Review of Anglesea Groundwater Impact Assessment:

Upper Eastern View Formation

By

Independent Technical Review Panel

February 2026

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1. Introduction

1.1 Groundwater Independent Technical Review Panel (ITRP)

The review was undertaken by the Technical Advisory Panel (ITRP). The ITRP was appointed by Southern Rural Water in 2022 to provide independent specialist advice relating to the existing and proposed groundwater licence amendments in the Anglesea River catchment (south-west Victoria).

The scope of work requested by Southern Rural Water in 2022 was to review relevant technical documents and provide independent technical advice relating to:

- the groundwater licence application to extend the pumping trial by Alcoa Pty Ltd
- the proposed impact assessment (and risk assessment) from Alcoa to extract groundwater to fill the mine
- the proposed groundwater modelling scenarios relating to the proposed application to use the pumped groundwater to rapidly fill the mine void
- other technical matters as required.

Prior to the ITRPITRP for Southern Rural Water, the panel members had been appointed in 2021 to a Technical Review Panel (TRP) to advise an Inter-Agency Group (IAG) comprising DEECA[1], SRW[2] and DJPR-ERR[3]. The TRP provided expert and independent review of technical groundwater investigations including modelling, which is used by both:

- Barwon Water to support the groundwater bulk entitlement review,

  and
- Alcoa to support its licence application.

1.2 Background on the ITRP experts

The ITRP is comprised of independent experts from a wide range of fields including geology, hydrogeology, modelling, geochemistry, and ecology, as outlined below.

Figure 1 - Photograph of ITRP members on site (L-R: Timms, Lloyd, Middlemis, Scott)

[1] DEECA is Department of Energy, Environment and Climate Action

[2] SRW is Southern Rural Water

[3] DJPR-ERR was previously known as Department of Jobs, Precincts and Regions - Earth Resources Regulator, and it has now been incorporated into DEECA

Professor Wendy Timms (Chair of ITRP)

Wendy has extensive expertise in geology, hydrogeology, and engineering, and over 30 years' experience. She is a Chartered Engineer (Civil Engineering, Environmental Engineering) and a former Vice President of International Association of Hydrogeologists. Wendy is Professor of Environmental Engineering at Deakin University, teaching geology for geotechnical engineering, water and waste engineering and leading research in geological carbon sequestration, water tracer technology, and groundwater hydrology, especially low permeability aquitards. She has engineering project and research experience at coal, gas, uranium, metals and potash and waste sequestration sites in Australia, Asia and Canada, and has published over 220 technical reports and more than 80 peer-reviewed journal papers.

Lance Lloyd (Ecology specialist)

Lance has almost 40 years' experience (following a M.Sc. by research) as an ecologist in SE Australia and, in the Pacific Islands and New Zealand, in freshwater, estuarine, coastal and inland environments in fish and aquatic fauna ecology and their management requirements. His key expertise is relating the ecology of aquatic systems to the needs of management issues (especially environmental flows, ecosystem restoration and impact assessment). Lance was also the ecological expert on Southern Rural Water's Independent Technical Review Panel for the Barwon Downs Remediation and Environment Protection Plan which addressed the acid discharge issues arising from Big Swamp. He currently chairs the Great Australian Bight Resource Assessment Group, Australian Fisheries Management Authority (AFMA – 2013 to present), was previously the chair of the Translocation Evaluation Panel (Fisheries Victoria – 2004 – 2017) and a member of the Victorian Catchment Management Council (2015 -2018).

Hugh Middlemis (modelling specialist)

Hugh is a groundwater modelling specialist based in Adelaide with a degree in civil engineering, a masters in hydrology and hydrogeology, and more than 40 years' experience across Australia and internationally. Hugh established HydroGeoLogic in 2013 as an independent consultancy, specialising in flow and solute models, stream-aquifer interactions, groundwater dependent ecosystems and uncertainty analysis. Hugh is a co-author of best practice guidelines on groundwater modelling and uncertainty analysis, and has been appointed to expert panels, including for the Barwon Downs and Yeodene/Big Swamp remediation project (SRW; 2019-25), the Victorian Murray Floodplain Recovery Project (VMFRP; 2020-23), the DEECA Groundwater Technical Review Panel (2021-25), and the NSW Mining and Petroleum Gateway Panel (2021-27).

Peter Scott (acid specialist)

Peter is a geochemist specialising in the assessment and management of disturbance of coastal acid sulfate soils (CASS) and disturbance by mining of sulfidic rock material resulting in the generation of acid and metalliferous drainage (AMD). Peter has more than 50 years of experience in managing and minimising environmental impacts from mining and coastal land development throughout the world. Peter is a leading specialist in AMD assessment and design of mining landforms for control of AMD. Peter has established benchmark understanding of land development planning for controlling and mitigation/minimising impacts resulting from disturbance of acid sulfate soils.

1.3 Previous independent reviews

The ITRP (and TRP) has provided several independent reviews for proposed activities in the Anglesea catchment including the following:

- Anglesea Groundwater Model – Review of Model Development and Calibration, January 2024.

  This TRP report for the Inter-Agency Group (IAG) summarised technical reviews of the groundwater model that was to be used by Barwon Water and Alcoa, in their subsequent scenario modelling. This TRP report was subsequently released publicly as part of Alcoa's application to amend its groundwater extraction licence (presented as Appendix B in the

Groundwater Impact Assessment ('GIA') prepared by EHS (2025)). The Panel assessed the model as very well designed and executed, and fit for purpose as the quantitative basis for the groundwater-related impact assessments.

- Technical Memos to Southern Rural Water on material matters; Nov. 2024; March 2025.

  A ITRP report provided Southern Rural Water with technical comments on Alcoa's draft groundwater impact assessment (GIA, July 2024) and material matters (November 2024). The ITRP then provided Southern Rural Water with technical comments (March 2025) on a Consolidated Leach Assessment (CLA) risk report.

- Alcoa has since provided a Groundwater Impact Assessment ('GIA', EHS, March 2025) which provides updated assessments and supporting information for their groundwater licence application. It is that report that is the focus of this current ITRP review report.
- The ITRP reviewers subsequently requested additional data and analysis which was provided in December 2025 (EHS 2025b), showing more granular detail on drawdown than the aggregated/averaged plots presented in the GIA (2025). ITRP comments on that update were provided to SRW (Dec. 2025), and that advice has been incorporated into this report.

A summary of model review findings is presented in Section 3.1, and a summary of material matters in Section 3.2.

1.4 Purpose of this report

This ITRP report to SRW addresses a request for independent advice on whether the additional technical information provided by Alcoa in the updated Groundwater Impact Assessment (GIA)(EHS 2025) is sufficient for review and assessment of a groundwater licence amendment application for extraction from the Upper Eastern Valley View Formation (UEVF).

The application from Alcoa seeks to reduce the existing licensed volume of extraction (or take) from 4 GL/a to 1.5 GL/a for a period of 10 years. The application also seeks to amend its use to accelerate filling of the former Anglesea mine void water body to help achieve the draft Mine Rehabilitation and Closure Plan (MRCP) objectives.

The GIA is dated March 2025, and extends to 2649 pages, as it includes appendices comprising detailed reports on previous technical investigations. For example, Appendix E which presents the report on the Anglesea Groundwater Model (2024a) is important, as it is used in the predictive scenario modelling that forms the quantitative basis for the impact assessments submitted by Barwon Water and Alcoa to support the Bulk Entitlement and licence application, respectively. The Anglesea Groundwater Model is discussed further in section 3. The GIA also includes the TRP report on the "Anglesea Groundwater Model Review of Model Development and Calibration" (Jan. 2024).

This 'Consolidated' ITRP report draws on previous TRP/ITRP reviews and includes new information to help address the scope of work requested by Southern Rural Water for:

- A summary of conclusions of the various review tasks (as TRP and/or ITRP)
- Technical comments
  - Scope and adequacy of submitted technical work
  - Modelling and Risk Assessment
  - Proposed Monitoring and Management
  - Other Considerations

2. Brief background

2.1 Historical extraction of groundwater

The Eastern View Formation (EVF) has two principal aquifers in the Jan Juc GMA (Table 1). The EVF includes two distinct high permeability aquifer units that are separated by low permeability aquitards. The main aquifer units are in the Upper EVF (UEVF) and the Lower EVF (LEVF):

- Lower or Basal units of the ***Upper EVF aquifer***, the focus of Alcoa.
- ***Lower EVF aquifer***, the focus of Barwon Water.

In the centre of the Anglesea depression, where the sediments and coal are thickest and suitable for open pit mining (Holdgate et al 2001), there are multiple layers of low permeability sediments including:

- aquitards within the Demons Bluff Group and aquitards within the upper parts of the Upper EVF are 90 to 180 m thick, overlying the aquifer of the Lower or Basal UEVF.
- the MEVF aquitard (40-70 m thick) separates the Upper EVF and Lower EVF.

