AECOM peer review (EES Attachment I). I note that the AECOM issues were addressed by the Coffey response (EES Attachment I), with which I concur, and thus I make quite brief comment on those issues, and more detailed comment on the other issues as per the items below. a) Table 8-8 appears in the main body of the EES Appendix A006, which is a report by Coffey (2020) on the Groundwater and Surface Water Risk Assessment. It could be better described as a risk-based impact assessment as it considers the Attachment F Risk Assessment along with the Surface Water and Groundwater Impact Assessments included in Appendix A006, and the mitigation measures detailed in Table 8-6 of EES Appendix A006. The mitigation measures are based on the hierarchy of avoiding, minimising, managing and offsetting risks and impacts, where required to reduce the residual risks listed in Table 8-8 to low to very low levels. The Attachment F Risk Report includes a 'Risk Register' as Table 5 that summarises the findings of the initial risk assessment process, which I understand is one of the inputs to the comprehensive risk-based impact assessment of Coffey (2020). It is therefore not unreasonable for the Attachment F Risk Report to be less detailed and for the risk-based impact assessment to be more detailed.

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	b) Submission 716 indicates that the following risks 'do not appear to have been considered in either Appendix A006 Table 8-8, or Attachment F': 1) Drawdown at the bore field is significantly greater than modelled with implications for groundwater availability, and quality; 2) The bore field is unable to provide the required supply volume and/or a 3 GL/year groundwater licence for Latrobe Group cannot be sourced through trade; 3) Groundwater extraction from shallow aquifer(s) is required to augment supply; 4) Seepage from TSF and/or mine void tailings impacts the beneficial uses of Balook Formation / Latrobe Valley Group groundwater; 5) Saline intrusion to the Latrobe Group aquifer due to decline in groundwater pressure at coast;		b) As discussed in item a), the key document is Table 8-8 of EES Appendix A006 (Coffey 2020), and I note that most of the impacts listed have been addressed in the Groundwater Assessment report (Appendix B to Appendix A006) and/or the Risk Assessment report itself at Table 8-8 (Appendix A006): 1) The groundwater modelling uncertainty analysis investigated the potential for borefield drawdown greater than the base case scenario (including supplying all of the project's needs for 15 years), and Table 8-8 considered the effect of drawdown negatively affecting users and GDEs. 2) The Groundwater Assessment has adequately established the aquifer properties and extraction bore capabilities such that there is low probability that the borefield capacity might be insufficient. For example, I also note that existing aquifer usage is estimated at 35 ML/d since 2005, compared to Fingerboards borefield demand of 3 ML/day for 3 to 15 years. 3) The existing aquifer system capacity has been adequately established and the mine water management system has investigated redundancies including dry climate scenarios (EES Appendix A006, section 7.1). 4) Table 8-8 considered impacts to the beneficial uses of Coongulmerang Formation groundwater from discharging Latrobe Group aquifer groundwater, but it has not considered impacts to the beneficial uses of Balook Formation / Latrobe Valley Group groundwater. 5) Saline intrusion is listed in Appendix A006 Table 8-8. The groundwater assessment (Appendix B to EES Appendix A006) has considered potential saline intrusion effects, although the report does not highlight the results. For example, the model predictions and uncertainty analysis indicate maximum drawdown occurs at mine year 3, with around 1m drawdown in the water table that interacts with the Gippsland Lakes and coast (eg. Figure 8.3) and around 1% maximum change to outflow at the coastal

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			boundary (Tables 8.3 to 8.5). While the drawdown in the deeper units under the Lakes and coast is greater (0.5 to 2m at some times and in some units, depending on the parameter values applied; eg. Figure 8.16), the effect is not transmitted upwards to the shallow units because of the intervening low permeability units. These effects would not invoke a material risk of saline intrusion, and would be much less than the ongoing Latrobe Group aquifer depressurisation effects associated with offshore petroleum production.
	6) Impact of groundwater extraction on the geothermal properties beneficial use, at depths shallower than 2500 m Beneficial Uses (p.63 refers to 2500 m to 4000m depth).		6) Table 3-9 of Appendix A006 indicates that the specific indicators for 'geothermal' beneficial use are temperatures of 30C to 70C, although this establishes the beneficial use as a low enthalpy system at less than 1,000 m depth, and as such it is exempt from Victorian geothermal legislation, but not the Water Act (RPS Aquaterra and Hot Dry Rocks, 2012). I note that the typical geothermal gradient is about 30C/km, which would generate a potential temperature increase of around 10C over the depth of the Fingerboards bores, which limits its beneficial use to low enthalpy (eg. ground sourced heat pumps). I also note that the Gippsland Regional Aquatic Centre in Traralgon is currently planning to open the first public aquatic facility in Victoria to incorporate a geothermal heating system. The system has production and injection bores at around 600 metres depth (ie. deeper than the 300m deep Fingerboards bores), where the in situ groundwater is about 65C due to the thermal insulation from overlying coal units, and where the cooled water is reinjected at about 40 degrees. Despite the obvious geological and hydrogeological differences between Traralgon and Fingerboards, I consider the GRAC project analogous in geothermal terms in that it demonstrates that beneficial uses can be assessed as sustainable even when there is a significant difference between in situ and injected water temperatures, even though such differences do not apply at Fingerboards.

