Submission from the Maules Creek Community Council (MCCC)

Maules Creek Coal Mine

Continuation Project

Project Application Number: SSD-63428218

4.8.2025

Photo 1: Pit lake with discharge pipes from pit pumps. 27 April 2018 - Before drought was declared

Photo 2: Pit pumps pumping groundwater welling up in the explosives drillholes 21 June 2018

"There is no credible hydrogeological evidence indicating that the bore drawdowns [...] are the result of anything other than the combination of rainfall and inadequate aquifer storage" - Whitehaven Coal, 2019. (Hannam, P. *(*2019, November 6*)*)

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Introduction

This submission is made on behalf of the Maules Creek Community Council (MCCC) in response to the proposed Maules Creek Coal Mine Continuation Project (SSD-63428218). It reflects more than a decade of lived experience, documented evidence, and independent expert review. While the proponent seeks approval now for an expansion that will not commence until 2034, our community continues to face the day to day consequences of the mine's existing operations; declining groundwater, loss of neighbours and farmland through land acquisition, environmental degradation, and the slow erosion of our social fabric.

We question the need for this project at all. In ten years' time, the world will be further advanced in the transition away from coal. The impacts of climate change are already more severe than predicted in 2011, and it is virtually certain that the 2 degree global warming limit will be breached. This project locks in another decade of uncertainty, risk, and avoidable harm, while ignoring opportunities for proactive post-mining planning and community renewal.

Many of the concerns MCCC raised during the original 2011 assessment remain unaddressed; air quality, health, noise, groundwater depletion, biodiversity loss, and the unresolved final void. Independent hydrogeological review confirms that key groundwater modelling assumptions are unsubstantiated, monitoring is incomplete, and modelled predictions understate the true risks to the Maules Creek Alluvium. Social impact analysis has proven to be more of a procedural requirement than a genuine planning tool, disconnected from the reality we live with and unlikely to alter the company's plans.

Maules Creek is not just a coal resource. It is a rural community with solid social capital, productive farmland, and a history worth protecting. We have existing housing stock, much of it on mine-owned land, that could be refurbished and repopulated, restoring vitality and supporting economic diversification. With strategic investment in water security infrastructure now, including a climate-resilient pipeline to offset mine depressurisation, Maules Creek could share in the regional growth opportunities created by Inland Rail and take pressure off neighbouring centres such as Narrabri.

This submission calls for the Department to recognise that the impacts of this project are already being felt, that the SIA and SIMP fail to address the most serious social and environmental risks, and that delaying closure by another decade without delivering durable community benefits is unacceptable. The recommendations that follow set out a pathway for genuine community led planning, climate adaptation, and regional revitalisation, a pathway that serves the public interest rather than prolonging the private gain of the proponent.

Executive Summary

The Maules Creek Community Council (MCCC) opposes the approval of the Maules Creek Coal Mine Continuation Project (SSD-63428218) on the grounds that it is unnecessary, high-risk, and fails to deliver credible social or environmental benefits. The expansion is not required until 2034, yet its impacts are already being felt in our community. Extending the mine's life to 2045 would prolong environmental harm, social fragmentation, and uncertainty while ignoring opportunities for a managed, just transition to a post-mining future.

Groundwater security is our most urgent concern. Independent hydrogeological review confirms that the proponent's modelling is based on unsubstantiated assumptions, underestimates drawdown in the Maules Creek Alluvium, and fails to account for key risk areas north of the mine. Monitoring is incomplete and poorly designed, with major data gaps where the coal seams likely subcrop the alluvium. The 2018 bore failures, when over 30 local bores ran dry, many before a drought was declared, demonstrate the failure of predictive models, triggers, and the Water Management Plan to protect our water supply.

The proposed Inter-Mine Water Transfer Pipeline is a clear example of the proponent's disregard for community concerns. Rather than addressing the causes of aquifer depressurisation, the pipeline would export precious groundwater out of the valley, masking real impacts and undermining local water security. Its omission from the Social Impact Assessment (SIA) is further evidence that consultation is treated as a procedural box tick, not a genuine dialogue.

Social impacts since the mine's commencement have included depopulation through land acquisition, the decay of mine owned housing, loss of farming enterprises, and the erosion of local organisations and services. The 2025 SIA and Social Impact Management Plan (SIMP) fail to engage meaningfully with these impacts, ignore cumulative effects, omit climate change entirely, and offer no credible plan for post-mining revitalisation. Independent peer review concludes that the SIA cannot be accepted without durable, deliverable response measures.

Biodiversity impacts will be severe and irreversible, particularly for Critically Endangered Box-Gum Woodland and foraging habitat of the Swift Parrot. Expert review finds the project fails key tests under the Biodiversity Conservation Act 2016 and underestimates extinction risk.

The MCCC calls on the Department to:

- Reject approval until a revised, independently verified groundwater model is completed.
- Abandon the Inter-Mine Water Transfer Pipeline.
- Require a revised SIA with genuine community participation.

- Mandate a binding social transition plan, re-population strategy, and climate resilient water infrastructure to offset mine depressurisation and support long term regional growth.
- Ensure that final void design and biodiversity offsets are reassessed against best practice environmental and climate adaptation standards.

This project is not in the public interest. The Department must use this moment to protect Maules Creek’s water, land, and community, and to invest in a sustainable future rather than prolonging harm for another decade.

Recommendations

Recommendations are provided throughout the Submission and Appendices

Groundwater Impact Assessment – Third Party Review

The MCCC commissioned a Independent Third-Party Review of the Maules Creek Continuation Project by Hydrogeologist.com.au, 29 July 2025. The Excellent Third Party Review can be found in Appendix A.

Key Findings

Hydrogeological Conceptualisation

The conceptual model presented by AGE (2025) assumes a hydraulic disconnection between the MCA and the underlying coal seams, mediated by a weathered regolith. However, the third-party review finds this unsupported by field data and inconsistent with earlier geological interpretations (e.g. Pacific Coal, 1982).

Multiple conceptual cross-sections (B-B', D-D', E-E') show disconnected or ambiguous flow paths, often unsupported by bore data or groundwater level gradients.

The role of the weathered regolith as the primary lateral flow path is repeated but not substantiated by direct measurements of hydraulic conductivity, water levels, or quality data (Hydrogeologist.com.au (2025), p. 26-27).

Numerical Modelling Limitations

The model setup appears biased to minimise drawdown in the alluvium:

- Layer 1 (Narrabri Formation) has a low specific yield (0.008).
- Layer 2 (Gunnedah Formation) has a very high Sy (0.25).

This configuration causes artificial buffering of depressurisation, which could conceal actual mine-induced drawdown effects (Hydrogeologist.com.au (2025), p. 32).

Application of the Edelman analytical solution for lateral flux from the alluvium is unexplained, inconsistent with the stated conceptual disconnection, and appears to duplicate capabilities of the 3D numerical model (p. 33).

Monitoring Network Gaps

- Multi-level bores penetrating both the alluvium and coal seams are limited to two locations and suffer from high measurement error (up to ±10 m) (p. 40).
- Weathered zone monitoring is almost non-existent, despite its critical role in the assumed groundwater flow pathways.

- Monitoring bores are not stratigraphically assigned to the Narrabri or Gunnedah Formations in many cases, undermining the modelled dual-layer structure of the alluvium.

Baseflow and Surface-Groundwater Interaction

- Although AGE (2025) acknowledges potential baseflow loss from Maules and Back Creeks, these are not consistently modelled or validated (p. 27).
- The risk of long-term drawdown in the alluvium due to depressurisation of connected seams remains under-acknowledged in both the modelling and mitigation plans.

Interpretation: Risks for the Maules Creek Alluvium and Pipeline

Risk Area	Concern	Interpretation
Hydraulic Connectivity	Assumed disconnection from coal seams unsupported by data	Drawdown may propagate into alluvium more than predicted
Model Bias	High Sy in deep layer buffers predicted drawdown	Undervalues indirect water take from the alluvium
Monitoring Deficiencies	Few multi-level bores; poor weathered zone coverage	Key pathways and pressure gradients not observed
Final Void	Weak coupling to surface hydrology; no alluvium drawdown considered	Potential long-term sink effect pulling from alluvium
Pipeline	Inter-mine transfers not integrated into model stress conditions	May redistribute depressurisation and mask real impacts

Recommendations

Revise the conceptual model to include potential connectivity of subcropping seams beneath MCA.

Install new multi-level bores across the alluvium, weathered zone, and Permian strata-especially in the area north and northeast of the mine.

Reparameterise the numerical model, particularly Sy values in the alluvium, and test drawdown sensitivity.

Separate and trace the influence of the pipeline transfer regime to assess whether it redistributes or masks impacts on local aquifers.

Model and validate final void recovery and potential sink behaviour, including cumulative losses from the MCA.

Groundwater Impacts – a community perspective

Introduction

Since the commencement of mining at Maules Creek, the local community has voiced persistent and well-founded concerns regarding the health and sustainability of the Maules Creek Alluvial Aquifer. These concerns are underpinned by field-based evidence, the Groundwater Impact Assessment Third Party Review and ecological studies, highlighting critical issues of aquifer depletion, ecological risk, and regulatory oversight.

These concerns have intensified with observed bore failures, rapidly falling water levels, and unexplained losses in groundwater yield, particularly since 2017.

The Maules Creek valley is a productive agricultural area that relies heavily on shallow alluvial groundwater. Unlike deeper fractured rock aquifers, the alluvial system is highly sensitive to drawdown, with limited capacity to recover from sustained depressurisation. Since mining began, more than 20 local farming families have had to drill new bores, deepen existing ones, or begin carting water, many for the first time in living memory. (See Fig 1) These disruptions carry significant economic and social consequences, threatening the long-term viability of farming in the region.

Of particular concern is the apparent mismatch between observed field conditions and the assumptions made in the proponent's groundwater models. Independent experts and local monitoring data indicate a likely hydraulic connection between the mine's targeted coal seams and the overlying alluvial aquifer, contradicting the mine's assertion of hydraulic separation. If this connection exists, as the evidence suggests, continued mine de-watering could irreversibly deplete the alluvial aquifer, with cascading impacts on rural water supply and land use.

Community members have also expressed frustration at the lack of transparency and accountability in groundwater management. Despite requests under the Water Management Act 2000 for temporary water restrictions and the installation of telemetry on mine pumps, government agencies have not taken decisive action. As the mine seeks approval to continue operations until 2045, the community believes it is critical that regulatory decisions reflect the growing body of evidence that groundwater risks are being underestimated and externalised onto farming families and the local environment.

This submission presents a summary of these community concerns, supported by local observations, historical data, expert reviews and calls for <u>robust regulatory intervention</u> to safeguard agricultural water security in the Maules Creek valley.

Community Groundwater Concerns

The key risk to groundwater resources in the Maules Creek Alluvium (MCA) is the de-watering and depressurisation from mining activities. Yet the predictive models, groundwater monitoring and groundwater management trigger levels and response are not fit for purpose to protect the MCA.

Moreover, Hydrogeologist.com.au concluded in the Third Party Review that the modelled impacts may under represent drawdown in the Maules Creek Alluvium and that passive take could not be reliably estimated using the current framework (Hydrogeologist.com.au, (2025), p. 30–35).

1.1 Sudden, Unexpected Decline in Groundwater, Surfacewater

In 2018, prior to a declared drought being declared, landholders in the Maules Creek valley experienced widespread groundwater reliability failures. At least 31 bores and wells were cleaned out, deepened, or replaced between 2018 and 2021, with further rapid declines recorded during 2023 and 2024 (Appendix L - Emergency Groundwater Actions Taken by Residents). In some cases, bore water levels dropped to a depth of less than 30 cm which impacts water quality and is insufficient for domestic or stock use.

There are up to 61 rural households (some are now owned by the proponent See Appendix C) in the Maules Creek Upper Management Zone which are or will be affected to different degrees. The observed loss of water security has created significant hardship for agriculture, emergency services, and community resilience.

1.2 Failure of Predictive Models to Anticipate Impact

The original 2011 Groundwater Impact Assessment (GIA) predicted less than 1 metre of drawdown in the alluvium near Maules Creek by year 21 (AGE - MCCM GIA 2011, p. 107). Observed drawdowns, however, have exceeded this prediction by factors of two to four, particularly in areas proximate to the mine. Comparative data shows a 4-metre drop at Middle Creek against a 1-metre drop at the Green Gully monitoring site (Appendix L - Letter to Fishburn, p. 2).

A formal review by a hydrologist from the NSW Department of Industry in October 2018 confirmed that the model used to support impact predictions was inconsistent with observed data. Specifically, the reviewer noted the inconsistency:

> “*The observed data generally indicates a downward gradient from the alluvium to the underlying coal basin, however the model has hydraulic gradient going from the coal basin to the alluvium. This inconsistency between the observed data and the modelled data is not addressed in any of the reviewed documents or captured by the trigger level response management.*”
> - *NSW DPI, Groundwater & Surface Water Assessment - State Significant Development, Oct 2018 (DOI - MCCM Ground and Surface Water Assessment Oct 2018, p. 2)*

<u>These concerns regarding defective modelling and poor predictability continue. Now in 2025 there are further serious conceptual concerns in the latest BTM Groundwater Model in relation to the top of the Boggabri Volcanics contours.</u> (Hydrogeologist.com.au (2025))

Such discrepancies directly undermine confidence in the use of the previous, current and proposed models for assessing drawdown impacts, setting triggers, or supporting the continuation of mining until 2045.

1.3 Monitoring Coverage Across Key Risk Areas

No monitoring infrastructure exists in high-risk areas to the north of the mine where the coal seams are likely to subcrop the MCA. There is a haphazard approach to monitoring north of Maules Creek, using a couple of landholder bores. This does not meet data collection methodologies such as that provided in the Geoscience Australia, Groundwater Sampling and Analysis – A Field Guide 2nd Edition (2024) (Hydrogeologist.com.au (2025) p40).

This is a critical oversight, as these are precisely the locations where hydraulic connection, if present, would generate the most significant drawdown effects. Absence of monitoring in these areas makes it impossible to detect early warning signs of aquifer interaction or to validate the mine's no-impact claim (Hydrogeologist.com.au (2025), p. 23).

1.3.1 Spacial gaps in monitoring correlate with 2018 bore failures

As shown in Fig: 1 below the 2018 bore failures had no mine bore monitoring network in the area. This is a significant spatial data gap for Maules Creek residents.

Fig 1: 2018-20 Bore Failure Locations (MCCC (2024)a)

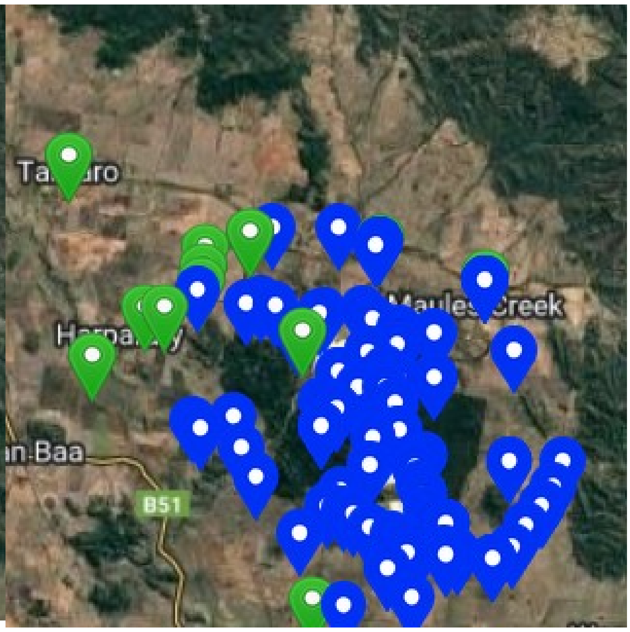

Fig 2: Mine Bore Monitoring Locations (MCCC (2024)b)

The absence of clear, real-time data and comprehensive coverage to the north of the mine site means that planning authorities and communities cannot independently verify compliance with groundwater conditions or assess early indicators of failure.

1.3.2 UNSW Groundwater monitoring infrastructure

The UNSW Water Lab Connected Waters Initiative (UNSW Connected Waters Initiative (2025)) has a network of groundwater monitoring bores in the MCA that have been in place since 2013 (Fig 3). It is an important source of baseline data that has been ignored in previous iterations of the BTM groundwater model and the WMP. The funding for the UNSW equipment has run out and it would be of benefit to the community, UNSW and the proponent to get this equipment fully funded and maintained.

Fig 3: UNSW groundwater monitoring locations (MCCC (2024)c))

To do that the MCCC would put forward the following proposal;

- A program of groundwater monitoring be developed for areas north of the Maules Ck that includes the UNSW infrastructure and new multi-level monitoring bores as described by Hydrogeologist.com.au in Appendix A.
- Monitoring data is collected either by transparently by telemetry (preferred) or independent service providers

- All data from all new and old bores is provided to the UNSW and is available publicly as open source
- The proponent provide a ongoing budget for the maintenance and operation of the equipment

This common sense proposal has the advantage that the community has visibility of the MCA, the UNSW has access to data for student teaching and research, and proponent has monitoring data for trigger levels in the MCA and for future modelling purposes.

1.4 Numerous Technical Monitoring Network Deficiencies

The Independent Review (Hyrdogeologist.com.au (2025)) of the Groundwater Impact Assessment (GIA), Water Management Plan (WMP) and Groundwater Monitoring Systems identified fundamental weaknesses in the monitoring system that compromise both transparency and scientific credibility (Hydrogeologist.com.au (2025), p.35-40).

- Lack of Monitoring in the Weathered Zone (Hydrogeologist.com.au (2025), p. 26-27).
- Insufficient Multi-Level Monitoring to Detect Vertical Gradients (Hydrogeologist.com.au (2025), p. 27)
- Alluvial Bores Not Screened Through Full Saturated Thickness (Hydrogeologist.com.au (2025), p. 37)
- Poor Geological Characterisation of Monitoring Bores (Hydrogeologist.com.au (2025), p. 37)

  "*The monitoring program does not adequately identify which bores are in the Narrabri Formation or Gunnedah Formation. This is critical to support the conceptual and numerical models.*" (Hydrogeologist.com.au (2025), p. 37)

These deficiencies render the current monitoring network unfit for purpose. It is neither capable of verifying model assumptions nor providing the data required to trigger timely and effective management responses under the mine's approval conditions. Until the network is upgraded to include coverage of the weathered zone, additional multi-level bores, and comprehensive stratigraphic data, it is not possible for regulators or the community to have confidence in the groundwater assessments being presented.

These concerns directly support the broader community position that the groundwater model and GIA must be redone with transparent inputs and peer-reviewed oversight. They also reinforce the need for a public compensatory water mechanism and community water supply infrastructure as part of any approval moving forward.

1.5 CCC Oversight and Reporting

In regard to community oversight, the graph below (Fig;3) is typical of environmental data presented to the Community Consultative Committee (CCC)[1] meetings. On its face it is simply not fit for purpose for anyone to assess groundwater impacts, to assess the adequacy of the current trigger responses, understand mine planning compliance or understanding the data gaps.

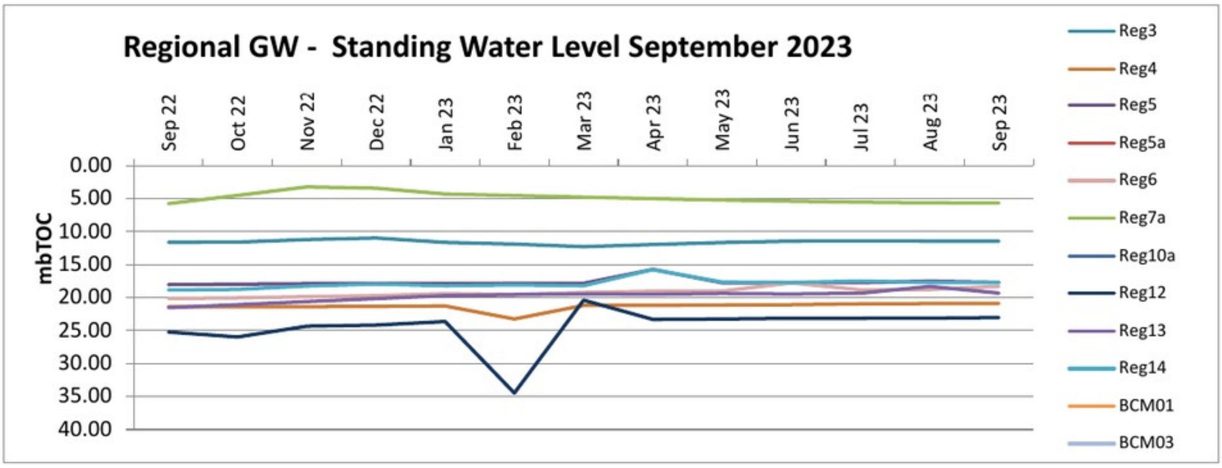

Fig 4: Groundwater Data Graph presented to the CCC meeting in 2023

1.5.1 Lack of Bore Location Context

The chart provides no spatial context for the monitoring bores listed (e.g. Reg3, BCM01). Community stakeholders cannot determine which areas of the Maules Creek valley these bores represent, whether they are in the alluvium or hard rock, upgradient or downgradient from the mine, or in proximity to affected residences. Without spatial correlation, the dataset cannot be used to assess localised impacts or to verify consistency with the mine's groundwater model predictions.

1.5.2. Vertical Axis Reference Point Is Not Interpretable

The y-axis is labelled "mbTOC" (metres below Top of Casing), which is a standard internal measurement. However, for external stakeholders, mbTOC values are meaningless unless converted to a consistent elevation datum (e.g. mAHD). Furthermore, no trigger thresholds, historical pre-mining baselines, or approval compliance levels are provided for context. As such, it is impossible to determine whether observed values reflect exceedances or significant drawdown.

1.5.3. Data Aggregation Obscures Trends

The chart overlays 14 different bore datasets on a single plot without grouping them by hydrostratigraphic unit (e.g. alluvium, hard rock), depth, or distance from the mine. This

1 Maules Creek Coal Mine CCC Meeting #43 Environmental Monitoring Report July-Sept 2023

aggregation masks differences in aquifer responses and prevents any meaningful interpretation of cause-effect relationships. Notably, several traces show sudden vertical shifts (e.g. BCM03), suggesting either abrupt drawdown or equipment error, but these are not explained or flagged.

1.5.4. No Error Bars, Sampling Metadata, or QA/QC Information

There is no indication of the measurement frequency, QA/QC protocols, or data integrity (e.g. telemetry vs manual dips). Without this, stakeholders cannot assess the robustness or reliability of the presented data.

Conclusion

The current chart is not sufficient to satisfy the principles of informed consultation. The presentation format lacks contextual information, uses undefined technical units, and omits spatial and threshold data required for community interpretation.

Recommendation - CCC Oversight and Reporting

To improve transparency and public confidence, the mine operator should be required to provide to the CCC:

- Maps showing bore locations and construction details
- Groundwater levels in mAHD, relative to pre-mining baselines and drawdown trigger thresholds
- Disaggregated charts grouped by hydrogeological unit and bore function
- Accompanying commentary that explains anomalies, patterns, or management responses

1.6 Disproportionate Impacts on the Community

Community members have borne the cost of failed and deepening bores, water carting, and lost productivity without compensation. This has occurred while the mine generated more than $14 billion in revenue since 2018 (MCCC (2024)e). There is a strong public perception that the economic benefits to the proponent and state have come at the expense of long-term rural water security and community wellbeing for the people of Maules Creek.

1.7 Loss of Groundwater Dependent Ecosystems (GDEs)

The MCA supports one of the most ecologically diverse and geographically isolated groundwater-dependent ecosystems (GDEs) in New South Wales (Appendix L - Serov P. (2012))

It includes a range of highly adapted biotic communities such as:

- **Stygofauna** - Subterranean aquatic invertebrates inhabiting the saturated pore spaces of the aquifer. These include rare and potentially endemic species adapted to low-nutrient, lightless environments.

- **Hyporheic ecosystems** - Dynamic ecological zones beneath and alongside surface waterways, where surface and groundwater interact. These zones support microbial processes critical to nutrient cycling and stream health.
- **Phreatophytes** - Deep-rooted vegetation such as river red gums and paperbarks, which access groundwater directly and play a central role in maintaining riparian habitat integrity, moisture retention, and native biodiversity.

This GDE system is not only locally significant but regionally unique. It contains the only formally surveyed groundwater stygofauna community west of Tamworth, with no ecological equivalent elsewhere in the Namoi catchment. As highlighted in survey reports:

> *"The Maules Creek stygofauna community has one of the highest subterranean biodiversity thus far encountered in NSW."* (Serov P. (2012))

Its combination of taxonomic richness, endemism, and hydrological reliance makes it a high conservation priority. Groundwater drawdown and aquifer depressurisation therefore risk not only community water supply, but the survival of entire ecosystems found nowhere else in the state.

2. Systemic Groundwater Modelling Failures

2.1 Conceptual Model Assumptions Lack Supporting Evidence

The 2025 GIA adopts a conceptual model that assumes hydraulic disconnection between the alluvium and the Braymont coal seams. This assumption is not supported by field evidence and contradicts previous interpretations (AGE - MCCM GIA 2011; Pacific Coal, 1982). DOI hydrologists have explicitly said that the observed gradient suggests a downward flow from the alluvium to the coal basin, not a disconnection or upward gradient (DOI - MCCM Ground and Surface Water Assessment Oct 2018, p. 2).

Fig 5: Maules Ck Surface water collapse 2018-19. No evidence of the "upward gradient" MCCC(2018)

2.1.1 Historical Exploration Bores – Braymont Seam Subrops

Historical field evidence obtained by the MCCC is outlined below. It shows the likelihood of a connection between the MCA and the underlying coal seams which in turn provides evidence of a direct pathway for groundwater depressurisation.

The section of Exploration Bore Log (Fig 6) from MAC67 in the Middle Creek - Horsearm Creek recharge area from 1982 show the top of the casing at 292.88 mAHD, the Herndale Seam at 37.83 mbTOC and the Braymont Seam at 43.07mbTOC. (Kembla Coal and Coke, Bore Log, MAC67 Maules Creek)

Based on the top of the Braymont seam at 43 mbTOC and the conceptualisation cross-sections DD and EE (AGE 2025) which show the MCA >50m, it appears that <u>both the Herndale and Braymont seams would subcrop the alluvium at MAC67, and possibly across the entire MCA. This means there is evidence to support a direct pathway for mining depressurisation of the Braymont seam to propagate along the seam to the MCA.</u>

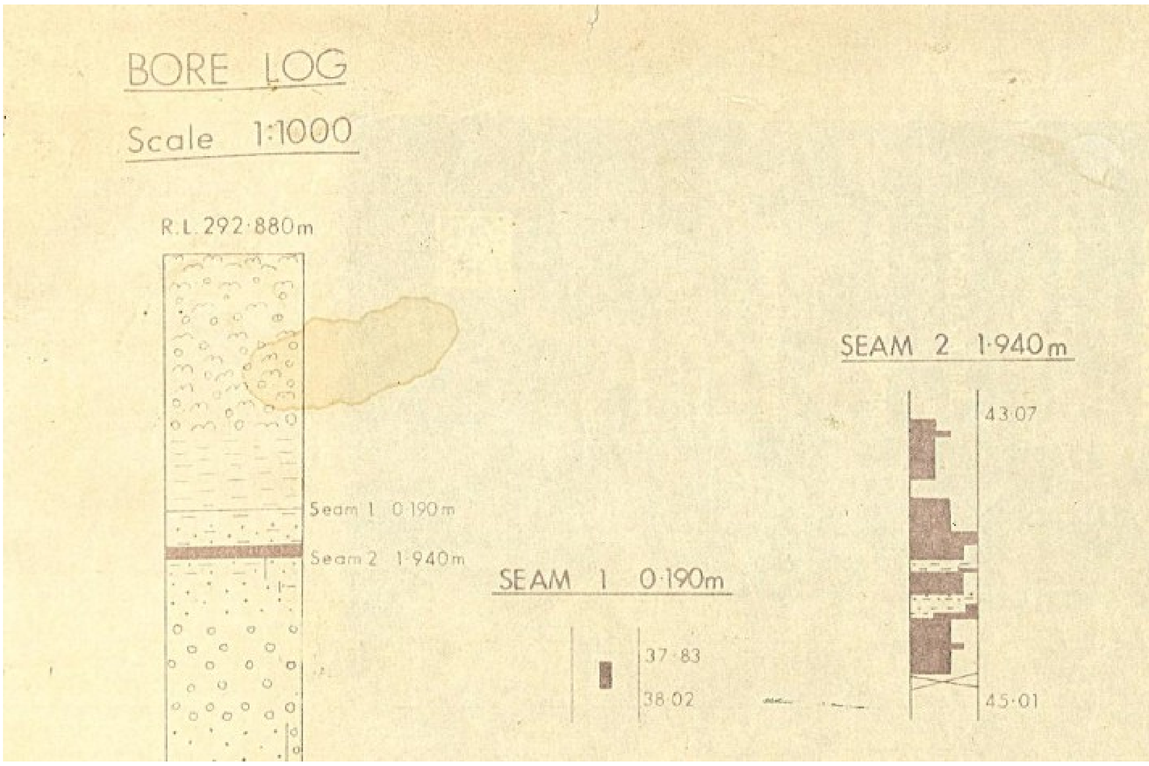

Fig: 6 - Segment of MAC0067 exploration bore log showing Herndale and Braymont seams (Pacific Coal 1982)

2.2.2 Location of the Braymont Seam in the MCA

This map shows the bottom contours from the Braymont Seam (Pacific Coal (1982)).

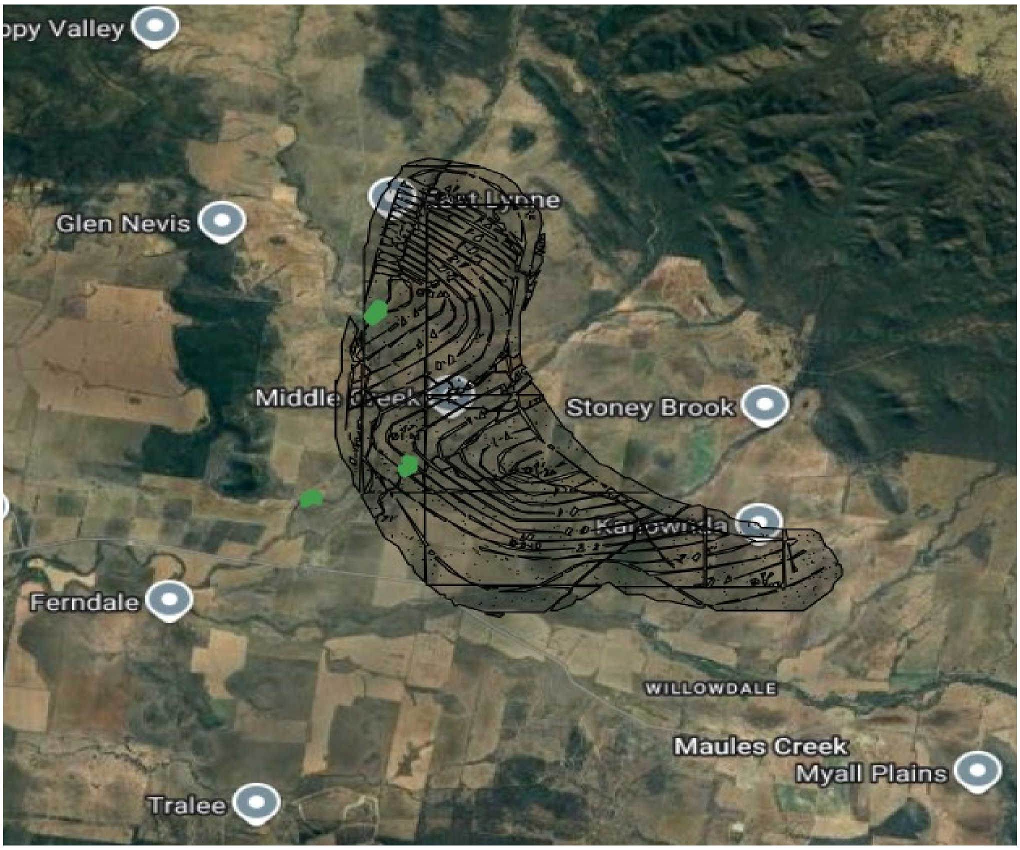

Fig: 6 Extent of the Braymont Seam in the MCA (MCCC(2025)a)

Note that the area shown contains a number of observed recharge areas (shown in green) in the valley. Examples of the recharge areas are shown below (Photo 3 and 4).

The severity and spatial concentration of the bore failures (Fig 1) in vicinity to the Braymont Seam subcrop area, strongly suggest that mining activity, rather than climate variability, was the dominant driver of aquifer drawdown.

2.2.3 Observed Recharge Areas in Horsearm Ck and Middle Ck

Photo 3: Horsearm Ck Recharge Area 17.6.2025

Photo 4: Middle Creek Recharge Area 13.5.2025

2.2.4 Anecdotal Evidence – Groundwater Drillers

Anecdotal evidence from groundwater drillers experienced in groundwater bore construction in the Maules Creek area confirm the likely connection of the alluvium and the coal seams. In 2018-19 drillers advised residents who were replacing groundwater bores not to drill below 18m because they will hit the coal beyond 20m and this will reduce water quality significantly. Locals cleaning out bores with large air compressors are also mindful of not cleaning out too much of the built up residue in case they pierce the coal.

2.2.5 Historic Exploration Bores – MCCM Pit

Exploration borehole MAC1263, drilled in 2010 and located within the current Maules Creek Coal Mine pit (approx. Lat: -30.56387, Lon: 150.14405; UTM: 226065E, 6615257N, Zone 56J), contains early, direct evidence of substantial groundwater interception in the Braymont Seam. According to driller's logs from the time, the bore encountered:

"LOTS of WATER at 115 metres. 20 litres in 18 seconds."

This equates to approximately 4,000 litres per hour, indicating a highly permeable fracture or aquifer zone—likely representing a point of direct hydraulic connection between the coal seam and groundwater system.

This site is now confirmed—through aerial photographs from 2022 (Fig 6a) as the location of active pit de-watering infrastructure. This short clip from June 2018 shows the dewatering infrastructure. https://maulescreek.org/video-pit-pump-footage-from-10-6-2018-flyover/. Note the water lying amongst the blast drill holes.

Fig 6a: MCCM pit showing location of MAC1263 in August 2022 adjacent to pit pumps (MCCC (2023)a)

From the 2022 Annual Review Table E-1, p.119, the nearby monitoring bore RB05_VW1 (–30.55030, 150.16534) is targeting the Braymont Seam and intersects it at 107 m below GL (328.4 mAHD) or 221.4 mAHD.

RB05_VW1 is approx 300m to the north of MAC1263 and it is reasonable to infer that the water intersected by the driller at 213.7 mAHD was coming from the Braymont Seam.

Ten kilometers north, in the Middle Creek area, MAC0067 intercepted the Braymont Seam at 249.8 mAHD, ~35m higher relative to sea level than MAC1263 in the MCCM pit. (Fig 6b)

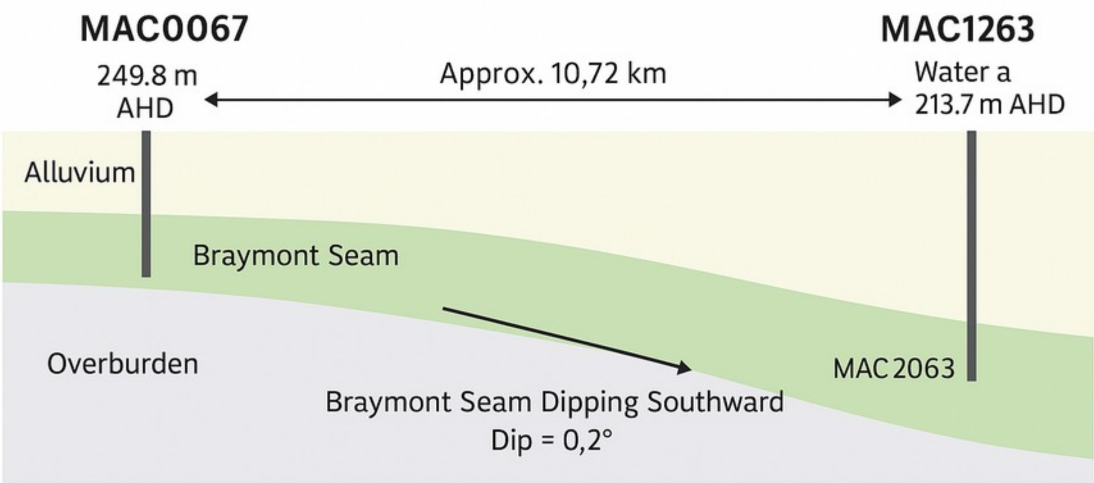

Fig 6b: Visualisation of Braymont seam between Middle Ck and MCCM Pit

This increase in height would increase hydrostatic pressure toward MAC1263 if the seam were continuous and hydraulically connected.

Photo 5: Groundwater waterfall midway up the highwall (MCCCM (2024))

The pit has continued to expand. Aerial photos from 2024 (Photo 5) show high volumes of water continue to flow into the MCCM pit approx 800m to the south of MAC1263.

This video shows a groundwater waterfall (potentially from the Braymont Seam) mid way up the highwall in March 2024. https://maulescreek.org/groundwater-pressures-in-2024/

Its the view of the MCCC that there is now plausible field evidence of a depressurisation pathway and confirmed on ground impacts;

1. the collapse of surface water levels at Elfin Crossing (Fig 5) in 2018-19,
2. residents 2018-20 bore failures,
3. documentation of the mine's interception of the regional groundwater table in 2018 (AGE - BTM Model Report 2021, Ch. 6.7.1.3, p. 75) and
4. the sudden transition from <10 ML/year of passive groundwater take to 576 ML/year in 2018

Anecdotally, something definitely changed on the ground from 2018. Creeks do not run as often or for as long. Horsearm creek rarely runs at Horsearm Crossing and it was once the most reliable creek. Groundwater bore levels are more volatile.

But things have changed with the proponent too. The coal mine has decided that it no longer will need to use the High Security water from the Namoi River so much, nor will it need to use the bores on the properties that it purchased in 2019-20. Now its planning a big dam in the old Tarrawonga final void and is also pushing for a inter-mine water transfer pipeline to get rid of the water make.

This Project is not a continuation, but a fundamental reshaping of the water access and distribution of Maules Creek groundwater.

2.2 Geological Interpretation Not Supported by New Data

Figures 7 and 8 below show a second inconsistency (Inconsistency 2) introduced into the BTM Groundwater Model between the settled 1982 Pacific Coal Groundwater Conception Model and the 2025 AGE Conceptual Model.

The 1982 contours are based on a spatially distributed network of exploration drill holes and a regionally focussed interpretation of the coal seams, Permian strata and volcanics which extended well to the north and south. As shown in Fig 6 there is a reasonable spread of exploration drill holes in the highlighted area of Fig 7 and 8 to demonstrate that the 1982 interpretation in this area was based on a sufficient number of data points.

Between the 2021 and 2025 modelling exercises, the proponent's conceptual modelling introduced up to 150 metres of vertical difference in volcanic basement contours across the Maules Creek area (Hydrogeologists.com.au (2025), p27). No new geological drilling or bore logs have been provided to justify this change, and the alteration appears to serve the modelled assumption of disconnection rather than reflect site conditions.

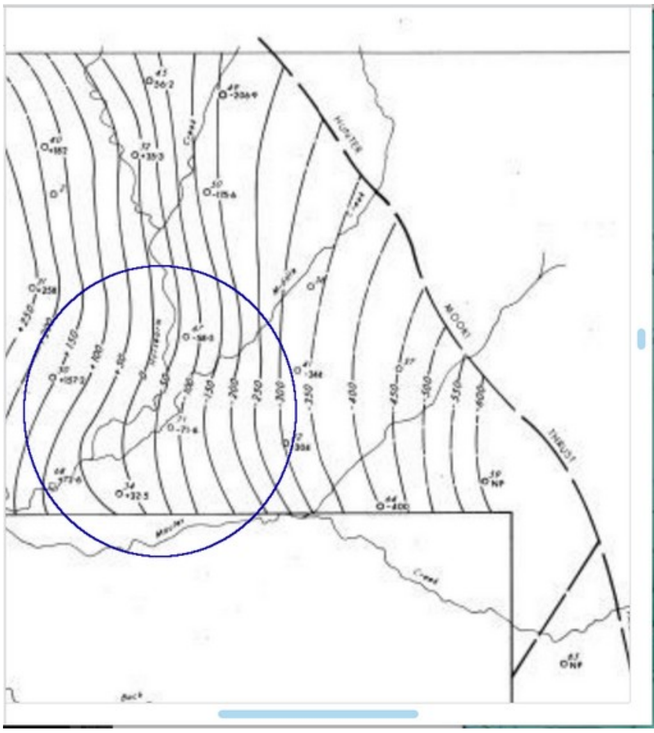

Fig: 7. Pacific Coal 1982 Exploration Report

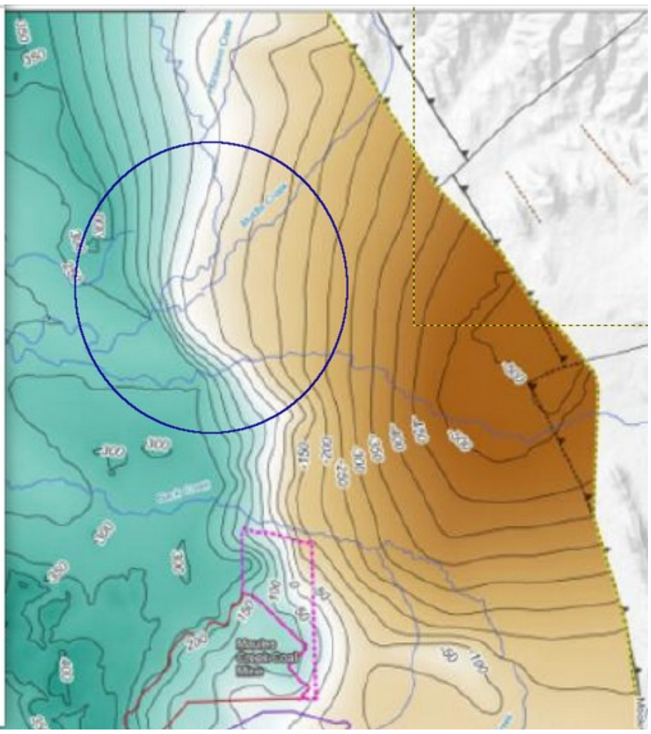

Fig 8: AGE 2025 Conceptualisation

"Contrary to AGE (2025), the top of the Boggabri Volcanics represented in this exploration report does not show a steep gradient in the basement surface. At the confluence of Horsearm Creek and Middle Creek, the contours show that the top of the Boggabri Volcanics is interpreted to be at an elevation of approximately 50 mAHD. At this same location, the top of the Boggabri Volcanics in the AGE (2025) report corresponds to approximately 200 mAHD.

This difference is significant (150 m vertical difference) and has major implications for the geology that is presented in the groundwater conceptualisation, with further major implications on the numerical model layering and the resultant predictions." (Hydrogeologist.com.au, (2025) p26)

The AGE Conceptual Model (AGE (2025) p.45) pushes the Boggabri Volcanics east in the observed recharge area of Middle Creek and Horsearm Creek. By doing so, the conceptual model introduces a 150m high barrier into the numerical model to plug the recharge mechanism by disconnecting the Braymont and other coal seams from subcropping the alluvium, reducing the likelihood of aquifer drawdown. Fig 9 below shows the 1982 coal seams and Boggabri Volcanics in comparison to the AGE conceptual model.

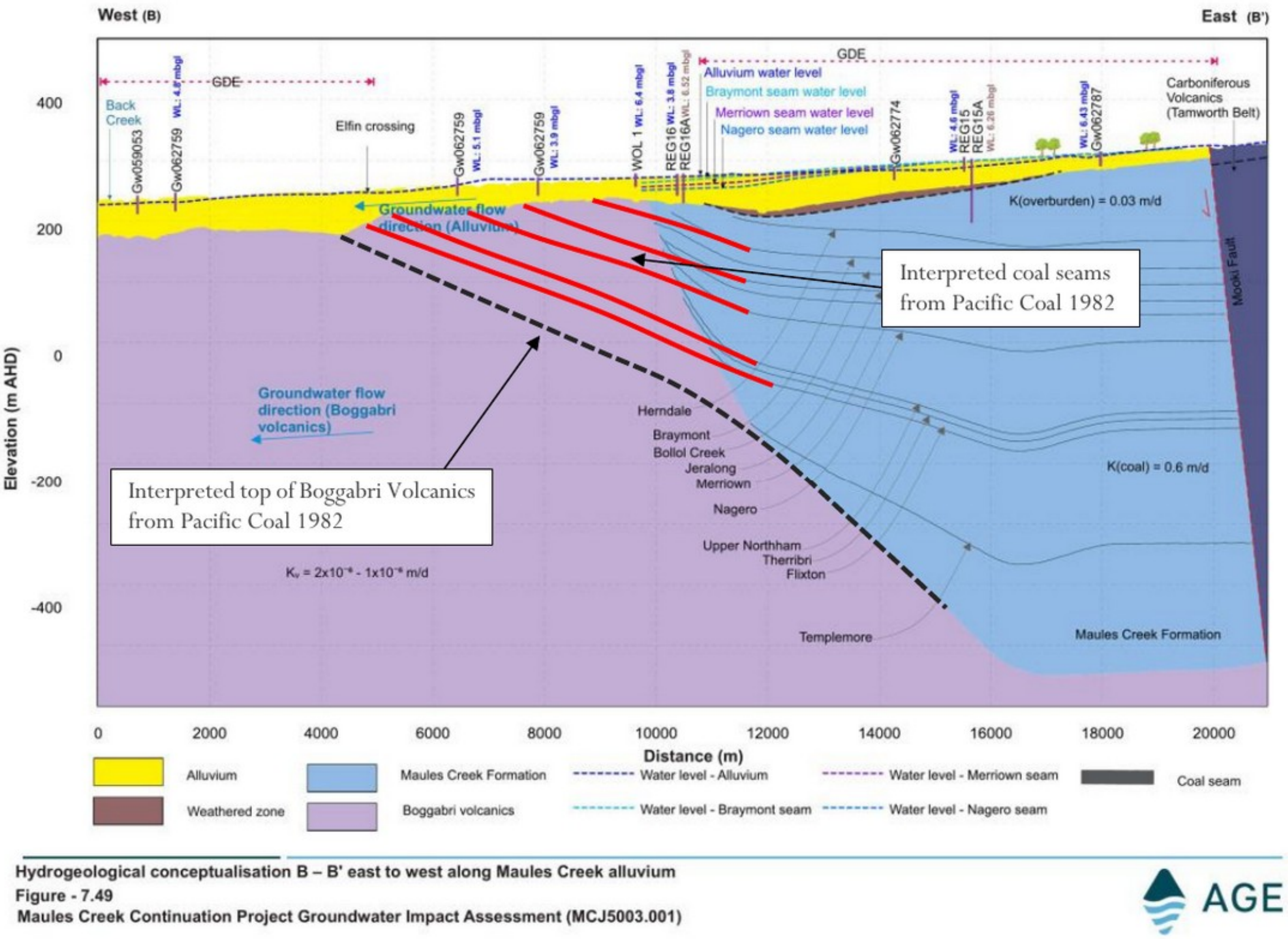

Fig 9: the 1982 interpretation of the coal seams overlaid of the AGE interpretation (Hydrogeologist.com.au (2025))

This is another inconsistency introduced by AGE. In the 2011 Groundwater Model, AGE introduced a discredited pressure-head gradient suggesting water flowed up from the coal into the alluvium *(DOI - MCCM Ground and Surface Water Assessment Oct 2018, p. 2)*.

This appears to be a pattern of behaviour by the expert consultant water modeller for the proponent to induce a artificial disconnect between the MCA and the subcropping coal seams. The consultancy would know what it is doing, would have multiple processes of technical review and would finally have a peer reviewer check its work.

2.3 Inadequate Groundwater Triggers and Monitoring Frameworks

Trigger thresholds for groundwater decline are not transparently tied to observed pre-mining conditions or ecological thresholds. The 2024 Water Management Plan fails to explain how drawdown will be identified early or managed once thresholds are breached (MCCM - Water Management Plan March 2024, p. 128). This omission is consistent with earlier criticisms by the Department of Industry regarding both the modelling approach and trigger management (DOI - MCCM Ground and Surface Water Assessment Oct 2018, p. 2-3).

Crucially, the current monitoring and trigger framework failed to initiate any formal action or notification when the mine's groundwater take increased sharply—from less than 10 ML/year to approximately 576 ML/year in 2018 (AGE - BTM Model Report 2021, Section 6.7.1.3, p. 75). This rapid escalation was not communicated to the community at the time, nor did falling water levels at critical sites such as Elfin Crossing prompt any formal response from the company. No assurances were given regarding curtailment of groundwater take, water re-injection, or future management planning to prevent recurrence.

2.3.1 Public Statements by Whitehaven Coal

In the wake of media (Hannam, P. *(*2019, November 6*)*) and community questioning over bore failures and rising groundwater take, Whitehaven Coal issued public statements attributing groundwater decline to regional drought conditions. The company stated:

> *"There is no credible hydrogeological evidence indicating that bore drawdowns […] are the result of anything other than the combination of lack of rainfall and inadequate aquifer storage."*
> *Whitehaven Coal, public statement (cited in historical media coverage of groundwater use concerns (*ABC News. Hannam, P. *(*2019, November 6*)))*

Apart from an indictment of the proponents inadequate groundwater monitoring program, this assertion lacks credibility in light of empirical data: groundwater levels at Elfin Crossing declined well beyond typical drought response thresholds, and community records show bore failures coinciding with the mine's dewatering ramp-up, not natural rainfall deficit. Importantly, the community had not observed a decline in rainfall patterns commensurate with the severity of groundwater loss.

These statements create a false equivalence between mine-induced aquifer drawdown and regional climate stressors. They ignore the magnitude and rapid onset of bore failures, fail to acknowledge the unprecedented scale of groundwater take, and dismiss localised aquifer collapse in favour of a broad narrative of drought. There is no evidence that Whitehaven undertook independent field testing, nor offered any compensatory measures.

2.3.2 Water Management Plan Unfit for Purpose

The failure to report or react to major groundwater extraction events, combined with public minimisation of the mine's role in aquifer stress, demonstrates that the current monitoring and response framework cannot be relied upon. The regulatory triggers have not activated preventive or remedial actions; the community has been left uninformed and unsupported, while the company leverages generalized statements to deflect responsibility.

Until the monitoring protocols are upgraded and the Water Management Plan defines enforceable trigger thresholds tied to actual mine operations, the system remains unfit for purpose and fundamentally lacking in accountability.

3. Checks and Balances

The community is concerned that the checks and balances to protect groundwater in our area are insufficient, conflicted, and largely opaque.

3.1 Checks and Balances are not working

In October 2018, after the community complained directly to the Minister, (NSW Department of Industry - Water, Oct 2018, p. 1) DOI hydrologists observed fundamental inconsistencies in groundwater pressure gradients (NSW Department of Industry - Water, Oct 2018, p. 2) that invalidated the groundwater model. This misrepresentation challenged the model's entire assumption of hydraulic disconnection and which should have warranted a public revision and independent investigation.

However, no such correction or clarification was provided in subsequent Annual Reviews. The community received no formal notice, no advice of adjustments to groundwater triggers and no additional monitoring commitments were implemented in high risk area of the MCA (Parsons Brinckerhoff. (2010)) in response. This continued silence has compounded community frustration and highlighted a serious governance failure.

Further, the replacement 2025 groundwater model appears to have mis-represented the geology in the north of the MCA, potentially ignoring the subcropping of the coal measures with the MCA. This indicates that the groundwater consultancy for the proponent has put forward a total of three groundwater conceptual models (2011, 2018, 2021) with obvious unjustified assumptions which serve the interests of the proponent.

3.2 Proponent Gaming the System

The question is; "Why didn't the internal review systems of the consultant, the proponent, or the Peer Reviewer pick up the conceptual model errors?" At what point does an "inconsistency" become fraud?

The flexible planning system introduced around 2011 consisting of expert environmental modelling, strategies, management plans (monitoring, triggers and responses), and the “reasonable and feasible” consent conditions has effectively enabled this proponent to game the system, to choose it’s own adventure. Its more profitable to make up its own geology and head pressures, and pay the consequences later.

Any consequences are necessarily light in view of the coal sales that the head pressure strategy has potentially allowed. At what point is it reasonable and feasible for the community to no longer consider that the conditions are working?

3.3 Fit and Proper Person

History shows that the proponent has a litany of misdemeanours, criminal prosecutions, enforceable undertakings and planning breaches (EDO (2023)).

It is the opinion of the MCCC that proponent is not a fit and proper person and took action against the EPA for granting a pollution licence to the proponent (EDO, 2023). We hold the view that the made up geology and head pressures identified above, designed to trick the groundwater numerical model to create a disconnection between the MCA and the underlying coal seams, is further evidence that the proponent is not a Fit and Proper Person. More so, as the High Risk of groundwater depletion established by the Namoi Catchment Water Study (Parsons Brinckerhoff. (2010)) creates a heightened duty of care for the consultancy and the proponent to protect the MCA.

3.3.1 Considerations Under the Mining Act 1992

The NSW Government's *Fit and Proper Person Policy* (NSW Resources Regulator, 2018) gives decision-makers the power to restrict, suspend, or cancel mining authorisations, or refuse renewal or transfer, if the proponent is not considered a "fit and proper person" to hold a mining title under section 380A of the Mining Act 1992.

The MCCM has advertised in the Narrabri Courier around the 26th of August 2025, that it has made an application for a new mining lease (**MLA 654)** to extend down toward Back Creek. This is likely due to the increased mine footprint of the Continuation Project.

The NSW Resources Regulator Fit and Proper Person policy applies to the proponent. The policy is intended to ensure that only mine operators who demonstrate technical competence, financial capacity, legal compliance, and good character may hold such leases.

The Continuation Project does not commence until 2034 and the proponent has plenty of time to demonstrate that it is a Fit and Proper Person under the policy.


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Mining Lease Application

Notice is given in accordance with Section 51A of the Mining Act 1992 and clauses 26 and 89K of the Mining Regulation 2016 that Mining lease application 654 (Act 1992) for coal has been lodged with NSW Resources by Aston Coal 2 Pty Ltd, ACN 139 472 567; ICRA MC Pty Ltd, ACN 147 657 074; and J-Power Australia Pty. Ltd., ACN 002 307 682, over an area of about 130 hectares which is located approximately 21 kilometres north northeast of the town of Boggabri in the Parishes of Berrioye and Leard, County of Nandewar as shown on the diagram below.

Information regarding this application can be obtained from Jorge Moraga, phone number 1800 942 863.

Information regarding landholder's rights is available at *https://regional.nsw.gov.au/landholder-access.* RM8493514

Key provisions of the policy include:

- A company may be deemed not "fit and proper" if it has compliance or criminal conduct issues,
- there is evidence of repeated or serious non-compliance, particularly with environmental legislation such as the *Environmental Planning and Assessment Act 1979* or the *Aquifer Interference Policy*.
- Decision-makers may consider whether the company has shown poor governance or culture.
- Non-compliance does not need to result in a conviction; sustained evidence of regulatory failure or harm to community interests is sufficient.

3.4 Application to MCCM

Given the documented history of:

- Criminal conduct (EDO, 2023)
- Repeated fabrications of the groundwater conceptual modelling detailed in this submission (Section 3.1)
- Inconsistencies between observed and modelled groundwater data left uncorrected (NSW Department of Industry - Water, Oct 2018, p. 2)

- Failure to act on significant aquifer decline in a known area of high risk (Parsons Brinckerhoff. (2010)), or to notify the community, even in the face of a >500 ML spike in groundwater extraction
- Absence of remedial action or admission of fault, doubling down, claiming "no evidence to suggest"

It is open to the NSW Resources Regulator to form the opinion that the proponent has not met the governance or compliance expectations required to continue holding its mining authorisation or to obtain additional authorisations without reworking the BTM Groundwater Conceptual Model, requiring a change in work culture in relation to its responsibilities to the impacted community, CCC and the regulator, and substantial recompense to ensure water security for the impacted community after 10 years of mining under false pretences.

It may also be opportune to tighten up the existing consent conditions, including management plans, removing opportunities to game the system, increasing onsite supervision and removing the offending consultancies from the list of approved expert consultancies.

4. Requirement for Revised GIA and Groundwater Model

Due to the numerous red flags outlined above, flawed conceptual modelling, unjustified geological assumptions, and failure to detect and respond to groundwater decline, the current GIA and associated numerical model cannot be relied upon as a basis for further approval.

The modelling must be redone, most likely by another groundwater modeller and peer reviewer.

The concern for the community, regulators and investors is that several of the BTM mines modifications have or may in the future rely on this groundwater conceptual model with made up geology.

Significant downstream components of the Continuation Project EIS will need to be redone. The groundwater numerical model, water balance, final void design, water pipeline justification, biodiversity, social impact assessment, agriculture assessment all touch on the accuracy of the groundwater conceptual model and are all in doubt due to the second "inconsistency".

The Department should investigate AGE for this and other GIA's that it has had a hand in.

5. Final Void Design Must Be Reassessed

The final void strategy proposed in the Maules Creek Continuation EIS does not explore alternative landuse options and presents unresolved hydrogeological, economic, and environmental risks. Key conclusions from the MCCC Review in Appendix H are:

- **Evaporation losses are substantial and permanent:** The void will lose ~3.7 GL/year through evaporation-representing an enduring loss of water resources in a groundwater-stressed region. No mitigation is proposed.
- **Water inputs are insufficient to sustain balance:** Modelled inflows (groundwater and surface water) fall significantly short of evaporation losses, resulting in a long-term water deficit that could exacerbate drawdown in nearby aquifers.
- **Opportunity costs are ignored:** The EIS does not assess the lost value of this water if used for irrigation, leasing, or climate adaptation. Estimated values exceed $2 billion over 1,000 years.
- **No economic or strategic comparison of backfill alternatives:** While a $2.1 billion operational cost is cited to justify non-backfill, it lacks transparency, inflation treatment, and itemisation. A full-cost comparison with alternative land uses has not been undertaken. We explore the benefits of one scenario, a solar/forestry land use.
- **Rehabilitation options are under explored:** Viable alternatives such as dual-purpose solar farms and native forestry are not considered despite alignment with state and national climate, water, and biodiversity goals.
- **Risk externalisation is likely:** The void will create an ongoing public liability unless a fully funded, enforceable, and adaptive post-closure strategy is adopted. This remains absent from the current proposal.

The full MCCC Final Void review in Appendix H finds the proposed final void plan inconsistent with long-term environmental sustainability, inefficient in resource use, and weakly justified in economic terms. A revised assessment that transparently compares landform and closure options-including opportunity cost, risk, and public benefit-is warranted.

6. Inter-Mine Water Pipeline Should Be Abandoned

The Inter-Mine Water Transfer Pipeline strategy proposed in the Maules Creek Continuation EIS does not explore alternative excess water make options such as aquifer injection or impermeable barriers.

Such a pipeline was not envisaged in the original 2011 Approval Conditions and one wonders now why it is? Residents are suspicious that the failed groundwater models used to obtain an Approval are giving way to a proposed pipeline to mask unjustifiable water extraction directly associated with the mine operation. Given the mine proponent’s compliance history and the risks of depressurisation and climate change, this is not an unreasonable concern.

The proposed inter-mine water transfer pipeline, as assessed in the 2025 Groundwater Impact Assessment (GIA), introduces a range of unaddressed and potentially compounding risks for the MCA. Despite being a critical and vulnerable aquifer relied upon for stock and domestic use, and rare and unique GDE's, the alluvium is insufficiently considered in pipeline risk modelling, cumulative impact assessment, or future water management planning.

The pipeline has the potential to:

- Restructure hydraulic gradients in ways that increase connectivity between depressurised seams and shallow alluvium
- Obscure attribution of drawdown impacts across adjacent operations through artificial redistribution of groundwater
- Exacerbate long-term aquifer stress, particularly if used to support mine life extensions or final void water management strategies

These concerns are amplified by the lack of integration of the pipeline into the current Water Management Plan (March 2024), the absence of any formal climate resilience modelling, and the limited application of the 'minimal harm' principle under the *Water Management Act 2000*.

The full MCCC Review of the Inter-Mine Water Transfer Pipeline can be found in Appendix I.

Recommendations:

- The Continuation Project should be put on hold in the SSD planning system until the revised groundwater model is accepted. This Continuation Project isn't required for 10 years and it is important that the groundwater model is correct. Downstream EIS Reviews may need to be redone.
- The modelling must be redone, most likely by another groundwater modeller and peer reviewer. Given the history, once complete, a third party reviewer should also be engaged by the community, but funded by the proponent
- The new groundwater model should include the impacts of the inter-mine water transfer pipeline to create impacts to the MCA
- The haphazard and inadequate groundwater monitoring should be reviewed and methodically improved with community input to address the many geospatial and data gaps. Systems should conform with the methodology provided in Geoscience Australia, Groundwater Sampling and Analysis – A Field Guide 2nd Edition (2024)
- The proponent fund the ongoing maintenance and operation of the UNSW groundwater monitoring equipment north of Maules Ck (Fig 1a). Where appropriate new multi-level bores be added to the monitoring network, with realtime data made publicly available
- CCC data reporting should be improved as per the recommendations above in Section 1.5

- The Department require the proponent release publicly the geological data on which AGE relied and release it immediately to the public
- The Department and the Resource Regulator should investigate the proponent for potentially fabricating the geological and conceptual model and review other GIA's that it has had a hand in
- The Resource Regulator should consider whether the proponent is a Fit and Proper Person for the purposes of the Mining Act and seek cultural
- The Final Void should be backfilled and the Inter-Mine Water Transfer Pipeline abandoned
- The proponent should apologise to the community for its previous poor groundwater predictions and trigger responses in 2018 -20 and commit to doing much better

Social Impact Assessment Peer Review

There are a number of social impacts being experienced in the district of Maules Creek since the commencement of the MCCM. The impacts are many and various and are explored below.

The proponent in the EIS and elsewhere downplays community concerns regarding groundwater declines and the SIA more specifically does not engage with key components of the Continuation Project that exacerbate these concerns.

For example the SIA fails to assess the social consequences of the Inter-Mine Water Transfer Pipeline, ignoring more than 10 years of well founded community concerns over groundwater loss and the lived experience of mine-induced aquifer depressurisation. This omission reflects a broader pattern: the company is not listening. The SIA reads as a box-ticking exercise, disconnected from reality and unlikely to influence the company's plans or genuinely respond to the community's needs or concerns.

The MCCC has engaged the services of Dr Richard Parsons to Peer Review the SIA.

In short Dr Parsons finds that the SIA does not reliably identify the social impacts to local people, nor produce evidence that the projects social benefits will outweigh its negative impacts. For example, the burden on current and future generations in NSW from the projects contribution to Climate Change is omitted, the distribution of the impacts opposed to the accretion of private economic benefits is inequitable, along with a raft of other failures.

See Appendix B for the excellent peer review by Dr Parsons. The peer review recommends that "the SIA Report cannot be accepted without tangible, deliverable and durably effective response measures" to the negative social impacts arising from the project.

Recommendations from the Peer Review

Recommendation 1: Seek comprehensive, qualitative evidence of how the most directly affected people have experienced the mine to date.

Recommendation 2: Neither the intragenerational inequities resulting from social distribution of benefits and burdens, nor the intergenerational inequities resulting from natural resource extraction and their contribution to climate change, can be proportionately mitigated or adequately managed. Continued population decline in Maules Creek could be addressed if the Project were not approved, as long as appropriate long-term planning measures were put in place.

If the project were approved, for some community members compensatory measures could be co-developed in response to spatial inequity; for example, in response to concerns regarding groundwater (p.20), a domestic water pipeline could benefit the Maules Creek community. While this measure would not mitigate the above impacts, Whitehaven could provide funding for the community to commission:

- an independent feasibility study for domestic and stock water pipeline;
- an independent social assessment to evaluate the potential value of such a pipeline to landholders and the community.

Recommendation 3: The social impacts of the project cannot be reliably evaluated because we do not know how those likely to be most directly affected will experience the project.

Recommendation 4: The merits of the project should be evaluated on the basis that some of the evaluations of significance are not credible, and that the overall balance of impacts is likely to be more negative than asserted in the SIA Report.

Recommendation 5: The SIA Report cannot be accepted without tangible, deliverable and durably effective response measures.

Recommendation 6: Prepare a monitoring and management framework in accordance with the guideline (Technical Supplement, p.18). For each impact, identify:

- the desired outcomes in social terms
- the indicator(s) that will be used to monitor change
- the targets against which performance will be assessed
- the methods that will be used to monitor the social impact
- the frequency of monitoring
- the people responsible for monitoring
- the methods that will be used to respond to monitoring results.

Include provisions for participatory monitoring of groundwater levels, including tangible measures to remedy material depletion.

Also propose arrangements for:

- a social incident notification and reporting process, including mechanisms to respond to complaints, breaches and grievances or to inform the community;
- ongoing and independent analysis of social risks and opportunities arising from the project, including timing and frequency of reviews.

Recommendation 7: The SIA Report should be read in the knowledge that it is promoting the proponent's private interests rather than the public interest.

Recommendation 8: To support and accelerate diversification and resilience in the locality, and consistent with a just transition, more effort should be placed on supporting the community to adapt to a post-mining future on the basis of the current closure date. This would include helping people to transfer existing skills and/or build new skills for emerging and future industries.

Recommendation 9: Should the project be approved, a review is needed on the distribution of benefits from the project, to align more closely with contemporary expectations for benefit-sharing from major developments that affect rural communities[2], and consistent with requirements and guidelines for renewable energy developments[3].

2 e.g. https://sgsep.com.au/publications/insights/community-benefit-sharing
3 e.g. https://www.planning.nsw.gov.au/sites/default/files/2024-11/benefit-sharing-guideline.pdf

Social Impacts - a community perspective

This section represents the lived experiences and concerns of local residents directly affected by the Maules Creek Coal Mine and its proposed continuation. It accompanies the peer review (Parsons R. (2025)) of the 2025 Social Impact Assessment (SIA) and Social Impact Management Plan (SIMP), offering a ground level perspective on the ongoing and projected social impacts facing the Maules Creek community. Our goal is to provide clarity on the human and community consequences that are underrepresented in formal assessments.

1. Living with Ongoing Uncertainty

For over a decade, Maules Creek residents have lived under the weight of continuous planning changes, mining expansions, and social fragmentation. The continuation of mining through 2045, as proposed in the current EIS, prolongs this state of uncertainty. This uncertainty affects everything, whether to invest in our homes, raise children here, or plan for retirement. The lack of a clear and enforceable timeline for mine closure or re-purposing undermines our ability to make informed life decisions. The recent unexplained drilling campaign outside the Continuation Project adds to that uncertainty.

2. Erosion of Community through Land Acquisition

As of 2024, 28.6% of the land in Maules Creek is owned by mining companies. Regionally, Whitehaven Coal and Boggabri Coal now control over 71,000 hectares (Appendix C (p1)). These purchases, though legal, have hollowed out the social and economic base of our community. They have removed neighbours, closed farms, and degraded the micro-economy. Those of us who remain carry the burden of sustaining a diminished community with fewer services, fewer families, and no formal support.

3. Groundwater is critical, Risk from Mining is High

In *2010*, long before mining began at Maules Creek, the Namoi Catchment Water Study assessed Zone 11 the Maules Creek Alluvial Aquifer as at “High Risk” with a Moderate level of Confidence. This was the most certain of any of the Namoi Catchment Water Studies findings. Parsons Brinckerhoff. (2010).

We do not want risks to our livelihoods and lifestyles to be trivialised, ignored or down played and this is what we can see is happening.