The lithology and thicknesses of the aquifers and aquitards are summarised in Table 1. The lithologies include sands, clay, coal, shale, mudstone and underlying sandstone. No drilling or bore logs record limestone. There is no evidence of sinkholes that are common in carbonate type geology.

Table 1. Summary of aquitards and aquifers (from EHS 2021, also page 419 of GIA 2025). The highlighted UEVF basal aquifer is the focus of this report, on the licence application of Alcoa.

Table 2-1 Lithological Summary

Hydrostratigraphic Unit	Unit	Elevation (mAHD)	Approx. Thickness (m)	Lithology
DBG	PWT Aquifer	+40 to +5	0 to 1	Topsoil
			2 to 20	Sandy clay.
	Boonah Sands Aquifer of the DBG	+20 to -10	1 to 25	Sequences of sands, clay, minor coal and silty clay
UEVF	Main Seam	-10 to -65	40 (25m of coal)	Coal
	Basal Clay	-15 to -70	1 to 4	Low permeability clay
	UEVF Upper Sands	-30 to -80	5 to 30	Sequences of coarse-grained sands and gravels interbedded with thin low permeability clay and coal
	L1 to L3 Seams and Interburden	-80 to -130	40 to 80	Thick sequences of low permeability coal, clay and thin sands
	Sub L3 Seam Sediments	-180 to -220	50 to 100	Low permeability coal and clay interbedded with discontinuous sand layers
	UEVF Basal Aquifer	**-230 to -280**	**30 to 60**	**Sands interbedded with silt, clay and thin coal**
MEVF	Aquitard	-285 to -355	40 to 70	Shale/mudstone
LEVF	Aquifer	-500	200 to 300	Sands interbedded with silt, clay and thin coal
Torquay Group	Basement	-500 +	>50	Bluey white sandstone

DBG – Demons Bluff Group
PWT – Perched Water Table
MEVF – Middle Eastern View Formation
LEVF – Lower Eastern View Formation

The UEVF and LEVF aquifers are accessed by two major borefields operated by Alcoa and Barwon Water (BW) near the town of Anglesea:

- Alcoa borefield: 7 bores in the basal sands of the Upper EVF established in 1969, 4 bores decommissioned to date; historical licence to extract 4 GL/yr for industrial use relating to the former Alcoa Power Station and open pit coal mine at Anglesea; licence subject to review/amendment by Southern Rural Water (SRW) based on current investigations;
- Barwon Water borefield: 7 bores in the Lower EVF established in 2009 (5 southern bores near the Anglesea pit void; 2 northern bores about 4.5 km north of the pit); these bores are at a depth of 450-660 m depth in the southern borefield. Bulk Entitlement (BE) licence to extract 10 GL/yr (average); includes trigger level conditions for the protection of the swamplands and groundwater dependent ecosystems (GDEs) in the upper Anglesea River.

A timeline of historical extraction from the UEVF (Alcoa), including via the mine sump, and from the LEVF (BW) is presented in Figure 2.

Figure 2 - Timeline of historical groundwater extraction (From EHS Support 2022)

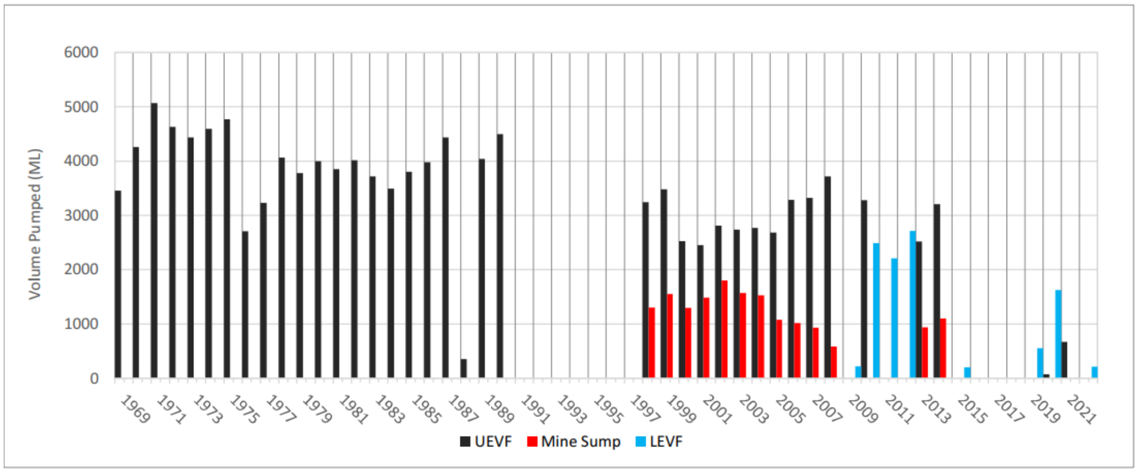


Figure Notes:

UEVF Data missing for 1991-1997, 2009 & 2011-2012
UEVF volumes prior to 1989 also include the mine sump volume
LEVF 2021 Data – Up to and including February 2022

2.2 Anglesea mine rehabilitation and closure plan (MRCP)

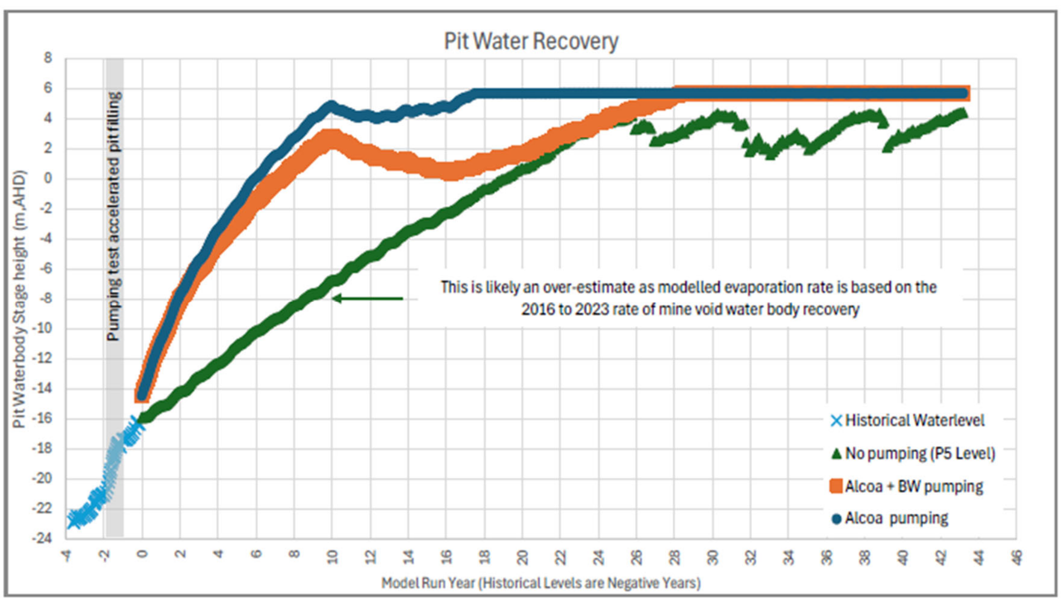
A draft Anglesea Mine Rehabilitation and Closure Plan (MRCP) was submitted by Alcoa to Earth Resources Regulator (ERR) in September 2017. It was estimated that allowing the pit void to naturally fill and form a water body (lake) would take 50-100 years to reach a final level of between -4 to +4 metres AHD (EHS Support, 2017). Alternatively, filling the pit void with groundwater extracted from the Alcoa UEVF borefield could reduce the timeframe, and enable a more rapid implementation of the MRCP.

In September 2020, Alcoa submitted a Groundwater Impact Assessment (GIA), evaluating risks to the environment and third-party users associated with a proposed 12-month groundwater pumping test of the UEVF aquifer. In October 2020, Southern Rural Water (SRW) issued an amended groundwater licence for that purpose.

On 13 May 2021, Alcoa commenced the groundwater pumping test of the UEVF aquifer, with the extracted groundwater being discharged to the pit void lake, and with monitoring and modelling investigations ongoing. The pumping test was paused on December 8, 2021, after 672 ML was extracted, about 44% of the licensed volume, while the data from the first 6-months of pumping was evaluated.

The GIA was updated in March 2025 to include data from the pumping test and groundwater modelling, and is the subject of the current review. The GIA states that the water body level will rise to an equilibrium level of about +5.5mAHD (after 10 years under the rapid fill case). This is well below the spill level to Marshy Creek of about +10mAHD. For the natural fill case, this takes at least 25 years (framed as 'decades longer' in the GIA). The ITRP is concerned that the long-term dynamic equilibrium for the natural fill case shows 2 m fluctuations in the water body level (see Figure 3- Predicted mine water body level (from GIA 2025, Fig.7-1) that are not apparent in the other scenarios and have not been explained adequately. The GIA states that the reasons for this are being explored by Alcoa in conjunction with Barwon Water, to inform the MRCP. While this is essentially a minor gap in the assessment, it can reasonably justify a natural fill period of up to 30 years and a rapid fill period of about 10 years.