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	c) Submission 716 indicates that the Groundwater Risk Assessment (EES Appendix A006 Table 8-8) would be improved if the following uncertainties are considered more thoroughly: 1) **Borefield**: i) Identify all potentially impacted groundwater users (including spring-fed dams, domestic and stock groundwater users); ii) The long-term water supply from the Latrobe Group is based on a short term, low yield, aquifer test. 2) Submission 716 indicates that the Groundwater Risk Assessment (EES Appendix A006 Table 8-8) would be improved if uncertainties around **filled voids and mounding** were considered more thoroughly: i) Layering in the Coongulmerang Fm impedes the downward drainage from filled voids;		c) I note that the groundwater assessment (Appendix B to Appendix A006) and related risk-based impact assessment (Appendix A006 Table 8-8) has indeed considered a wide range of uncertainties to an adequate level of detail. 1) **Borefield**: i) I note that all the known groundwater users are identified and specified in the model (Appendix B to EES Appendix A006); third party bores and pumping rates are summarised in Table 2.6, Table C1, and Figures 2.22, to 2.24; registered bores are mapped in Figure 3.6. I note that Table 8.14 of EES Chapter 8 lists spring-fed dams and section 3 of the groundwater assessment also considered GDEs. ii) The Latrobe Group aquifer test involved a pumping rate of 11-12 L/s for a duration of 4 days. In groundwater investigation terms, this would be considered a medium term test at a high pumping rate, and it is suitable for estimating aquifer parameter values to benchmark the groundwater model. More importantly, the groundwater modelling provides the long term, high pumping rate benchmarking test of aquifer responses, rather than a singular pumping test. The groundwater model calibration involved a long term simulation from 1960 that included historical pumping stresses of about 35 ML/d since about 2005 and a history match to extensive groundwater monitoring data. 2) **Filled voids and mounding**: i) There is no material evidence presented in Submission 716 or in the groundwater assessment on layering in the Coongulmerang Formation that would impede the downward drainage from filled voids. However, the effect of low permeability horizons was considered in Table 8-8.

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	ii) The use of groundwater for processing and implications for mine void seepage water chemistry; iii) Increased discharged to GDE and Mitchell River of groundwater with natural concentrations above criteria; iv) Shallow water table activates discharge to drainage lines on-site, land salinisation, impact on site structures and adjoining pit(s); v) The hydraulic connection between sediments under site, the Mitchell River flats and the Latrobe Valley Group at Woodglen is greater than indicated by the groundwater model; vi) Implication for bore field drawdown if tailings seepage is less than modelled; d) Submission 716 indicates that the **Groundwater Monitoring Program** (proposed management measure 013); the groundwater bore locations and monitoring program should:		ii) Table 8-8 of Appendix A006 adequately considers the implications of tailings seepage water infiltration on the groundwater quality impacts and beneficial uses, including GDEs. iii) Table 8-8 of Appendix A006 adequately considers the implications of groundwater discharges to GDEs and the Mitchell River. iv) The effect of raised groundwater levels was adequately considered in Table 8-8 in relation to mine infrastructure and water dependent ecosystems. v) The groundwater modelling uncertainty analysis and particle tracking simulations investigated potential hydraulic connections between the sediments under the site, the Mitchell River flats and the Latrobe Valley Group at Woodglen for a wide range of aquifer parameters and for an alternative conceptualisation in terms of the Seaspray Group extent. The results were used in the Table 8-8 assessment. vi) The groundwater assessment did not investigate the implication for borefield drawdown if tailings seepage rates are reduced. The application of hydrogeological first principles would indicate that the drawdown at the borefield, and the regional extent and magnitude of the drawdown, may increase somewhat, but not to an extent that would compromise the borefield capacity. It would be a straightforward matter for the groundwater consultants to prepare plots that 'unpack' the incremental borefield drawdown and/or mounding effects for specified scenarios. d) I note that EES Chapter 9.2.8, along with Section 9 and Table 9-1 of the risk-based impact assessment (Appendix A006), outline how the groundwater monitoring program for baseline, construction, operations and post-mining activities is designed to support the environmental management framework, in

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	1) reflect the location of potentially impacted GDE and groundwater users; 2) address gaps in the understanding of groundwater flow at the site; 3) address uncertainties in connections and impacts on groundwater and surface water north of the site; 4) include monitoring of impact on groundwater level and quality nearby groundwater users of shallow and deep groundwater; 5) the program should encompass operation and post-closure and include monitoring for shallow perching (waterlogging / land salinisation) and groundwater discharge to ground surface.		consultation with key agencies and catchment managers. I consider the proposed monitoring system as described would address the issues listed in items 1) to 5) opposite.
5	Submission 813 Chapter 1 discusses water issues, and includes many comments that are derivative of the AECOM peer review (EES Attachment I), including the following. a) Submission 813 suggests that details are lacking on design of key water engineering structures and implications for related construction, operation and/or closure risks. b) Submission 813 notes that the three westernmost bores of the proposed 7-bore Fingerboards borefield are located in the model to the west of the 'infrastructure options' borefield area that is centred on Cowells Lane between the railway line and the mine site. It is suggested that the groundwater extraction volume may be constrained due bore interference effects if the borefield can only lie within the area designated.	813	The groundwater-related issues of Submission 813 are largely derivative of the AECOM peer review (EES Attachment I). I note that these issues were addressed by the Coffey response (EES Attachment I), with which I concur. However, I also note the following brief comments on these issues: a) The **engineering design issues** were adequately addressed by the Coffey response at items 2.1, 2.2, 2.3, 2.4, 2.5 and 2.10. b) I note that the Modflow groundwater modelling code accounts for **interference effects** between all specified extraction wells, including the effect of injection wells and/or seepage, and I note that all the known groundwater extraction data is specified in the model (EMM 2019; Appendix B to EES Appendix A006): 1) third party bores and pumping rates are summarised in Table 2.6, Table C1, and Figures 2.22, to 2.24; 2) registered bores are mapped in Figure 3.6; 3) the Fingerboards borefield is mapped Figure 4.17 and is modelled as 95 L/s for years 1-3 of mining, from 7 bores pumping at 15 L/s from the Latrobe Group Gravels; 4) section 4.8 describes how all these well extractions are specified in the model, and also how regional aquifer