Table E2 Risk of impacts to groundwater levels and confidence in predictions

Management Area / Zone	Risk	Confidence	Source
Upper Namoi Alluvium Zone 1	Low	Low	Mining
Upper Namoi Alluvium Zone 2	Low	High	Mining and CSG
Upper Namoi Alluvium Zone 3	Low	High	Mining
Upper Namoi Alluvium Zone 4	Moderate	High	Mining
Upper Namoi Alluvium Zone 5	Moderate	Moderate	Mining and CSG
Upper Namoi Alluvium Zone 6	Low	Low	Mining and CSG
Upper Namoi Alluvium Zone 7	High	Low	Mining
Upper Namoi Alluvium Zone 8	Moderate	Moderate	Mining
Upper Namoi Alluvium Zone 9	Moderate	Low	Mining and CSG
Upper Namoi Alluvium Zone 10	Low	Low	Mining and CSG
Upper Namoi Alluvium Zone 11	High	Moderate	Mining
Upper Namoi Alluvium Zone 12	Low	High	N/A
Lower Namoi Alluvium	Low	High	CSG
Gunnedah Basin	High	Moderate	Mining and CSG
Oxley Basin	Moderate / High	Low	CSG
Liverpool Ranges Basalt	Low	Moderate	Mining and CSG
Great Artesian Basin	Low / Moderate	Moderate	CSG
GAB Alluvial	Low	Moderate	CSG
New England Fold Belt	Low	High	N/A
Peel Valley Alluvium	Low	High	N/A
Peel Valley Fractured Rock	Low	High	N/A
Misc. Alluvium of Barwon Region	Low	High	N/A
Galarganbone Tertiary Basalt	Low	High	N/A

Note - highlight colours reversed for Risk & Confidence

Fig: 10 Namoi Catchment Water Study Final Report Risks and confidence in predictions (Parsons Brinckerhoff. (2010))

The failure of the groundwater monitoring and trigger framework at Maules Creek Coal Mine in 2018 is not only a technical flaw , it represents a broader failure to meet the project's social impact mitigation obligations under the Environmental Planning and Assessment Act 1979.

Groundwater reliability is critical to the well-being, productivity, and livability of the Maules Creek community. The absence of responsive and enforceable groundwater triggers directly undermines the effectiveness of the mine's Social Impact Assessment (SIA) and the credibility of its social licence to operate. The following points illustrate this breakdown:

3.1 Failure to detect and respond to significant social impacts

In 2018, local landholders experienced sudden bore failures and the loss of surface water at Elfin Crossing. These events coincided with a dramatic increase in the mine's groundwater take from under 10 ML/year to over 576 ML/year (AGE - BTM Groundwater Model Report 2021, Section 6.7.1.3, p. 75). No communication, reassurances, or mitigation efforts were offered by the company. This lack of response to a material community water impact reflects a complete breakdown in the SIA mitigation framework.

3.2 Dismissal of lived experience and community concern

When residents raised groundwater concerns, Whitehaven Coal publicly rejected any link between mining and bore failures, attributing the impacts to “lack of rainfall” and “inadequate aquifer storage” (Whitehaven Statement, 2019). This stance ignored the spatial and temporal alignment of groundwater loss with mine dewatering and failed to respect the concerns and observations of those most affected.

3.3 Triggers that fail to serve their social purpose

The Water Management Plan (2014) included groundwater trigger levels, but these were not activated in response to the 2018 aquifer decline and bore failures (MCCM - Water Management Plan March 2024, p. 128). Earlier reviews by the Department of Industry had already warned that modelled groundwater behaviour did not align with observed data and that this discrepancy was not addressed by existing response frameworks (DOI - MCCM Ground and Surface Water Assessment Oct 2018, p. 3). A social impact mitigation framework that fails to detect or respond to such events is not fit for purpose.

3.4 Non-compliance with SIA principles and approval conditions

Approval conditions under the EP&A Act require that projects avoid or mitigate adverse impacts on local amenity, water access, and community resilience. The SIA framework further demands proactive identification and management of these impacts. The 2018 groundwater loss represented a clear, foreseeable, and preventable social impact , yet no mitigation was implemented, no compensatory water was offered, and no adaptation measures were initiated. This failure directly undermines the intent of the SIA and associated approval conditions.

4. Inadequacies of the SIA and SIMP

The 2025 SIA and SIMP present a sanitised picture of our experience. The assessments:

- Ignore the cumulative stress of land acquisition and depopulation
- Fail to acknowledge the social consequences of transition delays (Parsons R (2025) p.6)
- Rely on generic data from the Narrabri LGA that fails to reflect our local reality
- Omit climate change entirely, despite it being a major regional stressor
- Offers no plan for post mining social or economic recovery

There was no genuine consultation with those of us most affected. The assessment process has reinforced exclusion and deepened community mistrust.

5. Climate Risk and Future Planning

The complete omission of climate change from the 2025 SIA is unacceptable. This region is already feeling the effects of changing rainfall, increased heat, and fire risk. Social impacts cannot be isolated from environmental conditions. A forward looking assessment must address:

- Community resilience to extreme weather
- The long-term viability of agriculture post-mining
- Water security for both human and ecological needs
- Opportunities for adaptive infrastructure and energy transition

6. What We Call For

We are writing not simply to participate in another round of procedural engagement, but to insist that this process reflect the lived reality of the Maules Creek community. The continuation project is not forecast to be needed for at least another 10 years, yet its impacts are already being felt. The uncertainty it generates, the land it has locked up, and the social and economic erosion it accelerates are real and immediate.

This is not the first time we have made this request (Appendix J - MCCC Letter to Square Peg). If this process is to have any credibility, it must be restructured to put the community at its centre, before further damage is done.

We ask that the Department require the proponent to commit to positive social impacts:

- Conduct a revised Social Impact Assessment, led by the community, not one simply performed on it. This process must include meaningful participation and be guided by an independent consultant selected by residents—not appointed by the company.
- Establish a binding social transition plan with specific dates, measurable actions, and enforceable criteria for delivering long-term community benefit before and after mine closure.
- Commit to a re-population and rural revitalisation strategy for Maules Creek and surrounding villages, including land reform, affordable housing, and incentives to restore a functioning local economy.
- Integrate climate adaptation and post-mining land use planning into the SIMP, including assessment of future water access, heat stress risks, and alternative sustainable industries.
- Engage directly with Traditional Owners and long-term residents, not in isolation or through controlled one-on-one interviews, but through a transparent, collective process that supports co-design of legacy outcomes.

Maules Creek is not just a mining precinct, it is a place where people have lived, worked, and raised families for generations. We ask that our stories, needs, and visions for the future be properly recognised in this process.

Re-imagining Maules Creek

Leveraging Inland Rail Growth: The Case for Strategic Water Infrastructure in Maules Creek

Narrabri is preparing for a major transformation, with the NSW Government proposing rezonings to accommodate more than 2000 new, flood-free homes, a new city centre, and a jobs precinct connected to the Inland Rail corridor. For a town with just under 6000 existing dwellings, this is a significant expansion in housing, services, and industry. The jobs precinct alone is expected to generate hundreds of employment opportunities, positioning Narrabri as a key logistics and commercial hub between Melbourne and Brisbane. This proactive, state-led approach demonstrates what can be achieved when infrastructure, economic development, and community growth are strategically planned well in advance of anticipated demand.

Maules Creek, can play a role, but risks being left behind unless post-mining transition planning and water security are addressed now.

Fig 11: *Existing housing stock in Maules Creek, including properties on mine-owned land. Many dwellings are vacant or in disrepair, representing an immediate opportunity for refurbishment and reoccupation as part of post-mining revitalisation.* (MCCC (2025)b)

Mine-owned land includes significant existing housing stock, much of it in disrepair or sitting vacant, that could be refurbished to provide affordable homes quickly, without waiting for greenfield development. Reinvesting in and repopulating these dwellings would preserve and enhance the existing social capital of Maules Creek, maintaining community cohesion while attracting new residents. This approach, combined with selective new development in suitable areas, would offer an immediate and cost-effective way to increase the region's housing capacity.

A **climate-resilient water pipeline,** initially conceived to offset mine depressurisation, once implemented can also function as regional growth infrastructure. With reliable water supply, Maules Creek could absorb part of the growth expected in Narrabri, relieving pressure on its housing market and services. By integrating this water infrastructure into regional planning now, the pipeline becomes more than an environmental mitigation measure, it becomes the foundation for revitalisation, job creation, and resilience, ensuring that Maules Creek shares in the benefits of investment rather than watching them concentrate elsewhere. The Department should require the proponent to deliver this infrastructure as part of any project approval, mitigating depressurisation impacts and serving the long-term needs of the region.

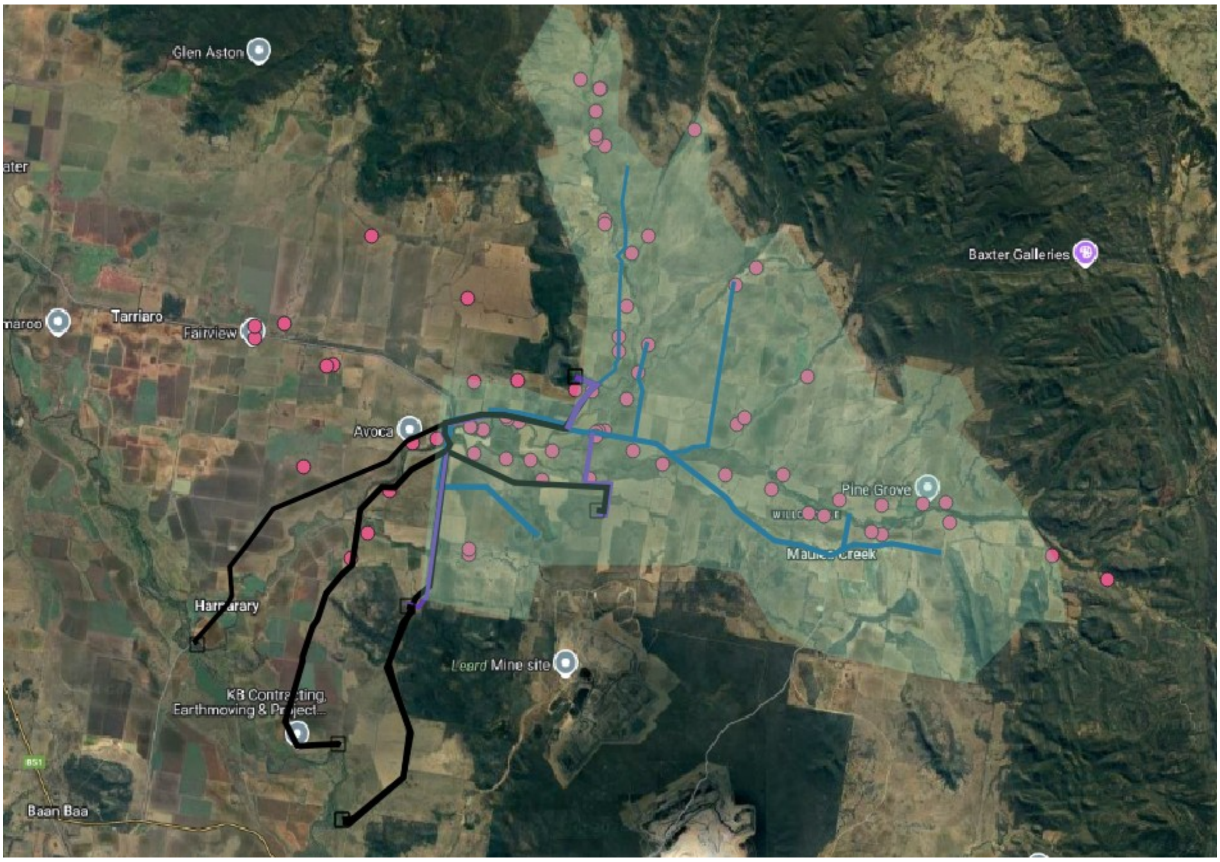

Fig 12: Potential groundwater pipeline infrastructure for Maules Creek (MCCC (2025)c)

Biodiversity Impacts - Native Vegetation

The MCCC commissioned The EnviroFactor Principle Ecologist, Wendy Hawes to review the impacts of the Maules Creek Continuation Project on the Leard Forrest Vegetation Communities. The excellent Report is contained in Appendix D – Biodiversity Independent Expert Report.

Wendy Hawes concludes that the Maules Creek Continuation Project will result in significant, long-term and likely irreversible impacts to Critically Endangered and Endangered Ecological Communities, particularly the Box-Gum Woodland CEEC. The proposal fails key tests under the Biodiversity Conservation Act 2016, including the SAII threshold, and does not demonstrate that proposed offsetting, restoration, or management measures will be ecologically effective, enforceable, or enduring. The inadequacies in impact assessment, mitigation planning, and offset integrity underscore the need for refusal of the project or substantial redesign in line with conservation legislation and best practice ecological management.

Biodiversity Impacts - Swift Parrot

The MCCC has commissioned Prof. Robert Heinson to review the impacts of the Maules Creek Continuation Project on the critically endangered Swift Parrot. The Report is contained in Appendix D - Swift Parrot Independent Expert Report.

The report concludes that:

- The proposed clearing of 548.7 ha of potential foraging habitat will cause serious and irreversible impacts on the Swift Parrot (*Lathamus discolor*) population.
- The Maules Creek Continuation Project (MCCP) fails to recognise the critical importance of Leard State Forest for Swift Parrot winter foraging.
- The delayed benefits from post-mining rehabilitation will arrive too late to prevent extinction, which is projected within 10 years.
- The Biodiversity Development Assessment Report (BDAR) underestimates risk and misinterprets migratory behaviour and habitat dynamics.

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MCCC (2024)c. UNSW groundwater monitoring locations [Map]. Unpublished community dataset

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MCCC (2023)a. MCCM pit showing location of MAC1263 in August 2022 adjacent to pit pumps [Map]. Unpublished community dataset

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List of Abbreviations

Abbreviation	Meaning
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AGMG	Australian Groundwater Modelling Guidelines
CCC	Community Consultative Committee
DA	Development Application
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DOI	NSW Department of Industry
DPE	NSW Department of Planning and Environment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
GDE	Groundwater Dependent Ecosystem
GIA	Groundwater Impact Assessment
GMP / GWMP	Groundwater Management Plan
GHB	General Head Boundary
mAHD	Metres above Australian Height Datum
mbTOC	Metres below Top of Casing
MCA	Maules Creek Alluvium
MCCC	Maules Creek Community Council Inc
MCCM	Maules Creek Coal Mine
ML/day	Megalitres per day
Mtpa	Million tonnes per annum
SEARs	Secretary's Environmental Assessment Requirements
Sy	Specific Yield
SIA	Social Impact Assessment
SSD	State Significant Development
SWL	Standing Water Level
TARP	Trigger Action Response Plan
TOC	Top of Casing
VWP	Vibrating Wire Piezometer
WAL	Water Access Licence
WMP	Water Management Plan

Appendices

Appendix A - Maules Creek Continuation Project Groundwater Review Report

Appendix B - Maules Creek Continuation Project - SIA Peer Review

Appendix C – SIA Local Perspective

Appendix D - Maules Creek Continuation Project Biodiversity Review

Appendix E - Swift Parrot Independent Expert Report

Appendix H - Final Void

Appendix I - Inter-Mine Water Transfer Pipeline

Appendix J – MCCC Letter to Square Peg

Appendix L - Reports and Correspondence

Appendix A

Maules Creek Continuation Project

Third Party Groundwater Review

hydrogeologist.com.au

REPORT ON

MAULES CREEK CONTINUATION PROJECT

INDEPENDENT THIRD-PARTY REVIEW

For: Maules Creek Community Council

Project number: 4184

Date: 29/07/2025

ABN: 50 627 068 866 www.hydrogeologist.com.au info@hydrogeologist.com.au

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Attachment

Maules Creek Continuation Project - Independent Third-Party Review

Prepared for

Maules Creek Community Council

1. Introduction

This report provides a third-party peer review of the groundwater impact assessment (GIA) and associated modelling for the Maules Creek Continuation Project (the Project). The Maules Creek Coal Mine (MCCM) is an approved open cut mine located in the Gunnedah Basin, approximately 17 kilometres (km) north-east of Boggabri, within the Narrabri Shire Local Government Area (LGA) in New South Wales (NSW).

The MCCM is an existing open cut coal mine in the Gunnedah Basin and has been operating since 2014. The mine is located adjacent to the Boggabri Coal Mine and the Tarrawonga Coal Mine. Mining at the MCCM is approved until December 2034 at a rate of up to 13 million tonnes per annum (Mtpa). MCCM proposes to extend the approved open cut mining operation and requires additional approvals to do so. Hence the Project requires an environmental impact statement (EIS) to be prepared.

The GIA has been prepared by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) for Whitehaven Coal Pty Ltd. The GIA considered the potential impacts of expanding the open cut pit and the associated changes to the groundwater system post-closure.

The elements of the project that are relevant to the GIA are:

- continuation of open cut operations within Coal Lease (CL) 375, Mining Lease 1719 and Authorisation 346 to allow mining and processing of additional coal reserves until December 2044;
- extraction of 117 million tonnes of run-of-mine (ROM) coal (in addition to the approved MCCM coal resource);
- extraction of up to 14 Mtpa of ROM coal (i.e., a 1 Mtpa increase from the currently approved maximum ROM coal mining rate of 13 Mtpa).

It is understood that the Maules Creek Community Council are concerned about how the current approved mining and the proposed continuation of mining at Maules Creek Coal Mine (and the cumulative impact of mining) has and will affect groundwater resources and the environment in the region.

This report provides an independent third-party review of the Maules Creek Continuation Project GIA and associated numerical modelling. The scope also includes a review of the existing Maules Creek Groundwater Management Plan (GMP) including an assessment of suitability of the monitoring locations and program, current triggers and actions. The GMP is currently included with the Maules Creek Water Management Plan (WMP).

This independent third-party peer review has been conducted by Daniel Barclay, Director and Principal Hydrogeologist and Andrew Macdonald, Principal Hydrogeologist at hydrogeologist.com.au.

Daniel holds a BSc (Hons) in Applied Science and is a Member of the International Association of Hydrogeologists (MIAH). He has more than 26 years professional experience undertaking groundwater assessments in the Australian resources sector. Daniel is an appropriately qualified person having the necessary experience and qualifications for the purposes of undertaking the independent third-party peer review. A CV for Daniel Barclay is provided in Attachment A of this report.

Andrew is a Hydrogeologist with 19 years' experience in a wide range of groundwater projects in Australia. He specialises in the evaluation and management of groundwater resources across a number of industry sectors including mining, energy, and construction. He has additional expertise in mining hydrogeology, project management, conceptualisation and desktop assessments, risk and impact assessments, aquifer testing and characterisation, groundwater monitoring network design and analytical analysis. A CV for Andrew Macdonald is provided in Attachment A of this report.

2. Documentation

The independent third-party peer review is based on the following reports:

- Maules Creek Continuation Project Groundwater Impact Assessment (AGE, 2025). 23 May 2025.
- Maules Creek Coal Mine Water Management Plan. Whitehaven Coal. 24 March 2025.
- Maules Creek Coal Project Groundwater Impact Assessment (AGE, 2011). Project Number G1508. June 2011.
- Boggabri, Tarrawonga, Maules Creek Complex Groundwater Model Update (AGE, 2021). Project Number G1850P. December 2021.
- Pacific Coal 1982. Geological report on relinquished portion of E.P. No.4. Pacific Coaly Pty Limited. February 1982.

The Maules Creek Continuation Project Groundwater Impact Assessment (AGE, 2025) includes the following major sections:

- Section 1 – Introduction.
- Section 2 – Objectives and scope of work.
- Section 3 – Regulatory framework.
- Section 4 – Project setting, including location, topography and drainage, climate, land use, surrounding mining operations, surface water, flow gauging, water quality objectives.
- Section 5 – Geology describing regional setting and stratigraphy, local geology, faults and dykes.
- Section 6 – Groundwater monitoring networks.
- Section 7 – Hydrogeology and groundwater regime including hydrostratigraphic units, hydraulic parameters, geological structures, recharge, water levels and flow directions, alluvial connectivity to coal measures, surface water connectivity to groundwater, discharge, groundwater quality, groundwater dependent ecosystems, groundwater users and conceptual model.
- Section 8 – Numerical model.
- Section 9 – Impact assessment.
- Section 10 – Mitigation, management and monitoring.
- Section 11 – References.

The AGE (2025) report appendices include:

- Appendix A - Water access licences and bore licences.
- Appendix B - Monitoring network construction details.
- Appendix C - Monitoring network installation report.
- Appendix D - Water supply bore census records.
- Appendix E - Back Creek ecohydrological data review.
- Appendix F - Groundwater modelling technical report.
- Appendix G - Peer review.
- Appendix H - Aquifer Interference Assessment Framework Form.

3. Methodology

The purpose of this independent third-party review is to determine whether:

- the groundwater model and impact assessment developed by AGE is based on an appropriate conceptualisation of the groundwater regime, that it is hydrogeologically sound and fit-for-purpose for assessing groundwater impacts in the region, and provides suitable conclusions and recommendations; and
- the GMP developed by Whitehaven Coal is a suitable document to manage and mitigate the current approved groundwater impacts and proposed impact from the Maules Creek Continuation Project.

There are no standard procedures for undertaking independent third-party reviews for groundwater impact assessments. The Australian Groundwater Modelling Guidelines (AGMG) were developed by Barnett *et al*. (2012), and for some time have been considered the most appropriate document to use for the assessment of suitability of conceptual groundwater models and numerical groundwater models. The AGMG provide a series of review checklists for a peer reviewer and these checklists have been used to inform the suitability of the conceptual and numerical models. The review checklists include a compliance checklist (see Table 9-1 of the AGMG), and a detailed review checklist (see Table 9-2 of the AGMG). The detailed review checklist is broken up into eight categories as follows:

- Planning;
- Conceptualisation;
- Design and construction;
- Calibration and sensitivity;
- Prediction;
- Uncertainty;
- Solute transport ; and
- Surface water-groundwater interaction.

The AGMG also provides a confidence level classification system for key criteria and indicators such as data, calibration and predictions. The model confidence level classification describes three classifications (one to three), with Class 1 relating to a simple model and Class 3 referring to a more complex model. The classification levels relate to the project and model objectives and the intended use of the groundwater model.

The Independent Expert Scientific Committee (IESC) released the Information Guidelines Explanatory Note: Uncertainty analysis for groundwater modelling in 2023. Within this Explanatory Note, the IESC (2023[1]) regards the confidence level classification outlined in the AGMG as redundant, recommending that the confidence level classification not be used during the review process. The Explanatory Note also states that "a fit-for-purpose assessment of a groundwater model and uncertainty analysis will be highly context specific and difficult to capture in formalised checklists or classifications". The Explanatory Note (IESC, 2023) is not a formal guideline, and the intended use of the Explanatory Note is to complement the AGMG.

In the absence of an alternative, and for the purposes of this independent third party review, the AGMG detailed review checklist has been used and is detailed in Section 4.

After the review of the GIA, the existing WMP was reviewed to ensure the monitoring locations and program, current triggers and actions are appropriate to monitor key risk areas and receptors identified as part of the GIA.

[1] Peeters LJM and Middlemis H (2023) Information Guidelines Explanatory Note: Uncertainty analysis for groundwater modelling. A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of Climate Change, Energy, the Environment and Water, Commonwealth of Australia 2023.

4. Checklist

Table 4-1 summarises the outcome of the model review checklist (after Barnett *et al.*, 2012). There are a number of items in the model review checklist that are not relevant, and these have been described as not applicable (N/A). Comments and discussion on the report, data and numerical model are provided in Section 5.

Table 4-1 **Model review checklist (after Barnett *et al*., 2012)**

Review questions	Yes/No	Comment
1. Planning		
1.1 Are the project objectives stated?	Y	Section 2 defined the objective of the GIA was to assess the types of impacts, the likelihood of impacts, and the magnitude of risk to the groundwater-related quantities of interest posed by the Project to support the regulatory decision-making process.
1.2 Are the model objectives stated?	Y	Appendix F F4 including four specific objectives.
1.3 Is it clear how the model will contribute to meeting the project objectives?	Y	Appendix F F4 including four specific rationales.
1.4 Is a groundwater model the best option to address the project and model objectives?	Y	Best option given complexity of the setting and the history of BTM groundwater models since 2010.
1.5 Is the target model confidence-level classification stated and justified?	N	Not listed.
1.6 Are the planned limitations and exclusions of the model stated?	Y	The limitations and assumptions are described in Appendix F F5.
2. Conceptualisation		
2.1 Has a literature review been completed, including examination of prior investigation	Y	No specific literature review section has been documented in the EIS Groundwater Impact Assessment. It is understood numerous BTM groundwater models have been completed since 2010 by AGE. Section 7.2 Hydraulic Parameter lists collated information sourced from the previous BTM Complex model updates. Appendix F lists the history of BTM groundwater models since 2010.
2.2 Is the aquifer system adequately described?	Y	The aquifer system is adequately described.
2.2.1 hydrostratigraphy including aquifer type (porous, fractured rock)	Y	Section 7 describes the local stratigraphy and hydro stratigraphic units. Text adequately describes the cover sequence and basement rocks.
2.2.2 lateral extent, boundaries and significant internal features such as faults and regional folds	Y	Section 7.1 text describes the local stratigraphy can be broadly classified into four distinct hydrostratigraphic units in the table below. Section 7.2.4 text describes the geological structures are discussed and listed below.

Review questions	Yes/No	Comment

Hydrostratigraphic unit	Groundwater bearing lithology	Hydrogeological characteristics	Groundwater bearing type
Narrabri Formation	Alluvium	The surface alluvial cover comprises extensive overbank clays with lesser channel sands/gravels. Relative to the underlying Gunnedah Formation, a greater presence of clay results in higher salinity and lower yields.	Aquifer
Gunnedah Formation	Alluvium	Basal paleochannel alluvium, comprising sands/gravel with interbedded clay. It can be extremely high-yielding and fresh. Groundwater abstraction from the aquifer is significant.	Aquifer
Maules Creek Formation and Boggabri volcanics	Regolith/ Weathered zone	Surficial soils and weathered bedrock. The weathered thickness of the Maules Creek Formation and the Boggabri volcanics generally ranges between 1 m and 30 m, with deeper weathering profiles found along fractures and potential fault zones. Pending on the clay content, it is interpreted to be more permeable than fresh rock, although still hydrogeologically 'tight'. There is limited information on hydraulic parameters and water quality.	Aquifer/ Aquitard
Maules Creek Formation	Permian Coal Measures	Prime water-bearing lithology of the Maules Creek Formation. Sixteen coal seams of variable thickness (with 15 seams targeted), with a cumulative thickness of more than 35 m. Low to moderately permeable and generally fresh to brackish close to the outcrop area.	Aquifer
	Interburden	Hydrogeologically 'tight' and, therefore, very low-yielding to essentially dry conglomerate/sandstone, which comprises most of the Maules Creek Formation.	Aquitard
Boggabri volcanics	Silicic volcanics	A small amount of outcrop in the study area generally forms the basement of Maules Creek Sub-basin. Considered to be of very low permeability/impermeable, particularly at depth. Where present, groundwater is likely stored in fractures and/or weathered material. Brackish to moderately saline in quality.	Aquitard

Review questions	Yes/No	Comment
2.2.3 aquifer geometry including layer elevations and thicknesses	Y	Details on the composition, extent and thickness of these hydrostratigraphic units are discussed in Section 5. No specific structure contours or isopach maps in the report. Aquifer geometry is shown in Figure 5.8. AGE (2025) Section 5.2.4 Permian Maules Creek Formation states *Seams below the Braymont seam onlap onto the Boggabri volcanics immediately to the north and west of MCCM, while the Braymont seam and those above (Herndale, Onavale, Teston and Thornfield) potentially subcrop beneath the Maules Creek alluvium.* AGE (2025) Section 7.9.1 Regional and local conceptual model states *The treatment and the implementation of the lateral connectivity between Maules Creek alluvium and subcropping coal seams, and the role of the weathered regolith as the primary pathway for lateral groundwater flow from the alluvium is further explained in Appendix F.* AGE (2025) Appendix F5.2 Limitations states *The Narrabri alluvium is laterally connected to Permian weathered regolith, while the Gunnedah alluvium is laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams. This aligns with the current conceptual model of the system, which assumes that weathered regolith is the primary pathway for lateral groundwater flow from the alluvium.* There is minimal information, data or description provided to support the concept that the Gunnedah alluvium is laterally disconnected, thus limiting flow to the vertical direction through sub-cropped coal seams. Further discussion on this is provided in Section 5.1 of this report. AGE (2025) Section 5.26 states *the Boggabri volcanics outcrop to the west of the MCCM, and the eastern flank of the volcanics dips steeply to the east with coal seams stratigraphically lower than the Jeralong seam onlapping onto the volcanics (Figure 5.8) in the vicinity of the MCCM.* Further to the above, Figure 5.10 provides the structure contours for the top of the Boggabri volcanics. It is unknown the source dataset for this layer. Further discussion on this is provided in Section 5.1 of this report.

Review questions	Yes/No	Comment
2.2.4 confined or unconfined flow and the variation of these conditions in space and time?	Y	Section 7.4 Water levels, hydraulic gradients and flow direction text describes the flow conditions in each HSU.
2.3 Have data on groundwater stresses been collected and analysed	Y	Section 7.5 Discharge describes groundwater stresses including pumping via stock, domestic and irrigation bores and interception of groundwater in mining areas.
2.3.1 recharge from rainfall, irrigation, floods, lakes	Y	Section 7.3 text discusses use of several methods to estimate rainfall recharge, including a soil moisture balance, chloride mass balance (CMB), and water table fluctuation. Section 7.4.6 Surface water connectivity to groundwater states *Plots indicate that Maules Creek only gains from groundwater during groundwater level peaks, which are generally short-term (creek bed elevations sourced from the 5 m NSW Government DEM). Most of the time, data shows that surface water is lost to underlying sediments.* Section 7.4.7 provides text on the relationship between change in water levels, mining and climate. Section 7.8.1 Groundwater-dependent ecosystems states *Conceptually, there are limited, ephemeral surface water features in the local area that have the potential to be groundwater-gaining. Observations and recent studies by Crosbie et al. (2023) indicate that most surface water features recharge the underlying groundwater systems during flow periods.* There is a demonstration of connection between surface waters and groundwaters.
2.3.2 river or lake stage heights	Y	Description of surface water features is provided in Section 4.2 Topography and drainage and Section 4.6 Surface Water.
2.3.3 groundwater usage (pumping, returns etc)	Y	Section 7.5 Discharge discusses pumping via stock, domestic and irrigation bores. Local bore census is available and search of registered bores in public database. A field hydrocensus in a 15 km radius of the BTM complex was conducted between 2023 and 2025 to identify groundwater users within the predicted zone of influence of the mine.
2.3.4 evapotranspiration	Y	Section 7.5 Discharge discusses evapotranspiration via deep-rooted riparian vegetation stands.
2.3.5 other?	N	
2.4 Have groundwater level observations been collected and analysed?	Y	Section 7.4 Water levels, hydraulic gradients and flow directions. Groundwater level data is available from 2006 providing 19 years of representative data.
2.4.1 selection of representative bore hydrographs	Y	Section 7.4 describes water levels, hydraulic gradients and flow directions. Numerous hydrographs are presented and discussed for each HSU and in relation to different processes.

Review questions	Yes/No	Comment
2.4.2 comparison of hydrographs	Y	Hydrographs are stacked and compared based on spatial layout and for representative cover sequence horizons.
2.4.3 effect of stresses on hydrographs	Y	Section 7.4 describes water levels, hydraulic gradients and flow directions and provides detail on influence of mining and site infrastructure on groundwater level behaviour. Section 7.4.3 *states Open cut mining at the MCCM is causing groundwater within the surrounding Permian bedrock to enter the open cut pit, leading to depressurisation of groundwater within the surrounding Permian bedrock strata.* Section 7.4.5 states *Multi-level monitoring that extends through both the alluvium and the coal measures is limited to two sites within the vicinity of the Project.* These are: Thornfield Crossing – monitored by REG02 and GW041027, located upstream along the south bank of Maules Creek, possibly within fault zone material. Green Gully – monitored by REG01 and GW967138, located north-northeast of the MCCM, along the north bank of Maules Creek. There are no multi-level monitoring bores available in the Maules Creek alluvium and the sub cropping coal seams to support the conceptualisation.
2.4.4 watertable maps/piezometric surfaces?	Y	See Figures 7.8 Quaternary alluvium water table and 7.18 Boggabri volcanics water table. Figures 9.6 and 9.7 show depth to water table maps. The extents are different for the Figures 7.8 Quaternary alluvium water table and 7.18 Boggabri volcanics water table. The Boggabri volcanics water table figure extends to Back Creek yet does not extend north to cover the Maules Creek area. The Boggabri Volcanics are shown to subcrop in this area on Figure 5.8.
2.4.5 If relevant, are density and barometric effects taken into account in the interpretation of groundwater head and flow data?	Y	Section F5.1 Assumptions states *Groundwater in the model domain is represented as a single-phase fluid with constant density in a continuous porous medium.* Barometric effects are not specified for groundwater head and flow data.
2.5 Have flow observations been collected and analysed?	Y	Appendix F F8.7 Mine inflow states *Accounting for all groundwater taken directly or indirectly from groundwater systems.* Figure F 72 to Figure F 74 show the estimated annual volume of groundwater directly intercepted by mining at the BTM Complex within each mining area.
2.5.1 baseflow in rivers	Y	Section 7.4.6 Surface water connectivity to groundwater states *Plots indicate that Maules Creek only gains from groundwater during groundwater level peaks, which are generally short-term.* Section 7.5 Discharge states *discharge as baseflow to Namoi River and in some areas of ephemeral creeks (e.g. lower reaches near Namoi River).* The report does not discuss in Section 7.5 baseflow at Maules Creek or Back Creek. But does acknowledge this in Section 7.9.2 as a potential risk. The baseflow from these systems is excluded from the Section 7.6 Water balance. Section 7.9.2 Eco-hydrological conceptual model lists the potential risks the Project poses to environmental receptors within the Maules Creek alluvial aquifer. These risks were identified in the report as *reduced baseflow at Maules Creek, Back Creek and Namoi River.*

Review questions	Yes/No	Comment
		Section 8 Numerical model. *The model has 34 layers and comprises up to 18,920 cells per layer, making it spatially a large and complex model. Systems stresses represented by the model includes flow of groundwater to ephemeral creeks as baseflow where the water table intersects the creek bed, including Maules Creek.* Section 9.3.3 Elfin Crossing. *During La Niña events, and for relatively short periods, the water table can rise above the creek bed and contribute baseflow to Maules Creek.* The conceptualisation and modelling demonstrate a connection between surface waters and groundwaters.
2.5.2 discharge in springs	Y	Section 7.8.1 Groundwater-dependent ecosystems states *There are 21 groundwater springs identified within the Namoi sub-catchment. The closest spring to the MCCM is approximately 20 km east of the Namoi River and is in a different hydrogeological area.*
2.5.3 location of diffuse discharge areas?	N	Diffuse discharge is not discussed. Diffuse recharge is discussed from rainfall events, losing conditions from creeks and river reaches, and groundwater connectivity through the eastern thrust fault system.
2.6 Is the measurement error or data uncertainty reported?	Y	Appendix F F7.3 Calibration targets states *The measurement error for the VWPs is considered potentially higher than that for the monitoring bores and possibly in the range of ±5 m to 10 m. Despite the potential for larger measurement errors in the VWP data, when used with caution, it remains a useful additional dataset for understanding the groundwater regime and guiding the calibration of the numerical model, provided that the observed pressure changes are considered conceptually sound. Absolute hydraulic heads were weighted less than temporal differences to focus on matching depressurisation trends. Weights were balanced so that the absolute hydraulic heads contributed approximately a third of the starting total objective function during calibration compared with two-thirds for the temporal differences.* This measurement error maybe considered significant and is likely to affect the conceptualisation of the system (e.g. if the Permian strata has an upward /downward gradient when compared to shallow aquifers. Appendix F F7.3.1 Water level history matching states *The structural error incurred from the explicit representation of the coal seam and interburden units may be very large. The model assumes that coal seams exist where point data is available to inform them. Seams are also assumed not to exist if their thickness is less than 0.5 m. Interpolation between points and extrapolation outside the convex hull of those points governs the continuity and thickness of the coal seam layers. The density of drill logs used to inform coal seam elevation and thickness is greatest near the mines but reduces significantly further from them. Consequently, there is an increasing potential for error in the elevations and thickness of coal seams with distance from the mines.* This structural error maybe considered significant and is likely to affect the conceptualisation of the system and how this is represented in the numerical model
2.6.1 measurement error for directly measured quantities (e.g. piezometric level, concentration, flows)	Y	Data quality control or assurance steps are not discussed. Section 7.4.2 states *Hydrographs within the weathered zone in the Boggabri volcanics and Maules Creek Formation show a muted response to rainfall recharge and no obvious depressurisation associated with mining. WOL2 has indicated a significant decrease over time; however, a review of available data suggests this is a measurement error.*
2.6.2 spatial variability/heterogeneity of parameters	Y	Spatial variability and heterogeneity have been addressed through pilot points and uncertainty.
2.6.3 interpolation algorithm(s) and uncertainty of gridded data?	Y	The estimated values for pilot points were interpolated across the model domain in each layer using ordinary kriging through PLPROC (Watermark Numerical Computing, 2023).
2.7 Have consistent data units and geometric datum been used?	Y	All units are consistent.

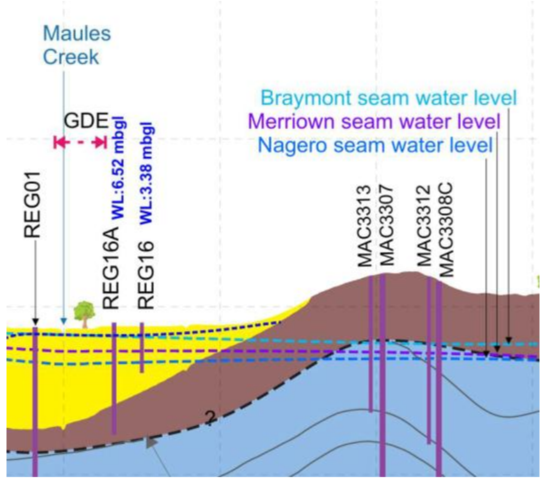
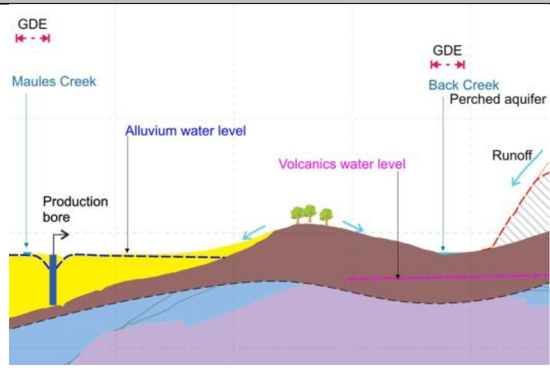
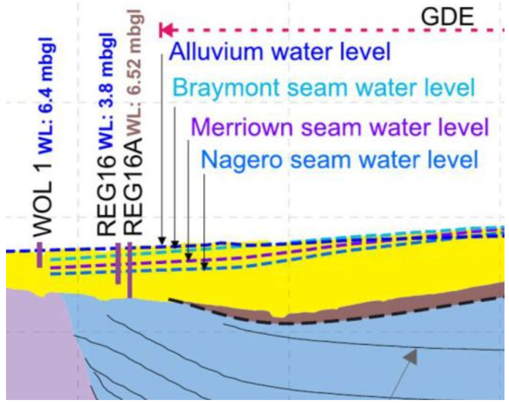
<table>
<tr><th>Review questions</th><th>Yes/No</th><th>Comment</th></tr>
<tr><td>2.8 Is there a clear description of the conceptual model?</td><td>Y</td><td>The conceptual model is described in Section 7.9. However there are potential discrepancies or alternatives to what is presented.</td></tr>
<tr><td>2.8.1 Is there a graphical representation of the conceptual model?</td><td>Y</td><td>
The conceptual model is provided in Figures 7.46 to 7.50. However, there are data or information gaps which raise the possibility of alternative conceptualisations. This is evident in:
Figure 7.47 Hydrogeological conceptualisation E-E' Displays uncertainty in weathered regolith thicknesses south of REG16 and does not clearly define the connection between the alluvium and subcropping coal seams. The alluvium appears to exceed 50 m in thickness, and there is no distinction or separation shown between the Narrabri Formation and the Gunnedah Formation. This conceptualisation is inconsistent with other figures and text in Section 7.


Figure 7.48 Hydrogeological conceptualisation D-D' Does not include any groundwater bores within the conceptual model. This limits the ability to validate interpreted water levels and lithological boundaries. The volcanic water level appears disconnected from the weathered zone towards the alluvium but remains continuous towards the MCCM Pit. As with Section E–E', the alluvium exceeds 50 m in thickness, and no separation is depicted between the Narrabri and Gunnedah Formations. The alluvial water table is shown as hydraulically disconnected from the Permian strata by the weathered zone. This conceptualisation is inconsistent with other figures and text in Section 7.
</td></tr>
</table>

Review questions	Yes/No	Comment
		 Figure 7.49 Hydrogeological conceptualisation B-B' Shows limited groundwater bores penetrating the full thickness of the alluvium. This reduces confidence in interpreted stratigraphy and connectivity. The data source for the Boggabri Volcanics is unknown and is represented as steeply dipping with subcropping coal seams. The regolith layer thins near REG16, with water levels in the alluvium and Braymont seam at near equilibrium, potentially indicating the location of a hydraulic connection between the alluvium and the underlying fresh Permian strata. This conceptualisation is inconsistent with other figures and text in Section 7. 
2.8.2 Is the conceptual model based on all available, relevant data?	Y	The main hydrostratigraphic units and conceptual model elements have been presented. Further data and better presentation would improve the conceptual model.
2.9 Is the conceptual model consistent with the model objectives and target model confidence level classification?	Y	The conceptual model could be further refined to be consistent with the model objectives. Confidence level classification is not considered relevant.

Review questions	Yes/No	Comment
2.9.1 Are the relevant processes identified?	Y	Relevant processes are identified locally. Section 7.9.1 Hydrogeological conceptual cross-sections states *The treatment and the implementation of the lateral connectivity between Maules Creek alluvium and subcropping coal seams, and the role of the weathered regolith as the primary pathway for lateral groundwater flow from the alluvium is further explained in Appendix F.* This statement is not correct, and the description cannot be found or explained in Appendix F. Appendix F states *The BTM Complex model incorporates two layers to represent the full thickness of the alluvium, with Layer 1 being the Narrabri alluvium, and Layer 2 being the Gunnedah alluvium. The Narrabri alluvium is laterally connected to Permian weathered regolith, while the Gunnedah Alluvium is laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams. This aligns with the current conceptual model of the system, which assumes that weathered regolith is the primary pathway for lateral groundwater flow from the alluvium.* There is a lack of information or description around the weathered regolith being the primary pathway for lateral groundwater flow from the alluvium. No data or information is presented to support the Narrabri Formation being laterally connected to Permian weathered regolith, while the Gunnedah Formation is laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams. Data or information is required to update the conceptual model and details in Table 7.1 (Hydrostratigraphic units Regolith/ Weathered zone) as there is limited information on hydraulic parameters and water quality.
2.9.2 Is justification provided for omission or simplification of processes?	Y	There is a lack of information or description around weathered regolith being the primary pathway for lateral groundwater flow from the alluvium. There is a lack of information or description around the alluvium being laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams.
2.10 Have alternative conceptual models been investigated?	N	Conceptual model has been developed incrementally over decades but has been changed with the latest version of the BTM numerical model. See Section 5 of this report for further discussion on this issue.
3. Design and construction		
3.1 Is the design consistent with the conceptual model?	Y	The key processes identified in the conceptual model are represented in the numerical model. There are inconsistencies that are listed below: The hydrogeological conceptualisation describes *Potential connections between MCCM and the alluvial groundwater system exist north of MCCM where coal seams sub crop beneath the Maules Creek alluvium. Data evidence suggests that this connection is mainly driven by downward hydraulic gradients from the alluvium to the coal seams. Thus, long-term depressurisation of targeted coal seams may eventually propagate along seams and induce enhanced downward vertical gradients, potentially triggering decreases in water levels across Maules Creek alluvium.* The information above conflicts with the numerical model Appendix F which states *The BTM Complex model incorporates two layers to represent the full thickness of the alluvium, with Layer 1 being the Narrabri alluvium, and Layer 2 being the Gunnedah alluvium. The Narrabri alluvium is laterally connected to Permian weathered regolith, while the Gunnedah Alluvium is laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams. This aligns with the current conceptual model of the system, which assumes that weathered regolith is the primary pathway for lateral groundwater flow from the alluvium.* There is a lack of information or description for the conceptual model regarding the above processes.

Review questions	Yes/No	Comment
		The BTM Complex model also incorporates two layers to represent the full thickness of the alluvium, with Layer 1 being the Narrabri alluvium, and Layer 2 being the Gunnedah alluvium. There is minimal information provided to support the Narrabri Formation is laterally connected to Permian weathered regolith, while the Gunnedah Formation is laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams. There is minimal information describing the connection between the Narrabri Formation and the Gunnedah Formation.
3.2 Is the choice of numerical method and software appropriate?	Y	The 3D groundwater flow model was developed using MODFLOW-USG. PEST parameter estimation software (Doherty, 2024) was used to automate the process of adjusting hydraulic properties and recharge rates to replicate the water level observations available from the BTM Complex groundwater monitoring network as closely as possible.
3.2.1 Are the numerical and discretisation methods appropriate?	Y	Voronoi mesh used for spatial representation. Temporal periods are appropriate An initial steady-state calibration guided the model calibration to obtain pre-mining conditions (prior to 2006). This was followed by a transient simulation for calibration, where groundwater levels and flows were matched to available measurements. Stress periods remained consistent with AGE (2022), i.e., quarterly stress periods, with the updated transient model comprising 75 quarterly stress periods from January 2006 to June 2024.
3.2.2 Is the software reputable?	Y	Industry standard and commonly accepted.
3.2.3 Is the software included in the archive or are references to the software provided?	N (software not provided) /Y (references)	Software is not provided but is freely available, however AlgoMesh is only available commercially. References are provided for the software.
3.3 Are the spatial domain and discretisation appropriate?	Y	The model grid consisted of two types of cells: rectangular cells aligned with the primary direction of mining for each of the BTM mines and voronoi polygons for the remainder of the model area.
3.3.1 1D/2D/3D	Y	3D
3.3.2 lateral extent	Y	The model domain is approximately 30 kilometres (km) wide and 40 km long.
3.3.3 layer geometry?	Y	The model represents the key hydrostratigraphic units identified in the conceptual model with 34 separate layers representing the alluvium, weathered rock, coal seams, interburden and volcanics basement.
3.3.4 Is the horizontal discretisation appropriate for the objectives, problem setting, conceptual model and target confidence level classification?	Y	The following cell dimensions were adopted: mining areas – 100 m x 50 m cells; adjacent to major creeks and rivers – 200 m x 200 m voronoi cells; buffer zone around mining area (contains most monitoring bores) – 100 m diameter voronoi cells; adjacent to active extraction bores – approximately 175 m diameter voronoi cells; adjacent to inferred Conomos Fault – approximately 450 m x 350 m voronoi cells; and away from areas of interest – approximately 650 m maximum diameter voronoi.
3.3.5 Is the vertical discretisation appropriate? Are aquitards divided in multiple layers to model time lags of propagation of responses in the vertical direction?	Y	34 layers.
3.4 Are the temporal domain and discretisation appropriate?	Y	See below comments.
3.4.1 steady state or transient	Y	Both steady state and transient simulations.

Review questions	Yes/No	Comment
3.4.2 stress periods	Y	Stress periods are appropriate. Stress periods remained consistent with AGE (2022), i.e., quarterly stress periods, with the updated transient model comprising 75 quarterly stress periods from January 2006 to June 2024.
3.4.3 time steps?	N	Not reported.
3.5 Are the boundary conditions plausible and sufficiently unrestrictive?	Y	Boundary condition changes have been completed in the 2024 model update compared to the AGE 2022 BTM Complex Model. Section F6.2.1 Perimeter Model Boundaries states b*oundary conditions were aligned with the conceptual hydrogeological model of the area, with groundwater flow in and out of the model largely occurring through the alluvium. Flow through the Namoi River alluvium was largely represented by General Head Boundaries (GHB) along the southern and western sides of the model, where alluvial groundwater enters and exits the model (layers 1 and 2).* *The limitations describe the Analytical Method Used – Edelman Solution. Based on lateral flow from the alluvium mostly happens through the weathered regolith. To estimate this flow, they used the Edelman Solution, a method that calculates water movement using a 1-metre drop in water level over 250 metres (a 0.004 slope).* There is a known issue with the model identified in Section 6.2.1 Perimeter model boundaries *The pinching of coal measures layers in the unstructured grid laterally disconnects the Permian sequence layers from other model layers, albeit only in the horizontal direction. Vertical connections remain unaffected.* The lateral disconnection described is a feature of the model, not necessarily a confirmed real-world condition. The "pinching" in the unstructured grid represents how the model simplifies the geological structure. It causes horizontal (lateral) disconnection between the Permian sequence and other layers within the model. In reality, whether the coal measures are truly laterally disconnected from surrounding units would depend on actual geological continuity, which may be partially connected or hydraulically isolated. Further information or data is needed to support the assumption that lateral flow from the alluvium is limited by the regolith thickness and disconnection between the Permian sequence and other layers. The Conomos fault likely acts as a groundwater flow barrier; however, the 2024 numerical model has been updated to assess the potential for flow conduits. It was assumed to have no impact on layer 1 of the model, representing the alluvium and weathered regolith. In the 2024 model update, however, the Conomos fault has been parameterised in a manner that allowed for assessing its potential for conduit behaviour as well. The Hunter-Mooki Thrust Fault System represents the boundary between the edge of the Maules Creek sub-basin and the non-coal New England Fold Belt fractured rock. It is represented as a vertical no-flow barrier along the eastern edge of the model, spanning layers 3 to 34. There is the benefit of previous numerical models to understand the general impacts of the BTM complex and the required model domain. Rainfall recharge and EVT include seasonality. River and surface waters represented.
3.5.1 Is the implementation of boundary conditions consistent with the conceptual model?	Y	Representation of structural geology and consistent with the conceptual model.

Review questions	Yes/No	Comment
3.5.2 Are the boundary conditions chosen to have a minimal impact on key model outcomes? How is this ascertained?	Y	Lateral model boundaries such as the Hunter-Mooki Thrust Fault System are considered sufficiently far away from mining area for minimal impact. Boundaries are assumed to feature static hydraulic heads and are distant. However the model predictions do show drawdown that propagates to the eastern model boundary. Further information or data is needed to support the assumption that lateral flow from the alluvium is limited by the regolith thickness and disconnection between the Permian sequence and other layers. Some features of the boundary conditions could underestimate flow paths, drawdown predictions, connectivity assessments and mitigation designs.
3.5.3 Is the calculation of diffuse recharge consistent with model objectives and confidence level?	Y	Diffuse recharge is discussed from rainfall events, losing conditions from creeks and river reaches, and groundwater connectivity through the eastern thrust fault system. Three recharge zones are modelled. Several methods are applied to assess diffuse recharge rates and listed in Section 7.6 Water balance.
3.5.4 Are lateral boundaries time-invariant?	Y	Time-invariant GHB along the eastern, southern and western edge.
3.6 Are the initial conditions appropriate?	Y	A steady-state model was used to reproduce groundwater levels prior to the onset of mining at the BTM Complex.
3.6.1 Are the initial heads based on interpolation or on groundwater modelling?		Groundwater modelling. The model is first run to steady-state and the resulting heads are used as the initial condition for the transient model.
3.6.2 Is the effect of initial conditions on key model outcomes assessed?	Y	Mean stresses (excluding mining operations) and hydraulic heads over the last two decades reasonably approximate system steady-state conditions.
3.6.3 How is the initial concentration of solutes obtained (when relevant)?	N/A	N/A
3.7 Is the numerical solution of the model adequate?	Y	The mass balance error, which is the difference between the calculated model inflows and outflows at the completion of the steady-state calibration, was 0.0%. The maximum percent discrepancy at any time step in the transient simulation was 0.05%. This value indicates that the model is stable and achieves an accurate numerical solution.
3.7.1 Solution method/solver	Y	Automated calibration was achieved using a technique called ENSI (ENsemble Space Inversion)
3.7.2 Convergence criteria	Y	The maximum error is within acceptable limits for adequate numerical convergence less than 2%.
3.7.3 Numerical precision	Y	The root mean square (RMS) error calculated for the calibrated model was 6.6 m. The total measured head change across the model domain was 156.52 m, with a standardised root mean square (SRMS) of 4.2%, which can be considered a good match for the modelled system type.
4. Calibration and sensitivity		
4.1 Are all available types of observations used for calibration?	Y	Absolute hydraulic heads and temporal head differences. Estimates of groundwater inflow from water balance models were used to guide the calibration process by means of an inequality constraint for total inflow not exceeding 5.0 GL/yr.
4.1.1 Groundwater head data	Y	The calibration dataset comprised 24258 observations during the period 2006-2024. Head targets distributed throughout model layers.
4.1.2 Flux observations	Y	Inequality constraint was applied to mine inflow rates for the entire BTM Complex, with an upper limit of 5.0 GL/yr (approximately three times the estimated value from inflow data). This represents the only flux target formally part of the calibration process.
4.1.3 Other: environmental tracers, gradients, age, temperature, concentrations etc.	N	No other qualitative calibration targets used in the model.

Review questions	Yes/No	Comment
4.2 Does the calibration methodology conform to best practice?	Y	Automated calibration was achieved using a technique called ENSI (ENsemble Space Inversion) from the PEST_HP suite.
4.2.1 Parameterisation	Y	Several parameterisation devices were used during calibration. These include pilot points for aquifer properties and recharge, seglists for river, stream and general head boundaries, and a structural overlay for the Conomos Fault.
4.2.2 Objective function	Y	Weights were balanced so that the absolute hydraulic heads contributed approximately a third of the starting total objective function during calibration compared with two-thirds for the temporal differences.
4.2.3 Identifiability of parameters	Y	Pilot points were implemented using PLPROC, with the same distribution of points used in each layer, noting that not all layers are laterally continuous. Points falling outside of discontinuous layers were removed so that only layer 1 and layer 34 included a full complement of points.
4.2.4 Which methodology is used for model calibration?	Y	Automated calibration was achieved using a technique called ENSI (ENsemble Space Inversion) from the PEST_HP suite.
4.3 Is a sensitivity of key model outcomes assessed against?	N	No sensitivity analysis reported. Traditional sensitivity analysis is no longer warranted when an ensemble-based method of calibration is applied.
4.3.1 parameters	N	No sensitivity analysis reported.
4.3.2 boundary conditions	N	No sensitivity analysis reported.
4.3.3 initial conditions	N	No sensitivity analysis reported.
4.3.4 stresses	N	No sensitivity analysis reported.
4.4 Have the calibration results been adequately reported?	Y	Section F7.3 Calibration targets.
4.4.1 Are the graphs showing modelled and observed hydrographs at an appropriate scale?	Y	All sites shown in Appendix F13 Calibration hydrographs. Overall, the model reasonably reproduces the trends and absolute hydraulic heads in the surficial aquifers.
4.4.2 Is it clear whether observed or assumed vertical head gradients have been replicated by the model?	Y	The model is able to simulate the influence of the approved mining and the Project on the groundwater regime, with a locally lowered water table and inward hydraulic gradients towards the mining location.
4.4.3 Are calibration statistics reported and illustrated in a reasonable manner?	Y	The total measured head change across the model domain was 156.52 m, with a standardised root mean square (SRMS) of 4.2%, which can be considered a good match for the modelled system type.
4.5 Are multiple methods of plotting calibration results used to highlight goodness of fit robustly? Is the model sufficiently calibrated?	Y	Figure F 17 presents the observed and modelled groundwater levels determined from the calibration in a scattergram. The root mean square (RMS) error calculated for the calibrated model was 6.6 m. The total measured head change across the model domain was 156.52 m, with a standardised root mean square (SRMS) of 4.2%, which can be considered a good match for the modelled system type.
4.5.1 spatially	N	Residuals have not been plotted spatially. Water Level Calibration Residuals are not available on a figure.
4.5.2 temporally	Y	Individual hydrographs are shown in Appendix F13 Calibration hydrographs.

Review questions	Yes/No	Comment
4.6 Are the calibrated parameters plausible?	Y	The final hydraulic property values determined from the calibration process are presented on the maps shown in Figure F 20 to Figure F 53. No table of values is presented, and it is difficult to read and extract values from the figures. This makes it difficult to determine if the calibrated parameters cover the expected ranges. Section F8.6 states there are *relatively high storage and high recharge characteristics of the Maules Creek alluvial aquifer*. The alluvium to the west of Maules Creek appears to be below Kh 0 m/day in Layer 1 while Table 7.3 lists values greater than 0 m/day for the Narrabri Formation. The decrease in hydraulic conductivity is evident in the Layer 2 Kv value which is lower than other areas. The exact calibrated values are difficult to assess, and it is unknown the reason for the calibrated values in this area for the alluvium in layer 1 and 2. Recharge rates are plausible. Estimates of groundwater inflow from water balance models were used to guide the calibration process by means of an inequality constraint for total inflow not exceeding 5.0 GL/yr.
4.7 Are the water volumes and fluxes in the water balance realistic?	Y	Simulated inflows compare well with observed inflows for MCCM and Boggabri Coal Mine. Section F7.3.5 Mine inflow verification states *there is a notable discrepancy between the inflows reported in the annual review for Tarrawonga and those from the numerical model. The difference is primarily related to removing the hydraulic barrier, which represents the Conomos Fault, from the Gunnedah alluvium.*
4.8 has the model been verified?	N	No discussion on the model being verified or a series of structured quality assurance checks.
5. Prediction		
5.1 Are the model predictions designed in a manner that meets the model objectives?	Y	The four model objectives are: ▪ Evaluate cumulative drawdown at all identified receptors (including GDEs). ▪ Evaluate incidental and passive water take from groundwater and surface water sources. ▪ Address the Project-specific Secretary's Environmental Assessment Requirements ▪ (SEARs). ▪ Forecast the range of potential inflows into the approved and proposed expansions of open cut pits for each BTM Complex mine. All objectives are able to be assessed by the model design.
5.2 Is predictive uncertainty acknowledged and addressed?	Y	Uncertainty analysis presented in Section F9 Uncertainty analysis.
5.3 Are the assumed climatic stresses appropriate?	Y	The rainfall, evaporation, land use, soil texture and hydrologic soil category were used to create 274 recharge zones. Specific combinations of soil type, climate conditions, and land use characterise each recharge zone. The recharge model is then used to estimate spatially variable recharge patterns across the numerical model area.
5.4 Is a null scenario defined?	Y	A 'null scenario' was developed that excluded mining.
5.5 Are the scenarios defined in accordance with the model objectives and confidence level classification?	Y	The model scenarios are complex when considering the impact of Boggabri, Tarrawonga and Maules Creek Mines. See F8.1 Model scenarios and setup.
5.5.1 Are the pumping stresses similar in magnitude to those of the calibrated model? If not, is there reference to the associated reduction in model confidence?	Y	See F6.3.4 Abstraction

Review questions	Yes/No	Comment
5.5.2 Are well losses accounted for when estimating maximum pumping rates per well?	N/A	N/A
5.5.3 Is the temporal scale of the predictions commensurate with the calibrated model? If not, is there reference to the associated reduction in model confidence?	Y	The calibration dataset comprised 24258 observations during the period 2006-2024. The predictive models were set up with quarterly stress periods of 91.3 days, representing the period from January 2025 to December 2044. The model scenarios were created by extending the model time to the end of approved or proposed mining and then for 200 years after mine closure to assess the recovery equilibrium of the groundwater regime.
5.5.4 Are the assumed stresses and timescale appropriate for the stated objectives?	Y	Timing suitably represents the approved and project mining.
5.6 Do the prediction results meet the stated objectives?	Y	The objectives F4 Model plan and objectives are assessed and presented in the report.
5.7 Are the components of the predicted mass balance realistic?	Y	See F7.3.4 Water budget.
5.7.1 Are the pumping rates assigned in the input files equal to the modelled pumping rates?	N/A	N/A
5.7.2 Does predicted seepage to or from a river exceed measured or expected river flow?	Y	See F8.4 Water budgets.
5.7.3 Are there any anomalous boundary fluxes due to superposition of head dependent sinks (e.g. evapotranspiration) on head-dependent boundary cells (Type 1 or 3 boundary conditions)?	N	This is not obvious in the report however the review has not considered model files.
5.7.4 Is diffuse recharge from rainfall smaller than rainfall?	Y	Figure F 8 shows the spatial distribution of recharge in the model for the steady-state condition. This indicates the long-term mean recharge, which has increased rates along waterways. Mean rainfall for the area is approximately 590 mm/yr, with the minimum at 0.6 mm/yr and the maximum at 76.9 mm/yr, approximately 0.1% and 13.1% of annual rainfall, respectively.
5.7.5 Are model storage changes dominated by anomalous head increases in isolated cells that receive recharge?	N	This is not obvious in the report however the review has not considered model files.
5.8 Has particle tracking been considered as an alternative to solute transport modelling?	N	N/A
6. Uncertainty		
6.1 Is some qualitative or quantitative measure of uncertainty associated with the prediction reported together with the prediction?	Y	Uncertainty analysis presented in Section F9 Uncertainty analysis.
6.2 Is the model with minimum prediction-error variance chosen for each prediction?	Y	ENSI using optimal multipliers to achieve minimum error variance.
6.3 Are the sources of uncertainty discussed?	Y	See F9 Uncertainty analysis.
6.3.1 measurement of uncertainty of observations and parameters	Y	See F9 Uncertainty analysis.

Review questions	Yes/No	Comment
6.3.2 structural or model uncertainty	N	Structure has not been explored through uncertainty.
6.4 Is the approach to estimation of uncertainty described and appropriate?	Y	See F9 Uncertainty analysis.
6.5 Are there useful depictions of uncertainty?	Y	See F9 Uncertainty analysis.
7. Solute transport - N/A		
8. Surface water-groundwater interaction		
8.1 Is the conceptualisation of surface water-groundwater interaction in accordance with the model objectives?	Y	One of model objectives was to evaluate incidental and passive (indirect) water take from groundwater and surface water sources.
8.2 Is the implementation of surface water-groundwater interaction appropriate?	Y	Model allows for the possibility of groundwater discharge to rivers and creeks.
8.3 Is the groundwater model coupled with a surface water model?	Y	Post closure groundwater model has been run iteratively with the final void surface water balance model. Operations model is not coupled with a surface water model.
8.3.1 Is the adopted approach appropriate?	Y	Coupled modelling during operations may be appropriate if sufficient surface water data exists.
8.3.2 Have appropriate time steps and stress periods been adopted?	Y	Stage time series for post closure.
8.3.3 Are the interface fluxes consistent between the groundwater and surface water models?	Y	Input to the final void surface water balance model from the groundwater model is provided as a rate (ML/d). Output from the final void surface water balance model to the groundwater model is provided as an elevation (mAHD).

5. Groundwater impact assessment review

5.1. Conceptualisation

The hydrogeological conceptualisation is presented in Section 7.9 (AGE, 2025) and is supported by the individual hydrogeological components throughout Section 7.

There are several aspects of the hydrogeological conceptualisation that are either not clear, and or require further information to assess whether they are adequately supported by representative data. The hydrogeological conceptualisation is then represented in the numerical model on which the impact assessment is based.

These aspects of the hydrogeological conceptualisation relate primarily to the potential hydraulic connectivity and flow paths between the Permian strata and the Maules Creek alluvium. In summary these conceptualisation aspects relate to the following:

- the geometry of the hydrostratigraphic layers and the data which underpins this layer geometry;
- the conceptualisation of the individual Permian coal seams to sub-crop[2] directly beneath the Maules Creek alluvium versus the conceptualisation of onlapping onto the Boggabri Volcanics; and
- the conceptualisation of the weathered zone and the connection between the Maules Creek alluvium and the weathered zone.

The potential hydraulic connections between the sub cropping coal seams beneath the Maules Creek alluvium is discussed in the report and referenced below. The wording implies that further information or data may be required to fully support the conceptualisation. For example, the report states:

Potential connections between MCCM and the alluvial groundwater system exist north of MCCM where coal seams sub crop beneath the Maules Creek alluvium (Figure 7.49). Data evidence suggests that this connection is mainly driven by downward hydraulic gradients from the alluvium to the coal seams (Section 7.4.5). Thus, long-term depressurisation of targeted coal seams may eventually propagate along seams and induce enhanced downward vertical gradients, potentially triggering decreases in water levels across Maules Creek alluvium. However, evidence from water levels and observed vertical gradients along Maules Creek suggest that shallower seams show no mining-induced decline in water levels, and only the deepest coal seams (Merriown and Templemore seams) show a decrease in water levels driven by mining. The treatment and the implementation of the lateral connectivity between Maules Creek alluvium and subcropping coal seams, and the role of the weathered regolith as the primary pathway for lateral groundwater flow from the alluvium is further explained in Appendix F.

It is important to note that the described content cannot be found or substantiated in Appendix F. None of the hydrogeological conceptualisation sections presented demonstrate a potential hydraulic connection where coal seams directly sub crop beneath the Maules Creek alluvium, thus allowing a potential or hydraulic connection between the alluvium and the coal seams such as the Braymont Seam. The conceptual models, such as conceptualisation section B-B' (reproduced below as Figure 5-1) shows a strong disconnection. The alluvium is generally shown to be separated by low-permeability units. The Herndale and Braymont Seams terminate before they reach the base of the alluvium.

Discussion of hydrogeological conceptualisation sections (critical to the hydraulic relationship between the Maules Creek alluvium and the Permian strata) are provided below.

[2] In this context, a subcropping coal seam refers to the location where the coal seam connects and terminates at a different geological layer (for example alluvium or weathered zone). These subcrops are important in groundwater studies because they may act as potential connection points between different strata (i.e., shallow aquifers (like alluvium) and the deeper aquifer (such as coal seams).

5.1.1. Hydrogeological conceptualisation B-B’

Hydrogeological conceptualisation B-B’ (Figure 5-1) shows that there are limited groundwater bores penetrating the full thickness of the alluvium. Hence, there are limited bores that penetrate into the underlying Permian strata and Boggabri Volcanics. This reduces confidence in the interpreted stratigraphy and connectivity.

The data source for the Boggabri Volcanics is unknown and the top of this formation is represented as steeply dipping with coal seams that subcrop or terminate at the top of the volcanics. The weathered zone is not extensive over the Permian strata and thins near REG16. The weathered zone is not present over the Boggabri Volcanics.

Further information or data is required to confirm the geology and potential hydraulic connections between MCCM and the alluvial groundwater system north of MCCM, particularly where the coal seams are expected to sub crop beneath the Maules Creek alluvium. Further data associated with geology, groundwater levels, permeability and water quality would improve the conceptual understanding of hydraulic connectivity between the Maules Creek alluvium and the Permian strata.

A conceptual model schematic is presented below from Pacific Coal (1982) to demonstrate the potential hydrogeological connections discussed above. Whilst it is recognised that the schematic is simplistic, the alternative conceptual model schematic (Figure 5-2) supports the AGE (2025) description of the potential connections between MCCM and the alluvial groundwater system existing north of MCCM where coal seams sub crop beneath the Maules Creek alluvium.

