# Expert Witness report

29 January 2021

By: Assoc Prof John Webb

Re: Fingerboards Mineral Sands Project
north-west of Bairnsdale, East Gippsland,
to be operated by Kalbar Operations Pty Ltd

Prepared for East Gippsland Shire Council
As part of a submission to the
Fingerboards Mineral Sands Project Inquiry and Advisory Committee

Instructed by Darren Wong of Planology

(a) Full name and address of expert witness

John Allan Webb
Department of Ecology, Environment and Evolution,
La Trobe University,
Melbourne, Victoria 3086

(b) Qualifications, experience and area of expertise

My qualifications are BSc Hons (University of Queensland 1973; awarded First Class Honours) and PhD (University of Queensland 3/9/1982). I have over 35 years' experience in geology and 25 years' experience in hydrogeology, both in terms of practice and tertiary level teaching. I publish in high-ranking international journals in hydrogeology, including Water Resources Research (JIF 4.397), Hydrology and Earth System Sciences (JIF 4.437), Earth Science Reviews (JIF 7.051). My h-index is 35 (Google Scholar; orcid.org/0000-0002-6357-5966); on average my papers have received 15.5 citations for 99 articles in Web of Science, with over 4200 citations in total, including >300/year for 2015-2017 (Google Scholar). As Co-Chief Investigator, I have received $1,512,057 in grants over the last 6 years, including 2 ARC Discovery projects and 2 ARC Linkage projects, as well as 2 LIEF grants. I have supervised 102 honours students, 29 PhD students and 3 MSc students to completion in a variety of geological and hydrogeological projects. I have participated in over 70 consulting projects and have been an invited member of 3 expert panels to assess groundwater and contaminated site management. Over the past 17 years I have acted as an expert witness in 10 court cases and tribunal hearings on hydrogeological and hydrogeochemical topics, including appearing for a dairy farmer seeking a groundwater licence, the Alpha Coal Mine Queensland Land Court appeal heard in 2013 and the Objection to Mining Lease and Environmental Authority for Carmichael Coal Mine heard in 2015.

Attachment A to this report is my curriculum vitae.

(c) Expertise to make the report

As detailed above, I am a very experienced geologist and hydrogeologist. In particular, I am familiar with the geology and hydrogeology of East Gippsland; I have published papers on groundwater geochemistry in the Latrobe Valley and the geology and geomorphology of the Hoddle/Strzelecki Ranges and the Buchan region.

(d) Any private or business relationship between the expert witness and the party for whom the report is prepared

I have no relationship with the client other than a business engagement to comment on this matter.

(e) Instructions that define the scope of the report

I was instructed by Darren Wong of Planology on 16 December 2020 to:

a. review the technical reports and related documents prepared for the Fingerboards Minerals Sands Project Environment Effects Statement (EES), the proposed Works Approval and the proposed planning scheme amendment that are relevant to my expertise, including the scoping requirements for the EES; and
b. prepare a statement of evidence, relevant to my expertise, on:
    i. the adequacy of the materials and technical reports prepared by the Proponent, noting the IAC has required the Proponent to prepare additional information;
    ii. the adequacy of the conclusions expressed in the EES and the other supporting documents; and
    iii. the adequacy of the proposed mitigation measures and whether additional mitigation measures should be considered; and
c. consider the Council's submission, including the SLR Technical Review and identify any areas of the review to which you disagree.

Attachment B is the complete letter of instructions.

(f) Facts, matters and all assumptions upon which the report proceeds

Kalbar Operations Pty Ltd proposes to undertake open pit mining of a mineral sands resource at Fingerboards, approximately 20 kilometres north-west of Bairnsdale in East Gippsland, to extract approximately 170 million tonnes of ore over a projected mine life of 20 years to produce approximately 8 Mt of mineral concentrate. The project requires 3GL of process water per annum; a borefield south of the site will be established to potentially supply this from groundwater within the Latrobe Group aquifer. Tailings from processing of the ore will be disposed of on-site; pore water from the tailings will raise the watertable beneath the site. Groundwater impacts from both processes have been modelled and the results presented in a series of reports within the Environment Effects Statement for the proposed mine.

These reports have been reviewed and the data and interpretation within them assessed on the basis of my knowledge and understanding of hydrogeology in general, and the hydrogeology of the proposed minesite in particular. I have referred to additional references (detailed below) where necessary. I have not carried out any additional modelling.

(g) Those documents and other materials the expert has been instructed to consider or take into account in preparing the report

For this review I examined the Environment Effects Statement August 2020 chapters 8 and 9 (abbreviated below as EES 8 and 9), Appendix A006 Groundwater and Surface Water Impact Assessment (abbreviated below as A006), which includes Appendix B Groundwater Modelling Report (abbreviated below as A006B) and Appendix D Geochemical Testing of Fingerboard Tailings and Overburden (A006D), Appendix A007 Water Supply Options Study: Technical Groundwater Assessment (A007), Appendix A001 Landform, Geology and Soil Investigation (A001) and Appendix A002 Geochemistry and Mineralogy Summary Report (A002), as well as the Targeted Technical Review of the Kalbar Operations Pty Ltd EES by SLR Consulting Australia Pty Ltd for East Gippsland Shire Council.

I also referred to the following references:

Domenico, P.A. and Schwartz, F.W., 1990. Physical and chemical hydrogeology.

EPA Victoria Information Bulletin Acid Sulfate Soil and Rock Publication 655.1, July 2009.

Scanlon, B. R., Healy, R. W., and Cook, P. G. 2002: Choosing appropriate techniques for quantifying groundwater recharge, Hydrogeol. J., 10, 18–39.

SRW Hydrogeological Assessment Guidelines for non-Urban Supply Groundwater Licence Applications (version 1.2 June 2008).

(h) Identity and qualifications of the person who carried out any tests or experiments upon which the expert relied in making the report

No-one carried out any tests or experiments for my report.

(i) Summary of opinion

1. There will be two impacts on groundwater from the Fingerboards Mineral Sands Project: drawdown of the potentiometric surface due to pumping from a borefield within the gravels at the top of the Latrobe Group, and mounding of the watertable beneath the mine site due to leakage from the tailings. The results of the pumping test that provided data for the modelling of the borefield impact are very difficult to understand; an additional test is required if the difficulties cannot be clarified. If the results of this additional test are different to the original data, then the modelling of the drawdown will have to be redone. There are also problems with the modelling of both impacts that require additional work.
2. There are uncertainties around the likelihood of the presence of Acid Sulfate Soils at the site that must be addressed with additional analyses, and errors on the conceptual geological cross-sections that need to be corrected.
3. These uncertainties mean that the groundwater monitoring program is very important, and this data needs to be made publicly available on a website.
4. The uncertainties also mean that the technical reports as they stand are not adequate to make conclusions as to the likely impacts of the mine on groundwater and whether the proposed mitigation measures are sufficient.
5. I have not identified any areas of the SLR Technical Review with which I disagree.
6. My review does not contain any provisional opinions that are not fully researched or any questions falling outside my expertise, and is not incomplete or inaccurate in any respect.

(j) Declaration

I confirm that I have read and that I understand the Planning Panels ‘Guide to Expert Evidence’ and that I comply with the provisions of that guide.

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

Assoc Prof John Webb
Department of Ecology, Environment and Evolution,
La Trobe University

28 January 2021

## Review of the groundwater impact of the Fingerboards Mineral Sands Project

### Drawdown of the potentiometric surface within aquifers around the mine site due to pumping from gravels at the top of the Latrobe Group

1. The modelling of the drawdown due to borefield pumping is based on the result of the pumping test, which was used to calculate the aquifer properties. There are two aspects of the pumping test results that require clarification. Firstly, it is stated that after pumping started there was "an initial drawdown of 40 m in LA-01-PB (the pumping bore) followed by a sustained water level" (A006B, p. 65). The standing water level (pre-test) in LA-01-PB was 83.59 mbTOC measured on 3 July 18, almost the same as in bore LA-01-DM, ~10 m away, (84.38 mbTOC measured on 3 July 18) (Table 2.12, A006B). Does this mean that the initial water level in bore LA-01-PB was ~40 mbTOC? Why would the water level be 40 m different between 2 bores screened in the same aquifer only ~10 m apart? The explanation provided is that the 40 m drawdown was due to "bore storage, low well efficiency and borehole turbulence" (A006B, p. 65), but this cannot explain the difference between the two bores.
2. Secondly, when pumping starts there is an initial drawdown period before the cone of depression has a steady shape, so plotting the time-drawdown data on semilog paper gives a straight line after this initial period (Domenico and Schwartz, 1990). The data from this initial period are not generally used to calculate aquifer properties. It appears that this initial period was regarded as "a delayed yield response" when analysing the pumping test data and used for an "early time analysis" of aquifer properties, even though "late time data are considered more appropriate for deriving bulk aquifer properties" (A006B, p. 66). The latter statement is correct, and unless there is a specific reason, early time data should not be used to calculate aquifer properties.

**Table 2.13 Constant-rate test results (based on drawdown observed at LA-01-DM)**

| Solution Type | Aquifer Type | Aquifer Thickness (m) | Partial Penetration | T (m2/d) | Kh (m/d) | S |
|---|---|---|---|---|---|---|
| Hantush-Jacob (early) | Leaky confined | 38 | Yes | 1032 | 27.3 | $9.57 \times 10^{-5}$ |
| Hantush-Jacob (late) | Leaky confined | 38 | Yes | 213 | 5.6 | 0.1 |
| UWD (early)[2] | Leaky confined | 38 | No | 988 | 26 | $1.1 \times 10^{-4}$ |
| UWD (late)[2] | Leaky confined | 38 | No | 210 | 5.5 | 0.1 |

Note: 1. T = Transmissivity; Kh = horizontal hydraulic conductivity; m/day = metres per day; S = storativity (dimensionless)
2. Solution derived utilising the multi-layered analytical model (MLU)
3. UWD = uniform well-face drawdown

*Table 1. Pumping test results (Table 2.12 in A006B)*

3. This means that the transmissivity and storativity values derived for the Latrobe Group aquifer from the pumping test are ~210 $m^2$/day and 0.1 respectively (Table 1). The report has ignored this storativity value and instead used the much lower value (~1 x $10^{-4}$) from the early time data (Table 1). This is incorrect methodology. The value of 0.1 should have been used. The reason that it was not is that it is characteristic of an unconfined aquifer, and the Latrobe Group is a confined aquifer.