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	c) Submission 813 suggests that the groundwater modelling is oversimplified, downplaying the possibility of perched aquifers above the base of the mine and underestimating mining activity impacts on groundwater mounding and groundwater dependent ecosystems (GDEs).		depressurisation effects due to a combination of mining and offshore petroleum well production is represented appropriately via drain cell features. Submission 813 does not specify which bores it is referring to about potential interference effects. It may possibly be assuming that only the four (eastern) bores that lie within the options area will be permitted, in which case the extraction rates would have to increase in order to yield the 95 L/s total, and thus drawdowns will increase. However, it is also possible that licensing and other negotiations may allow some latitude in borefield layouts. Nonetheless, the effects on third party bores as predicted will be different if the borefield location and layout is different from that presented in the EES. However, the EES predictions and uncertainty analysis do provide an objective assessment of the incremental borefield drawdown effects, including potential interference effects. c) It is worthwhile establishing a definition for **'perched aquifer'** conditions, before discussing potential implications. With reference to the conceptual hydrogeological terminology graphic shown below (after Doody et al. 2019), groundwater may be defined as water contained within and completely saturating the pore spaces associated with rocks and sediments below the ground surface (ie. generally in the saturated zone below the regional water table). Perched groundwater may be defined as an isolated region in the unsaturated zone (ie. below the ground surface and above the regional water table) where the pore spaces associated with rocks and sediments may be locally saturated where they overlie a low permeability lens, thus forming a limited extent 'perched' groundwater lens. By definition, perched conditions are isolated and not connected to the regional water table and are not affected by drawdown of the water table. Similarly, perched conditions are generally not affected by mounding of the water table, unless the mound rises to establish saturated water table conditions above the low permeability lens.

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			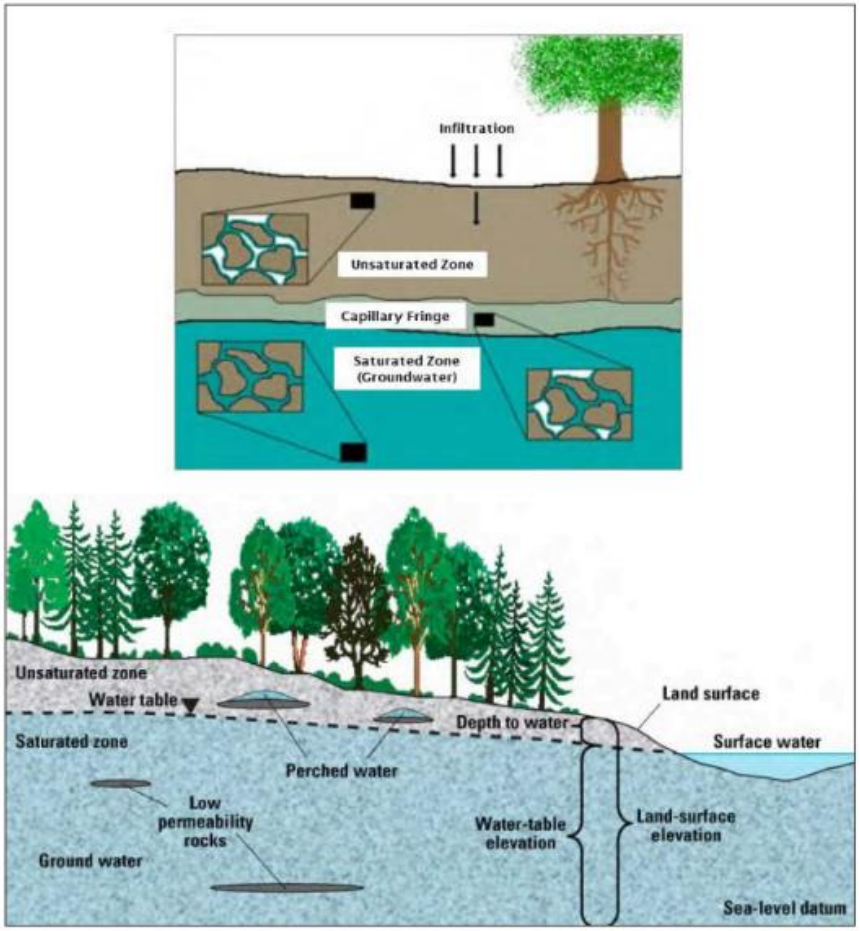 Figure 1. Top: difference in saturation among particles in the unsaturated zone, capillary fringe and saturated zone (Michigan State University 2018); bottom: perched aquifers in the unsaturated zone, which can be an important water source for some GDEs (Snyder 2008) Conceptual hydrogeological terminology (after Doody et al. 2019) At Fingerboards, the depth to water table is typically more than 30 metres (except near the Gippsland Lakes, on main river floodplains and in creeks and gullies north of the mine area). The mounding that develops due to mining activities is largely

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			constrained to the mine area, with steep hydraulic gradients at the edge of the tailings cells, as shown by many figures in section 7 of the Groundwater Assessment (Appendix B to EES Appendix A006). Although the 'mounding' (as defined by the 0.5 metre contour illustrating the lateral spreading of the significant mounding that develops under the mine path) extends up to 4 km from the mine, the mounding effect outside the mine area is generally less than 2 metres. This means that the depth to regional water table is not materially affected by mounding outside the mine area, and thus there is a very low potential for water table mounding effects on any perched conditions that may exist, such as in the Providence Ponds area. Finally, I note that low permeability horizons was considered in the risk-based impact assessment (Appendix A006, Table 8-8). As there almost no evidence of perched aquifer conditions, especially in the mine area, in my view the groundwater modelling has not been 'oversimplified' and thus it does not underestimate mining activity impacts on groundwater mounding or GDEs. In fact, in terms of perched aquifer issues, the Fingerboards model is consistent with previous East Gippsland Groundwater Modelling that was conducted by GHD in 2010 on behalf of the Victorian government agencies for the Ensym/ecoMarkets initiative and was independently peer reviewed. Such an approach is consistent with best practice guiding principles (eg. Barnett et al. 2012, section 3), in that: "*In regional problems where the focus is on predicting flow, predictions depend on large scale spatial averages of hydraulic conductivity rather than on local variability. Moreover, in large regions there may be insufficient data to resolve or support a more variable representation of hydraulic conductivity. A parsimonious approach may be reasonable, using constant properties over large zones, or throughout a hydrostratigraphic unit*". In any case, even if isolated perched conditions exist above the base of the mine, the mining process would remove the