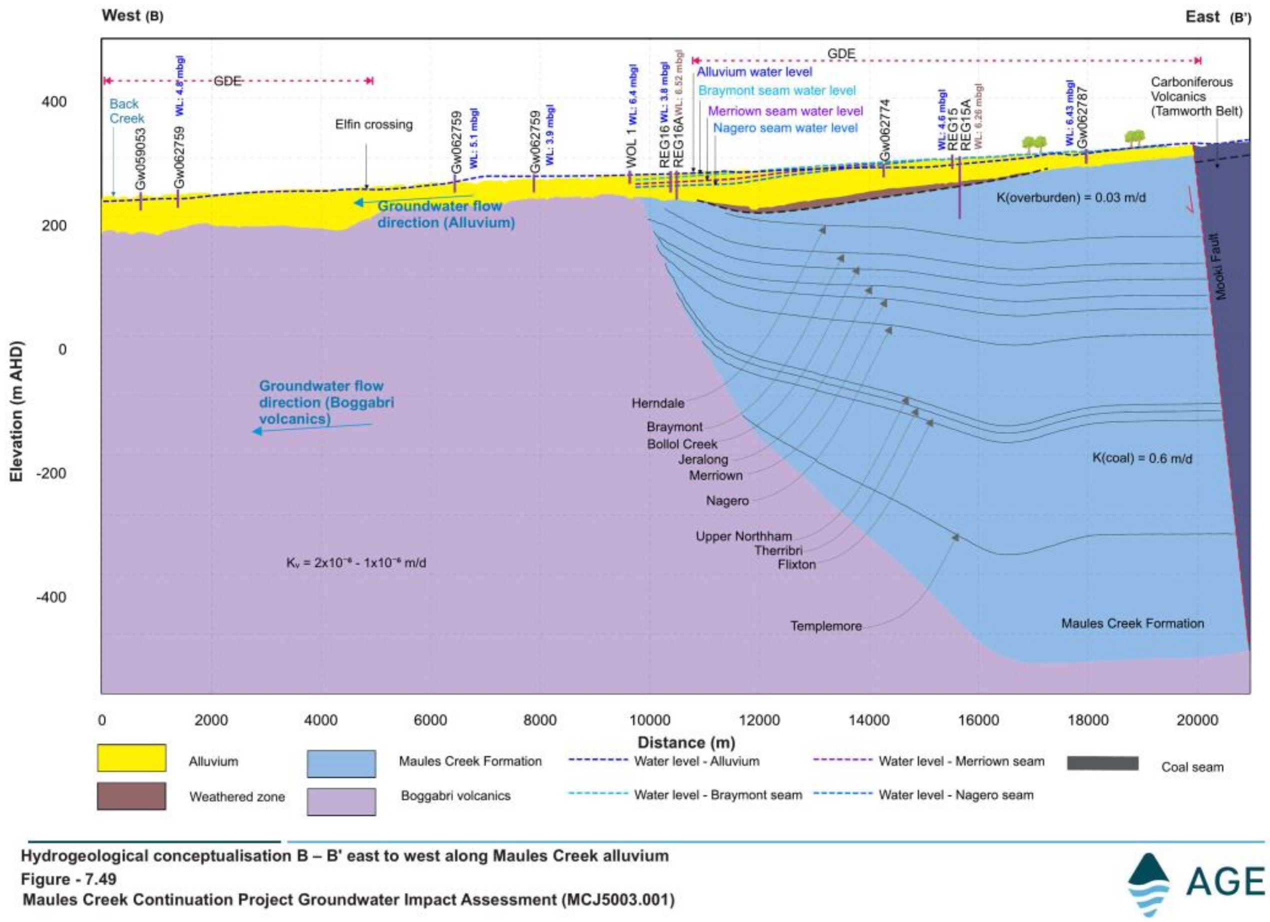


Figure 5-1 Hydrogeological conceptualisation B-B’ (AGE, 2025)

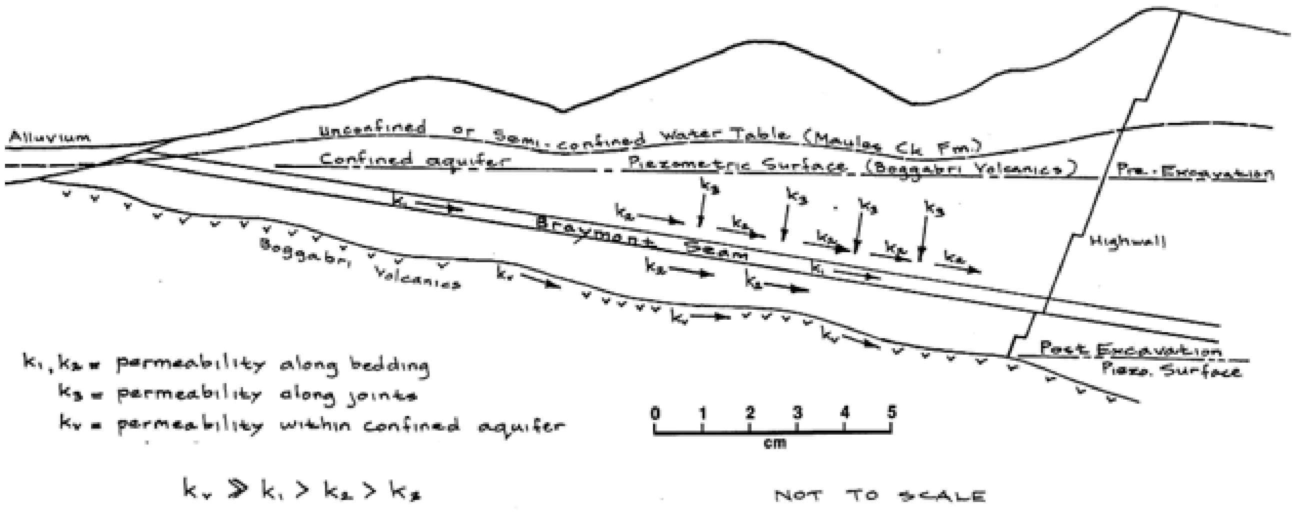


Figure 5-2 Alternative conceptual model schematic (Pacific Coal, 1982)

5.1.2. Hydrogeological conceptualisation D-D'

Hydrogeological conceptualisation D-D' is shown in Figure 5-3. The conceptual model does not represent any groundwater bores within the cross section. This limits the ability to validate the interpreted groundwater levels and geology.

The Boggabri Volcanic groundwater level appears disconnected from the weathered zone towards the alluvium but remains continuous towards the MCCM Pit. The alluvium exceeds 50 m in thickness (which is significantly different to the alluvium thickness that is shown in Figure 5.3 of AGE (2025)), and there is no separation depicted between the Narrabri Formation and the Gunnedah Formation, which is a critical component of the groundwater conceptualisation. The alluvial groundwater table is shown as being hydraulically disconnected from the Permian strata by the weathered zone. Further to this there is minimal information or data provided to support the thickness and extent of the weathered zone. Table 7.1 of AGE (2025) states that the weathered zone ranges between 1 m to 30 m thick, however hydrogeological conceptualisation D-D' shows the weathered zone to be at least 50 m or 60 m thick in some areas of the section.

The conceptual cross-section suggests vertical infiltration from waste rock and lateral flow through the Permian strata and Boggabri Volcanics. The geometry of the Boggabri Volcanics and presence of a thick weathered zone effectively cut off or laterally isolate the Permian strata and coal seams between the MCCM and the northern side of the section (near Maules Creek). This infers a limited potential for lateral groundwater flow from the northern coal seams and alluvium into the MCCM, due to both physical truncation and low permeability of the volcanics.

The interpreted Boggabri Volcanics extent does not align with the geology layer (circa 1990s) used in the AGE (2025) reporting called Gunnedah Coalfield Rock Unit (1:100K), nor does it align with the most recent surface geology that is available from the NSW government[3]. There is minimal information or data provided to support the Boggabri Volcanics thickness and extent.

[3] https://minview.geoscience.nsw.gov.au/#/?lon=150.1410&lat=-30.56228&z=11&bm=bm5&l=ge1:n:100,ge0:y:100,ut2:n:100,ut1:y:100,ad0:y:100

Without detailed stratigraphic logs or supporting data it is unclear whether the Boggabri Volcanics and the weathered zone act as lateral hydraulic barriers, or whether subcropping coal seams may provide undetected hydraulic pathways connecting the Maules Creek alluvium to the MCCM. Further data is required for both the Boggabri Volcanics and weathered zone to confirm potential pathways and hydraulic connectivity of groundwater flow between the alluvium to the coal seams.

Without verified groundwater level data across the described units, the hydrogeological conceptual model lacks the necessary evidence to support assumptions regarding flow directions, aquifer connectivity and hydraulic separation.

The data limitations for hydrogeological conceptualisation D-D' are listed in Table 5-1.

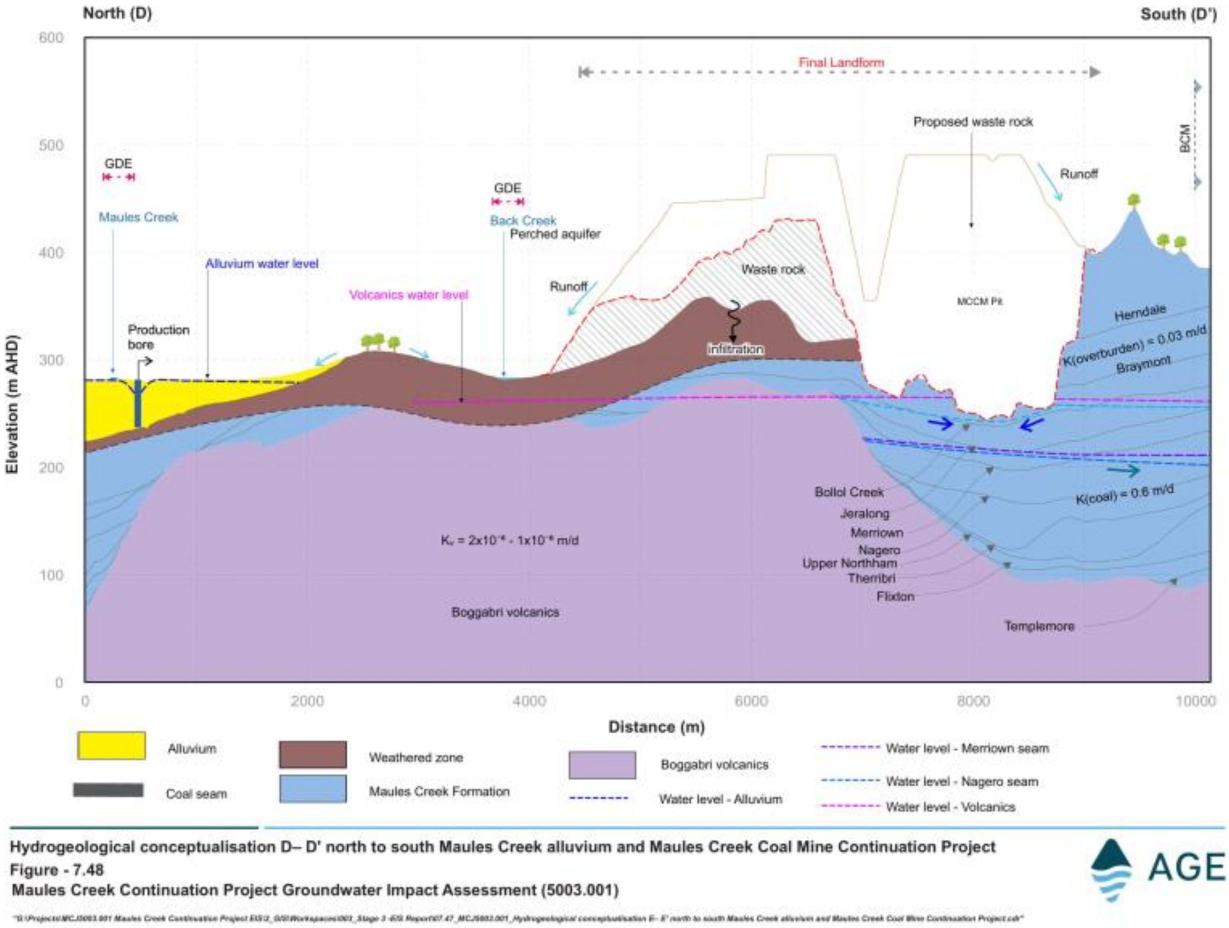


Figure 5-3 Hydrogeological conceptualisation D-D' (AGE, 2025)

Table 5-1 Main data limitations in hydrogeological conceptualisation D-D'

Category	Data limitations	Implications
Geology – Volcanics	Unknown source of data for extent, dip, or geometry	Geometry of Boggabri Volcanics is uncertain and may not truncate coal seams as shown.
Geology – Coal Seams	Sub cropping coal seams inferred but not supported by geological logs or cross-sections	May influence hydraulic connection between coal seams and other units
Weathered zone	No data on thickness, extent, or hydraulic properties near alluvium	Cannot verify the weathered zone and the lateral flow pathway
Permeability data	Weathered zone there is limited information on hydraulic parameters. Boggabri volcanics hydraulic testing is limited.	Weathered zone and volcanics may be more or less permeable than assumed.
Monitoring bores	Limited groundwater monitoring bores	Lack of monitoring prevents testing of vertical or lateral gradients and connectivity
Groundwater levels and flow paths	No bore references or measured water levels shown Groundwater levels are disconnected, and data gaps exist in the groundwater level schematic	Flow directions and gradients are schematic, and potential connections cannot be confirmed Potential for over-simplification or misrepresentation of groundwater behaviour

5.1.3. Hydrogeological conceptualisation E-E'

Hydrogeological conceptualisation E-E' shown in Figure 5-4 displays uncertainty in the weathered zone thickness south of REG16 (see use of question marks) and does not clearly define the connection between the alluvium and the sub cropping coal seams. The alluvium appears to exceed 50 m in thickness, and there is no distinction or separation shown between the Narrabri Formation and the Gunnedah Formation. The weathered zone is noticeably thicker near the alluvium, particularly in the northern part of the cross-section around Maules Creek. There is minimal data available to show the weathered zone as the main pathway for lateral groundwater flow from the alluvium to the coal seams.

The conceptualisation that the weathered zone represents the primary lateral groundwater flow pathway between the alluvium and the underlying coal seams is not substantiated by data. The conceptual model does not present dedicated monitoring bores, hydraulic head measurements, or permeability data within the weathered zone to verify lateral connectivity. Further information or data is required for the weathered zone beneath the alluvium, and between the alluvium and the MCCM to confirm pathways for groundwater flow between the alluvium and the coal seams.

The main data limitations for the hydrogeological conceptualisation cross sections are listed in Table 5-2.

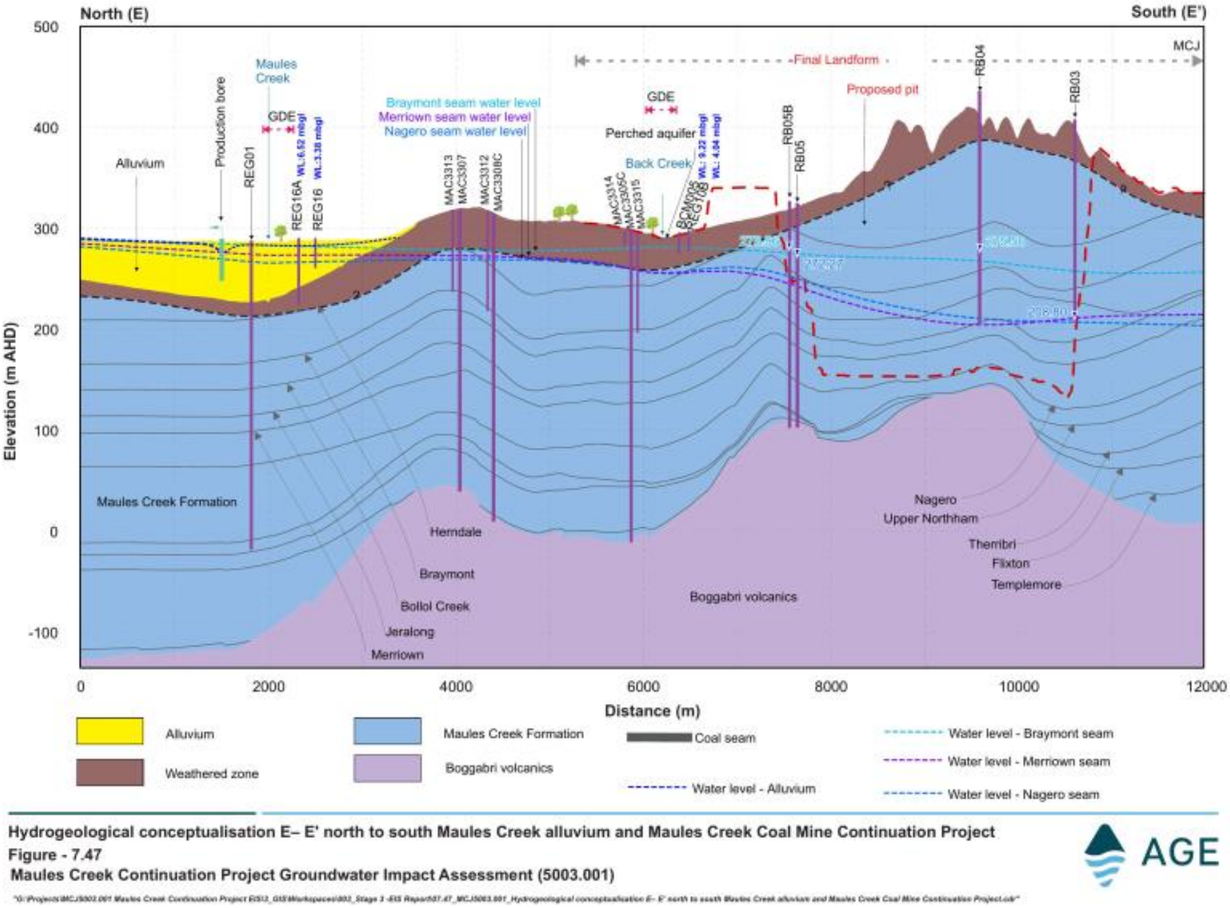


Figure 5-4 Hydrogeological conceptualisation E-E' (AGE, 2025)

Table 5-2 Main data limitations in hydrogeological conceptualisation E-E'

Category	Data limitations	Implications
Weathered zone thickness	Thickness is uncertain and variable, especially south of and at REG16. The weathered regolith at REG16A is not shown in hydrogeological conceptualisation B-B' (AGE, 2025).	Cannot confirm continuity or hydraulic role of weathered zone
Stratigraphic differentiation	No distinction made between Narrabri and Gunnedah Formations	Limits understanding of which unit is connected or disconnected from coal seams
Alluvium thickness	Alluvium exceeds 50 m, but internal layering and hydraulic properties are not defined	Unclear if full thickness contributes to lateral flow or interacts with deeper units
Weathered zone / Coal Seam connection	Connection between weathered zone and sub cropping coal seams is not clearly shown	Uncertain whether lateral flow pathway exists or is blocked by the weathered zone
Hydraulic data	No water level or pressure head data shown in regolith or transition zones	Flow directions and gradients across units cannot be confirmed.
Permeability information	Regolith/weathered zone there is limited information on hydraulic parameters. Boggabri volcanics hydraulic testing is limited.	Cannot assess permeability for example regolith/weathered zone and volcanics may be more or less permeable than assumed.
Monitoring bores	No monitoring bores shown within the weathered zone between the alluvium and coal seams	Conceptual flow path is unsupported by data or observations
Conceptual flow arrows	Flow paths are schematic, without data-based support	May misrepresent actual groundwater movement
Geological control	Data source for geometry and thickness of units is not cited	Reduces confidence in stratigraphic boundaries and inferred connections
Temporal data	No indication of water level trends or time-series	Cannot assess if mining-induced drawdown propagates through regolith into the alluvium or vice versa

5.2. Summary of data / information gaps

There are data gaps and a lack of supporting information or descriptions regarding several key processes that are relied upon in the numerical model:

- The BTM Complex model incorporates two layers to represent the full thickness of the alluvium, with Layer 1 being the Narrabri Formation, and Layer 2 being the Gunnedah Formation. There is minimal information provided to support the stratigraphic differentiation, and the hydraulic parameters assigned.
- No data or supporting information is presented to support the concept that the Narrabri Formation is laterally connected to the weathered zone, while the Gunnedah Formation is said to be laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams.
- The following statement is not supported, and the described content cannot be found or substantiated in Appendix F. *The treatment and the implementation of the lateral connectivity between Maules Creek alluvium and subcropping coal seams, and the role of the weathered regolith as the primary pathway for lateral groundwater flow from the alluvium is further explained in Appendix F.* No such explanation or supporting detail is provided in the referenced appendix.
- There is insufficient information or description to support the assumption that the weathered zone acts as the primary pathway for lateral groundwater flow from the alluvium. There is limited data on the hydraulic properties and water quality of the weathered zone, to support the conceptualisation.

- Further information or supporting data is required to justify the assumption that lateral flow from the alluvium is limited by the weathered zone thickness and the disconnection between the Permian strata. These features and boundary conditions may underestimate connectivity, flow paths and drawdown predictions.
- The report does not address baseflow to Maules Creek or Back Creek in Section 7.5. However, this issue is acknowledged in Section 7.9.2 as a potential risk. Model predictions are later used to conclude that negligible baseflow loss is expected in the lower and middle reaches of Maules Creek, and that baseflow to Back Creek is non-existent. Further information or data is required to address the environmental impact or groundwater assessment report.
- Section 7.4.5 notes multi-level monitoring extends through both the alluvium and the coal measures, is limited to two sites within the vicinity of the Project. Additional investigation and the installation of multi-level monitoring bores would improve the data set to support the conceptualisation, particularly in the area of the sub cropping coal seams.
- Measurement error management needs to be addressed with greater detail. This is required as the measurement error for the VWP is considered potentially higher than that for the monitoring bores and possibly in the range of ±5 m to 10 m (AGE, 2025). Greater multi-level monitoring extending through both the alluvium and the coal measures, is limited to two sites within the vicinity of the Project REG02 and GW041027, REG01 and GW967138. However, the assessed VWP measurement error at these sites may be significant, potentially affecting confidence in the interpretation of vertical hydraulic gradients and connectivity between strata.
- To support the conceptualisation that the alluvium is hydraulically disconnected from the coal seams, further detail is required on vertical groundwater elevation differences and temporal water level trends, to demonstrate the hydraulic separation.

A key input to the groundwater model is the representation of the Boggabri Volcanics basement surface. The Boggabri Volcanics basement surface which is represented in the AGE 2025 report is significantly different to that presented in previous reporting (AGE, 2011 and AGE, 2021). Figure 5-5 shows the comparison between the Boggabri Volcanics basement surface presented in AGE (2021) versus AGE (2025).

Approaching Maules Creek, AGE (2021) shows the top of the Boggabri Volcanics rising toward the west, with elevations approaching 250 mAHD, and dipping westward to below -150 mAHD, forming a clear east west gradient (Figure 5-5). AGE (2025) confirms the presence of this east west gradient and westerly structural high but introduces a steeper elevation gradient from east to west. This difference indicates that an update or reinterpretation of the Boggabri Volcanics surface must have been carried out between 2021 and 2025. However, there is no mention of additional drilling that has been completed between 2021 and 2025 in this area to warrant the reinterpretation of the Boggabri Volcanics structure contours. The source dataset used to generate the Boggabri Volcanics surface is not specified and further clarification is needed to understand why this was carried out and the implications this has on the model calibration and predictions.

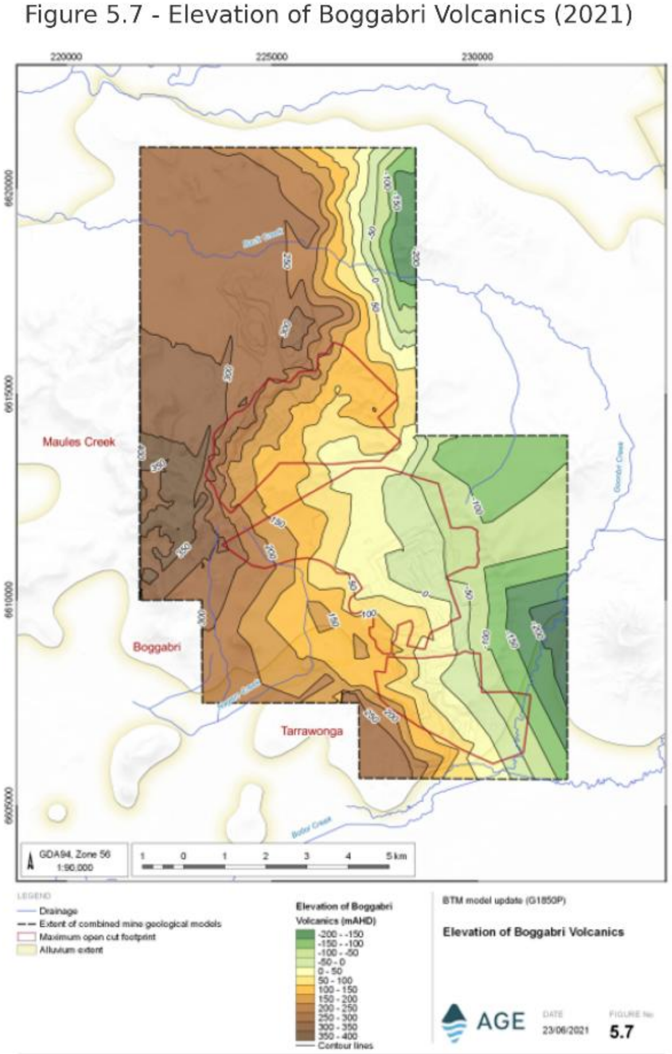
An additional map showing the top of the Boggabri Volcanics is shown in Figure 5-6. This figure is contained within a coal exploration report (Pacific Coal, 1982) which was downloaded from NSW DIGs. The map also shows the location of numerous coal exploration drill holes that were used to interpret the top of the Boggabri Volcanics.

Contrary to AGE (2025), the top of the Boggabri Volcanics represented in this exploration report does not show a steep gradient in the basement surface. At the confluence of Horsearm Creek and Middle Creek, the contours show that the top of the Boggabri Volcanics is interpreted to be at an elevation of approximately 50 mAHD. At this same location, the top of the Boggabri Volcanics in the AGE (2025) report corresponds to approximately 200 mAHD. This difference is significant (150 m vertical difference) and has major implications for the geology that is presented in the groundwater conceptualisation, with further major implications on the numerical model layering and the resultant predictions. The data from the exploration report (Pacific Coal, 1982) would also suggest that the Permian coal measures and coal seams are far more extensive beneath the Maules Creek alluvium that what is conceptualised and presented by AGE (2025). Figure 5-7 shows a markup of hydrogeological conceptualisation B-B' with an alternative representation of geological layering. Based on the data from Pacific Coal (1982) there is likely to be significantly more Permian strata beneath the Maules Creek alluvium, and with this an increased chance of hydraulic connection between these two hydrostratigraphic units.

Further to the above, the publicly available surface geological mapping indicates extensive outcrop and subcrop of the Permian coal measures (Maules Creek Formation), however the conceptual and numerical model presented by AGE (2025) shows an increased presence of the low permeability Boggabri Volcanics beneath the Maules Creek alluvium, and a corresponding reduction in the extent of the higher permeability Permian coal measures.

Further information is required to validate the AGE conceptualisation and interpretation of the geology in this area. The presentation of detailed geological cross-sections (including the underlying drill hole datasets) would assist in demonstrating the relationship between the Boggabri Volcanics, the Permian coal measures and the Maules Creek alluvium.

As discussed above, this geological conceptualisation and interpretation has the ability to influence the lateral and vertical flow of groundwater (and propagation of mine related depressurisation) between the Maules Creek alluvium and the MCCM.



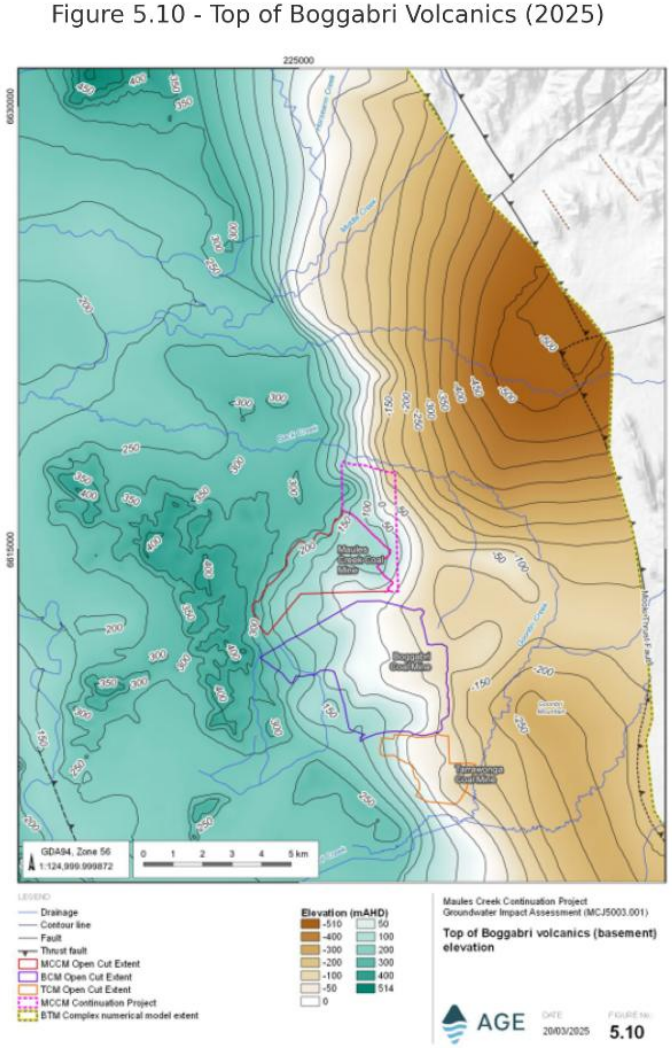


Figure 5-5 Top of Boggabri volcanics (AGE 2021 and 2025)

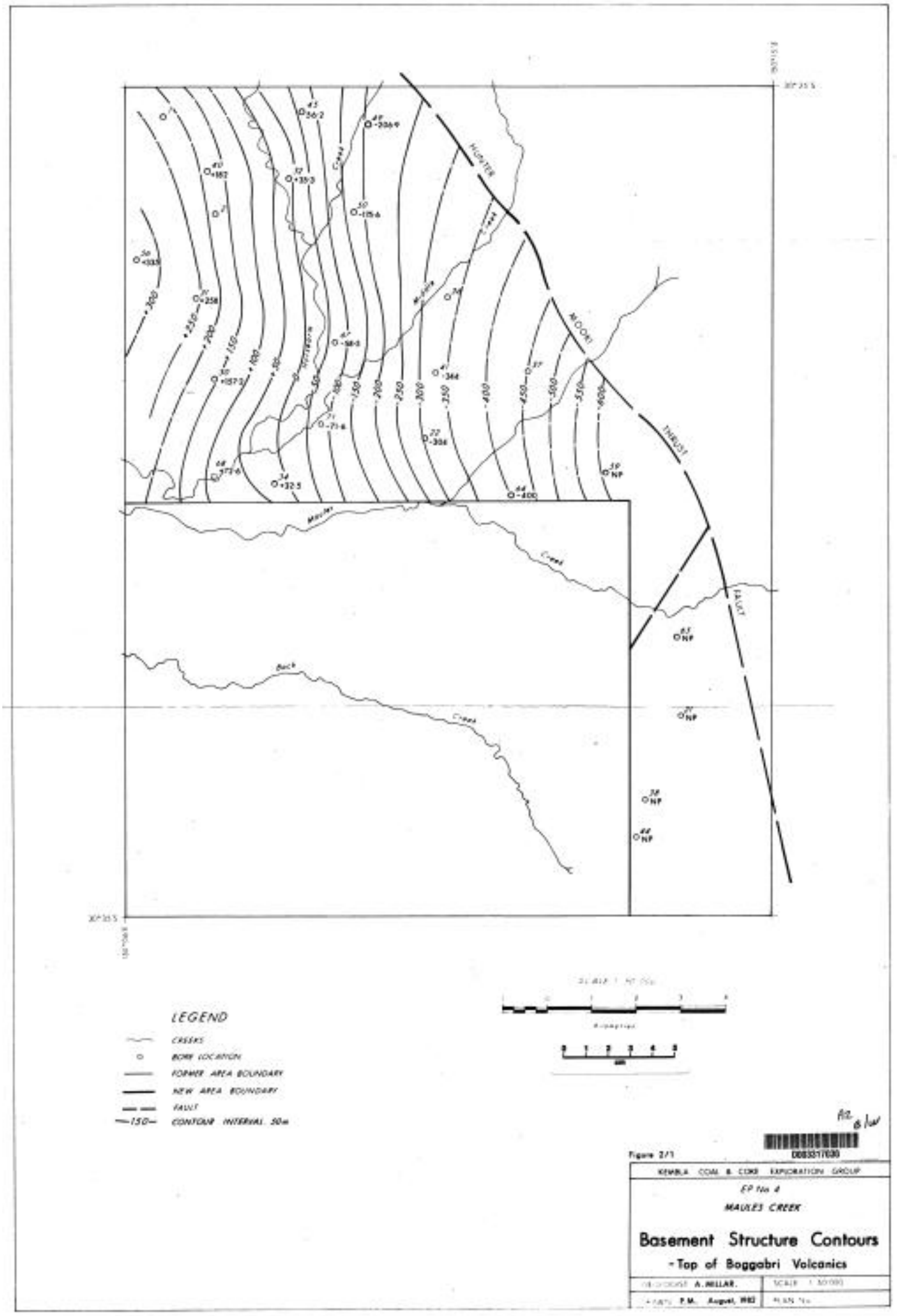


Figure 5-6 Top of Boggabri Volcanics (Pacific Coal, 1982)

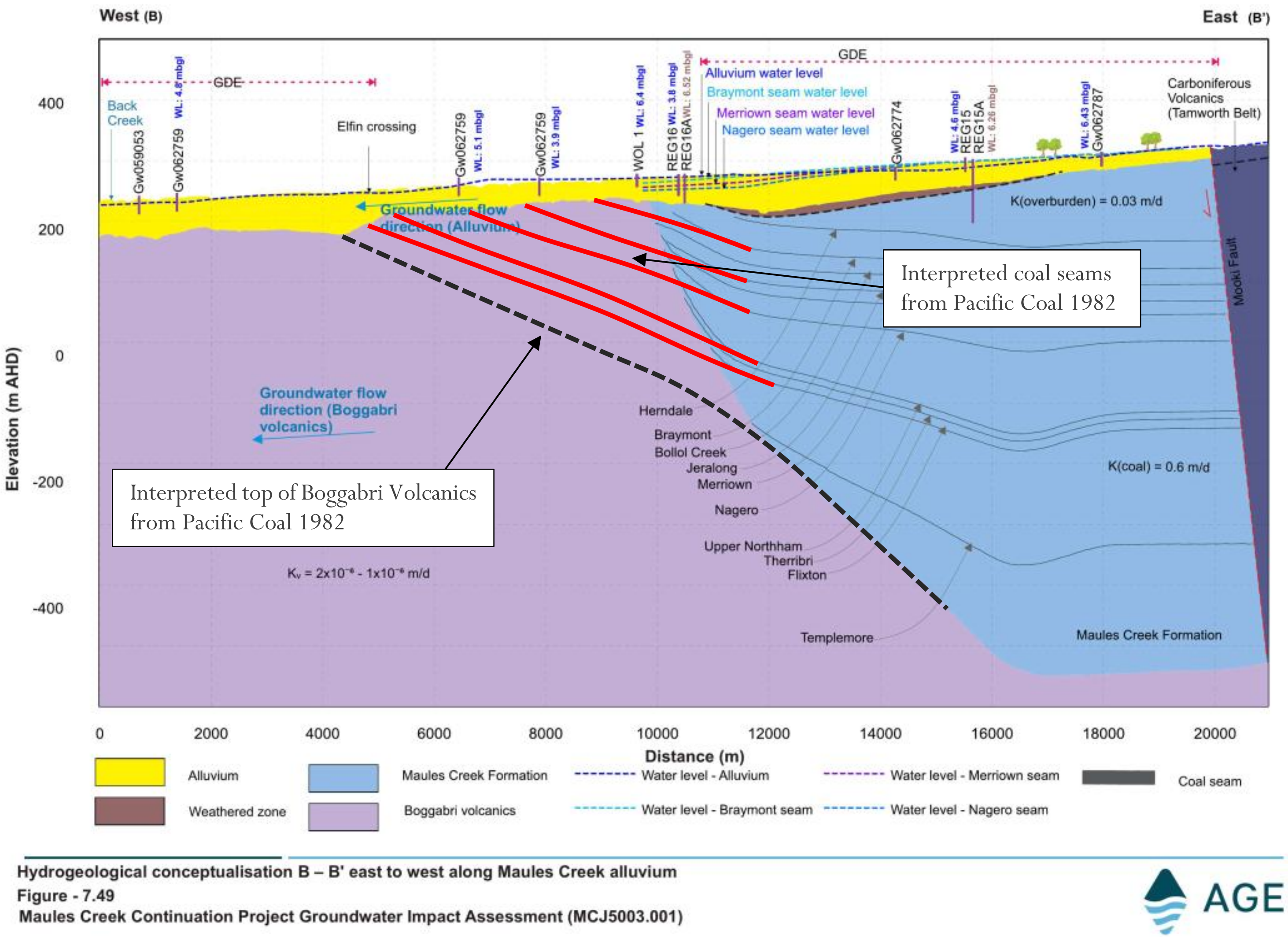


Figure 5-7 Markup of hydrogeological conceptualisation B-B' (AGE, 2025)

5.3. Modelling

5.3.1. Drawdown within the Maules Creek alluvium

It is difficult to assess the model calibrated hydraulic parameters the way they are presented as spatial plots in Figures F20 to F53. For example, a red colour may be shown on the map, however this red colour has a range of potential values in the figure legend which varies by an order of magnitude. A summary table of calibrated parameters which lists hydraulic properties would better to assist in understanding the model calibrated hydraulic parameters.

Table F9 shows potential inconsistencies in the assigned parameter values. For example layer 1 (Alluvium – Narrabri Formation) is assigned a (pre-calibrated) specific yield (Sy) of 0.008 which appears to be very low for an unconfined alluvial aquifer. Whereas layer 2 (Alluvium – Gunnedah Formation) has a (pre-calibrated) Sy of 0.25 which is arguably at the higher end for an alluvial aquifer.

The total thickness of alluvium is provided in the report, however nowhere in the documentation are there figures to present the thickness of individual model layers. The thickness of model layers is important in understanding how the geology has been assigned and how the model behaves. For example, model layer 1 in the footprint of the Maules Creek alluvium maybe a uniform 1 m thick (albeit unlikely) which would render the model layer as unsaturated and dry throughout the model simulations.

Layer 1 (Alluvium – Narrabri Formation) has a very small Sy (volume of drainable porosity), whereas layer 2 (Alluvium – Gunnedah Formation) is likely to be acting as a buffer with its high Sy value. The effect of this may unrealistically dampen any drawdown or depressurisation effects that may propagate from the underlying model layers. The layering and parameterisation may affect how the model predicts drawdown in the alluvium. Potentially effecting the timing of drawdown, the volume of indirect groundwater take from the alluvium and the magnitude and extent of drawdown propagation.

Section F8.6 of the AGE (2025) report confirms the dampening or buffering effect described above and provides some information on how the model is configured to simulate responses in the Maules Creek alluvium, it states:

The model also predicts less than 1 m of drawdown within the Maules Creek alluvium to the north. The relatively high storage and high recharge characteristics of the Maules Creek alluvial aquifer mean that any losses occurring through the base of the aquifer to the low-permeability bedrock are a small portion of the total system water budget and, therefore, are readily buffered. This small amount of drawdown would not likely be discernible from climatically induced fluctuations in groundwater levels (recharge-discharge cycles) observed in monitoring bores.

The model parameterisation (along with the geological layering – see Section 5.2) will result in the minimal prediction of drawdown in the Maules Creek alluvium. Greater detail is needed to support and justify the conceptual model and groundwater model setup for the Narrabri Formation and Gunnedah Formation in the vicinity of the Maules Creek alluvium.

5.3.2. Analytical assessment of lateral flow from the alluvium

Section 5.2 Limitations, discusses that the lateral flow from the alluvium is limited by the weathered zone thickness.

The BTM Complex model incorporates two layers to represent the full thickness of the alluvium, with Layer 1 being the Narrabri alluvium, and Layer 2 being the Gunnedah alluvium. The Narrabri alluvium is laterally connected to Permian weathered regolith, while the Gunnedah Alluvium is laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams. This aligns with the current conceptual model of the system, which assumes that weathered regolith is the primary pathway for lateral groundwater flow from the alluvium.

This assumption implies that lateral flow from the alluvium is limited by the regolith thickness, which was assessed using an analytical approach that considers the full saturated thickness of the alluvium being available for lateral flow. The Edelman Solution (Edelman, 1947) is a transient 1D solution that calculates hydraulic head response and changes in flux at a fixed distance from a step change in hydraulic head. This solution assumes constant transmissivity but can be applied to unconfined systems when the head change is less than 20% of the saturated thickness, as it produces solutions comparable to those of the linearised Boussinesq equation (Boussinesq, 1877). The application of the solution in this analysis assumes a 1.0 m head difference across 250 m (gradient of 0.004) as representative of the drawdown.

Typical values of hydraulic conductivity, storage coefficient and saturated thickness (Table F 3) for the two alluvial formations were used to estimate the change in flux at equilibrium. A total flux from the alluvium into the Permian can be estimated by assuming a 10 km stretch of alluvium is affected by drawdown, resulting in 0.09 ML/d discharge from the Narrabri and 0.52 ML/d discharge from the Gunnedah. In a calendar year, this equates to approximately 219 ML, which remains well below the WALs held by the proponent of the Project. The 10 km length is approximately the same as the length of Upper Maules Creek alluvium affected by drawdown through the regolith, according to the numerical model.

The conceptualisation of the Maules Creek alluvium and weathered zone interaction is not clear, and the mechanism for how this conceptualisation is represented in the numerical model is also not clear. Further, the use and justification of the analytical equation is confusing.

It is unclear how layer 2 (Alluvium – Gunnedah Formation) contributes a discharge of 0.52 ML/day, which is significantly more than the 0.09 ML/day attributed to layer 1 (Alluvium – Narrabri Formation) given that the Gunnedah Formation is conceptualised as being laterally disconnected from the weathered zone.

The total flux from the alluvium into the Permian was estimated by assuming a 10 km stretch of alluvium however it is not specified where the stretch of alluvium is located. The extent is stated to correspond to the estimated extent of the Upper Maules Creek alluvium affected by drawdown through the weathered zone as represented in the numerical model, however further detail is not provided. Further the numerical model predictions currently do not show any predicted drawdown in the Maules Creek alluvium.

There is insufficient detail or information to confirm if the use of the analytical equation is appropriate, and whether this has been correctly applied. It is also unclear why the analytical equation has been used and reported on when a 3D numerical model is available to predict the total flux from the alluvium into the Permian strata and from the alluvium to the weathered zone.

5.3.3. Perimeter model boundaries

F6.2.1 Perimeter Model Boundaries, discusses that the boundary conditions were aligned with the conceptual hydrogeological model of the area, with groundwater flow in and out of the model largely occurring through the alluvium.

Boundary conditions were aligned with the conceptual hydrogeological model of the area, with groundwater flow in and out of the model largely occurring through the alluvium. Flow through the Namoi River alluvium was largely represented by General Head Boundaries (GHB) along the southern and western sides of the model, where alluvial groundwater enters and exits the model (layers 1 and 2). Groundwater levels at the Namoi River alluvium GHBs were determined based on the average groundwater levels measured in monitoring bores in proximity to the model boundary. A detailed description of this process is provided within AGE (2022), but no update is provided here as there has been no significant change since then.

The AGE (2022) model represented large sections of the northern, western and southern model perimeter boundaries with 'no-flow' conditions (Figure F 1). This included the areas on the eastern boundary where catchments continue, and topography and associated hydraulic gradients would allow groundwater inflow to the model from the New England Fold Belt fractured rock groundwater system. An analytical estimate of groundwater flow from the New England Fold Belt fractured rock into the model domain indicated potential inflows of approximately three megalitres per day (ML/day). The model was initially updated to represent this inflow with GHBs assigned in all model layers along the eastern model boundary adjacent to the Maules Creek and Bollol Creek alluvial plains. However, this resulted in the model failing to converge. The cause of numerical instability was attributed to the explicit representation of geology associated with the Permian coal measures sequence, where all layers are laterally discontinuous and pinch out in the west against the Boggabri volcanics. The pinching of coal measures layers in the unstructured grid laterally disconnects the Permian sequence layers from other model layers, albeit only in the horizontal direction. Vertical connections remain unaffected. The addition of the GHBs along the eastern edge of the model domain was subsequently modified to only occur in model layer 1 (Narrabri alluvium and weathered regolith), where layer 2 (Gunnedah alluvium) was present. Hydraulic heads assigned to the GHBs were set at the model cell's topographic elevation but were assumed to be approximately 2 km from the model. This simulated an effective hydraulic gradient between 0.001 and 0.003 (1:1000 to 1:333), depending on the model cell location and was factored into the initial conductance calculation for each GHB boundary cell.

Generally, there is a lack of information or description on the refinements made to the numerical model general head boundaries. An estimate of groundwater inflow from the New England Fold Belt fractured rock into the model domain was assessed at 3 ML/d and an attempt was made to represent this in the numerical model. However, the model failed to converge, and this boundary condition was modified so that this groundwater inflow from the New England Fold Belt fractured rock only occurred through layer 1 (where layer 2 was present). Layer 1 represents the shallow Narrabri alluvium and weathered zone and not the deeper fractured rock that occurs further to the east.

There is insufficient detail or information to confirm if this application of the GHB is appropriate and whether it validates the conceptual water balance discussed above. It potentially underestimates or overestimates fluxes, affects the water balance and misrepresents groundwater interaction with surrounding units.

6. Water management plan review

The current Maules Creek Coal Mine Water Management Plan (WMP) is dated 24 March 2025. The WMP provides details of the management of surface water and groundwater related impacts associated with the construction and operation of the MCCM.

WMP Appendix C contains the Groundwater Management Plan (GWMP) for Maules Creek Coal Mine (MCCM) which describes the management of groundwater at MCCM. This includes details of the GWMP, predicted impacts and compliance conditions. The GWMP outlines the groundwater data collection/analysis methods, performance measures, trigger thresholds and Trigger Action Response Plans (TARPs).

A review of Appendix C Groundwater Management Plan has been undertaken including an assessment of suitability of the monitoring locations and program, current triggers and actions.

6.1. Suitability of monitoring locations

The existing monitoring network is described in Section 4 Groundwater Infrastructure. The existing monitoring network includes standpipe bores and vibrating wire piezometers (VWP) installed in a series of campaigns since 2010. The locations and status of the monitoring network infrastructure are shown in two figures. A table summarises the groundwater monitoring network and described below.

All of the 'MAC' series monitoring bores and VWPs were damaged or destroyed by the progress of mining, or by protestors, with the exception of standpipe bore MAC1280 which remains active. The MAC1280 monitoring bore is now located immediately to the east of the out of pit waste rock dump. It is recognised that these decommissioned bores may have been important in the past, but it necessarily complicates the current monitoring strategy.

The 'RB' series of bores was designed to replace the 'MAC' series. The 'RB' series comprises three groundwater monitoring bores and five multi-level VWPs. Two of the locations (RB01 and RB02) were constructed in the Maules Creek mining footprint and were removed during mining activities in early 2017.

The 'REG' series comprises twelve regional groundwater monitoring bores and six multi-level VWPs designed to detect cumulative impacts in the alluvial aquifers surrounding the BTM Complex. Of these monitoring locations, BCM1, BCM3 and REG10A were installed along Back Creek to assess the potential for shallow groundwater and the presence of groundwater dependent ecosystems.

The NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) maintain a network of monitoring bores within the Namoi alluvium that surrounds MCCM. The purpose of these bores is to monitor groundwater levels and quality within the Narrabri and Gunnedah Formations. These bores all have the prefix 'GW'. Some of the bores have electronic water level loggers and are equipped with telemetry with real time datasets available online2.

'REG' bores have been strategically located adjacent to selected 'GW' series monitoring bores to create a pair of nested monitoring points that allow the water level trends within the alluvium and underlying bedrock to be recorded and compared, and the potential influence of mining areas assessed. The 'REG' series monitoring bores were originally intended to form part of the BTM complex regional monitoring network. As these bores were located well beyond the mining areas, the intention was they would allow any cumulative impacts that propagated via the Permian and into the overlying alluvium to be detected and assessed. Since inception MCCM has taken responsibility for monitoring the REG series of bores. While this was not the original intention, for consistency the steps to investigate exceedance events, i.e. the TARPs, have been retained within the MCCM GWMP. In the case where exceedances are due to other mines the TARPs provide a process for evaluating cumulative impacts from the BTM complex.

The following additional bores were installed in 2023:

- *REG15 / REG15A and REG16 / REG16 improve the monitoring network coverage within the alluvial deposit along Maules Creek;*
- *REG15 / REG15A and REG16 / REG16A improve the pore pressure monitoring network within the bedrock underlying the Maules Creek alluvium and to allow the interconnectivity between the alluvium and bedrock to be evaluated;*

- *REG4A create additional multi-level nested bores by installing bores adjacent to existing sites at different depths;*
- *WRD1 and WRD2 provide shallow water table monitoring sites adjacent to the out of pit emplacement to measure water quality trends;*
- *BCM04 and BCM05 determine the presence of water table along Back Creek which will provide input to Groundwater Dependent Ecosystem (GDE) monitoring;*
- *REG15A, REG16A, BCM04, and BCM05 assess groundwater and surface water interactions along Back Creek and Maules Creek; and*
- *RB05B and REG10B provide water level measurements from open standpipe monitoring bores to verify the pore*
- *pressures recorded by selected VWP's.*

The GWMP lacks a figure that shows the current consolidated groundwater monitoring network. A table of the 45 active monitoring bores are listed in Table 6-1 and Figure 6-1 shows the existing groundwater monitoring network. Consisting of monitoring bores 21 alluvium, 1 weathered overburden, 8 volcanics, 15 Permian strata (including coal seams).

In terms of the suitability of the network, there are spatial data gaps in the following areas:

- Further information or data is required to measure or confirm the potential connections between MCCM and the alluvial groundwater system north of MCCM where coal seams sub crop beneath the Maules Creek alluvium. There are no monitoring bores in this area further west of GW967138_1 and GW967138_2. This is needed to confirm water levels, geology extent and thickness, or water quality analysis. This would improve or confirm the understanding for a connection or disconnection between the Maules Creek alluvium and the Permian strata.
- Further monitoring of the alluvium in the area described above would assist in supporting the conceptualisation and modelling of the two layers to represent the full thickness of the alluvium, being Layer 1 being the Narrabri alluvium, and Layer 2 being the Gunnedah alluvium. There is minimal information provided to support the stratigraphic differentiation, and the permeability parameters assigned.
- Further data or supporting information is required to support the concept that the Narrabri alluvium is laterally connected to the weathered zone, while the Gunnedah alluvium is laterally disconnected, limiting flow to the vertical direction through sub-cropped coal seams.
- Multi-level monitoring extending through both the alluvium and the coal measures, is limited to two sites within the vicinity of the Project REG02 and GW041027, REG01 and GW967138. The installation of additional multi-level monitoring bores would improve the data set to support the conceptualisation, particularly in the area of the sub cropping coal seams. Further detail is required on vertical groundwater elevation differences and temporal water level trends, to demonstrate the hydraulic separation.
- Monitoring of the weathered zone is limited and is currently undertaken by only one monitoring bore. Monitoring of the weathered zone between the MCCM and Maules Creek alluvium is required. Greater monitoring is needed as the weathered zone was identified as the primary pathway for lateral groundwater flow from the alluvium. Currently there is limited data on the hydraulic properties and water quality of the regolith or weathered zone, to support the conceptualisation.
- Further monitoring of the weathered zone in the area described above is needed to support the assumption that lateral flow from the alluvium is limited by the regolith thickness and the disconnection between the Permian strata and other layers. These features and boundary conditions may underestimate connectivity, flow paths and drawdown predictions.
- Greater monitoring bores will assist in assessing the groundwater baseflow to both Maules Creek or Back Creek. Further information or data is required to address the environmental impact or groundwater assessment report.

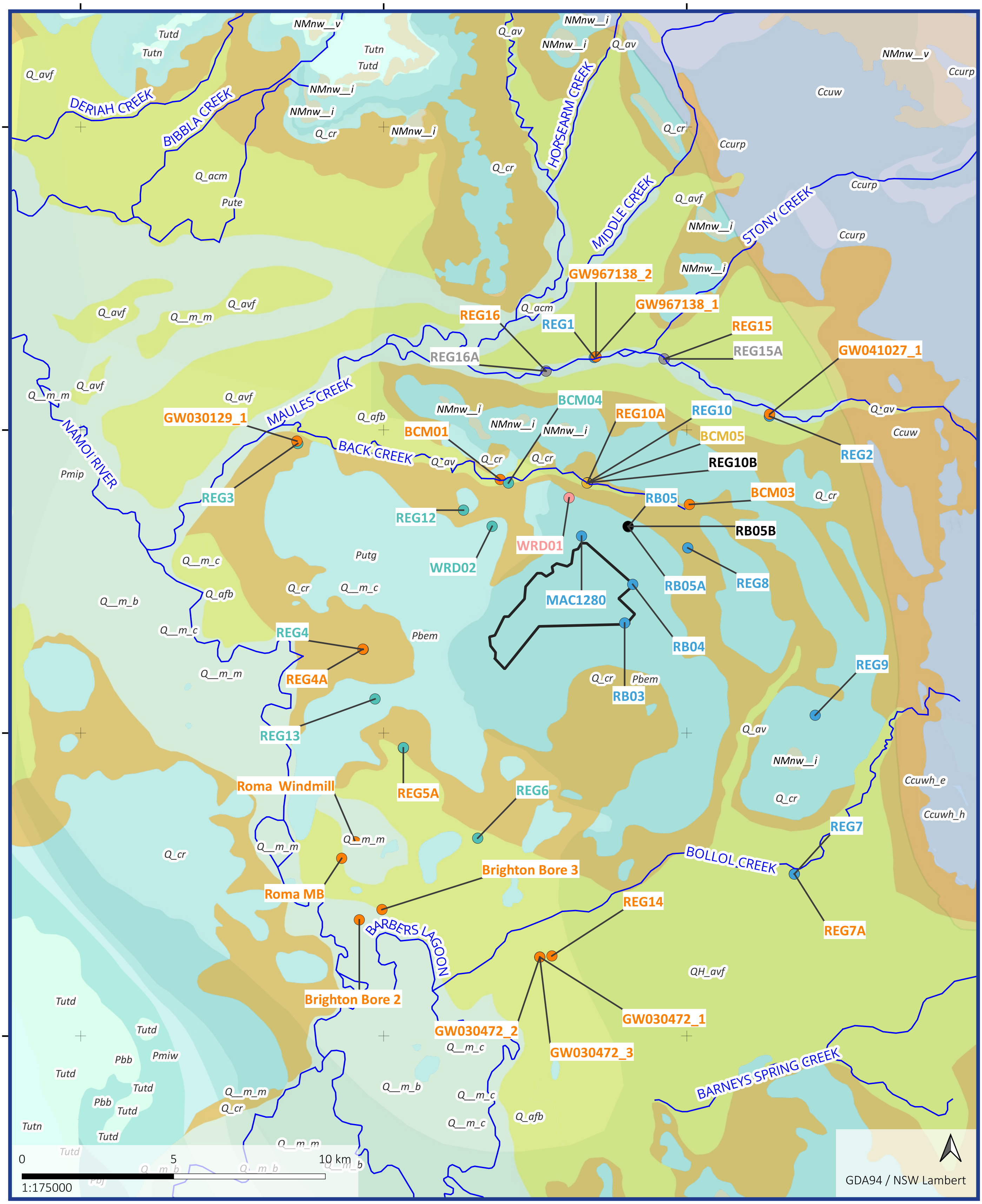
All alluvium monitoring bores should be drilled through the full thickness of the alluvium and not partially through the alluvium. This will ensure the monitoring bores define the full thickness of alluvial sediments, captures the complete saturated profile of the aquifer, avoids underestimating groundwater levels or pressure gradients, ensures representative water quality sampling and provides critical information to support the connection or disconnection between MCCM and the alluvial groundwater system.

The alluvium monitoring bores should clearly identify the alluvium separation described in the conceptual model and groundwater model setup for the Narrabri Formation and Gunnedah Formation. The monitoring program does not adequately identify which bores are in the Narrabri Formation or Gunnedah Formation. This is critical to support the conceptual and numerical models.

Table 6-1 Active monitoring locations

Bore ID	Geology	Easting	Northing	Elevation (mAHD)	Depth (mbgl)	Screen or VWP depth (mbgl)
MAC1280	Permian	226,525	6,616,503	323.5	60	56-59
BCM01	Alluvium	223,841	6,618,371	273.4	10	6.75 - 9.75
BCM03	Alluvium	230,085	6,617,546	305	10	6.75 - 9.75
RB03	Permian	227,947	6,613,635	407.9	324.4	164 / 242 / 289 / 317
RB04	Permian	228,213	6,614,910	437.5	354	209 / 272.5 / 309 / 339
RB05A	Permian	228,065	6,616,810	328.4	245.3	239 - 245
RB05	Permian	228,071	6,616,813	328	382	107 / 231 / 280 / 382
REG1	Permian	226,946	6,622,396	286.2	255.2	118.7 / 134.5 / 193.5 / 281.5
GW967138_1	Alluvium	227,001	6,622,422	313.6	82.5	
GW967138_2	Alluvium	227,001	6,622,422	313.6	82.5	71 - 77
REG2	Permian	232,722	6,620,459	317	255.2	60 / 120 / 200 / 260
GW041027_1	Alluvium	232,730	6,620,523	318.5	18	8.25 - 14.25
REG3	Volcanics	217,164	6,619,558	241.6	57	50.50 - 56.50
GW030129_1	Alluvium	217,135	6,619,637	248	24.4	23.2 - 24.4
REG4	Volcanics	219,323	6,612,763	260	72.5	65.5 - 71.5
REG5A	Alluvium	220,646	6,609,514	252	22	18 - 21
REG5	Volcanics	220,649	6,609,521	252.2	78.7	72.2 - 78.2
REG6	Volcanics	223,100	6,606,534	250.7	96	88.0 - 94.0
REG7A	Alluvium	233,545	6,605,359	291.7	36	24 - 30
REG7	Permian	233,543	6,605,348	291.6	255.2	67.5 / 148.2 / 242.5
REG8	Permian	230,030	6,616,113	341.6	TBC	91.5 / 221 / 274
REG9	Permian	234,233	6,610,591	346.8	279.2	116.8 / 175.2 / 268
REG10A	Alluvium	226,717	6,618,260	287.1	10	6.75 - 9.75
REG10	Permian	226,723	6,618,261	287.1	189.4	55 / 144.2 / 178 / 185.5
REG12	Volcanics	222,632	6,617,358	285.6	48.3	38.4 - 44.4
REG13	Volcanics	219,713	6,611,129	277.1	133	128 - 132
REG14	Alluvium	225,547	6,602,649	250.2	102	90 - 96
GW030472_1	Alluvium	225,148	6,602,611	248	101.5	23.8 - 25

Bore ID	Geology	Easting	Northing	Elevation (mAHD)	Depth (mbgl)	Screen or VWP depth (mbgl)
GW030472_2	Alluvium	225,148	6,602,611	248	101.5	57.3 - 59.7
GW030472_3	Alluvium	225,148	6,602,611	248	101.5	94.5 - 101.5
Roma Windmill	Alluvium	219,058	6,606,417	TBC	~12	TBC
Roma MB	Alluvium	218,612	6,605,871	TBC	89	TBC
Brighton Bore 3	Alluvium	219,942	6,604,179	TBC	16.4	12.8 – 15.8
Brighton Bore 2	Alluvium	219,194	6,603,840	TBC	TBC	TBC
RB05B	Braymont seam	228,057	6,616,825	328	110	106.17
REG10B	Braymont seam	226,719	6,618,263	289.1	55	42.2
WRD01	Weathered overburden	226,113	6,617,766	299.5	20	19.9
BCM04	Volcanics	224,114	6,618,253	276.6	20	17.99
WRD02	Volcanics	223,575	6,616,826	304.5	50	49.19
BCM05	Alluvium /weathered overburden	226,705	6,618,254	288.9	20	TBC
REG15	Alluvium	229,249	6,622,349	298.3	<40	28.82
REG15A	Permian coal measures	229,249	6,622,349	298.3	100	58.96
REG16	Alluvium	225,355	6,621,947	280.2	<30	28.37
REG16A	Permian coal measures	225,355	6,621,947	280.2	60	57.44
REG4A	Alluvium	219,313	6,612,772	260.2	40	37.94



Existing groundwater monitoring network

4184 – Maules Creek Continuation Project - ITPR

Figure 6 - 1

28/07/2025

- Lease boundary
- Watercourse
- Alluvium
- Alluvium or weathered overburden
- Weathered overburden
- Volcanics
- Permian
- Permian coal measures
- Braymont seam

Geology

- Q_avf / Q_acm / Q_afb / Q_ath / Q_av / QH_avf - Alluvium
- Q_m_b / Q_m_c / Q_m_l / Q_m_m - Marra Creek Formation
- CZ_c / Q_cr - Colluvium & residual deposits
- NMnw_v / NMnw_t / NMnw_i - Nandewar Volcanic Complex
- Pbb - Brothers Subgroup
- Pbem - Maules Creek Formation
- Putg - Boggabri Volcanics
- Tutd - Digby Formation
- Tutn - Napperby Formation
- Ccurp - Plagyan Ignimbrite Member
- Ccuw - Willuri Formation
- Ccuwh - Birken Head Volcanic Member
- Ccuwp - Penryn Rhyolite Member

6.2. Suitability of monitoring program

The data collection and methodology should be updated with the latest information provided in the Geoscience Australia Groundwater Sampling and Analysis – A Field Guide 2nd Edition (2024). Including the quality control and quality and standard operating procedures.

Measurement error management needs to be included in the monitoring program. This is required as the measurement error for the VWP is considered potentially higher than that for the monitoring bores and possibly in the range of ±5 m to 10 m (AGE, 2025). This identified range of error is far outside the expected error range for properly functioning VWPs. Error ranges should be around ± 0.1 to 0.5 m depending on the sensor type. Measurement error management should be included for the electronic pressure transducers/loggers installed since 2014. Error ranges should be around ± 0.005 to 0.1 m depending on the transducer sensor type. Measurement error management involves sensor selection, installation best practices, calibration / verification, error and drift management, data quality assurance, understanding target error ranges for acceptable standards.

Greater multi-level monitoring extending through both the alluvium and the coal measures is required. Currently this is limited to two sites within the vicinity of the Project REG02 and GW041027, REG01 and GW967138. However based on the above, the assessed VWP measurement error at these sites is significant, potentially affecting confidence in the interpretation of vertical hydraulic gradients and connectivity between aquifers.

REG01, REG10 and GW967138, monitor coal seams between the MCCM and the Maules Creek alluvium. REG10 is closer to MCCM and exhibits depressurisation in the deeper seams. This is currently represented in the numerical model, albeit to a lesser extent than what is observed. REG01 is a multilevel VWP site adjacent to Maules Creek and NSW Government monitoring bore GW967138. The monitoring bore has two sensors at different depths, both located in the second layer of the model; consequently, the simulated hydrographs are the same. The model simulates the higher groundwater level observed within the alluvial aquifer and a lower pressure within the underlying Permian bedrock, indicating a downgradient from the alluvium to the underlying bedrock. At REG01, the different pressures observed within the Permian VWP sensors are not well replicated by the model.

6.3. Triggers and control charts

There are several bores where trigger thresholds are applied with TBC (see Table 8-4 of the WMP), which is defined as less than two years of monitoring. Given the duration of operations at MCCM sufficient monitoring data should now be available and the application of TBC is no longer appropriate.

Further, Section 8.2.3 states *The control charting method has not been adopted for metal concentrations as these are typically less variable. Dissolved metal concentrations will be compared to the most appropriate ANZECC guidelines depending on the environmental value of the monitored hydrostratigraphy, which generally draws water for stock, domestic and irrigation purposes.*

The WMP should specify and define the analytes and values for the appropriate ANZECC guidelines based on beneficial use.

Attachment B of the WMP contains a summary of the water level and water quality time series data including comparison of the data against the triggers. These graphs have not been updated since 2021 or 2022. These graphs need to be updated to allow for a comparison of recent data against the level and quality triggers.

7. Conclusions

The key risk to groundwater resources in the Maules Creek alluvium is the dewatering and depressurisation from mining activities. This dewatering and depressurisation may potentially occur through long term depressurisation within coal seams that are targeted by mining (e.g. Braymont seam). Where these coal seams sub-crop beneath the Maules Creek alluvium, there is the potential for the coal seam to be in direct connection with the Maules Creek alluvium. Groundwater interaction between these two units may occur vertically or laterally.

The Maules Creek alluvium is conceptualised to have a relatively high hydraulic conductivity and high storage capacity (specific yield). The geometry of the underlying Permian strata and coal seams appears to modelled so that there is a hydraulic separation between the Maules Creek alluvium and the Permian strata. Under such conditions groundwater modelling will generally predict minimal drawdown in the shallow aquifer.

There is a risk that the alluvial sediments may not have as high a storage capacity as modelled, and that there is a greater hydraulic connection between the Maules Creek alluvium and the Permian strata. Under these conditions there is a greater probability of greater drawdown and indirect water take from the Maules Creek alluvium than is currently predicted by AGE (2025), and hence drawdown within the alluvium may be more extensive than predicted.

Attachment A CVs for Daniel Barclay and Andrew Macdonald

Daniel Barclay
Principal Hydrogeologist

Education

- Bachelor of Applied Science (Honours), Queensland University of Technology, Brisbane, 1996/1997.
- Bachelor of Applied Science – Geology, Queensland University of Technology, Brisbane, 1996.

Memberships

- International Association of Hydrogeologists, Member, Australian Chapter.

Employment history

July 2018	**hydrogeologist.com.au** **Principal Hydrogeologist / Director**
2012 – July 2018	Australasian Groundwater and Environmental Consultants Pty Ltd Principal Hydrogeologist/Managing Director
2009 – 2012	Independent Consultant Senior Hydrogeologist
2007 – 2009	BHP Billiton, Olympic Dam Expansion Project Senior Hydrogeologist
2006 – 2007	Klohn Crippen Berger Ltd Senior Hydrogeologist
2002 – 2006	Australasian Groundwater and Environmental Consultants Pty Ltd Hydrogeologist
1997 – 2002	Queensland Government – Department of Natural Resources Hydrogeologist

Skills

Daniel has over 25 years' experience as a hydrogeologist within the consulting, government and mining sectors, with hydrogeological exposure within the mining environment in Australia, Asia and North America. He has carried out numerous groundwater assessments within underground and open cut mines in Queensland, New South Wales, South Australia, Victoria, Papua New Guinea and Laos. His skills include:

- conceptualisation, design, supervision and monitoring of groundwater infrastructure;
- groundwater supply operations;
- seepage investigations;
- hydrogeochemical assessments;
- conceptual modelling;
- numerical modelling (FEFLOW, SEEP/W and MODFLOW);
- impact assessment and project approvals; and
- project management.

Experience

Environmental licensing:

Daniel has completed numerous annual groundwater monitoring reviews, borefield performance reports and exceedance investigation reports to assist mining companies with regulatory conditions and reporting obligations. He also has significant experience in undertaking baseline assessments and bore assessments for coal seam gas companies as part of on-going requirements under the underground water impact reports.

Such reporting requires scrutiny of existing and historical hydrogeological data (water level and water quality) and relating this back to the hydrogeological understanding of the site and the impacts of the activity on the groundwater regime. Daniel understands that data quality is integral in such assessments to be able to provide good quality advice to the clients. Examples of environmental licensing experience are outlined below:

- Eloise Copper Mine (QLD), Annual Groundwater Review Reports. Groundwater quality trigger development, Exceedance Investigations.
- Callide Mine, Annual Groundwater Review Reports. AWL monitoring reports, Groundwater level and quality trigger development, Exceedance Investigations.
- Mackenzie North, Annual Groundwater Review Reports. AWL monitoring reports, Exceedance Investigations.
- Progressive Rehabilitation and Closure Plans for Eloise Copper Mine, Callide Mine, Moorvale Mine, Blair Athol Mine.
- Meadowbrook Project, Underground Water Impact Report.
- Norwich Park Mine QLD (BMA), Annual Groundwater Review Report.
- Oaky Creek Mine QLD (Glencore), Annual Groundwater Review Report.
- Gregory Crinum Mine QLD (BMA), Annual Groundwater Review Report and Borefield Performance Review Reports.
- Cameby Downs QLD (Yancoal), Annual Groundwater Review Report.
- Surat Basin QLD (Arrow Energy), Bore Assessments and Baseline Assessments.
- Grassdale Feedlot QLD (Arrow Energy), Bore Condition Report.
- Ernest Henry Mine QLD (Glencore), Ernest Henry Mine Borefield Performance Review Reports.
- Ernest Henry Mine QLD (Glencore), Mount Margaret Mine Performance Review Reports.
- Ernest Henry Mine QLD (Glencore), Ernest Henry Mine and Mount Margaret Mine Trigger Reports.
- Lady Loretta Mine QLD (Glencore), Annual Groundwater Review Report.
- Numerous Annual Environmental Monitoring Reports for coal mines in NSW.