4. Unless these inconsistencies and problems with the pumping test data can be explained, the results of the pumping test must be regarded as invalid and a new test will have to be carried out. If the aquifer properties derived from this new test are significantly different from the earlier results, the modelling of drawdown in the Latrobe Group aquifer as a result of borefield pumping will have to be redone.

5. There is an additional problem in that modelling of the impact of pumping from the Latrobe Group has not been carried out in accordance with two of the SRW Hydrogeological Assessment Guidelines for non-Urban Supply Groundwater Licence Applications (version 1.2 June 2008).

6. Firstly, a worst case scenario must be modelled: "assume entire allocation volume is extracted in one pumping period at twice the proposed extraction" rate (SRW Guidelines, p. 2). The current modelling assumed a "constant water supply of 95 L/s … using seven bores … to ensure a pumping rate below 15 L/s per bore" (A006B, p. 125). The worst case scenario in the present modelling is based only on "the aquifer's hydraulic conductivities and recharge", so additional modelling is required.

7. Secondly, "complete combined drawdown assessment (must be carried out) assuming all identified neighbouring bores pumping simultaneously over 1 year/extraction season (current licensing info to be obtained from SRW records via info statement). Use Principle of Superimposition to add individual drawdown impacts from multiple pumping bores" (SRW Guidelines, p. 2). This has not been carried out.

8. The modelling shows that "no drawdown (in a third party bore) exceeds 12% of available drawdown (A006B, p. 182). This is at the limit of what is normally regarded as an acceptable level. Kalbar should consider negotiating make-good agreements with those landholders whose bores could be significantly affected by drawdown. If water has to be transferred to the affected properties, that could potentially reduce the amount of water that will be available to Kalbar; this needs to be taken into consideration.

## Groundwater mounding beneath the mine site

9. Groundwater mounding beneath the mine site is due to leakage from the tailings, which will be wet when disposed of. The tailings will comprise both coarse sand and slime; "only seepage associated with the sand tailing stream (was) simulated" in the modelling (A006B, p. 153). The modelling showed that "localised mounding up to the elevation of the tailings cells, on the order of 75 m above the pre-mining water table, will occur in the vicinity of the tailing cells; mounding will be constrained to the active tailing cells and their immediate vicinity, with steep hydraulic gradients at the edge of the tailing cells" (A006B, p. 154; Fig. 1 below). This means that the watertable within the tailings cells is modelled to reach the ground surface in the cells, where it will be subject to evaporation with a consequent increase in salinity. This has not been considered in the modelling.

10. The groundwater mounding is superimposed on the pre-mining watertable, which ranges "from 45 … mAHD in the western part of the project area, falling to the northeast towards Mitchell River where levels were generally between 27 and 28 mAHD." (A006, p. 117; Fig. 2 below)

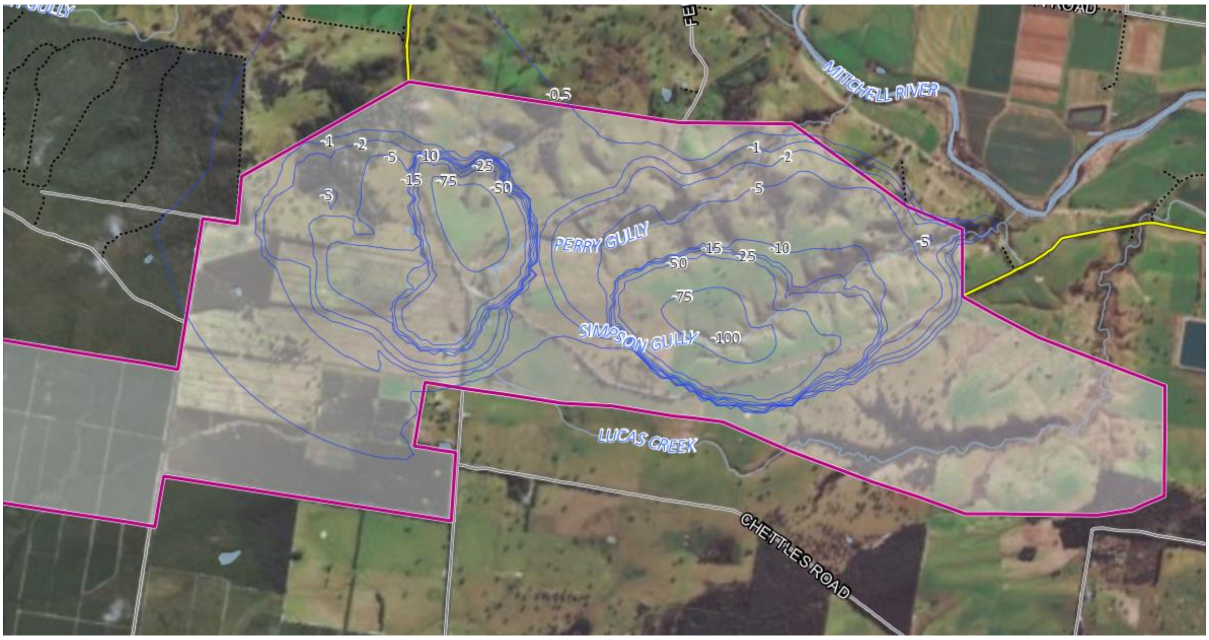


*Fig. 1. Modelled groundwater mounding at year 5 (Fig. 7.8, A006B)*

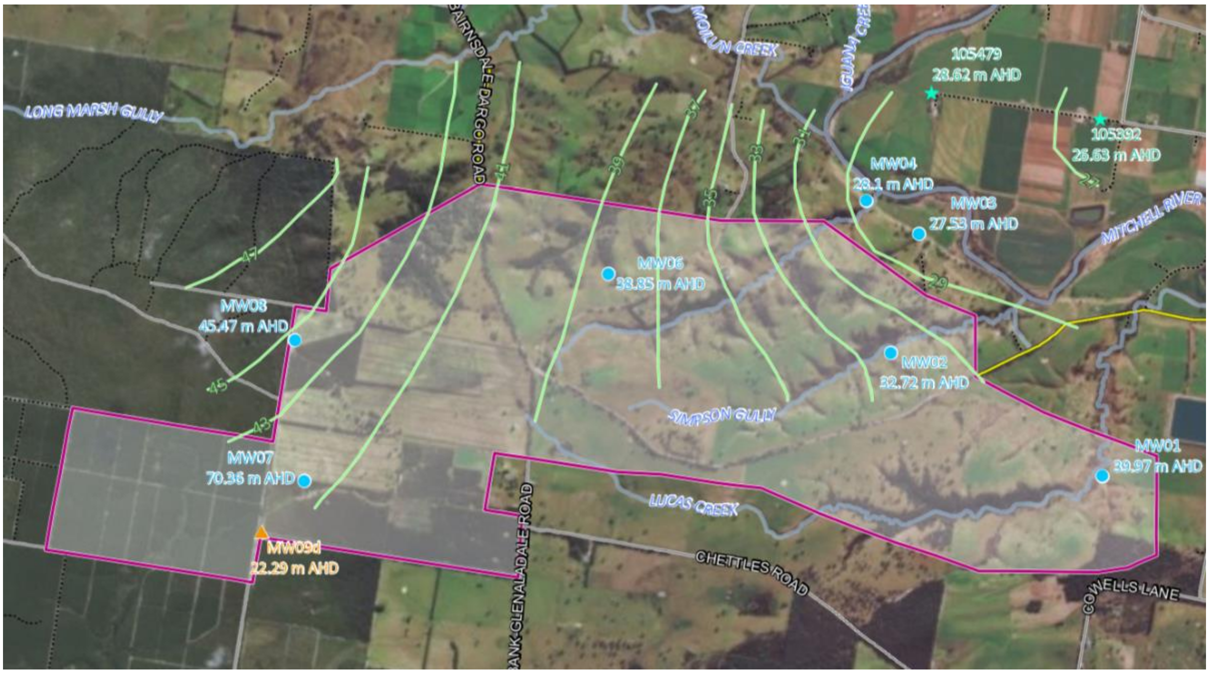


*Fig. 2. Groundwater level across mine site (Fig. 2.13 A006B)*

11. The conceptual diagram of the hydrogeology of the mine site (Fig. 6-1, A006, Fig. 2.52 A006B; Fig. 3 below) does not match the information in the previous paragraphs, and several aspects are clearly incorrect. The watertable is shown as horizontal when in fact it rises towards the west, and the groundwater mounding beneath the tailings does not extend, as it should, to the ground surface. These inaccuracies mean that the conceptual diagram is misleading with respect to how close the watertable approaches the ground surface across the mine site.

12. This is important because one factor that will contribute to a rise in the watertable beneath the site has been neglected: rainfall recharge into the active pits.