Figure 3- Predicted mine water body level (from GIA 2025, Fig.7-1)



The modelling results show that the pit void water body acts as a long-term sink ('groundwater discharge feature') under all scenarios, although the GIA does not present a contour plan of groundwater levels to show the extent and magnitude of the sink 'cone of depression'. The long-term groundwater inflows are balanced by an ongoing evaporative loss of about 0.3 GL/a.

3. Previous independent reviews

The ITRP (or TRP) has provided several independent reviews to Southern Rural Water for proposed activities in the Anglesea catchment that are summarised in this section.

3.1 Review of groundwater model development and calibration

The Anglesea Groundwater Model (GHD 2024a, presented as Appendix E to the GIA 2025) was used in the predictive scenario modelling that forms the quantitative basis for the impact assessments submitted by Barwon Water and Alcoa.

The ITRP/TRP review concluded that the model is suitable for the ongoing water management and planning needs of both Barwon Water and Alcoa, to support:

- the Barwon Water Anglesea Borefield planning, management and approvals works under the Bulk Entitlement (BE) process, including periodic model updates and re-assessment of sustainability.
- the Alcoa mine closure and rehabilitation planning and management works, including the licence application to SRW for long-term groundwater abstraction to fill the pit water body.

It was found that the Anglesea model updates (GHD 2024a, EHS 2025) used the latest numerical code, refined layer structure and parameterisation schemes, the latest methods of history-matching to observation data, including new information gleaned from the 6-month pumping test, and with integrated uncertainty analysis methods. The groundwater model is representative of shallow and deep aquifer systems and stream-swamp-aquifer interaction processes.

The Anglesea catchment is a very complex system and it is very challenging to quantify precise predictions of ecological hazards or impacts given this complexity and the gaps in historical data. The model is capable of simulating groundwater levels, groundwater flows, and surface water flows; however, it is not designed to directly simulate the processes of acid generation and mobilisation, or ecological impacts.

An appropriate balance was achieved between model design complexity and simplicity, and implementation in the numerical model, consistent with best practice guidelines, including for uncertainty assessment (Barnett al 2012; Peeters and Middlemis 2023) and climate change (DELWP 2020).

Available observation data have been used for model calibration/history-matching. The model history-match period 1968-2022 includes a very wide range of stresses including climate variability (rainfall-runoff, recharge/discharge and evapotranspiration, above and below average rainfall periods), groundwater pumping, pit void rehabilitation and development of the water body in the residual mine void. The excellent calibration/history-match performance provides confidence that the Anglesea model is a suitable predictive tool under a range of climate and other stresses for surface water and groundwater interactions, interactions with the pit, interaction between the main aquifers (UEVF, LEVF and ASA), groundwater trends, water balances, pit water levels, flux exchanges and parameter realisations.

The latest methods of groundwater modelling and uncertainty analysis were applied. Scenario forecasts are presented in terms of probabilities of occurrence of effects of groundwater extraction.

The ITRP was impressed by the insights available from analysis of the composite plots presented in the model calibration report (GHD 2024a, Figures 6-14, 6-15; presented below as Figure 4). They provide an effective mini-hindcast within the history-match period when there were distinct campaigns of groundwater pumping (or no pumping) from the Barwon Water and/or Alcoa borefields, and demonstrate clearly that climatic drivers dominate ASA system. This is not surprising in the Anglesea Syncline area, north of the mine area, where the ASA is a predominantly losing system. Further investigation is recommended by the ITRP to benchmark the proxy hydraulic indicators (e.g. drawdown) to ecosystem impacts such as acidity mobilisation, oxygen depletion in waterways and/or fish-kill information for 2016-2020, to provide insights to confirm whether the model and the proxy indicators are indeed suitable for such 'unpacking' of the key hydrological drivers.

Figure 4. Composite plot of measurements and model predictions demonstrating that climatic drivers (not pumping effects) dominate the ASA system (from GHD 2024a, Fig. 6-14)

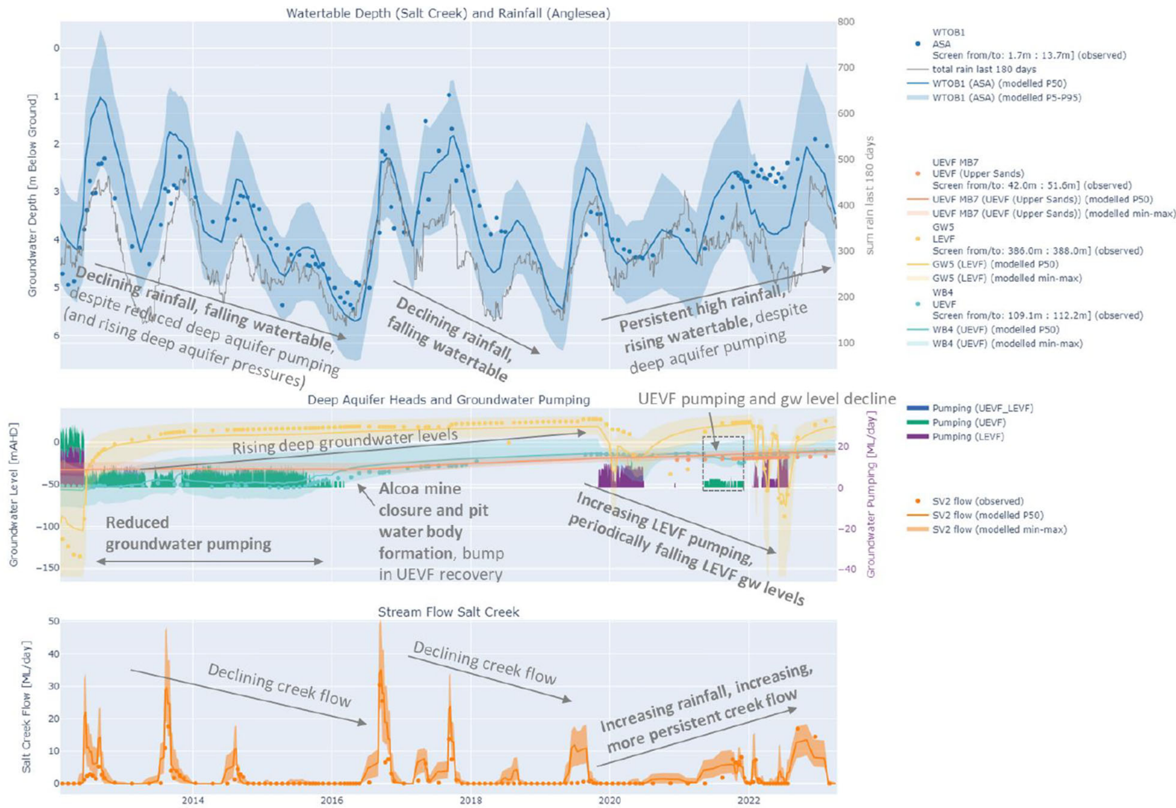


Figure 6-14 Model history matching: stress response cause-and-effect processes [lower Salt Creek]

3.2 Assessment of material matters

Material matters are key to making an assessment of a groundwater licence application. It is important to be able to clearly identify the impacts of the activity to be licensed, and also how that activity may contribute with other activities that, when combined (i.e. cumulative), may be unacceptable.

As noted in Section 1.3, the ITRP provided Southern Rural Water with technical comments on material matters (November 2024). Material gaps and licence take risks that may be materially significant that remain in the updated GIA (March 2025) are outlined in Section 4 following.

4. Summary of conclusions of this review

This non-technical summary of the conclusions of the ITRP review presents our conclusions and brief reasons for our findings.

4.1 Summary of ITRP review

The standard of impact assessment is considered to be satisfactory for most of the work that has been completed for the proposed amendment of Alcoa's groundwater licence, subject to limitations.

The geological, groundwater and associated environmental data that are available across the catchment and mine site, **are satisfactory** to develop and calibrate a groundwater model. Over 10 years of detailed monitoring data, including during dry and wet climatic periods and higher rates of groundwater extraction, and zero extraction, has quantified variability in the aquifer system and the stream-swamp-aquifer interactions.

- The groundwater model is of **a high standard** with best practice uncertainty analysis using probabilistic approaches.
- The model scenarios to predict potential groundwater drawdown **are satisfactory** and the analysis of the predicted changes in water levels and flows are plausible.
- The conceptual models of generation and metals mobilisations from the upper and mid-catchments **are satisfactory.** The understanding of water quality processes is based on extensive monitoring and acid sulphate soils testing throughout the Salt Creek and Anglesea River catchments (outside the former mine lease area).
- The standard of impact assessment for risks to other users associated with (volumetric) licence take ***are satisfactory.***
- However, the ITRP review ***recommends further clarification of the impact assessment of risks to the environment from acid generation*** that is associated with drawdown in the ASA that is projected by modelled scenarios.
- Risk mitigation and monitoring plans outlined to date are ***progressing however are currently not adequate for the material risk of increased acid generation***. The ITRP review have provided a number of recommendations to consider in further developing these plans as part of an updated mine closure plan.