Item	Groundwater-related Concerns, Comments and/or Issues	Submission#	Response by Groundwater Expert Mr Hugh Middlemis
			underlying lenses of low permeability units that support the perching, although that would not affect the occurrence and properties of any perching conditions that may exist outside the mine path. In my view, the potential for perched conditions has been adequately investigated (eg. as outlined in Groundwater Assessment section 7.12), and should continue to be during ongoing investigations.
	d) Submission 813 notes that the mine area is partly in the headwaters of the Providence Ponds 'chain of ponds' system, where the depth to the regional water table is around 30m. It notes that this indicates that the ponds are not supported by the regional groundwater system, but suggests that there may be some shallow perched water tables, albeit disconnected from the regional water table, that may support associated GDEs which may be affected by drawdown or mounding due to mining activities.		d) As described above at item c), perched conditions are isolated and not connected to the regional water table, and therefore any **perching in the Providence Ponds** area cannot be affected by drawdown of the regional water table. Nor can it be affected by seepage from the tailings storages that results in mounding of the water table, as the water table is around 30 metres deep in that area, and mounding is predicted to generally less than about 1 metre outside the mine area. However, it is theoretically possible for perched conditions in the Providence Ponds system to be affected by localised mound-related impacts of tailings seepage from the south-west corner of the project site, if the Seaspray Group marls are more extensive than previously assumed. Under such conditions, any water table mounding that develops within the Coongulmerang Formation would dissipate more slowly because it would be underlain by the Seaspray Group marls that are less permeable than the Balook Formation / Latrobe Valley Group gravels that typically underlie the Coongulmerang Formation. However, this was assessed via an alternative hydrogeological model, as described in sections 7.11 and 7.12 of the Groundwater Assessment. The assessment was supported by data analysis of the clay content in 347 drillholes in the Fingerboards and Glenaladale areas, and was accompanied by a description of groundwater control and drainage measures that could be invoked if conditions warrant.

Item	Groundwater-related Concerns, Comments and/or Issues	Submission#	Response by Groundwater Expert Mr Hugh Middlemis
	e) Submission 813 notes that the estimated annual **surface water extraction volume requirement of 3GL/year from the Mitchell River during the winterfill period** is subject to periods when pumping is restricted. It suggests that the borefield may be unable to compensate for a large volume shortfall, which may be exacerbated by any shortfall in the recovery and re-use of process water and/or demand for dust suppression in excess of water balance estimates. It is suggested that if the Proponent has under-estimated the water requirement, and/or over-estimated its ability to obtain the necessary water, they will have no option but to suspend production, which carries closure and rehabilitation implications.		e) Given the importance of surface water and groundwater interactions to the hydrogeological flow system, the following points explore some surface water data uncertainties that should be understood. The Surface Water Assessment Regional Study (Appendix F to EES Appendix A006) includes an assessment of **extraction effects on the Mitchell River** at section 3.7 (the cross-reference in the Coffey response is wrong). A summary of the surface water assessment is also presented in chapter 8.4.3 of the EES, which notes that winterfill extractions are permitted between July and October, and then only when the flow (threshold) exceeds 1400 ML/day at the Glenaladale flow gauging station 224203. While the surface water assessment does not explore the flow gauging data uncertainty implications, I note that the rating table for station 224203 shows that the threshold flow of 1400 ML/day corresponds to a gauge height of 1.165 m. If we assume the Fingerboards 3 GL winterfill volume is extracted over 80 days, then the daily extraction rate is 37.5 ML/day (Appendix F to EES Appendix A006, section 3.7). An incremental flow of 37.5 ML/day corresponds to an incremental gauge height change of about 0.012 m (12 mm) at the 1400 ML/day threshold flow. The 37.5 ML/day incremental flow is 2.6% of 1400 ML/day, which is well within a typical flow gauging accuracy of around 10%, so while it may be measurable in principle, it is subject to considerable data uncertainty. I note that a streamflow gauge margin of error of plus or minus 12.4% (with 95% confidence) was established during a recent NSW Land and Environment Court case into alleged water theft on the Barwon-Darling River (WaterNSW v Harris [2018] NSWLEC 188). I also note that analysis of recorded flows at Glenaladale (1998-2018) shows that pumping restrictions occurred around 18% of the time during the winterfill period (EES Chapter 8, bottom of page 8-88), which equates to about 100 days of the 120-day winterfill period, demonstrating the practicality and reliability of the surface water extractions from the Mitchell River. The other issues relate to site water balance considerations, which I understand is to be addressed by others.

Item	Groundwater-related Concerns, Comments and/or Issues	Submission#	Response by Groundwater Expert Mr Hugh Middlemis
	f) Submission 813 indicates that the Class 2 model confidence level classification that is endorsed in the Groundwater Peer Review Report (Middlemis (2019), Attachment I) is not fully understood, but **challenges the acceptance of adequacy of the modelling and uncertainly analysis**. It also challenges the Peer Review comment that the project is "relatively low risk', noting that a number of the dams on site will be subject to ANCOLD dam risk/safety guidelines. It also suggests that recent uncertainty assessment guiding principles (Middlemis and Peeters, 2018) suggest that modellers should "justify assumptions and choices in technical reports in a manner that is transparent and open to scrutiny", while noting that the proponent 'did not use or access all available hydrogeological data, existing data is misrepresented, flawed and lacking transparency'. It concludes that the conceptual model predicting impacts of mining to inform environmental impact assessments is not robust as it cannot be calibrated in the absence of appropriate data.		f) The model confidence level classification system of the best practice Australian Groundwater Modelling Guidelines ('AGMG'; Barnett et al. 2012) is a method of evaluating the performance of the model in the context of the data and other resources available for a modelling investigation (time, budget, etc), and qualitatively assessing the likely confidence in the model as a predictive tool. The ANCOLD guidelines are not relevant or applicable to groundwater modelling. The relatively low risk characterisation was justified in the Groundwater Peer Review Report (EES Attachment I) in terms of the magnitude and extent of the predicted drawdown and mounding impacts in relation to the depth to water table in particular, and the understanding of the aquifer system robustness in terms of its responses to existing long term stresses of groundwater extraction for irrigation and of depressurisation due to mining and petroleum production. It was also noted the risks to areas of ecological value outside the project footprint were assessed as low (EES Appendix A005). The 'low risk' characterisation was also made in the context of the section 3.5 of the Groundwater Assessment (Appendix B to EES Appendix A006) that outlines the low to high risk assessment criteria for drawdown, mounding and depth to water table that have been established by the Victorian government and others. The AGMG actually recommends the confidence level method for application to situations when a formal uncertainty analysis has not been conducted (ie. unlike the Fingerboards case), although it is a common misconception that the model confidence level assessment is mandatory for every model. The model confidence level is assessed in terms of the: • geological and hydrogeological understanding; • data available, especially aquifer responses to hydrological stresses under a range of climatic and development conditions;