Mining / Extractive industries:

Daniel has a broad range of experience in coal seam gas, quarrying, coal and metalifferous mines within Australia and overseas. His experience includes conceptual model development, design and installation of bores (monitoring, production, dewatering and depressurisation), groundwater sampling, hydrochemical assessments and the use of analytical and numerical methods to simulate mine activities. Examples of mining / extractive industry experience are outlined below:

- Eloise Copper Mine, development of a TSF Seepage Management Plan, Groundwater Management Plan, Borefield Performance Review Reports.
- Dalswinton Sand and Gravel Quarry. Groundwater Impact Assessment.
- Wards Well / Lancewood coal project. Project management for the installation of monitoring bores, vibrating wire piezometers, dataloggers and collection of groundwater level and quality data to support pre-development baseline monitoring.
- Wilson Creek Project (Vitrinite Coal), installation of 15 monitoring bores, dataloggers and collection of groundwater level and quality data to support pre-development baseline monitoring.
- Vulcan Complex Project (Vitrinite Coal), installation of 12 monitoring bores, dataloggers and collection of groundwater level and quality data to support pre-development baseline monitoring.
- Burrum Heads Sand Quarry (Australian Grazing & Pastoral Co), Groundwater and Surface Water Management Plans.
- Rocky Gully Sand Quarry (Zanows), Groundwater Impact Assessment.
- Olympic Dam SA (BHP Billiton Pty Ltd), Olympic Dam Expansion Project.
- Oil Sands Mine, Fort McMurray, Alberta, Canada (Suncor Energy Inc.), Drilling supervision of production wellfield and monitoring network.
- Surat Basin, QLD (Kokstad Mining), Bore Assessment for Precipice Sandstone Evaporative Brine.
- Gregory-Crinum Mine QLD (BMA), surface geophysics and installation of groundwater monitoring bores.
- Isis and Gordon Mines, Stradbroke Island QLD (Consolidated Rutile Limited), water management and groundwater modelling, construction supervision of monitoring bores and dewatering systems.
- Numerous quarry developments within south-east QLD.

Water resource assessments:

Daniel has undertaken numerous groundwater resource assessments throughout Australia, including desktop assessments, program design and conceptualisation studies. He has significant experience in drilling and installation of monitoring and production bores, pumping tests and sampling. Daniel can develop schedules and strategies for large-scale groundwater supply projects and has been involved with large production bore trials and commissioning. An example of water resource assessment experience is outlined below:

- Central Lockyer Valley Groundwater Model (Lockyer Water Users Forum), Review of supporting technical documents to the draft Water Plan.
- Goondiwindi Town Water Supply (Goondiwindi Regional Council), Water licence application.
- Roma Town Water Supply (Streamline Hydro), Numerical modelling to support a water licence application.
- Angoram PNG (UDP Consulting), Town groundwater assessment.
- Bauxite Mine, QLD (Bechtel Services (Australia) Pty Ltd), Beneficiation Plant Water Supply.
- Clarence-Moreton Basin QLD (Hampton Irrigators), A groundwater supply assessment, design, construction, downhole geophysical logging and pumping test analysis.
- Surat Basin CMA QLD (Office of Groundwater Impact Assessment), Technical secondment.
- Surat Basin QLD (BG-Group), Injection of Associated CSG Water.
- Olympic Dam SA (BHP Billiton Pty Ltd), Tailings Dam Water Resource Assessment.
- Olympic Dam SA (BHP Billiton Pty Ltd), Trial Dewatering Project.
- Lihir Gold Mine North Kapit Stockpile PNG (Lihir Management Company), seepage collection system design.
- Lihir Gold Mine PNG (Lihir Management Company), groundwater supply.
- Lady Annie QLD (CopperCo Ltd), Construction Water Supply.
- numerous groundwater assessments for pastoral and drilling companies within QLD.
- Great Artesian Basin Recharge Project (Queensland Government), drilling of monitoring bores and coring for chloride profiles, monitoring bore construction and published papers and final report.
- Queensland's Groundwater Resources (Queensland Government), regional analysis of Queensland's groundwater resource using the DRASTIC methodology.
- Great Artesian Basin Bore Audit (Queensland Government), Developed the Great Artesian Basin Bore Audit.
- Undertaken baseline assessments and bore assessments within the Surat Basin in accordance with government guidelines.

Mine site dewatering and depressurisation:

Daniel has experience in numerous mine site dewatering and depressurisation projects. Of particular note, Daniel was involved with the Olympic Dam Expansion Project which considered the feasibility of developing a large open cut mine at the existing underground mine in South Australia. The project involved conceptualisation, design / planning and construction of deep dewatering bores and depressurisation bores within the open pit area. The bores were operated for over 12 months in a trial dewatering system which required planning, construction, commissioning and operation. Daniel was involved in all facets of the trial including re-injection of the produced water into a distant limestone aquifer. The trial dewatering was incorporated into a three dimensional groundwater flow model (FEFLOW) to assess the effectiveness of the trial. Examples of other mine site dewatering experience are outlined below:

- Phu Kham, Laos (PanAust), Numerical modelling of TSF embankment and open pit.
- Lihir Gold Mine, PNG (Lihir Management Company), Groundwater dewatering modelling and bore network optimisation.
- Frieda River PNG (PanAust), Open Pit Feasibility Study.
- Burton Widening Project QLD (Peabody Energy Australia), Dewatering and Depressurisation Assessment.
- Ernest Henry Mine QLD (Ernest Henry), Supervised the designing, tender process, drilling and construction of 5 deep test-holes and 2 deep dewatering bores.

Groundwater impact assessments:

Daniel has compiled and assisted with numerous groundwater impact assessments for mining operations requiring environmental approvals. The assessments typically require collection of baseline data, conceptual model development, development of a numerical flow model, prediction of impacts on the groundwater regime, and reporting. Daniel has often played a major part in these assessments providing an effective project manager or project director for the groundwater studies reporting to the EIS manager. Examples of groundwater impact assessment experience are outlined below:

- Broadlea Mine, EA amendment Groundwater Impact Assessment (in-progress).
- GEMCO Southern Leases Project, Groundwater Impact Assessment (in-progress).
- Curragh Bord and Pillar Project, EA amendment Groundwater Impact Assessment.
- Rixs' Creek North Continuation Project, EIS Groundwater Impact Assessment (in-progress).
- Big Vein South Project, EA application Groundwater Impact Assessment (in-progress).
- Vulcan Mine Complex and Vulcan South Project, EA application Groundwater Impact Assessment.
- Taronga Tin Mine, EIS Groundwater Impact Assessment (in-progress).
- Carborough Downs South Extension Project, EA amendment Groundwater Impact Assessment.
- Olympic Dam SA (BHP Billiton Pty Ltd), Olympic Dam Expansion Project.
- Aurukun bauxite (Glencore), EIS Groundwater Impact Assessment.
- Frieda River PNG (PanAust), EIS Groundwater Impact Assessment.
- Moranbah South QLD (Hansen Bailey), EIS Groundwater Impact Assessment.
- Rocky Hill Project NSW (R.W. Corkery), EIS Groundwater Impact Assessment.
- Taroborah QLD (AARC), EIS Groundwater Impact Assessment.
- Broughton QLD (U&D), EIS Groundwater Impact Assessment.

Numerical modelling:

Daniel has individually developed and completed numerous numerical flow models for mines and development activities both in Australia and overseas. These models include both finite difference and finite element models including FEFLOW, MODFLOW and SEEP/W. In addition to this, Daniel has been involved with a large number of numerical models providing conceptual input to the modellers or providing project management and guidance. Examples of numerical modelling experience are outlined below:

- Moranbah North Extension Project, Numerical modelling to support the Water Dependent Ecosystem Management Plan.
- Esmeralda Inflow assessment, Numerical modelling of pit inflows to support the preliminary site water balance.
- Jericho Project, Numerical modelling to support the Underground Water Impact Report.
- Roma Town Water Supply (Streamline Hydro), Numerical modelling to support a water licence application.
- Phu Kham Mine, Laos (PanAust), Numerical modelling of TSF embankment and open pit.
- Ernest Henry Mine QLD (Glencore), Regional modelling and impact assessment.
- King Vol Mine QLD (Auctus), Underground Water Impact Report.
- Mt Dromedary QLD (GraphiteCorp), Underground Water Impact Report.
- Surat Basin QLD (Arrow Energy), Regional CSG Impact Assessment Modelling.
- OK Tedi, PNG (OK Tedi Mining Ltd), Sand Stockpile 3D Groundwater Model.
- Lady Annie QLD (CopperCo Ltd), Pit Dewatering 3D groundwater model.
- Ok Tedi PNG (OK Tedi Mining Ltd), Finite element groundwater pit model.
- Olympic Dam SA (BHP Billiton Pty Ltd), EIS groundwater model and pit dewatering.
- Waldon Pit WA (Northern Star Resources), Impact assessment of supernatant disposal.

Training

- Professional writing workshop, presented by Professional Writing Australia, 2013.
- Apply First Aid and CPR (formerly Senior First Aid), renewed 2024.
- Coal Board Medical, renewed 2024.
- Generic Mine Induction – Standard 11 – Surface Operations, Training in coal mines as set by the Queensland Mines Inspectorate, 2024.
- 16th Australian Groundwater School, Centre for Groundwater Studies, 1998.

Publications

- Kellett J.R., Ransley T.R., Coram J., Jaycock J., **Barclay D.F.**, McMahon G.A., Foster L.M. and Hillier J.R. 2003. "*Groundwater Recharge in the Great Artesian Basin Intake Beds, Queensland*". Final Report for NHT Project #982713. Sustainable Groundwater Use in the GAB Intake Beds, Queensland.

Conference presentations

- Australasian Groundwater Conference 2015, Canberra. "*Application of trigger levels for groundwater resource development*".

April 2025

ANDREW MACDONALD
Principal Hydrogeologist

hydrogeologist.com.au

Education

- Master of Hydrogeology and Groundwater Management, University of Technology, Sydney, 2010.
- Bachelor of Applied Science (Environmental Management), Massey University, New Zealand, 2003.

Memberships

- International Association of Hydrogeologists (IAH), Australian Chapter.

Training

- Applied First Aid and CPR, July 2024
- Sonic Health Plus Fitness for Work and Drug & Alcohol, 14 February 2024
- White Card Work Safely in the Construction Industry, 2011
- Full Manual Driver's License
- Mining Supervisor S1, S2, S3, 2017

Employment history

July 2024 to Present	**hydrogeologist.com.au** **Principal Hydrogeologist**
2023 to 2024	Worley Consulting, Brisbane Principal Hydrogeologist
2021 to 2023	CDM Smith Consulting, Brisbane Senior Hydrogeologist
2018 to 2021	WSP Consulting, Brisbane Senior Hydrogeologist
2016 to 2018	SLR Consulting, Brisbane Senior Hydrogeologist
2014 to 2016	Gilbert & Sutherland Pty Ltd, Brisbane Hydrogeologist
2012 to 2014	Fluor/SANTOS GLNG Project Environmental Water Specialist
2011 to 2012	URS Corporation Hydrogeologist
2008 to 2011	Mighty River Power, New Zealand Geothermal Engineer
2005 to 2008	Mighty River Power, New Zealand Geothermal Technician

Skills

Andrew is a Hydrogeologist with 20 years of experience in a wide range of groundwater projects in Australia, specialising in hydrogeological investigations in the evaluation and management of groundwater resources across a number of industry sectors including mining, energy and construction. He has additional expertise in mining hydrogeology, project management, conceptualisation and desktop assessments, risk and impact assessments, aquifer testing and characterisation, groundwater monitoring network design and analytical analysis. His skills include:

- hydrogeological conceptualisation;
- groundwater impact assessment and regulatory approvals;
- bore field planning, design, commissioning and assessment;
- groundwater monitoring and assessment;
- drilling supervision and aquifer testing; and
- one dimensional (1D) and two dimensional (2D) modelling.

Experience

Project Experience – Mining

Principal Hydrogeologist | Lake Vermont Northern Extension Project, QLD | Jellinbah Group | 2025

The project scope of work was to review the 3D groundwater model results and assessed the predicted impacts from groundwater drawdown, including impacts on surface water assets. The 3D groundwater model was developed as part of the Project approval conditions and the groundwater model results were reviewed to assess predicted drawdown impacts.

Principal Hydrogeologist | Walton Project, QLD | Magnetic South | 2025

The project scope of work was to review of the existing groundwater monitoring network for the Project approvals. The assessment was required to determine if the network provides adequate coverage of potential pathways to receptors.

Principal Hydrogeologist | Fairhill Coal Mine and Wilton Mine, QLD | Futura Resources | 2025

The project scope of work was to complete an investigation into consecutive Environmental Authority trigger value exceedances.

Principal Hydrogeologist | Wilton Mine, QLD | Futura Resources | 2025

The project scope of work was to prepare an Annual Groundwater Monitoring Report and review of the Groundwater Monitoring Program to ensure it meets the requirements of EA conditions.

Principal Hydrogeologist | Washpool Project, QLD | Magnetic South | 2025

The project scope of work was to review the existing bore network against the current mine plan layout and the hydrogeological setting of the Project region to determine a network that provides adequate coverage of potential pathways to receptors.

Principal Hydrogeologist | Meadowbrook Extension Project, QLD | Bowen Basin Coal | 2025

The project scope of work was to develop an underground water impact report (UWIR) for the Meadowbrook Extension Project in central Queensland. The project is an extension of the existing operational Lake Vermont open cut mine operated by Bowen Basin Coal Pty Ltd and will consist of an underground longwall mine with a small satellite open cut pit.

Principal Hydrogeologist | Gemini Project, QLD | Magnetic South | 2025

The project scope of work was to develop an underground water impact report (UWIR) for the Project. The Project is located approximately 150 km to the east of Rockhampton and 8 km west of the town of Dingo.

Principal Hydrogeologist | Fairhill Coal Mine, QLD | Futura Resources | 2024

The project scope of work was to assess the groundwater monitoring network for the Project's Environmental Authority. The assessment considered the logic and rationale associated with the proposed monitoring bores.

Principal Hydrogeologist | Gemini Project, QLD | Magnetic South | 2024

The project scope of work was to develop an underground water impact report (UWIR) for the Project, on behalf of Magnetic South to satisfy the Project regulatory conditions.

Principal Hydrogeologist | Jellinbah Mine, QLD | Jellinbah Group | 2024

The project scope of work was to provide input into the closure studies including three dam options which required groundwater inflow assessments. The approximate volume of seepage from the environmental dam to the pit was calculated based on Darcy's Law.

Principal Hydrogeologist | Gemini Project, QLD | Magnetic South | 2024

The project scope of work was to develop a groundwater monitoring program to satisfy the Project regulatory conditions.

Principal Hydrogeologist | Washpool Coal Mine Project, QLD | Magnetic South | 2024

The project scope of work was to review the existing groundwater monitoring bore network against the current mine plan layout and the hydrogeological setting of the Project. The report provided an assessment of whether the existing monitoring bore network provided adequate coverage considering contemporary regulator guidelines, environmental values, and stakeholder expectations.

Principal Hydrogeologist | Wilton Coal Mine, QLD | Futura Resources | 2024

The project scope of work was to investigate the groundwater quality exceedances of contaminate limits in accordance with EA Conditions.

Principal Hydrogeologist | Lake Vermont Northern Extension Project, QLD | Jellinbah Group | 2024

The project scope of work was to assess potential groundwater impacts due to the open cut pit extension area associated with the Phillips Creek diversion realignment.

Principal Hydrogeologist | Lake Vermont Northern Extension Project, QLD | Bowen Basin Coal | 2024

The project scope of work was to complete an Underground Water Monitoring Program to satisfy the Project regulatory conditions. The groundwater model results were reviewed to assess the predicted impacts on surface water.

Principal Hydrogeologist | Vecco Critical Minerals Project, QLD | Vecco Industrial | 2024

The project scope of work was to develop a groundwater impact assessment to support an application for an environmental impact statement (EIS). The report detailed the existing groundwater environment, investigations undertaken, a numerical groundwater model and assessment of the potential for groundwater level impacts.

Principal Hydrogeologist | Central North Extension Project, QLD | Jellinbah Group | 2024

Annual Groundwater Monitoring Report for the Central North Extension Project to satisfy the conditions of the Project's Associated Water Licence.

Principal Hydrogeologist | Mackenzie North Project, QLD | Jellinbah Group | 2024

Annual Groundwater Monitoring Report for the Mackenzie North Project to satisfy the conditions of the Project's Associated Water Licence.

Principal Hydrogeologist | Caravel Baseline Groundwater Monitoring Plan, WA | Caravel Minerals | 2024

The project scope of work was to develop a Groundwater Monitoring Plan (GWMP) which considers the Bindi and Dasher Pits, associated infrastructure, and neighbouring environmental receptors, including the Lake Ninan Nature Reserve and associated water features. The GWMP was developed based on the results from the numerical modelling. Caravel required a monitoring plan which provided statistically relevant baseline data for water quality and water levels at the proposed project site. The groundwater monitoring plan was based on existing and proposed monitoring bore locations to support future proposed work and included establishment of a baseline groundwater monitoring regime to include seasonally variability, monitoring frequency and methods.

Senior Hydrogeologist | Kimberley Mineral Sands Hydrogeological Assessment, WA | Thunderbird Operations | 2023

Project manager for a hydrogeological assessment supporting the Kimberley Mineral Sands Project. The objective of the hydrogeological assessment was to collect, analyse and report data in relation to the environmental setting of the Project. The project involved a desktop hydrogeology assessment, conceptual model development to identify key features and develop a description of beneficial uses of groundwater.

Senior Hydrogeologist | Hydrogeological Assessment Mt Magnet, WA | Liontown Resources | 2023

Project manager for a groundwater assessment and investigations to determine the quantity and quality of available groundwater in the vicinity of Mt Magnet, nominally in a 70km radius.

Senior Hydrogeologist | FMG Mindy South GW Model, Mindy South, WA | Fortescue Metals Group | 2023

Project manager for Mindy South Groundwater Modelling Study (the Project) to Fortescue Metals Group Limited (FMG). Including: Phase 1 Data review and conceptual model development. Phase 2 Leapfrog and groundwater model construction, calibration and sensitivity analysis, presentation. Phase 3 Model predictions, uncertainty analysis and impact assessment. Phase 4 Presentation of numerical model results in the Leapfrog model. Phase 5 Detailed reporting.

Senior Hydrogeologist | Sth32 Worsley Numerical Model Review | Worsley Alumina, WA | 2023

Project manager for an independent model review and services in relation to GHD's responses to questions from the Department of Climate Change, Energy, the Environment and Water (DCCEEW) about various potential impacts on groundwater and surface water, including drawdown, mounding, acid sulfate soils (ASS) and salinity.

Senior Hydrogeologist | South32 Extended Hydrogeological Assessment | Worsley Alumina, WA | 2023

Project manager for the South32 Worsley Alumina Pty Ltd Joint Venture (South32) with water related studies supporting the Extended Mining Areas called Quindanning and Hotham North Project (the Project). Including: Phase 1 Desktop Assessment and Baseline Study. Phase 2 Drilling, Bore Construction and Testing. Phase 3 Modelling, Potential Impacts and Final Reporting.

Senior Hydrogeologist | Lady Loretta Mine Groundwater Closure Report, Hydrogeology, Australia | Glencore | 2022

The objective of the Lady Loretta Mine groundwater scope is to characterise the key hydrogeological features of the site, represent these in the model domain and consider contaminants of concern in relation to the groundwater at the site. To assist in assessing groundwater system response to mine closure it is necessary to update the hydrogeological conceptualisation and the existing numerical groundwater flow model to support CoC fate and transport predictions via solute transport modelling.

Senior Hydrogeologist | Glencoe Mine Site Water Studies, NT Australia | ERIAS Group | 2022

Provide advice on the most efficient option/s for collecting site specific data to enable development of a numerical groundwater model. Water related studies supporting the Mt Bonnie Oxide Project consists of the following desktop assessment and baseline study, drilling, bore construction and testing, modelling, potential impacts and final reporting.

Senior Hydrogeologist | Brocks Creek Dewatering Strategy - Hydrogeology, NT Australia | Bacchus Resources | 2022

Complete the NT EPA referral self-assessment and present this and the dewatering strategy to the NT EPA. To support statements relating to any potential for influence of groundwater quality, develop graphs of select water quality parameters to make an order-of-magnitude assessment of the difference between water quality within the pits (Alligator and Faded Lily) and relevant groundwater bores.

Senior Hydrogeologist | Brocks Creek Dewatering Strategy - Hydrogeology, Australia | VHM Limited | 2022

Under the Environment Effects Act 1978 VHM is required to prepare an Environment Effects Statement (EES) to assess the potential environmental impacts of the project. The project involved a desktop hydrogeology assessment, conceptual model development, numerical groundwater modelling, forward particle tracking and potential Impacts.

Senior Hydrogeologist | Environmental Impact Statement Response and Groundwater Monitoring Plan, Fountain Head Gold Project, NT | ERIAS Group Australia | 2021

Address comments made from the Department of Environment, Parks and Water Security (DEPWS) regarding monitoring groundwater drawdown and mounding. Update the Water Management Plan (WMP) to incorporate groundwater drawdown and mounding triggers. Develop a Trigger Action Plan if the groundwater triggers are exceeded.

Senior Hydrogeologist | Groundwater Model and Mounding Assessment, Goschen Project, Victoria | VHM Limited | 2021

Develop a conceptual site model and associated numerical model to support a preliminary risk assessment associated with groundwater mounding at the Goschen Project. The objective of the groundwater model is to assess indicative impacts associated with seepage from tailings and potential groundwater mounding impacts.

Senior Hydrogeologist | Bengalla Mine Groundwater Inflow to Open Cut Pit Assessment, Bengalla, NSW | Bengalla Mining Company | 2018 - 2021

Assessment of groundwater inflows to the open cut pits to complete the annual water balance for the Bengalla Mine (Bengalla) Annual Review (AR). Estimates of likely groundwater inflows to the pit were made using an analytical equation-based groundwater flow model.

Senior Hydrogeologist | Valeria Project, Emerald, QLD | Glencore Coal Assets | 2020

As part of the development of a data sourcing strategy and baseline characterisation for groundwater studies, a census of existing landholder groundwater bores and hydraulic tests on the existing monitoring network was conducted in 2020. The purpose of the study was to inform groundwater conceptualisation for the groundwater impact assessment and document pertinent hydrogeological information.

Senior Hydrogeologist | Valeria Project, Emerald, QLD | Glencore Coal Assets | 2020

A review of data collected for the Valeria project relevant to the groundwater studies was conducted, and a gap analysis of the available data. Development of a preliminary groundwater sampling plan considering groundwater interaction with surface waters. The analytical suite selected was based on field investigations to confirm that identified groundwater and surface water environmental values and water quality objectives were not compromised.

Senior Hydrogeologist | Bayswater North Pit Dewatering Rate Curves, Ravensworth, NSW | Glendell Coal Mine | 2020

Hydrogeological and geotechnical assessment of the final high wall in the Bayswater North Pit (Ravensworth East Mine). The assessment included an analytical assessment to calculate a range of dewatering rates over time associated with the variance of aquifer parameters and proposed mining block length and depth.

Senior Hydrogeologist | Mt Owen West Pit Seepage Bores, NSW | Mt Owen Coal Mine | 2020

Update and review the existing conceptual site model (CSM) with respect to the additional information available for the West Pit TSF operation and West Pit Tailings Aquifer. Develop a Leapfrog model and incorporate existing mine void, pit shell, groundwater level and Bayswater seam to allow for siting of a test seepage recovery bore and associated monitoring locations for aquifer testing. Analytical assessment to locate appropriate test production and monitoring bore separation distances. Determine bore locations (test production and monitoring), construction details and the specifications for aquifer testing.

Senior Hydrogeologist | Water Management, NSW | Glencore Coal Assets | 2019

Study of alluvial impacts on key trench and cut off design for levees. To assess the impact and influence that sand and gravel alluvium soils may have on key trench or cut off design for the Farrell's Creek and Mitchell levees.

Senior Hydrogeologist | Bulga Coal Mine Extension Project, Bulga, NSW | Glencore Coal Assets | 2019

Development of a two-dimensional seepage model using SEEP/W for a stability and seepage assessment at the Mt Thorley Warkworth/Bulga boundary for a proposed Northern Tailings Storage Facility expansion.

Senior Hydrogeologist | Groote Eylandt Mining Company (GEMCO) Process Borefield investigation and relocation, Groote Eylandt, NT | South32 | 2019

To assist in selecting potential sites for the relocation of the existing process borefield. A staged approach for the relocation of the existing borefield was conducted, with the initial assessment based on calculated borefield drawdown and interference effects. The second assessment involved development of several geological sections to assist interpretation of the basement topography and locate potential areas of paleochannel sediments.

Senior Hydrogeologist | Groote Eylandt Mining Company (GEMCO) Groundwater monitoring bore census, Groote Eylandt, NT | South32 | 2019)

Hydrogeologist to complete the mine bore census and the status of the in-field groundwater monitoring locations.

Senior Hydrogeologist | Groote Eylandt Mining Company (GEMCO) TSF11 Groundwater Impact Assessment, Groote Eylandt, NT | South32 | 2019

To develop a two-dimensional seepage model using SEEP/W to assess risks associated with seepage and groundwater mounding associated with an embankment rise to TSF11. Outcomes of the assessment included a descriptive assessment of the potential risks to groundwater associated with the TSF development and assessment of the interceptor drain performance on mitigating seepage to the adjacent significant site.

Senior Hydrogeologist | Groote Eylandt Mining Company (GEMCO) Numerical model development and collation of Existing Data, Groote Eylandt, NT | South32 | 2019

Complete the data collation review and assess the suitability of the existing datasets, determine the information gaps, and confirm the requirements for additional field investigations.

Senior Hydrogeologist | Groote Eylandt Mining Company (GEMCO) TSF15 Pre-Feasibility Study, Groote Eylandt, NT | South32 | 2019

Desktop review of available datasets and reports to characterise the local hydrogeology, simulate mounding impacts (2D) on existing groundwater levels at each of the proposed TSF locations, description of likely fate of transport impacts on sensitive receptors and ranking of each proposed location based on the hydrogeological assessment.

Senior Hydrogeologist | Groote Eylandt Mining Company (GEMCO) TSF15 Pre-Feasibility Study, Groote Eylandt, NT | South32 | 2019

ASN quarry and TARP assessment. This included a review of available MVT groundwater level monitoring datasets from 2016 to 2018. The development of groundwater level trigger values based on the datasets and HARTT analysis. The development of a Trigger Action Response Plan and remedial actions should triggers be exceeded.

Senior Hydrogeologist | Curragh Coal Mine Expansion Project, Blackwater, QLD | Coronado Curragh | 2019

Development of a drilling fieldwork plan to complete the installation of the monitoring bores. Including monitoring bore locations and target formations, installation methodology and construction requirements, aquifer testing and groundwater sampling methodologies and a project schedule with proposed timelines for delivery of key milestones.

Assessing reference monitoring site locations for Groundwater Dependent Ecosystems (GDEs) and development of a GDE monitoring program to improve the understanding of GDE dependence on groundwater systems around proposed pits and monitor potential impacts.

Senior Hydrogeologist | Cannington Mine, Cannington, QLD | South32 Cannington | 2018

Refining the hydrogeological understanding of the groundwater systems to improve the mine dewatering strategy.

Senior Hydrogeologist | New Acland Stage 3 Project Mine Expansion, Oakey, QLD | New Hope Group 2016 - 2018

Hydrogeologist for a range of studies being undertaken in response to project approval conditions, including: monitoring bore drilling and construction, aquifer testing, routine monitoring and sampling, landholder liaison for Make Good agreements, and the planning and implementation of farm bore baseline assessments.

Senior Hydrogeologist | Sarsfield Expansion Project, Ravenswood, QLD Carpentaria Gold | 2017

Hydrogeological assessment and analysis of the Sarsfield expansion project, EA amendment application, including desktop review, groundwater risk assessment and proposed monitoring program.

Senior Hydrogeologist | Groundwater Monitoring New Acland Mine, Clarence-Moreton Basin, Southeast Queensland, QLD | New Hope Coal | 2016 - 2017

Report author for six monthly reviews of groundwater monitoring data to identify any environmental harm related to groundwater from mine operations.

Senior Hydrogeologist | Glencore OCAL Mine Complex Closure, Edgeworth, NSW | Glencore | 2016

Hydrogeological assessment and analysis of the Detailed Mine Closure Plan for the entire Oceanic Coal Australia Limited (OCAL) Complex, including desktop review, groundwater risk assessment, proposed monitoring program and compiling numerical modelling datasets.

Hydrogeologist | Boral Quarry Expansion, Gold Coast Quarry, QLD | Boral | 2016

Desktop review, hydrogeological regime investigation, groundwater impact assessment and reporting.

Hydrogeologist | Gravel Quarry Groundwater Assessment, Brisbane, QLD | Neilson Group Gravel Quarry | 2015

Report review, including investigation and assessment of groundwater impacts.

Hydrogeologist | Quarry Groundwater Assessment, Mt Moriah Basalt Quarry, Toowoomba, QLD | Private Landholder | 2015

Desktop review, hydrogeological regime investigation, groundwater impact assessment and reporting.

Field Hydrogeologist | Glencore Wandoan Project, Wandoan, QLD | Glencore | 2011

Field hydrogeologist including undertaking landholder bore census, groundwater monitoring network drilling installation and water quality analysis.

Field Hydrogeologist | BMA Goonyella Riverside Mine Expansion, Moranbah, QLD | BMA | 2011

Field hydrogeologist for the installation of a groundwater monitoring network and site monitoring.

Coal Seam Gas

Senior Hydrogeologist | Groundwater Monitoring Event, APLNG Curtis Island GME, Gladstone Qld | 2023

Project manager for the ConocoPhillips (CoP) 2023 Groundwater monitoring event (GME) at the Australia Pacific Liquified Natural Gas (LNG) Facility (the Facility) on Curtis Island. The GME formed part of an ongoing, proactive groundwater monitoring and management program (GMMP, 2018) that has been implemented at the Site.

Senior Hydrogeologist | Shell QGC Pond Seepage Detection Bore, Shell QGC's Central Development Area, Miles Qld | 2023

Project manager for the Shell QGC with water related studies supporting the pond seepage detection bore network. Including a detailed assessment for water present within the seepage monitoring bores to determine the likely water source. The seepage detection bore network was installed in Q4 2022. The network is installed southeast of Miles, Queensland around ponds called Berwyndale South Pond 4, Kenya Large, Rhynie, Orana 1, Condamine Power Station Pond 1 and Condamine Power Station Pond 2.

Senior Hydrogeologist | Coal Seam Gas landholder bore baseline assessments, Bowen Basin, QLD | Galilee Energy | 2018 - 2021

Annual planning and implementation of Galilee Energy's Baseline Assessment Program (BAP) associated with the Galilee Energy Basin tenement ATP 2019.

Senior Hydrogeologist | Coal Seam Gas Hydrogeological Services, Brisbane, QLD | SANTOS | 2018

Preparation and submittal for groundwater monitoring and extraction data to the Office of Groundwater Impact Assessment (OGIA).

Hydrogeologist | Coal Seam Gas Upstream Plant Construction, Surat Basin, QLD | Fluor Santos GLNG | 2012 - 2014

Assessment including conceptual and analytical model development and environmental impact monitoring for a groundwater construction supply bore network.

Hydrogeologist | CSG Beneficial Reuse, Surat Basin, Dalby, QLD | Arrow Energy | 2011

Coal Seam Gas water treatment and beneficial reuse groundwater assessment including monitor bore installation, permeability testing, groundwater modelling, long term monitoring.

Groundwater Resources and Management

Principal Hydrogeologist | CSBP Albany Fertiliser dispatch Depot Site, WA | Wesfarmers Chemicals, Energy and Fertilisers | 2024

The project scope of work was to develop a comprehensive options study report for the permanent treatment of phosphorus and nitrogen contamination of stormwater runoff from the Albany fertiliser dispatch depot site. The objective of the hydrogeological assessment was to collect, analyse and report data in relation to the environmental setting of the Project. The project involved a desktop hydrogeology assessment, conceptual model development to identify key features and develop a description of beneficial uses of groundwater. Numerical modelling and solute transport modelling were completed to support CoC fate and transport predictions via solute transport modelling.

Principal Hydrogeologist | Groundwater Resource Assessment, QLD | Queensland Government Department of Regional Development, Manufacturing and Water | 2024

The objective of the Groundwater Resource Assessment Implementation Area 1 project was to prepare a report providing a groundwater assessment and impact assessment for Implementation Area 1 of the Lockyer Valley Groundwater Management Area to assess the relevant outcomes and measures. A desktop hydrogeological assessment and conceptualisation of the groundwater system was completed for the Implementation Area 1 of the Lockyer Valley GMA for hydrogeological characteristics. Impact assessment was completed on the conditions required for the sustainable management of groundwater in Implementation Area 1 of the Lockyer Valley GMA, and the impacts of groundwater recharge and use on the groundwater flow system that supports them. Including identification of potential impacts, both positive and negative, including consideration of how the take of groundwater has impacted, and expected to impact, groundwater storage, induced recharge, and discharge processes.

Senior Hydrogeologist | Mount Rawdon Pumped Hydro Project, QLD | Evolution Mining | 2023

Groundwater assessment works to inform the Environmental Impact Statement (EIS) for the proposed Mt Rawdon Pumped Hydro Project. Including a substantial groundwater modelling component and geological modelling (Leapfrog), groundwater flow modelling, solute transport modelling and water balance modelling.

Senior Hydrogeologist | Hydrogeological Assessment for Five Remote Landfill Sites, NT | East Arnhem Regional Council | 2022

The objective of the work was to undertake field investigation and desktop hydrogeological assessment to characterise the underlying aquifer systems in proximity to the landfills for hydrogeological characteristics using available datasets and information. The purpose was to inform environmental management planning, hydrogeological studies were completed on five landfill sites.

Senior Hydrogeologist | Former Caltex Depot Kingaroy (Site ID: 11715) Groundwater Remediation Action Plan (RAP), QLD | Ampol Australia Petroleum Limited | 2021

Analytical groundwater simulation using the software AnAqSim was developed to simulate pumping and remedial scenarios to the aquifer system, providing indicative results to inform the ROA and risk assessment.

Senior Hydrogeologist | Sydney Water Corporation in partnership with D4C, NSW | D4C | 2021

Calculate groundwater inflows into trench and excavation in accordance with the Sydney Water Planning and Design Guideline titled Ground Water Management Working Draft, May 2020. A set of steady-state analytical solutions of groundwater inflows to open excavation or trench were used for estimate of rates of groundwater flows during the project work timeframe. The solutions use a 2- dimensional steady state analysis. This analytical equation-based methodology is suitable for minor and moderate groundwater interactions.

Senior Hydrogeologist | Finland Road water main replacement Groundwater Assessment, Sunshine Coast, QLD | Unity Water | 2019

Hydrogeological assessment component for the Finland Road water main replacement project. Slug testing and permeability analysis for monitoring bores was completed and groundwater inflow estimates into an open trench using an analytical model approach. The software package AQTESOLV was used to analyse transient groundwater flow modelling and simulate head contours under postulated injection scenarios.

Senior Hydrogeologist | 7 Eleven remediation Wickham, Newcastle, NSW | 7-Eleven Stores | 2019

Hydrogeological assessment component for the underground petroleum storage system (UPSS) replacement program at the 7-Eleven Wickham Service Station. The software package AQTESOLV was used to analyse the hydraulic tests and analytical equations used to calculate groundwater inflows into the open excavations.

Senior Hydrogeologist | Groundwater Inflow Assessment, Melbourne, VIC | South East Water | 2019

Hydrogeological assessment component of the Pakenham East Branch Sewer. The assessment included calculating groundwater inflow rates into trenches using an analytical model approach.

Senior Hydrogeologist | Numerical groundwater model, Melbourne, VIC | Program Alliance (SPA) "AWP1" | 2019

A preliminary dewatering design for the excavation and construction works was completed using a 2D SEEP/W model to assess the effectiveness of a horizontal bore to dewater to below the base of the excavation within a ninety-day period, and to predict dewatering discharge rates. An independent review of the preliminary dewatering design was completed by developing a local conceptual hydrogeological site model, based on the available hydro-stratigraphic information, which included bore completion logs, aquifer test data, and groundwater level information. A local 3D MODFLOW groundwater model was then developed for the Mentone site to verify the 2D SEEP/W assessment.

Senior Hydrogeologist | PFAS groundwater investigations, Katherine, NT | Tindal Air Force Base 2018

Drilling and bore construction for PFAS investigations. Pumping test analysis and results using the software package AQTESOLV. Well network design using AnAqSim software and analytical equations to determine well spacing and network design for a PFAS treatment process.

Senior Hydrogeologist | Pilot Wells, Oakey, QLD | Oakey Air Force Base | 2018

Pumping test analysis and results using the software package AQTESOLV. Well network design using AnAqSim software and analytical equations to determine well spacing and network design for a PFAS treatment process.

Senior Hydrogeologist | EIS MIM Landfill Expansion, Mount Isa, QLD | Mount Isa Mines | 2018

Hydrogeological assessment of existing landfill site, detailed risk assessment for landfill expansion area and assessment of environmental values.

Senior Hydrogeologist | Impact Assessment Report, Rushes Creek, NSW | Proten | 2016

Groundwater assessment and potential groundwater impact report for the Preliminary Environmental Assessment (PEA).

Hydrogeologist | Groundwater Monitoring Program Assessment, Braddon, ACT | SESL Australia | 2015

Review and report on groundwater monitoring program objectives and historic water quality results for a contaminated groundwater site.

Hydrogeologist | UCG Investigation, Gold Coast, QLD | Gilbert & Sutherland | 2014 - 2016

Underground Coal Gasification groundwater impact assessment including hydrogeological evaluation and technical reporting.

Hydrogeologist | Groundwater Impact Assessment, Armidale, NSW | URS | 2011

Hydrocarbon contaminated land impact assessment, groundwater monitoring and reporting.

Geothermal

Senior Hydrogeologist | Geothermal Assessment, Pacific Dunes, QLD | Pacific Dunes Golf Course | 2019

Geothermal assessment and characterisation of the local hydrostratigraphy at the Pacific Dunes site to describe the aquifer parameters, aquifer yields, aquifer water quality and regional geothermal gradient.

Engineer / Operator | Geothermal exploration and operational steam field monitoring and testing, Taupo, New Zealand | Mighty River Power | 2005 - 2011

Exploration and resource assessment for geothermal fields named Mokai, Rotokawa, Kawerau and Nga Awa Purua. Including well test design, wire line logging, completion testing, output testing, production testing, drill stem testing, tracer testing, field and resource compliance monitoring, database management, telemetry installation, project management, data management and interpretation, detailed technical reporting. Rotokawa Geothermal Power Station operator.

January 2025

Appendix B

Maules Creek Continuation Project

Social Impact Assessment

Peer Review

Maules Creek Continuation Project:
Peer review of Social Impact Assessment

Prepared by Dr Richard Parsons, August 2025

Executive Summary

This Peer Review critically evaluates the SIA Report prepared by Square Peg Social Performance as part of the Environmental Impact Statement for the proposed *Maules Creek Continuation Project*, SSD-63428218. For this purpose, the SIA has been independently assessed using a framework developed by the author for DPHI in 2023. The review sought to identify any significant methodological errors, any omissions or misrepresentations, and any inadequate responses (mitigations and enhancements).

The author is an independent social scientist, and was DPHI's SIA Specialist from 2016-2022. He is also a Certified SIA Practitioner through the CEnvP scheme. The review has been undertaken in line with the SIA guideline, and in consideration of the *EIANZ Guidance note for ethical practice in undertaking peer reviews*.

This review finds that the negative social impacts of the project outweigh the positive, on the basis that:

- Several aspects that could materially affect the balance of social impacts have been omitted from consideration, including:
  - social impacts of the project's contribution to climate change
  - evidence and insights (via primary research and engagement) on how local residents have experienced the mine's presence to date, and how they will experience the project should it be approved
  - consideration of distributive equity
  - likely impacts on First Nations culture in the locality
  - negative impacts of employment in mining
  - gender equity and impacts on vulnerable groups
  - proper consideration of any social impacts in the categories of:
    - way of life
    - health and wellbeing
    - decision-making systems
  - analysis of how neighbours currently experience noise, dust, blasting, visual disturbance, and groundwater impacts.
- Any benefits will accrue to current generations only, while burdens will be experienced by both current and future generations.
- The supposed benefits are principally economic and would accrue to private interests, not to public or shared (social) interests.
- Adverse and ongoing impacts on people's physical and psychological health and wellbeing, community cohesion, and sense of place would be experienced disproportionately by those living closest to the mine, while benefits would accrue to those who are less exposed to the harms and who live further afield.
- Continuation of the mine is likely to cause continued population decline in Maules Creek, potentially threatening its viability as a community.
- Lack of transparency on evaluation of magnitude obfuscates the methodological process and justification for each rating, and leaves the evaluations of significance unreliable. In general, positive impacts appear to be exaggerated and negative impacts downplayed in terms of significance.
- The proposed response measures are not tangible, durably effective, or enforceable, and will not alter likely impact significance because they are largely recommendations or aspirations.
- Extending the closure date would prolong employees' and suppliers' dependence on mining for their livelihoods, rather than encouraging long-term resilience through skills transfer and diversification.

1. Context

1.1. Social impact assessment (SIA) in NSW

Proposed State significant projects are required to consider how they may affect people – both positively and negatively – whether directly, indirectly, and/or cumulatively. Identifying and analysing these social impacts helps to inform responses that aim to avoid, mitigate or reduce negative impacts and to enhance positive impacts (SIA Guideline, 2023, p.7).

The consent authority is required to consider social impacts in the locality, and to consider the public interest. The public interest includes the object of promoting the social and economic welfare of the community, and the object of ecologically sustainable development, which requires effective integration of social, economic, and environmental considerations in decision-making (*Environmental Planning and Assessment Act 1979 No 203, S4.15(1)(e)*).

1.2. Purpose of this review

This peer review is not another SIA; rather, it critically evaluates the SIA Report prepared by Square Peg Social Performance as part of the Environmental Impact Statement (EIS) for the proposed *Maules Creek Continuation Project*, SSD-63428218. Where necessary to better understand likely social impacts, and to cross-reference with other aspects of the project, the review has referred to other documents.

Four telephone interviews were conducted with nearby landholders to provide further insight. Interviewees were referred from Maules Creek Community Council; while this small selection cannot be representative of the whole community, discussions suggested that the interviewees held a range of views towards the proposal, some positive and some negative.

This review focuses on both the adequacy of the SIA process and methods in applying the provisions of the guideline, and the content of the SIA relative to the likely social impacts of the proposal, including social impacts that may flow on from other relevant matters.

The review is limited in scope, owing to the time constraint presented by needing to be completed during the public exhibition period. It aims to identify any material shortcomings such as:

- any significant methodological errors;
- any omissions or misrepresentations in the identification of likely social impacts;
- any inadequate responses (mitigations and enhancements) that fall significantly short of the requirements in the SIA guideline, particularly whether they are proportionate to likely impacts.

1.3. Authorship declaration

This review was prepared by Dr Richard Parsons CEnvP (SIA), an independent social scientist. Dr Parsons was DPHI's SIA Specialist from 2016-2022, and led the technical development and implementation of the SIA guidelines from 2016-2022. He was also the first person globally to achieve SIA certification, in 2023, and currently is one of only two Certified SIA Practitioners in Australia.

This review is based on *impartial and independent* analysis of the project SIA. While social science analysis inevitably involves interpretations that can be contested, the findings have not been unduly influenced or altered by any third party.

To ensure methodological rigour combined with ethics, the review has been conducted in accordance not only with the SIA guideline, but also with new guidelines expressly for this purpose: the *EIANZ Guidance note for ethical practice in undertaking peer reviews*, endorsed by the EIANZ Board on 7th May 2025. Importantly, this guidance notes that peer reviews should "give honest and fair professional criticism." Consistent with procedural fairness, therefore, the author of the SIA Report was invited to discuss the project, but was contractually unable to do so. Any critique of the SIA is therefore based on the author's professional judgement of the evidence available.

2. Findings

The peer review is structured according to a framework originally developed in 2023 to support DPHI (then DPE) Assessment Officers in reviewing SIAs internally. The framework examines 13 attributes of an SIA in accordance with the provisions of the SIA guideline. For each question, a summary rating level is provided, followed by analysis and, where appropriate, recommendations for action. The meaning of each rating level is:

1 = inadequate

2 = fair

3 = meets minimum requirements

4 = high

5 = very high

See the Appendix for a full explanation of the evaluation method.

1. How well structured and readable is the document?

Rating = 5

The SIA Report is structured appropriately and is readable, and the length is appropriate.

2. Does the SIA meet the requirements for authorship?

Rating = 4

Daniel Holm is a suitably qualified and experienced practitioner, and meets most of the requirements in the SIA guideline (p.33). The only exception is that there is no explanation of how the SIA Report meets the following provision: "Safeguards should be put in place, and documented, to ensure that the assessment and the outcomes provide an impartial assessment and avoid potential conflicts of interest" (SIA guideline, p.33).

3. Is the SIA evidence-based, applying appropriate social science methods?

Rating = 3

The SIA process appears to align with the guideline's suggested methodological approach, including the consideration of the 'no-go' scenario. It has used a range of data sources and methods, and acknowledges some (but not all) limitations. However, some evidence is missing.

4. Is the social locality a reasonable representation of the spatial distribution of likely social impacts?

Rating = 3

The identification of social locality appears reasonable, and a distinction is made between primary and secondary localities. However, subsequent to preparation of the SIA, the International Court of Justice[1] has found that states are legally obliged to prevent harms caused by climate change, both inside and outside their boundaries. From a social impact perspective, the relevant consideration is the increasing exposure that climate change presents – particularly for vulnerable communities – to extreme weather events such as cyclones, flooding rain, extreme heat, and drought.

On this basis, for projects that involve fossil fuel exports being burned overseas, it could be argued that the broader (secondary or perhaps tertiary) social locality can be defined to include communities globally that are particularly exposed to harm, for example low-lying Pacific Islands.

See further comments in response to Q.5.

5. Is the social baseline comprehensive and appropriate?

[1] https://www.icj-cij.org/sites/default/files/case-related/187/187-20250723-adv-01-00-en.pdf

Rating = 2

The social baseline initially appears fairly comprehensive and includes some helpful analysis alongside the data. However, the occasional grouping (e.g. Fig.29) of the small populations of Maules Creek (87 at 2021) and Harparary (47) communities with the much larger population of Boggabri (1,203) is problematic from an analytical point of view as these localities are quite different demographically. We should expect to see much more evidence of how people in these places have experienced the mine *differently*. The SIA guideline (p.21) clearly states that disaggregation is sometimes necessary to understand local experiences. In the absence of reliable data, the SIA could have used more first-hand, qualitative insights.

The SIA Report (p.23) implies that figures from smaller communities are sometimes omitted because of the need to protect anonymity; however, this means that the SIA lacks some analysis that would help the reader (and the consent authority) to understand the communities that are most directly affected. For example, the absence of data on long-term health conditions (p.49) is justified on the basis that such data are unreliable owing to small values; however, it would be better to provide the data with this caveat rather than not provide it at all. Additionally, lack of secondary local data could be addressed by using more primary evidence from interviews with people in Maules Creek and Harparary. Without these local insights, we do not know whether those living closest to the mine are experiencing different health and other outcomes.

Some figures (16 and 17) contain incomplete information by providing figures at the LGA level only (i.e. for Narrabri and Gunnedah. This aggregation of data masks the relatively low socio-economic status of Boggabri. However. Figures 18 and 19 compensate for this with SEIFA scores.

The SIA Report provides some commentary on vulnerability (p.51), a critical consideration in SIA.

Recommendation: Seek comprehensive, qualitative evidence of how the most directly affected people have experienced the mine to date. Revise the social baseline in line with a broader definition of social locality (as above in response to Q4), to include consideration of the project's contribution to climate change (see also responses to Q6 below).

6. Are there any material omissions in the SIA?

Rating = 1

There are material omissions regarding:

- **Social impacts of the project's contribution to climate change** – see details in response to Q.7.
- **Inclusivity of local residents in engagement** – see details in response to Q.8.
- **Disaggregated analysis at the local level** – see details in response to Q.5.
- **Distributive equity** – see details in response to Q.7.
- **First Nations culture** – the SIA Report notes that the proportions of people who identified as Aboriginal or Torres Strait Islander or both in the social localities in 2021 are significantly higher than the NSW average. This statistical fact warrants deeper analysis, in particular to understand the 'intangible' dimensions of cultural identity and value, and the likely impacts on this group. Given the fundamental attachment that First Nations people experience between landscapes, water and culture, it is important to understand how Gomeroi people locally have experienced the mine, and how they expect to experience continued mining activity, not only in relation to the economic opportunities it has provided but also in relation to its impacts on their culture. The impact assessment section also confines culture to physical sites, overlooking cultural values pertaining to ongoing impacts on the landscape (see also response to Q.9.)
- **Negative impacts of employment in mining** – see details in response to Q.13.
- **Gender equity and impacts on vulnerable groups** – see details in response to Q.7.
- **Way of life, health and wellbeing, and decision-making systems** – the Report (p.53) argues that no material impacts in these categories were identified. Given that SIAs for nearly every mining project would identify impacts in these categories, this assertion is difficult to accept without substantiation. This suggests that several impacts may have been overlooked, and/or – for impacts that cross multiple categories – that certain aspects of other impacts have not been properly considered.

7. Does the SIA consider the principle of distributive equity and how different groups may be disproportionately affected by the project?

Rating = 1

Distributive equity or justice "concerns the just distribution of environmental benefits and environmental burdens of economic activity. Distributive justice is promoted by giving substantive rights to members of the community of justice to share in environmental benefits (such as clean air, water and land, a quiet acoustic environment, scenic landscapes and a healthy ecology) and to prevent, mitigate, remediate or be compensated for environmental burdens (such as air, water, land and noise pollution and loss of amenity, scenic landscapes, biological diversity or ecological integrity). Issues of distributive justice not only apply within generations (intra-generational equity) but also extend across generations (inter-generational equity)."[2]

The SIA Report (S5.4) discusses distributive equity, noting both intergenerational and intragenerational dimensions. However, the findings are contestable.

- *Climate change – an intergenerational* <u>*and*</u> *intra-generational issue*

From an analytical point of view, and from a social impact perspective, it is important to note that intergenerational and intragenerational equity need not be mutually exclusive. Climate change presents a clear example. In SIA, we must consider how people across generations will differently experience the climate change-related impacts of the project, and we must also consider how people are already experiencing climate change-related impacts, such as increasing intensity and frequency of extreme weather events. While it is not the task of SIA to interpret climate science, SIA performs the unique and important role of assessing the *social* dimensions (today and into the future) of climate change-related impacts of the project.

For example, while there is no unequivocal evidence that the mine is causing groundwater depletion, some local residents have experienced such depletion, and it is reasonable to predict that:

- ongoing climate change will exacerbate this problem;
- ongoing extraction of groundwater by the mine for a further 10 years will contribute to that depletion;
- depletion will adversely affect people whose lives (everyone) and livelihoods (agricultural operations) depend on reliable access to water of reasonable quality at an affordable price.

The SIA Report does not assess these social impacts, or social dimensions of other climate change-related impacts such as increased intensity and frequency of bushfires – this is a major omission. The next two subsections discuss intergenerational and intragenerational aspects in turn.

- *Intergenerational equity*

The Report claims that Project extension would not "compromise the ability of those future generations to meet their needs" (p.69). In contrast, it is reasonable to propose that extending any fossil fuel project does precisely that, by adding to greenhouse gas emissions that exacerbate the impacts of extreme weather on people (a required consideration in the SIA guideline, p.17).

Of course, the magnitude of emissions from this project relative to global emissions is relatively small, but nonetheless they make a contribution: "The global problem of climate change needs to be addressed by multiple local actions to mitigate emissions… climate change is caused by cumulative emissions from a myriad of individual sources, each proportionally small relative to the global total of GHG emissions, and will be solved by abatement of the GHG emissions from these myriad of individual sources"[3]

This matter was reinforced very recently by the decision in the NSW Court of Appeal to rule the Independent Planning Commission's approval of the Mount Pleasant Optimisation Project invalid,[4] on the

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[2] Gloucester Resources Limited v Minister for Planning [2019] NSWLEC 7. Available at: https://www.caselaw.nsw.gov.au/decision/5c59012ce4b02a5a800be47f, paragraph 398.

[3] Ibid., paragraph 515-516.

[4] Denman Aberdeen Muswellbrook Scone Healthy Environment Group Inc v MACH Energy Australia Pty Ltd [2025] NSWCA 163. Available at: https://www.caselaw.nsw.gov.au/decision/198358b0f4e9e10f2b50c718

basis that the IPC approval failed to consider the impact of all of the project's greenhouse gas emissions on the *local* environment. While this decision is now subject to a review in the Land and Environment Court, the relevance for SIA is that the local environment is a material matter for consideration in terms of it constituting people's surroundings (one of the eight categories in the SIA guideline).

Intergenerational impacts are not restricted to consideration of the social dimensions of climate change. As the Rocky Hill judgement noted, "The extraction of finite natural resources for the economic benefit of people today necessarily implies a burden on future generations, for the simple reason that the resource has been used, and the social and environmental legacies will remain for future generations."[5] Furthermore, prolonging an industry in decline is inconsistent with the notion of a just transition, because delaying transitional planning and action places a disproportionate burden on future generations to act and adapt more quickly at a later date.[6]

To this extent, the proposal necessarily presents intergenerational inequities that are not discussed in the SIA Report. In short, any benefits will accrue to current generations only, while burdens will be experienced by both current and future generations.

- *Intragenerational equity*

While intergenerational equity is concerned with distribution across time, intragenerational equity is concerned with spatial distribution (between different places or geographies) and social distribution (between different groups, with a particular focus on vulnerable groups).

The Report acknowledges that "the Project would affect different social groups differently" (p.69), but claims that it is "unlikely that any negative impacts would disproportionally impact vulnerable groups" (p.69), although no vulnerable groups are specifically identified and the only evidence for this claim is anecdotal. To that extent, it is impossible to verify this claim regarding social distribution.

Historical evidence suggests that the benefits of mining projects have tended to flow largely to private interests such as the company owners, while vulnerable groups disproportionately experience negative impacts. In particular:

  - First Nations people, who represent a significantly higher proportion of the population in the social locality compared with the NSW average, are not discussed here despite constituting a historically marginalised group who have experienced considerable harm from mining, while generally seeing few benefits. Discussions for this review also indicated that there is no First Nations representative on the Community Consultative Committee, a situation that is likely to entrench historical marginalisation.
  - The Report does not mention distributive equity by gender. Given that mining-related jobs tend to flow predominantly to men, and that women are more vulnerable to the presence of mine workers, extending the mine's operation would potentially exacerbate gender inequities in the locality. There are no proposed measures to address this impact.
  - The Report does discuss concerns around groundwater impacts, but not from a social or equity perspective. Evidence from the interviews for this review indicates an ongoing concern regarding the mine's use of groundwater, and the impact of this use on other users' ability to access water over time. Regardless of technical findings (which some may not trust, and which may be subject to revision or disagreement), the equity issue is that, should the project be approved, the reality and/or perception of inequitable allocation will continue.
  - Other vulnerable groups are likely to include lower socio-economic groups, older people, young people, and people with pre-existing health conditions (e.g. respiratory and cardiovascular disease). Impacts on these groups is not discussed and there are no response measures.

On spatial distribution, the Report acknowledges that "nearby landholders would be more affected by negative amenity related impacts", as is typical with mining projects. However, by assuming that these impacts are confined to 'amenity', the Report downplays other social impacts that are commonly experienced disproportionately by those living near coal mines. These include adverse and ongoing impacts on people's physical and psychological health and wellbeing, community cohesion, and sense of

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[5] Ibid., paragraph 404

[6] Edwards, G.A.S. et al. (2022). 'Towards a just transition from coal in Australia?' Sydney Environment Institute and Global Environmental justice Group.

place. Interviews for this review indicated a general sense that the mine had caused and continues to cause community divisions.

The engagement outcomes section (pp.19-20) cites negative experiences of community decline and conflict in Maules Creek since the arrival of the mine. It is reasonable to assume that, should the extension proceed, such experiences would continue. In other words, the benefits flowing from economic opportunities would largely accrue to people outside the locality where most adverse impacts are already being – and would continue to be – experienced, presenting a distributive (spatial) inequity.

In contrast, the likely beneficiaries of the project include company owners, investors, financiers, employees, contractors, suppliers, and state and local governments. People within these groups are not vulnerable or disadvantaged, and are likely to live sufficiently geographically distant from the Project so as to be less affected by the adverse impacts of the Project.

In these ways, should the project be approved, both the social and spatial (i.e. intragenerational) distribution of both positive and negative impacts (benefits and burdens) would be inequitable.

Recommendation: Neither the intragenerational inequities resulting from social distribution of benefits and burdens, nor the intergenerational inequities resulting from natural resource extraction and their contribution to climate change, can be proportionately mitigated or adequately managed. Continued population decline in Maules Creek could be addressed if the Project were not approved, as long as appropriate long-term planning measures were put in place.

If the project were approved, for some community members compensatory measures could be co-developed in response to spatial inequity; for example, in response to concerns regarding groundwater (p.20), a domestic water pipeline could benefit the Maules Creek community. While this measure would not mitigate the above impacts, Whitehaven could provide funding for the community to commission:

- an independent feasibility study for domestic and stock water pipeline;
- an independent social assessment to evaluate the potential value of such a pipeline to landholders and the community.

8. Is the SIA engagement meaningful and effective?

Rating = 2

The SIA engagement (often referred to in the SIA Report as 'consultation', which is slightly confusing as it has a narrower meaning in public participation practice) appears initially to have been relatively extensive. The SIA Report explains the process fully, and much engagement appears to have comprised interviews and meetings, rather than relying on surveys which tend to be relatively superficial as a research tool. The use of direct quotes in the Report is helpful.

However, it is noteworthy that only one impact was added during the SIA phase in response to findings from engagement – this raises the question of how much the engagement actually contributed to identification of impacts. It is normal to expect a genuine engagement process to elicit material issues that were not identified by scoping and desktop work. (The point on p.53 that the CCC confirmed the identification of impacts is some comfort, but not conclusive since the representativeness of CCCs is often questionable.)

It is also concerning that, given the objective to "Prioritise stakeholders that are likely to be directly affected" (p.14), apparently only six meetings were held with nearby landholders. According to the social baseline, the 2021 population of Maules Creek was 87 and of Harparary was 47, making a total of 134 directly affected people even if we exclude Boggabri. Given that local residents are the most directly affected people, meeting with only six households seems a *significant shortfall of representation* through engagement activities. This shortcoming is then manifested in the impact evaluations, which rely heavily on the findings of other technical reports without consideration of lived experience – for example, the evaluation of visual impacts (p.58) accepts the Landscape and Visual Impact Assessment findings without any input from engagement outcomes, which would have informed *perceived* impact significance. It is also not clear that all relevant community organisations were involved in the SIA engagement – for example, there is no mention of the Maules Creek Branch of the Country Women's Association/

Another concern is the presence of a Whitehaven representative at some of the interviews. This is not normal SIA research practice, as it can prevent participants from speaking freely about their concerns for fear of reprisals, especially if they are beneficiaries of company procurement, employment, or community investments. To that extent, it is possible that the engagement outcomes have been inadvertently influenced by the proponent.

Recommendation: The social impacts of the project cannot be reliably evaluated because we do not know how those likely to be most directly affected will experience the project.

9. Does the SIA provide an evidence base and credibly evaluate all dimensions of significance (likelihood, extent etc.)?

Rating = 2

The impact assessment and evaluation sections (5.2 and 5.3) and tables (11 and 12) provide a descriptive analysis of predicted impacts. However, some of the evaluations of significance are not credible – many of the negative impacts appear to be downplayed and the positive impacts exaggerated. (See responses to Q.13 below for an example regarding employment and business benefits.) This leads to a distorted impression of the overall balance of positive and negative impacts.

In evaluating significance, Tables 11 and 12 provide a combined or aggregate evaluation of magnitude for each impact, without explaining the *dimensions* of magnitude in each case. The guideline (Technical Supplement, p.11) states that the SIA Report "should explain and justify the logic, evidence and assumptions used to complete the evaluation" for each impact, whether positive or negative.

The five dimensions of magnitude (with language adjusted from conventional risk assessment to encompass both positive and negative impacts) are: *extent, duration, severity or scale, sensitivity or importance, and level of concern/interest*.

These dimensions are noted in Appendix C (p.100) of the SIA Report, but their application in the SIA evaluation is not explained or justified. Some of the impact narratives imply some of these dimensions (for example concern about groundwater impacts appears to weigh on the magnitude rating, p.59), but they are not clearly assessed, and none are included in the tables. This obfuscates the methodological process and justification for each magnitude rating, and leaves the evaluations themselves unreliable.

In terms of the evidence for, and credibility of, specific impacts:

- **Livelihoods** – these impacts are discussed in response to Q.13.
- **Surroundings** – the evaluation of the magnitude of noise, dust, and lighting impacts on nearby landholders as minor is questionable. It seems reasonable to imagine that the prospect of another 10 years of these impacts may constitute a tipping point in some people's capacity to cope (resilience). Interviewees for this review suggested some concerns regarding these matters, and a weariness and resignation at the prospect of another 10 years of these impacts. One described the reflection in the sky from the site's lighting as similar to the sky above a city. However, the SIA does not provide first-hand evidence of how these neighbours currently experience noise, dust, blasting, visual disturbance, and groundwater. Such evidence would help to substantiate the likely magnitude ratings, considering each dimension as explained above.
- **Culture** – the assessment (p.59) misunderstands culture for the purposes of SIA by referring only to cultural *sites*, and neglects to consider cultural practices and values. The SIA guideline (p.19) requires proponents to assess culture in terms of "shared beliefs, customs, practices, obligations, values and stories, and connections to Country, land, waterways, places and buildings", specifically to differentiate this matter from cultural *heritage* assessment.

Recommendation: The merits of the project should be evaluated on the basis that some of the evaluations of significance are not credible, and that the overall balance of impacts is likely to be more negative than asserted in the SIA Report.

10. Does the SIA propose adequate and appropriate response measures?

Rating = 1

The SIA guideline states that mitigation measures should be *tangible*, *deliverable* by the proponent, and *durably effective*. To understand these qualities more clearly, we can refer again to Preston,[7] who

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[7] Gloucester Resources Limited v Minister for Planning [2019] NSWLEC 7. Available at: https://

identifies that mitigation measures should be *specific, achievable, and enforceable commitments* rather than recommendations or aspirations, and should directly address the relevant impacts.

For the purposes of this review, each proposed measure in Table 11 has been examined against these criteria.

Proposed measure	**tangible commitment**	**deliverable by the proponent**	**durably effective**
Stakeholder/Community Engagement Strategy	no	yes	no
Community Investment Strategy	no	yes	no
Local Employment and Training Strategy	no	yes	no
Whitehaven Diversity Policy	no	yes	no
Biodiversity Management Plan	no	yes	no
Air Quality and Greenhouse Gas Management Plan	no	yes	no
Noise Management Plan	no	yes	no
Blast Management Plan	no	yes	no
Waste Rock Emplacement Strategy	no	yes	no
Rehabilitation Management Plan	no	yes	no
Water Management Plan	no	yes	no
Aboriginal Archaeology Cultural Heritage Management Plan	no	yes	no
Housing Investment Strategy	no	yes	no
Whitehaven Housing Stock Management	no	yes	no

In short, of the response measures:

- seven are plans,
- five are strategies,
- one is a policy,
- one is 'management'.

None of these is a *tangible* commitment because they are merely documents or frameworks rather than specific measures or actions. As documents, they are all *deliverable* by the proponent, in principle, because they do not depend on a third party. None of them is *enduring* because a document alone cannot be durably effective at responding to an impact.

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www.caselaw.nsw.gov.au/decision/5c59012ce4b02a5a800be47f, paragraph 418.

On this basis, none of the measures in Table 11 can be said to alter the significance rating, so the SIA Report is misleading in asserting that residual significance will be changed by these measures.

Table 14 provides more detail; for example, "advertising employment opportunities locally" (p.72), and "conduct joint inspections with community members of Whitehaven-owned housing to determine suitability for occupation" (p.74). However, none of these meet the criteria:

- Advertising jobs locally may support a desirable outcome but does not itself mitigate the impact.
- Conducting joint inspections is part of monitoring, not mitigation.

Many measures clearly lack enforceability because they are recommendations or aspirations:

- "Consider strategies for supporting employment opportunities for spouses and partners for relocating workers" (p.72);
- "Consider funding relocation incentives for early learning or community services workers" (p.73);
- "Consider supporting expansion of housing in Narrabri, Gunnedah and Boggabri, with a focus on affordable housing, should the housing market remain constrained when the Project proceeds" (p.75);
- "Encourage business diversification" (p.76).

Many measures involve 'engagement', which is also not an enforceable commitment, although it can help to address relationship-related matters such as perceived lack of communication, information, or trust.

Recommendation: The SIA Report cannot be accepted without *tangible*, *deliverable* and *durably effective* response measures.

11. Are the monitoring and management arrangements appropriate and proportionate?

Rating = 1

The SIA Report does not include a specific monitoring program. Two monitoring measures are proposed in Table 14 in relation to housing and groundwater, but there is insufficient detail to determine whether the monitoring program as a whole would be adequate. The recommendation for "Participatory monitoring of groundwater levels" (p.75) would be desirable if implemented effectively.

Recommendation: Prepare a monitoring and management framework in accordance with the guideline (Technical Supplement, p.18). For each impact, identify:

- the desired outcomes in social terms
- the indicator(s) that will be used to monitor change
- the targets against which performance will be assessed
- the methods that will be used to monitor the social impact
- the frequency of monitoring
- the people responsible for monitoring
- the methods that will be used to respond to monitoring results.

Include provisions for participatory monitoring of groundwater levels, including tangible measures to remedy material depletion.

Also propose arrangements for:

- *a social incident notification and reporting* process, including mechanisms to respond to complaints, breaches and grievances or to inform the community;
- *ongoing and independent analysis* of social risks and opportunities arising from the project, including timing and frequency of reviews.

12. Is it an impartial assessment?

Rating = 2

When reviewing an SIA report, an indication of impartiality is the relative treatment of positive and negative impacts, including the way in which language is used to either downplay or exaggerate impacts. Where SIAs are commissioned and paid for by the proponent (as they typically are), there is a well-known risk that the findings will be biased in favour of proponent interests. This risk can derive from direct pressure, or from unconscious bias, or both. An apparent lack of impartiality can make it difficult to have confidence in the SIA findings, especially where there is already low trust among community members.

Interviews with community members for this review, combined with Whitehaven's record of non-compliance incidents and breaches at Maules Creek and other sites,[8] suggest that trust is indeed an ongoing challenge. Some spoke of good relations with site staff, but low trust in the company more broadly. As one said, "The guys on the ground are fine, but they're only the messengers." In this context of suspicion regarding Whitehaven's integrity, impartiality in an SIA process is critical.