The ITRP consider that the information provided is suitable for an assessment of the water licensing/take, including potential impacts on the aquifer/catchment system, but is not confident of the ecological and acid generation risk assessment.

4.2 Matters that are out of scope

Water quality targets and a long-term water quality management plan for the mine water body are to be finalised as part of an updated mine closure plan. As a result Southern Rural Water has deemed that the proposed water quality of the pit lake or mine water body was not within scope of this ITRP review. The water quality of the mine water body needs to be evaluated and addressed for mine closure.

The pit stability is beyond the scope of the TOR for the ITRP review of the groundwater licence amendment application for extraction from UEVF.

4.3 Proposed fast-fill with groundwater and geochemical modelling

The future pit water quality is relevant to this review of proposed groundwater take. Where seepage may materially impact groundwater or surface water quality outside of the pit lake (see

Section 4.5.3), water quality in the mine water body during fast-fill with groundwater is a consideration.

The ITRP review is not confident that the interim water quality targets for the mine water body will be achieved over 10 years of fast-fill with groundwater as proposed. The pH and concentration of metals in the mine water body over 10 years are highly uncertain. Based on available information, the concentration of metals (e.g. Al, Fe, Mn, Zn) in the proposed scenario could exceed the interim water quality performance targets in Table 4-11 of the CLA (GIA 2025).

It is not possible to further evaluate potential impacts on the future pit water quality with the information presented in the GIA 2025 because of these material gaps: 1) The water quality data presented is incomplete 2) There is limited geochemical data for pit walls and floor materials and assumed geochemistry and 3) The geochemical modelling is inadequate, because the methodology is overly simplistic, and the outputs (ie. from PHREEQC models) presented for this fast-fill scenario are highly uncertain.

4.4 Groundwater model build and construction

The ITRP has independently reviewed the groundwater model development and predictive uncertainty analysis, and assessed them as ***fit for purpose*** as the quantitative basis for the groundwater-related impact assessment. The prediction scenarios have been ***conducted appropriately*** to quantify the cumulative effects in terms of climatic factors (medium and high climate change), the Barwon Water Bulk Entitlement, and the Alcoa pumping, and to also unpack the incremental effects of Alcoa pumping only for the fast-fill case.

The modelling scenarios included an 'Alcoa only' scenario to quantify the effects of pumping only from the UEVF and inform the risk assessment. This scenario was achieved by subtracting outputs of Scenario 2 (Barwon Water only pumping) from Scenario 3 (Alcoa + Barwon Water pumping), which is a best practice method of 'unpacking' individual actions.

This approach for a 'project only' scenario is acceptable and common practice for large extraction projects given complex and non-linear processes that occur with cumulative hydraulic stresses on a groundwater system.

4.5 Licence take risks

4.5.1 Risk of groundwater drawdown based on observations and pump tests

The ITRP review has evaluated the risks of groundwater drawdown based on observations and pumping tests. In general, the ITRP members are confident in the predictions of groundwater drawdown, as these are based on fit for purpose groundwater modelling that is adequately history-matched to extensive monitoring data over many years at a higher pumping rate than proposed in the Alcoa licence application.

We highlight the following key information and ***observations*** from previous pumping:

a) The proposed groundwater extraction volume of 1.5 GL/year is less than the 4 GL/year of previous extraction from the same aquifer (basal sands of the UEVF). This aquifer is at least 150 m below ground and overlain by low permeability aquitards.

b) The proposed pumping volume of 1.5 GL/year (or 1500 ML/year or 32 L/second) is equivalent to <4% of the average annual rainfall over the area of the former mine lease (~7000 hectares, 600-773 mm/year rainfall). Thus, a relatively small volume of water is proposed to be extracted from the basal sands of the UEVF.

c) Groundwater drawdown in the ASA was not observed (Figure 5) during pumping from deeper aquifers at various times including during the 6 month pumping test in 2021.

Figure 5 - Stable water table levels in the ASA compared with drawdown in the deeper UEVF and LEVF aquifers from 2009 to 2022. The effects of pumping are evident in the deeper aquifers at various times, including the 6 month pump test (from GHD 2024a, also Appendix E to GIA (EHS 2025)).

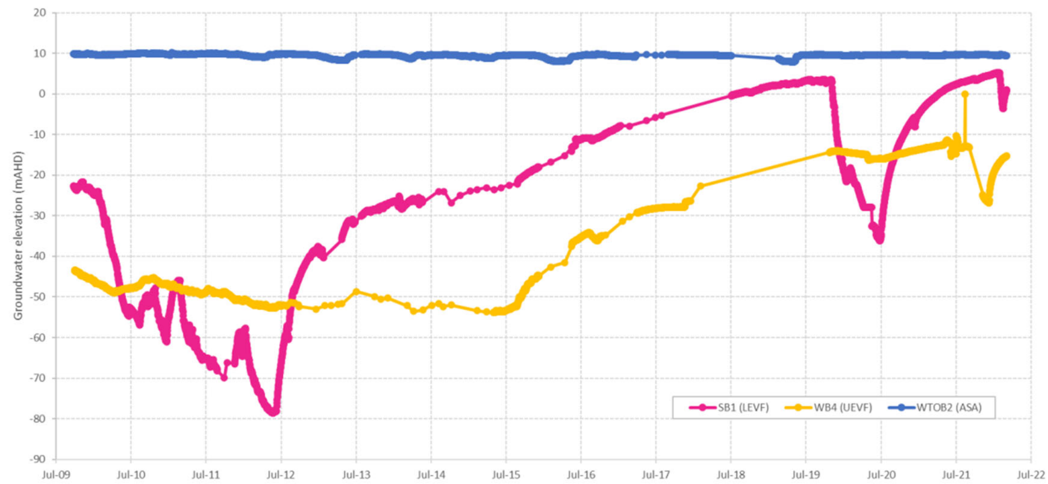


Figure 3-16 Lower Anglesea Swampland: WTOB2 (ASA,)WB4 (UEVF) & SB1 (LEVF) Nested Hydrograph

However, the ITRP review has found that there could be a ***risk of moderate groundwater drawdown despite the relatively small volume*** of the proponent's proposed groundwater take, which **may be a material acid generation risk** as discussed below.

Groundwater model scenarios project a small to moderate drawdown (0.1 to 2 metres) of the water table in some ASA areas during 10 years of Alcoa's proposed pumping from the basal sands of the UEVF. The GIA has tended to focus on the predictions of small drawdown (<0.1 m), and has not highlighted that there is evidence that predicted groundwater levels due to Alcoa-only pumping may be deeper in some areas (e.g. <2 m) compared to historical variations in response to rainfall and other cumulative effects including previous pumping. The ITRP consider that such small to moderate drawdown is not a major concern in terms of the ecological basis for the guidelines for groundwater dependent ecosystems (DELWP 2015a), but is a material concern in terms of potential acid generation, as discussed further below.

4.5.2 Risk of increased acid generation/acid discharges

The conceptual model of acid generation and transport that naturally occurs in the catchments above the mine site is robust. The unique geology of the Upper Anglesea and Salt Creek geology and catchments are a natural source of sulfidic sediments that when exposed to oxidation can release acidity and associated metals (Wong et al 2020, Maher 2011, Tutt 2008). Dry periods due to seasonal, yearly and decadal variations in rainfall have resulted in lowered groundwater levels, oxidation and mobilisation of acidity and metals. The first major rainfall events after these dry periods then mobilise poor quality water down the catchments, past the mine site to the estuary. It is important to note that the oxidation and release of acidity and metals from the ASAs to receiving waters within the Anglesea River and Salt Creek catchments is a continual process.