Item	Groundwater-related Concerns, Comments and/or Issues	Submission#	Response by Groundwater Expert Mr Hugh Middlemis
			• numerical model design and performance. It is expected that any model will have attributes that fall into more than one 'class', with the overall 'confidence level' indicated from the weight of criteria that are met. This is described and justified in the Groundwater Peer Review Report, consistent with the guidance in the AGMG (Barnett et al. 2012), and in the recent uncertainty analysis guidance (Middlemis and Peeters 2018; Middlemis et al. 2019). As the Groundwater Peer Review Report sets out, the extensive groundwater data set was comprehensively evaluated and used to develop a sound and robust hydrogeological model and a numerical model with good performance in terms of calibration history match to data on aquifer responses to substantial hydrological stresses under a range of climatic and development conditions. The stresses notably included third party groundwater extraction that ramped up from about 1960 to about 35 ML/day by 2005, which is ten times more than the proposed Fingerboards borefield extraction and more than five times the duration of pumping, which helps to confirm confidence in the Fingerboards model as fit for purpose.

Notes and References regarding Table 1 content:

1) Middlemis H, Merrick N, Ross J, Rozlapa K (2001) Groundwater Flow Modelling Guideline. Prepared for Murray–Darling Basin Commission by Aquaterra, January 2001. https://www.mdba.gov.au/sites/default/files/archived/mdbc-GW-reports/2175_GW_flow_modelling_guideline.pdf

2) Barnett B, Townley LR, Post V, Evans RE, Hunt RJ, Peeters L, Richardson S, Werner AD, Knapton A and Boronkay A. 2012. Australian groundwater modelling guidelines. Waterlines report 82. National Water Commission, Canberra. http://webarchive.nla.gov.au/gov/20160615064846/http://archive.nwc.gov.au/library/waterlines/82

3) Middlemis H, Walker G, Peeters L, Richardson S, Hayes P and Moore C. 2019. Groundwater modelling uncertainty – implications for decision making. Summary report of the national groundwater modelling uncertainty workshop, 10 July 2017, Sydney. Flinders University, National Centre for Groundwater Research and Training. http://groundwater.com.au/news_items/groundwater-modelling-uncertainty

4) Middlemis H, Walker G, Peeters L, Richardson S, Hayes P, Moore C (2019) Groundwater modelling uncertainty – implications for decision making. Summary report of the national groundwater modelling uncertainty workshop, 10 July 2017, Sydney, Australia. Flinders University, National Centre for Groundwater Research and Training. https://dspace.flinders.edu.au/xmlui/handle/2328/39111

5) Doody TM, Hancock PJ, Pritchard JL (2019). Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2019.

6) GHD (2010) East Gippsland CMA groundwater model. Prepared for Department of Sustainability and Environment.

7) RPS Aquaterra and Hot Dry Rocks (2012). Geothermal Energy and Water Use. Waterlines Report Series, No. 72, February 2012. Prepared for National Water Commission.

8) DELWP (2016). Guidelines for Assessing the Impact of Climate Change on Water Supplies in Victoria. The State of Victoria, December 2016.

8. **Declaration**

8.1. I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Fingerboards Inquiry and Advisory Committee.

……

Signed

Date: 28 January 2021

Annexure A – Matters Raised by Guide to Expert Evidence

1. **Name and address or the expert:**

1.1. Hugh Middlemis, HydroGeoLogic Pty Ltd, PO Box 383, Highgate, 5063, South Australia.

2. **Qualifications, Experience and Areas of Expertise (see also CV at Annexure B):**

2.1. B.E. (Civil Engineering), University of Adelaide, South Australia, 1980

2.2. M.Eng.Sci. (Hydrology and Hydrogeology), University of New South Wales, 1990

2.3. Hugh Middlemis has 40 years' experience overall on engineering, hydrogeology, hydrology and modelling investigations and related management for natural resources, the built environment and mining/energy projects across Australia and internationally. Hugh established HydroGeoLogic as an independent consultancy in 2013.

2.4. Hugh is a leading groundwater modeller and independent reviewer, with more than 30 years' experience in this particular field, specialising in flow and solute models, stream-aquifer interactions and groundwater dependent ecosystems.

2.5. Hugh is principal author of the 2001 best practice guidelines for groundwater modelling (Middlemis et al 2001) that formed the basis for the latest (Barnett et al 2012) best practice guidelines (references are detailed as footnotes to Table 1 above). Hugh was awarded a Churchill Fellowship in 2004 to benchmark international best practice. Hugh is co-author of two recent reports on model uncertainty analysis within a risk management framework (Middlemis and Peeters 2018; Middlemis et al 2019) (references are detailed as footnotes to Table 1 above).

2.6. Hugh Middlemis has appeared before IAC proceedings regarding the following recent cases:

2.6.1. In 2019, Hugh Middlemis provided expert Hydrogeologist and Groundwater Modelling inputs to the IAC hearings on the North East Link Project (before Chair Mr Nick Wimbush on 5 August 2019).

2.7. Hugh Middlemis has appeared before Planning Panels Victoria and VCAT regarding the following recent cases:

2.7.1. In 2016, Hugh Middlemis provided expert Hydrogeologist and Groundwater Modelling inputs to the PPV EES Inquiry Panel hearings on the Melbourne Metro Rail Project (before Chair Ms Kathy Mitchell on 25 August 2016.)