13. For the modelling, rainfall recharge across the site was regarded as “small … relative to regional groundwater flow” (A006B, p. 25), because “characteristics of the surface soils minimise(s) the capacity to infiltrate recharge from rainfall” (A006B, p. 41). Average recharge across the site can be calculated using the Chloride Mass Balance method (Scanlon, B. R., Healy, R. W., and Cook, P. G.: Choosing appropriate techniques for quantifying groundwater recharge, Hydrogeol. J., 10, 18–39, 2002), where median groundwater Cl concentration across the site is 270 mg/L (Table A1, A006) and the likely Cl concentration of rainfall is ~5 mg/L. This gives an average recharge of ~2% of rainfall, which is small but typical of many parts of southeastern Australia.

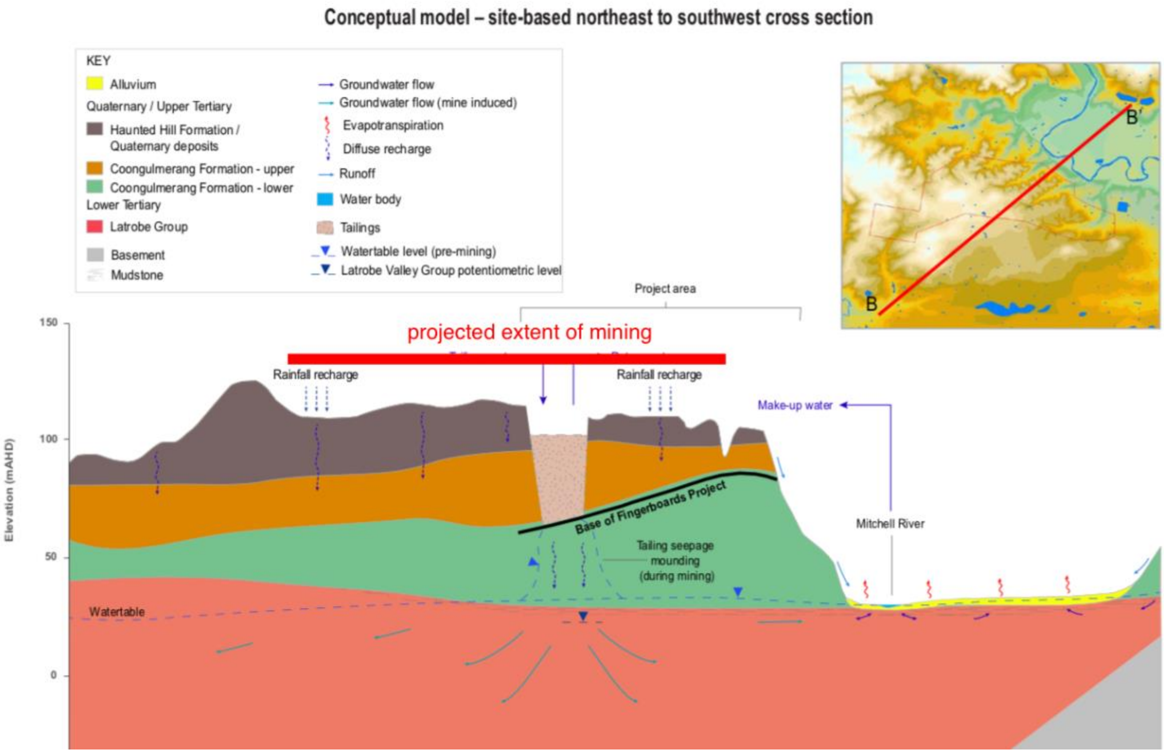


*Fig. 3 Conceptual hydrogeology of mine site (Fig. 6-1, A006)*

14. The Groundwater Modelling Report states that “the majority of the water balance inflow (is) dominated by (through-flow system originating from the north) within the EES study domain”, and “the water table does not mimic topography as recharge to the water table is small” (A006B, pp. 41, 25 respectively). On this basis rainfall recharge has been largely dismissed from the modelling. However, as the recharge calculation above shows, rainfall recharge is small but significant. Furthermore, groundwater flow across the site is from the west (Fig. 2), where the highest nearby topography is located (Fig. 4), so the watertable does mimic the topography, confirming the importance of rainfall recharge.

15. A major factor that has been completely overlooked in the groundwater modelling is that rainfall recharge will increase substantially once the surface soil is removed, as transpiration by vegetation, which is the major process that decreases recharge under natural conditions, will cease. Therefore there will be considerable rainfall recharge into the active pits, much greater than 2% of rainfall. In addition, the base of the pits is likely to be relatively permeable for two reasons. Firstly, the ore horizon is better sorted and therefore more porous and permeable than the overlying sediments, as it was formed by a period of wave reworking during a transgression. Secondly, “after approximately four months, when the mine void has enough capacity, coarse sand tailings will be deposited

into the mine void" (A006B, p. 2). This coarse sand will certainly be quite permeable. Therefore, it is very likely that there will be increased rainfall recharge through the floors of the active pits during mining; this has not been considered in the modelling.

16. For a mine pit near the tailing disposal area, this increased recharge will occur next to the elevated water table due to leakage from the moisture in the tailings, so the elevated watertable could extend into the mine pit. The ore horizon lies up to 50 m below the ground surface; because the water table lies ~75 m below the ground surface, it needs to rise only 25 m to intersect the floor of the pit in some places across the site. Therefore, it is far from certain that "the groundwater table will not be intersected during the project" (A002 Appendix D, p. 6).

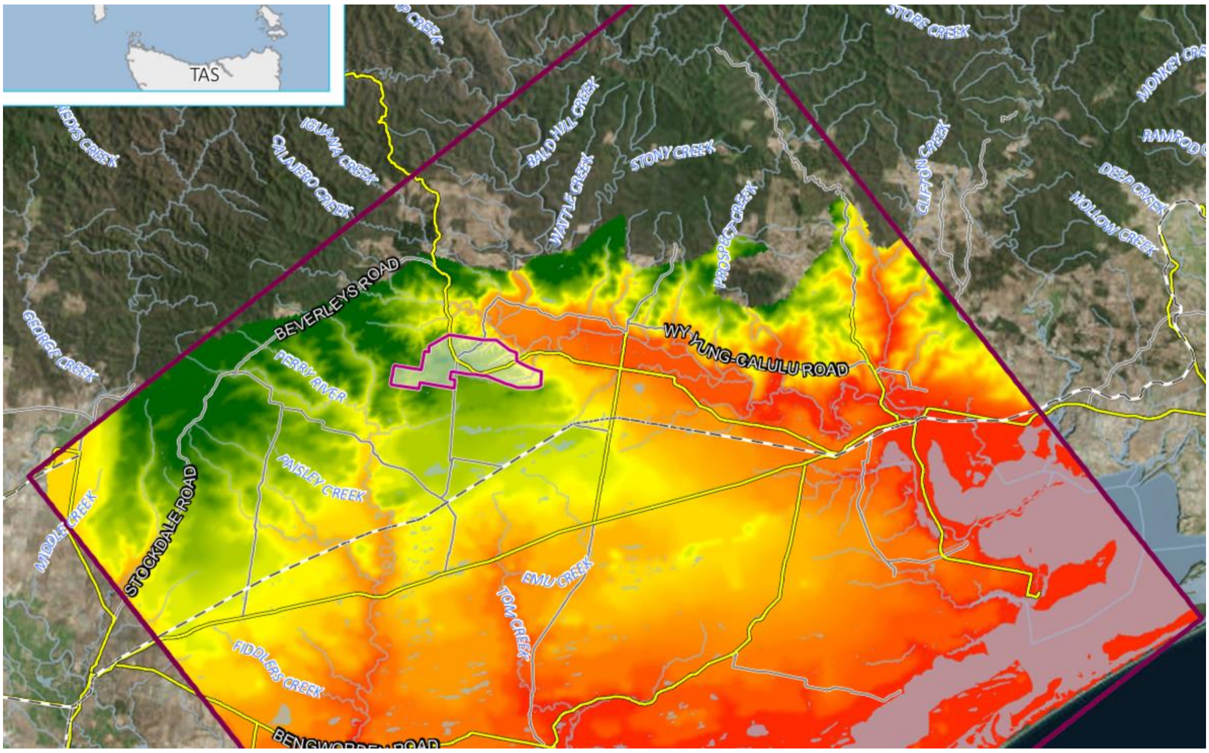


*Fig. 4. Topography of the area around the mine site (Fig. 2.2, A006B)*

17. The sediments below the mine pits in the southern part of the mine site may be "unable to dissipate mounding, … due to the low transmissivity of the Coongulmerang Formation and potential underlying Seaspray Group marls" (A006B, p. 203). This is also true for the northern part of the mine site, where the Coongulmerang sediments have similarly low transmissivity (apart from the ore layer, as discussed above). As a result, any increase in the watertable beneath the mine pits due to direct rainfall recharge will accumulate beneath the pits and not dissipate readily.

18. If the watertable reached the base of the mine pit as a result of the processes detailed above, this could become a serious problem, adversely affecting the stability of the pit walls and making it difficult to mine using the proposed dry, strip mining method with conventional earthmoving machinery.

19. If the watertable is raised as a result of increased rainfall recharge, this could potentially cause groundwater discharge to drainage lines on-site, and evaporation of the shallow watertable could lead to patches of dryland salinization along these gullies.

20. The groundwater modelling needs to be rerun taking rainfall recharge into the mine pits into account, and also "the temporal changes in aquifer hydraulic properties expected to

occur as a result of excavation and subsequent backfilling of the mine pits". These were not previously considered because the "water table is/will be below the base of the mine pits" (A006B, p. 246), but as the previous discussion shows, this may not be the case.