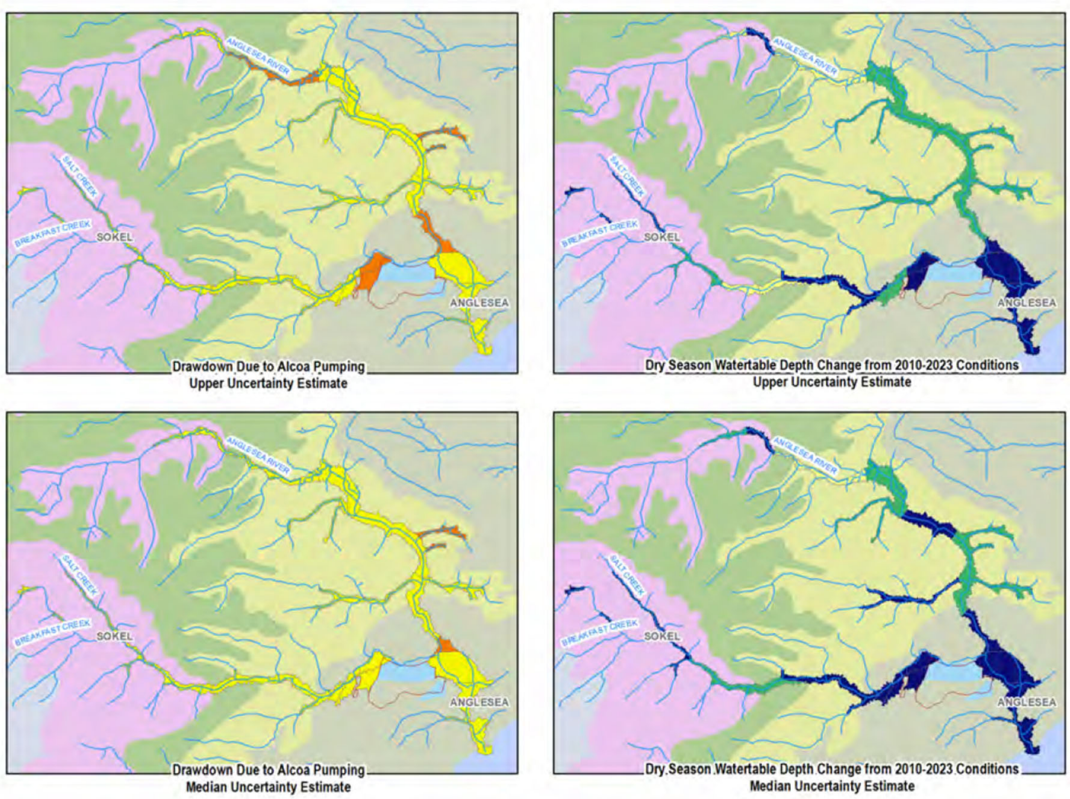
Alcoa developed a risk assessment and impact assessment based on the evidence and data presented, predictive scenarios in the groundwater model and conceptual models of acid generation and transport.

The independent ITRP review previously recommended improvements to the modelling of scenarios, analysis of model outcomes, and some clarifications to the risk assessment. The improvements that were then implemented by Alcoa have improved the reporting of potential impacts. However, the outcomes reported warrant further clarification to more clearly present and evaluate the risk of additional acid generation associated with drawdown in some areas of the ASA.

The modelling shows that hydrological and acid generating processes in the ASA are driven predominantly by climatic effects and that ASA drawdown due to UEVF pumping at 1.5 GL/a is small. For example, Figure 6 below shows <0.1m incremental or 'unpacked' effect due to Alcoa pumping only for medium climate change (yellow areas), but some areas up to 2m drawdown (orange) in the mid-Anglesea catchment. Such additional moderate drawdown would drive additional oxidation of sulfidic sediments and acid generation processes outside the mine area.

The ***ITRP review is not confident that the modelled impact of proposed pumping on drawdown in the ASA would not contribute to acid generation*** (when compared to natural water table fluctuation). For example, the GIA Figure 7-5 caption does not clearly highlight the green areas (right frame) where it is probable that groundwater levels would be 0.1 to 2 m lower than historical conditions (i.e. high risk of acid generation). The left frame shows (orange) areas of Alcoa-only drawdown of 0.1 to 2 m in the mid-Anglesea swamps that align with the predictions of lower than historical water table levels (i.e. also high risk). These mid-swamp areas also host the persistent pools AGP2 and ASP7, as discussed later.

Figure 6 - Model scenarios projecting water table drawdown in the ASA due to proposed groundwater pumping. (from GIA 2025, Figure 7-5).



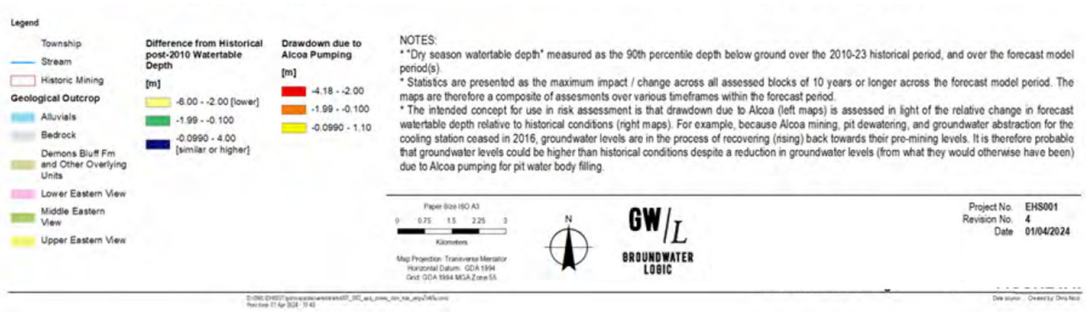


Figure 7-5 Modelled P10, P50, and P90 of Maximum Drawdown (Median Climate Change)

Also, Figure 7-13 (median climate change) and Figure 7-15 (high climate change) attempt to show seasonable variability of the water table compared to Alcoa-only pumping. However, these results are averaged over long time periods (e.g. years 1-10, years 11-21), which does not show the magnitude and duration of any intervening periods of greater drawdown (risk factor) effects (e.g. as was clearly shown in the Barwon Water scenarios; GHD 2024b).

These areas are not reported by GIA 2025 as high risk because the risk assessment criteria for acid generating events (GIA 2025, section 8.1.2) uses drawdown and its seasonal variability at two specific ASA bores (WTOB1 and WTOB2) rather than the spatial drawdown plots shown above (along with the zero-flow days criterion). The P50 Alcoa-only drawdowns at these two bores do not exceed the 0.1 m minor consequence criterion for the median or high climate change scenarios (e.g. GIA Figs 7-2, 7-8). However, the predicted water table depth seasonal range due to Alcoa-only pumping does extend into the moderate consequence range of 0.1 to 1 m (e.g. GIA Fig 7-12, 7-14), indicating water tables deeper than historical observations, which would very likely invoke a high risk of acid generation events.

In summary, while the risk assessment uses reasonable proxy hydraulic indicators (drawdown) at WTOB1 And WTOB2 (along with the zero-flow days criteria), it does not consider spatially mapped drawdown metrics that are readily available for other sensitive swamp areas (such as persistent pond locations in the mid-Anglesea catchment). The ITRP reviewers subsequently requested additional data and analysis which was provided in December 2025 (EHS 2025b), showing more granular detail on drawdown than the aggregated/averaged plots presented in the GIA (2025), as discussed later.

The projected small to moderate additional drawdown ***could be materially significant*** because of the additional acid generation and associated additional metals that can be mobilised to Salt Creek and the Anglesea River catchments. However, it is not possible to quantify the changes in pH and metal concentrations in the surface waters, as this detail is beyond the design capability of the current models, which currently use drawdown as a 'proxy hydraulic indicator' of acidity risk.

4.5.3 Risks on surface water and groundwater associated with pit filling

In summary, the ITRP advise that there are three different areas of potential connectivity of the mine water body and associated levels of risk for waterways and aquifers.

1. In simple terms, the mine water body is ***within a 'bathtub' that is generally hydraulically disconnected*** from aquifers and waterways. The mine water body is predicted to behave as a hydraulic sink, rather than as a source of pollution (from reactive 'bath wall' geochemistry) to aquifers and waterways in the catchment. Site data and modelling predictions presented in GIA 2025 suggest that there will be no potential impacts of the mine water body on the waterways or the ASA aquifer.

2. Evidence indicates a negligible risk to aquifers from hydraulic connections through small areas of the pit floor. This is ***like a small 'plughole' in the base of a 'bathtub' that is not plumbed to any system*.** There are direct seepage pathways through 'shoe-string' sands, and where the basal clay was removed during operations, but these features are of limited extent and do not appear to be hydraulically connected beyond the pit area. The flux exchange through these features would occur irrespective of the pit filling strategy (i.e. natural or rapid fill).

3. However, there is a plausible small seepage path that could develop at a later stage of filling, from the mine water body to the Lower Anglesea River area. Such a seepage path**, *if it exists, is like a small 'plughole' at a high level on the side of a 'bathtub' with uncertain connections*.** The consequences of this small seepage on water quality could not be evaluated with the available data and modelling.

The ITRP review of GIA 2025 has ***not found hydrogeological information or suitable model scenarios investigating potential impacts of plausible pathways for seepage*** from the mine water body to waterways. Records are required for the lithology or permeability testing of the ***backfilled materials in the former channel of Lower Salt Creek***, and other plausible pathways for seepage between the mine water body (at elevations >0 m AHD) and waterways and alluvium near the original confluence of this creek with the Anglesea River (see Figure 7).

Figure 7 - Locations of plausible pathways for additional evaluation. *(from 'Anglesea Mine Rehabilitation and Closure Plan' for consultation, June 2017, annotated by ITRP)* a) Concept sketches of a flow-through pit lake that would be re-connected to the River, with at least two low elevation areas that were backfilled with DBF materials, between areas of undisturbed DBF materials. b) Satellite photo showing former Lower Salt Creek Channel and confluence with Lower Anglesea River.