2.7.2. In 2014, Hugh Middlemis provided expert Hydrogeologist and Groundwater Modelling inputs to the PPV EES Inquiry Panel hearings on the Stockman Base Metals Project (before Chair Ms Cathie McRobert on 24 June 2014).

2.7.3. In 2014, Hugh Middlemis appeared as an expert Hydrogeologist at the VCAT Compulsory Conference in relation to Tutchewop Lakes (before Senior Member Levine on 28 April 2014).

3. **Other Significant Contributors to the Report (if any):**

3.1. None.

4. **All instructions that define the scope of this statement (original and supplementary and whether in writing or verbal):**

4.1. My instructions to prepare this witness statement are set out in Annexure C.

5. **Identity of Persons who have carried out tests or experiments upon which reliance has been placed (if any):**

5.1. Not applicable.

6. **Expertise to make Report and Areas falling outside Expert's expertise:**

6.1. My key expertise is in the fields of hydrogeology and groundwater modelling.

6.2. Areas that fall outside my expertise and were not considered during the independent review nor in preparation of this statement notably include groundwater contamination risks, human health risks, or land settlement risks due to groundwater drawdown.

7. **Key Assumptions made in preparing the Groundwater Peer Review Report:**

7.1. Not applicable.

8. **Any departures from the findings or opinions expressed in the Groundwater Peer Review Report and, if so, why?**

8.1. None.

9. **Whether the Groundwater Peer Review Report is incomplete or inaccurate in any respect:**

9.1. Not applicable.

10. **Details of any changed circumstances or assumptions since the Groundwater Peer Review Report was prepared and whether these affect the opinions expressed in the Groundwater Peer Review Report:**

10.1. None.

11. **Reports Relied Upon to Prepare Expert Witness Statement:**

11.1. The primary report on which I conducted an independent peer review:

11.1.1. EMM Consulting (2019). Fingerboards Groundwater Modelling Report - in support of Environmental Effects Statement. Prepared for Kalbar Resources Limited. Version 5, 14 January 2019.

11.2. Secondary reports considered:

11.2.1. EMM Consulting (2020). Fingerboards Groundwater Modelling Report in support of Environmental Effects Statement. Prepared for Kalbar Resources Limited. April 2020. Presented as Appendix B to Appendix A006 of the Fingerboards EES.

11.2.2. Fingerboards Mineral Sands Project Environmental Effects Statement. Summary Report and groundwater-related subsidiary reports, as listed. August 2020.

Hugh Middlemis Curriculum Vitae

PRINCIPAL GROUNDWATER ENGINEER, HYDROGEOLOGIC PTY LTD

B.E. (Civil Engineering), University of Adelaide, South Australia, 1980

M.Eng.Sci. (Hydrology and Hydrogeology), University of New South Wales, Sydney, 1990.

BIOGRAPHY

Hugh is a groundwater modeller, hydrogeologist, engineer and independent reviewer, with 40 years' experience. Hugh established the HydroGeoLogic independent consultancy in 2013, working in natural resources, mining/energy and the built environment sectors. Hugh has a degree in civil engineering and a masters in hydrology and hydrogeology, and specialises in flow & solute models, stream-aquifer interactions, groundwater dependent ecosystems and uncertainty analysis. He was principal author of the 2001 best practice guidelines that formed the basis for the 2012 Australian Groundwater Modelling Guideline, and he was awarded a Churchill Fellowship in 2004 on modelling best practice. Hugh co-authored the 2018 IESC and 2019 NCGRT reports on model uncertainty analysis within a risk management framework.

Hugh also has business skills (Operations Manager, Aquaterra, Adelaide 2002-10), and project management skills and leadership experience. Other technical experience includes bore drilling, testing & headworks; design, construction & operation of pipeline & pumping systems; drainage designs for open cut pit drainage, railway & road creek crossings, and related risk analysis/management. Hugh has completed projects across Australia, and in Africa, Indonesia, Ireland, Mongolia, Oman, New Zealand, South America, USA, and in the UK where he based for 4 years in the early 1990s.

INDEPENDENT EXPERT / REVIEW

- **Expert Witness** at Land/Environment Courts, Tribunals, Independent Panels for: Administrative Appeals Tribunal (AATA 933, 2020); *North East Link* (2019); *Melbourne Metro Rail* (2016); *Tutchewop Lakes* (Vic VCAT 2015); *Stockman Mine* (Vic PPV 2014); *Boral Berrima Colliery* (NSW 2013); *NZ Board of Inquiry for Tukituki model* (2013). *Dargues Reef* (NSW 2012); *Moolarben Coal* (NSW 2006); *Wilpinjong Coal IHAP panel member* (NSW 2005); Appeals Court in Republic of Ireland (1994) re *Lisheen* mine (Chevron) and *Galmoy* mine (Government).
- **Expert Panels** *Victorian Murray Floodplain Restoration Project* (VMFRP, 2019-20); *Barwon Downs and Yeodene/Big Swamp remediation* (Southern Rural Water, 2019-20); *Confidential* (NSW, 2019-20).
- **Tunnel projects:** *Snowy 2.0*, and *Burrawang-Avon Tunnel* (EMM, 2018-20); *Suburban Rail Loop* (Melbourne 2020); *North East Link* (Melbourne 2018-19); *Melbourne Metro Rail* (2016).
- **Mining project independent reviews** of groundwater/modelling impact assessments: *New Acland Coal* (QLD DNRME 2019); *China Stone Coal* (QLD OCG, 2017); *Carmichael Coal* (DoE, 2014); *Cowal Gold, Bowdens Silver, Tarrawonga Coal, Tahmoor South Coal, Vickery Coal Extension, Hume Coal, Wambo Coal* (all NSW DPE 2015-20).
- **Due Diligence Audits**: *Goldfields* (WA 2016); *Arizona* (USA 2016). Pre-2014 (@Aquaterra): *Broken Hill (NSW); Nifty Copper & Argyle Diamonds* (WA), *Phosphate Hill, Ernest Henry* and *Galilee Basin* (QLD); *Carpentaria Basin* (NT).
- **Water Allocation Plan modelling** review/design of regional models to investigate options and inform WAPs: *Eromanga Basin/GAB* (SA DEW, 2018-20); *Cambrian Limestone & Roper River coupled model (NT DENR, 2020); Tukituki* and *Heretaunga Plains* (Hawkes Bay, NZ; 2013-2018); *Broken Hill Emergency Water Supply* project Menindee modelling & uncertainty analysis (Water NSW, 2015-16); *Myalup* (WA DWER, 2018); *Padthaway, Poocher Swamp, Uley South* and *Wattle Range* (SA DEW, 2016-2020); *Tindall Limestone Aquifer* (NT DLRM, 2015); *NVic Riverine Plains SDL* (MDBA, 2015).
- **Water and salinity management** project peer reviews for *Murray Darling Basin Authority* since 2005.