21. It should be noted that the problems with the current modelling add to its present uncertainties. "Predicted seepage from mine tailings most likely represents the largest uncertainty local to the mine site since the rate is based on preliminary processing water balance estimates and the authors' own experience with operating mineral sand mines of similar magnitude" (A006B, p. 128). Therefore, even if the new modelling shows that the watertable is not expected to intersect the bottom of the pits, contingency measures should be put in place to guard against that possibility: "groundwater mounding will require monitoring during mine operations from a pit wall instability … perspective" (A006B, p. 42). In addition, "installation of pit-floor drainage systems is planned" (A006B, p. 84); this should be regarded as a necessity.

## Acid Sulfate Soils

22. The S content of a 10 tonne bulk sample of ore is 0.028 wt%S and that of subsoil (0.2 to 0.5m) is 0.042 wt%S (Table 7-8, p. 166, A006; p. 6 A006D). These values are close to or above 0.03%, which identifies a sample as an Acid Sulfate Soil (ASS), provided the S is present as Cr-reducible S (for disturbance >1000 tonnes; EPA Victoria Information Bulletin Acid Sulfate Soil and Rock Publication 655.1, July 2009).

23. It is "assumed that all of the sulfur would occur exclusively as sulfate" (A006, p. 166), but there are no analyses to verify this. ASS are common at mineral sands mines and may cause serious problems, as they can release acidity and often toxic metals into groundwater and surface water, causing fish kills.

24. ASS often contain pyrite, which is responsible for the release of acidity. Pyrite was not detected in the Fingerboards samples by X-ray diffraction, but the limit of detection of this method is too high to pick up low (but still problematic) levels of pyrite.

25. It is very important to demonstrate that ASS do not occur at the Fingerboards site. Representative samples must be analysed for Cr-reducible S and the results compared with the EPA Victoria guidelines.

## Conceptual cross-section of regional hydrogeology

26. It is correctly stated that "Palaeozoic basement underlies the Pliocene sands and is exposed in river cuttings a few kilometres to the north and intersected at depth in several drill holes" (A002, p. 45), but the conceptual cross-sections of regional hydrogeology in Fig 6-1 (A006) (Fig. 5 below) and Fig 2.36 (A006B) incorrectly show basement as entirely Strzelecki Group (Cretaceous). This error is also present in Table 3-4 (A006) and Table 2.2 (A006B). These errors need to be corrected.

27. Fig 6-1 also incorrectly shows the screened interval pumped by the borefield; this should be thinner (40-50 m) and at the top of the Latrobe Group. This too needs to be corrected.

28. In addition, Fig. 6-1 A006 shows a downward flow of groundwater into the Latrobe Group over the whole cross-section, but A006 (p. 42) states that "vertical hydraulic gradients reverse towards the south resulting in discharge from the deeper aquifers to

the overlying shallow aquifers”. Either the diagram or the statement in the text need to be corrected.

### Mitigation measures and monitoring

29. Because the groundwater modelling indicates that the mine will have little impact on groundwater (both quality and quantity), little is proposed in terms of mitigation measures (EES 9.9). However, if the revised groundwater modelling discussed above shows that impacts on groundwater are greater than previously expected, additional mitigation measures may be required, e.g. making good any loss of groundwater resources at third party bores with significant drawdown.

30. Given the uncertainties in the modelling of both the mounding of the watertable beneath the mine site and drawdown due to pumping from the Latrobe Group, it is critical that there is active groundwater monitoring in and around the minesite and around the borefield. The bore locations for the proposed groundwater monitoring program need to be checked to ensure that they can immediately identify any threats to the site itself and potentially impacted users of both shallow and deep groundwater.

31. The data collected from the groundwater monitoring program needs to be made publicly available on a website, so it can be accessed by any interested party. This ensures transparency. At present the data will be reported to the relevant regulators, but this does not guarantee that it is publicly available.

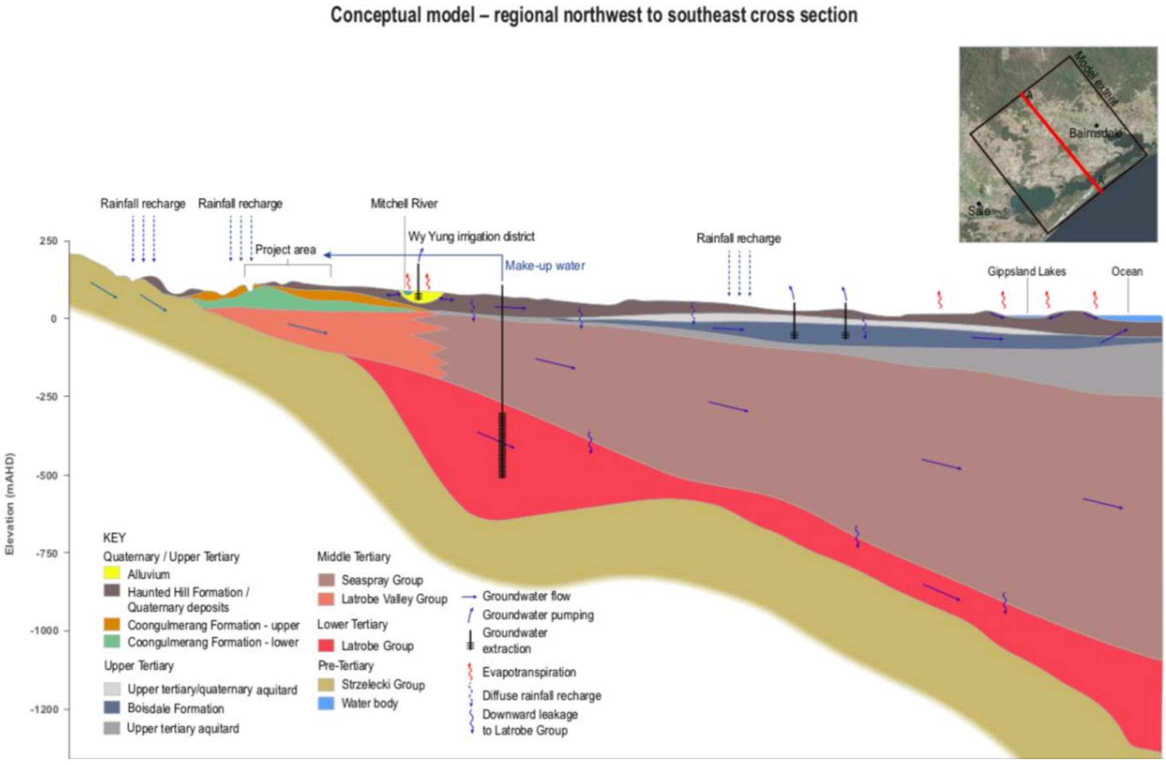


*Fig. 5. Conceptual regional hydrogeology (Fig. 6-1 A006)*

## Conclusions

32. The uncertainties in the modelling mean that the technical reports as they stand are not adequate to make conclusions as to either the likely impacts of the mine on groundwater or whether the proposed mitigation measures are sufficient.

# Attachment A – Curriculum Vitae

Name: John Allan WEBB

Business address: Department of Ecology, Environment and Evolution,
La Trobe University
Victoria, 3086, Australia
[redacted]
Email [redacted]

ACADEMIC QUALIFICATIONS

BSc Hons (Queensland) 1973. Awarded 23/4/1974. First Class Honours
PhD (Queensland) – awarded 3/9/1982. Thesis entitled: "Taxonomic and biostratigraphic study of Triassic plants and conchostracans from southeast Queensland".

<u>Awards</u>
W.H. Bryan Prize (1970), H.C. Richards prize (1971), A.B. Walkom Scholarship (1973), University of Queensland medal (1974).

Awarded the Edie Smith Award for outstanding service to Australian speleology (both scientific and administrative) over a long period of time at the biennial Australian Speleological Federation Conference on 6-11 January, 2013, at Galong, NSW.

Awarded Selwyn Medal by the Victorian Division of the Geological Society of Victoria for significant ongoing contributions of high calibre to Victorian geology. Presented at Selwyn Symposium, 29 September, 2016, at University of Melbourne. The Selwyn Medal is named in honour of Sir Alfred Selwyn, the eminent Victorian pioneering geologist and founder of the Geological Survey of Victoria.

Expert Spokesperson for the Australian Geoscience Council (as of Feb 2019) on karst, caves and sinkholes

<u>Invited editorships and review boards</u>

Principal editor (with Susan White) of Australian Caves and Karst Systems, in the book series Cave and Karst Systems of the World, published by Springer.

Guest editor (with Christoph Delage) of Cherts and prehistory in the Near East – recent advances; Special Issue of *Journal of Archaeological Science: Reports.*

Invited to join the Reviewer Board of Minerals

PROFESSIONAL APPOINTMENTS

2005-present *Associate Professor*, Environmental Geoscience, La Trobe University

1992-2004 *Senior Lecturer*, Department of Earth Sciences, La Trobe University

6/4/1986-1991 *Lecturer*, Department of Earth Sciences, La Trobe University

1985 *Senior Tutor*, Department of Geology, University of Melbourne

1981 -1984 *Tutor*, Department of Geology, University of Melbourne

1980 *Geological consultant*, Qld. Division, Geological Society of Australia, assessing sites proposed as geological monuments

1979 *Tutor* (Part-time), Department of Geology, University of Queensland

1974 *Field Geologist*, Union Oil (mapping Tertiary clastic and carbonate sediments in East Kalimantan)

1973 *Tutor*, Department of Geology, University of Queensland

PROFESSIONAL ORGANISATIONS

2006 to present – member, Geochemical Society
1994 to present - member, International Association of Hydrogeologists (committee member, Victorian division, 2007-2013)
1974 to present - member, Geological Society of Australia
1989 to present - member, Australia / New Zealand Geomorphology Research Group

## TEACHING

SHORT COURSES

I taught the first day of the 5-day Australian Groundwater School in Melbourne, in 2011 (26-30/9/2011), 2013 (18-22/3/2013) and 2016 (22-26/8/2016), organised by the National Centre for Groundwater Research and Training, with 30-50 attendees, mostly from interstate and overseas. I also gave the lecture on surface water – groundwater interaction in the 2016 Australian Groundwater School.