There is nothing in the SIA Report to suggest an *intentional, conscious* bias. The SIA Report includes discussion and analysis of both positive and negative impacts. For example, the decline in students at Fairfax School, and the incremental acquisition of property, are discussed as significant concerns and causally linked to the mine. However, interviews for this review suggest that the gravity (or magnitude) of these impacts on the community has been downplayed. These are complex and multidimensional issues whose impact accumulates over time, affecting people's connection to place.[9]

Importantly, there is no explicit commitment to impartiality, nor any discussion of how the SIA process sought to avoid conflicts of interest. The consultation materials reproduced in Appendix B show a clear tendency to publicise potential Project benefits but not any adverse impacts. While these materials appear to have been developed by the proponent, not by the SIA practitioner, the use of them may have unduly influenced how people responded during engagement. Commentary on engagement around the Project not proceeding (p.22) is very sparse, so it is not clear how much opportunity participants had to reflect on the implications and impacts of this alternative scenario. Finally, the finding of material omissions (see response to Q.6) suggests that impartiality is implicitly compromised.

Recommendation: The SIA Report should be read in the knowledge that it is promoting the proponent's private interests rather than the public interest.

13. Does the SIA demonstrate it has resulted (or will result) in better social outcomes?

Rating = 2

The SIA Report (p.55) implies that the Project would result in better social outcomes principally via:

- "Continued opportunities for businesses to supply goods or services to the Project, thus contributing to a diversified and resilient business community"
- "Continued provision of employment opportunities for residents, thus contributing to socio-economic wellbeing."

It is helpful that the Report identifies social benefits in terms not just of numbers of jobs, but as flow-on impacts to livelihoods and wellbeing, categories that align with the guideline. Nevertheless, the claims warrant closer scrutiny.

- *Business opportunities*

The nature of any benefit here appears to be principally economic rather than social. That is, private business owners are predicted to experience continued revenue over the continuation period. Importantly, the SIA does not claim that there would be any substantial *new* opportunities, only that they would continue. Nevertheless, from a social perspective, this has a negative dimension that the SIA does not discuss – that is, the extension of the status quo could actually damage the prospects for a "diversified and resilient business community" over time, as business owners would perceive no need to adapt to changing circumstances for another 10 years, or longer if there is a further continuation. Instead, they may remain partly or wholly dependent on one industry (mining) for their livelihoods, exposing them to shocks as the industry is likely to decline during this period.

- *Employment opportunities*

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[8] https://www.lockthegate.org.au/whitehaven_coal_shame_file

[9] Askland, H.H., 2018. A dying village: mining and the experiential condition of displacement. Extr. Ind. Soc. 5 (2), 230–236. https://doi.org/10.1016/j.exis.2018.02.007

The SIA Report notes that the Project would generate an increase of the operational workforce from 865 to an average of approximately 940 people (i.e. 75 people, plus up to approximately 35 construction workers in the first year of the Project. It cites income figures from the Economic Assessment, and anecdotal evidence of the value that people (at least in the regional towns, if not in Maules Creek or Harparary) place in employment. Several problems emerge in the social significance attached to this matter:

- The Report acknowledges that the scale of this impact represents only "a marginal increase in local employment opportunities" (p.56), yet then evaluates the impact "as a *moderate* consequence, resulting in a *high* significance" (p.56). Applying the guideline, it could be reasonably argued that the significance is as follows:
  - Likelihood = likely (rather than almost certain, since it is problematic to be almost certain about something that is 10 years away, and operational efficiencies may reduce labour needs over time)
  - Extent = local and regional
  - Duration = 10 years from 2035-2044
  - Scale = mild (i.e. marginal, as the Report acknowledges)
  - Importance = moderate (since some people value this matter highly)
  - Level of interest = moderate (assuming people who currently benefit are very interested, while others are not).

  This evaluation suggests a mild improvement, and an overall a magnitude rating of *minor*, resulting in <u>overall significance of *medium*</u>.
- As with business opportunities, the impact here is less one of change and more one of continuity (i.e. little impact *per se*). Again, this carries the social risk of prolonging employees' dependence on mining for their livelihoods, rather than encouraging long-term resilience through skills transfer and development.
- The Boggabri community has lower SEIFA scores, higher rates of unemployment, and lower rates of school completion than nearby Narrabri and Gunnedah. At the same time, Boggabri appears to host the greater number of non-resident mine workers (p.46). Yet few MCCM jobs appear to be held by residents of Boggabri (the actual number of jobs held by residents is not disclosed), so claims of employment benefits flowing to "people previously experiencing disadvantage or poverty" (p.56) may be exaggerated.
- The SIA Report also notes that, if the project were not approved, 1,300 operational jobs (approximately 10% of the labour force across the region) would be removed within a short period of time. However, the mine is already approved to operate to 31st December 2034, meaning ten years until scheduled closure currently. This would seem to present a very reasonable adjustment period, particularly for an activity known to have an end date.

Further problems with relying on the SIA's analysis of employment impacts as delivering significant social benefits are:

- Anecdotal evidence from the interviews for this review suggests a community perception that it is very difficult to obtain a job at the mine unless you are in favour with the 'right' people, with one interviewee describing the employment situation as 'incestuous'.
- The actual number of jobs held by residents of the three shires is difficult to discern due to use of percentages, inconsistent use of FTEs, and because the data do not match those in the Economic Impact Assessment (Appendix K).
- The SIA Report notes that mining is not the largest contributor to local employment in either Narrabri, Boggabri or Gunnedah, although this depends on how we interpret the largest category, 'Other' (p.40).
- The employment market is always changing. In the case of mining, change occurs due to the operation of global markets, availability of alternative resources, government policies, and changing technology. These changes will continue no matter whether the mine extension is approved or not.
- The SIA Report is unclear about the extent to which this mine's jobs are held by local (i.e. Maules Creek and Harparary) residents. This is important because adverse impacts flow disproportionally to local residents. If, say, 90% of jobs associated with this mine are not held by local residents, these workers are not reliant on the local employment markets for alternative work. No analysis is provided as to the impact of discontinuation on non-resident Whitehaven Coal workers.

    - The benefits of jobs in mining carries the implicit assumption that jobs are inherently and unequivocally positive socially. From a social perspective, what matters is the *quality* of jobs – which has several components such as how much control people have over their work[10] – and how they affect people's lives. In SIA, an increase/decrease in jobs is just one indicator of a social change in the locality, which may have both positive and negative impacts. We need to weigh both – i.e. any benefits to livelihoods and wellbeing against the risks to these workers, and the risks to the residents of the region, associated with this type of work and with project continuation – these include:
        - the local impacts of climate change-related impacts of the project;
        - impacts on community safety, especially for women living among a male-dominated workforce;
        - displacement of jobs in smaller industries that cannot afford mining wages (an ongoing issue that was mentioned in the interviews for this review, with the loss of skilled apprentices to the mining industry noted as a long-term problem);
        - loss of culture for Aboriginal employees immersed in a 'western' narrative;
        - continued population decline in Maules Creek (pp.20, 27 & 29).

On this evidence, continuation of existing jobs *per se*, plus a modest potential increase from 2035-2044 does not constitute a material social benefit, and may present some burdens by delaying support for people to adapt to the inevitable process of transition and diversification. The possibility of further continuations presents additional uncertainty.

Recommendation: To support and accelerate diversification and resilience in the locality, and consistent with a just transition, more effort should be placed on supporting the community to adapt to a post-mining future *on the basis of the current closure date*. This would include helping people to transfer existing skills and/or build new skills for emerging and future industries.

Recommendation: Should the project be approved, a review is needed on the distribution of benefits from the project, to align more closely with contemporary expectations for benefit-sharing from major developments that affect rural communities,[11] and consistent with requirements and guidelines for renewable energy developments.[12]

3. Conclusion

Having reviewed the evidence available, the negative social impacts of the project appear to outweigh the positive, on the basis that:

- Several aspects that could materially affect the balance of social impacts have been omitted from consideration, including:
    - social impacts of the project's contribution to climate change
    - evidence and insights (via primary research and engagement) on how local residents have experienced the mine's presence to date, and how they will experience the project should it be approved
    - consideration of distributive equity
    - likely impacts on First Nations culture in the locality
    - negative impacts of employment in mining
    - gender equity and impacts on vulnerable groups
    - proper consideration of any social impacts in the categories of:
        - way of life
        - health and wellbeing
        - decision-making systems
    - analysis of how neighbours currently experience noise, dust, blasting, visual disturbance, and groundwater impacts.

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[10] Churchill, B. (2025). 'Underemployment and job quality among young Australians: A gendered analysis using the HILDA survey (2009–2022)', *Australian Journal of Social Issues*; 0:1–12. https://doi.org/10.1002/ajs4.70043

[11] e.g. https://sgsep.com.au/publications/insights/community-benefit-sharing

[12] e.g. https://www.planning.nsw.gov.au/sites/default/files/2024-11/benefit-sharing-guideline.pdf

- Any benefits will accrue to current generations only, while burdens will be experienced by both current and future generations.
- The supposed benefits are principally economic and would accrue to private interests, not to public or shared (social) interests.
- Adverse and ongoing impacts on people's physical and psychological health and wellbeing, community cohesion, and sense of place would be experienced disproportionately by those living closest to the mine, while benefits would accrue to those who are less exposed to the harms and who live further afield.
- Continuation of the mine is likely to cause continued population decline in Maules Creek, potentially threatening its viability as a community.
- Lack of transparency on evaluation of magnitude obfuscates the methodological process and justification for each rating, and leaves the evaluations of significance unreliable. In general, positive impacts appear to be exaggerated and negative impacts downplayed in terms of significance.
- The proposed response measures are not tangible, durably effective, or enforceable, and will not alter likely impact significance because they are largely recommendations or aspirations.
- Extending the closure date would prolong employees' and suppliers' dependence on mining for their livelihoods, rather than encouraging long-term resilience through skills transfer and diversification.

Appendix – Review approach

This appendix explains the approach and review framework used to review the SIA. This framework was originally developed by Richard Parsons in 2023 to support DPHI (then DPE) Assessment Officers in reviewing SIAs internally. The purpose of this framework is to support a consistent approach to evaluating the quality of SIAs.

Reviewing SIAs requires an understanding of SIA methodology combined with skills in critical analysis to evaluate whether the quality is consistent with that required by the SIA guideline. Appendix C of the SIA guideline provides a series of 21 review questions that reviewers can use to evaluate quality. The review framework presented here condense those 21 questions into 13 questions, to support a more concise yet rigorous evaluation process.

Each question is rated on a scale from 1-5. While each number theoretically represents a discrete level of quality, in practice SIA quality exists on a continuum. The reviewer's task is to use their informed judgement, based on critical analysis, to rate each aspect of the SIA according to the most appropriate level. The table below explains the meaning of each rating level.

Rating	Quality	General indicators
1	Inadequate	• significant omissions • insufficient, unverified, misleading, or inaccurate data • unsubstantiated claims
2	Fair	• some material omissions • lacking some evidence • some lack of clarity and/or transparency
3	Meets minimum requirements	• minor omissions only • findings based on evidence, with some gaps • mostly clear reasoning and analysis
4	High	• minor omissions only • findings based on evidence, with no significant gaps • clear analysis and assumptions
5	Very high	• no material omissions • very clear analysis and fully substantiated claims • very clear assumptions and limitations

SIA quality evaluation

In the table below, examples of quality are provided for points 1 (inadequate), 3 (meets minimum requirements), and 5 (very high). Reviewers can infer that levels of quality lying between these points should be rated 2 or 4.

Review question	Rating				
	1	**2**	**3**	**4**	**5**
	Examples of quality indicators				
1. How well structured and readable is the document?	Poorly laid out, with an illogical structure that makes it difficult to discern likely social impacts.		Logical structure, and mostly easy to read and understand.		Clearly laid out, with a logical structure that makes it readable for a lay audience.
2. Does the SIA meet the requirements for authorship?	Authors not suitably qualified, or insufficient information about author		At least one author meets requirements.		All authors are suitably qualified persons.

	qualifications or experience				
3. Is the SIA evidence-based, applying appropriate social science methods?	Superficial analysis, lacking evidence for assertions of impacts. Selective methods.		Includes various methods, using both quantitative and qualitative analysis. Findings are supported by available evidence.		Includes references to experiences on similar projects, and research literature. All limitations and assumptions identified.
4. Is the social locality a reasonable representation of the spatial distribution of likely social impacts?	Uses arbitrary boundaries. Excludes places where people will almost certainly experience impacts.		Social locality is logical and a fair representation of likely experience. Includes a map clearly illustrating location of impacts.		Social locality is highly disaggregated.
5. Is the social baseline comprehensive and appropriate?	Data dump of irrelevant statistics. No map.		Data and analysis provide a reasonable sense of what is important to people in the locality. Identifies any vulnerable or marginalised groups. Includes a diversity of groups and different views and interests. Social indicators drawn from trustworthy sources (e.g. SEIFA).		Uses a wide range of sources to build a complete picture of the locality. Includes historical and trend analysis.
6. Are there any material omissions in the SIA?	Obvious omissions in terms of people, impacts, and/or relevant methods.		All affected groups and all material impacts included. Impacts on vulnerable or marginalised groups specifically analysed.		Includes specific focus on gender, human rights, and public health. Includes detailed analysis of cumulative social impacts and intangible impacts. Assesses social dimensions of economic changes.
7. Does the SIA consider the principle of distributive equity and how different groups may be disproportionately affected by the project?	No consideration of the distribution of impacts or equity.		Data are disaggregated to analyse difference and diversity, and to assess uneven experiences of impacts. Focus on how vulnerable or marginalised groups will be affected.		Assesses multiple dimensions of equity (gender, spatial, age, socio-economic, cultural, intergenerational, intragenerational, democratic).
8. Is the SIA engagement meaningful and effective?	SIA engagement is non-existent or superficial.		SIA engagement is proportionate to the scale of likely impacts, and its outcomes directly inform the identification and characterisation of social impacts.		SIA engagement is representative, diverse, inclusive, participatory, equitable, culturally responsive, tailored, dialogic, community-centred, and empowering.
9. Does the SIA provide an evidence base and credibly evaluate all dimensions of	Evaluation of significance lacks evidence or omits to assess some dimensions.		Evaluation of significance demonstrates evidence, and appears credible and impartial. It		Process for evaluating significance conducted in using participatory methods to collaborate with affected

significance (likelihood, extent etc.)?			includes all dimensions, both negative and positive impacts, and both pre- and post-mitigation.		communities (‘co-evaluation’).
10. Does the SIA propose adequate and appropriate response measures?	Proposed measures are unlikely to mitigate negative impacts or enhance positive impacts.		Most proposed responses are tangible, likely to be durably effective, deliverable by the proponent, directly related to the respective impact, and adequately delegated and resourced.		All proposed responses are tangible, likely to be durably effective, deliverable by the proponent, directly related to the respective impact, and adequately delegated and resourced.
11. Are the monitoring and management arrangements appropriate and proportionate?	No monitoring or management proposed (where required).		Preliminary plans or provisions included for monitoring and management. Provisions include an effective grievance and remedy mechanism, and public reporting.		Detailed plans (with indicators and targets) for monitoring, management, review and reporting. Includes clear accountabilities, and mechanisms for communities to participate in monitoring. Provision made for funds to address any legacy impacts.
12. Is it an impartial assessment?	The SIA makes highly contestable or misleading claims, exaggerating likely benefits and downplaying negative impacts.		The SIA has no material omissions, and fairly and transparently represents the likely impacts on, and views of, affected and interested people.		The SIA presents competing points of view, and provides first-hand testimony to illustrate diversity. It is peer-reviewed and signed by an independent practitioner.
13. Does the SIA demonstrate it has resulted (or will result) in better social outcomes?	Project is likely to produce little change or deterioration in people’s wellbeing. Vulnerable people may be exposed to disproportionate harm.		Some affected people, including vulnerable groups, are likely to experience improved overall wellbeing as a result of the project.		All affected people are likely to experience improved overall wellbeing as a result of the project.

Appendix C

Maules Creek Continuation Project

SIA Review – Local Perspective

Appendix C - SIA Local Perspective

Land Purchases leading to Community Fragmentation

One of the obvious impacts of land purchases for mine infrastructure, offsets and zone of affectation is the depopulation of Maules Creek This impacts the micro economy and has left the residual population with the task of maintaining a community and its social capital until the post mining era begins.

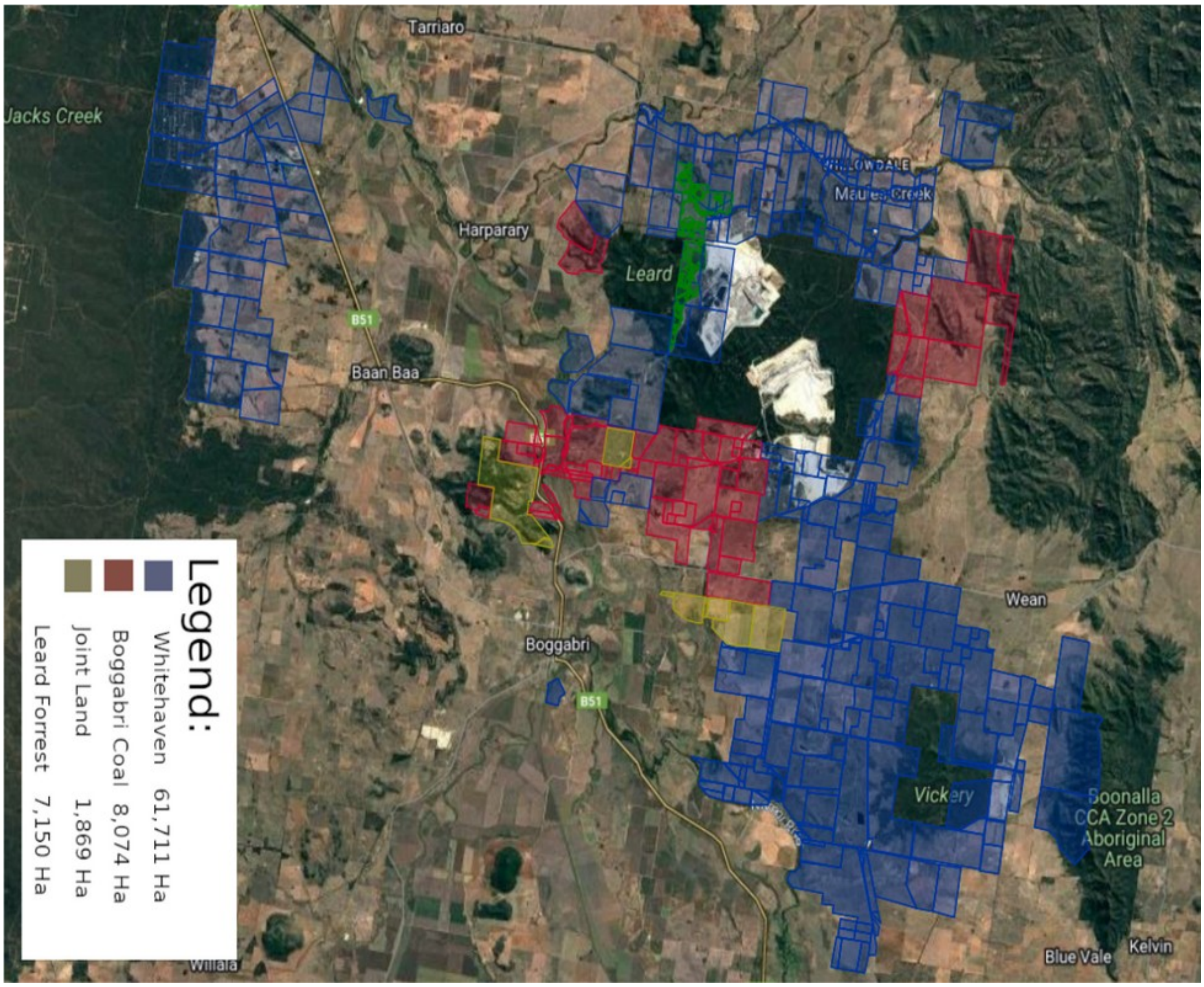
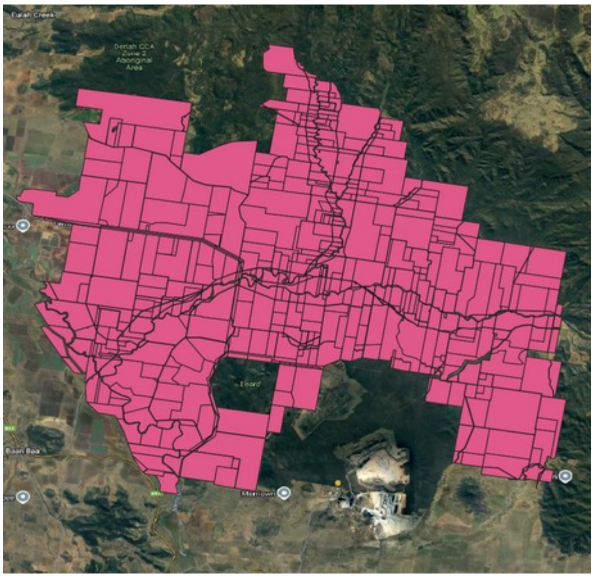


Fig 1.0 - Mine Owned Land Map

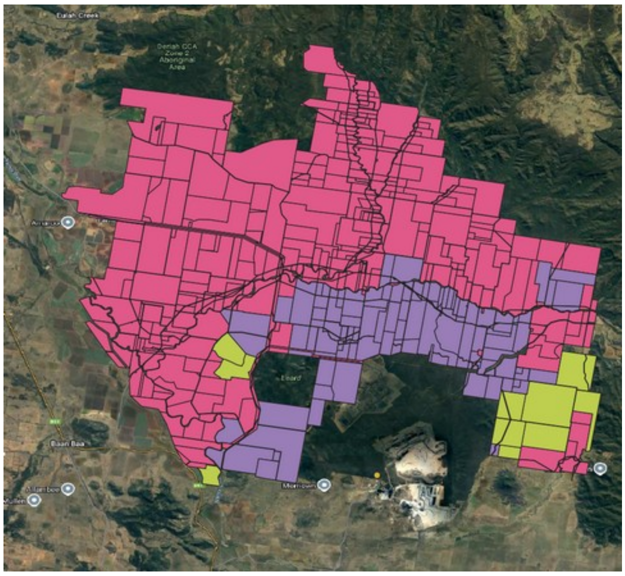
Mine Owned Land

MCCC analysis of the lot numbers in the region shows that mining companies own approximately 71,655 Ha in the Narrabri - Gunnedah area. Add the controlled areas of the Leard State Forrest and the area under control by mining is close to 80,000 Ha or approximately more than 20% of the land.

Maules Creek and Regional Land Ownership

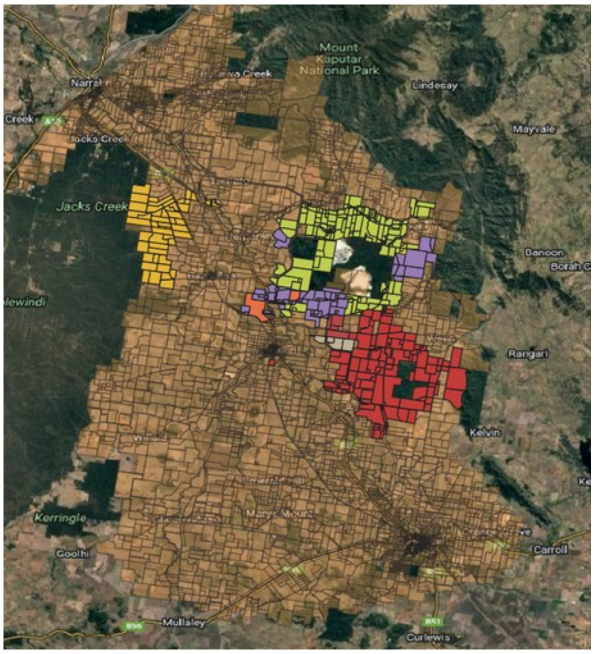


Maules Creek Valley - 52,263.78 Ha approx



Total Mine Owned Land in Maules Ck (28.6%)
- WHC (Purple) 11,734 Ha approx (22%)
- BC (Green) 3,236 Ha approx (6.2%)

Narrabri - Gunnedah Land - 371,268 Ha



Total Mine Owned Land 71,654 Ha approx (19.3%)
- WHC (Green, Yellow, Red) 61,711 Ha approx (16.6%)
- BC (Purple) 8,074 Ha approx (2.2%)
- Joint Owned (Orange) 1,869 Ha approx (0.5%)

NB: Does not incl offset lands outside of the region

Fig 1.1 Local and Regional Scale Mine Owned Land Maps

Together with the other coal mines in the Maules Creek area, coal mines have cumulatively acquired more than 28% of the local land with most of the associated residences unoccupied. In the region from Narrabri to Gunnedah, more than 19% of land is owned by mining companies. (See Fig 1.0 and Fig 1.1)

Potentially 28% of Maules Creek will be either mined and rehabilitated for native veg, or mostly set aside as offset lands permanently sterilising the majority of the proponents local land to agriculture. This is a dramatic change to the pre-mining landuse at Maules Creek that has removed people from the landscape, disrupted the micro-economy and reduced the social capital.

Groundwater Impacts

In 2018, landholders across the Maules Creek valley experienced an abrupt and widespread failure of groundwater bores, particularly in the shallow alluvial aquifer. Water levels at Elfin Crossing and surrounding properties fell precipitously, with 31 bores failing. (Appendix L – Emergency Actions taken by Residents). These impacts coincided with a sharp and unannounced increase in the mine's groundwater extraction, from less than 10 ML/year to over 576 ML/year as pit dewatering began in earnest. The company did not notify the community, provide explanations, or offer compensatory water. Instead, Whitehaven Coal publicly attributed the losses to "lack of rainfall" and "inadequate aquifer storage," denying any responsibility and rejecting community claims as "nonsensical" (Whitehaven Statement, 2019).

This rapid escalation in groundwater take is consistent with earlier red flags raised by the NSW Department of Industry in its 2018 assessment of the Maules Creek Groundwater and Surface Water systems. The Department specifically identified a fundamental inconsistency in observed head pressures between the alluvium and underlying coal seams: field data showed a downward hydraulic gradient from the alluvium to the coal basin, whereas the proponent's model reversed this gradient, asserting that water flowed from the coal into the alluvium. This reversal is not a minor technical discrepancy, it fundamentally undermines the assumption of hydraulic disconnection between the two systems.

The Department noted that this inconsistency was not explained or addressed in any of the reviewed documents, and more critically, it was not captured by the project's trigger level and response framework (DOI - MCCM Ground and Surface Water Assessment, Oct 2018, p. 3). This represents a serious modelling oversight with direct implications for groundwater impact predictions, monitoring, and management.

At no point since this issue was identified has either the proponent (Whitehaven Coal) or its groundwater consultant (AGE Consultants) publicly acknowledged the error, explained its implications to the community, or issued any form of correction or apology. This silence has contributed to a sustained erosion of community trust and raises legitimate concerns about the transparency, accountability, and integrity of the groundwater assessment and approval process.

It was at this time that the community found out that the Water Management Plan (WMP) trigger thresholds for groundwater decline are not transparently tied to observed pre-mining conditions or ecological thresholds. The 2024 WMP fails to explain how drawdown will be identified early or managed once thresholds are breached (MCCM WMP, March 2024, p. 26).

Crucially, the current monitoring and trigger framework failed to initiate any formal action or notification when the mine's groundwater take increased more than fifty-fold in 2018 (AGE - BTM Model Report 2021, Section 6.7.1.3, p. 75). Nor did the substantial and well-documented drawdowns at Elfin Crossing prompt any public response or precautionary action by the company. No reassurances were provided to the community that groundwater extraction would be reduced, reinjection considered, or contingency planning implemented to prevent recurrence.

Whitehaven Coal's public statement (Whitehaven Coal. (2019, November 5)) that there was "no credible hydrogeological evidence" linking mining to drawdown contradicts observed field data, including the spatial and temporal alignment between the mine's dewatering and rapid aquifer decline. The company's response dismissed the lived experience of affected landholders and disregarded known deficiencies in the conceptual model and monitoring system.

Moreover, under the Environmental Planning and Assessment Act 1979, approval conditions for State Significant Developments are expected to include defined groundwater trigger levels that must initiate timely and enforceable management responses. (NSW Aquifer Interference Policy (2012), Section 5.1.2 and 5.2)

These thresholds must be transparent, evidence-based, and aligned with the project's Social Impact Assessment (SIA) obligations, which require proponents to identify, mitigate, and monitor social impacts—including those arising from water stress and loss of community amenity. (NSW DPIE, *Social Impact Assessment Guideline for State Significant Projects*, 2021, Section 4.3 & 5.2) The failure of the current framework to activate during one of the most significant aquifer decline events in recent memory is not only a technical shortcoming but a breach of the project's broader planning and social licence obligations.

This failure to act when the community most needed certainty and support represents more than a technical oversight, it is a breach of trust. Communities are told that if groundwater impacts occur, the company will respond, mitigate, and adapt. That promise underpins not only the Social Impact Assessment framework but the entire premise of negotiated coexistence. Yet when faced with clear evidence of aquifer drawdown, bore failures, and expert identification of a fundamental conceptual error in the groundwater model, neither Whitehaven Coal nor its consultant AGE Consultants offered any public admission, apology, or correction. The community was left to carry the consequences, financially, emotionally, and operationally, while the proponents continued to assert no responsibility and no causality. There has been no recompense offered, no remediation proposed, and no meaningful engagement to address the breach of the model's assumptions.

When commitments made in planning documents, management plans, and CCC meetings are not upheld, it sends a clear message: those commitments are conditional, selective, or symbolic. The community is entitled to rely on those commitments in good faith. Respecting our reliance on groundwater is not optional, it is a condition of the mine's continued approval, a requirement of its social impact obligations, and central to the legitimacy of the entire assessment and regulatory process.

Post Mining

The SIA does not set or envisage a realistic timeline for mine closure so that the impacted community of Maules Creek can plan forward, but leads people to think that the mine will be done and dusted by 2045. This untruthfulness has costs for local people on their health, life choices and finances.

The post mining recovery from the cumulative depopulation and land acquisition is something that long term Maules Creek residents struggle with. Once critical mass is lost it is difficult to attract services and re-invigorate the micro-economy.

There are significant opportunities to reinvigorate Maules Creek post mining but the basics (water, safe and suitable land, community infrastructure and a road network) need to be built on or put in place now during the Continuation Project Planning phase.

The basics require State Government intervention from Planning and the IPC because the mining companies and the local Narrabri Shire Council (NSC) do not have community rebuilding as part of their remit. This necessary rebuild is squarely in the remit of State Significant Development (SSD) planning as the entire Leard Forest Precinct has been coordinated under the SSD planning approach. The future re-population and re-build cannot be left to the NSC or local people to pick up the pieces once the mines have gone.

Climate Change

The SIA is a document that is firmly rooted in the past. The assessment does not mention Climate Change at all. It does not frame the impacts of the projects Scope 1,2 or 3 emissions on the local community, region or state. It does not canvas the cumulative risks that Climate Change poses on top of the mining risks inherent in the Continuation Project.

In particular it ignores the cumulative risks to the Maules Creek community's resilience and agricultural viability from Climate Change and the high risk of groundwater depressurisation from the mine operations. Parsons Brinckerhoff. (2010).

By 2045 climate pressures are forecast to play a very significant role in shaping regional population trends, economic activity, and wellbeing. Forecasts are being exceeded every day. By ignoring this key threat the SIA cannot be regarded as a best practice SIA to be used for transition planning, building community trust or improving community resilience.

Uncertainty

As identified in Point 10 of Dr Parsons review the main SIA response measures revolve around creating strategies, plans and engagement. The proponent relied on mining company supervised consultant interviews during the SIA development and unlike renewable energy projects, there has been no community meeting or drop in day to ground truth assumptions, seek our vision for the post mining future or co-design community benefit sharing.

The SIA is the opposite to certainty. It does not identify or model and monetise the impacts that the environmental impacts or the prolonged uncertainty creates. At the same time it lacks enforceable commitments, fails to define community benefit outcomes particularly for the Maules Creek community, and does not establish a transition plan for the post-mining period.

Furthermore the SIA adds to the uncertainty by ignoring the proponents intentions to mine the other side of Back Creek. Everyone has seen the drilling rigs getting more core samples on mine owned land beyond the current footprint. The mine forward program goes out of its way to exclude publication of the drilling sites and which side of Back Creek it is investigating.(MCCM (2025) Furthermore the document renames the Maules Creek coal Mine to the Maules Creek Mine Complex reframing the proponents mine as numerous ongoing projects.

These actions suggest that the published SIA for the Continuation Project is merely a stepping stone to the next modification, expansion or extension and is already obsolete. To that extent the SIA is a dishonest and inadequate document for the community to identify the cumulative social impacts and responses to the proponents project.

Stating the bleeding obvious, for certainty, what the Maules Creek community and the State of NSW needs is a commitment by the State Government to the phase out of coal mining in line with Australia's Paris Commitments. Surely by 2030 there will be no new coal mines or approvals in NSW. Now is the time to set industry and community expectations in this regard.

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Appendix D

Maules Creek Continuation Project

Biodiversity Independent Expert Report

MAULES CREEK CONTINUATION PROJECT

Expert advice regarding the impact of the project on the Threatened Ecological Communities listed under both NSW *Biodiversity Conservation Act 2016* & Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Wendy Hawes | The Envirofactor Pty Ltd

Report prepared for the Maules Creek Community Council

July 2025

Disclaimer

CONTENTS

EXPERT ADVICE REGARDING the IMPACTS on THREATENED ECOLOGICAL COMMUNITIES of the MAULES CREEK CONTINUATION PROJECT

1. Statement of expertise

I (Wendy Hawes) am a qualified Ecologist with a Bachelor of Science and Master of Science (prelim) from the University of New England. As a result of my previous and current employment, I have over 32 years' experience in flora and fauna survey, assessment and provision vegetation management advice on public and private land in NSW.

I have prepared this report in response to an expert brief provided by Grace Huang, Solicitor from the Environmental Defenders Office (EDO), on behalf of the Maules Creek Community Council. In its preparation I have read, understood and complied with Division 2 of Part 31 of the *Uniform Civil Procedure Rules 2005* (UCPR), and the Expert *Witness Code of Conduct* (Code of Conduct) contained in Schedule 7 of the UCPR.

In respect the ecological communities in the brief I have the following experience and expertise. Regarding *White Box Yellow Box Blakely's Red Gum grassy woodland and derived native grasslands* critically endangered ecological community (subsequently referred to as Box Gum Woodland CEEC) and the threatened species it supports, my experience includes:

- participation on the Commonwealth (Cth) Department of Environment, Water, Heritage and the Arts (DEWHA) [now Cth Department of Climate Change, Energy, the Environment and Water (DCCEEW)] expert panel to establish a threshold definition for *White Box Yellow Box Blakely's Red Gum grassy woodland and derived native grasslands*.
- preparing the draft National Recovery Plan for *White Box Yellow Box Blakely's Red Gum grassy woodland and derived native grasslands*.
- numerous on-ground surveys and assessments within the Box Gum Woodland ecological community for:
    - clearing applications and compliance actions under NSW native vegetation legislation
    - compliance actions under the *EPBC Act*
- the presence of the Box Gum Woodland CEEC on a mining development at Muswellbrook for DEWHA (now DCCEEW)
- identification of high conservation value vegetation on Travelling Stock Routes within the Border Rivers Gwydir Catchment Management Authority (CMA) and Lachlan CMA areas (now Northern Tablelands and Riverina Local Land Services areas respectively)

- voluntary conservation agreements under NSW Office of Environment and Heritage (OEH) Conservation Partnerships Program and NSW Biodiversity Conservation Trust
- baseline data and on-going monitoring of Box Gum Woodland CEEC at Ross Hill Reserve, Inverell for GWYMAC Landcare Inc
- OEH- Central West Native Vegetation Mapping Program
- Nandewar Regional Biodiversity Fauna Assessment Survey
- Split Rock Dam Stage 1 Upgrade for NSW State Water Corporation
- ground-truthing Box Gum Woodland CEEC mapping on the Maules Creek Coal Mine Northern Offsets for the Environmental Defenders Office.
- co-authorship and/or contribution to publications relevant to the assessment and management of this community including:
    - Nadolny C, Hunter JT and Hawes W (2010) *Native Grassy Vegetation in the Border-Rivers-Gwydir Catchment: diversity, distribution, use and management.* A report to the Border Rivers-Gwydir Catchment Management Authority
    - Nadolny C et al (2003) Grassy Vegetation in North-western NSW and Guidelines for its Management for Conservation. Armidale Tree Group, Armidale, NSW
    - Department of Land and Water Conservation (1999) *Interim Guidelines - for targeted and general flora and fauna surveys under the* Native Vegetation Conservation Act 1997. Centre for Natural Resources NSW Dept of Land and Water Conservation, Parramatta
    - Turner K and PL Smith (1996) Guidelines for assessing the significance of native vegetation removal on threatened species, populations, or ecological communities, or their habitats. Dept of Land and Water Conservation publication.

- development of DVD series on the '*History of Box Gum Grassy Woodland*' for the Grassy Box Woodland Conservation Management Network.
- training government agency field/assessment staff in the identification of Box Gum Woodland CEEC including Border Rivers Gwydir, Namoi and Central West CMAs, NSW Local Land Services (LLS) and NSW Dept Environment and Heritage, Biodiversity Development Assessment Report (BDAR)
- participation on CSIRO and NSW Department of Environment Climate Change and Water (DECCW now NSW DCCEEW] expert panel to determine benchmarks for native vegetation communities, used in the Property Vegetation Planning Tool for the assessment of clearing applications and delivery of incentive funding under the NSW *Native Vegetation Act 2003*.
- participation on the NSW Department of Planning, Industry and Environment (DPIE now NSW DCCEEW) expert reference group for mapping the extent of the NSW *White Box – Yellow Box – Blakely's Red Gum grassy woodland and derived native grassland* CEEC.

In relation to *Poplar Box Grassy Woodland on Alluvial Plains* my experience includes;

- numerous on-ground assessments for clearing applications and compliance actions under NSW legislation (State Environmental Planning Policy No 46 and Native Vegetation Conservation Act 1997).
- numerous threatened species assessments under the NSW *Threatened Species Conservation Act 1995* (known as the 7 Part Test) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (significance assessment guidelines) for clearing and development activities, in relation to this community.
- identification of this community and assessments of condition for areas proposed for protection under the conservation agreements for the NSW Biodiversity Conservation Trust.
- training Local Land Services staff in the identification and/or assessment of the open forest and woodlands that comprise this ecological community.

In relation to *Grey Box (*Eucalyptus microcarpa*) Grassy Woodland* my experience includes;

- On-ground audit of vegetation community mapping of this community for the Namoi Catchment Management Authority
- identification of this community and assessments of condition on Travelling Stock Reserves in the Lachlan Catchment NSW for the Grassy Box Woodland Conservation Management Network.
- Mentoring/training Biodiversity Conservation Trust staff in the identification of this species and community.

2. Expert brief

My brief from the EDO was as follows:

a) Please summarise any key impacts that you predict to arise in relation to the following ecological communities as a consequence of the Project, bearing in mind the mitigation measures proposed (Ecological Communities):

Listed under the BC Act

i. White Box - Yellow Box - Blakely’s Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions Critically Endangered Ecological Community (Box Gum Woodland CEEC).

ii. Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions Endangered Ecological Community

Listed under EPBC Act

iii. Box – Gum Grassy Woodland and Derived Grassland (formerly White Box – Yellow Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland)

iv. Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia.

v. Poplar Box Grassy Woodland on Alluvial Plains

b) Noting the definition of 'serious and irreversible impacts' in s 7.16 BC Act, the principles at cl 6.7 BC Regulation, and departmental guidance, in your opinion, is the Project likely to have a serious and irreversible impact on the Box Gum Woodland CEEC?

c) In your opinion, was the assessment of impacts on the Ecological Communities, as far as it relates to your areas of expertise, appropriate and sufficient?

d) In your opinion, has the assessment adequately considered any cumulative impacts to the Ecological Communities arising from the Project?

e) In your opinion, are the measures proposed as part of the Project to mitigate and avoid impacts to the Ecological Communities adequate? Are there any additional and appropriate measures that would minimise those impacts if consent was to be granted to the Project?

3. Background information

In preparing this report I have reviewed the following documents and reports:

- Planning NSW (October 2023): Advice of Biodiversity, Conservation and Science Directorate on Secretary's Environmental Assessment Requirements – Maules Creek Continuation Project (SSD-63428218). Letter.
- Department of Planning and Environment NSW (November 2023) Planning Secretary's Environmental Assessment Requirements – Maules Creek Continuation Project (SSD-63428218).
- Department of Planning, Housing and Infrastructure (March 2025) Supplementary Planning Secretary's Environmental Assessment Requirements – Matters of National Environmental Significance. Maules Creek Continuation Project (SSD-63428218/EPBC 2024/09936).
- *Department of Planning, Housing and Infrastructure (March 2025)* Guidelines for preparing assessment documentation relevant to the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) for proposals being assessed under the NSW Assessment Bilateral. *Maules Creek Continuation Project (SSD-63428218/EPBC 2024/09936).*

- Whitehaven (2025) Maules Creek Continuation Project. Environmental Impact Statement. **Executive Summary, Section 3** Project Description, **Section 6** Environmental Assessment.
- Whitehaven (2025) Maules Creek Continuation Project. Environmental Impact Statement. Attachments and Appendices: **Attachment 7** Rehabilitation and Mine Closure, **Attachment 8** Summary of Mitigation Measures, **Attachment 15:** Serious and Irreversible Impact Reports, **Appendix A** Groundwater Impact Assessment, **Appendix C** Biodiversity Development Assessment Report.
- *Unwelt (2017)* Leard Forest Regional Biodiversity Strategy Stage 2 – Strategy Report. Final. *Prepared for the NSW Department of Planning and Environment.*
- NSW Department of Planning, Industry & Environment (2019) Guidance to assist a decision maker to determine a serious and irreversible impact. DPIE publication, Sydney.

4. Project description

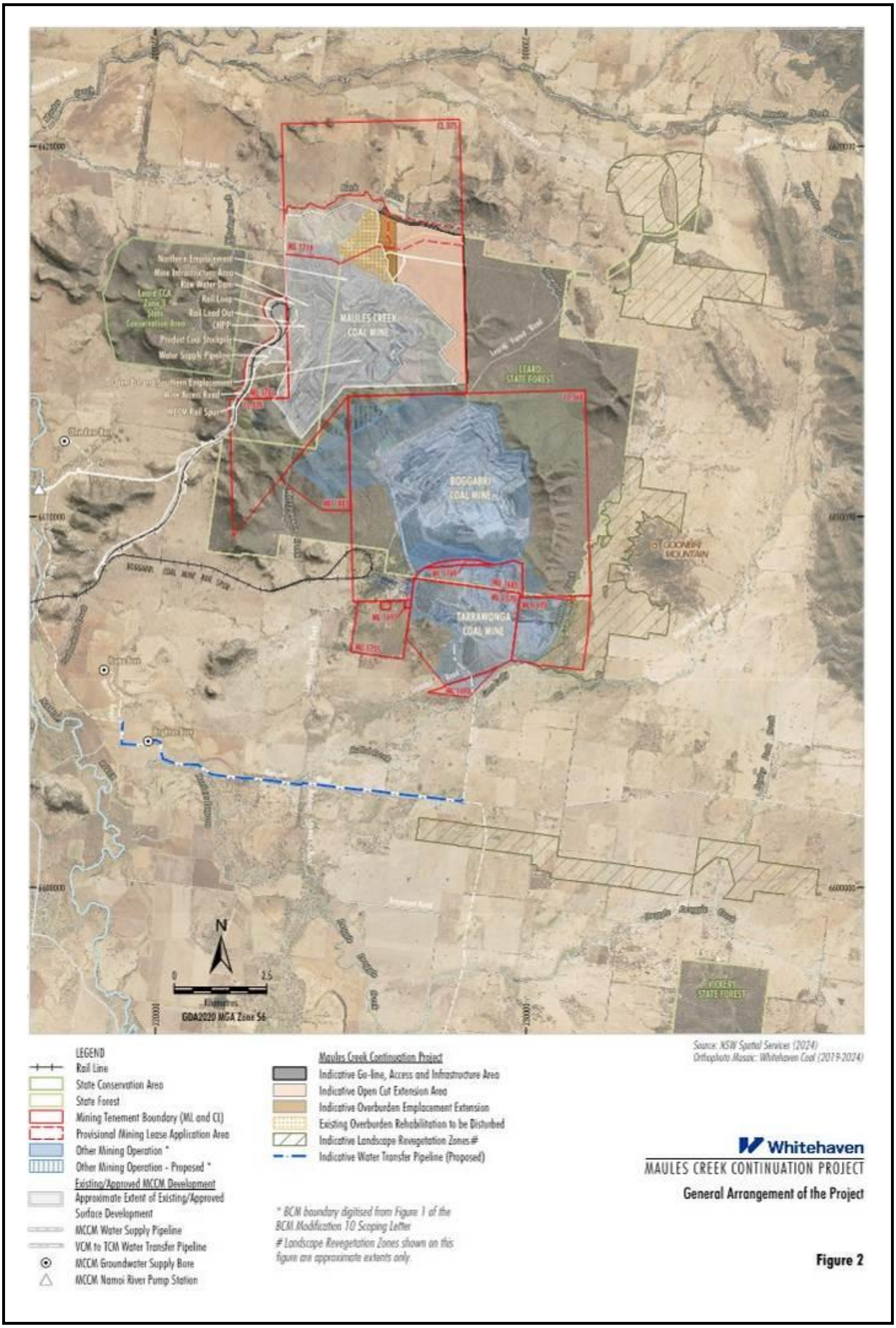
As described in the Whitehaven EIS (2025), Maules Creek Coal Mine (MCCM) is currently an open cut coal mining operation located approximately 17 kilometres north-east of Boggabri in New South Wales (NSW). The Maules Creek Continuation Project (MCCP) proposes the expansion of this existing mine. The Project would involve clearing native vegetation on the proposed development footprint associated with the mine activity (676.5 hectares [ha]) and clearing and/or temporary disturbance of both native and non-native vegetation for construction of a water transfer pipeline (6.4ha). The proposal also offers a revegetation program in the wider landscape involving approximately 2,255ha in three separate Landscape Revegetation Zones. The revegetation initiative proposed is in addition to standard biodiversity offset/credit requirements (Whitehaven 2025). Refer Figure 1.

The EIS (Whitehaven 2025) also states, '*Native vegetation would be progressively cleared (over approximately 13 years [2028 to 2040]) and post-mine landforms and Landscape Revegetation Zones would be progressively revegetated. The Project would result in the loss of approximately 642 ha of existing native vegetation within the development footprint associated with Phases 1 to 3, comprising approximately 49.5 ha of derived native grassland, 482.1 ha of woodland/forest and 110.4 ha of land undergoing mine rehabilitation.*'

Additionally, in s6.1.1.1 of Appendix C (Premise 2025) the EIS states, when discussing areas avoided and/or minimised for clearing, '*The original development footprint associated with the mine site was 771.3 ha compared to the final proposed development footprint 682.9ha'.* In s7.4.4 Appendix C (Premise 2025) in describing the areas of rehabilitation it talks about the additional 656ha area of rehabilitation on the continuation project footprint.

It is unclear in the EIS why there are these discrepancies in the areas of vegetation to be cleared and/or rehabilitated on the project footprint. If MCCP is unsure of the area to be cleared on the development footprint how can an approval authority be sure.

***FIGURE 1:** Maules Creek Continuation Project*



5. Brief questions addressed

a) Please summarise any key impacts that you predict to arise in relation to the following ecological communities as a consequence of the Project, bearing in mind the mitigation measures proposed (Ecological Communities):

Listed under the BC Act

i) White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions Critically Endangered Ecological Community (Box Gum Woodland CEEC).

ii) Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions Endangered Ecological Community (EEC)

Listed under EPBC Act

i) White Box – Yellow Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC (Box-Gum Woodland CEEC)

ii) Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia EEC

iii) **Poplar Box Grassy Woodland on Alluvial Plains EEC**

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i) *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland* Critically Endangered Ecological Community listed under both NSW and Commonwealth legislation (subsequently referred to as Box Gum Woodland CEEC).

In my opinion, the key impacts arising in relation to Box Gum Woodland CEEC because of the Maules Creek Continuation Project (MCCP) are as follows:

Clearing native vegetation

In relation to Box Gum Woodland CEEC the MCCP will clear approximately 79.9 ha of Box-Gum Woodland CEEC listed under the BC Act, of which approximately 21.9 ha is Box-Gum Woodland CEEC listed under the EPBC Act (Premise 2025). This 79.9ha will be removed from the mine development footprint.

According to Appendix C (Premise 2025) 21.9ha of the Box Gum Woodland CEEC identified meets the condition criteria for the Commonwealth CEEC listing. This 21.9ha comprises 21.5ha of woodland and 0.4ha of derived native grassland. The consistency of this area with the Commonwealth CEEC listing indicates to me that this vegetation is in good condition.

This opinion is based in the key attributes that identify the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) listed community and my participation on the expert panel that originally formulated these attributes. As outlined in the DEH (2006) guideline, (refer Appendix 1) these attributes are:

- the area must be, or have been previously (in the case of derived grassland), dominated or co-dominated by one or more of the following tree species (or hybrids of these species with any other Eucalyptus species): white box (*Eucalyptus albens*), yellow box (*E. melliodora*) or Blakely's red gum (*E. blakelyi*) [or western grey box (*E. microcarpa*) or coastal grey box (*E. moluccana*) in the Nandewar bioregion].
- it must have a predominately native understorey (i.e. more than 50% of the perennial vegetative ground layer must comprise native species).
- the area covered by the ecological community (i.e. the patch size) must be greater than 0.1 hectares (ha) and contain 12 or more native forb species (species that are not grasses), including one or more important species as listed in Appendix 2.
- if the ground layer does not meet this last criterion (i.e. does not contain 12 or more native forb species and one or more important species) then the patch size must be 2ha or greater in area AND have an average of 20 or more mature trees per ha, OR natural regeneration of the identified dominant overstorey eucalypts.

Areas which do not meet the above criteria, i.e. the balance of Box Gum Woodland (58ha) on the mine development footprint, are not considered to be part of the EPBC Act listed CEEC. However, as indicated in the EIS (Premise 2025) the area excluded from the listed EPBC community definition above may still be the NSW listed CEEC, *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland* under the (BC Act), as the NSW definition of the community is much broader than the EPBC listed CEEC.

The key difference between these listings is the BC Act listing does not;

- require a predominantly native ground layer, and
- there is no threshold for the number of native non grass species nor any requirement for 'important' species to be present.

For listing under the BC Act, areas with predominately native canopy, dominated by the relevant species (white box, yellow box and Blakely's red gum), but with a predominately non-native ground layer are included. In their final determination the NSW TSSC (2020) identified '*the need for flexibility to adapt recovery and management priorities to different settings and action types*', and therefore did not '*propose prescriptive or generic thresholds for this purpose*'.

The clearing of 79.9ha of Box Gum Woodland CEEC consistent with both the EPBC Act (21.9ha) and BC Act (79.9ha) listing will not only remove the plant species which comprise the CEEC including threatened plants *Dichanthium setosum* and *Digitaria porrect*a, but also important habitat elements necessary for the ongoing survival for the entire suite of fauna (including threatened species) that are an integral part of the CEEC. These habitat elements include:

- more than 79.9ha of feed trees (woodland) which are important for species such as koalas, squirrel gliders, yellow bellied gliders, swift parrots, little lorikeets, and regent honeyeaters.
- tree bark (decorticating, fissured or otherwise) provides important shelter for invertebrates and Corben's long-eared bat and foraging habitat for species such as the varied sitella, brown treecreeper and microbats
- mistletoes provide important food and/or nesting resources for species including painted honeyeater, squirrel glider and regent honeyeater.
- tree hollows, in live and dead standing trees, are a necessary requirement for shelter and/or breeding of many fauna species including for example the squirrel glider, little lorikeet, brown treecreeper, turquoise parrot, masked owl, barking owl, pale headed snake, Corbens long-eared bat and yellow-bellied sheath-tailed bat.
- fallen logs, provide plant and fungi habitat, animal shelter and breeding sites for invertebrates. As well as important foraging habitat for species including the brown treecreeper and grey crowned babbler as well as provide denning sites for spotted-tailed quoll.
- surface rock provides plant habitat, animal shelter, protection from predators, escape from bushfires and breeding sites for invertebrates and small reptiles (e.g geckoes small skinks).
- leaf litter provides plant and fungi habitat, food resources and breeding habitat for the numerous invertebrates which provide nutrient recycling services and form the basis of the food chain within the CEEC, as well as providing cover/moisture for small reptiles (e.g. striped legless lizard) and small mammals (e.g. dunnarts).
- native grass and forbs provide shelter and food resources (seeds, flowers and leaves) for many fauna species including reptiles and the diamond firetail.

Consequently, the clearing of 79.9ha of Box Gum Woodland and derived native grassland staged or otherwise will potentially result in the death and injury of many fauna species. It will also force those fauna species capable of escaping, or those relocated during vegetation clearing, into surrounding areas of already occupied habitat. This forced evacuation/relocation will result in increased inter and/or intra fauna species competition for the existing resources in these surrounding areas (i.e. food, shelter, breeding habitat and mates). This in turn will potentially result in further fauna deaths from conflict injuries, starvation, stress and increased disease.

In recognition of the impacts of vegetation clearing described above, the following key threatening processes have been listed under both the NSW BC Act and/or Commonwealth EPBC Act:

- *Clearing of native vegetation* - BC Act (NSW TSSC 2001) and *Land clearance* - EPBC Act (TSSC 2001)
- *Loss of tree hollows* - BC Act (NSW TSSC 2007)
- *Removal of dead wood and dead trees* – BC Act (NSW TSSC 2003)

- *Bush rock removal* - BC Act (NSW TSSC 1999).

The MCCP proposes to avoid, minimize and/or mitigate the impact of the loss of 79.9ha of Box Gum Woodland CEEC by;

1 clearly marking the area of vegetation to be cleared. Clearing and disturbance would be restricted to the delineated area and no stockpiling of equipment, machinery, soil or vegetation would occur beyond this boundary.

2 locating the mine development site 200m back from the mapped top bank of Back Creek which avoids 2.9ha of CEEC.

3 staged clearing of the mine development footprint.

4 timing of vegetation clearing of woodland/forest native vegetation which will be undertaken in late summer and early autumn to avoid breeding and/or hibernating fauna species (i.e. between 15 February to 30 April), except under exceptional circumstances in the first year of mining operations for the project. So, in the first-year vegetation clearing will potentially take place when fauna are breeding and/or hibernating significantly increasing the risk of fauna injury and death from clearing operations.

5 staged rehabilitation of the mine footprint.

6 the existing commitment to establish 544ha of Box-Gum Woodland CEEC on the post-mine landform (Condition 25 of EPBC Act Approval 2010/5566).

7 replanting 340.9 ha of species representative of Box Gum CEEC on one or more of the 3 landscape revegetation zones identified in the EIS to the north/northeast and southeast of the mine development footprint and Leard State Forest, and southeast of the water transfer pipeline.

The implementation of Actions 1 and 2 above will assist in maintaining a very small patch (2.9ha) as well as other adjoining CEEC remnants from the impacts of clearing. Mitigation of the MCCP relies heavily on rehabilitation of the post mine landscape and replanting of species consistent with the component CEEC species on the post mine landscape and within the landscape revegetation zones. I have no doubt Whitehaven will undertake rehabilitation and replanting on the mine project site and replanting within the revegetation zones. But what is unknown and highly problematic is whether these plantings will be successful in the long term in re-establishing recognizable areas of CEEC.

In my opinion, all the actions proposed will not mitigate the loss of 79.9ha of currently extant mature/old growth CEEC in a predominantly mining/agricultural landscape. Ecological communities are not just a list of flora species, but they are a function of the interaction of flora species at all their various stages of growth and maturity with soil biota (vertebrates, invertebrates and mycorrhizal fungi), soil type, soil nutrients, local watertables and the suite of fauna species adapted to the habitat the community provides.

The EIS Appendix C (Premise 2025) states there is approximately 4,090.6ha of extant Box-Gum Woodland CEEC and 1,518ha of replanted of CEEC in Maules Creek Coal Mine (MCCM) existing offset areas (conserved in-perpetuity under conservation agreements). However, it is important to note the offset areas for the existing mine operation are spread across three bioregions (Brigalow Belt South, Nandewar and New England Tablelands), with very little of this area contiguous with the mine continuation project area. Areas of Box Gum CEEC outside the Brigalow Belt South (where the MCCP is located) are subject to different environmental factors [e.g climatic conditions (humidity, temperature, rainfall and wind), altitude, soil types, soil nutrient/hydrological regimes]. Consequently, they will naturally support a different range of flora and fauna species to that on the mine development footprint.

Additionally, the replanted CEEC on these offset properties is currently only some 10 years old, and (as demonstrated by photos in the EIS) it is at best a functionally single aged shrubland with limited habitat value (Ausecology Appendix C, 2025). The limited habitat value is due to;

- little or no structural diversity (i.e. no tree canopy cover with understorey shrubs and tree/shrub regeneration) – necessary for species including the speckled warbler and diamond firetail
- no mature feed/nectar producing trees - for species such as the koala and squirrel gliders
- no mistletoes - for species including the painted honeyeaters and diamond firetail, and
- no mature/old growth hollow-bearing trees or dead standing trees – essential as shelter and breeding sites for brown-treecreepers, Corben's long-eared bat, yellow-bellied sheathtail bat and squirrel gliders.

For replantings to achieve a similar level of condition and habitat value as the 79.9ha of CEEC cleared will take a minimum of 100-120 years (which is how long it takes a small tree hollow to form) (Gibbons and Lindenmayer 1997, NSW NPWS 1999). It is unclear in the EIS how long Whitehaven proposes to manage the mine rehabilitation site or the landscape revegetation zones. There is also no indication that replanted areas within the revegetation zones will be protected in perpetuity. So, the possibility exists that long before these replanted areas reach a similar level of habitat value to the 79.9ha of CEEC to be cleared, Whitehaven could sell these revegetation zones and the replanted vegetation potentially could be cleared.

In 2006, the Commonwealth TSSC estimated that less than 5% of the original distribution of Box Gum Woodland remained, but the '*extent to which remaining examples continue to support characteristic biota, their interactions and function is unknown*'. Of the area to be cleared for the mine development footprint, 21.9ha meets the condition criteria for the Commonwealth listed CEEC and is therefore considered habitat critical to the survival of the CEEC (DECCW 2010).

As identified by Hunter Eco (2025) there are approximately 44.2ha of Box-Gum Woodland CEEC within 1,000 ha surrounding the mine development footprint and approximately 190.3ha within in the surrounding 10,000ha. These occurrences are scattered patches that lie mostly in a cleared agricultural matrix. Scattered patches are typical of Box Gum Woodland CEEC occurrences in agricultural landscapes and why it is at serious risk of extinction.

Based on the Hunter Eco (2025) figures the removal of 79.9ha of CEEC on the mine development footprint will result in a 64% reduction in the CEEC within the surrounding 1,000ha landscape and a 30% reduction in the wider surrounding 10,000ha landscape. Such significant area losses in a predominantly agricultural/mining landscape, of a CEEC which is estimated to have less than 5% remaining is untenable. In the long-time lag between the clearing and the proposed replanted vegetation reaching a similar level of condition and habitat value it is likely local extinctions of component species will occur. Additionally, it should be noted that there is no guarantee of future success of replantings on the revegetation zones nor is it proposed to protect them in-perpetuity.

Increased fragmentation

Fragmentation is caused by clearing native vegetation into ever smaller more isolated patches (NSW Scientific Committee 2001). Factors to consider in assessing the impacts of fragmentation include the distance between fragments as well as the area of the fragments and their shape (NSW Scientific Committee 2001). Clearing native vegetation increases the edge/area ratio of vegetation which in turn increases the impacts of edge effects such as changed microclimate (temperature, humidity, wind and light penetration) and susceptibility to invasion by non-indigenous species (NSW Scientific Committee 2001).

According to the EIS (Premise 2025) three patches of Box-Gum Woodland CEEC inside the development footprint would be completely removed by the Project. Two patches would be partially removed, decreasing the area of one patch from 2.9ha to 1.2ha and 143.6ha to 94.1ha for the other. This is a 58% and 34% reduction respectively for these patches.

The clearing of 79.9ha of Box Gum Woodland will therefore, and contrary to information provided in the EIS (Premise 2025), further fragment the CEEC by removing patches on the mine development site and significantly reducing the size of remnant patches of Box Gum Woodland CEEC along Back Creek and in adjoining areas of Leard State Forest to the east.

Landscape connectivity can be considered as, the configuration of suitable habitat within a landscape, that allows for the movement of species across hostile areas of non-habitat (e.g. open cut mine voids and haul roads). A high level of connectivity is important to the maintenance of healthy ecosystems and biodiversity, as it facilitates dispersal/interaction of species and the exchange of genetic material across the landscape.

Landscape connectivity can be continuous (corridors) or discontinuous (paddock trees and/or vegetation patches that act as 'stepping-stones' between areas of habitat). The connectedness of any landscape is dependent upon individual species' movement abilities, the distance between remnants and the character of the intervening matrix (Doerr *et al* 2010). For example, discontinuous corridors (stepping–stones) are unlikely to be suitable for small, less mobile species dependent on continuous habitat cover for protection against predation and desiccation (Dendy 1987) such as small birds, mammals, reptiles and amphibians. But habitat stepping-stones often facilitate the movement of more mobile species including medium to large birds, mammals and reptiles.

Under the MCCP the remaining patches of the CEEC (woodland, derived grassland) along Back Creek to the north and Leard State Forest to the east outside the disturbance footprint would remain. Patches of remnant CEEC within these areas will still be connected by other treed and native grassland communities, so while connectivity will be significantly reduced by the MCCP through the loss of 676.6ha of native vegetation that includes 79.9ha of CEEC on the mine development footprint, remnant patches the CEEC itself within the remaining landscape will not be further isolated.

Increased edge effects

Edge effects are the changes in microclimate and that occur in adjoining remnant vegetation as a result of clearing and fragmentation. These effects include changes to the abiotic factors, such as humidity, temperatures, sunlight, rainfall and wind penetration. These changes in microclimate:

- result in detrimental changes to the habitat value of the adjoining uncleared vegetation for many resident native plants and animals
- are known to increase the potential for weed invasion, and
- increase feral predation (by cats and foxes) due to improved access (Rowley *et al* 1993, May and Norton 1996).

The distance these changes in microclimate penetrate into adjoining intact vegetation will vary depending upon an individual species' sensitivities. But what is known is that areas impacted by edge effects generally have a different native species composition (flora and fauna), have higher weed loads and different abiotic factors to those within the core habitat (i.e. areas not affected by edge effects) of a vegetation community (López-Barrera *et al* 2007). Edge effects impacting remaining areas of CEEC adjoining the development footprint, because of clearing and fragmentation, will be further exacerbated in this case by mining operations. Mining activities will result in increased noise, dust, vibration and light pollution and changed soil hydrological regimes within adjoining areas of remnant CEEC from the operation of machinery, movement of people and vehicles, blasting and mine excavation.

In recognition of the impact of edge effects have on remnant vegetation the following key threatened processes have been listed under both the NSW BC Act and/or Commonwealth EPBC Act:

- *Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners,* Manorina melanocephala (Latham, 1802) – BC and EPBC Act
- *Competition and grazing by the feral European Rabbit,* Oryctolagus cuniculus (L.) – BC and EPBC Act
- *Competition and land degradation by feral goats* – BC and EPBC Act
- *Novel biota and their impact on biodiversity* – EPBC Act
- *Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants* – BC and EPBC Act
- *Predation by feral cats* - BC and EPBC Act
- *Predation by European red Fox* (Vulpes vulpes) – BC and EPBC Act
- *Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs* – BC and EPBC Act
- *Forest eucalypt dieback associated with over-abundant psyllids and Bell Miner*s – BC Act
- *Invasion of native plant communities by exotic perennial grasses* – BC Act.

According to Premise (2025) the impact of increased edge effects on remnant vegetation outside the mine development footprint will be mitigated and managed by the implementation of:

1 erosion and weed management protocols on site

2 a Noisy Miner control program along remnant habitat edges

3 dust and noise reduction measures

4 the use of directional lighting wherever practicable along the edge of the mine site

5 feral animal control programs, and

6 vehicle speed limits.

While these actions will potentially reduce the impacts of some of the edge effects from degrading remnant areas of CEEC adjoining mining site, no evidence is provided in the EIS to support the efficacy of these actions in maintaining habitat values for flora and fauna.

Of the actions proposed Actions 1, 2 and 5 are the most likely to be successful in maintaining habitat values if implemented. There is no evidence that Actions 3, 4 and 6 will be effective in reducing noise and dust particularly for CEEC remnants adjoining the access road to the go line along the northern boundary of the mining pit. The EIS (Ausecology 2025) indicates that vehicle movements along the northern access road to the go line will be in the order of 350 vehicle movements per day, each of which will generate dust, noise and vibration. The 24-hour operation of the mine would also indicate that even if directional lighting is used, adjoining remnants will still suffer light pollution from 24hr lighting, as well as from vehicle lights moving around the mining pit and along the northern access track.

In fact the EIS (Premise 2025) states that '*Noise modelling has been undertaken by specialist noise consultants RWDI Australia Pty Ltd (RWDI, 2025) for the Project and it shows that the amount of noise would increase mainly due to a greater number of mining trucks and equipment (to reflect the increase in ROM* [Run of Mine] *coal mining rate proposed and increasing open cut pit extent), but also extend into the eastern part of the State Forest. The same assessment shows a similar outcome for blasting emissions.'* According to the EIS (Whitehaven 2025) there is potential for two blasts per day which according to the EIS (Premise 2025) '*would also have impacts on individual animals however these impacts would be mitigated by the weekly average number of blasts reaching the same (i.e. altogether blasting may occur twice in a day, the average of four a week would remain)'*. It is difficult to see how on-going blasting and 24hr vehicle movements will not detrimentally impact the habitat values of adjoining CEEC remnants and their faunal components.

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ii) *Inland Grey Box Woodland* listed under NSW legislation and *Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands* listed under the Commonwealth legislation (both subsequently referred to Grey Box Woodland). Both communities are listed as Endangered Ecological Communities (EECs)

In my opinion, the key impacts arising in relation to Grey Box Woodland EEC as a consequence of the Maules Creek Continuation Project (MCCP) are as follows:

Clearing native vegetation

The MCCP will remove 3.4ha of *Inland Grey Box Woodland* listed under the NSW BC Act. This 3.4ha occurs on the water transfer pipeline approximately 10km to the south of the mine development footprint (refer Figure 1) and comprises 0.9ha of woodland and 2.5ha of derived native grassland. Of the 3.4ha of NSW BC Act EEC, 3.0ha comprises *Grey Box (*Eucalyptus microcarpa*) Grassy Woodland* EEC listed under the EPBC Act. Which consists of 0.7ha of woodland and 2.3ha of derived native grassland. The consistency of this area with the Commonwealth CEEC listing indicates to me that this vegetation is in good condition.

This opinion is based in the key attributes that identify the Commonwealth EPBC Act listed community and my experience in this community. As outlined in the DSEWPaC (2012) guideline, (refer Appendix 3) these attributes are:

- the most common tree species is, or was previously, Grey Box (*Eucalyptus microcarpa*), and
- the area of the ecological community (i.e. the patch size) is at least 0.5ha in size, and
- non-grass weeds make up less than 30% of the vegetated ground cover, and
- trees cover at least 10% of the patch, and
- the patch is bigger than 2ha and there are at least 8 trees/ha that either contain hollows or have a diameter >60 cm at 1.3 m above ground level, and

- at least 10% of the plant cover in the ground layer made up of perennial native grass species

OR

- if the patch is less than 2ha in size there must be at least 8 perennial native species in the mid and ground layers, and
- at least 50% of the plant cover in the ground layer is made up of perennial native species

OR

- if the patch is bigger than 2ha but there are less than 8 trees/ha that either contain hollows or have a diameter >60 cm at 1.3 m above ground level there must be at least 20 live trees/ha with a diameter >12 cm at 1.3 m above ground level, and
- at least 50% of the plant cover in the ground layer is made up of perennial native species

OR

- if trees cover less than 10% patch, there is evidence that Grey Box trees were once common in the patch and
- there at least 12 perennial native species in the mid and ground layers, and
- at least 50% of the plant cover in the ground layer is made up of perennial native species.