ENERGY AND MINING SELECTED PROJECT EXPERIENCE:

- **In Situ Recovery:** Independent hydrogeological review for Lake Way Potash (SO4 2019-20); Arizona ISR (2014). Beverly ISR mine groundwater modelling and particle tracking of ISR operations and disposal fluid plume (SA, 2002-2007, for Heathgate Resources). Groundwater modelling of brine lakes for lithium mines at Salar del Hombre Muerto (Argentina, 1994) and Salar de Atacama (Chile, 1994). Searles Lake groundwater flow, solute and heat transport (borax/trona ISR, California, 1992). Eastville gold ISR drilling & testing (Vic, 1981).
- **Coal Mine water management**: groundwater model impact assessments for open cut and/or underground coal mine projects in eastern Australia, including *Ashton, Abel, Berrima, Bickham, Bloomfield, Donaldson, Moolarben, Mt Penny, Wilpinjong* (all in NSW), and *South Galilee* (QLD) (2002-2013, for various clients).
- **Unconventional and Conventional Gas/CSG & Oil:** *Surat CSG* (QGC 2019-20); SA Cooper Basin co-produced water model (Beach 2017); infiltration basin site model (Senex 2018). SEO/EIRs in SA Cooper (2013-15 for Strike, Senex). Operational compliance reports in various basins for various operators (2014-18). Oil reservoir flood water supply & re-injection models at *Safah, Daleel, Lekhwair, Qarn Alam* (Oman; 2000-2007).

- **Iron Ore and Manganese (water supply / dewatering / drainage)** for strategy, operations and closure planning Pilbara projects since 2016 @HGL: *Silvergrass, Iron Valley, Marillana Creek, Sino*. Pilbara projects 1994-2001 @AQT: *Hope Downs* and *Mining Area C (*inc. Weeli Wolli Spring*); West Angela*, *Orebody 18, Yarrie*, *Finucane Island car dumper*, *Central Pilbara Study;* and *Groote Eylandt* (NT). SA projects 2002-2012 @AQT: *Fusion-Koppio*; *Iron Road*.
- **Base Metals mine water management (hydrology, hydrogeology, modelling and/or engineering)**: *McPhillamys Gold* (NSW 2019-20); *Jervois* (NT, 2019-20); Carrapateena (OZ Minerals 2016); *Stockman* U/G & *Lake St Barbara TSF* (2012-18); *McArthur River zinc* (NT, 2012-13); *Olympic Dam* (SA, 2006-13 for BHP Billiton); *Prominent Hill* (SA, 2005-7, for Oxiana); *White Dam* (SA, 2005-7 for PolyMetals); *Copper Hill* and *Kempfield* (NSW, 2011-12); *Woodcutters* (NT, 1999); *Kundana*, *St Ives & Wallaby* (WA, 1999-2001).
- **Other Mining projects** that Hugh has supervised/reviewed: *Chandler Salt* (NT 2017). *Ammaroo* phosphate (NT 2017). *Mineral sands* (Kalbar *Fingerboards* 2019; Iluka: *Putallam* Sri Lanka 2018, *Balranald, Douglas* and *Cataby* 2014-16). *Penrice Angaston* high grade limestone (SA 2009-12). Uranium projects: *Angela* (NT, 2010-11, Cameco-Paladin) and *Rossing* (Namibia, Rio Tinto, 2009-2012).

NATURAL RESOURCES MANAGEMENT SELECTED PROJECT EXPERIENCE:

- **Groundwater Flow and Salinity Modelling:** Regional groundwater models and strategies to manage salt load impacts to the River Murray in southern connected basin since 2002. Eastern Mallee EM1.3 upgrade (MDBA 2019-20). General Review of Salinity Management (MDBA 2014). **Salt Interception Scheme reviews:** Pike (SA Water Corp. 2019-20); Upper Darling SIS (MDBA 2019); Wakool-Tullakool SSDS (Murray Irrigation 2018).
- **Surface-groundwater interactions/modelling:** Review of *Lake Eyre Basin Springs Assessment* (DoE 2016). Technical Director to investigate wetlands, floodplains and groundwater interactions, and to develop models and/or management plans for: *Pike Floodplain* (2016); *SA Riverland Floodplains Integrated Infrastructure Program* (2014 & 2015-16); *Commonwealth Environmental Water Holder* (2010, for DSEWPaC); *Lake Tutchewop* (2005-2013 for G-MW); *Lindsay-Walpolla and Gol floodplain* (2008-9 for Mallee CMA); *Chowilla* (2009-10 for DWLBC); *Weir Pool Manipulation* (2009, for SA MDB NRM Bd.); *Future Risks to BSMS Salinity Registers* (2010, for DWLBC); *Coorong-Lower Lakes-Murray Mouth* (2008-2009, for MDBA); *Pike-Murtho floodplain* (2005-6 for DEW); NT models with complex surface-groundwater interactions: *Groote Eylandt, Woodcutters, Middle Point* and *Elizabeth River* (1998-2000, NT).
- **Solute Transport Modelling – Regional Scale:** *Adelaide Plains* (SA, 2011); *Angas-Bremer* (SA, 2010); *Padthaway* (SA, 2007); *Salalah* (Oman, 2005) *Beverley ISR uranium mine* (SA, 2002-2007); *McLaren Vale* (SA, 2005); *Scott Coastal Pain* (WA, 2003); *Salar del Hombre Muerto* (Argentina, 1994); *Salar de Atacama* (Chile, 1994); *Searles Lake* (California, 1992).
- **Forestry impacts on groundwater** investigations and modelling for government and industry clients in the southeast of SA (2008-10). Clients: SA Dept for Water, South East NRMB, Forest Industry Groups.
- **Kemerton Water Management Plan** integrated investigation and modelling study in WA to evaluate surface and groundwater interaction dynamics and quantify EWR/EWP requirements (2001, for WRC).