UNDERGRADUATE TEACHING

- **water geochemistry** – 18 lectures, 7x3 hr practicals, 0.5 day excursion; covers basic theory, carbonate system, changes in water composition due to water/rock interaction and evaporation, redox; practicals based on real examples (some of them consulting jobs); applies theory to problems like dryland salinity, acid rock drainage and contaminant transport. The excursion visits a an area of dryland salinity and the mineral springs at Daylesford.

  Taught (and continually updated) since 1987; from 1988-2001 taught as part of the Land Contamination unit in the Environmental Engineering course at RMIT, and in 1992, 1994 and 1996 shortened version given at Melbourne University as part of Master of Science (Hydrogeology).
- **hydrogeology** – 15 lectures, 5x3 hr practicals, 0.5 day excursion; covers hydrogeological parameters, including Darcy's Law, hydraulic conductivity, storativity, as well as pumping tests

(Theis and Jacob methods) and sea water intrusion; practicals include exercises based on real datasets from consulting jobs. Taught since 1998.

- **remote sensing/GIS** – 8 lectures, 10x3 hr practicals; covers the principles behind remote sensing and GIS, and how to use the programs Globalmapper, ENVI and ArcGIS, using real data sets in Victoria in the practicals. First taught in 2006. Also taught as a VIEPS short course to Honours and PhD students from other Melbourne universities from 2007-2020.
- **climate change** – 14 lectures, 5x3 hr practicals; covers causes and mechanisms of climate change, history of past climate change; practicals involve using local and overseas data sets to gain insights into causes and effects of climate change. First taught in 2005.
- **environmental science project subjects** - supervise research projects for the third year subject; students must collect and analyse data, write a substantial report, and give a presentation.

**Student assessment**

As shown by the results of student assessment questionnaires, my courses are highly regarded by the majority of students taking them, even for the most difficult course I teach (Water Geochemistry). I use a variety of teaching aids and strategies, including interactive teaching wherever possible. Average responses indicate an approval rating of greater than 4 (on a scale of 1 to 5).

CURRENT RESEARCH PROJECTS

**Hydrogeology**

Groundwater management, including its influence on dryland salinity is one of the major problems facing agriculture across southern Australia. I have led a group at La Trobe University researching the hydrogeology of this topic in western and central Victoria, financially supported by the National Centre for Groundwater Research and Training, Department of Environment and Primary Industries Victoria, Glenelg-Hopkins and Wimmera Catchment Management Authorities, Goulburn-Murray Water and several landcare groups, as well as Australian Institute for Nuclear Science and Energy. The results have been presented at numerous national and international conferences, published in Journal of Hydrology and Hydrogeology Journal, and have been actively used in management and location of good quality groundwater resources in the area.

My hydrogeological research profile was recognised when I was invited to be a member of program 4 (Groundwater-Vegetation Interactions) within the National Centre for Groundwater Research and Teaching; this project is also supported by the Victorian Department of Primary Industries, who contributed over $250,000 to the instrumentation of the field sites. This major project is on the effect of climate and land use change on surface and groundwater resources in western and central Victoria, and has received over $250,000 in additional funding from the Groundwater Centre.

**Remediation of acid mine drainage**

Acid mine drainage (AMD) is generated when sulphide minerals, usually exposed by mining, are exposed to the atmosphere and oxidise, releasing acidity and dissolved heavy metals. AMD must be neutralised before it can leave a site, and this process generates a sludge which has to be disposed of. My research on AMD has concentrated on neutralisation using limestone, particularly anoxic and open limestone drains, as well as increasing the chemical stability (resistance to leaching) of neutralisation sludges. Results of these projects have been presented at international conferences and published in Environmental Science and Technology and Applied Geochemistry. We are currently researching ways of reducing generation of AMD from waste rock dumps using cement.

**Geoarchaeology and Geomorphology**

My geoarchaeological/geomorphological interests include the interaction between landscape evolution and human settlement; I have worked on the geomorphology of archaeological sites in Australia, China, Papua New Guinea and New Caledonia, and looked in detail at the influence of coastal and volcanic processes and neotectonics on settlement patterns. I have also worked on a number of artefact sourcing projects, including silcrete in eastern and central Australia, and hornfels and ochre in Tasmania. I have studied the distribution and origin of silcrete throughout Australia, and used this information to help understand the location of aboriginal silcrete quarries. I supervised a project on the mechanical properties of artefact materials and the influence of these properties on the types of tools manufactured.

RESEARCH FUNDING (LAST 10 YEARS)

As Co-CI, I have received $1,512,057 over the last 6 years, including 2 ARC Discovery projects and 2 ARC Linkage projects, as well as 2 LIEF grants.

| **Project Id** | **CI Name/s** | **Amount Funded** | **Administering Organisation** | **Project Title** |
|---|---|---|---|---|
| LP190100713 | Prof Adrian Werner, Dr Dylan Irvine, Dr Matthew Currell, Dr John Webb | 2020-2023; $340,357 | Flinders University | Identifying the drivers of spring flow in a remote, semi-arid setting |

| **Project Id** | **CI Name/s** | **Amount Funded** | **Administering Organisation** | **Project Title** |
|---|---|---|---|---|
| DP150100586 | Cosgrove, Richard; Garvey, Jillian; Webb, John | 2015 - 2020; $356,322 | La Trobe University | Well beaten tracks: antiquity of Aboriginal landuse in eastern Tasmania |

| Project Id | CI Name/s | Amount Funded | Partner/Collaborating Organisations | Project Title |
|---|---|---|---|---|
| LE150100050 | Yaxley, A/Prof Greg M; Hermann, Prof Joerg; Berry, Dr Andrew J; O'Neill, Prof Hugh S; Rapp, Dr Robert P; Boger, Dr Steven D; Woodhead, Prof Jonathan D; Gleadow, Prof Andrew J; Aye, A/Prof Lu; Sloggett, A/Prof Robyn J; Huston, Dr David L; Tomkins, Dr Andrew G; Nutman, A/Prof Allen P; Webb, Dr John A; McKnight, Mr Stafford W; Florentine, Dr Singarayer K | 2015: $970,000 | The University of Melbourne, Geoscience Australia, Monash University, University of Wollongong, La Trobe University, Federation University. Administering Organisation: The Australian National University | A new national electron microprobe facility |

| Project Id | CI Name/s | Amount Funded | Partner/Collaborating Organisations | Project Title |
|---|---|---|---|---|
| **DP140101049** | Edwards, Dr Phillip C; Shewan, Dr Louise G; Webb, Dr John A | 2014 - 2016; **$333,363** | La Trobe University, Monash University; Administering Organisation - La Trobe University | Ice Age Villagers of the Levant: sedentism and social connections in the Natufian period |
| **LP140100871** | Daly, E., Rüdiger, C., Webb, J., Beringer, J., Walker, J., Dresel, P., Morse-McNabb, E., Camporese, M. | 2014 - 2017; **$246350** | Monash University, Department of Economic Development, Jobs, Transport and Resources (Victoria), La Trobe University, University of Padua; Administering Organisation - Monash University | Catchment water balance and CO2 fluxes: a comparison between productive land uses |

| Project Id | CI Name/s | Amount Funded | Partner/Collaborating Organisations | Project Title |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| LE130100072 | Wilson, S.A; Hutchinson, C.R; Davies, C.H; Cheng, Y-B.; Zhang, L.; Stanford, Nicole; Hodgson, Prof Peter D; Guo, Prof Qipeng; Yang, Dr Wenrong; Webb, Dr John A; Kamenetsky, Prof Vadim; Wallace, A/Prof Malcolm W | 2013: $350,000 | Deakin University, La Trobe University, University of Tasmania, University of Melbourne Administering Organisation Monash University | An x-ray scattering facility for advanced characterisation of natural and novel materials |

| **Project Id** | **CI Name** | **Amount Funded** | **Amount of Years** | **Project Title** | **Dates** |
|---|---|---|---|---|---|
| National Centre for Groundwater Research and Training: Program 4: Vegetation – Atmosphere – Groundwater Interaction | John Webb | 235,594 | 5 | Influence of land-use change on groundwater resources in western Victoria | Started 10 June 2009, finish 10 June 2014 |

**Postgraduate supervision (last 10 years)**

*PhD* (% supervision)

1. Sarah Hagerty, 2013. Groundwater resources and salinity associated with granites in the Upper Wimmera catchment. (100%)
2. Alex Fink, 2014. Mineralogy and origin of Lightning Ridge black opal. (40%)
3. Josh Dean, 2014. Effect of land use change on surface and groundwater resources and quality in western Victoria (80%)
4. Matej Lipar, 2014. Origin of solution pipes in Quaternary aeolianites of southern Australia (80%).
5. Bruce Gill, 2017. Social research and groundwater management (80%).
6. Fahmida Perveen, 2016. Effect of timber plantations on surface and groundwater resources and quality in western Victoria. (80%)
7. Fiona Glover, 2016. Inland acid sulphate soils in the Corangamite region, western Victoria. (80%)
8. Sanjeeva Manamperi, 2016. Effect of episodic groundwater recharge due to flooding across the north Victorian plains. (80%)
9. Tim Robson, 2016. Groundwater – surface water interactions at Lake Tutchewop, northern Victoria. (80%)

10. Michael Sephton, 2018. Use of alkalinity covers to reduce AMD generation in waste rocks and tailings.
11. Jeff Theys, 2019. Hornfels sourcing in central Tasmania
12. Rakhshan Roohi, 2020. Use of remote sensing to estimate evapotranspiration for pasture and tree plantations in SW Victoria (100%).
13. Farah Ali, current. Secondary mineral precipitation from acid mine drainage (70%).
14. Shannon Burnett, suspended. Sand deposition across SE Victoria during the LGM.
15. Campbell Van Praagh, current. The White Hills Gravel in central Victoria – origin and significance.
16. Karen Kapteinis, current. Pleistocene alluvial megafans of central northern Victoria.