Areas which do not meet the above criteria, i.e. the balance of Grey Box Woodland (0.4ha) on the water transfer pipeline, are not considered to be part of the listed Grey Box Woodland EEC under the EPBC Act. However, as indicated in the EIS (Premise 2025) the area excluded from the listed EPBC community definition above may still be the NSW listed EEC, *Inland Grey Box Woodland* under the BC Act, as the NSW definition of the community is much broader than the EPBC listed EEC.

The key difference between these listings is the BC Act listing does not specify;

- a minimum patch size, or
- a predominantly native ground layer.

The NSW TSSC (2011a) state that at severely disturbed sites the ground layer in the listed Grey Box Woodland EEC may be absent and that disturbed remnants are considered to form part of the listed community.

According to Premise (2025), the development footprint associated with the water transfer pipeline is 6.4ha. Of this area 2.4ha (37%) traverses cultivated agricultural land which Premise (2025) has assessed as Category 1 – Exempt Land within the meaning of the LLS Act. The remainder of the pipeline runs parallel to Rangari Road through 0.2ha of Grey Box Woodland which would be underbored to avoid removing mature trees and 2.5ha of derived native grassland which would either have pipe laid on the soil surface or be trenched in. There is one named waterway, Bollol Creek, which would be traversed by the water transfer pipeline.

The impacts of clearing as outlined previously for Box Gum Woodland CEEC remain very similar for Grey Box Woodland EEC. Similarly, as stated previously, in recognition of the impacts of vegetation clearing on habitat values, the following key threatening processes have been listed under both the NSW BC Act and/or Commonwealth EPBC Act:

- *Clearing of native vegetation* - BC Act (NSW TSSC 2001) and *Land clearance* - EPBC Act (TSSC 2001)
- *Loss of tree hollows* - BC Act (NSW TSSC 2007)
- *Removal of dead wood and dead trees* – BC Act (NSW TSSC 2003)
- *Bush rock removal* - BC Act (NSW TSSC 1999).

According to the EIS (Whitehaven 2025) it is planned that if the MCCP is approved the water transfer line would be constructed and rehabilitated within the first year of commencement. Trenching in the pipeline will involve placing the pipeline in an excavated trench approximately 0.5m wide by 1m deep (Premise 2025). The disturbed area would be rehabilitated following construction. According to Premise (2025) when rehabilitation of the water pipeline is complete there would be no change to the surface water flows or quality in Bollol Creek.

The avoidance and mitigation measures proposed by Premise (2025) for the clearing of 3.4ha of Grey Box Woodland for the construction of the water transfer pipeline include:

1 clearly mark the area of vegetation to be cleared. Clearing and disturbance would be restricted to the delineated area and no stockpiling of equipment, machinery, soil or vegetation would occur beyond this boundary.

2 underboring trees to avoid the need to remove mature trees.

3 where trenching is proposed near trees, a tree protection zone would be applied consistent with Australian Standard AS4970. The tree protection zone can be calculated as twelve times the diameter at breast height of the tree or 1m past the drip line of the tree.

4 installing the pipeline parallel to Rangari Road to avoid further intersection of the landscape.

5 laydown pipeline areas (i.e laying the pipeline on the soil surface) would be preferentially located in the lowest quality vegetation available.

6 pipeline route has been chosen to avoid waterways (the exception being Bollol Creek) and locating pipeline laydown areas outside of waterways.

7 the length of excavated trench that would be open at any one time would be minimised during construction of the pipeline, to reduce the risk of fauna becoming trapped. The excavated trench would be inspected daily for trapped fauna.

Additionally, mitigation includes a proposal to establish/enhance approximately 348.6ha of Inland Grey Box EEC listed under the BC Act and Grey Box Grassy Woodland EEC listed under the EPBC Act in the landscape revegetation zones.

The avoidance and mitigation measures Actions 1 to 7 above will, in my opinion, significantly reduce the impacts of clearing for the water transfer pipeline. The linear nature of the clearing, its one off occurrence, its small width (0.5m), the use of underboring, avoidance of trenching near mature trees, the location of pipe laydowns in the lowest quality vegetation areas and the immediate rehabilitation of the ground layer post construction should, providing the above mitigation measures are implemented, ensure that impacts on the quality and habitat values (i.e. tree hollows, dead trees and woody debris and bush rock) will be retained within patches of remnant Grey Box Woodland EEC. The exception being the immediate pipeline disturbance area.

In my opinion the proposal to establish/enhance approximately 348.6 ha of Inland Grey Box EEC listed under the BC Act and Grey Box Grassy Woodland EEC listed under the EPBC Act in the Landscape Revegetation Zones, is somewhat irrelevant to the MCCP proposal. The enhancement of extant Grey Box Woodand within the Revegetation Zones has significant merit in the short to medium term. But given there is no indication of the length of time these areas will be managed for conservation outcomes or that these areas will ever be protected under Conservation Agreements in-perpetuity, the value as a mitigation action is questionable.

Similarly, as described for Box Gum Woodland, for the proposed replanting of areas of Grey Box Woodland EEC to achieve a similar level of condition and habitat value as the 6.4ha of EEC cleared will take a minimum of 100-120 years (which is how long it takes a small tree hollow to form) (Gibbons and Lindenmayer 1997, NSW NPWS 1999). Again, it is unclear in the EIS how long Whitehaven proposes to manage the revegetation zones, and again there is no indication that replanted areas within the revegetation zones will be protected in perpetuity. So, the possibility exists that long before these replanted areas reach a similar level of habitat value to the 6.4ha of EEC to be cleared, Whitehaven could sell these revegetation zones and the replanted vegetation potentially could be cleared.

Increased fragmentation

Refer to the description of fragmentation and connectivity given previously for Box Gum Woodland CEEC. Any fragmentation of the Grey Box Woodland EEC caused by construction of the water pipeline will be, providing avoidance and mitigation actions stated in the EIS (Premise (2025) are implemented, minimal and temporary in nature. This is because installation of the pipeline is a one-off action and rehabilitation will occur immediately following installation.

In my opinion, the greatest risk posed by the construction of the water transfer pipeline is the trenching. Which, while open, will act as a pitfall trap for small fauna (reptiles, small mammals and amphibians). Grey Box EEC fauna that do become trapped in the trench are susceptible to desiccation, drowning, hypothermia, starvation and/or predation. In my opinion, the EIS must provide greater detail as to the length of trench that is open at any given time. Simply stating that the length of excavated trench open at any given time will be minimised is not good enough. Additionally, any areas of open trench must be checked more than once per day for trapped fauna. Without more specification it is highly likely the trench will fragment habitat and result in injuries and death of ECC fauna.

Increased edge effects

As described earlier, for Box Gum Woodland CEEC, detrimental edge effects arise from clearing and fragmentation of native vegetation. Similarly, in recognition of the impact of edge effects have on remnant vegetation the same key threatening processes listed under both the NSW BC Act and/or Commonwealth EPBC Act apply.

This notwithstanding, it is my opinion, that providing the mitigation measures outlined in the EIS (Premise 2015) are applied to the water transfer pipeline development footprint including; clearly marking the limits of clearing (exclusion zones), erosion and weed management protocols, dust and noise reduction measures and stated mitigation measures are implemented then the any negative impacts of increased edge effects on areas of Grey Box Woodland EEC will be minimal.

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iii) *Poplar Box Grassy Woodland on Alluvial Plains* listed as an Endangered Ecological Community (EEC) under the Cth EPBC Act.

In my opinion, the key impacts arising in relation to *Poplar Box Grassy Woodland* EEC as a consequence of the Maules Creek Continuation Project (MCCP) are as follows:

Clearing native vegetation

The MCCP will remove 3ha of vegetation that meets the EPBC Act criteria for Poplar Box Woodland EEC from the mine development footprint, with a further 0.7ha of EEC ground cover removed for the installation of the water transfer pipeline (Ausecology 2025).

The consistency of these areas with the Commonwealth CEEC listing indicates to me that this vegetation is in good condition. This opinion is based in the key attributes that identify the Commonwealth EPBC Act listed community and my experience in this community. This opinion is supported by the DoEE (2019) listing advice for Poplar Box Woodland EEC which states, the '*national listing focuses legal protection on patches of the ecological community that are in comparatively good condition i.e. relatively natural*'.

As outlined by the DoEE (2019) listing advice these attributes are:

- the area must comprise grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale, and.
- a tree canopy must be present (derived grasslands are not included as part of the listed community) that shows these features:
  - tree canopy species are capable of reaching 10 m or more in height, and
  - Poplar Box (*Eucalyptus populnea*) must be present as the dominant tree species in the canopy, or
  - where hybrids of Poplar Box with other Eucalyptus spp are present, they should be counted as part of the *E. populnea* component of the tree canopy when assessing the previous criterion, and.

- a mid layer (1-10 m) crown cover of shrubs to small trees is low, about 30% or less, and
- a ground layer (<1m) ranging from sparse to thick and mostly dominated by native grasses, forbs and occasionally chenopods (during extended dry periods) occurs across the patch.

A patch having met the key diagnostic criteria above, must then meet the condition criteria outlined in Table 1 below. These condition criteria are designed to identify relatively good quality patches for protection under national environment law (i.e. those of moderate to high value) (DoEE 2019). Category C being the minimum condition criteria for the community to be considered part of the EPBC Act EEC. DoEE (2019) definitions of minimum patch sizes for linear remnants along roadsides and Travelling Stock Routes are shown in Appendix 4.

As stated above the MCCP proposes to remove 3ha of *Poplar Box Grassy Woodland* EEC in good condition from the mine development site and remove a further 0.7ha of ground cover within the EEC along the water transfer pipeline.

The impacts of clearing on the habitat values of Poplar Box Woodland are similar to those stated previously for Box Gum Woodland CEEC. Consequently, in recognition of the impacts of vegetation clearing, the following key threatening processes have been listed under both the NSW BC Act and/or Commonwealth EPBC Act:

- *Clearing of native vegetation* - BC Act (NSW TSSC 2001) and *Land clearance* - EPBC Act (TSSC 2001)
- *Loss of tree hollows* - BC Act (NSW TSSC 2007)
- *Removal of dead wood and dead trees* – BC Act (NSW TSSC 2003)
- *Bush rock removal* - BC Act (NSW TSSC 1999).

The removal of the 3ha on the mine development footprint will involve the operation of all four of these key threatening processes. Which according to MCCP will be mitigated by:

1. clearly marking the area of vegetation to be cleared. Clearing and disturbance would be restricted to the delineated area and no stockpiling of equipment, machinery, soil or vegetation would occur beyond this boundary.
2. locating the mine development site 200m back from the mapped top bank of Back Creek thereby avoiding 137.6ha of Poplar Box woodland.
3. staged clearing of the mine development footprint.
4. timing of vegetation clearing of woodland/forest native vegetation which will be undertaken in late summer and early autumn to avoid breeding and/or hibernating fauna species (i.e. between 15 February to 30 April), except under exceptional circumstances in the first year of mining operations for the project. So, in the first-year vegetation clearing will potentially take place when fauna are breeding and/or hibernating significantly increasing the risk of fauna injury and death from clearing operations.
5. staged rehabilitation of the EEC on the post mine footprint.

TABLE 1: *Condition categories and thresholds for the Poplar Box Grassy Woodland on Alluvial Plains ecological community. Note the key diagnostic features also apply. Condition Classes A, B and C are the defined ecological community (from DoEE 20219).*

Category and rationale	Native cover and diversity thresholds	Minimum patch size thresholds*
CLASS A HIGHEST QUALITY		
Category A1. Little to no perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is ≥10% **AND** ≥ 90% of perennial vegetation cover in the ground layer** is native **AND** ≥ 30 native plant species per patch in the ground layer	≥ 1 ha
Category A2. A large patch with low perennial weeds and diverse native understorey	The crown cover of canopy trees in the patch is ≥10% **AND** ≥70% of perennial vegetation cover in the ground layer** is native **AND** ≥ 30 native plant spp. per patch in the ground layer	≥ 5 ha
CLASS B GOOD QUALITY		
Category B. A large patch with good quality native understorey or with mature trees	The crown cover of canopy trees in the patch is ≥10% **AND** ≥ 50% of perennial vegetation cover in ground layer** is native **AND EITHER** ≥ 20 perennial native plant species per patch in the ground layer **OR** ≥ 10 mature trees+ per ha with ≥ 30cm dbh*** (and/or hollows)	≥ 5 ha
CLASS C MODERATE QUALITY		
Category C A large patch with low native cover but retains good native understorey diversity and habitat features of mature trees	The crown cover of canopy trees in the patch is ≥10% **AND** **If** < 50% of perennial vegetation cover in ground layer** is native, then the patch **must** have: ≥ 20 native plant spp. per patch in the ground layer **AND** ≥ 10 mature trees+ per ha with ≥ 30cm dbh*** (and/or hollows) **AND** smaller trees+, saplings or seedlings suggestive of periodic recruitment	≥ 5 ha

* **Minimum patch size thresholds** apply to patches of various shapes but, a minimum patch width threshold applies to linear remnants, such as along roadsides or former travelling stock routes. These are explained in the next section on 'Defining a patch'.

** **Perennial native vegetation cover in the ground layer** (i.e. below the tree canopy) includes vascular plant species of the ground layer with a life-cycle of more than two growing seasons. The ground layer includes grasses and herbs (i.e. forbs) and some low shrubs (woody plants ≤ 1 m high). Measurement of perennial ground layer vegetation cover excludes annuals, cryptogams (i.e. mosses, lichens and related flora), leaf litter or exposed soil.

6 revegetation of approximately 1,026.4ha of previously cleared vegetation in Landscape Revegetation Zones to the east and south-east of the mine development footprint with species characteristic of Poplar Box Woodland EEC.

The implementation of Actions 1 and 2 above will assist in maintaining 137.6ha adjoining EEC remnants from the impacts of clearing. Mitigation of the MCCP relies heavily on maintaining the habitat quality of the remaining 137.6ha of EEC along Back Creek, replanting of species consistent with the component EEC species on the post mine landscape and within the revegetation zones identified in the EIS. As identified for Box Gum Woodland CEEC, it is my opinion that remnant areas adjoining the mine development footprint will, despite the proposed mitigation measures be detrimentally impacted edge effects from by mine operations including; dust, noise, vibration, light pollution and air blasts.

In reference to the proposed replanting, I have no doubt Whitehaven will undertake rehabilitation and replanting on the mine project site and replanting within the revegetation zones. But what is unknown and highly problematic is whether these plantings will be successful in the long term in re-establishing recognizable areas of EEC. DoEE (2019) in the listing advice state, in regard to the rehabilitation of mine sites for Poplar Box EEC, '*once vegetation is cleared and topsoil stripped, these areas cannot be recovered to a pre-mining state, particularly for open-cut mines'*.

According to Premise (2025), the development footprint associated with the water transfer pipeline is 6.4ha. Of this area 2.4 ha (37%) traverses cultivated agricultural land which Premise (2025) has assessed as Category 1 – Exempt Land within the meaning of the LLS Act. The remainder of the pipeline runs parallel to Rangari Road through 0.7ha of Poplar Box Woodland which would be underbored to avoid removing mature trees.

The avoidance and mitigation measures proposed by Premise (2025) for the clearing of 0.7ha of ground cover within *Poplar Box Grassy Woodland* EEC for the construction of the water transfer pipeline include:

1 clearly mark the area of vegetation to be cleared. Clearing and disturbance would be restricted to the delineated area and no stockpiling of equipment, machinery, soil or vegetation would occur beyond this boundary.

2 underboring trees to avoid the need to remove mature trees.

3 where trenching is proposed near trees, a tree protection zone would be applied consistent with Australian Standard AS4970. The tree protection zone can be calculated as twelve times the diameter at breast height of the tree or 1m past the drip line of the tree.

4 installing the pipeline parallel to Rangari Road to avoid further intersection of the landscape.

5 laydown pipeline areas (i.e laying the pipeline on the soil surface) would be preferentially located in the lowest quality vegetation available.

6 pipeline route has been chosen to avoid waterways (the exception being Bollol Creek) and locating pipeline laydown areas outside of waterways.

7 the length of excavated trench that would be open at any one time would be minimised during construction of the pipeline, to reduce the risk of fauna becoming trapped. The excavated trench would be inspected daily for trapped fauna.

Additionally, mitigation includes a proposal to establish/enhance approximately 1,026.4 ha of *Poplar Box Grassy Woodland EEC* listed under the EPBC Act in the Landscape Revegetation Zones.

The avoidance and mitigation measures Actions 1 to 7 above will, in my opinion, significantly reduce the impacts of clearing for the water transfer line. The linear nature of the clearing, its one off occurrence, its small width (0.5m), the use of underboring, avoidance of trenching near mature trees, the location of pipe laydowns in the lowest quality vegetation areas and the immediate rehabilitation of the ground layer post construction should, providing the above mitigation measures are implemented, ensure that habitat values (i.e. tree hollows, dead trees and woody debris and bush rock) will be retained within patches of remnant Grey Box Woodland EEC. The exception being the immediate pipeline disturbance area.

In my opinion the proposal to establish approximately 1,026.4ha of *Poplar Box Grassy Woodland EEC* listed under the EPBC Act in the Landscape Revegetation Zones, is again somewhat irrelevant to the MCCP proposal. As described for the previous Threatened Ecological Communities (TECs), replanting of areas of *Poplar Box Grassy Woodlands* EEC to achieve a similar level of condition and habitat value as the 3.0ha of EEC cleared will take a minimum of 100-120 years (which is how long it takes a small tree hollow to form) (Gibbons and Lindenmayer 1997, NSW NPWS 1999). It is unclear in the EIS how long Whitehaven proposes to manage the revegetation zones, and again there is no indication that replanted areas within the revegetation zones will be protected in perpetuity. So, the possibility exists that long before these replanted areas reach a similar level of habitat value to the 3.0ha EEC to be cleared, Whitehaven could sell these revegetation zones, and the replanted vegetation potentially could be cleared. As a result, the value of this as a mitigation action is questionable.

Increased fragmentation

Premise (2025) states that in total three patches of Poplar Box Woodland EEC that overlap the boundary of the mine development footprint will be impacted by partial clearing such that the patch size would decrease for one patch from 5.7ha to 4.5 ha, 2.3ha to 1.0ha for a second patch and 6.6ha to 6.2ha for the third. This represents losses in area for these three remnant patches of 21%, 57% and 6% respectively. Consequently, and contrary to statements in the EIS (Premise 2025), the MCCP will increase the fragmentation of local occurrences of this EEC.

Under the MCCP the remaining patches of the *Poplar Box Grassy Woodland* EEC along Back Creek to the north and Leard State Forest to the east outside the disturbance footprint would remain. Patches of remnant EEC within these areas will still be connected by other treed and native grassland communities, so while connectivity will be significantly reduced by the MCCP through the loss of 676.6ha of native vegetation that includes 3.0ha of EEC on the mine development footprint, remnant patches the EEC itself within the remaining landscape will not be further isolated.

Any fragmentation of the *Poplar Box Grassy Woodland* EEC caused by construction of the water pipeline will be, providing avoidance and mitigation actions stated in the EIS (Premise (2025) are implemented, minimal and temporary in nature. This is because installation of the pipeline is a one-off action.

As described previously for Grey Box Woodland EEC the greatest risk posed by the construction of the water transfer pipeline is, in my opinion, the trenching in. Which, while open, will act as a pitfall trap for small fauna (reptiles, small mammals and amphibians). *Poplar Box Grassy Woodlands* EEC fauna that do become trapped in the trench are susceptible to desiccation, hypothermia, starvation, drowning and/or predation. In my opinion, the EIS must provide greater detail as to the length of trench that is open at any given time. Simply stating the length of excavated trench open at any given time will be minimised is not good enough. Additionally, any areas of open trench must be checked more than once per day for trapped fauna. Without more specification it is likely that the trench will fragment habitat and result in injuries and death of ECC fauna.

Increased edge effects

As described for the previous Threatened Ecological Communities, detrimental edge effects arise from clearing and fragmentation of native vegetation. Similarly, in recognition of the impact of edge effects have on remnant vegetation the same key threatening processes listed under both the NSW BC Act and/or Commonwealth EPBC Act apply.

According to Premise (2025) the impact of increased edge effects on remnant vegetation outside the mine development footprint will be mitigated and managed by the implementation of:

1 erosion and weed management protocols on site

2 a Noisy Miner control program along remnant habitat edges

3 dust and noise reduction measures and

4 the use of directional lighting wherever practicable along the edge of the mine site

5 feral animal control programs, and

6 vehicle speed limits.

While these actions will potentially reduce the impacts of some of the edge effects from degrading the 137.6ha of remnant *Poplar Box Grassy Woodland* EEC adjoining mining site, no evidence is provided in the EIS to support the efficacy of these actions in maintaining habitat values for flora and fauna.

Of the actions proposed Actions 1, 2 and 5 are the most likely to be successful in maintaining habitat values, if implemented. There is no evidence that Actions 3, 4 and 6 will be effective in reducing noise and dust particularly for EEC remnants adjoining the access road to the go line along the northern boundary of the mining pit. The EIS (Ausecology 2025) indicates that vehicle movements along the northern access road to the go line will be in the order of 350 vehicle movements per day, each of which will generate dust, noise and vibration. The 24-hour operation of the mine would also indicate that even if directional lighting is used, adjoining remnants will still suffer light pollution from 24hr lighting, as well as from vehicle lights moving around the mining pit and along the northern access track during darkness.

In fact the EIS (Premise 2025) states that '*Noise modelling has been undertaken by specialist noise consultants RWDI Australia Pty Ltd (RWDI, 2025) for the Project and it shows that the amount of noise would increase mainly due to a greater number of mining trucks and equipment (to reflect the increase in ROM [Run of Mine] coal mining rate proposed and increasing open cut pit extent), but also extend into the eastern part of the State Forest. The same assessment shows a similar outcome for blasting emissions*.' According to the EIS (Whitehaven (2025) there is potential for two blasts per day which according to the EIS (Premise 2025) '*would also have impacts on individual animals however these impacts would be mitigated by the weekly average number of blasts reaching the same (i.e. altogether blasting may occur twice in a day, the average of four a week would remain)*'. It is difficult to see how on-going blasting and 24hr vehicle movements will not detrimentally impact the habitat values of adjoining CEEC remnants and their faunal components.

The above notwithstanding, it is my opinion, that providing the mitigation measures outlined in the EIS (Premise 2015) are applied to the water transfer pipeline development footprint including; clearly marking the limits of clearing (exclusion zones), erosion and weed management protocols on site, dust and noise reduction measures and stated mitigation measures are implemented then the any negative impacts of increased edge effects on areas of *Poplar Box Grassy Woodlands* EEC will be minimal.

Increased Groundwater Drawdown

As identified in the EIS (Whitehaven 2025) some of the Eucalypt species including yellow box (*Eucalyptus melliodora*) and poplar Box (*E. populnea*) that will be retained along Back Creek are facultative groundwater dependent species. Both these species are component species of the Poplar Box Grassy Woodlands EEC.

Facultative groundwater dependent species are species that have an infrequent (e.g. during periods of drought and low rainfall) or partial dependence on groundwater (Zencich *et al.* 2002). As per the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Serov *et al* 2012), minor changes to the groundwater regime may not have any adverse impacts on facultative GDEs that use groundwater as opportunistically. But these ecosystems can dieback if reduced access to groundwater is prolonged or if the change is too rapid and trees are unable to adapt.

Facultative ground water dependent species extract water either;

- indirectly from the water table via the capillary effect or
- from the soil profile immediately above the water table where groundwater has moved upwards due to capillary action, i.e. the unsaturated (moist) soil above the water table.

Modelling by AGE (Whitehaven Section 6, 2025) indicates existing groundwater depths are between approximately 10 to 25 m below surface along Back Creek adjacent to the mine development footprint.

The EIS (Whitehaven Section 6, 2025) states that '*drawdown could result in additional stress to larger trees associated with the facultative ground water dependent ecosystems during prolonged drought conditions, but is not likely to result in the widespread loss of the larger trees, or prevent the long-term viability of the dependent ecosystem*'. The EIS acknowledges that in a prolonged drought there could potentially be an impact (i.e. tree death and/or dieback) in remnants of *Poplar Box Grassy Woodland* EEC. It is therefore difficult to understand why in a prolonged drought drawdown, as a result of mining operations, would not result in the widespread loss of larger trees or detrimentally impact the long term viability of the EEC.

According to the EIS (Whitehaven Section 6 2025) '*any management, monitoring or mitigation measures relevant to GDEs would be described in the Water Management Plan'*. However, the Water Management Plan is not included in the EIS, so the efficacy of any management, monitoring or mitigation actions cannot be assessed by an approval authority.

b) Noting the definition of 'serious and irreversible impacts' in s7.16 BC Act, the principles at cl 6.7 BC Regulation, and departmental guidance, in your opinion, is the Project likely to have a serious and irreversible impact on the Box Gum Woodland CEEC?

Serious and irreversible impacts (SAII) are defined in s7.16 of the BC Act as the '*impacts on biodiversity values as determined under section 6.5 that would remain after the measures proposed to be taken to avoid or minimise the impact on biodiversity values of the proposed development or activity*'. Section 6.5 of the BC Act directs the reader to the principles prescribed in cl 6.7 of the *Biodiversity Conservation Regulation 2017* (BC Reg). Under cl 6.7 BC Reg principle (2):

An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community becoming extinct because:

(a) it will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or

(b) it will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or

(c) it is an impact on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or

(d) the impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.

The DPIE *Guidance to assist a decision maker to determine a serious and irreversible impact* (2019) and DEH Serious and Irreversible Impacts website [Serious and irreversible impacts | Biodiversity Offsets Scheme | Environment and Heritage] (accessed July 2025), provide information to assessors and decision makers to assist in determining whether a threatened species and threatened ecological communities are at risk of serious and irreversible impacts. DEH website identifies Box Gum Woodland CEEC as an entity at risk of serious and irreversible impacts and Principles (a) or (b) of cl 6.7 BC Reg as relevant to this CEEC. With principal (a) being the relevant consideration for determining SAII for Box Gum Woodland CEEC. In relation the MCCP, is the project likely to *cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.*

Given that, as detailed in the *National Recovery Plan* (DECCW 2010), prior to European settlement Box Gum Woodlands formed an almost continuous band comprising several million hectares from Queensland through NSW into Victoria. However, since European settlement its occurrence on moderate to high fertility soils has resulted in the preferential clearing of large areas of this ecological community for urban, industrial and agricultural development and/or its modification for pasture improvement and grazing (DECCW 2010). In 2007, Australian Government estimated that only 405,000ha (less than 6%) of the original several million hectares of this ecological community remained in all its various condition states (DECCW 2010). While in 2006, the Commonwealth TSSC was of the opinion that less than 10% of the original extent of Box Gum Woodlands remained (TSSC 2006). But of that remaining 10% only 5% was of sufficient condition and extent to comprise the listed Box Gum CEEC under the EPBC Act (TSSC 2006).

HunterEco (2024) in the assessment of SAII on Box Gum Woodland CEEC for the MCCP concluded the following:

'*This assessment has presented evidence to indicate that the impacts of the Project will not contribute significantly to the risk of the ecological community becoming extinct in NSW on the grounds that:*

- *The ecological community does not have a very limited distribution.*
- *The ecological community has been shown to respond to measures to improve its habitat and vegetation integrity.*
- *There is in the order of 16,090,000 ha of Box-Gum Woodland CEEC in NSW meaning that the total lost to the Project is 0.0005% of the total occurrence, which would not place Box-Gum Woodland CEEC as a whole at risk of extinction.*
- *The Project would not result in isolation of any Box-Gum Woodland CEEC remnants.'*

While I agree with the first dot point, based on the extensive natural distribution of the CEEC, I strongly disagree with the next 2 dot points for the following reasons.

Dot point 2 - is correct only in that the CEEC has been shown to respond to management actions such that the habitat values and vegetation integrity of extant degraded remnants can be improved (DPIE 2021). However, there are to my knowledge, no examples of successful re-establishment of the CEEC on severely disturbed ground such as back-filled mine voids. In fact, the NSW TSSC (2020) in their final determination state, '*the restoration of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland or Derived Native Grassland following conversion to cropping is unlikely'.* It is important to note, that land that has been cleared and cultivated for cropping is much less disturbed than back-filled mine voids. So, if restoration is considered unlikely on the cultivated land then it will be even less likely, if not impossible, on back-filled mine voids.

Mitigation for the clearing of 79.9ha of Box Gum Woodland CEEC on the MCCP mine development footprint relies heavily on, replanting CEEC species on the post mine landscape and within the revegetation zones identified in the EIS, as well as the existing commitment to establish 544ha of Box-Gum Woodland CEEC on the post-mine landform (Condition 25 of EPBC Act Approval 2010/5566).

As discussed previously, even on the proposed revegetation zones to achieve a similar level of condition and habitat value as the 79.9ha of CEEC cleared (i.e. replanting within existing CEEC derived native grasslands) will take a minimum of 100-120 years (which is how long it takes a small tree hollow to form) (Gibbons and Lindenmayer 1997, NSW NPWS 1999). It is unclear in the EIS how long Whitehaven proposes to manage the mine rehabilitation site or the revegetation zones. There is no indication that replanted areas within the revegetation zones will be protected in perpetuity. So, the possibility exists that long before these replanted areas reach a similar level of habitat value to the 79.9ha of CEEC to be cleared, Whitehaven could sell these revegetation zones and the replanted vegetation potentially could be cleared.

The evidence of the timeframes required to achieve many CEEC habitat elements is evidenced in the replantings on offset properties for the existing mining operation which are protected under existing Conservation Agreements. The replanted CEEC on these properties is currently some 10 years old, and (as demonstrated by photos in the EIS, 2025) it is at best a functionally single aged stand shrubland with limited habitat value (Ausecology Appendix C 2025). The limited habitat value of these replantings is due to;

- little or no structural diversity (i.e. no tree canopy cover with understorey shrubs and tree/shrub regeneration) – necessary for species including the speckled warbler and diamond firetail
- no mature feed/nectar producing trees - for species such as the koala and squirrel gliders
- no mistletoes - for species including the painted honeyeaters and diamond firetail, and
- no mature/old growth hollow-bearing trees or dead standing trees – essential a shelter and breeding sites for brown-treecreepers, Corben's long-eared bat, yellow-bellied sheathtail bat and squirrel gliders.

In the EIS, Ausecology (2025) proposes to reintroduce some short to medium term supplementary habitat features to attract fauna back to these replanted areas, such as:

- vertical placement of standing dead hollow-bearing trees (stags)[1]
- installation of glide poles to assist gliders to cross rehabilitation areas
- installation of rope bridges from existing habitat to rehabilitation areas
- installation of bird perches[1] (salvaged from cleared vegetation) to give birds crossing replanted areas places to rest, roost and potentially hunt from
- reintroduction of fallen timber and hollow logs[1]
- introduction of rock piles
- installation of artificial nest boxes, and
- transplanting mistletoes.

However, many of these actions cannot be effective in newly planted areas and/or even areas 10-years-old, which are functionally single aged shrublands, as per the existing rehabilitation areas. This is because many of these actions require tree stem diameters of a minimum of 20cm or larger to be installed, e.g. transplanting mistletoe and/or installation of artificial nest boxes. While other actions could be installed earlier (e.g. glide poles, rope bridges, bird perches and standing stags) but until the replanted areas are of sufficient maturity to have habitat value for the species they are intended for, i.e trees are flowering and producing nectar (for gliders) and/or habitat for prey species is present (for birds of prey) they are unlikely to be successful. This is because woodland and forest fauna species tend to prefer woodland and forest vegetation structures not single aged stand shrublands. To venture into open shrubland areas often places these species at high risk of predation, desiccation, hypothermia and/or starvation.

Of the actions proposed the introduction of fallen timber, hollow logs and rock piles are likely to be more effective in the short to medium term. This is because smaller ground-layer and/or grassland dependent species (e.g. skinks, dunnarts and echidnas) can often take advantage of quicker growing cover provided by native grasses and shrub/tree saplings, providing their food/prey sources are present. Hence, they can utilize the re-introduced shelter/breeding resources e.g. fallen timber, hollow logs and rock piles mush earlier in the regrowth cycle.

The EIS lacks any specificity as to the appropriate timing for the installation of any of the supplementary habitat feature proposed above but rather states for all, the anticipated timing and duration is, '*from commencement of rehabilitation of the Project until rehabilitation works are complete*' (Ausecology 2025). Which is misleading, as this implies the mitigation actions proposed will be effective from the time of installation, which they clearly will not. Paton *et al* (2004) in proposing rehabilitation of patches of >100ha of cleared

[1] Salvaged from cleared vegetation

agricultural land in South Australia for threatened bird species states, '*this restoration program will take a 100 or more years to produce self-sustaining woodland habitats that the birds can use'*.

Does the reader and/or the approval authority have to presume that Whitehaven plan to manage the rehabilitated mine sites and revegetation zones for 100 years or more, because only then is it likely the rehabilitated areas are self-sustaining.

Dot point 3 – in 2020 the NSW TSSC estimated there were 15,110,000ha of Box Gum Woodland CEEC remaining. It is important to note this estimate is the area of CEEC based on the NSW determination, i.e. Box Gum Woodland in all known condition forms. However, Premise (2025) identified that of the 79.9ha of Box Gum Woodland on the MCCP mine development footprint 21.9ha is consistent with the Commonwealth CEEC listing, i.e. in good condition. This is supported by the Commonwealth Approved Conservation Advice (DCCEEW 2023) which states, the '*national listing focuses legal protection on patches of the ecological community that are the most functional, relatively natural and in comparatively good condition'.*

Hunter Eco (2025) has calculated the area of Box-Gum Woodland CEEC using the NSW State Vegetation Type Mapping (SVTM) and the NSW Government Plant Community Type (PCT) mapping, as well as the associated assignment of PCTs to the Box-Gum Woodland CEEC. The result of this calculation is '*in the order of 16,090,000 ha of Box-Gum Woodland CEEC in NSW meaning that the total lost to the Project is 0.0005%* (Hunter Eco 2025). There are a few issues with how the area of 16,090,000ha has been determined, some of which have been acknowledged by Hunter Eco and others which have not. These issues include:

- the areas of the mapped PCTs within the NSW SVTM have been computer modelled. This means very few areas of NSW and the mapped PCTs have been ground truthed. From previous ground-truthing audits of the SVTM mapping undertaken by myself and Dr John Hunter, for the Namoi Catchment Management Authority and Combined Hunter Councils, the areas of mapped PCTs in the SVTM are often less than 35% accurate.
- As identified by Hunter Eco (2025) only a few of the mapped PCTs conform to the NSW Box Gum Woodland listing. There are however a range of PCTs which may, in part, given the correct environmental conditions, co-occurrences of species and density of growth forms meet the definition of the NSW CEEC listing. However, the percentage of any area of these PCTs conforming to the CEEC description is impossible to determine from the mapped polygons.
- There is no derived native grassland mapping and given the pre-1750 SVTM is incomplete for Box Gum Woodland (Hunter Eco 2025), there is no way to accurately determine the current area of Box Gum derived native grasslands. So, given the above, the areas of Extent of Occurance (EOO) and Area of Occupancy (AOO) proffered in the Hunter Eco (2025) report are at best guesstimates. Consequently, the percentage of 0.0005% total loss of Box Gum Woodland CEEC as a result of the MCCP cannot be accepted at face value.

- There are also no mapped condition ratings for the PCTs so there is no way to determine whether any of the wooded PCTs within the NSW SVTM comprise the Commonwealth Box Gum Woodland CEEC listing and therefore would be classified as having good condition.

Hunter Eco (2025) asserts, based on the EOO map in the report, that the Box Gum Woodland CEEC on the MCCP mine development footprint is not at the limit of its distribution. I strongly reject this statement. Based on my knowledge and experience of the geographic distribution of Box Gum Woodland CEEC, but particularly in northern NSW and the Brigalow Belt South IBRA region, I know the Box Gum Woodland CEEC on the MCCP mine development footprint is at the western edge of its distribution. This opinion is supported by Dr John Hunter (*pers com* 2025) who also has personal experience of distribution of Box Gum Woodland in northern NSW and the Brigalow Belt South IBRA region.

Further Hunter Eco (2025) has identified that there are approximately 44.2ha of Box-Gum Woodland CEEC within 1,000ha surrounding the MCCP mine development footprint and approximately 190.3ha within the surrounding 10,000ha. These occurrences are scattered patches that lie in a mostly cleared agricultural matrix. Based on these figures the removal of 79.9ha of CEEC on the mine development footprint will result in a 64% reduction in the CEEC within the surrounding 1,000ha landscape and a 30% reduction in the wider surrounding 10,000ha landscape. Such significant area losses in a predominantly agricultural/mining landscape, of a CEEC which has an estimated less than 5% remaining in relatively good condition is far more relevant to the impact of the MCCP clearing then any assessment of area losses on a statewide scale.

It must be remembered that this community once covered millions of contiguous hectares and has, since European settlement, been cleared, fragmented and/or modified area by area and hectare by hectare. Today the remaining area of Box Gum Woodland CEEC continues to undergo loss and detrimental change due to ongoing clearing (legal and illegal), weed invasion, grazing, pasture improvement, conversion to set stocking, and the effects of fragmentation (TSSC 2006, DCCEEW 2023).

Box Gum Woodland is listed as critically endangered under both NSW and Commonwealth legislation. This means that both the NSW and Commonwealth TSSCs are of the opinion that Box Gum Woodland CEEC is at '*an extremely high risk of extinction in Australia in the immediate future*' (NSW TSSC 2020). In my opinion, it is the continued incremental loss (i.e. death by a thousand cuts) including the clearing proposed of 79.9ha on the MCCP mine development footprint that will inevitably contribute to its extinction.

Dot point 5 - while the project will not isolate any occurrences of the CEEC it will cause significant fragmentation and increased edge effects [refer previous section (i)] which in turn will threaten the on-going existence and quality of the remaining CEEC patches over and well beyond the life of the MCCP.

c) In your opinion, was the assessment of impacts on the Ecological Communities, as far as it relates to your areas of expertise, appropriate and sufficient?

In my opinion, the assessment of the impacts on the Ecological Communities was neither appropriate nor sufficient, particularly on and adjacent to the mine development footprint.

The BC Act s6.3A requires, for the purposes of the biodiversity offsets scheme, developments to implement an *avoid, minimise and offset hierarchy* regarding the impacts of their actions on biodiversity values. As outlined in the BC Act the implementation of this hierarchy is required as follows:

(a) the proponent of the action first takes all reasonable measures to avoid the impacts of the action on biodiversity values,

(b) after taking all reasonable measures under paragraph (a), the proponent then takes all reasonable measures to minimise the impacts that have not been avoided,

(c) having taken the measures under paragraph (b), the proponent then takes biodiversity conservation measures under the biodiversity offsets scheme to offset or compensate for any residual impact on biodiversity values.

According to the EIS (Premise 2025) the MCCP has reduced its clearing/disturbance area from its original design of 771.3ha to 682.9, which according to Premise (2025) is an avoidance of 91.3ha. However, the actual area of avoidance based on these figures is 88.4ha not 91.3ha. What's more the avoidance area includes 2.3ha of exempt land and/or non-vegetated land, further reducing the area of native vegetation avoided to 86.1ha. It also includes approximately 74.5ha of mine rehabilitation area which according to Premise (2025) is likely to comprise PCT 592 *Narrow-leaved Ironbark-Cypress Pine – White Box Shrubby Open Forest* which is not a Threatened Ecological Community (TEC). Areas of TECs that have been avoided (Premise 2025) include:

- 3.8ha along the water transfer pipeline of Grey Box Grassy Woodland EEC, and
- 7.8ha of TECs north of the final proposed mine development footprint comprising 2.9ha of Box Gum Woodland CEEC and 4.9ha of Poplar Box Grassy Woodland EEC.

In summary, while the MCCP EIS has reduced the area of TECs to be cleared, it appears to have done so to the minimal extent necessary. Notwithstanding this avoidance, the disturbance footprint immediately abuts several patches of Box Gum Woodland CEEC and Poplar Box Grassy Woodland EEC to the north and east.

According to the BCT hierarchy outlined above, having avoided the clearing of 11.6ha of TECs the proponent '*then takes all reasonable measures to minimise the impacts that have not been avoided*'.

With regard to the Grey Box Woodland and Poplar Box Woodland EECs along the water transfer pipeline it is my opinion [refer s(a)ii] that provided all mitigation measures proposed in the EIS (Premise 2025) are implemented, this MCCP installation will have a minimal impact on this EEC.

In contrast, and as discussed earlier [refer s(a)i and s(a)iii], the clearing for the mine development footprint will significantly increase the fragmentation of the remaining patches of TECs outside and adjoining the footprint. Increased fragmentation will result from a reduction in patch size and alterations to patch shape, which will increase these patches susceptibility to edge effects. Consequently, should this development be approved, the current quality of these remnants and the habitat they provide for their faunal component will be significantly impacted by; dust, noise, vibration, air blasts and light pollution. These impacts are due to the remnant's proximity to MCCP 24hr mining operations and the 350 vehicle movements per day (Ausecology 2025) along an adjoining access track to a go line.

As discussed previously [refer s(a)i and s(a)iii] (Premise 2025) noise modelling indicates that should the MCCP be approved the amount of noise will increase from 24hr/day vehicle movements and blasting. Twenty-four hour/day operation will also mean that adjoining vegetation will be subject to light pollution (notwithstanding the proposed use of directional lighting) and vibration.

A part of the mitigation for the clearing TECs and native vegetation, the EIS (Premise 2025) proposes progressive revegetation of the post mine landforms following completion of active mining operations. Establishing approximately 481.2ha of woodland and forest on these areas. However, in s7.4.4 Appendix C (Premise 2025) in describing the areas of rehabilitation on the post mine void it talks about the additional 656ha area of rehabilitation on the continuation project footprint. It is unclear in the EIS why this variation in the proposed MCCP rehabilitation area exists.

Further, Premise (2025) states that revegetation would aim to establish self-sustaining native woodland and forest communities that were present prior to the commencement of mining on the final MCCP landform. No areas of TECs to be reestablished on these reconstructed landforms is given. While this is concerning, of more concern is scarcity of detail regarding how the presence of self-sustaining woodland and forest communities would be determined after replanting. The only indication given in the EIS is the statement, '*MCC would aim to create recognisable PCTs in the BioNet Vegetation Classification'* (Premise 2025). Nonetheless, it is my opinion that a PCT that conforms with the BioNet Vegetation Classification (BVC) description would not necessarily be self-sustaining, nor would it have the habitat values of the vegetation communities cleared. This is because the BVC descriptions are primarily lists of co-occurring flora species in the constituent strata of any given PCT. There are no condition ratings nor habitat values associated with a BVC PCT.

As stated previously [refer s(a)i and (a)iii] it will take more than 100 years for replanted vegetation to achieve the same habitat values as that cleared, if ever. This includes areas of TEC. So much more detail is required in the EIS as to how a self-sustaining vegetation community will be identified.

This is also true for the proposed Landscape Revegetation Zones. Where it is planned as part of the mitigation to enhance existing extant TEC areas and/or replant species consistent with the three TECs within areas of derived native grassland, non-native vegetation and non-vegetated areas (i.e. cropped areas). This includes:

- 340.9 ha of Box-Gum Woodland CEEC listed under the NSW BC Act and Commonwealth EPBC Act
- 1,026.4 ha of Poplar Box Woodland EEC listed under the Commonwealth EPBC Act, and
- 348.6 ha of Inland Grey Box Woodland EEC listed under the NSW BC Act.

While this proposal looks good on paper, i.e. much greater areas of the TEC will be created than areas cleared, all the issues with such a proposal outlined previously in this document remain true. These are:

- MCC are not proposing to protect these revegetation landscape zones under any in-perpetuity Conservation Agreement. Consequently, there will be no oversight of the success or otherwise of this proposal nor any protection into the future.
- No detail is provided as to how long these areas will be managed for, or whether they will be sold off in future years and potentially cleared.
- The probability of successfully reestablishing any of the TECs on re-shaped mine void areas and previously cropped land is highly unlikely.
- Even if successful, it will take more than 100 years to achieve TECs with similar habitat values (i.e. with hollow bearing trees). Will these areas be managed by MCC for that length of time?
- There are significant differences in vegetation condition between the NSW and Commonwealth listings for Box Gum Woodland CEEC and Poplar Box Woodland EEC. No detail is provided in the EIS as to how these differences will be assessed in re-established vegetation.
- No contingency plans are provided for the potential impacts of stochastic and/or climate change events e.g. extended droughts, flooding or bushfire intensities.

d) In your opinion, has the assessment adequately considered any cumulative impacts to the Ecological Communities arising from the Project?

In my opinion, the assessment of the MCCP has not adequately considered any cumulative impacts to the Box Gum Woodland CEEC arising from the Project.

According to the EIS (Premise 2025), the cumulative impact of MCCP and other major projects in the area including: Boggabri Coal Mine, Tarawonga Coal Mine, Vickery Coal Mine, Narrabri Underground Mine, Maules Creek Solar Farm, Whitehaven Solar Farm, Narrabri Solar Farm and Narrabri South Solar Farm is the loss of 1,260.5ha of Box Gum Woodland CEEC either cleared or proposed to be cleared. However, this cumulative impact is proposed to be mitigated by 1,314.7ha of Box Gum Woodland CEEC rehabilitated on post-mine landforms, approximately 340.9ha voluntarily planted in the MCCP landscape revegetation zones and the current protection of 9,540.2ha of CEEC in perpetuity on off-set properties.

For all of this, the only guaranteed positive outcome for Box Gum Woodland CEEC is the conservation of existing areas of CEEC (9,540.2ha) on the off-set properties. This is because these are existing extant areas of Box Gum Woodland CEEC, either listed under NSW legislation or Commonwealth legislation, that will be managed in perpetuity for conservation outcomes. The downside to this 9,540.2ha is that the existing MCC offset properties are located across three IBRA bioregions (Brigalow Belt South, Nandewar and New England Tablelands). Consequently, those outside the Brigalow Belt South (where the MCCP is located) have limited value as 'like for like' in protecting the values of the 79.9ha to be cleared under the MCCP. Being in different IBRA regions means areas of Box Gum Woodland CEEC exist in different climate zones (rainfall, temperature, wind and humidity) and occur on different landforms, soil types and soil nutrient/hydrological regimes. They therefore support different suites of flora and fauna species.

It must also be noted, the area of 9,540.2ha is currently 79.9ha larger with the inclusion of the CEEC on the MCCP mine development footprint, which will only be cleared if the project is approved. Consequently, should this project be approved there will be a net loss of CEEC, as all mitigation proposed is unlikely to protect extant remnant stands adjoining the mine footprint and any rehabilitation, if successful, will not achieve the same condition or habitat values for more than 100 years.

As for the 1,314.7ha of rehabilitated CEEC on post-mine landforms and the 340.9ha CEEC on the MCCP landscape revegetation zones these are yet to be realised. As detailed previously, I do not believe it will be possible in the short to medium term to re-establish this CEEC on rehabilitated post-mine landforms, if at all. Further, it may be possible to replant CEEC species on the proposed revegetation zones but, in my opinion, even if re-establishment is successful, it will take more than 100 years to achieve the same condition and habitat values as the 79.9ha to be cleared for the MCCP. Given the already highly fragmentated and modified nature of Box Gum Woodland remnants, the loss of a further 64% within the surrounding 1,000ha landscape and a 30% loss in the wider surrounding 10,000ha landscape (Hunter Eco 2025) of this critically endangered community is likely contribute to local extinctions of composite flora and fauna.

The EIS provides no figures or assessment regarding the cumulative impacts on Grey Box Woodland or Poplar Box Woodland EECs.

e) In your opinion, are the measures proposed as part of the Project to mitigate and avoid impacts to the Ecological Communities adequate? Are there any additional and appropriate measures that would minimise those impacts if consent was to be granted to the Project?

In my opinion the avoid and mitigation measures proposed for the MCCP water transfer pipeline on Grey Box Woodland and Poplar Box Grassy Woodland EECs are adequate, providing they are implemented as written.

I don't believe the measures proposed to avoid impacts to the Box Gum Woodland CEEC and Poplar Box Grassy Woodland EEC on the mine development footprint are adequate. This is because they rely heavily on replanting these TECs on the post-mine landscape and in the proposed landscape revegetation zones. As described previously, I don't believe it will be possible to re-establish either of these TECs on the post-mine landscape. This opinion is supported by both the NSW TSSC (2020) and DoEE (2019).

As described previously [refer s(a)i and s(a)ii] extant remnant areas of these two TECs adjoining the northern boundary of the mine development footprint will be significantly and detrimentally impacted by; dust, noise, blasting, vibration and light pollution from mining operations the proposed mitigation measures notwithstanding. I don't believe, due to the proximity of extant remnants along the eastern and northern boundary of the mine development footprint, that there are any additional or appropriate mitigation measures that would minimise the impact of the MCCP on the Box Gum Woodland CEEC and Poplar Box Grassy Woodland EEC.

In contrast, replanting within the landscape revegetation zones is likely to be successful with appropriate management, at least in areas of CEEC and EEC derived grasslands. It will however take more than 100 years to achieve the same habitat values as the areas of these TECs cleared from the mine development footprint. Of concern is the lack of significant detail in the EIS regarding many of the mitigation measures associated with the replanting including; how self-sustaining ecological communities will be identified, how the age/structure of rehabilitation sites will influence the installation of supplementary fauna habitat features and how replanting on the landscape revegetation zones will be managed and protected into the future.

Wendy Hawes

Principal Ecologist | The Envirofactor

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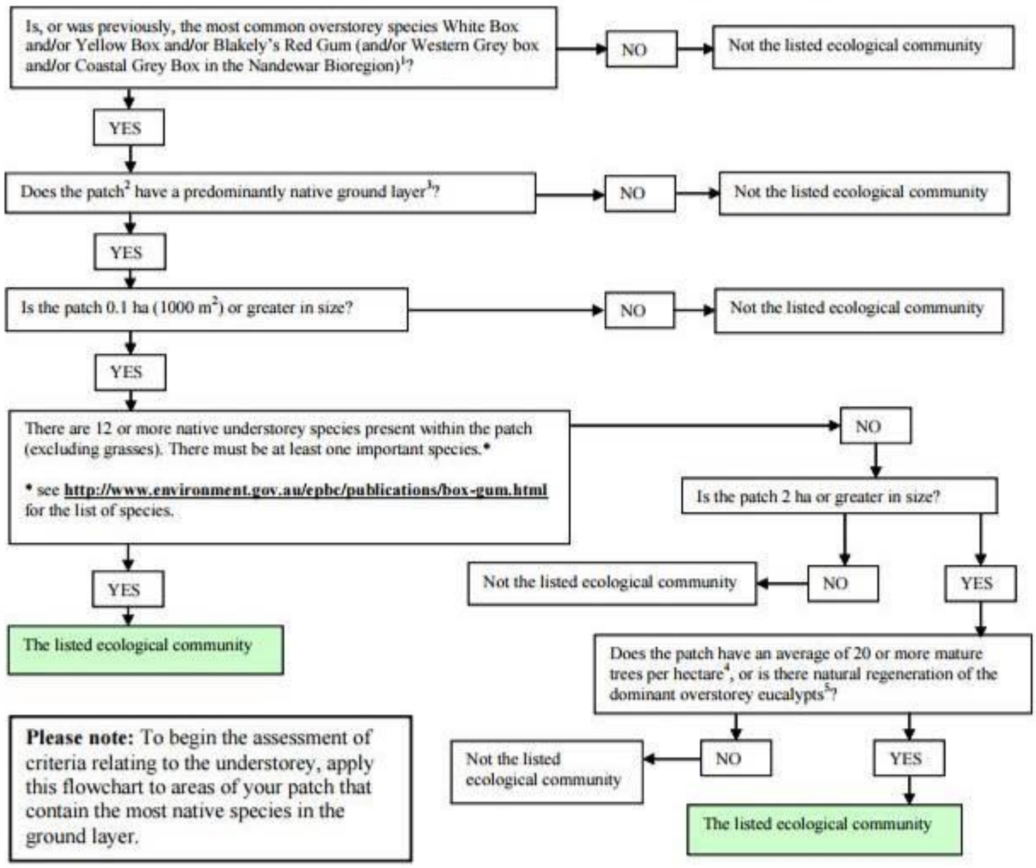
Appendix 1:

FLOWCHART for the IDENTIFICATION of the CRITICALLY ENDANGERED *WHITE BOX YELLOW BOX BLAKELY'S RED GUM GRASSY WOODLAND and DERIVED NATIVE GRASSLAND* ECOLOGICAL COMMUNITY LISTED UNDER the EPBC Act (from the National Recovery Plan DECCW 2010)

Updated from: DEH (2006) *White Box-Yellow Box-Blakely's Red Gum grassy woodlands and derived grasslands. EPBC Act Policy Statement. Department of the Environment and Heritage.*

The flowchart below represents the lowest condition at which patches are included in the listed ecological community. This is not the ideal state of the ecological community. Large patches, those that link remnants in the landscape, those that occur in highly cleared areas, those that contain rare, declining or threatened species, and those that represent the entire range of the ecological community, are important for the long-term future of the ecological community.

Determining if your land has an area of the listed ecological community



[1] These dominant species may include hybrids with any other *Eucalyptus* species.

[2] Patch – a patch is a continuous area containing the ecological community (areas of other ecological communities such as woodlands dominated by other species are not included in a patch). In determining patch size it is important to know what is, and is not, included within any individual patch. The patch is the larger of:
• an area that contains five or more trees in which no tree is greater than 75 m from another tree, or
• the area over which the understorey is predominantly native.

[3] A predominantly native ground layer is one where at least 50 per cent of the perennial vegetation cover in the ground layer is made up of native species. The best time of the year to determine this is late autumn when the annual species have died back and have not yet started to regrow.

[4] Mature trees are trees with a circumference of at least 125 cm at 130 cm above the ground.

[5] Natural regeneration of the dominant overstorey eucalypts occurs when there are mature trees plus regenerating trees of at least 15 cm circumference at 130 cm above the ground.

Appendix 2: Important Species List for EPBC listed Box Gum Woodland CEEC

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community **Species List**

This species list is designed to provide information about plant species that can be found in the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ecological community listed under the *Environment Protection and Biodiversity Conservation Act 1999*. The species list was developed to complement the Listing Information Guide, and should be read in that context.

It provides information on scientific and common names of the species, the kind of plant the species is, whether it is an 'important' species for the purposes of this ecological community and whether it is exotic or native, perennial or annual.

The list is not exhaustive and not all of the species listed will occur in every patch of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. If there are any species that you think should be added to the list, removed from the list, or that are categorised incorrectly, please contact Peter.Komidar@deh.gov.au. As such, this document may change over time and you should check that you are referring to the most recent version of the list.

Pictures and distribution maps can be found at http://plantnet.rbgsyd.nsw.gov.au/search/simple.htm

Caveat: This list has been compiled from a range of sources. While reasonable efforts have been made to ensure the accuracy of the information, no guarantee is given, nor responsibility taken, by the Commonwealth for its accuracy, currency or completeness. The Commonwealth does not accept any responsibility for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the information contained in this list. The information contained in this list does not necessarily represent the views of the Commonwealth. The list is not intended to be a complete source of information on the species it deals with.

Scientific Name	common name	category	native or exotic	Important species	annual/ perennial	Family	Common name of family	Old scientific name
Native								
Fern								
Asplenium flabellifolium	Necklace Fern	Fern	Native		perennial	Aspleniaceae	ferns	
Botrychium australe	Parsley Fern	Fern	Native		perennial	Ophioglossaceae	ferns	
Cheilanthes austrotenuifolia	Rock-fern	Fern	Native		perennial	Adiantaceae	maidenhair fern	
Cheilanthes distans	Bristly Cloak Fern	Fern	Native	Important	perennial	Adiantaceae	maidenhair fern	
Cheilanthes sieberi	Narrow Rock Fern	Fern	Native		perennial	Adiantaceae	maidenhair fern	
Pteridium esculentum	Common Bracken, Gurgi (Cadigal), Austral Bracken, Bracken	Fern	Native		perennial	Dennstaedtiaceae	bracken ferns	
Grass								
Aristida behriana	Brush Wiregrass, Bunch Wiregrass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Aristida calycina	Dark Wire-grass, Branched Wiregrass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Aristida ramosa	Purple Wiregrass, Kerosene Grass, Prickly Threeawn	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia auriculata	Lobed Wallaby-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia bipartita	Bandicoot Grass, Wallaby Grass, Leafy Wallaby Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia caespitosa	Ringed Wallaby-grass, Common Wallaby-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia carphoides	Short Wallaby-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia eriantha	Hill Wallaby-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia laevis	Wallaby Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia monticola	Small-flower Wallaby Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	*Notodanthonia monticola, Rytidosperma monticola*
Austrodanthonia pilosa	Velvet Wallaby Grass, Smooth-flowered Wallaby-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia racemosa	Clustered Wallaby-grass, Slender Wallaby Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrodanthonia setacea	Bristly Wallaby Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrofestuca eriopoda	Snow Fescue	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrostipa bigeniculata	Tall Speargrass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrostipa blackii	Crested Spear-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrostipa densiflora	Dense Spear-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	

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Austrostipa nodosa	Knotty Speargrass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrostipa rudis	Veined Speargrass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Austrostipa scabra	Corkscrew, Corkscrew Speargrass, Rough Spear-grass, Rough Needle-grass, Speargrass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Bothriochloa macra	Redgrass, Redleg Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Chloris truncata	Windmill Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Chloris ventricosa	Tall Windmill Grass	Grass	Native			Poaceae	grass, bamboo, spinifex	
Cymbopogon refractus	Barbed Wire Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Deyeuxia quadriseta	Reed Bent-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Dichanthium sericeum	Queensland Blue-grass	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	
Dichelachne crinita	Longhair Plumegrass	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	
Dichelachne hirtella	Slender Plumegrass	Grass	Native	Important	annual	Poaceae	grass, bamboo, spinifex	
Dichelachne inaequiglumis	Plume Grass	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	
Dichelachne micrantha	Short-hair Plumegrass	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	
Dichelachne parva	Plume Grass	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	
Dichelachne rara	Plume Grass	Grass	Native	Important	annual	Poaceae	grass, bamboo, spinifex	
Echinopogon caespitosus	Tufted Hedgehog-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Echinopogon cheelii	Long-flowered Hedgehog Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Echinopogon ovatus	Forest Hedgehog-grass, Hedgehog Grass, Rough-bearded Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Elymus scaber	Common Wheat-grass, Wheatgrass, Rough Wheatgrass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Enneapogon nigricans	Black-head Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Glyceria australis	Australian Sweetgrass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Imperata cylindrica	Blady Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Joycea pallida	Silvertop Wallaby Grass, Redanther Wallaby Grass	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	*Chionochloa pallida, Danthonia pallida*
Microlaena stipoides	Microlaena, Weeping Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Panicum effusum	Hairy Panic, Poison Panic	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Poa labillardierei	Tussock Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Poa meionectes	Fine-leaved Snow Grass, Fine-leaved Tussock-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Poa petrophila	Rock Tussock-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Poa sieberiana	Snow Grass, Fine-leaved Tussock-grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Rytidosperma nudiflorum	Alpine Wallby Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	*Danthonia nudiflora, Notodanthonia nudiflora*
Sorghum leiocladum	Wild Sorghum	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	
Sporobolus creber	Western Rat-tail Grass, Slender Rat's Tail Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Sporobolus elongatus	Slender Rat's-tail Grass	Grass	Native		perennial	Poaceae	grass, bamboo, spinifex	
Themeda australis (syn. Themeda triandra)	Kangaroo Grass	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	
Themeda triandra (syn. Themeda australis)	Kangaroo Grass	Grass	Native	Important	perennial	Poaceae	grass, bamboo, spinifex	
Tripogon loliiformis	Fiveminute Grass	Grass	Native	Important	annual	Poaceae	grass, bamboo, spinifex	
Herb								
Acaena agnipila	Sheep's Burr, Bidgee-widgee	Herb	Native		perennial	Rosaceae	roses, blackberries, apples	
Acaena echinata	Sheep's Burr	Herb	Native		perennial	Rosaceae	roses, blackberries, apples	
Acaena novae-zelandiae	Bidgee-widgee, Biddy Biddy	Herb	Native		perennial	Rosaceae	roses, blackberries, apples	
Acaena ovina	Sheep's Burr, Bidgee-widgee	Herb	Native		perennial	Rosaceae	roses, blackberries, apples	
Ajuga australis	Australian Bugle, Austral Bugle	Herb	Native	Important	perennial	Lamiaceae	mints, sages, mintbush	
Alternanthera nana	Hairy Joyweed, Downy Pigweed	Herb	Native	Important	annual	Amaranthaceae	cockscombs, mulla-mullas, pussytails	
Ammobium alatum	Tall Ammobium	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	

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Ammobium craspedioides	Yass Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Aphanes australiana	Australian Piert	Herb	Native		annual	Rosaceae	roses, blackberries, apples	
Arachnorchis spp.	Spider Orchids	Herb	Native	Important	perennial	Orchidaceae	orchids	*Caladenia*
Arthropodium milleflorum	Vanilla-lily, Pale Vanilla-lily	Herb	Native	Important	perennial	Anthericaceae	lilies	
Arthropodium minus	Small Vanilla Lily	Herb	Native	Important	perennial	Anthericaceae	lilies	
Asperula conferta	Common Woodruff	Herb	Native	Important	perennial	Rubiaceae	gardenias, coffee	
Asperula scoparia	Prickly Woodruff	Herb	Native	Important	perennial	Rubiaceae	gardenias, coffee	
Billardiera scandens	Appleberry, Snotberry, Apple Dumplings	Climber	Native		perennial	Pittosporaceae	native frangipani	
Brachyscome aculeata	Hill Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Brachycome aculeata*
Brachyscome decipiens	Field Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Brachycome decipiens*
Brachyscome diversifolia	Large-headed Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Brachycome diversifolia*
Brachyscome graminea	Grass Dairy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Brachycome graminea*
Brachyscome heterodonta	Lobe-seed Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Brachycome heterodonta, Brachsycome dentata, Brachycome dentata*
Brachyscome multifida	Cut-leaved Daisy	Herb	Native	Important	annual	Asteraceae	daisies, sunflower	*Brachycome multifida*
Brachyscome rigidula	Leafy Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Brachycome rigidula*
Brachyscome scapigera	Tufted Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Brachycome scapigera*
Brachyscome spathulata	Spoon Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Brachycome spathulata*
Brunonia australis	Pincushion, Blue Pincushion	Herb	Native	Important	perennial	Brunoniaceae	brunonias	
Brunoniella australis	Blue Trumpet	Herb	Native		perennial	Acanthaceae	bear's britches	*Ruellia australis*
Bulbine bulbosa	Bulbine Lily, Native Onion, Native Leek, Golden Lily	Herb	Native	Important	perennial	Asphodelaceae	lilies	
Bulbine glauca	Rock Lily	Herb	Native	Important	perennial	Asphodelaceae	lilies	
Burchardia umbellata	Milkmaids	Herb	Native	Important	perennial	Colchicaceae	lilies	
Caesia calliantha	Blue Grass-Lily	Herb	Native	Important	perennial	Anthericaceae	lilies	
Calocephalus citreus	Lemon Beautyheads	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Calochilus robertsonii	Purplish Beard Orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	plus other *Calochilus* species
Calotis cuneifolia	Purple Burr-daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Calotis glandulosa	Mauve Burr-daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Calotis lappulacea	Yellow Burr-daisy, Yellow Daisy-burr	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Calotis scabiosifolia	Rough Burr-daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Carex inversa	Knob Sedge, Common Sedge	Herb	Native		perennial	Cyperaceae	sedges	
Centella asiatica	Pennywort	Herb	Native	Important	perennial	Apiaceae	carrots, parsley, fennel	
Centella cordifolia	Centella	Herb	Native		perennial	Apiaceae	carrots, parsley, fennel	
Centrolepis strigosa	Hairy Centrolepis	Herb	Native		annual	Centrolepidaceae	sedges	
Chamaesyce drummondii	Caustic-weed	Herb	Native		perennial	Euphorbiaceae	spurges	
Chenopodium pumilio	Clammy Goosefoot, Small Crumbweed	Herb	Native		annual	Chenopodiaceae	saltbushes, bluebushes, samphires, chenopods	
Chrysocephalum apiculatum	Yellow Buttons, Common Everlasting	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Chrysocephalum semipapposum	Clustered Everlasting, Yellow Buttons	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Clematis microphylla	Small-leaved Clematis	Climber	Native		perennial	Ranunculaceae	buttercups, anemones	
Convolvulus erubescens	Australian Bindweed, Blushing Bindweed	Herb	Native		perennial	Convolvulaceae	morning glory, bindweed	
Correa reflexa	Common Correa, Native Fuchsia	Herb	Native		perennial	Rutaceae	boronias, citrus, native fuchsias	
Cotula australis	Common Cotula, Carrot Weed	Herb	Native		annual	Asteraceae	daisies, sunflower	
Craspedia canens	Billy Buttons, Grey Billybuttons	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Craspedia variabilis	Billy Buttons	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Crassula colorata	Annual Stonecrop, Dense Crassula, Dense Stonecrop	Herb	Native		annual	Crassulaceae	stonecrops	
Crassula helmsii	Swamp Stonecrop	Herb	Native		annual	Crassulaceae	stonecrops	
Crassula sieberiana	Australian Stonecrop, Sieber Crassula	Herb	Native		perennial	Crassulaceae	stonecrops	
Cullen microcephalum	Dusky Scurf-pea, Mountain Psoralea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	*Psoralea adscendens*

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Cullen tenax	Emu-foot, Emu Grass, Tough Scurf-pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	*Psoralea tenax*
Cymbonotus lawsonianus	Bear's Ear, Austral Bears-ears, Bears-ears	Herb	Native		perennial	Asteraceae	daisies, sunflower	Maybe be syn *Cymbonotus preissianus*
Cymbonotus preissianus	Austral Bear's Ear	Herb	Native		perennial	Asteraceae	daisies, sunflower	Maybe be syn *Cymbonotus lawsonianus*
Cynoglossum australe	Australian Forget-me-not, Australian Hound's-tongue	Herb	Native		perennial	Boraginaceae	heliotropes, forget-me-nots, borage	
Cynoglossum suaveolens	Sweet Hound's-tongue	Herb	Native		perennial	Boraginaceae	heliotropes, forget-me-nots, borage	
Daucus glochidiatus	Australian Carrot, Native Carrot, Austral Carrot	Herb	Native	Important	annual	Apiaceae	carrots, parsley, fennel	
Derwentia perfoliata	Digger's Speedwell	Herb/Shrub	Native		perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Desmodium brachypodum	Large Tick-trefoil	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Desmodium varians	Slender Tick-trefoil	Herb	Native	Important	annual	Fabaceae	peas, eg. sturt desert pea	
Dianella longifolia	Smooth Flax Lily	Herb	Native	Important	perennial	Phormiaceae	lilies	
Dianella revoluta	Blueberry Lily, Black-Anther Flax Lilly, Spreading Flax Lily	Herb	Native	Important	perennial	Phormiaceae	lilies	
Dichondra repens	Kidney Grass, Kidney Weed	Herb	Native		perennial	Convolvulaceae	morning glory, bindweed	
Dichopogon fimbriatus	Chocolate Lily, Nodding Chocolate Lily	Herb	Native	Important	perennial	Anthericaceae	lilies	
Dichopogon strictus	Chocolate Lily	Herb	Native		perennial	Anthericaceae	lilies	
Dipodium punctatum	Hyacinth Orchid, Pink Hyacinth Orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris aequalis	Buttercup Doubletail	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris behrii	Golden Cowslips	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris chryseopsis	Common Golden Moths	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris dendrobioides	Long-tail Purple Diuris, Wedge Diuris	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris maculata	Leopard Orchid, Nanny Goats, Leopard Diuris, Spotted Doubletail	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris monticola	Highland Golden Moths	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris ochroma	Pale Golden Moths	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris pedunculata	Small Snake Orchid, Two-leaved Golden Moths, Golden Moths, Cowslip Orchid, Snake Orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	Annual or perennial?
Diuris punctata	Purple Donkey-orchid, Purple Double-tails, Purple Diuris, Purple Cowslip, Dotted Double tails	Herb	Native	Important	perennial	Orchidaceae	orchids	
Diuris semilunulata	Donkey-ears	Herb	Native	Important	perennial	Orchidaceae	orchids	*Diuris maculata*
Diuris sulphurea	Tiger Orchid, Hornet Orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	
Drosera peltata	Hairy Climbing Sundew, Pale Sundew	Herb	Native		perennial	Droseraceae	sundews	
Drosera pygmaea	Pigmy Sundew, Tiny Sundew	Herb	Native		perennial	Droseraceae	sundews	
Einadia nutans	Climbing Saltbush, Nodding Saltbush	Herb	Native		perennial	Chenopodiaceae	saltbushes, bluebushes, samphires, chenopods	
Eriochilus cucullatus	Parson's Bands	Herb	Native	Important	perennial	Orchidaceae	orchids	
Erodium crinitum	Native Crowfoot, Blue Storks-bill, Blue Crowfoot, Blue Herons-bill	Herb	Native		annual	Geraniaceae	storksbills, cranesbills, geraniums	
Eryngium ovinum	Blue Devil	Herb	Native	Important	annual	Apiaceae	carrots, parsley, fennel	
Eryngium rostratum	Blue Devil	Herb	Native		annual	Apiaceae	carrots, parsley, fennel	
Eryngium vesiculosum	Prostrate Blue Devil, Prickfoot	Herb	Native	Important	perennial	Apiaceae	carrots, parsley, fennel	
Euchiton gymnocephalus	Creeping Cudweed	Herb	Native		perennial	Asteraceae	daisies, sunflower	
Euchiton involucratus	Star Cudweed	Herb	Native		perennial	Asteraceae	daisies, sunflower	
Euchiton sphaericus	Annual Cudweed, Star Cudweed	Herb	Native		annual	Asteraceae	daisies, sunflower	
Euphrasia collina	Eyebright	Herb	Native		perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Galium gaudichaudii	Rough Bedstraw	Herb	Native	Important	perennial	Rubiaceae	gardenias, coffee	