A monitoring bore (MB5) in the UEVF and DBF is located near one of these potential pathways. The second of these potential pathways is located between MB5 and MB4. The characteristics of these plausible seepage pathways with hydraulic connection, are summarised as follows:

- There appears to be plausible pathways for hydraulic connection laterally through the upper part of the backfilled materials on the eastern side of the mine pit, along the former channel of the Lower Salt Creek to the Lower Anglesea river.
- There is a lack of evidence of low permeability design and site testing of re-worked materials in this area that was backfilled prior to a change in concept for mine closure (since 2017) from a mine water body that was 'through flow' to a predicted 'hydraulic sink'.
- The potential for seepage through this small area of backfilled material was not evaluated by regional model scenarios or local scale SEEP/W modelling.
- Seepage appears to be plausible through this area when the water levels in the mine water body are higher than water levels in the DBF near the pit and Lower Anglesea

River. The potential for seepage in this area is higher during the late stages of filling of the mine water body, between RL ~1 m (i.e. 1 m above 0 mAHD), and at 'full stage' of approximately RL 5 m.

- If seepage occurs through backfilled material, it will not be detectable for years, if not decades, if at all. The precautionary principle should therefore be applied to evaluate this plausible pathway, with monitoring and mitigation if required.
- If seepage occurs from the mine water body with poor water quality (pH ~3.5 and dissolved metals), it might (or might not) impact water quality in a waterway or shallow aquifer. ***The consequences of a plausible seepage on surface water quality are uncertain*** given highly uncertain water quality of the mine water body (Section 4.3), and also additional water-rock-sediment interactions along the flow path and mixing with surface waters that could potentially occur.

The ITRP reviewers requested additional data and analysis which was subsequently provided (EHS 2025b). The new information indicated **a low but not zero risk** of a plausible seepage pathway at high water levels towards waterways, and confirmed a data gap for permeability in the former channel area of Salt Creek. The elevation DEM provided indicated an invert level of the creek at about +2mAHD adjacent to MW38 at the 'pinch point' of the Lower Anglesea River. While that has not yet been verified with field survey data, and it is not known whether this is the lowest point of the channel in this area, there appears to be only a few metres of head difference between the predicted pit full water level to the closest point of the waterway, over a distance of 0.6 km. Under such conditions, the hydraulic gradient driving the potential for seepage would be low, although the possibility of a permeable seepage pathway has not been ruled out.

Groundwater level data was provided for this area between the pit water body and the creek indicating a relatively high water table (the MW72 'saddle' area). This suggests a flow divide in the backfill area and thus a low risk of seepage to waterways from the pit water body at near-full and 'full' water levels (ie. above 0 mAHD). The ITRP recommends that the modelling should investigate whether the nominal flow divide in the backfill area would be maintained under a range of future environmental conditions to confirm whether the seepage risk may be effectively avoided.

Additional modelling and evaluation are recommended to determine the risk to waterways, if any, as follows:

- Modellers are recommended to adopt the hypothesis that such a pathway exists (or doesn't exist). This should be followed by predictive uncertainty modelling to quantify the potential impacts (flux volumes and water levels) and probabilities under a range of future environmental conditions that can be used for risk assessment.
- If a material risk of such potential seepage is confirmed, the ITRP recommends consideration of site monitoring (refer to Section 5.5) and/or mitigation actions, commensurate with long-term risks and the precautionary principle. For example, a low permeability barrier could be installed before the mine water body fills to an elevation where the potential for impacts increases to an unacceptable risk.

4.5.4 Risk of broader ecological impacts

Broader ecological impacts could occur either from drawdown effects of proposed groundwater extraction, or from potential connectivity of the mine water body to waterways and aquifers, including swamps, rivers and the estuary.

The ITRP review notes that the fill level of the mine water body is about 4-6 metres below the spill point to Marshy Creek at around +10mAHD[4], so there is ***negligible risk of direct overflow*** of the mine water body during wet periods that may cause broader ecological impacts.

As indicated in Section 4.5.3, the risk of potential connectivity of the mine water body ranges from negligible to plausible, depending on the potential impact pathway. There may or may not be associated risks of broader ecological impacts, depending on the further evaluation of the plausible seepage pathway, which has not yet been adequately investigated.

The ***ITRP review is not confident that two permanent/persistent pools will not be adversely affected by the projected drawdown in the ASA***. Two pools are located in the mid-Anglesea swamps are within the areas of 0.1 to 2 m projected drawdown that could affect sensitive ecological receptors. The pool AGP2 is located on the pumping bore side of the anticline, and within ~3km of the pumping bore (Figure 4-2, GIA 2025). The pool ASP7 is located on the other side of the anticline to the pumping bore, but within the <2m mapped drawdown of the ASA (e.g. compare Figure 4-2 from GIA 2025 with Figure 6 of this report).

Whilst noting the uncertainty of the projected drawdown from Alcoa-only and cumulative effects, the ITRP review is not confident that these pools will not be adversely affected. This is important as these habitats are noted to be of high ecological value for fauna such as Southern pygmy perch. No information on the relative sources of water, or connectivity of the pools with the ASA could be located, although the GIA states (without evidence) that the pools 'are not connected to groundwater'. The ITRP review could not locate environmental tracer (e.g. isotopes) data specifically for these two pools and it is not clear if these pools have been monitored for changes, if any, in depth, extent or ecology.

The ***change in zero flow days risk criteria indicates the potential for broader ecological impacts due to pumping and is a useful metric to combine with the drawdown criteria***. The zero-flow day metrics were mostly found to indicate a high risk, but were higher for high climate change scenarios in the Anglesea River and Salt Creek catchments. This could be very significant to the ecology of the system where zero-flow days increase in frequency or duration, as this threatens shallow areas drying out and the refugia nature of these pools is removed. Additional impacts occur when zero flow days are combined with acid generating events. Risks of reduction in surface water flows for Alcoa-only pumping (GIA 2025, Table 8.10) were mostly found to be a low risk, but were elevated risks with cumulative pumping.

The ITRP reviewers requested additional analysis which resulted in updated plots of drawdown impacts that provided more detailed and localised information on drawdown in the ASA than the aggregated spatial/temporal plots presented in the GIA (2025). **This new information (EHS 2025b) confirmed there was indeed likely to be significant groundwater drawdown in the ASA resulting in risks of acid generation and potential environmental consequences, including impacts on biota**.

This new information (EHS 2025b) shows extensive effects in some ASA segments (notably including the area of permanent/persistent pools in the mid-Anglesea swamps) that persist 100% of the time for multiple years due to drawdown of 'Alcoa only' proposed extraction of groundwater. The potential consequences for acid generation have not been quantitatively estimated for change in pH and metals in the Lower Anglesea river during flow events.

For example, the new information presents P50 results in Figure 10 and associated discussion, from which the ITRP conclude that the largest drawdown impacts are predicted in 2040 and occur 100% of the time over several years at the following magnitudes and extents:

- 0.1 to 0.2 m drawdown across 15.9% of the ASA segment or 58,362 m^2.
- 0.2 to 0.5 m drawdown across 7.2% of the ASA segment or 26,636 m^2.

[4] GIA (2025), section 1.1; noting the ~2 metre predicted annual range in the level of the mine water body (GIA (2025), section 7.3.1)

There are clear potential ecosystem impacts for long periods (6 months) of increased acid generation, such as:

- Resident fish fauna (e.g. southern pygmy perch - already occurring in a low pH environment that other populations don't exist in, but are not long lived) and the estuary species (e.g. black bream) which rarely swap between estuaries.
- Each estuary fish kill is likely leading to significant loss of genetic diversity and longer term local extinction. Other species may recolonise when conditions improve but estuarine resident species may in fact disappear under a regime of increasing frequency, duration and extent of acid events. There are likely to be other ecosystem impacts in the freshwater and estuarine reaches of the Anglesea River.

These new P50 drawdown results for the ASA due to 'Alcoa only' proposed extraction of groundwater show potential conditions for acid generation and 'fish kill' events. The new P90 drawdown results for the ASA indicate more extensive consequences (though much lower likelihood) than the P50 drawdown results.

The ITRP conclude:

- Although acid generation and 'fish kill' events may be naturally occurring in this catchment (with its unique geology), the proposed Alcoa-only groundwater extraction appears to **increase the frequency, extent and severity of:**
  - **acid generation** (as a result of ASA drawdown exposing ASA soils to oxidising conditions, release of ferrous iron to receiving waters by flushing rains and oxidation of ferrous iron to ferric iron and depletion of dissolved oxygen in receiving waterways) **and**
  - **'fish kill' conditions** (including oxygen depletion within the Anglesea River and Salt Creek waterways as a result of oxidation of ferrous iron to ferric iron)
  - There is a high degree of uncertainty regarding hydro-geochemical processes in this catchment, so assumptions on the timing, rates and duration of sulfide formation and acid generation are required. Acid generation with oxidation of the ASA and drawdown of the water table is uncertain.
- Predicted groundwater level drawdown in the ASA with 'Alcoa only' pumping indicates that it may be prudent to invoke a ***precautionary approach to find alternative sources of water and/or rehabilitation options*** for this mine pit instead of extracting of groundwater from an underlying aquifer (UEVF).