PUBLICATIONS

**Refereed journal papers** (last 10 years)


1. Webb, J.A., 2020. Supergene sulphuric acid speleogenesis and the origin of hypogene caves: evidence from the Northern Pennines, UK. *Earth Surface Processes and Landforms*. DOI: 10.1002/esp.5037

2. Webb, J.A. and Nash, D.J., 2020. Geochemistry of southern African silcretes: Implications for silcrete origin and sourcing of silcrete artefacts. *Earth Surface Processes and Landforms*. DOI: 10.1002/esp.4976

3. Delage, C. and Webb, J., 2020. Cherts and prehistory in the Near East – recent advances: an introduction. *Journal of Archaeological Science: Reports*, 32, 102446. https://doi.org/10.1016/j.jasrep.2020.102446

4. Adelana, S.M., Heaven, M.W., Dresel, P.E., Giri, K., Holmberg, M., Croatto, G. and Webb, J., 2020. Controls on species distribution and biogeochemical cycling in nitrate-contaminated groundwater and surface water, southeastern Australia. *Science of the Total Environment* 726, 138426. https://doi.org/10.1016/j.scitotenv.2020.138426

5. Spry, C., Hayes, E., Allen, K., Long, A., Paton, L., Hua, Q., Armstrong, B.J., Fullagar, R., Webb, J., Penzo-Kajewski, P., Bordes, L. and Steele, A., 2020. Wala-gaay Guwingal: a mid-twentieth century Aboriginal culturally modified tree with an embedded stone tool. *Australian Archaeology* https://doi.org/10.1080/03122417.2020.1769912

6. Hall, B., Currell, M. and Webb, J., 2020. Using multiple lines of evidence to map groundwater recharge in a rapidly urbanising catchment: Implications for future land and water management. *Journal of Hydrology* 580, 124265. https://doi.org/10.1016/j.jhydrol.2019.124265

7. Wakelin-King, G.A. and Webb, J.A., 2020. Origin, geomorphology and geoheritage potential of Australia's longest coastal cliff lines. *Australian Journal of Earth Sciences*, 67, 649-661. DOI: 10.1080/08120099.2020.1742202

8. Burnett, S., Webb, J.A., White, S., Lipar, M., Ferk, M., Barham, M., O'Leary, M. and Glover, F.S., 2020. Etched linear dunefields of the Nullarbor Plain; a record of Pliocene-Pleistocene wind patterns across southern Australia. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 557, 109911. https://doi.org/10.1016/j.palaeo.2020.109911

9. Cleverly, J., Vote, C., Isaac, P., Ewenz, C., Harahap, M., Beringer, J., Campbell, D., Daly, E., Eamus, D., Liang He, Hunt, J., Grace, P., Hutley, L., Laubach, J., McCaskill, M., Rowlings, D., Jonker, S.R., Schipper, L., Schroder, I., Teodosio, B., Qiang Yu, Ward, P., Walker, J., Webb, J. and Grover, S., 2020. Carbon, water and energy fluxes in agricultural systems of Australia and New Zealand. *Agricultural and Forest Meteorology* 287:107934. DOI: 10.1016/j.agrformet.2020.107934.

10. Theys, J., Webb, J.A. and Cosgrove, R., 2019. Sourcing hornfels artefacts in eastern Tasmania: understanding Aboriginal mobility in a lithic-rich landscape. *Journal of Archaeological Science: Reports* 26, doi.org/10.1016/j.jasrep.2019.101883

11. Sephton, M., Webb, J.A. and McKnight, S., 2019. Applications of Portland cement blended with fly ash and acid mine drainage treatment sludge to control acid mine drainage generation from waste rocks. *Applied Geochemistry*, 103, 1-14.

12. Sephton, M.G. and Webb, J.A., 2019. The role of secondary minerals in remediation of acid mine drainage by Portland cement, *Journal of Hazardous Materials*, 367, 267-276. doi.org/10.1016/j.jhazmat.2018.12.035.

13. Edwards, P.C., Shewan, L., Webb, J., Delage, C., Valdiosera, C., Robertson, R., Shev, E. and Valka, A.M., 2018. La Trobe University's 2014 season of geological survey and archaeological excavation at the Natufian site of Wādī Ḥammeh 27. *Annual of the Department of Antiquities of Jordan* 59: 247-258.

14. Edwards, P.C., Shewan, L., Webb, J. and Delage, C., 2018. La Trobe University's 2015 geological survey and archaeological excavation season at the Natufian site of Wādī Ḥammeh 27. *Annual of the Department of Antiquities of Jordan* 59: 259-271.

15. Yihdego Y., Webb J.A., 2018. Comparison of evaporation rate on open water bodies: energy balance estimate versus measured pan. *Journal of Water and Climate Change*, 9, 101-111.

16. Dresel, P.E., Dean, J.F., Perveen, F., Webb, J.A., Hekmeijer, P., Adelana, S.M., Daly, E., 2018. Effect of *Eucalyptus* plantations, geology, and precipitation variability on water resources in upland intermittent catchments, *Journal of Hydrology* 564, 723-739. doi.org/10.1016/j.jhydrol.2018.07.019

17. Webb, J.A., 2017. Denudation history of the Southeastern Highlands of Australia. *Australian Journal of Earth Sciences*, 64, 841-850.

18. Greenwood, D.R., Keefe, R.L., Reichgelt, T. and Webb, J.A., 2017. Eocene paleobotanical altimetry of Victoria's Eastern Uplands. *Australian Journal of Earth Sciences*, 64, 625-637.

19. Currell, M., Werner, A., McGrath, C. and Webb, J.A., 2017. Problems with the application of hydrogeological science to decision-making for Australian mining

projects: Carmichael Mine and Doongmabulla Springs. *Journal of Hydrology* 548, 674-682.

20. Sephton, M. and Webb, J.A., 2017. Application of Portland cement to control acid mine drainage generation from waste rocks. *Applied Geochemistry* 81, 143-154.

21. Gill, B.C., Webb, J.A., Stott, K., Chen, X., Wilkinson, R. and Cossens, B., 2017. Economic, social and resource management factors influencing groundwater trade: Evidence from Victoria, Australia. *Journal of Hydrology* 550, 253-267.

22. Cochrane, G.W.G, Webb, J.A., Doelman, T. and Habgood, P.J., 2017. Elemental differences: geochemical identification of Aboriginal silcrete sources in the Arcadia Valley, eastern Australia. *Journal of Archaeological Science Reports*, 15, 570-577.

23. Yihdego, Y., Webb, J.A. and Vaheddoost, B., 2017. Highlighting the role of groundwater in lake–aquifer interaction to reduce vulnerability and enhance resilience to climate change. *Hydrology*, *4*, 10; doi:10.3390/hydrology4010010

24. Lipar, M., Webb, J.A., Cupper, M.L. and Wang, N., 2017. Aeolianite, calcrete/microbialite and karst in southwestern Australia as indicators of Middle to Late Pleistocene palaeoclimates. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 470, 11-29.

25. Yihdego, Y. and Webb, J.A., 2017. Assessment of wetland hydrological dynamics in a modified catchment basin: the case of Lake Buninjon, Victoria, Australia. *Water Environment Research* 89, 144-154.

26. Webb, J.A. and White, S., 2016. Karst in Deserts, Reference Module in Earth Systems and Environmental Sciences, Elsevier. doi: 10.1016/B978-0-12-409548-9.10259-3.

27. Yihdego, Y., Webb, J.A. and Leahy, P., 2016. Response to Parker (2015) - Rebuttal: "Modelling of lake level under climate change conditions: Lake Purrumbete in southeastern Australia" by Yihdego et al. (2015). *Environmental Earth Sciences*, 75, 1-4.

28. Yihdego, Y. and Webb, J.A., 2016. Validation of a model with climatic and flow scenario analysis: Case of Lake Burrumbeet in Southeastern Australia. *Environmental Monitoring and Assessment*, 188, article 308, 1-14

29. Dean, J.F., Camporese, M., Webb, J.A., Grover, S.P.P., Dresel, P.E., and Daly, E., 2016. Water balance complexities in ephemeral catchments with different land uses: insights from monitoring and distributed hydrologic modeling. *Water Resources Research*, 52, 4713-4729. DOI: 10.1002/2016WR018663

30. Robson, T.C. and Webb, J.A., 2016. The use of environmental tracers to determine focused recharge from a saline disposal basin and irrigation channels in a semiarid environment in Southeastern Australia. *Journal of Hydrology,* 538, 326–338.

31. Yihdego, Y., Webb, J.A. and Leahy, P., 2016. Modelling water and salt balances in a deep, groundwater-throughflow lake—Lake Purrumbete, southeastern Australia. *Hydrological Sciences Journal*, 61, 186-199.

32. Lipar, M, and. Webb, J.A., 2015. The Middle-late Pleistocene Bridgewater Formation on Cape Bridgewater, southwestern Victoria: chronostratigraphy and palaeoclimatic significance. *Proceedings of the Royal Society of Victoria*, 127, 81-91. doi:10.1071/RS15020

33. Doelman, T., Webb, J., Williams, A., and May, J., 2015. Paleo-channels and Patches: A geoarchaeological assessment of silcrete sources in the Cumberland Plain, eastern Australia. *Geoarchaeology*, 30, 495-510.