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Gastrodia sesamoides	Cinnamon Bells, Potato Orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	
Genoplesium	Midge Orchids	Herb	Native	Important	perennial	Orchidaceae	orchids	
Geranium antrorsum	Antrorse Geranium	Herb	Native	Important	perennial	Geraniaceae	storksbills, cranesbills, geraniums	
Geranium graniticola	Granite Cranesbill	Herb	Native	Important	perennial	Geraniaceae	storksbills, cranesbills, geraniums	
Geranium neglectum	Swamp Cranes-bill	Herb	Native		perennial	Geraniaceae	storksbills, cranesbills, geraniums	
Geranium retrorsum	Common Cranes-bill	Herb	Native		perennial	Geraniaceae	storksbills, cranesbills, geraniums	
Geranium solanderi	Native Geranium	Herb	Native		perennial	Geraniaceae	storksbills, cranesbills, geraniums	
Glossodia major	Wax-lip Orchid, Parson-in-the-pulpit	Herb	Native	Important	perennial	Orchidaceae	orchids	
Glycine clandestina	Twining Glycine	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Glycine tabacina	Glycine Pea, Variable Glycine	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Gonocarpus elatus	Hill Raspwort	Herb	Native		perennial	Haloragaceae	raspworts, milfoils	
Gonocarpus tetragynus	Common Raspwort	Herb	Native		perennial	Haloragaceae	raspworts, milfoils	
Goodenia bellidifolia	Daisy-leaved Goodenia, Rocket Goodenia	Herb	Native		perennial	Goodeniaceae	goodenias, dampieras	
Goodenia hederacea	Forest Goodenia, Ivy Goodenia	Herb	Native	Important	perennial	Goodeniaceae	goodenias, dampieras	
Goodenia humilis	Swamp Goodenia	Herb	Native		perennial	Goodeniaceae	goodenias, dampieras	
Goodenia pinnatifida	Scrambled Eggs, Cut-leaf Goodenia	Herb	Native	Important	perennial	Goodeniaceae	goodenias, dampieras	
Goodenia stelligera	Spiked Goodenia	Herb	Native		perennial	Goodeniaceae	goodenias, dampieras	
Gratiola nana	Creeping Brooklime	Herb	Native	Important	perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Gratiola pedunculata	Brooklime	Herb	Native	Important	perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Gratiola peruviana	Austral Brooklime	Herb	Native	Important	perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Gypsophila tubulosa	Annual Chalkwort	Herb	Native		annual	Caryophyllaceae	carnations	*Gypsophila australis*
Helichrysum collinum	Hill Daisy	Herb	Native		perennial	Asteraceae	daisies, sunflower	
Helichrysum scorpioides	Button Everlasting	Herb	Native		perennial	Asteraceae	daisies, sunflower	
Hydrocotyle laxiflora	Stinking Pennywort	Herb	Native		perennial	Apiaceae	carrots, parsley, fennel	
Hymenochilus bicolor	Bicolor Greenhood	Herb	Native	Important	perennial	Orchidaceae	orchids	*Pterostylis bicolor* annual or perennial?
Hymenochilus cycnocephalus	Swan Greenhood	Herb	Native	Important	perennial	Orchidaceae	orchids	*Pterostylis cycnocephala*
Hymenochilus muticus	Midget Greenhood, Blunt Greenhood, Dwarf Greenhood	Herb	Native	Important	perennial	Orchidaceae	orchids	*Pterostylis mutica* annual or perennial?
Hypericum gramineum	Small St John's Wort	Herb	Native	Important	perennial	Clusiaceae	garcinias	
Hypericum japonicum	Small St John's Wort, Matted St John's Wort	Herb	Native	Important	perennial	Clusiaceae	garcinias	
Isoetopsis graminifolia	Grass Cushion	Herb	Native	Important	annual	Asteraceae	daisies, sunflower	
Isotoma axillaris	Rock Isotome	Herb	Native		perennial	Lobeliaceae	lobelias	
Kennedia prostrata	Running Postman, Scarlet Running Pea, Scarlet Coral-pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Lagenophora stipitata	Blue-bottle Daisy, Common Lagenophora	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Lagenifera stipitata*
Laxmannia gracilis	Slender Wire-Lily	Herb	Native	Important	perennial	Anthericaceae	lilies	
Leptorhynchos elongatus	Lanky Buttons, Hairy Buttons	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Leptorrhynchos elongatus*
Leptorhynchos squamatus	Scaly Buttons	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Conyza squamata, Chrysocoma squamata, Leptorhynchus squamatus*
Leucochrysum albicans	Hoary Sunray	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Helipterum albicans*

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Limosella australis	Australian Mudwort	Herb	Native		perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Linum marginale	Wild Flax, Native Flax	Herb	Native	Important	perennial	Linaceae	flaxes	
Lobelia dentata	Toothed Lobelia, Wavy Lobelia	Herb	Native		perennial	Lobeliaceae	lobelias	perennial?
Lobelia gibbosa	Tall Lobelia	Herb	Native		perennial	Lobeliaceae	lobelias	perennial?
Lomandra bracteata	Mat-rush	Herb	Native		perennial	Lomandraceae	lomandras	
Lomandra filiformis	Wattle Mat-rush	Herb	Native		perennial	Lomandraceae	lomandras	
Lomandra longifolia	Spiny-headed Mat-rush, Honey Weed	Herb	Native		perennial	Lomandraceae	lomandras	
Lomandra multiflora	Many-flowered Matrush	Herb	Native		perennial	Lomandraceae	lomandras	
Lotus australis	Austral Trefoil, Australian Trefoil	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Lythrum salicaria	Purple Loosestrife	Herb	Native		perennial	Lythraceae	loose strifes, crepe myrtles	
Mentha diemenica	Slender Mint	Herb	Native		perennial	Lamiaceae	mints, sages, mintbush	
Mentha satureioides	Creeping Mint, Native Pennyroyal	Herb	Native		perennial	Lamiaceae	mints, sages, mintbush	
Microseris lanceolata	Yam Daisy, Murnong	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Microtis parviflora	Slender Onion-orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	
Microtis unifolia	Common Onion-orchid, Onion-orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	
Mimulus repens	Creeping Monkey-flower	Herb	Native		annual	Scrophulariaceae	foxgloves, snapdragons, witchweeds	annual or perennial
Opercularia diphylla	Stinkweed	Herb	Native		perennial	Rubiaceae	gardenias, coffee	
Opercularia hispida	Hairy Stinkweed	Herb	Native		perennial	Rubiaceae	gardenias, coffee	
Ophioglossum lusitanicum	Adder's Tongue	Herb	Native	Important	perennial	Ophioglossaceae	ferns	
Oreomyrrhis argentea	Silvery Carraway	Herb	Native		perennial	Apiaceae	carrots, parsley, fennel	
Oreomyrrhis eriopoda	Australian Carraway	Herb	Native	Important	perennial	Apiaceae	carrots, parsley, fennel	
Oxalis exilis	Shady Wood Sorrel, Indian Sorrel	Herb	Native		perennial	Oxalidaceae	wood sorrels, soursob	
Oxalis perennans	Grassland Wood Sorrel, Grass Wood-sorrel, Creeping Yellow Sorrel	Herb	Native		perennial	Oxalidaceae	wood sorrels, soursob	
Patersonia sericea	Silky Purple-flag	Herb	Native		perennial	Iridaceae	irises, patersonias	
Pelargonium australe	Native Storks-bill, Austral Storks-bill, Wild Geranium	Herb	Native	Important	perennial	Geraniaceae	storksbills, cranesbills, geraniums	
Pelargonium inodorum	Scentless Storks-bill	Herb	Native	Important	annual	Geraniaceae	storksbills, cranesbills, geraniums	annual or short-lived perennial
Pelargonium rodneyanum	Magenta Storks-bill	Herb	Native	Important	perennial	Geraniaceae	storksbills, cranesbills, geraniums	
Plantago debilis	Shade Plantain, Slender Plantain	Herb	Native		perennial	Plantaginaceae	plantains	
Plantago euryphylla	Plantain	Herb	Native		perennial	Plantaginaceae	plantains	
Plantago gaudichaudii	Narrow-leaf Native Plantain, Narrow Plantain	Herb	Native	Important	perennial	Plantaginaceae	plantains	
Plantago varia	Variable Plantain, Small Plantain, Sago-weed	Herb	Native	Important	perennial	Plantaginaceae	plantains	
Podolepis hieracioides	Tall Copper-wire Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Podolepis jaceoides	Showy Copper-wire Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Polygala japonica	Dwarf Milkwort	Herb	Native	Important	perennial	Polygalaceae	milkworts	
Poranthera microphylla	Small Poranthera, Small-leaved Poranthera	Herb	Native	Important	annual	Euphorbiaceae	spurges	
Portulaca oleracea	Common Pigweed, Common Purslane, Munyeroo	Herb	Native		annual	Portulaceae	purslanes, pigweeds	
Prasophyllum petilum	Tarengo Leek Orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	plus other *Prasophyllum* species
Pratia purpurascens	Whiteroot	Herb	Native		perennial	Lobeliaceae	lobelias	annual or perennial?
Pseudognaphalium luteoalbum	Jersey Cudweed	Herb	Native		annual	Asteraceae	daisies, sunflower	
Ptilotus erubescens	Hairy Tails, Hairy Heads	Herb	Native	Important	perennial	Amaranthaceae	cockscombs, mulla-mullas, pussytails	
Ranunculus graniticola	Granite Buttercup	Herb	Native		perennial	Ranunculaceae	buttercups, anemones	
Ranunculus lappaceus	Common Buttercup, Australian Buttercup	Herb	Native	Important	perennial	Ranunculaceae	buttercups, anemones	
Ranunculus pachycarpus	Thick-fruited Buttercup	Herb	Native		perennial	Ranunculaceae	buttercups, anemones	
Rhodanthe anthemoides	White Sunray, Chamomile Sunray	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	*Helipterum anthemoides*

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Rhodanthe pygmaea	Pigmy Sunray	Herb	Native		annual	Asteraceae	daisies, sunflower	*Helipterum pygmaeum*
Rostellularia adscendens	Pink-tongues, Bearded Anthem, Dwarf Justicia	Herb	Native			Acanthaceae	bear's britches	annual or perennial?
Rumex brownii	Swamp Dock, Slender Dock	Herb	Native		perennial	Polygonaceae	docks, buckwheat	
Rumex dumosus	Wiry Dock	Herb	Native	Important	perennial	Polygonaceae	docks, buckwheat	
Rumex tenax	Shiny Dock	Herb	Native		perennial	Polygonaceae	docks, buckwheat	
Rutidosis leiolepis	Monaro Golden Daisy	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Rutidosis leptorhynchoides	Button Wrinklewort	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Rutidosis multiflora	Small Wrinklewort	Herb	Native	Important	annual	Asteraceae	daisies, sunflower	
Scleranthus biflorus	Spiny Mat-plant, Knawel, Cushion-bush, Two-flowered Knawel	Herb	Native	Important	perennial	Caryophyllaceae	carnations	
Scleranthus diander	Tufted Knawel	Herb	Native		perennial	Caryophyllaceae	carnations	
Scutellaria humilis	Dwarf Skullcap	Herb	Native		perennial	Lamiaceae	mints, sages, mintbush	
Sebaea ovata	Yellow Centaury	Herb	Native	Important	annual	Gentianaceae	gentians	
Selliera radicans	Swamp Weed	Herb	Native		perennial	Goodeniaceae	goodenias, dampieras	
Senecio hispidulus	Hill Fireweed	Herb	Native		perennial	Asteraceae	daisies, sunflower	annual or perennial?
Senecio quadridentatus	Cotton Fireweed	Herb	Native		perennial	Asteraceae	daisies, sunflower	
Senecio tenuiflorus	Woodland Groundsel, Narrow Groundsel, Cotton Groundsel, Slender Fireweed	Herb	Native		annual	Asteraceae	daisies, sunflower	annual or biennial
Sida corrugata	Corrugated Sida	Herb	Native	Important	perennial	Malvaceae	cotton, hibiscus	
Solenogyne dominii	Smooth Solenogyne	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Solenogyne gunnii	Hairy Solenogyne	Herb	Native	Important	perennial	Asteraceae	daisies, sunflower	
Spiranthes sinensis	Austral Ladies' Tresses	Herb	Native	Important	perennial	Orchidaceae	orchids	annual or perennial?
Stackhousia monogyna	Creamy Candles, Creamy Stackhousia	Herb	Native	Important	perennial	Stackhousiaceae	stackhousiaceae	
Stackhousia viminea	Slender Stackhousia	Herb	Native		perennial	Stackhousiaceae	stackhousiaceae	
Stellaria angustifolia	Swamp Starwort	Herb	Native		perennial	Caryophyllaceae	carnations	
Stellaria filiformis	Thread Starwort	Herb	Native	Important	annual	Caryophyllaceae	carnations	
Stellaria multiflora (Back Creek)	Back Creek Many Flowered Starwort, Back Creek Rayless Starwort	Herb	Native		annual	Caryophyllaceae	carnations	uncertain taxonomy, categorised based on *Stellaria multiflora*
Stellaria pungens	Prickly Starwort	Herb	Native		perennial	Caryophyllaceae	carnations	
Stuartina hamata	Crooked Cudweed, Hooked Cudweed	Herb	Native	Important	annual	Asteraceae	daisies, sunflower	
Stuartina muelleri	Spoon Cudweed	Herb	Native	Important	annual	Asteraceae	daisies, sunflower	
Stylidium despectum	Dwarf Triggerplant	Herb	Native		annual	Stylidiaceae	triggerplants, styleworts	
Stylidium graminifolium	Grass Triggerplant	Herb	Native	Important	perennial	Stylidiaceae	triggerplants, styleworts	
Stypandra glauca	Nodding Blue Lily	Herb	Native	Important	perennial	Phormiaceae	lilies	
Swainsona behriana	Behr's Swainson-pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Swainsona monticola	Moutain Swainson-pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Swainsona oroboides	Variable Swainson-pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Swainsona queenslandica	Smooth Darling Pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	*Swainsona galegifolia*
Swainsona recta	Mountain Swainson-pea, Small Purple-pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Swainsona reticulata	Kneed Swainson-pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Swainsona sericea	Silky Swainson-pea	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Tetratheca spp.	Black-eyed Susans	Herb	Native		perennial	Tremandraceae	black-eyed susans	
Thelymitra ixioides	Spotted Sun-orchid, Dotted Sun-orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	annual or perennial?
Thelymitra malvina	Mauve-tuft Sun-orchid, Mauve-tufted sun orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	annual or perennial?
Thelymitra pauciflora	Slender Sun-orchid, Few-flowered Sun-orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	annual or perennial?
Thelymitra rubra	Pink Sun-orchid, Salmon Sun-orchid, Red Sun-orchid	Herb	Native	Important	perennial	Orchidaceae	orchids	annual or perennial?
Thesium australe	Austral toadflax, Austral Toad-flax, Australian Toadflax	Herb	Native	Important	perennial	Santalaceae	sandalwood	
Thysanotus patersonii	Twining Fringe-lily	Herb	Native	Important	perennial	Anthericaceae	lilies	

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Thysanotus tuberosus	Common Fringe-lily	Herb	Native	Important	perennial	Anthericaceae	lilies	
Trachymene humilis	Alpine Trachymene	Herb	Native		perennial	Apiaceae	carrots, parsley, fennel	
Tricoryne elatior	Yellow Rush-lily, Yellow Autumn-lily	Herb	Native	Important	perennial	Anthericaceae	lilies	
Triptilodiscus pygmaeus	Austral Sunray	Herb	Native	Important	annual	Asteraceae	daisies, sunflower	
Urtica incisa	Stinging Nettle	Herb	Native		perennial	Urticaceae	stinging nettles	
Velleia montana	Velleia	Herb	Native	Important	perennial	Goodeniaceae	goodenias, dampieras	
Velleia paradoxa	Spur Velleia	Herb	Native	Important	perennial	Goodeniaceae	goodenias, dampieras	
Veronica calycina	Hairy Speedwell	Herb	Native		perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Veronica gracilis	Slender Speedwell	Herb	Native	Important	perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Veronica plebeia	Trailing Speedwell, Creeping Speedwell	Herb	Native		perennial	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Viola betonicifolia	Showy Violet, Arrow-head Violet, Native Violet, Purple Violet	Herb	Native	Important	perennial	Violaceae	voilets	
Viola caleyana	Swamp Violet	Herb	Native		perennial	Violaceae	voilets	
Viola hederacea	Native Violet, Ivy-leaf Violet, Ivy-leaved Violet	Herb	Native		perennial	Violaceae	voilets	
Viola sieberiana	Diamond Violet	Herb	Native		perennial	Violaceae	voilets	
Vittadinia cuneata	Fuzzweed	Herb	Native		annual	Asteraceae	daisies, sunflower	can be annual or perennial
Vittadinia muelleri	Narrow-leaf New Holland Daisy	Herb	Native		perennial	Asteraceae	daisies, sunflower	
Wahlenbergia ceracea	Waxy Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia communis	Tufted Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia densifolia	Fairy Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia gracilenta	Annual Bluebell	Herb	Native		annual	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia gracilis	Australian Bluebell, Sprawling Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia graniticola	Granite Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia littoricola	Edge Bluebell, Coast Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia luteola	Yellow-wash Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia multicaulis	Tadgell's Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia planiflora	Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wahlenbergia stricta	Tall Bluebell, Austral Bluebell, Australian Bluebell	Herb	Native		perennial	Campanulaceae	wahlenbergias, bluebells	
Wurmbea dioica	Early Nancy	Herb	Native	Important	perennial	Colchicaceae	lilies	
Xerochrysum bracteatum	Golden Everlasting	Herb	Native		annual	Asteraceae	daisies, sunflower	*Bracteantha bracteata*
Xerochrysum subundulatum	Orange Everlasting, Alpine Everlasting	Herb	Native		annual	Asteraceae	daisies, sunflower	*Bracteantha subundulata, Helichrysum acuminatum*
Xerochrysum viscosum	Sticky Everlasting	Herb	Native		annual	Asteraceae	daisies, sunflower	*Bracteantha viscosa*
Zornia dyctiocarpa	Zornia	Herb	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Sedge/Rush								
Isolepis cernua	Nodding Club-rush	Sedge/Rush	Native		perennial	Cyperaceae	sedges	
Isolepis hookeriana	Grassy Club-sedge, Grassy Club-rush	Sedge/Rush	Native		annual	Cyperaceae	sedges	
Isolepis inundata	Swamp Club-sedge, Swamp Club-rush	Sedge/Rush	Native		perennial	Cyperaceae	sedges	
Juncus australis	Austral Rush	Sedge/Rush	Native		perennial	Juncaceae	rushes	*Juncus communis*
Juncus bufonius	Toad Rush	Sedge/Rush	Native		annual	Juncaceae	rushes	
Juncus flavidus	Yellow Rush	Sedge/Rush	Native		perennial	Juncaceae	rushes	
Juncus fockei	Slender Joint-leaf Rush	Sedge/Rush	Native		perennial	Juncaceae	rushes	
Juncus homalocaulis	Wiry Rush	Sedge/Rush	Native		perennial	Juncaceae	rushes	
Juncus sarophorus	Broom Rush	Sedge/Rush	Native		perennial	Juncaceae	rushes	
Juncus subsecundus	Finger Rush	Sedge/Rush	Native		perennial	Juncaceae	rushes	
Lepidosperma laterale	Sword Sedge, Variable Swordsedge	Sedge/Rush	Native		perennial	Cyperaceae	sedges	
Luzula densiflora	Dense Woodrush	Sedge/Rush	Native		perennial	Juncaceae	rushes	
Luzula meridionalis	Common Woodrush	Sedge/Rush	Native		perennial	Juncaceae	rushes	

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Luzula modesta	Southern Woodrush	Sedge/Rush	Native		perennial	Juncaceae	rushes	
Luzula ovata	Clustered Woodrush	Sedge/Rush	Native		perennial	Juncaceae	rushes	
Schoenus apogon	Common Bog Sedge, Fluke Bogrush	Sedge/Rush	Native		annual	Cyperaceae	sedges	
Shrub								
Acacia brownii	Prickly Moses, Golden Prickly Wattle, Heath Wattle	Shrub	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia dawsonii	Poverty Wattle, Dawson's Wattle, Mitta Wattle	Shrub	Native	Important	perennial	Mimosaceae	wattles (acacias)	
Acacia deanei	Deane's Wattle, Green Wattle	Shrub/Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia decora	Western Silver Wattle, Showy Wattle, Western Golden Wattle, Pretty Wattle	Shrub	Native	Important	perennial	Mimosaceae	wattles (acacias)	
Acacia decurrens	Black Wattle, Early Black Wattle, Green Wattle, Queen Wattle, Sydney Green Wattle	Shrub/Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia doratoxylon	Currawang, Lancewood, Spearwood, Cooriwan, Hickory, Brown Lancewood	Shrub/Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia falcata	Sickle Wattle, Burra, Sickle-shaped Acacia, Sally, Hickory Wattle, Silver-leaved Wattle	Shrub	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia genistifolia	Spreading Wattle, Early Wattle, Wild Irishman	Shrub	Native	Important	perennial	Mimosaceae	wattles (acacias)	
Acacia gunnii	Ploughshare Wattle, Dog's Tooth Wattle	Shrub	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia mearnsii	Black Wattle, Green Wattle, Late Black Wattle	Shrub/Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia paradoxa	Prickly Acacia, Acacia Hedge, Kangaroo Thorn, Hedge Wattle, Kangaroo Acacia, Prickly Wattle, Paradoxa Wattle	Shrub	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia parramattensis	Sydney Green Wattle, Parramatta Wattle, Parramatta Green Wattle	Shrub/Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia rubida	Red-stem Wattle, Red-leaved Wattle	Shrub/Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia siculiformis	Dagger Wattle	Shrub	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia ulicifolia	Prickly Moses, Juniper Wattle	Shrub	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia verniciflua	Varnish Wattle	Shrub/Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acrotriche serrulata	Honeypots	Shrub	Native		perennial	Epacridaceae	southern heaths or epacrids	
Astroloma humifusum	Native Cranberry, Cranberry Heath	Shrub	Native	Important	perennial	Epacridaceae	southern heaths or epacrids	
Astrotricha ledifolia	Common Star-hair	Shrub	Native		perennial	Araliaceae	ginseng	
Banksia marginata	Silver Banksia, Honeysuckle Banksia, Dwarf Honeysuckle, Warrock	Shrub/Tree	Native		perennial	Proteaceae	waratahs, banksias, grevilleas, proteas	
Boronia algida	Alpine Boronia	Shrub	Native		perennial	Rutaceae	boronias, citrus, native fuchsias	
Bossiaea buxifolia	Box-leaved Bitter-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Bossiaea prostrata	Creeping Bossiaea, Prostrate Bitter-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Bossiaea riparia	River Leafless Bossiaea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Brachyloma daphnoides	Daphne Heath	Shrub	Native		perennial	Epacridaceae	southern heaths or epacrids	
Bursaria spinosa	Australian Blackthorn, Bursaria, Blackthorn, Native Blackthorn, Sweet Bursaria (Native Box), Whitethorn, Christmas Bush, Prickly Pine, Prickly Box	Shrub/Tree	Native		perennial	Pittosporaceae	native frangipani	
Callistemon sieberi	Alpine Bottlebrush, River Bottlebrush	Shrub/Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Calytrix tetragona	Fringe Myrtle, Common Fringe-myrtle, Heath Myrtle	Shrub	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Cassinia aculeata	Common Cassinia, Chinese-scrub, Sifton Bush, Dogwood, Dolly Bush	Shrub	Native		perennial	Asteraceae	daisies, sunflower	

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Cassinia arcuata	Drooping Cassinia, Chinese Tea-scrub, Sifton Bush, Chinese Shrub	Shrub	Native		perennial	Asteraceae	daisies, sunflower	
Cassinia longifolia	Shiny Cassinia, Cauliflower Bush, Long-leaf Dogwood	Shrub	Native		perennial	Asteraceae	daisies, sunflower	
Cassinia quinquefaria	Rosemary Cassinia	Shrub	Native		perennial	Asteraceae	daisies, sunflower	
Cheiranthera cyanea	Finger Flower	Shrub	Native		perennial	Pittosporaceae	native frangipani	
Comesperma ericinum	Heath Milkwort, Heath-leaved False-pea, Pyramid Flower	Shrub	Native		perennial	Polygalaceae	milkworts	
Cryptandra amara	Bitter Cryptandra	Shrub	Native		perennial	Rhamnaceae	blueblossom	
Daviesia genistifolia	Spiny Bitter-pea, Broom Bitter-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Daviesia latifolia	Hop Bitter-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Daviesia leptophylla	Narrow-leaf Bitter-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	*Daviesia virgata*
Daviesia mimosoides	Narrow-leaf Bitter-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Daviesia ulicifolia	Gorse Bitter-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Dillwynia cinerascens	Grey Parrot-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Dillwynia glaucula	Michelago Parrot-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Dillwynia prostrata	Matted Parrot-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Dillwynia retorta	Heathy Parrot-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Dillwynia sericea	Showy Parrot-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Discaria pubescens	Australian Anchor-plant	Shrub	Native	Important	perennial	Rhamnaceae	blueblossom	
Dodonaea procumbens	Trailing Hop-bush	Shrub	Native	Important	perennial	Sapindaceae	hop bushes	
Dodonaea viscosa	Sticky Hop-bush, Giant Hop-bush	Shrub	Native		perennial	Sapindaceae	hop bushes	
Einadia hastata	Saloop, Berry Saltbush	Shrub	Native		perennial	Chenopodiaceae	saltbushes, bluebushes, samphires, chenopods	
Epacris spp.	Native Heaths	Shrub	Native		perennial	Epacridaceae	southern heaths or epacrids	
Eremophila debilis	Winter Apple, Creeping Boobialla, Amulla	Shrub	Native		perennial	Myoporaceae	emu bush	
Exocarpos cupressiformis	Cherry Ballart, Native Cherry, Wild Cherry, Cherry Wood	Shrub/Tree	Native	Important	perennial	Santalaceae	sandalwood	
Exocarpos strictus	Pale Ballart, Pale-fruit Ballart, Dwarf Cherry	Shrub	Native	Important	perennial	Santalaceae	sandalwood	
Geijera parviflora	Wilga	Shrub/Tree	Native		perennial	Rutaceae	boronias, citrus, native fuchsias	
Gompholobium huegelii	Pale Wedge-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Grevillea iaspicula	Wee Jasper Grevillea	Shrub	Native	Important	perennial	Proteaceae	waratahs, banksias, grevilleas, proteas	
Grevillea lanigera	Woolly Grevillea	Shrub	Native	Important	perennial	Proteaceae	waratahs, banksias, grevilleas, proteas	
Grevillea ramosissima	Fan Grevillea, Branching Grevillea, Prickly Parsley Bush	Shrub	Native	Important	perennial	Proteaceae	waratahs, banksias, grevilleas, proteas	
Grevillea rosmarinifolia	Rosemary Grevillea	Shrub	Native	Important	perennial	Proteaceae	waratahs, banksias, grevilleas, proteas	
Grevillea wilkinsonii	Tumut Grevillea	Shrub	Native	Important	perennial	Proteaceae	waratahs, banksias, grevilleas, proteas	
Hakea microcarpa	Small-fruit Hakea, Small-fruited Needlebush	Shrub	Native	Important	perennial	Proteaceae	waratahs, banksias, grevilleas, proteas	
Hardenbergia violacea	False Sarsparilla, Purple Coral-pea, Native Lilac	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Hibbertia calycina	Lesser Guinea-flower	Shrub	Native	Important	perennial	Dilleniaceae	hibbertias	
Hibbertia obtusifolia	Hoary Guinea-flower	Shrub	Native	Important	perennial	Dilleniaceae	hibbertias	
Hibbertia riparia	Stream Guinea-flower, Erect Guinea-flower	Shrub	Native	Important	perennial	Dilleniaceae	hibbertias	*Hibbertia stricta*
Hovea linearis	Creeping Hovea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	*Hovea heterophylla*
Hymenanthera dentata	Tree Violet	Shrub	Native		perennial	Violaceae	voilets	
Indigofera adesmiifolia	Tick Indigo, Leafless Indigo, Broad-leaved Indigo	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community Species List

Indigofera australis	Austral Indigo, Australian Indigo, Native Indigo, Hill Indigo	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Jacksonia scoparia	Winged Broom-pea, Dogwood, Broom	Shrub/Tree	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Jasminum suavissimum	Native Jasmine, Sweet Jasmine	Shrub	Native		perennial	Oleaceae	olives	
Kunzea ericoides	Burgan, Kanuka	Shrub/Tree	Native	Important	perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Kunzea parvifolia	Violet Kunzea, Tickbush	Shrub	Native	Important	perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Leptospermum myrtifolium	Swamp Myrtle, Swamp Tea-tree, Myrtle-leaved Tea-tree, Grey Tea-tree	Shrub	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Leptospermum obovatum	River Tea-tree, Blunt-leaf Tea-tree	Shrub	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Lespedeza juncea	Perennial Lespedeza	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Leucopogon fletcheri	Pendant Beard Heath	Shrub	Native	Important	perennial	Epacridaceae	southern heaths or epacrids	
Leucopogon fraseri	Beard Heath	Shrub	Native	Important	perennial	Epacridaceae	southern heaths or epacrids	
Leucopogon virgatus	Common Beard Heath	Shrub	Native	Important	perennial	Epacridaceae	southern heaths or epacrids	
Lissanthe strigosa	Peach Heath	Shrub	Native		perennial	Epacridaceae	southern heaths or epacrids	
Maireana microphylla	Eastern Cottonbush, Small-leaf Bluebush, Bluebush	Shrub	Native		perennial	Chenopodiaceae	saltbushes, bluebushes, samphires, chenopods	
Melaleuca parvistaminea	Honey-myrtle	Shrub/Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	*Melaleuca ternifolia*
Melichrus urceolatus	Urn Heath	Shrub	Native		perennial	Epacridaceae	southern heaths or epacrids	
Mirbelia oxylobioides	Mountain Mirbelia	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Muehlenbeckia axillaris	Wire Plant, Matted Lignum	Shrub	Native		perennial	Polygonaceae	docks, buckwheat	
Muehlenbeckia tuggeranong	Tuggeranong Lignum	Shrub	Native	Important	perennial	Polygonaceae	docks, buckwheat	
Olearia elliptica	Sticky Daisy-bush	Shrub	Native		perennial	Asteraceae	daisies, sunflower	
Ozothamnus spp.	Everlastings	Shrub	Native		perennial	Asteraceae	daisies, sunflower	
Pimelea curviflora	Curved Rice-flower	Shrub	Native	Important	perennial	Thymelaeaceae	thymelias	
Pimelea glauca	Shrubby Rice-flower	Shrub	Native	Important	perennial	Thymelaeaceae	thymelias	
Pimelea pauciflora	Poison Pimelea, Poison Rice-flower	Shrub	Native	Important	perennial	Thymelaeaceae	thymelias	*Pimelea neo-anglica*
Pomaderris pallida	Pale Pomaderris	Shrub	Native		perennial	Rhamnaceae	blueblossom	
Pomaderris spp.	Pomaderris	Shrub/Tree	Native		perennial	Rhamnaceae	blueblossom	
Pultenaea fasciculata	Bush-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Pultenaea microphylla	Spreading Bush-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Pultenaea procumbens	Heathy Bush-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Pultenaea spinosa	Bush-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	*Pultenaea cunninghamii*
Pultenaea subspicata	Low Bush-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Rhytidosporum procumbens	White Marianth	Shrub	Native		perennial	Pittosporaceae	native frangipani	*Pittosporum procumbers, Billardiera procumbens*
Rubus parvifolius	Small-leaf Raspberry, Small-leaved Rasberry, Native Rasberry	Shrub	Native		perennial	Rosaceae	roses, blackberries, apples	
Rulingia prostrata	Dwarf Kerrawang	Shrub	Native	Important	perennial	Sterculiaceae	kurrajongs, bottletrees	
Solanum linearifolium	Mountain Kangaroo-apple, Kangaroo-apple	Shrub	Native		perennial	Solanaceae	tomato, potato, tobacco	
Styphelia triflora	Pink Five-corners	Shrub	Native		perennial	Epacridaceae	southern heaths or epacrids	
Templetonia stenophylla	Leafy Templetonia, Leafy Mallee-pea	Shrub	Native	Important	perennial	Fabaceae	peas, eg. sturt desert pea	
Vittadinia gracilis	Woolly New Holland Daisy	Shrub	Native		perennial	Asteraceae	daisies, sunflower	
Westringia eremicola	Slender Westringia	Shrub	Native		perennial	Lamiaceae	mints, sages, mintbush	
Wilsonia rotundifolia	Round-leaf Wilsonia	Shrub	Native		perennial	Convolvulaceae	morning glory, bindweed	
Xanthorrhoea australis	Grass Tree	Grass Tree	Native		perennial	Xanthorrhoeaceae	grass trees	
Tree								
Acacia dealbata	Silver Wattle	Tree/Shrub	Native		perennial	Mimosaceae	wattles (acacias)	

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community Species List

Acacia implexa	Lightwood, Hickory Wattle, Black Wattle, Hickory, Sally Wattle, Scrub Wattle, Screw-pod Wattle, Bastard Myall, Lignum Vitae, Fish Wattle, Broad-leaf Wattle	Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia melanoxlyon	Blackwood, Black Wattle, Hickory, Mudgerabah, Paluma Blackwood, Sally Wattle	Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Acacia obliquinervia	Mountain Hickory Wattle	Tree	Native		perennial	Mimosaceae	wattles (acacias)	
Allocasuarina littoralis	Black Sheoak	Tree	Native		perennial	Casuarinaceae	cassuarinas, she-oaks	
Allocasuarina luehmannii	Buloke, Bull Oak, Bulloak, Bull Sheoak	Tree	Native		perennial	Casuarinaceae	cassuarinas, she-oaks	
Allocasuarina verticillata	Drooping Sheoak, Coast She-oak, Hill-oak, Sheoak	Tree	Native		perennial	Casuarinaceae	cassuarinas, she-oaks	*Casuarina stricta*
Angophora floribunda	Rough-barked Apple, Roughbark Apple, Apple Box (Qld), Apple, Boondah, Gum Myrtle, Rusty Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Brachychiton populneus	Kurrajong	Tree	Native		perennial	Sterculiaceae	kurrajongs, bottletrees	
Callitris endlicheri	Black Cypress Pine, Black Cypress, Red Cypress, Black Pine, Mountain Pine, Black Callitris, Red Cypress Pine	Tree	Native		perennial	Cupressaceae	cypress pines	
Callitris glaucophylla	White Cypress-pine, White Cypress, White Pine	Tree	Native		perennial	Cupressaceae	cypress pines	
Eucalyptus aggregata	Black Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus albens	White Box	Dominant tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus amplifolia	Cabbage Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus blakelyi	Blakely's Red Gum	Dominant tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus bridgesiana	Apple Box, But-but	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus caliginosa	New England Stringybark	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus camaldulensis	River Red Gum, Red Gum, Murray Red Gum, River Gum (WA)	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus cinerea	Argyle Apple, Silver-leaved Stringybark	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus conica	Fuzzy Box	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus dalrympleana	Mountain Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus dives	Broad-leaved Peppermint, Peppermint, Blue Peppermint (Vic)	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus goniocalyx	Long-leaved Box, Bundy, Olive-barked Box	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus macrorhyncha	Red Stringybark	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus mannifera	Brittle Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus melliodora	Yellow Box, Yellow Jacket, Honey Box (Qld), Yellow Ironbark (Qld)	Dominant tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus microcarpa	Grey Box, Narrow-leaved Box, Inland Grey Box, Western Grey Box	Dominant tree (in Nandewar)	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Ecological Community Species List

Eucalyptus moluccana	Grey Box, Gum-topped Box	Dominant tree (in Nandewar)	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus nortonii	Mealy Bundy, Large-flowered Bundy	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus ovata	Swamp Gum, Black Gum (southern Tas), White Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus pauciflora	Snow Gum, Cabbage Gum (Tas), Weeping Gum (Tas), White Sally	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus polyanthemos	Red Box	Tree/Mallee	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus populnea	Bimble Box, Poplar Box, Bimbil Box	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus rossii	Scribbly Gum, Snappy Gum, White Gum, Inland Scribbly Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus rubida	Candlebark, Ribbon Gum, White Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus sideroxylon	Red Ironbark, Mugga, Mugga Ironbark	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus stellulata	Black Sally	Tree/Mallee	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Eucalyptus viminalis	Manna Gum, Ribbon Gum	Tree	Native		perennial	Myrtaceae	gum trees, paper barks, bottle brushes, guavas	
Notelaea microcarpa	Native Olive	Tree	Native		perennial	Oleaceae	olives	
Exotic								
Grass								
Aira elegantissima	Delicate Hairgrass	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Anthoxanthum odoratum	Sweet Vernal Grass, Sweet-scented Vernal-grass, Sweet Vernal	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Avena barbata	Bearded Oats	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Avena fatua	Wild Oats	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Briza maxima	Quaking Grass, Blowfly Grass	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Briza minor	Shivery Grass, Lesser Quaking Grass	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Bromus diandrus	Great Brome	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Bromus molliformis	Silky Brome, Soft Brome	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Cynosurus echinatus	Rough Dogstail	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Dactylis glomerata	Cocksfoot, Orchard Grass	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Holcus lanatus	Yorkshire Fog	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Hordeum leporinum	Barley-grass	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Hyparrhenia hirta	Coolatai Grass	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Lolium perenne	Perennial Ryegrass	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	annual or short-lived perennial
Lolium rigidum	Ryegrass	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Lolium spp.	Ryegrass	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Nassella neesiana	Chilean Needle-grass	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Nassella trichotoma	Serrated Tussock	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Paspalum dilatatum	Paspalum	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Phalaris aquatica	Phalaris	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Poa bulbosa	Bulbous Poa	Grass	Exotic		perennial	Poaceae	grass, bamboo, spinifex	
Vulpia bromoides	Squirrel Tail Fescue, Silver Grass	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Vulpia myuros	Rat's Tail Fescue	Grass	Exotic		annual	Poaceae	grass, bamboo, spinifex	
Herb								
Acetosella vulgaris	Sorrel, Sheep Sorrel	Herb	Exotic		perennial	Polygonaceae	docks, buckwheat	
Anagallis arvensis	Scarlet Pimpernel, Blue Pimpernel, Pimpernel	Herb	Exotic		annual	Primulaceae	primroses	

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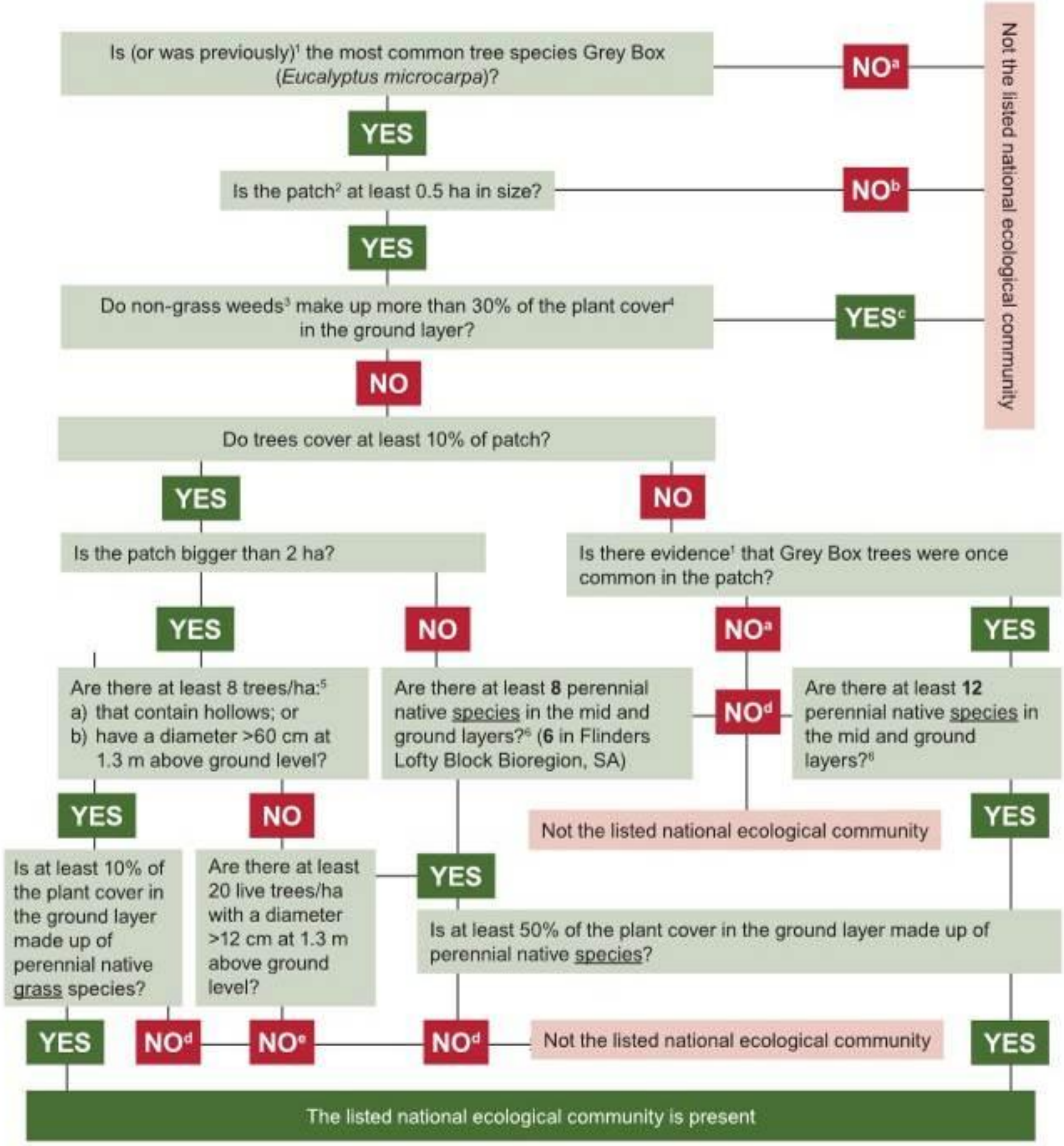
Arctotheca calendula	Cape Weed, African Marigold, Cape Dandelion	Herb	Exotic		annual	Asteraceae	daisies, sunflower	
Carthamus lanatus	Saffron Thistle	Herb	Exotic		annual	Asteraceae	daisies, sunflower	
Centaurium erythraea	Common Centaury	Herb	Exotic		annual	Gentianaceae	gentians	
Cerastium glomeratum	Broad-leaved Mouse-ear Chickweed, Sticky Mouse-ear Chickweed	Herb	Exotic		annual	Caryophyllaceae	carnations	
Chondrilla juncea	Skeleton-weed	Herb	Exotic		perennial	Asteraceae	daisies, sunflower	
Cirsium vulgare	Spear Thistle	Herb	Exotic		annual	Asteraceae	daisies, sunflower	
Echium plantagineum	Paterson's Curse, Salvation Jane, Murrumbidgee Bluebell, Riverina Bluebell	Herb	Exotic		annual	Boraginaceae	heliotropes, forget-me-nots, borage	
Geranium molle	Cranes-bill Geranium	Herb	Exotic		annual	Geraniaceae	storksbills, cranesbills, geraniums	
Hypericum perforatum	St John's Wort, Perforated St John's Wort	Herb	Exotic		perennial	Clusiaceae	garcinias	
Hypochaeris glabra	Smooth Cat's-ear	Herb	Exotic		annual	Asteraceae	daisies, sunflower	
Hypochaeris radicata	Flatweed, Cat's-ear	Herb	Exotic		perennial	Asteraceae	daisies, sunflower	
Lepidium africanum	Common Pepper-cress, African Pepper-cress, Rubble Pepper-cress	Herb	Exotic		annual	Brassicaceae	cabbages, radishes, wallflowers	annual or perennial
Linaria pelisseriana	Pelisser's Toadflax	Herb	Exotic		annual	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Medicago lupulina	Black Medic, Hop Medic	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Moenchia erecta	Erect Chickweed, Upright Moenchia	Herb	Exotic		annual	Caryophyllaceae	carnations	
Myosotis discolor	Yellow and Blue Forget-me-not, Forget-me-not	Herb	Exotic		annual	Boraginaceae	heliotropes, forget-me-nots, borage	
Orobanche minor	Lesser Broomrape, Broomrape, Clover Broomrape	Herb	Exotic		annual	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Parentucellia latifolia	Red Bartsia, Common Bartsia	Herb	Exotic		annual	Scrophulariaceae	foxgloves, snapdragons, witchweeds	
Petrorhagia nanteuilii	Proliferous Pink, Childing pink	Herb	Exotic		annual	Caryophyllaceae	carnations	
Plantago lanceolata	Ribwort, Ribgrass, Lamb's Tongue	Herb	Exotic		annual	Plantaginaceae	plantains	
Romulea rosea	Onion-grass, Guildford Grass	Herb	Exotic		perennial	Iridaceae	irises, patersonias	
Salvia verbenaca	Wild Sage, Vervain	Herb	Exotic		perennial	Lamiaceae	mints, sages, mintbush	*Salvia clandestina, Salvia horminoides*
Sherardia arvensis	Blue Fieldmadder, Field Madder	Herb	Exotic		annual	Rubiaceae	gardenias, coffee	
Silene gallica	French Catchfly, Five-wounded Catchfly	Herb	Exotic		annual	Caryophyllaceae	carnations	
Trifolium angustifolium	Narrow-leaved Clover	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Trifolium arvense	Hare's-foot Clover	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Trifolium campestre	Hop Clover	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Trifolium glomeratum	Clustered Clover	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Trifolium scabrum	Rough Clover	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Trifolium striatum	Knotted Clover	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Trifolium subterraneum	Subterranean Clover, Sub Clover	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Urtica urens	Small Nettle	Herb	Exotic		annual	Urticaceae	stinging nettles	
Vicia sativa	Common Vetch, Narrow-leaved Vetch	Herb	Exotic		annual	Fabaceae	peas, eg. sturt desert pea	
Shrub								
Rosa rubiginosa	Sweetbriar, Briar Rose, Eglantine	Shrub	Exotic		perennial	Rosaceae	roses, blackberries, apples	

Appendix 3:

from DSEWPaC (2012)

Flowchart 2: Is the patch of potential Grey Box (*E. microcarpa*) Grassy Woodlands or derived native grasslands of sufficient quality for national listing?



1 Evidence that Grey Box was originally present might include stumps, historical records or presence in nearby vegetation.
2 When considering a patch it is important to note that a patch may extend beyond a property or development site boundary. For the purposes of determining whether or not a patch meets the minimum patch size of the condition thresholds for the ecological community, the entire patch should be considered, not just the area occurring on a property or development site.
3 A weed is defined here as a plant species that is not native to Australia and the species has established viable self-sustaining populations in a region.
4 Plant cover excludes mosses and lichens. Patches of bare ground or leaf litter are also not included.
5 Dead trees are included if present, up to 50% of the total tree count.
6 Relevant growth-forms to include are: grasses, other graminoids, forbs and shrubs less than 4 metres tall. Shrubs that are 4 metres or more in height and non-vascular plants (mosses and lichens) are not included.

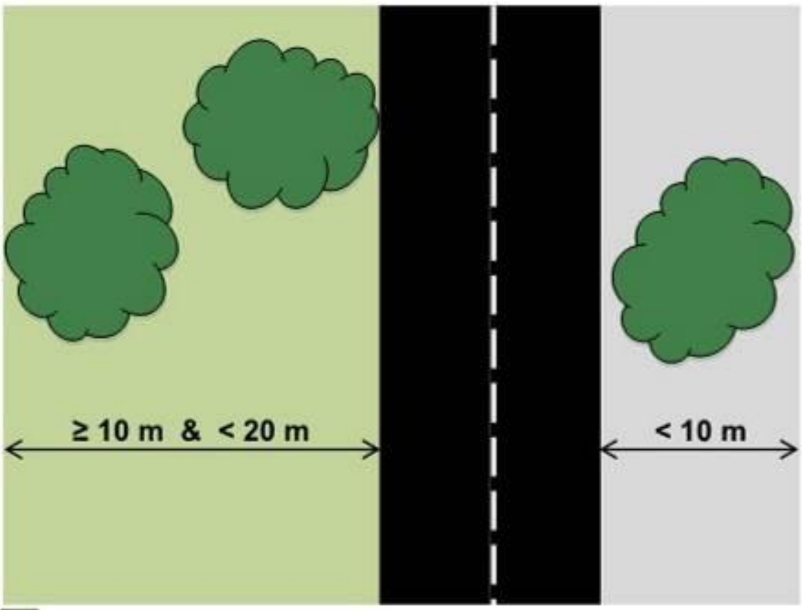
Why does my patch not belong to the listed national ecological community? a Patch belongs to a different ecological community; **b** Patch is too small; **c** Degraded: patch is too weedy **d** Degraded: too few native species or insufficient native species cover in ground layer; **e** Degraded: too few trees AND insufficient native species cover in ground layer. Rehabilitation work may be able to restore degraded patches enough to qualify as the listed community.

24 | Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia

Appendix 4:

Interpreting linear patches of *Poplar Box Grassy Woodland* EEC, such as a roadside verges and travelling stock routes (from DoEE 2019)

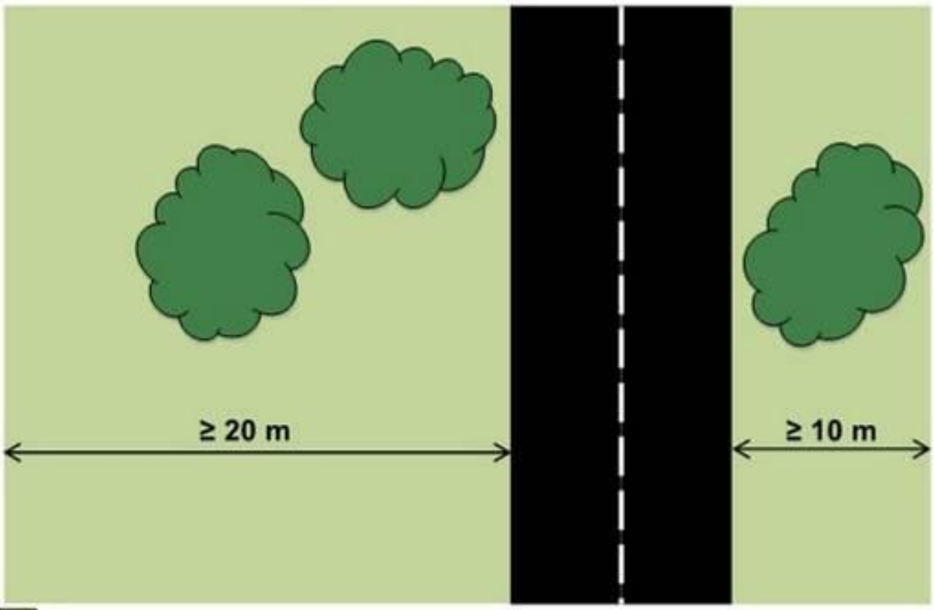
Diagram 1. Patch width thresholds for linear remnant roadside vegetation containing Poplar Box Grassy Woodland. Linear patches must be ≥ 10 m in width.



The ecological community if key diagnostics and condition thresholds are met

Not the ecological community

Diagram 2. Patch width thresholds for linear remnant roadside vegetation containing Poplar Box Grassy Woodland. Linear patches ≥ 20 m in width.



The ecological community if key diagnostics and condition thresholds are met

Appendix E
Maules Creek Continuation Project
Swift Parrot
Independent Expert Review

Impact on Swift Parrots (*Lathamus discolor*) of proposed Maules Creek Continuation Project (Maules Creek Coal Pty Ltd):

Independent Expert Report

Robert Heinsohn
Professor of Conservation Biology
Australian National University

29 July 2025

Summary

1. In this report I use data and analyses from my research group's long term study of Swift Parrots (*Lathamus bicolor*) to conclude that habitat lost from woodland clearing for the Maules Creek Continuation Project is likely to have serious and irreversible impacts on biodiversity values. The loss of habitat is likely to cause a further decline in the critically endangered Swift Parrot, a species that is already known to be in a rapid rate of decline. Swift Parrots are unlikely to respond to measures to improve their habitat in the future because the additional foraging habitat will not become available soon enough to help prevent their extinction.

2. Swift Parrots are projected to become extinct within 10 years. They have been identified as one of Australia's priority 20 bird species for conservation action. Loss of habitat in the breeding and winter migration ranges are the greatest threats to Swift Parrots.

3. The unusual ecology of Swift Parrot winter movements makes retention of the small areas of remaining habitat on mainland Australia essential for their conservation. The ephemeral and unpredictable nature of winter flowering of their feed trees means the birds must search vast areas to find food, with the patches available varying greatly from year to year. A single patch of foraging habitat is often not available for use every year but may be essential for the birds over a multi-year cycle.

4. Swift Parrots have been recorded from an area in Leard State Forest east of the Maules Creek Continuation Project site on 29 occasions and flocks of 16 and 20 were observed during surveys for the nearby Boggabri coal mine site. This high frequency of visitation confirms that Leard State Forest is an important winter foraging site for Swift Parrots. Impacts on Swift Parrots of habitat removal include direct loss of important food resources and fragmentation of a large habitat patch into smaller areas of habitat leading to habitat degradation through increased edge effects.

5. Migration is energetically costly to Swift Parrots and they only travel as far north from Tasmania over autumn and winter as they need to find food. The repeated sightings of Swift Parrots at Leard State Forest confirm that it provides essential habitat in years when food resources are not available further south (e.g. Victoria). The further reduction in available habitat will decrease the likelihood that there are sufficient feed trees in flower when they arrive at Leard State Forest which is likely to impact survival during their winter migration.

6. I found important flaws in arguments made in the MCCP BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT concerning significant impact criteria relevant to Swift Parrots. Contrary to the report's assertion, knowledge of Swift Parrot migratory behaviour and ecology strongly suggests that the 548.7 ha loss of potential foraging habitat will have a significant impact on the population. The MCCP BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT further argues that progressive rehabilitation of the post mine landform and restoration of further areas will ultimately increase the area of potential foraging habitat for Swift Parrots. However the planned landscape restoration is likely to occur too slowly to help the Swift Parrot population as its numbers fall sharply towards extinction over the next 10 years.

Background

In 2021, the Australian Federal Government made a commitment to 'no new extinctions'. To achieve this goal in the face of the need for sustainable development in coming decades will require a thorough understanding of not only the threats facing declining populations but also the effectiveness of conservation actions to prevent and reverse population declines. Habitat loss is a major driver of population decline in many threatened species. Such loss often occurs in a slow-paced, piecemeal way as a result of multiple developments. In isolation, such developments may have negligible impacts on threatened species' populations, but the cumulative impact of multiple developments on the population viability of threatened species is often substantial. A major challenge for legislative and planning processes is that under current frameworks, planning applications are generally assessed on a case-by-case basis, often on a local or regional scale much smaller than the extent of occurrence of many threatened species. In this instance, the potential impacts associated with individual planning applications on threatened entities may well be minimal, but the cumulative impacts of multiple development applications could have significant and irreversible impacts on threatened entities. Accurately forecasting potential cumulative impacts is an important conservation goal; by explicitly considering cumulative impact risks, planning processes are better placed to first avoid their occurrence, second minimise their magnitude and third offset them.

I have been engaged by the Environmental Defenders Office, acting on behalf of Maules Creek Community Council (MCCC), as an independent expert to review the impacts of the proposed Maules Creek Continuation Project (SSD-33083358) on the endangered (NSW)/ critically endangered (Commonwealth, IUCN) Swift Parrot (*Lathamus discolor*). I am a Professor of Conservation Biology working at the Fenner School of Environment and Society, ANU, and have specialised in parrot conservation for over 30 years (https://researchportalplus.anu.edu.au/en/persons/robert-heinsohn). My research lab includes the Difficult Bird Research Group, which specialises in studying Australia's most challenging threatened bird species (see https://www.difficultbirds.com/). Since 2007 I have led a team conducting a major research program on the conservation requirements of Swift Parrots both in their breeding range in Tasmania and over their winter migration range in SE Australia. I am a long standing member of the Swift Parrot Recovery Team. My research team and I have published over 30 peer-reviewed scientific papers on Swift Parrot ecology, behaviour, and conservation biology. I have read the Expert Witness Code of Conduct and agree to be bound by it. I have had no contact with the MCCC and all information presented here is either from peer-reviewed science conducted by my team or others, or my professional opinion based on our scientific program.

Swift Parrot conservation status

The Swift Parrot is the only member of the genus *Lathamus*, is listed as Critically Endangered nationally and internationally, and has been identified as one of Australia's priority 20 bird species for conservation action (Commonwealth of Australia 2016; NESP TSR Hub 2019). It is in a rapid state of decline and with only a small population remaining is already at significant risk of extinction. The National Recovery Plan for the Swift Parrot (DCCEEW 2024) identifies a number of major threats to the survival of the remaining Swift Parrot population. Additional pressures placed on swift parrots and its habitat may severely harm the chances of species recovery.

The breeding biology and dynamic breeding and non-breeding distributions of swift parrots have been thoroughly studied by my team, to the extent that key demographic parameters around breeding and movement strategies during breeding and migration are understood with a high degree of confidence. Our existing peer-reviewed population models confirm that swift parrots are headed for extinction by the early 2030's if the threats they face are not addressed effectively (Heinsohn et al. 2015, Owens et al. 2022). The three greatest threats to swift parrots are as follows.

1. In the Tasmanian breeding grounds of Swift Parrots, blue gum *E. globulus* and black gum *E. ovata* forests continue to be commercially logged on a large-scale, leading to the ongoing loss of both hollow-bearing trees and nectar resources from flowering upon which swift parrots depend for breeding. This loss of habitat is exacerbated by land clearing and tree-felling for other purposes (DCCEEW 2024).

2. Habitat loss in Tasmania is exacerbated by high, spatially-variable rates of nest predation by introduced sugar gliders *Petaurus breviceps.* Sugar gliders predate not only swift parrot eggs and nestlings but also adult females while they are on the nest, leading to continuing severe population decline from this source alone (Stojanovic et al. 2014; Heinsohn et al. 2015) and a heavily male-biased adult sex ratio (Heinsohn et al. 2019). Attempts to ameliorate the threats from predation by sugar gliders at nest hollows have thus far achieved only minimal success (DCCEEW 2024).

3. The entire population of Swift Parrots migrates from Tasmania to SE mainland Australia for the autumn and winter where the birds become nomadic in search of nectar and lerp from winter-flowering *Eucalytus spp* (Saunders and Heinsohn 2008). The ephemeral and unpredictable nature of winter flowering of their feed trees means they must search vast areas to find food with the patches available for use varying greatly from year to year. A single patch of foraging habitat is often not available for use each year but may be essential for the birds over a multi-year cycle. The range of Swift Parrots in mainland Australia is vast (>400,000 km^2) extending from inland and coastal areas of Victoria to southern Queensland. The amount of habitat they have to utilise within that area is severely limited especially in drought conditions (Saunders and Heinsohn 2008). In south-eastern mainland Australia, the principal threat facing Swift Parrots is the loss and degradation of foraging habitat. Habitat loss and degradation occur primarily due to agricultural and other land clearing in the west of the species' wintering range and residential/commercial development in the east. Habitat fragmentation and degradation is linked to eucalypt dieback associated with severe drought events and wildfires. Drought and wildfire are both linked to climate change, which is predicted to lead to further reductions in swift parrot habitat.

Our population viability analysis (PVA) confirmed that swift parrots are critically endangered and forecast a rate of population decline whereby the species will be functionally extinct by the early 2030's (Heinsohn et al. 2015; Owens et al. 2022). The population was estimated at approximately 750 individuals in 2021 (Webb et al. 2021) and is likely to be considerably lower by the time of writing this report in 2025 (Figure 1).

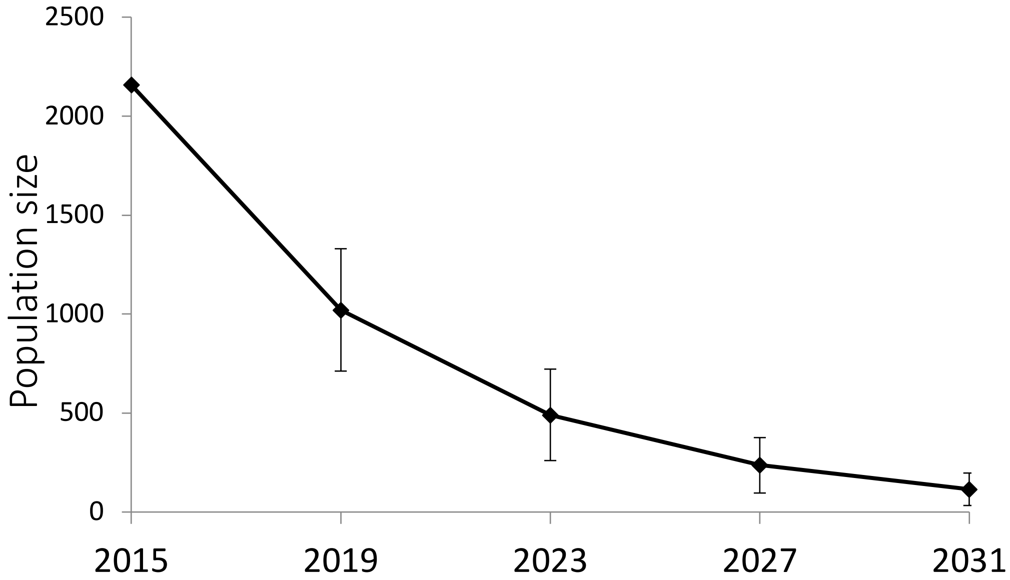


Figure 1. Predicted population size by year from population viability analysis carried out by Heinsohn et al. 2015. Predictions and standard error bars are shown at four year intervals.

Impact of habitat loss in mainland range of Swift Parrots

We recently quantified the cumulative impact of habitat loss on Swift Parrots in their winter, post-breeding migration range in south-eastern mainland Australia (Crates et al. 2025; Crates and Heinsohn 2025). Our aim was to assess whether swift parrots have sufficient habitat remaining on mainland Australia to support the population during migration, and the impact of continuing habitat loss. We used PVA to quantify the cumulative impacts of the loss of important swift parrot habitat across the species' entire wintering range, and specifically at one major site of habitat loss (Hunter Central Coast), over 50-100 years. We modelled a range of scenarios varying combinations of factors including future rates and the spatial extent of habitat loss, the carrying capacity of the environment, the proportion of the swift parrot population wintering affected by developments, and the timescale of concern. Assuming the threats in Tasmania are addressed (currently not the case), our models predicted that the Swift Parrot population will decline by around 16% due to lost habitat on the mainland alone i.e. further to losses forecast from other causes primarily in Tasmania. Our study emphasised the need to complement urgent action to address threats in the Tasmanian breeding grounds with the preservation of wintering habitat, if the long-term future of the swift parrot population is to be secured.

Likelihood of significant impacts of Maules Creek Continuation Project

When evaluating the potential for significant negative impacts on Swift Parrots within their winter range, and at the proposed development site more specifically, it is important to take the following points into consideration. These are based on the latest research and insights into the species' winter ecology and movements.

1. Habitat loss, degradation and fragmentation remain the largest threats to Swift Parrots

The single largest threat to Swift Parrots continues to be the ongoing loss, degradation and fragmentation of habitat, with cumulative impacts from many smaller scale impacts ("death by a thousand cuts"). The species is largely dependent on habitats that are also Endangered Ecological Communities (DCCEEW 2024). This includes both the direct loss of habitat from clearing and the process of unnatural habitat fragmentation and disturbance. These result in the reduction in the total area of the habitat (reducing chances of finding suitable food), and decreases to the interior/edge ratio, with concomitant increases in edge effects (mainly increasing predation and competition with aggressive species e.g. Noisy Miners, Rainbow Lorikeets). Although some foraging sites for Swift Parrots are contained within conservation reserves, most habitat is not formally protected at the regional, state/territory or national levels (DCCEEW 2024; Saunders 2008). The Leard State Forest is clearly an important foraging site for Swift Parrots (see below) but will have been reduced to slightly more than half its original size (54%, as specified in the MCCP BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT) due to mining developments by the time the new Maules Creek development is implemented. The impacts include direct loss of potential habitat, fragmentation into smaller areas of habitat, and habitat degradation including through edge effects.

2. Swift parrots only use small areas of winter habitat depending on where they find winter flowering Eucalyptus

The wide-ranging nomadic behaviour of Swift Parrots is an adaptation to the highly ephemeral and patchy available of this resource over vast areas. Swift Parrots must have many possible habitat patches to explore each year in order to be assured of finding some that have sufficient flowering to provide enough food for the population. Flowering in a local area when it does occur is often prolific. Swift parrots' radio-tracked within their winter range in two separate studies have revealed just how small their winter foraging areas can be, and how important these small habitat patches are for conservation of the species. In 2017 Swift Parrots were tracked to reveal winter foraging range sizes between 250-500ha of habitat for the entire winter period, including a highly concentrated roost site supporting up to 30% of the population (Saunders 2017). In 2019 the small size of Swift Parrot winter foraging habitats was further emphasised when approximately 30% of the population (200 birds) were concentrated within 6.8 to 75.6 ha (Saunders 2017).

3. Swift Parrots are known to use the site and surrounding area repeatedly

Sighting records show that Swift Parrots have been repeatedly observed foraging in Leard State Forest near to the continuation project area and are very likely to use the continuation project area (see below). Site fidelity is considered to be important for the long-term survival of migrants at wintering sites (Villard et al. 1995), with research conducted through the recovery program demonstrating this is true for Swift Parrots (Kennedy and Overs 2001, Kennedy and Tzaros 2005; Saunders 2008). Swift Parrots are known to return to the same sites repeatedly, including the same individual trees year after year (Saunders and Heinsohn 2008). However, the importance of areas where site fidelity has not been established should not be dismissed as it may be due to observational and accessibility limitations together with long-term resource availability cycles (Saunders *et al.* 2007). The National Swift Parrot Recovery Plan (DCCEEW 2024) notes that priority habitats of particular importance for conservation management of the species include sites that are used by large proportions of the Swift Parrot population repeatedly over time (site fidelity) and for extended periods of time (site persistence).