- It is questionable to rely on adaptive management (e.g. triggers for groundwater levels in the ASA) to manage risks of potential environmental consequences, given the time lags and natural sensitivity of this environment with high acidity. Section 5 further considers this issue in the context of monitoring and management.

4.5.5 Risks relating to the delay in groundwater recovery

The modelling results show that the aquifer recovery is somewhat delayed due to the extraction for rapid filling purposes. However, this is predicted to occur only in a very limited sense, within about 1 km of the WB16 pumping bore, and only for the 10-year pumping period and the subsequent 5 years (15 years total). Even then, only the Lower Sands unit of the UEVF is materially affected, and that is not known to directly support any GDEs.

The ITRP found this assessment and the results to be ***reasonable and adequately justified***. It is worth noting that there are other effects that enhance recovery on a local scale near the mine, such as minor leakage from the mine void water body filling process that actually speeds the recovery of the adjacent aquifer units.

4.5.6 Risk to existing users (including Barwon Water BE)

There is ***negligible risk*** to existing consumptive users in the Anglesea catchment of the proposed groundwater take.

Barwon Water are authorised to extract from the deep LEVF aquifer, and there is one other relatively small volume licence at a quarry in the far north of the catchment. There is limited hydraulic connectivity between the UEVF and LEVF, with small drawdown interference and time lags involved, as identified during the long term pumping test and detailed modelling. The LEVF is a deep aquifer that is confined by multiple aquitards, and separated from the UEVF by low permeability aquitards of the MEVF in the lower to middle parts of the catchment, but not in some upper catchment areas, where it can underly the ASA.

4.6 Uncertainty in the impact and risk assessment

The level of uncertainty in the impact assessment ***is acceptable***, ***based on best practice approaches***, in predicting potential groundwater drawdown and associated potential impacts on waterways and aquifers across the catchment. There are inherent uncertainties in geological materials and processes that occur below the ground, and in future variability of rainfall and other climatic conditions that drive many of these processes. A best practice probabilistic approach to groundwater modelling has accounted for uncertainties due to natural processes and for groundwater extraction.

The level of uncertainty in the impact assessment ***is acceptable though subject to limitations,*** regarding the potential for acid generation and ecological impacts to waterways and aquifers. The groundwater model was not designed to directly model these processes in the waterways including creeks and the estuary, however there is ***a reasonable degree of confidence in using modelled groundwater drawdown as a proxy for the assessment of impacts*** given the extensive monitoring and investigations across the catchment.

While drawdown is a reasonable proxy indicator, the ***ITRP review is critical of the risk assessment criteria for assessing the potential for acid generation in the ASA***, as explained below. These criteria were presented in the GIA (section 8.1.2, page 170 of PDF) for the ASA water table at key shallow monitoring bores with reasonable historical range (i.e. the 2010 to 2023 period exhibits reasonable hydrological variability through extended dry and wet periods, and pumping and non-pumping periods) with the following consequences:

- ***Minor consequence***, where ***no more than 0.1 m greater*** than historical range, in isolation of other pumping or climatic influences) and/or no reduction in observed zero-flow days.
- ***Moderate consequence***, where ***0.1 to 0.5 m greate*****r** than historical range, in isolation of other pumping or climatic influences) and/or ***0-10 % reduction*** in observed zero-flow days.
- ***Significant consequence***, where ***>0.5 m greater*** than historical range, in isolation of other pumping or climatic influences) and/or ***>10 % reduction*** in observed zero-flow days.

The ITRP members note that acid generation can occur at <0.1 m beyond historical drawdown and oxidation depth and thus could exceed 'minor' consequence level, regardless of the cause of the stress. That is to say, a 'low' risk rating doesn't preclude events due to the additional effects of stress associated with groundwater pumping. Furthermore, Figs 7-5 and 7-10 in the GIA 2025 (see Figure 6 above) show that the ***predicted drawdown exceeds 0.1 m and is up to 2 m across extensive areas*** (i.e. the yellow areas on the left frame), while similar areas show the same or greater than historical depth to water table (i.e. up to 2 m in the green areas on the right frame). As discussed above in section 4.5.4, new information (EHS 2025b) shows extensive effects in some ASA segments (notably including the area of permanent/persistent pools in the mid-

Anglesea swamps) where effects are predicted to persist 100% of the time for multiple years due to drawdown of 'Alcoa only' proposed extraction of groundwater.

A ***conventional risk assessment matrix outcome of 'low risk' therefore doesn't preclude impacts*** of acid generation on fresh waters and the estuary that ***could actually result in 'moderate risk'***. The event-specific conditions and impacts of acid generation would depend on complex factors that are not directly modelled by the groundwater model. It is also important to note that the oxidation and release of acidity and metals from the ASAs to receiving waters within the Anglesea River and Salt Creek catchments is a continual/ongoing process.

5. Proposed Monitoring and Management

The ITRP has reached the view that ***while a relatively small volume of groundwater is proposed to be extracted from the UEVF*** (1.5 GL/a for a period of 10 years), ***it is now clear that there are material risks for increased acid generation from the ASA***. If the proposed groundwater extraction was to be approved with these material risks, additional field and modelling studies to quantify the impacts of increased acid generation would be required to adequately justify the decision, and more substantial monitoring and management of ASS would be warranted.

The monitoring plans outlined appear to have been progressing in a satisfactory manner (noting that the ITRP has not been involved in that process), but as this ITRP review has outlined herein, there are some areas of material risk that have not been adequately addressed. Further review of the adequacy of monitoring and management plans will be required after these are submitted with the Mine Closure Plans, whether or not the proposed groundwater extraction is approved.

The ITRP reviewers note that an Acid Sulfate Soil Management Plan is triggered when net acidity >18 mol H^+/t where ***groundwater extraction should be avoided*** (Wong et al 2020). National guidance for such high net acid environments are to avoid disturbance of acidic materials (Sullivan et al 2018, Shand et al 2018), and for more focused site investigation and management if disturbance is large (>1000 m^3 of materials). The new information on predicted groundwater drawdown (EHS 2025b) summarised in Section 4.5.2 of this report indicate drawdown impacts of 0.2 to 0.5 m over at least 26,636 m^2 that persists 100% of the time for several years for the P50 case of medium climate.

This new information on groundwater level drawdowns has not been integrated with existing information and geochemical data (Wong et al 2020) to enable quantification of risks of acid generation and the increased frequency and severity of fish kill events or other potential impacts to the environment or ecosystems. Monitoring and mitigation that is proposed addresses many of the key risks of the proposed pumping to the aquifers and waterways. However, the monitoring focus needs to be refined in the ASA in the mid part of the Anglesea River, where there is ***an elevated risk that may be attributed to multiple stresses, but which the latest analysis (EHS 2025b) has shown can be directly attributed to Alcoa's proposed pumping.***

The ITRP generally supports the proponent's monitoring plan methods that are proposed to include:

- Daily groundwater level loggers
- Nested multi-level groundwater observation bores in the mid Anglesea River catchment with more than 10 years of data will be part of continuous monitoring.
- Daily groundwater level monitoring in ~25 monitoring bores that target different aquifers in the lower and mid catchments of Anglesea River and Salt Creek.
- Trigger levels for groundwater (e.g. for a cessation of pumping, see below) to be developed using USEPA methods for confidence limits of 95%, with a series of contingency steps to follow if there is an exceedance to evaluate if the change is real or due to errors or other factors not related to Alcoa pumping.
- Quarterly sampling of water quality is proposed for the mine water body. However, annual water quality sampling of groundwater monitoring bores should also be included.

If the proposed groundwater licence is approved, the following management actions could be considered:

1. ***Installation of new multi-level groundwater monitoring within backfilled mine materials along the former channel of Salt Creek***, between the mine water body and Anglesea River. There should be monitoring of at least two locations from west to east along the former creek channel to provide 'early' warning, with hydraulic testing

and ongoing monitoring of water levels and groundwater quality. These can be located to complement existing nearby monitoring bores MB5 and MB4, either directly in the centre of the potential pathways, and/or located at different distances along the same potential pathway. The horizontal hydraulic conductivity of this material should be determined and compared with model parameterisation within this former channel, and implications if any for modelled scenario outcomes. Regular monitoring of groundwater levels and water quality including pH, major ions including alkalinity, sulfate and chloride, trace elements including metals (Fe, Al, Mn, Zn) and dissolved organic carbon.