34. Lipar, M., Webb, J.A., White, S.Q. and Grimes, K.G., 2015. The genesis of solution pipes: evidence from the Middle – Late Pleistocene Bridgewater Formation calcarenite, southeastern Australia. *Geomorphology,* 246, 90–103.

35. Raiber, M., Webb, J.A., Cendón, D.I., White, P.A., Cox, M.E. and Jacobsen, G.E. 2015. Environmental tracers meet 3D geological modelling: Conceptualising recharge and structurally-controlled aquifer connectivity in the basalt plains of south-western Victoria, Australia. *Journal of Hydrology*, 527, 262-280.

36. Dean, J.F., Webb, J.A., Jacobsen, G., Chisari, R. and Dresel, P.E., 2015. A groundwater recharge perspective on locating tree plantations within low-rainfall catchments to limit water resource losses. *Hydrology and Earth System Sciences* 19, 1107-1123.

37. Yihdego, Y. and Webb, J.A., 2015. Use of a conceptual hydrogeological model and a time variant water budget analysis to determine controls on salinity in Lake Burrumbeet in southeast Australia. *Environmental Earth Sciences,* 73, 1587-1600.

38. Lipar, M, and. Webb, J.A., 2015. The formation of the pinnacle karst in Pleistocene aeolian calcarenites (Tamala Limestone) in southwestern Australia. *Earth Sciences Reviews*, 140, 182–202.

39. Adelana, M., Dresel, E., Hekmeijer, P., Zydor, H., Webb, J.A, Reynolds, M. and Ryan, M., 2015. A comparison of streamflow, salt and water balances in adjacent farmland and forest catchments in south-western Victoria, Australia. *Hydrological Processes* 29, 1630-1643.

40. Yihdego, Y., Webb, J.A. and Leahy, P., 2015. Modelling of lake level under climate change conditions: Lake Purrumbete in southeastern Australia. *Environmental Earth Sciences* 73, 3855-3872.

41. White, S. and Webb, J., 2015. The influence of tectonics on flank margin cave formation on a passive continental margin: Naracoorte, southeastern Australia. *Geomorphology* 229, 58-72.

42. Dean, J.F., Webb, J.A., Jacobsen, G., Chisari, R., and Dresel, P.E., 2014. Biomass uptake and fire as controls on groundwater solute evolution on a Southeast Australian granite: aboriginal land management hypothesis. *Biogeosciences*, 11, 4099–4114.

43. Lipar, M, and. Webb, J.A., 2014. Middle – Late Pleistocene and Holocene chronostratigraphy and climate history of the Tamala Limestone, Cooloongup and Safety Bay Sands, Nambung National Park, southwestern Western Australia. *Australian Journal of Earth Sciences*, 61, 1023-1039.

44. Camporese, M., Daly, E., Dresel, P.E., Webb, J.A., 2014. Simplified modeling of catchment-scale evapotranspiration via boundary condition switching. *Advances in Water Resources*, 69, 95-105.

45. Gill, B.C., Webb, J.A., Wilkinson, R. and Cherry, D., 2014. Irrigator responses to groundwater resource management in northern Victoria, southeastern Australia. Journal of Hydrology 518, 83–93.

46. Burnett, S., Webb, J.A. and White, S., 2013. Shallow caves and blowholes on the Nullarbor Plain, Australia - flank margin caves on a low gradient limestone platform. Geomorphology, 201, 246-253.

47. Yihdego, Y., Webb, J.A., 2013. An empirical water budget model as a tool to identify the impact of land-use change on stream flow in southeastern Australia. Water Resources Management, 27, 4941-4958.

48. Webb, J., Finlayson, B. Cochrane, G., Doelman, T. and Domanski, M., 2013. Silcrete quarries and artefact distribution in the Central Queensland Highlands, Eastern Australia. *Archaeology in Oceania*, 48, 130-140.

49. Kappen, P. and Webb, J.A., 2013. An EXAFS study of arsenic bonding on amorphous aluminium hydroxide. *Applied Geochemistry* 31, 79–83.

50. Dresel, P.E., Hekmeijer, P., Dean. J.F., Harvey, W., Webb, J.A. and Cook, P., 2012. Use of laser-scan technology to analyse topography and flow in a weir pool. *Hydrology and Earth System Sciences*, 16, 2703-2708. http://www.hydrol-earth-syst-sci.net/16/2703/2012/

51. Yihdego, Y. and Webb, J. A., 2012. Modelling of seasonal and long-term trends in lake salinity in south-western Victoria, Australia. *Journal of Environmental Management*, 112, 149-159.

52. Cochrane, G.W.G., Habgood, P.J., Doelman, T., Herries, A.I.R. and Webb, J., 2012. A progress report on research into the stone artefacts of the southern Arcadia Valley, central Queensland**.** *Australian Archaeology*, 75, 98-103.

53. Doerr, S.H., Davies, R.R., Lewis, A., Pilkington, G., Webb, J.A., Ackroyd, P.J., Bodger, O., 2011. Origin and karst geomorphological significance of the enigmatic Australian Nullarbor Plain 'blowholes'. *Earth Surface Processes and Landforms*, 37, 253-261.

54. Robson T.C. and Webb J. A., 2011. Late Neogene tectonics in northwestern Victoria: evidence from the Late Miocene-Pliocene Loxton Sand. *Australian Journal of Earth Sciences* 58, 579–586.

55. Shaqour, F., White, S. and Webb, J.A., 2011. Geotechnical characterization of geomaterial blends with zeolitic tuffs for use as landfill liners. *Bulletin of Engineering Geology and the Environment*, 70, 691-697. doi:10.1007/s10064-011-0375-6

56. Glover, F., Whitworth, K.., Kappen, P., Baldwin, D., Rees, G., Webb, J., Silvester, E., 2011. Acidification and buffering mechanisms in acid sulfate soil (ASS)

wetlands of the Murray-Darling Basin, Australia. *Environmental Science and Technology*, 45, 2591–2597.

57. Yihdego, Y. and Webb, J. A., 2011. Modeling of bore hydrographs to determine the impact of climate and land use change in a temperate subhumid region of southeastern Australia. *Hydrogeology Journal*, 19, 877-887. doi:10.1007/s10040-011-0726-1

58. Webb, J.A., Gardner, T.W., Kapostasy, D., Bremar, K.A. and Fabel, D., 2011. Mountain building along a passive margin: Late Neogene tectonism in southeastern Victoria, Australia. *Geomorphology* 125, 253-262. doi:10.1016/j.geomorph.2010.09.022

**Consulting projects and reports (last 10 years)**

1. Webb, J.A., 2020. Peer review of reports for Technical Advisory Group for Bendigo Groundwater Project (Victorian Department of Environment, Land, Water & Planning).
2. Webb, J.A., 2020. Geomorphological setting of calcrete quarries near Swan Hill; report for Coburns Earthmoving Pty Ltd.
3. Webb, J.A., 2020. Geomorphology of proposed quarry site near Lang Lang; report for Westvic Heritage Management Pty Ltd.
4. Webb, J.A., 2020. Geomorphological assessment of possible aboriginal site near Bulla; report for Wurundjeri Cultural Heritage Aboriginal Corporation.
5. Webb, J.A., 2019. Report on artefacts recovered from excavations at the Munro Site, adjacent to Queen Victoria Market, for Extent Heritage Pty Ltd.
6. Webb, J.A., 2019. Review of documentation relating to pH levels in groundwater, Apollo Bay Water Storage Basin (Victoria), for Barwon Water.
7. Webb, J.A., 2018. Review of AECOM CSIA Groundwater Assessment Monroe Clovelly Park, for Cardno Victoria Pty Ltd.
8. Webb, J.A., 2018. Report on evidence of aboriginal quarrying of silcrete at Lilydale Quarry, for Biosis Research Pty. Ltd.
9. Webb, J.A., 2017. Peer review of groundwater management plan for proposed quarry at Birregurra, for Colac Otway Shire.
10. Webb, J.A., 2017. Technical input to project on Yeodene Swamp - water management and swamp rehabilitation; for Jacobs on behalf of Barwon Water.
11. Webb, J.A., 2017. Peer assessment of report on Acid Sulphate Soil assessment of Third Reedy Lake for Jacobs.
12. Webb, J.A., 2017. Invited member of panel to develop Long Term Water Resource Assessments: Method development and preliminary state-wide assessment for groundwater resources. (consultant for Jacobs for project co-ordinated by Victorian Department of Environment, Land, Water & Planning).

13. Webb, J.A., 2017. Peer assessment of groundwater and acid sulphate soils aspects of Princetown Ecotourism Resort proposal for Harwood Andrews Lawyers.

14. Webb, J.A., 2017. Invited member, Technical Advisory Group for Bendigo Groundwater Project (consultant for Victorian Department of Environment, Land, Water & Planning).

15. Webb, J.A., 2016. The role of karst in groundwater resource assessment for the Upper Tertiary aquifer in western Victoria. Report to Jacobs for DWELP.

16. Webb, J.A., 2016. Review of GHD assessment of acid sulfate soils risk for Third Reedy Lake bypass project (part of Connections Project) for Goulburn-Murray Water (Pat Feehan).

17. Webb, J.A., 2015. Expert witness report on hydrogeological impact of flooding adjacent to the Hazelwood open-cut in relation to the Morwell Main Drain**.** Report for Maddocks Lawyers on behalf of Latrobe City Council.

18. Webb, J.A., 2015. Expert witness report and testimony in the Land Court on modelling of groundwater impact from the proposed Kevins Corner Coal Mine, central Qld, for Environmental Defenders Office, Qld.

19. Webb, J.A., 2015. Expert witness report and testimony in the Land Court on modelling of groundwater impact from the proposed Carmichael Coal Mine, central Qld, for Environmental Defenders Office, Qld.