PROFESSIONAL HISTORY:

Principal Groundwater Engineer	HydroGeoLogic independent consultancy (Adelaide SA)	since 2013
Principal/Senior Principal	Aquaterra (Perth WA 1998-2001; Adelaide SA 2002-13)	1998-2013
Senior Water Resources Engineer	AGC Woodward-Clyde (Perth WA)	1994-1998
Senior Modeller	Water Management Consultants (Shrewsbury, UK)	1990-1994
Senior Groundwater Modeller	South Australian Department of Agriculture (Adelaide)	1989-1990
Hydrologist	NSW Dept of Water Resources (Sydney; Hydrology and Hydrogeology Divisions of DWR)	1985-1989
Engineer Operations	NSW Water Resources Commission (Wakool & Deniliquin)	1982-1985
Engineer	Minenco (Melbourne Vic.)	1981

ACHIEVEMENTS AND MEMBERSHIPS:

- Churchill Fellowship 2004 on benchmarking groundwater modelling best practice.
- National Committee on Water Engineering, Institution of Engineers Australia (1997 to 2004).
- International Association of Hydrogeologists (IAH), National Executive (2002-2005).

PUBLICATIONS AND TRAINING DELIVERY:

Notable guidelines on modelling & uncertainty. Over 30 conference and journal publications. Full list available on request.

Presenter at conferences, training sessions and webinars on modelling, uncertainty analysis & stream-aquifer interactions.

WHITE & CASE

15 January 2021

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Hugh Middlemis
Principal Goundwater Engineer
Hydrogeologic Pty Ltd

By email: hugh@hydrogeologic.com.au

Confidential and subject to legal professional privilege

Dear Mr Middlemis,

Fingerboards mineral sands project

We act as legal advisors to Kalbar Operations Pty Ltd (**Kalbar**), the proponent of the Fingerboards mineral sands project (**Project**).

This letter confirms and sets out the scope of your retainer to prepare an expert witness statement, and to present evidence at the inquiry hearing to be held in relation to the environment effects statement (**EES**) prepared for the Project pursuant to the *Environment Effects Act 1978* (Vic).

1. The Project

Kalbar proposes to develop the Project on an area of approximately 1,675 hectares within the eastern part of the Glenaladale mineral sands deposit in East Gippsland, Victoria. The Project site is located near the Mitchell River, approximately 2 km south of Glenaladale, 4 km south-west of Mitchell River National Park and 20 km north-west of Bairnsdale.

The Project includes the development of an open cut mineral sands mine and associated infrastructure. It is expected to have a mine life of 15–20 years and involve extraction of approximately 170 Mt of ore to produce approximately 6 Mt of mineral concentrate for export overseas.

2. EES inquiry

The EES and the studies and assessments that underpin it (together with a draft planning scheme amendment and application for an EPA works approval) were publicly exhibited in September – October 2020. Copies of all documents are available online. Over 900 submissions were made in relation to the exhibited documents, and copies of these are also available online.

The inquiry is scheduled to commence on **15 February 2021**. Kalbar is likely to be allocated 9 days to present its case at the beginning of the hearing. Expert witness statements must be exchanged by midday on **Friday 29 January 2021**. A copy of the directions and timetable are enclosed.

We will keep you informed of any relevant directions, including the timetable for filing evidence and, if required, any expert conferences.

15 January 2021

3. Scope

This letter is confirmation of your engagement as an independent expert to:

(a) prepare an expert witness statement in which you:

(i) set out your background and relevant expertise;

(ii) describe and summarise the Fingerboards Groundwater Modelling Independent Review, dated 25 February 2019, and your role in preparing it; and

(iii) consider address the matters within your expertise raised in key EES submissions, in particular the submission of the East Gippsland Shire Council, Mine Free Glenaladale, and the water authorities; and

(b) prepare and present expert evidence at the panel/inquiry hearing.

We will provide further instructions on the scope of your engagement and any new instructions as necessary.

4. Your duties and responsibilities as an expert witness

Even though you are engaged by Kalbar, you will be asked to provide expert evidence to the inquiry. As such, you are retained only as an independent expert, and you should assume that you may be called as an expert to assist the inquiry as a witness, in which case you have an overriding duty to it. You are instructed to be objective, professional and form an independent view as to the matters in respect to which your opinion is sought.

We enclose for your reference, a copy of Planning Panel Victoria's *Guide to Expert Evidence*.

5. Timing

You will be required to complete your expert witness statement as soon as possible, in advance of the dates set out in Part 2 of this letter. We will be in touch shortly regarding timing.

6. Conflict of interest

It is important that you are free from any possible conflict of interest in providing your advice. You should ensure that you have no connection with any potential party to this matter that could preclude you from providing your opinion in an objective and independent manner.

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15 January 2021

7. Costs and invoicing

Hydrogeologic Pty Ltd will be contractually engaged by Kalbar and Kalbar will be responsible for the payment of your fees. Your accounts should be sent directly to the appropriate person nominated by Kalbar.

8. Confidentiality

Your engagement and any documents you prepare under it should be marked "Confidential and subject to legal professional privilege".

If anyone other than ourselves, Kalbar, or Kalbar's technical advisers contact you about this engagement or the work you are undertaking under this engagement, please contact us immediately.

If you have any questions about this letter or require any additional information, please contact us.

Yours sincerely,

Tim Power

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Partner

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Enc: Planning Panel Victoria's *Guide to Expert Evidence* — April 2019
Inquiry directions and timetable, 23 December 2020