Dissolved organic carbon (DOC) is important as part of evaluating the bioavailability of potential toxic concentrations of elements. DOC in soils also acts as a crucial energy source for sulfate-reducing bacteria facilitating the anaerobic reduction of sulfate to sulfide under submerged or waterlogged conditions. This process is dependent on anoxic conditions, with high DOC concentrations promoting sulfide accumulation, which can in turn, react with metal ions (i.e. iron) to form metal sulfides a key component of acid sulfate soils.

2. The groundwater ***model is suitable for use in a data worth analysis to identify optimum sites for filling gaps in the monitoring network*** (e.g. in the ASA, such as in the lower catchments to augment the existing bores WTOB1 and WTOB2). The ITRP reviewers also recommend additional modelling and evaluation to determine the risk to waterways, if any
    a. Modellers are recommended to adopt the hypothesis that such a pathway exists (or doesn't exist). This should be followed by predictive uncertainty modelling to quantify the potential impacts (flux volumes and water levels) and probabilities under a range of future environmental conditions that can be used for risk assessment.
    b. If a material risk of such potential seepage is confirmed, the ITRP recommends consideration of site monitoring and/or mitigation actions, commensurate with long-term risks and the precautionary principle are recommended. For example, a low permeability barrier could be installed before the mine water body fills to an elevation where the potential for impacts increases to an unacceptable risk.

3. ***The ITRP review supports the proposal in GIA 2025 to develop a trigger event that results in 'cessation of pumping'*** *(Section 10.2, Figure 10-2).* The application of this trigger in practice needs to be considered further, including criteria of depth to the saturated zone (re-oxidised materials) and drawdown beyond a historic new low *(i.e. deeper than the previous maximum depth*) predicted in the ASA in the mid-Anglesea catchment and/or Salt Creek. The continual process of oxidation and release of acidity and metals from the ASAs to receiving waters, which would be exacerbated by additional drawdown that has been attributed to Alcoa-only pumping, has not been adequately considered.

    Given the time lags involved in groundwater processes, such adaptive management can be problematic and requires detailed consideration for success in practice. It is questionable to rely on adaptive management (e.g. triggers for groundwater levels in the ASA) to manage risks of potential environmental consequences, given the time lags and natural sensitivity of this environment with high acidity.

    It is not clear that groundwater pumping could recommence when the depth to the saturated zone returns to within the range of previous data recorded in these areas of the ASA. In reality, a trigger could occur during record dry periods when these sensitive receptors are under stress with a high risk of naturally oxidising acid sulfate sources. Note that 'historic low water levels' were one of five triggers during the pump test in 2021 (Table 3-2, water level trigger rules, GIA 2025, EHS 2021 pumping test monitoring plan).

4. ***Water quality monitoring upstream and downstream of the mine site*** (upper catchment sites and mid/lower sites AV1, AV2; downstream SP3/AR1) is important as part of an 'early warning system'. Downstream monitoring locations should be located below the original confluence of Salt Creek and above any tidal influence, while another downstream location could coincide with a Water Watch site for basic monitoring (e.g. open culverts under Coal Mine Road, near the top of the estuary). The parameters should include all field parameters, major ions including alkalinity, acidity, sulfate and trace elements including metal ions and dissolved organic carbon. Dissolved organic carbon is important as part of evaluating the bioavailability of potential toxic concentrations of elements (see also comments in bullet #1 above).

5. ***Groundwater quality monitoring and water quality triggers for the extracted groundwater <u>before and after discharge</u> to the mine water body and monitoring of selected monitoring bores.*** Regular monitoring of extracted groundwater quality, at the point of pumping prior to discharge into the mine water body (and within the mine water body) should be undertaken at the same time as surface water quality monitoring. Annual water quality monitoring should also be undertaken in the same groundwater monitoring bores proposed for water level monitoring. The parameters should include all field parameters, including pH, EC, DO, major ions including alkalinity, acidity, sulfate, Ca, Na, K, Mg, and trace elements including key metal ions and dissolved organic carbon.

Evaluation, mitigation and management of water quality in the mine water body is not within the scope of this report.

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7. Appendix A – Glossary

7.1 Glossary of key terms used in this report

Table 2 - Glossary of key terms

Term	Description
Adaptive Management	An approach to natural resource management that comprises implementing management action, monitoring and evaluating outcomes and systematically adapting those actions according to what is learned.
Artesian	The potentiometric groundwater level is above the ground surface level, usually within a bore casing that has a deep intake screen within a confined aquifer. Note: An artesian spring, with seepage at the surface can occur where there is a leakage pathway through an aquitard from a deep and confined aquifer (e.g. via a geological fault). However, many springs are seepages from shallow water tables or perched aquifers. These local groundwater flows occur during wet periods and are not 'artesian'.
ASA	Alluvial Swamp Aquifer (swampland sediments)
ASS	Acid Sulfate Soils
calibration / history match	The modification of model input data in a systematic fashion (e.g. aquifer and aquitard parameters, recharge, boundary conditions) and repeatedly running the model over the history-match period until the model output matches measured data within an acceptable level of accuracy.
CHM	Conceptual Hydrogeological Model - a simplified and idealised representation (usually graphical) of the physical hydrogeologic setting and our hydrogeological understanding of the essential flow processes of the system; includes the identification and description of the geologic and hydrologic framework, aquifer media type, hydraulic properties, sources and sinks, and important aquifer flow and surface-groundwater interaction processes.
Confined aquifer (or unconfined aquifer)	**A confined aquifer** is overlain by low permeability aquitards, with a potentiometric groundwater level that is above the top of the aquifer. For example, a groundwater level change in a confined aquifer is not associated with any change in overlying aquifers or waterways or rainfall. **In contrast, groundwater level change in an unconfined aquifer (or water table)** is directly related to rainfall and other changes. **Partly-confined or 'leaky' aquifers** have hydraulic properties of both confined and unconfined aquifers, based on multiple lines of evidence.
EVF (EVF, UEVF, LEVF)	Eastern View Formation (EVF, Upper EVF, Lower EVF)
Fit for purpose	Peeters and Middlemis (2022, in press) propose a model as fit for purpose when it is useful, reliable, and feasible for its given context. A groundwater model can be considered fit

	for purpose in the context of impact assessment for coal mines and coal seam gas developments when it provides: • objective evidence that the uncertainties affecting decision-critical predictions of impacts on aquifer resources and dependent systems are not underestimated, and; • information about uncertainties in the conceptualisations and model simulation outputs in a way that allows decision makers to understand the effects of uncertainty on project objectives (echoing the AS/NZS ISO 31000:2009 risk definition) and the effects of potential bias.
Groundwater Dependent Ecosystem (GDE)	Ecosystems that require access to groundwater on a permanent or intermittent basis to meet all or some of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services. GDEs include terrestrial vegetation, wetlands (swamps, lakes and rivers) and ecosystems in aquifers and caves.
GMA	Groundwater Management Area
Model – conceptual	See also CHM - Conceptual Hydrogeological Model. A descriptive and/or schematic hydrological, hydrogeological and ecological representation of a site, environment or process showing the stores, flows and uses of water, which illustrates the geological formations, water resources and water-dependent ecosystems. It provides a basis for developing water and salt balances and inferring water-related ecological responses to changes in hydrology, hydrogeology, and water quality.
Model – numerical	Computer codes that enable simulation of physical systems and processes such as groundwater and/or surface water flow and can be applied to assess the potential impacts of a project or management plan. Similar to analytical models in that they make simplifying assumptions; however, features of the governing equations and boundary conditions in numerical models (e.g., aquifer geometry, hydrogeological properties, pumping rates or sources of solute) can be specified as varying over space and time. This enables more complex representations of groundwater or surface water systems than could be achieved with an analytical model.
Quantity of Interest (QoI)	A model outcome from a specified model scenario, with a predefined spatial and temporal setting, that is relevant to assessing the likelihood and consequence of a causal pathway element representing a hazard. An alternative term is 'key prediction or scenario forecast'.
sustainable groundwater extraction	The groundwater extraction regime, measured over a specified planning timeframe, which allows acceptable levels of stress and protects the higher value uses that have a dependency on the water.
DELWP	Department of Environment, Land, Water and Planning
DEECA	Department of Energy, Environment, and Climate Action
DJPR / ERR	DJPR-ERR was previously known as Department of Jobs, Precincts and Regions - Earth Resources Regulator, and it has now been incorporated into DEECA

Inter-Agency Group (IAG)	comprises representatives from DELWP, SRW and DJPR/ERR who have shared responsibilities for, and interest in, various aspects of groundwater management in the Jan Juc GMA
SRW	Southern Rural Water One of four rural water corporations in Victoria. Responsibilities include the regulation of surface water, groundwater licensing and dams and managing the bulk entitlements for environmental water, power generation companies and the raw water for some regional and urban water corporations to treat for drinking water.
TRP	Technical Review Panel appointed by DELWP
ITRP	Independent Technical Review Panel appointed by SRW