20. Webb, J.A., 2014. Peer review of groundwater management plan for proposed quarry at Birregurra, for Colac Otway Shire.

21. Webb, J.A., 2014. Expert review of groundwater reports on East West Link, for Yarra City Council.

22. Webb, J.A., 2013. Expert witness report on groundwater impact of proposed landfill at Arthurs Seat, Mornington Peninsula, for residents' group.

23. Webb, J.A., 2013. Expert witness report and testimony in the Land Court on modelling of groundwater impact from the proposed Alpha Coal Mine, central Qld, for Environmental Defenders Office, Qld.

24. Webb, J.A., 2013. Review of Kerang Lakes diversion proposal. Report for Goulburn Murray Water.

25. Webb, J.A., 2012. Comments on potential groundwater impacts of Moonee Valley Racecourse redevelopment, for residents' group.

26. Webb, J.A., 2012. Review of draft report on structural control of Cenozoic aquifers in Victoria. Report for GHD Pty Ltd.

27. Webb, J.A., 2012. Review of geomorphological development and sediment age at Werribee rail crossing site. Report for Andrew Long & Assoc.

28. Webb, J.A., 2011. Extent of Pleistocene sand sheet around Dowds Lane Quarry, Gippsland. Report for Keith Heywood.

29. Webb, J.A., 2011. Hydrogeological assessment of Renmark Group aquifer, central western Campaspe catchment, prepared for Morrison and Sawers

Lawyers. Expert witness statement and testimony at VCAT.

30. Webb, J.A., 2011. Wonthaggi geomorphology report. Report for Ochre Imprints.

31. Webb, J.A., 2011. Assessment of acid sulphate soils risk at Cataby Mine, Western Australia. Report for Iluka Pty Ltd.

32. Webb, J.A. and Glover, F., 2011. XRD analysis of tailings samples; prepared for Lane Piper Pty Ltd.

Planology

# Attachment B

# MEMORANDUM TO ASSOCIATE PROFESSOR JOHN WEBB

1. Planology acts for East Gippsland Shire Council (**Council**) with respect to presenting its submission to the Fingerboards Mineral Sands Project Inquiry and Advisory Committee (**IAC**). Sarah Porritt and Robert Forrester, both of Counsel, have also been briefed.

2. The hearing is currently listed to commence on **15 February 2021** and is expected to run for 7-8 weeks**.**

3. A Directions Hearing was held on **14 December 2020**. The IAC's directions and proposed timetable for the hearing are still being finalised. It is expected that Council's case will be presented in **mid March 2021**.

## Background

4. The following sets out the relevant background according to our instructions.

5. The Fingerboards Project relates to approximately 1,675 hectares of land located approximately 20 kilometres north-west of Bairnsdale in East Gippsland.

6. Kalbar Operations Pty Ltd (**Proponent**) proposes to undertake open pit mining to extract approximately 170 million tonnes (**Mt**) of ore over a projected mine life of 20 years to produce approximately 8 Mt of mineral concentrate. Mine products are proposed to be transported via road or by rail for export overseas.

7. The final transport route of the mine products is yet to be determined.

8. The Project includes the following elements:

    8.1 the development of a mineral sands mine;

    8.2 two mining unit plants;

    8.3 wet concentrator plant (comprising mineral separation processing and tailings thickening and disposal plant);

    8.4 water supply infrastructure;

    8.5 tailings storage facility; and

    8.6 additional site facilities, such as a site office, warehouse, workshop, loading facilities and fuel storage.

9. The IAC has been appointed pursuant to:

9.1 the *Environment Effects Act 1978* as an inquiry; and

9.2 the *Planning and Environment Act 1987* as an advisory committee; and

9.3 other legislation as set out in chapter 5 of the exhibited material.

10. The IAC has issued a request for further information (**RFI**). A copy of the RFI is included in your brief.

## Council's position

11. At a meeting on 1 December 2020, Council considered a draft submission. Council resolved:

THAT COUNCIL:

1. RECEIVES AND NOTES THE REPORT AND THE FINGERBOARDS MINERAL SANDS PROJECT TECHNICAL REVIEW PREPARED BY SLR CONSULTING PTY LTD AS AT ATTACHMENT 1;

2. ON THE BASIS OF CLAUSE 1 ABOVE, OPPOSES THE PROPOSED FINGERBOARDS MINERAL SANDS MINE AS PROPOSED BY KALBAR OPERATIONS OR ANY OTHER PROPONENT ON THE BASIS OF THE EVIDENCE BEFORE COUNCIL;

3. ENDORSES THE FINGERBOARDS MINERAL SANDS PROJECT TECHNICAL REVIEW, AS AT ATTACHMENT 1, AND THE KEY MATTERS FOR EAST GIPPSLAND SHIRE COUNCIL, AT ATTACHMENT 2, AS COUNCIL'S SUBMISSION;

4. REQUIRES THE CHIEF EXECUTIVE OFFICER, OR DELEGATE, TO PREPARE AN ADDENDUM TO THE SUBMISSION THAT INCLUDES, BUT IS NOT LIMITED TO, ISSUES RELATING TO HUMAN HEALTH AND CLIMATE CHANGE, AS THE SCOPE FOR THE TECHNICAL REVIEW DID NOT INCLUDE DETAILED REVIEW;

5. AUTHORISES THE CHIEF EXECUTIVE OFFICER TO LODGE THE AMENDED COUNCIL SUBMISSION AND COUNCIL OBJECTION TO THE PROPOSED MINE WITH THE MINISTER FOR PLANNING FOR CONSIDERATION AS PART OF THE ENVIRONMENTAL EFFECTS STATEMENT, DRAFT PLANNING SCHEME AND DRAFT WORKS APPROVAL PROCESSES;

6. AUTHORISES THE CHIEF EXECUTIVE OFFICER OR THEIR DELEGATE TO PRESENT AT THE INQUIRY ADVISORY COMMITTEE PANEL HEARING BEFORE THE MINISTERIAL ADVISORY COMMITTEE IN RELATION TO THE FINGERBOARDS MINERAL SANDS PROJECT;

7. AUTHORISES THE CHIEF EXECUTIVE OFFICER TO ENGAGE APPROPRIATE LEGAL REPRESENTATION FOR PREPARATION AND REPRESENTATION AT THE INQUIRY ADVISORY COMMITTEE PANEL HEARING; AND

8. OBJECTS TO THE DRAFT PLANNING SCHEME AMENDMENT SPECIAL CONTROLS OVERLAY PROVISIONS WHICH EFFECTIVELY REMOVE THE EAST GIPPSLAND SHIRE COUNCIL AS THE RESPONSIBLE AUTHORITY FOR LAND USE PLANNING AND IMPLEMENTATION STRATEGIES FOR THE PRIVATELY OWNED LAND OUTSIDE THE MINE FOOTPRINT THAT THE MINE PROPOSES FOR ITS OWN PURPOSES.

12. A copy of the Council report, Technical Review undertaken by SLR Consulting and the addendums referred to in Resolution 4 are included in your brief.

## Your instructions

13. You are instructed to:

    13.1 review the technical reports and related documents prepared for the Fingerboards Minerals Sands Project Environment Effects Statement (**EES**), the proposed Works Approval and the proposed planning scheme amendment that are relevant to your expertise,[1] including the scoping requirements for the EES; and

    13.2 prepare a statement of evidence, relevant to your expertise, on:

        13.2.1 the adequacy of the materials and technical reports prepared by the Proponent, noting the IAC has required the Proponent to prepare additional information;

        13.2.2 the adequacy of the conclusions expressed in the EES and the other supporting documents; and

        13.2.3 the adequacy of the proposed mitigation measures and whether additional mitigation measures should be considered; and

    13.3 consider the Council's submission, including the SLR Technical Review and identify any areas of the review to which you disagree.

14. There are currently 909 submission to the EES. A list of the submitters is included in your brief. We understand that the IAC will direct the Proponent to prepare a document identifying the technical issues raised in each submission. When we have received this document, we will provide it to you, together with the relevant submissions for your consideration.

15. A copy of the relevant material can be accessed using the link in the cover email.

16. We expect that your statement of evidence will be required to be circulated by **1 February 2021** and there will be directions for a conclave. Once we receive the IAC's directions, we will confirm these arrangements.

## Other matters

17. The preparation of your expert witness statement and the giving of expert evidence to the IAC must comply with the Guide to Expert Evidence – April 2019. We are awaiting formal directions by the IAC which may also set out further requirements of which we will make you

[1] A copy of all technical reports and EES documents are included in your brief.

aware once these directions are received. A copy of the Guide to Expert Evidence – April 2019 and the Expert Witness Declaration is included in your brief.

18. You should assume that all documents and correspondence passing between Planology and you, may be, or will become, discoverable and therefore be seen by all other parties to the IAC hearing and proceeding arising out of the subject-matter of your retainer. Such documents include this brief, email other communications and any drafts of your expert evidence.

19. Please do not discuss this matter or any of the material provided with any person, without the prior consent of Planology or in accordance with the IAC's directions. All communications should in the first instance be through this office. This includes seeking further documents or information in order to form your opinion; this should be done through Planology rather than any other person directly.

20. Should it be necessary for you to retain the services of another person in order to assist you in the preparation of any aspect of your report, please let us know. Should that be necessary, you are (of course) at liberty to discuss the matter and the documents provided to you with that person provided that you do so on a strictly confidential basis and only after Council has approved their engagement.

21. Should you need to visit the site or surrounding area please contact Planology so that we can make necessary arrangements.

22. Please use the link in the cover email to access an electronic copy of the brief of documents.

23. If you require any other documents or a hard copy of the brief, please let us know.

……………………..
Planology
16 December 2020