Small flocks (2-9 individuals) and single birds were recorded from an area east of the development site on 29 occasions between 2012 and 2023 (BioNet). The road network on Leard State Forest is limited so the concentration of sightings probably reflects that this is an accessible and popular point for bird watchers and naturalists. Further observations including flocks of 20 (2022) and 16 individuals (2023) were made during surveys for the nearby Boggabri coal mine. Because the habitat is similar across Leard State Forest it is highly likely that much of the forest is regularly visited by Swift Parrots each year, without these events being recorded by bird watchers. The proposed development site and surrounding areas currently form a contiguous area of known habitat that appears to still form a large enough habitat patch to provide sufficient resources in enough years such that the birds return repeatedly leading to high site fidelity and persistence. The integrity and value of Leard State Forest to Swift Parrots is highly likely to be impacted by the further loss of habitat.

4. Dependence on functional foraging habitat

Although Swift Parrots seek winter food resources over a very wide range, the area of functional habitat (habitat actually providing accessible food resources) is often a small fraction of the total potential habitat in any given year (Webb *et al.* 2017). This highlights the importance of protecting all remaining habitat that is known to be used by the species as it is all likely to be important over multiple years, especially in years with poor *Eucalyptus* flowering (e.g. drought years). Further, migration is extremely energetically expensive. Swift Parrots will only fly as far as they need to, for example, if habitat in northern Victoria has sufficient flowering they may go no further that season. However if they do not find sufficient food in Victoria they must continue their search and will continue northwards often as far as northern NSW and occasionally southern Queensland. They can lose up to 50% of their body weight on migration (ABBBS data) and are likely to suffer high mortality in years when resources are scarce. If they reach Leard Forest they have flown more than 1500km from their breeding grounds in Tasmania and may not have the reserves needed to survive the next leg of their journey if there are insufficient flowering trees. The repeated sightings of Swift Parrots at Leard State Forest, including sizeable flocks of 16-20, confirms that it provides essential habitat in years when food resources are not available further south. The further reduction in available habitat will decrease the likelihood that there are sufficient feed trees in flower when they arrive at Leard State Forest. This is likely to impact their chances of surviving the winter migration.

Assessment of significant impact criteria and mitigation measures for Swift Parrots are inadequate

Here I note inadequacies in arguments made concerning significant impact criteria relevant to Swift Parrots in the MCCP BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT (pg 400, in Table 71).
Point 1 in Table 71 stresses that clearing of woodland forest will mostly occur in a clearing window (late summer and early autumn), with some exceptions. This consideration is of relatively low importance for Swift Parrots as loss of foraging habitat is the primary concern.
Point 2 stresses that no records exist for the Swift Parrot in the study area and develops an

argument that the AOO will not be reduced. However, as outlined above, it is highly likely Swift Parrots use habitat in the Action Area. Not finding Swift Parrots in one particular time period means very little given their widely nomadic behaviour and dependence on many habitat patches over multiple years.

Point 4 states that 548.7 ha of potential foraging habitat would be progressively cleared by the Action. It argues that progressive rehabilitation of the post mine landform and restoration of further areas will ultimately increase the area of potential foraging habitat for Swift Parrots. Although commendable, the planned landscape restoration is likely to occur too late to help the Swift Parrot population as its numbers decrease sharply such that extinction is predicted within 10 years. Further, the statement that alternate foraging resources would continue to occur in the habitat outside of the Action Area is only likely to be true some of the time. As argued above, Swift Parrots are only likely to move as far north as Leard State Forest (and sites even further north e.g. southern Queensland) when they have trouble locating food resources in the south of their winter range (e.g. Victoria) and may be physiologically stressed by the time they arrive. There is no guarantee they will find other foraging sites if patches in Leard Forest are not available to them. Removing habitat at sites as far north and as frequently visited by Swift Parrots as Leard State Forest may actually cause greater harm to the species than removal of habitat elsewhere because the birds are clearly in great need when they choose to use them.

Point 6. The loss of 549.4 ha in the Action Area is over 30% of total habitat in the wider study area. This is a major and probably a very impactful loss of habitat. As above, provision of future habitat may be too late to help save the species from extinction. The same reservation applies to Point 9 and the Conclusion (9.5.2.1) presented on page 402.

Conclusions

Swift Parrots are among our most critically endangered bird species; action to save the wild population from extinction must occur within the next 10 years. Actions likely to cause further decline must be avoided. The unusual ecology of Swift Parrot winter movements makes preservation of remaining habitat on mainland Australia essential for their conservation. The high frequency of visitation confirms that Leard State Forest is an important winter foraging site for Swift Parrots. In this report I outline how the proposed Actions regarding the Maules Creek Continuation Project are likely to have major impacts on Swift Parrots that have not been fully recognised or addressed in the MCCP BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT. In particular the MCCP BIODIVERSITY DEVELOPMENT ASSESSMENT REPORT has not recognised the importance of the potential foraging habitat that will be lost, and has missed the critical point that the provision of future habitat through restoration will not occur in time to help this species avoid extinction. Thus the further loss of habitat from Actions concerning the Maules Creek Continuation Project is likely to have serious and irreversible impacts on Swift Parrots, a species known to be in a rapid rate of decline.

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Appendix H

Maules Creek Continuation Project

MCCC Final Void

MCCC Critical Review

Appendix H - Final Void

The final void strategy proposed in the Maules Creek Continuation EIS does not explore alternative landuse options and presents unresolved hydrogeological, economic, and environmental risks.

1. Risks

These risks include;

1.1. Evaporation losses are substantial and permanent

The void will lose ~3.7 GL/year through evaporation-representing an enduring loss of water resources in a groundwater-stressed region. No mitigation is proposed.

1.2. Water inputs are insufficient to sustain balance

Modelled inflows (groundwater and surface water) fall significantly short of evaporation losses, resulting in a long-term water deficit that could exacerbate drawdown in nearby aquifers.

1.3. Opportunity costs are ignored

The EIS does not assess the lost value of this water if used for irrigation, leasing, or climate adaptation. Estimated values exceed $2 billion over 1,000 years.

1.4. No economic or strategic comparison of backfill alternatives

While a $2.1 billion operational cost is cited to justify non-backfill, it lacks transparency, inflation treatment, and itemisation. A full-cost comparison with alternative land uses has not been undertaken. We explore the benefits of one scenario, a solar/forestry land use.

1.5. Rehabilitation options are under explored

Viable alternatives such as dual-purpose solar farms and native forestry are not considered despite alignment with state and national climate, water, and biodiversity goals.

1.6. Risk externalisation is likely

The void will create an ongoing public liability unless a fully funded, enforceable, and adaptive post-closure strategy is adopted. This remains absent from the current proposal.

This Review critically challenges the claims made in the WRM Final Void Section 9 of the EIS and looks at alternative options that will create positive social and economic outcomes rather than a permanent social and economic loss that is the “Final void”.

2. Proponents Proposal

2.1. Final Void Water Balance Summary

Appendix B of the 2025 EIS describes the long-term water balance of the Maules Creek final void using a 1,000-year simulation informed by SILO climate data (1889-2024). The final void is predicted to reach a steady-state water level of approximately 138-144 mAHD, which is 155 m below the overflow level, indicating it will function as a permanent groundwater sink with no risk of overtopping (Appendix B, p. 142).

2.2. Evaporation Loss Estimates

Average annual evaporation at the site is estimated at 1,852 mm, with a 90th percentile value of 1,994 mm. The modelling uses Morton's lake evaporation method, reduced by a factor of 0.85 to account for shading and wind protection within the void geometry (Appendix B, p. 90).

Assuming a void surface area of 200 ha (2,000,000 m²), estimated evaporation losses are:

- ~3.70 GL/year under average conditions.
- ~3.99 GL/year under 90th percentile evaporation scenarios.

These estimates do not explicitly account for future increases in evaporation due to climate change beyond historical trends.

2.3. Inflow Requirements and Surface Water Runoff

To maintain a water balance at the void's equilibrium level, surface water and groundwater inflow must approximately match evaporation losses. Therefore:

- ~3.70 GL/year of inflow is required under average climate conditions to offset evaporation.
- This equates to approximately 10.1 ML/day.

Appendix B Figure 9.4 indicates a long term groundwater inflow of only 430 ML/year approx.

Assuming:

- A total catchment area of 440 ha, of which 200 ha is the final void.
- An annual rainfall of 600 mm/year.
- A runoff coefficient of 30-50% for the non-void catchment area (240 ha).

The estimated surface water runoff would be:

- ~0.43 to 0.72 GL/year from rainfall on the non-void catchment (240 ha × 600 mm × 0.3-0.5 runoff coefficient).
- +1.2 GL/year directly from rainfall onto the void surface itself (200 ha × 600 mm).
- Total surface inflow = ~1.63 to 1.92 GL/year, not including groundwater inflow.

Together with the reported ~430 ML/year of groundwater inflow, these sources may contribute ~2.06 to 2.35 GL/year, which is still below the required ~3.7 GL/year evaporation loss.

2.4. Conclusion

This suggests the void will remain in persistent deficit unless inflows are underestimated.

2.5. Potential for Unmanaged Drawdown and Economic Implications

The predicted role of the void as a long-term groundwater sink raise concerns about unmitigated depressurisation of connected aquifers. The MCA, in particular, could be subject to vertical leakage or lateral drawdown toward the void under certain conditions.

No mitigation measures or long-term rehabilitation strategies are proposed in Appendix B to manage this potential impact. This is a major gap in the analysis, because the remediation bonds will not be sufficient to repair the damage.

3. Re-imagining the Final Void

3.1. Opportunity Cost of Evaporation Losses

If the estimated 3.7 GL/year of evaporated water from the final void were instead made available for productive use, the foregone economic value would be significant.

3.1.1 Water Leasing Scenario

Assuming an average lease price of $250/ML in today's dollars: This price is consistent with recent surface water lease benchmarks for the Lower Namoi, which generally range between $200-$400/ML/year depending on reliability and allocation conditions (Marsden Jacob Associates, 2021; NSW DPIE, 2024).

- The annual opportunity cost is $925,000.
- Over 1,000 years, this equates to $925 million in lost value (undiscounted).

3.1.2 Cotton Irrigation Scenario

Assuming 7 ML/ha water use for irrigated cotton:

- 528 ha of cotton could be irrigated annually.
- At 8 bales/ha and $500 per bale, this represents $2.11 million per year in cotton value.
- Over 1,000 years, the cumulative opportunity cost would be approximately $2.11 billion in today's dollars (undiscounted).

Note: All opportunity cost figures are expressed in 2025 dollars without discounting. While this approach highlights the magnitude of long-term value foregone, it does not account for inflation or apply a present value discount rate. If standard economic discounting were applied (e.g. 4-7% per annum), the apparent value of future losses would be significantly reduced-potentially undervaluing intergenerational impacts.

These scenarios highlight long-term economic trade-offs not explored in the EIS. The water lost to evaporation could have otherwise supported drought resilience, food production, and regional adaptation. The lack of cost-benefit analysis undermines the strategic basis for accepting a non-beneficial, evaporative final void as the long-term land use outcome.

This also contrasts with the NSW Water Management Act 2000's objective to prioritise efficient and equitable water use across users, particularly in over-allocated or climate-vulnerable catchments. This reinforces the importance of recognising economic opportunity costs in long-term void planning, especially when market benchmarks clearly support the feasibility of alternative, higher-value water uses (Marsden Jacob Associates, 2021; NSW DPIE, 2024).

3.2. Strategic Case for Backfilling the Final Void

In addition to avoiding the opportunity cost for water loss of potentially $2.11 billion described above, the additional value of beneficial land use should be included. In the following section we challenge the unjustified Final Void cost estimate of backfilling and reclaiming the final void and provide scenarios of beneficial land uses to illustrate the opportunities.

3.2.1 Critique of Final Void Remediation Cost Estimate

The EIS and Appendix B do not provide a transparent or itemised cost estimate for the long-term management of the final void, including monitoring, water quality management, or physical remediation. This lack of detail obscures the true cost of leaving the void unfilled.

Key concerns include:

- Absence of whole-of-life costing: There is no comprehensive financial modelling of long-term void maintenance, including the cost of groundwater quality monitoring, tailwater control, fencing, signage, or future risk management under climate variability.
- Evaporation losses externalised: The EIS does not quantify the opportunity cost of evaporated water as a remediation liability, despite evidence that 3.7 GL/year will be lost perpetually, representing a substantial environmental and economic externality.
- No backfilling feasibility comparison: the Mine Closure Addendum (Attachment 7, p. A7-31) claims an additional operating cost of $2.1 billion would be incurred to support the alternative final landform (AFL) involving full backfill. However, this figure lacks itemisation and conflates site-wide operational cost escalation with landform-specific actions, making it unsuitable for comparing the net benefit of backfilling versus void retention.
- Undefined dollar values: The $2.1 billion figure is not presented with a clear price year, CPI escalation, or discount rate, reducing transparency. Regulators cannot assess whether these reflect present-day capital cost, life-of-mine OPEX, or discounted liabilities.
- Public cost shifting risk: In the absence of a clearly funded and enforced post-closure plan, there is a risk that future governments or communities will bear the cost of monitoring, securing, or remediating the void in perpetuity.

A robust financial assurance framework would require the proponent to quantify and secure funds for the full cost of final void risks and obligations. The current EIS lacks sufficient evidence to demonstrate that the chosen approach is the most economically or environmentally responsible strategy for long-term closure.

3.2.2 Landuse Alternative - Integrated Renewable Energy and Forestry

One scenario for the backfilled void rehabilitation would be to develop a solar farm with battery storage on the reclaimed surface, leveraging the site’s flat terrain and existing mine infrastructure. A hypothetical 100 hectare solar farm with 100 MW battery capacity would represent a viable post-mining land use aligned with NSW climate and energy policy.

- A 100 ha solar farm could support ~40 MW of solar PV capacity, assuming 0.4 MW/ha installation density.
- Annual energy generation (at 1,700 kWh/kW/year typical NSW yield) = 68 GWh/year.
- At a wholesale market value of $80/MWh, this yields $5.44 million/year.

- Over 40 years (a realistic upper-bound lifespan with modern PV and battery upgrades), this could generate ~$217.6 million in gross energy value, excluding storage services and co-benefits.

In parallel, a 100-hectare Cypress Pine (Callitris spp.) forestry plantation could:

- Yield 10 m^3/ha/year over a 30-year rotation, based on Forestry Corporation of NSW guidelines for semi-arid sites in Central North NSW (e.g. Pilliga, Narrabri region).
- Generate $100,000/year at $100/$m^3$ stumpage value, resulting in $100 million in gross value over 1,000 years (undiscounted), supported by ABARES plantation pricing data.
- Provide co-benefits through carbon sequestration (estimated 12-15 tCO_2e/ha/year for native dryland reforestation), ecosystem recovery, and fire resilience.

In addition, such a plantation could be eligible for carbon credit revenue under the Emissions Reduction Fund or NSW biodiversity offsets market, further increasing its long-term economic and environmental value. Comparatively, biodiversity credit rates for offset plantings in this region can exceed $5,000/ha depending on species and strategic value.

By combining a solar farm and native forestry across the full 200-hectare void area, the project would support a dual-purpose land use strategy that aligns with NSW climate, biodiversity, and energy transition objectives.

The current void plan forecloses productive reuse and should be reconsidered in light of evolving energy and climate objectives and land rehabilitation policy. An options assessment considering the hydrogeological, economic, and land use implications of backfilling should be incorporated into future revisions of the EIS to ensure that the final landform delivers maximum environmental and social value.

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Appendix I

Maules Creek Continuation Project

Inter-mine Water Transfer Pipeline

MCCC Critical Review

Appendix I - Inter-Mine Water Transfer Pipeline

The AGE (2025) Groundwater Impact Assessment, as referenced through the Surface Water Assessment, does not provide a targeted or quantitative assessment of the potential for long-term interconnectivity between depressurised coal seams and the MCA arising from shifts in hydraulic gradients induced by the proposed inter-mine pipeline.

While the GIA acknowledges cumulative impacts from adjacent mines (MCCM, TCM, BCM) (Appendix B, p. 156), and the Surface Water Assessment discusses pipeline transfers and their impact on mine water inventories (Appendix B, p. 100), no specific modelling or risk analysis addresses whether these transfers could establish or enhance pathways for induced leakage or recharge interception across hydrostratigraphic boundaries.

This is a critical omission given that:

- Water transfers can reconfigure direction and magnitude of hydraulic gradients across regional stratigraphy.
- The MCCM final void will act as a long-term hydraulic sink (Appendix B, p. 142), and under certain pipeline scenarios, up to 10% of simulations suggest the TCM void may also be pumped dry (Appendix B, p. 148).

Such conditions could promote cross-formational flows from the MCA into underlying coal seams or final voids, especially if the system lacks adequate confining layers or is affected by faults or historical depressurisation. No site-specific hydrogeological cross-sections, aquitard integrity assessments, or gradient vector plots are provided to rule out this possibility (source not specified).

This absence is notable given the pipeline's intent to manage water across three major mines, potentially at different hydraulic heads, and the historical significance of the MCA as a groundwater-dependent system.

Shift from Low Predicted Groundwater Inflow (2011 GIA) to Need for Water Pipeline (2025 GIA)

The original 2011 Groundwater Impact Assessment (AGE, 2011) forecasted minimal groundwater inflow to the Maules Creek Mine pit under baseline conditions. At that time, the conceptual hydrogeological model characterised the MCA and underlying units as largely disconnected or weakly transmissive, resulting in predictions of low seepage rates and negligible long-term dewatering needs (source not specified).

However, the 2025 EIS introduces a substantial inter-mine water transfer pipeline, with capacity for 8 ML/day transfers and operational assumptions that mine pits including MCCM and TCM will be used as interchangeable water storage voids (Appendix B, p. 100). The need for this infrastructure contradicts earlier assumptions of isolated pit hydrology and low inflow.

The Surface Water Assessment (Appendix B) now indicates:

- A risk of overflow at MCCM in wet years without pipeline capacity to divert water to TCM (Appendix B, p. 149);

- A dependency on water imports from TCM to meet dry-year operational shortfalls, in which up to 10% of simulations deplete the TCM final void (Appendix B, p. 148);
- And significant use of bore and river sources as fallback in the absence of pipeline water.

These findings imply a marked shift in groundwater behaviour or management expectations, yet the EIS does not transparently reconcile these changes with the original predictions of the 2011 GIA. There is no clear explanation of whether:

- Actual groundwater inflows have exceeded predictions;
- Regional mining depressurisation has altered hydrogeological gradients;
- Climate variability or under-estimated recharge has affected storage;
- Or operational water demands have escalated due to expanded production (source not specified).

This discrepancy raises questions about the accuracy and reliability of previous groundwater models, and whether new infrastructure like the pipeline is compensating for unanticipated or under-disclosed cumulative drawdown effects.

The lack of continuity between the 2011 and 2025 conceptual models, and the absence of retrospective analysis explaining the pipeline's necessity, undermines the accountability of groundwater planning under the EP&A Act 1979 and the Water Management Act 2000.

Lack of Evaluation of Alternatives to the Inter-Mine Water Pipeline

The proponent does not provide a substantive assessment of alternative water management strategies to the inter-mine pipeline, despite its potential to impose regional hydrological and socio-environmental risks.

Appendix B of the EIS frames the pipeline as a preferred operational solution for balancing mine water inventories, without reference to other structural or passive alternatives that may mitigate similar risks without enabling inter-mine drawdown propagation (Appendix B, p. 100, p. 149).
There is no discussion of:

- Aquifer injection (managed aquifer recharge) using surplus treated water to replenish groundwater stores or support MCA resilience;
- Impermeable bunding or separation infrastructure to isolate mine water systems and prevent inter-catchment transfer of hydrological stress;
- Construction of contained, above-ground storages that limit interaction with shallow aquifers;
- Or investment in community or catchment-scale adaptation measures, such as public drought resilience pipelines (source not specified).

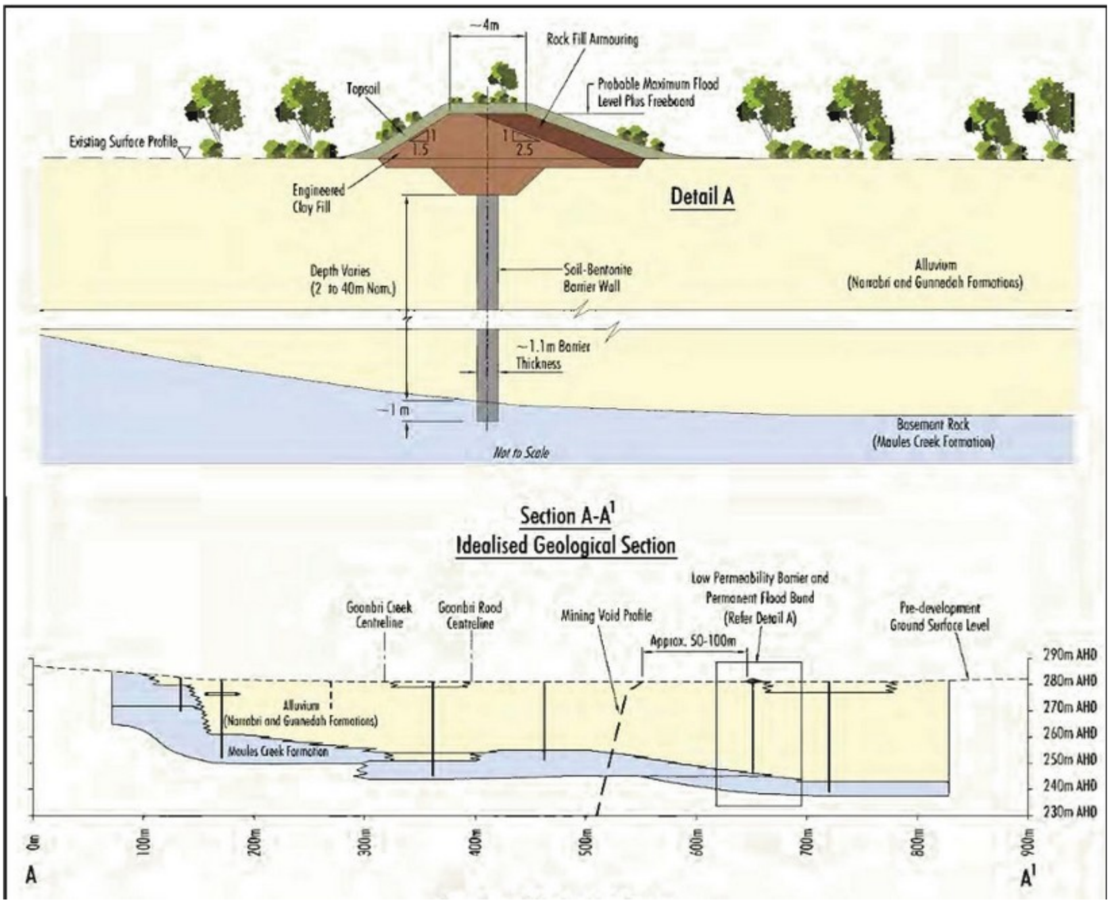

Fig: 1.0 Impermeable bund approved by PAC for the Tarrawonga mine

The lack of alternative analysis is a key omission, particularly given the project's potential to:

- Reconfigure regional groundwater gradients;
- Reduce water availability for non-mine users during drought;

NSW planning and water policy frameworks-including the EP&A Act 1979, the Water Management Act 2000, and the National Water Initiative-emphasise that strategic infrastructure must be evaluated in terms of least harm, best value, and sustainability. The absence of a comparative options analysis is inconsistent with these principles.

Without evidence that less risky or more publicly beneficial alternatives were considered and ruled out on technical or financial grounds, the proponent's preference for the pipeline lacks procedural rigour and undermines confidence in the project's alignment with long-term catchment adaptation objectives.

Justification for Inter-Site Transfers of Mine-Affected Water in a Declining Water Table Region

The proponent does not provide a robust justification for transferring mine-affected water between sites in a region already subject to long-term groundwater level declines, particularly near Maules Creek domestic bores and riparian ecosystems.

While Appendix B frames the inter-mine pipeline as a water management efficiency measure-reducing discharge risk and enhancing flexibility during wet or dry periods (Appendix B, p. 149)-it does not assess whether such transfers externalise hydrological risks onto nearby landholders or sensitive aquatic systems.

Specifically:

- The pipeline enables the MCCM to extract water from the TCM final void, and vice versa, based on pre-set volume triggers (Appendix B, p. 100).
- In dry scenarios, up to 10% of simulations result in the TCM final void being pumped dry, shifting reliance to borefields and river take (Appendix B, p. 148).

These dynamics reflect a system that responds to mine operational needs but lacks an overlay of environmental or social impact thresholds for offsite receptors. The GIA and Surface Water Assessment do not quantify the proximity or vulnerability of domestic bores, nor do they evaluate the ecological baseflow requirements of riparian corridors in relation to additional drawdown or interception risk (source not specified).

There is also no evidence of:

- Groundwater modelling of cumulative depressurisation zones near Maules Creek bores;
- Assessment of groundwater-dependent ecosystems (GDEs) in or adjacent to pipeline corridors;
- Or a commitment to monitor or mitigate third-party impact risks through adaptive management or access protections.

Given that regional aquifers such as the MCA have experienced historic drawdown pressures from mine dewatering and drought, introducing new transfer pathways without transparent benefit-cost analysis or resilience testing raises concern. These risks are not acknowledged in the Surface Water Assessment or associated appendices (source not specified).

Accordingly, the project lacks a precautionary framework to ensure that the benefits to mine water inventory flexibility do not come at the expense of public water access, rural water security, or ecological integrity contrary to the ESD principles in the EP&A Act 1979 and the protective intent of the Water Management Act 2000.

Risk that Pipeline Enables Extended Mining Impacts Beyond Approved Limits

The proponent provides no clear evidence or regulatory safeguard demonstrating that the proposed inter-mine pipeline will not be used to facilitate water-sharing between operations in a manner that indirectly extends the life or intensity of mining beyond currently approved limits.

While the Surface Water Assessment describes the pipeline as enabling more efficient and adaptive mine water management (Appendix B, p. 149), it does not contain any binding limitations or conditions that constrain the pipeline’s use to currently approved operational volumes, production rates, or timeframes.

This raises concern because strategic infrastructure such as pipelines can: - Allow a mine with insufficient local water availability to continue or expand operations by importing water from adjacent sites. - Mask hydrological constraints that would otherwise trigger a curtailment or staged closure of operations.

The pipeline forms part of a system that interconnects MCCM, TCM, and VCM, allowing mine water to be moved according to inventory triggers. However, no cumulative lifecycle water usage cap or approval aligned throughput ceiling is stated to prevent expanded usage scenarios (Appendix B, p. 100).

The Surface Water Assessment and GIA also do not discuss whether pipeline operation is linked to mine scheduling, expansion planning, or sequencing decisions that might extend or intensify water-related impacts, particularly to the MCA (source not specified).

In the absence of:

- A clear environmental constraint binding the pipeline to approved EIS forecasts;
- A risk assessment of its potential enabling role in impact escalation;
- Or a performance-based monitoring condition to detect unintended intensification

The project does not meet precautionary standards under the EP&A Act 1979, nor does it demonstrate compliance with NSW regulatory guidance that infrastructure must not be used to enable or obscure unapproved project intensification.

Absence of Comparative Cumulative Impact Modelling for Pipeline Scenarios

The cumulative impact modelling presented in the AGE (2025) Groundwater Impact Assessment does not include side-by-side scenario comparisons of the MCA under "with pipeline" versus "without pipeline" conditions.

The Surface Water Assessment references simulations involving pipeline-enabled transfers, such as from the TCM final void to MCCM (Appendix B, p. 100), and acknowledges that 5-10% of modelled runs result in significant depletion of the TCM void (Appendix B, p. 148). However, these simulations are not contrasted with an alternative case where no pipeline is constructed and each mine must rely solely on localised water sources.

Specifically, the GIA does not:

- Provide spatial drawdown comparisons of the alluvium with and without pipeline infrastructure;
- Quantify whether pipeline operations accelerate or mitigate depressurisation trends in the MCA;
- Or evaluate long-term hydrological trade-offs for the catchment (source not specified).

This lack of comparative modelling undermines the ability to determine whether the pipeline constitutes a net environmental benefit or burden for the region. While the infrastructure may improve mine water management flexibility, this does not equate to a broader public or ecological water resource benefit, particularly given the existing and projected stress on the alluvial system.

No metrics of aquifer recovery time, bore reliability, or GDE vulnerability are presented to demonstrate that the pipeline reduces long-term water risks to third parties. As such, the cumulative impact modelling is incomplete, and the project does not meet the expected standard under the EP&A Act 1979 for fully disclosed and balanced environmental evaluation.

Consistency of the Inter-Mine Pipeline with the Groundwater Management Plan (GMP)

The 2025 Surface Water Assessment and associated GIA do not provide clear evidence that the proposed inter-mine pipeline is explicitly embedded within or consistent with the current Groundwater Management Plan (GMP) for Maules Creek.

Although Appendix B outlines the operational logic of the pipeline (e.g. transfer triggers at 900 ML and 1,548 ML, Appendix B, p. 100), there is no direct reference to GMP protocols, compliance thresholds, or adaptation of the GMP to include the new inter-mine connectivity.

Key concerns include:

- No indication that the GMP has been updated to reflect hydraulic gradient shifts or connectivity risks induced by pipeline-enabled transfers between MCCM and TCM;
- Absence of any cross-reference to groundwater management zones, license limits, or risk matrices that would apply under the pipeline regime;
- No detail on monitoring, reporting, or adaptive response if the pipeline induces unintended drawdown impacts on third-party bores or the MCA (source not specified).

This suggests a procedural gap between infrastructure planning and groundwater governance. Given the potential for the pipeline to reconfigure groundwater movement and increase reliance on regional alluvium and voids, its absence from an updated GMP framework undermines its compliance with:

- The adaptive management obligations under the EP&A Act 1979;
- The impact mitigation hierarchy required under the Water Management Act 2000;
- And the integrated water planning principles embedded in NSW Aquifer Interference Policy.

The Role of the Inter-Mine Pipeline in Masking Mine-to-Mine Hydrological Interactions

The proposed inter-mine pipeline may significantly mask the true extent of hydrological interaction between connected mines, by enabling the redistribution of mine water in ways that obscure the independent water balance and groundwater dependency of each operation.

According to the Surface Water Assessment, the pipeline is designed to transfer water between Maules Creek Coal Mine (MCCM), Tarrawonga Coal Mine (TCM), and Vickery Coal Mine (VCM), depending on storage thresholds and operational need (Appendix B, p. 100). While this provides short-term flexibility in managing water inventory, it has the effect of:

- Obscuring the hydrogeological isolation or vulnerability of each mine;
- Making it more difficult to attribute localised drawdown, overflow risk, or dewatering impacts to specific operations;
- And diffusing regulatory scrutiny of water take limits, as water can be “borrowed” or “stored” off-site without transparent metering of environmental consequence (source not specified).

The interconnection through shared infrastructure dilutes the ability to:

- Assess whether one mine (e.g. MCCM) is over-reliant on external voids for inflow buffering;
- Detect which mine is causing drawdown in shared aquifers such as the MCA;
- Or identify the mine most responsible for pressure recovery delays or induced leakage between stratigraphic units.

No disaggregated water balance or accountability framework is provided that distinguishes between mine-specific impacts once the pipeline is operational. There is also no discussion of whether individual mine approvals or Water Access Licences (WALs) will be adjusted to reflect this operational blending (source not specified).

As a result, the pipeline introduces a degree of hydrological opacity, raising questions about whether the Environmental Impact Statement (EIS) maintains sufficient clarity to support robust, mine-specific compliance, especially under the Water Management Act 2000 and the adaptive management provisions of the EP&A Act 1979.

The absence of mine-by-mine impact attribution once pipeline connectivity is established may compromise future enforcement, monitoring, and adaptive response, especially if one mine's operational needs begin to drive systemic groundwater depletion shared across the network.

Appendix J

Maules Creek Continuation Project

Letter to Square Peg

Appendix J – Letter to Square Peg

Ms. Roselyn Druce,
Public Officer, Maules Creek Community Council
66 Teston Lane,
MAULES CREEK, via BOGGABRI 2382
20th June 2023

Dear Daniel Holm,

On behalf of the Maules Creek Community Council and as representatives of the Maules Creek mine CCC and residents of Maules Creek district we write in response to your request for one-on-one interviews to undertake the Social Impact Assessment for the new Maules Creek mine proposed expansion.

Firstly, we note that the scoping study and EIS is planned for later in 2023. Therefore, we think we are justified in requesting that we take the time to determine an appropriate, genuine, fair and community-led process – supported by a genuinely independent practitioner – for this Social Impact Assessment to be undertaken. Proponent-led processes, where the proponent selects and pays for its chosen consultant, are intrinsically biased in favour of the proponent's vested interests, and cannot provide for procedural fairness.

You would appreciate that our community members have been through this process with the original approval of the Maules Creek mine, many also went through this process for the Vickery Extension project and the Narrabri Underground expansion. Many of us have also participated in Departmental processes that have seen 9 modifications to the Maules Creek mine, 9 modifications to the Boggabri Coal mine, 10 modifications to the Tarrawonga mine and 7 modifications and an expansion to the Narrabri Underground mine. We are painfully familiar with the Department of Planning's approvals process, including the Social Impact Assessment aspects.

At each of these processes we have raised the lack of social acceptance that Whitehaven has in the region and our concerns have been minimised, rarely being reflected in the Statement of Reasons when the projects reached approval.

As an illustration of its lack of social licence, that Whitehaven has over 35 fines, convictions and breaches to its name (please see the list attached).

At Maules Creek mine itself the community has suffered a string of broken promises, seen dozens of locals bought out, even beyond the originally identified impacted area, decimated the Fairfax School, been convicted of stealing water that would have moved into Maules Creek. These are distinct negative Social Impacts.

With a 13-year history of negative social impacts leading to no social licence, it is intriguing to consider how Whitehaven's approach of hiring an external consultant to hold one on one meetings with local CCC members will overcome this chasm of lost trust, and it is impossible to believe that it will suddenly acquire a social licence.

In order for this SIA process to have any credibility and validity at all, and therefore to hope to go anywhere near meeting the new Social Impact Assessment Guidelines, it must be community led.

This must be a genuine process with the following parameters:

- An independent consultant will be chosen by the community and paid for by the company (Square Peg will be invited to respond to the tender request)
- To be eligible, a consultant must demonstrate that they have no private or vested interest whatsoever in the outcome of the development, must not have worked for the proponent in the last ten years, and will be contractually bound not to undertake further work for the proponent for ten years from submitting all documents associated with the SIA including any management plans.

- The consultant's role is to guide and support the community-led process, and not to drive it.
- The process will be completely transparent, with no confidential agreements.
- Locals will not be isolated to meet individually, unless they request it
- Local expert witnesses who have a wealth of knowledge about the social impacts will be paid >$60 per hour (plus GST where applicable) to provide their expertise to the process. This payment is provided without conditions, regardless of their testimonies.
- The process will culminate in a public Citizens Jury that is overseen by a Kings Counsel where Whitehaven will have the opportunity to respond to community questions as to how it can legally guarantee that the same issues that have occurred for the last 13 years, will not occur with the new expansion
- This process will also consider social impacts created from continued expanding carbon emissions and the resultant climate change impacts and seek representation from those who can speak to these impacts as well.

We believe this process could begin in August 2023 in order to meet the timeline aimed for by the proponent.

A similar a community-led process was initiated in 2012 in the form of the Gunnedah Basin Health Impact Assessment[1] and should be reviewed. Further guidance on community-led processes should learn from the examples of the Real Deal project at the University of Sydney.[2]

From the Maules Creek Community Council, CCC members and broader community members

Sincerely,

Roselyn Druce
Public Officer, Maules Creek Community Council

1 https://www.aph.gov.au/DocumentStore.ashx?id=ad8cc794-d700-40e1-b3b5-287edb1af2b2
2 https://www.sydney.edu.au/sydney-policy-lab/our-research/real-deal.html

Appendix L
Maules Creek Continuation Project
Reports and Correspondence

File Reference: Not provided
WAMs: 27807

NSW GOVERNMENT | Department of Industry

Memorandum

Groundwater Assessment - Major Projects and Developments

Project name	Boggabri, Tarrawonga, Maules Creek coal mines (BTM Complex)
Project stage	Numerical Groundwater Model Update
Due date	17 October 2018
Context	Assessment of numerical model report and independent review against periodic model verification and coordination consent conditions
Water Regulation Officer	Tim Baker 02 6841 7403

Advice request

Natural Resources Access Regulator (NRAR) requested assessment of numerical model report and independent review required against the following consent conditions:

- "a program to validate the groundwater model for the project, including an independent review of the model every three years, comparison of monitoring results with modelled predictions".
- "coordinate modelling programs for validation, recalibration and re-running of the groundwater and surface water models using approved mine operation plans".

NRAR specifically requested the following:

1. Groundwater Modelling Review
   - Adequacy of the model update report to address the two relevant consent conditions listed above.
   - Advise on the adequacy of the recalibration of the model and updated predictions for drawdown and take of water/entitlement from all water sources.
   - Any further recommendations (if any) for the groundwater monitoring program to improve ongoing model validation/recalibration.
   - Consider Dr Merrick's peer review advice.
   - Advise on any meeting requirements to discuss further.
2. Consider the outcomes of review of the numerical model update in terms of advice to be provided for the following:
   - Maules Ck Annual Review 2017 revised (initial advice for this matter is requested now and can be updated into the future if needed).
   - Maules Ck Water Management Plan.
   - BTM Water Management Strategy.
   - Tarrawonga Water Management Plan.

Copy of NRAR advice request is provided in Attachment A.

Assessment Overview

Water Assessments has reviewed the 2018 BTM Cumulative Groundwater Model update, noting this document was assessed in conjunction with the Boggabri, Tarrawonga, Maules Creek Complex (BTM) Water Management Strategy, the MCCM Annual Review, the MCCM Water Management Plan (WMP) and the Tarrawonga WMP.

The BTM coal mining complex (BTM Complex) is located in the Gunnedah Basin, approximately 15 km northeast of the township of Boggabri in north-western NSW. It comprises three adjacent open cut coal mines referred to as Boggabri, Tarrawonga and Maules Creek.

Boggabri Coal Operations Pty Ltd commissioned a groundwater flow numerical model, a modelling report, and independent review as required by consent conditions. This is an assessment of the adequacy of the completed work to meet the relevant consent conditions. It is based on reviewing the following documents:

1. Document titled "Report on Boggabri, Tarrawonga, Maules Creek Complex Numerical Model Update." Prepared for Boggabri Coal Operations Pty Ltd by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE), dated August 2018 (v04.01).
2. Memo referenced as "Boggabri-Tarrawonga-Maules Creek Complex - Groundwater Model Review", from Dr Noel Merrick of Hydro Simulations, dated 28 August 2018.

Detailed assessment of the above documents is presented in Attachment B. The main findings of the assessment are as follows:

- The model and report are clearly prepared for the Boggabri Coal Mine. Although the model covers all the BTM Complex area, there is no evidence that the model or its report are embraced by either of the other two neighbouring mining operations.
- The required program/s for periodic validation of groundwater models and plan/s for coordinated modelling are not provided in the reviewed material. They are also not provided in the "Draft Water Management Strategy for Boggabri – Tarrawonga – Maules Creek Complex", dated June 2018 (WMS).
- The independent review is generally positive about the reported model. However, it pinpoints poor model calibration in some areas (order and trend) and general poor simulation of seasonality. It suggests that the model mostly meets Class 2 confidence level criteria as defined in the Australian Groundwater Modelling Guidelines (2012). The review highlights substantial uncertainty in the estimated licensable takes.
- The reported model verification is inadequate. It involved only one previous model (AGE, 2014) for Maules Creek Coal Mine. Other models were not verified. It compares AGE (2014) model predictions to groundwater level observations and mine inflows estimates for the period 2013-2016. Quality of predictions is found to vary from generally reasonable to poor (e.g. observed decline in groundwater level but model predicted rise). No in-depth analysis is provided for noticed correlation or deviation from observations or previous modelled predictions.
- There is no evidence that the new model has benefited from the verification of previous models to provide improved estimates and predictions. For example, the reported verification considers that improper parametrisation and inaccurate representation of mining progression in the previous model could be reasons for poor simulation and predictions in AGE (2014) model. Nonetheless, such issues are not addressed in the new model. There are also examples of poorer performance by the new model compared to previous models including reversed vertical groundwater flow direction and groundwater level trends.
- There are conceptual and numerical model implementation omissions in the new model that severely degrade its ability to reliably simulate the groundwater system and predict its behaviour and responses to stresses.

- In its current form, the updated model is not a reliable tool for predicting drawdowns and mine inflows, apportionment of cumulative effects, or estimation of licensing requirements.
- The model is required to be revised to enhance its simulation and prediction capabilities. It must adequately represent important traits in the system (e.g. heterogeneity), observed behaviour (seasonality and trend), and hydraulic relationships (e.g. groundwater exchanges between alluvium and other strata).
- Given the proximity of the BTM complex to the productive water sources of the Namoi (alluvial and surface water) the model should aim to for Class 3 model confidence level criteria as much as possible. This new model must be built according to the Australian Groundwater Modelling Guidelines (2012), and the key principles as defined in the IESC draft note on Uncertainty Analysis in Groundwater Modelling. The new model must include progressive review.
- A regional scale model may not be able to adequately simulate and make prediction for certain areas or purposes (e.g. alluvium-bedrock groundwater exchanges in specific a zone). Further grid refinement and/or local models may be required for adequate simulation and predictions in some areas such as around the alluvial groundwater sources. These options must be explored in the required model revision.
- There is a need to assess the monitoring network fitness for purpose, particularly the usability of vibrating wire piezometer (VWP) data for model calibration purposes and gap areas given the data quality at some sites is questionable and no quality assurance or verification of the VWP data has been provided in any of the documents reviewed.
- The model report is required to be revised and updated to present the revised verification and model/s. Including; verification of all previous models developed for the BTM complex, present additional necessary information, describe the revised conceptualisation and numerical model, and present updated model simulation and prediction data.

Recommendations

Department of Industry - Lands and Water (Lands and Water) recommend that the Department of Planning and Environment (DPE) requires the following:

1 Clarify if this model will be adopted by all three mines within the BTM Complex, and update the individual Water Management Plans for each mine to explicitly state the status of the modelling and what model is being used to assess impacts.

Noting the MCCM and Tarrawonga do not specifically reference this model in their updated Water Management Plans.

2 The BTM Water Management Strategy to include a clear program for ongoing model validation and updating to enhance model simulation and predictions capabilities and reliability as new data become available across the BTM complex, including:

i. Individual and/or combined plans for coordinating modelling programs for validation, recalibration and re-running of the groundwater and surface water models using approved mine operation plans for all three mines in the BTM Complex. This should include plans for sharing relevant data.

ii. Aligning relevant consent conditions for the three mining operations in the BTM Complex.

3 Requesting revision of the model and modelling report, including the following as a minimum:

i. Clear definition of the objectives of previous model verification.

ii. Clear definition of the objectives of the new model.

iii. Comprehensive verification of previous models and a clear plan or strategy to use the findings to improve new models.

iv. Systematic development of the new model according to the Australian Groundwater Modelling Guidelines (2012) targeting achieving Class 3 model confidence level, and according to the key principles as defined in the IESC draft note on Uncertainty Analysis in Groundwater Modelling. The new model must include plans to enhance reliability of future models.

v. Defensible conceptual model including inter-formation groundwater exchanges. This needs to be clearly described in the report in addition to graphical presentation as may be necessary.

vi. Addressing all the comments in the independent model review, particularly with respect to faults, heterogeneity, recharge estimates, decreasing hydraulic conductivity with depth, simulation of mine progression, and progressive review.

vii. Undertaking sensitivity analysis for assumed and possible boundary conditions, particularly for the assumed constant head boundary conditions in the alluvium and the faults located to the north and south of the BTM complex.

viii. Clear definition of calibration target acceptable error and confidence ranges (heads and fluxes), appropriate model discretisation and graphical presentation, and effective correlation between observation datasets and simulated heads and fluxes to enable effective model calibration, sensitivity analysis and uncertainty assessment.

ix. Considering and comparing alternative methods for apportionment of cumulative effects (e.g. capture zone delineation, zone budgets, etc).

x. Considering the need for refining the model grid and/or building local scale models to adequately simulate and make prediction for certain areas or purposes (e.g. alluvium-bedrock groundwater exchanges in specific a zone).

xi. Revised model estimates for needed licensed takes from each individual water source.

xii. Ensuring realistic representation of inter-aquifer relationships, vertical hydraulic gradients and flows, including appropriate presentation and discussion in the report.

xiii. Ensuring realistic simulation of groundwater level seasonal and long-term trends in response to pumping, mine void development, and climate conditions and trends.

xiv. Revision of the report to include a summary, list of abbreviations and acronyms, results of the comprehensive verification of all previous models, additional necessary information, description of the revised conceptual and numerical models, and new model simulation and prediction results.

xv. Combine Appendices B and C, redesigned and monitoring sites re-ordered to enable easy comparison between observation and simulated data (old and new models) as well as checking the correctness of the conceptual model.

xvi. Considering the comments on the report and model provided in the Extended Background and Discussion below (Attachment B) and identifying any meeting or further discussion needs with Lands and Water.

4 A review the monitoring network, including filling the gap noticed in the model independent review, assessment of the suitability of vibrating wire piezometer (VWP) data for model calibration purposes, and analysis of network adequacy using numerical modelling sensitivity analysis techniques.

Lands and Water technical staff will make themselves available for a meeting with the proponent to address the recommendations regarding the water management plan, annual review and issues with the modelling.

➨ **Manager Water Assessment endorsement: FH** **Date:30/10/2018**

Comments:

Approvals

Position	Signature	Date
Author: Hisham Zarour, Contractor Hydrogeologist, 02 9842 8549	Hisham	18/10/2018
Reviewer: Cate Barrett, Lead Hydrogeologist 02 67631424	CB	29/10/2018

Background

Boggabri, Tarrawonga, Maules Creek coal mines (BTM Complex) are required to undertake periodic verification of numerical modelling predicted groundwater impacts against observed data. Schedule 3 in each of the three mining project approvals requires "*a Groundwater Management Plan, which includes … a program to validate the groundwater model for the project, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions.*"

Approvals for the three mines were granted at different times and their model verification timeframes are not the same. Model verification for each of the three mines is required to include assessment of cumulative impacts from the other two mining operations.

The Leard Forest Mining Precinct Water Management Strategy applies to all mining operations in the BTM Complex. It requires them to "*coordinate modelling programs for validation, recalibration and re-running of the groundwater and surface water models using approved mine operation plans*".

The centrally situated Boggabri Mine reached its model verification date (2017). AGE was commissioned to undertake the required model verification and updating for Boggabri Coal. Reportedly, the three BTM Complex mines agreed to generate a combined model that uses data and assesses effects from all mining operations (AGE, 2018). However, there is no evidence that the Tarrawonga Coal Mine or MCCM embrace the completed model verification and updating reported in AGE (2018).

Groundwater Source(s) and Water Sharing Plan(s)

- Gunnedah-Oxley Basin MDB Groundwater Source
- Upper Namoi Zone 11 Groundwater source (Maules Creek)
- Upper Namoi Zone 4 Groundwater source
- Upper Namoi Zone 5 Groundwater source
- Lower Namoi Regulated River Water Source
- Maules Creek Water Source (Unregulated)

A list of common acronyms and explanation of key terms is included in Appendix D.

Assessment

Table 1. Response to specific advice requested by Water Regulation on the groundwater modelling review.

Advice request	Lands and Water comments

Advice request	Lands and Water comments
Adequacy of the model update report to address the two relevant consent conditions listed above.	**Condition 1:** "*a program to validate the groundwater model for the project, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions.*" - Boggabri Mine has reached the review date (not clear 2016 or 2017). - A groundwater model (not clear 2016 or 2017), report (2018) and independent review (2018) have been prepared for the Boggabri Mine. - There is no evidence that the new model, report and review are embraced by the other two mining operations in the BTM Complex. - The model report does not include the required periodic model verification and updating program, which is also not provided in the "Draft Water Management Strategy for Boggabri – Tarrawonga – Maules Creek Complex", dated June 2018 (WMS). **Condition 2:** "*Coordinate modelling programs for validation, recalibration and re-running of the groundwater and surface water models using approved mine operation plans.*" - The report does not provide the required program for coordinated validation, recalibration and re-running of groundwater and surface water models using approved mine operation plans. - The model and report are groundwater focused. There is no reference to surface water models. - The BTM Complex draft WMS treats surface water and groundwater modelling separately and does not include any indication of coordinated or integrated surface water and groundwater modelling. - For groundwater, the draft WMS adopts a recommendation from Heritage Computing (2012) stating: "*Each of the BCM, TCM and MCCM models undergo regular maintenance and recalibration as additional data on groundwater responses to progressive mining improves the understanding of the groundwater systems*". Clearly, this does not indicate or present a plan for coordination or collaboration.

Advice request	Lands and Water comments
Advise on the adequacy of the recalibration of the model and updated predictions for drawdown and take of water/entitlement from all water sources.	- The model report was independently reviewed, but the review did not include the numerical model itself. - The independent review is generally positive about the model and report, however, it notes that calibration is reasonable to very poor, predictions unreliability, counter intuitive apportionment of cumulative effects, and that the model results maybe plausible. - The reported model verification compares groundwater level observations and mine inflow estimates only against AGE (2014) model predictions. It ignores all other previous models. - The verification is inadequate and has not contributed to enhancement of the new model. - The model mostly meets Class 2 model confidence criteria. Given the proximity of the BTM complex to the productive water source of the Namoi, an increase in the model confidence to Class 3 (as much as possible) is required, especially if this model it is going to be adopted by all three mines. - Simulation of groundwater level seasonality and trends is inadequate and simulation of vertical hydraulic gradients, groundwater fluxes and inter-formation groundwater exchanges contains errors. - There are examples of the new model performing poorer than its predecessors. - Conceptual deficiencies include ignoring heterogeneity, disregard of faults, inaccurate recharge estimates, unchanged hydraulic conductivity with depth, and unrealistic representation of mine progression. - Boundary conditions must be revised, particularly the faults, recharge, evapotranspiration and constant heads in alluvium. - Impacts assessments and licensing requirements must be recalculated using the revised model. - Apportionment of effects methodology between mining operations needs verification or replacement. - Model vertical discretisation (layers) requires revision to enable proper representation of vertical flow components. - There may be a need for revision of the methodology for assignment of observation data to model layers is recommended to enhance model calibration. - There may be need for further grid refinement and/or local scale models for specific areas and/or to answer specific questions. - The report must be revised and updated. - In its current form, the updated model is not adequate to provide reliable predictions for drawdowns and takes of entitlement from all water sources – see detailed comments Attachment B.

Advice request	Lands and Water comments
Any further recommendations (if any) for the groundwater monitoring program to improve ongoing model validation/recalibration.	- Review is needed of suitability of vibrating wire piezometer (VWP) data in general and specifically for model calibration purposes. - The peer review (Hydro Simulations) of the model identified a data gap area that needs a monitoring site – it is suggested the proponent address this. - The adequacy of the monitoring network needs to be analysed using sensitivity modelling techniques.
Consider Dr Merrick's peer review advice.	- The review is thorough, objective and useful. It highlights omissions and makes recommendations to enhance the model, including improved calibration and additional monitoring to improve future modelling. - There are matters that have not been detected in the independent review, including potentially serious conceptual and numerical modelling omissions.
Advise on any meeting requirements to discuss further.	- This assessment has identified a number of shortcomings in the model and report (Attachment B). It could be useful for hydrogeologists from Lands and Water to meet with the proponents and/or their modelling consultants to discuss the issues and agree on a way forward.

Table 2. Other issues identified by Lands and Water

Issue	Lands and Water comments
Does the report clearly describe and quantify pre- and post-mining groundwater exchanges between the bedrock and alluvium?	- The reviewed report (AGE, 2018) does not adequately description or quantification hydraulic relationships between various formations prior to or post commencement of mining operations in the BTM Complex area. - There is evidence of erroneous conceptualisation and simulation of alluvium and bedrock hydraulic relationships.

Issue	Lands and Water comments
Does the report include plans for the three mining operations with regards to how, when and frequency of undertaking combined model verification and updating to meet the similar requirements of individual approvals and the common Leard Forest Mining Precinct Water Management Strategy, particularly with regards to cumulative impacts of the three mines on groundwater? This includes plans for information sharing.	- The reviewed modelling report (AEG, 2018) does not include individual or combined plans to undertake individual, coordinated or combined model verification or updating work as required from the BTM Complex mines through individual approvals and the Leard Forest Mining Precinct Water Management Strategy. - The "Draft Water Management Strategy for Boggabri – Tarrawonga – Maules Creek Complex", dated June 2018 (WMS) also does not present any plans for individual or collaborative periodic model verification and updating.
Does the report clearly outline a plan to use results of model updates to inform updates of the water management strategies for the three mining operations, specifically in terms of improvements and updates of the management triggers and responses?	- The model report does not include any plans for future model verification, updating or contributions to water management plans in the BTM Complex area.

Attachments

Attachment	Title
A	Water Regulation Request, including relevant Conditions of Approval
B	Extended Background and Discussion
C	Summary of independent review
D	Acronyms and Abbreviations

Water Regulation Request, including relevant Conditions of Approval

Advice request – major projects and developments

BACKGROUND

Contact Officer	Tim Baker (6841 7403)	
SSD Number	**Project Name**	
09_0182 (Boggabri), 10_0138 (Maules), 11_0047 (Tarrawonga)	Maules Creek Coal Mine/Boggabri Coal Mine/Tarrawonga Coal Mine (BTM Complex)	
Proponent	**Location**	**Project Stage**
Whitehaven Coal / Idemitsu Australia Resources	15km north-east Boggabri	Numerical Groundwater Model Update
Project description		

The Maules Creek Coal Mine, Boggabri Coal Mine and Tarrawonga Coal Mine are existing mines operating in close proximity approximately 15km north of Boggabri. The approval conditions issued by DP&E require the preparation of a suite of environmental strategies developed in partnership by all three mines of the BTM complex.

The model update report indicates its objective was to satisfy a condition in each of the three consents which requires

"a program to validate the groundwater model for the project, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions".

The model update also needs to address the following condition related to the Leard Forest Mining Precinct Water Management Strategy which relates to all three mines:

"coordinate modelling programs for validation, recalibration and re-running of the groundwater and surface water models using approved mine operation plans".

A copy of the complete consent condition for the Water Management Plan is at the end of this request.

DP&E has requested this model report to be reviewed and can arrange any meetings as required with the mines, AGE or Dr Merrick to clarify any information.

Known WSP & water source(s)

Gunnedah Oxley Basin Water Source
Maules Creek Groundwater source
Lower Namoi Regulated River Water Source
Maules Creek Unregulated Water Source
Upper Namoi Groundwater source

Known licences or approvals		
Advice requested from	**Requested date**	**Due date**
Groundwater	25/09/18	17/10/18
Specific advice requests		
Please provide the following: 1. Groundwater Modelling Review • Adequacy of the model update report to address the two relevant consent conditions listed above. • Advise on the adequacy of the recalibration of the model and updated predictions for drawdown and take of water/entitlement from all watersources. • Any further recommendations (if any) for the groundwater monitoring program to improve ongoing model validation/recalibration. • Consider Dr Merrick's peer review advice. • Advise on any meeting requirements to discuss further. 2. Consider the outcomes of review of the numerical model update in terms of advice to be provided for the following current matters. Please update the advice and refer to this recent model update where required. Therefore the following matters do not need to be finalised until the outcomes of this matter have been. • Maules Ck Annual Review 2017 revised (initial advice for this matter is requested now and can be updated into the future if needed) • Maules Ck Water Management Plan • BTM Water Management Strategy • Tarrawonga Water Management Plan		
Relevant section(s) or pages of (EA / Management Plan / Other document)		
https://drive.google.com/open?id=1hIZX0iiqW7Hw_63pH84BguBhAADtsghu		
URL		

DP&E Project Approval Maules Creek Coal Project 10_0138

Water Management Plan

40. The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must be prepared in consultation with OEH, DPI Water and North West LLS, by suitably qualified and experienced person/s whose appointment has been approved by the Secretary, and be submitted to the Secretary for approval prior to the commencement of construction.

In addition to the standard requirements for management plans (see condition 3 of schedule 5), this plan must include:

(a) a Site Water Balance, that:
- includes details of:
  - sources and security of water supply, including contingency for future reporting periods;
  - water use on site;
  - water management on site;

  - any off-site water discharges;
  - reporting procedures, including the preparation of a site water balance for each calendar year;
  - a program to validate the surface water model, including monitoring discharge volumes from the site and comparison of monitoring results with modelled predictions; and
- describes the measures that would be implemented to minimise clean water use on site;

(b) a <u>Surface Water Management Plan</u>, which includes:

- detailed baseline data on surface water flows and quality in the water-bodies that could potentially be affected by the project;
- detailed baseline data on hydrology across the downstream drainage system of the Namoi River floodplain from the mine site to the Namoi River;
- a detailed description of the water management system on site, including the:
  - clean water diversion systems;
  - erosion and sediment controls (dirty water system);
  - mine water management systems;
  - discharge limits in accordance with EPL requirements;
  - water storages;
  - mine access road and Maules Creek rail spur line;
- detailed plans, including design objectives and performance criteria for:
  - design and management of final voids;
  - design and management for the emplacement of reject materials, sodic and dispersible soils and acid or sulphate generating materials;
  - design and management for construction and operation of the rail spur line and mine access road;
  - reinstatement of drainage lines on the rehabilitated areas of the site; and
  - control of any potential water pollution from the rehabilitated areas of the site;
- performance criteria for the following, including trigger levels for investigating any potentially adverse impacts associated with the project:
  - the water management system;
  - downstream surface water quality;
  - downstream flooding impacts, including flood impacts due to the construction and operation of the rail spur line and mine access road, and flooding along Back Creek; and
  - stream and riparian vegetation health, including the Namoi River;
- a program to monitor:
  - the effectiveness of the water management system; and
  - surface water flows and quality in the watercourses that could be affected by the project;
  - downstream flooding impacts; and
- reporting procedures for the results of the monitoring program;
- a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the project; and

(c) a <u>Groundwater Management Plan</u>, which includes:

- detailed baseline data of groundwater levels, yield and quality in the region, and privately-owned groundwater bores including a detailed survey/schedule of groundwater dependent ecosystems (including stygo-fauna and Melaleuca riparian forest communities), that could be affected by the project;
- the monitoring and testing requirements specified in the PAC recommendations for groundwater management as set out in Appendix 6;
- detailed plans, including design objectives and performance criteria, for the design and management of:
  - the proposed final void; and
  - coal reject and potential acid forming material emplacement;
- groundwater assessment criteria including trigger levels for investigating any potentially adverse groundwater impacts;
- a program to monitor and assess:

- groundwater inflows to the open cut mining operations;
- the seepage/leachate from water storages, emplacements, backfilled voids and the final void;
- interconnectivity between the alluvial and bedrock aquifers;
- background changes in groundwater yield/quality against mine-induced changes;
- the impacts of the project on:
  - regional and local (including alluvial) aquifers;
  - groundwater supply of potentially affected landowners;
  - groundwater dependent ecosystems (including potential impacts on stygo-fauna and Melaleuca riparian forest communities) and riparian vegetation;

- a program to validate the groundwater model for the project, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions; and
- a plan to respond to any exceedances of the performance criteria; and

(d) a Leard Forest Mining Precinct Water Management Strategy that has been prepared in consultation with other mines within the Precinct to:

- minimise the cumulative water quality impacts of the mines;
- review opportunities for water sharing/water transfers between mines;
- co-ordinate water quality monitoring programs as far as practicable;
- undertake joint investigations/studies in relation to complaints/exceedances of trigger levels where cumulative impacts are considered likely; and
- co-ordinate modelling programs for validation, re-calibration and re-running of the groundwater and surface water models using approved mine operation plans.

Note: The Leard Forest Mining Precinct Water Management Strategy can be developed in stages and will need to be subject to ongoing review dependent upon the determination of and commencement of other mining projects in the area.

Extended Background and Discussion

A. Introduction

A groundwater flow model (AGE 2017), modelling report (AGE, 2018) and independent review of these two items have been prepared to meet conditions of approval for the Boggabri Mine and satisfy a relevant condition in the Leard Forest Mining Precinct Water Management Strategy, which also apply to the neighbouring Tarrawonga and the Maules Creek coal mines. Collectively, the three separately owned, licensed and operated coal mines are referred to as the BTM Complex.

Schedule 3 in each of the three BTM Complex mining project approvals requires "*a Groundwater Management Plan, which includes … a program to validate the groundwater model for the project, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions.*"

The condition relevant to all three mining operations in the Leard Forest Mining Precinct Water Management Strategy is "*coordinate modelling programs for validation, recalibration and re-running of the groundwater and surface water models using approved mine operation plans*".

In response to advice request from Water Regulation (Attachment A) and considering the above two requirements from the Boggabri Mine, this assessment by Lands and Water is intended to provide answers to the following questions:

1. What does the independent review by Hydro Simulations suggest?
2. Have previous model predictions been adequately verified?
3. What is the outcome of the previous model predictions verification?
4. Is the updated model adequate to reliably update predictions for drawdowns and takes of entitlement from all water sources?
5. Does the groundwater monitoring program require improvements to enable ongoing model validation/recalibration?
6. Are any meetings required to discuss further?
7. Does the report clearly describe and quantify pre- and post-mining groundwater exchanges between the bedrock and alluvium?
8. Does the report include plans for the three mining operations with regards to how, when and frequency of undertaking combined model verification and updating to meet the similar requirements of individual approvals and the common Leard Forest Mining Precinct Water Management Strategy, particularly with regards to cumulative impacts of the three mines on groundwater? This includes plans for information sharing.
9. Does the report clearly outline a plan to use results of model updates to inform updates of the water management strategies for the three mining operations, specifically in terms of improvements and updates of the management triggers and responses?

Lands and Water's assessment of the model report with respect to the above nine questions is provided in **Section B** below. This is followed by additional comments on the report (AGE, 2018) and model (AGE, 2017) presented in **Section C**.

To complete the required assessment, the following documents have been reviewed:

1. Document titled "Report on Boggabri, Tarrawonga, Maules Creek Complex Numerical Model Update" Prepared for Boggabri Coal Operations Pty Ltd by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE), dated August 2018.
2. Memo referenced as "Boggabri-Tarrawonga-Maules Creek Complex - Groundwater Model Review", authored by Dr Noel Merrick of Hydro Simulations, dated 28 August 2018.

B. Response to specific questions

1. <u>What does the independent review by Hydro Simulations suggest?</u>

The independent review provided by Hydro Simulations is thorough, objective and useful. It is summarised in Attachment C.

Lands and Water has noticed that the independent review has overlooked omissions in the model such as the poor simulation of the groundwater exchange between the alluvium and the bedrock strata in the "L01 North – Alluvium" area, monitored through REG1[1] 4-level vibrating wire piezometer (VWP) of the Cumulative Network and Lands and Water's nested 2-level piezometer GW967138 (for location, see Figure 1).

This matter has serious implications to the overall adequacy of the simulation reliability and the model predictions of impacts, including cumulative effects and licensing requirements. This point is further discussed below. This particular conceptual error is presented only as an example of omissions in the reported model (AGE, 2017), but there may be other undetected issues that require attention.

The independent review highlights the following points:

- The independent review was not conducted progressively, i.e. the reviewer was not involved at all stages of the model development and application.
- The independent review is based solely on the material reported in the modelling report (AGE, 2018), i.e. the actual computer implementation of the model has not been checked.
- The model report is good quality and fit for purpose.
- The used modelling code (MODFLOW-USG) and spatial discretisation methodology (unstructured grid) are appropriate.
- Direct comparison of performance between the previous model and the current model is not possible due to differences in model software and setup.
- Calibration for groundwater levels vary across the model domain from very good to poor.
- Seasonality is poorly simulated.
- Representation of spatial variability of hydraulic conductivity (heterogeneity) in the model would enhance the model simulations and predictions.[2]
- The estimates of porous rock water volumes that require licensing is thought to be possibly unreliable.
- The next update of the model should incorporate actual progression in the Maules Creek Mine and decreasing hydraulic conductivities of interburden and coal seam with depth.

[1] Also referred to as REG01 and REG_01 in the modelling report and appendices.
[2] This will require re-calibration of the model using pilot-points rather than property zones.

- The partitioned contributions to drawdown in Layers 1, 2 and 8 based on single-mine simulations show some counter-intuitive results.

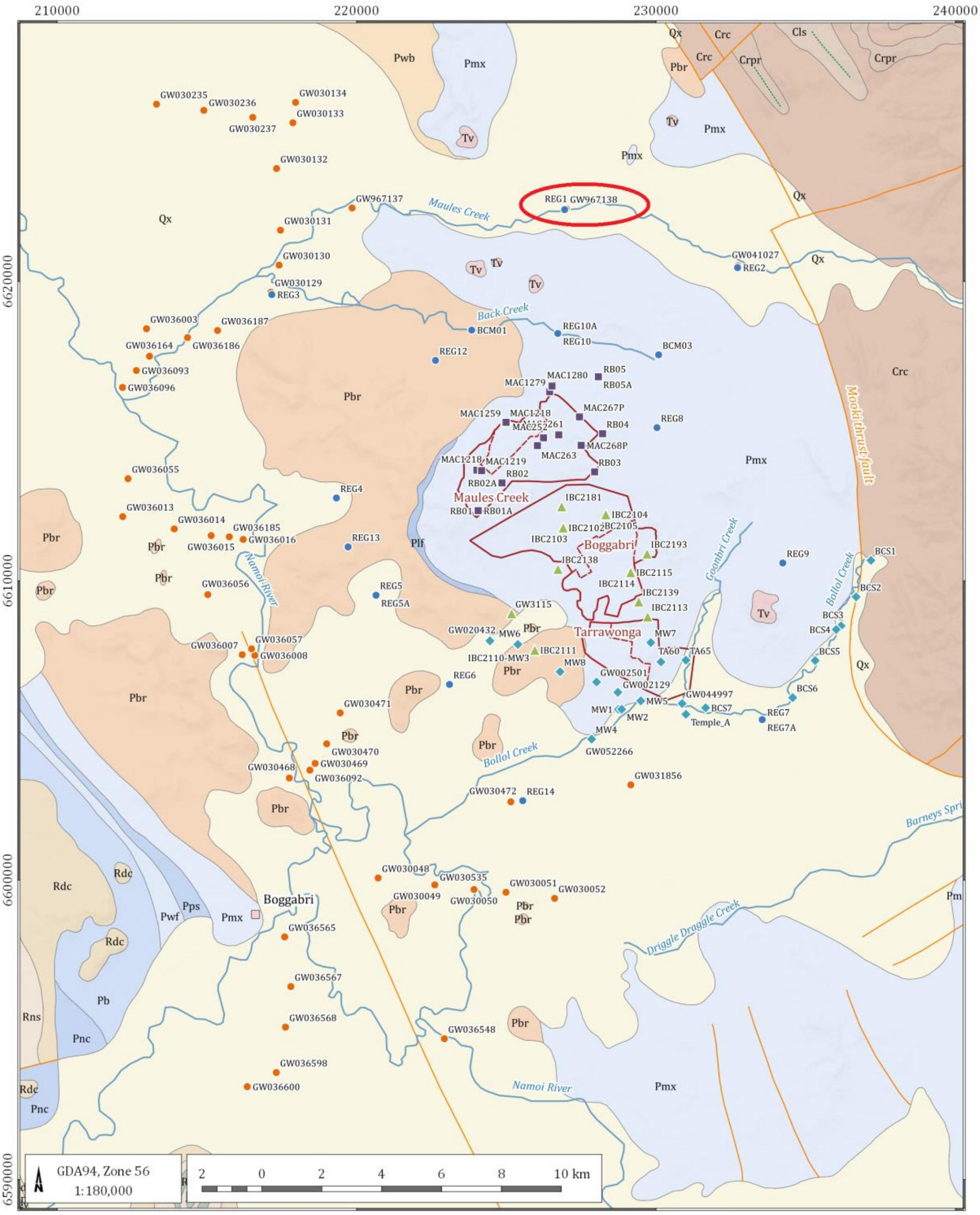

Figure 1. Groundwater monitoring network map, showing the location of sites REG1 and GW967138 (approximately 60 m apart).

- There is a data gap area that needs to be bridged to improve future modelling.
- Uncertainty analysis is considered adequate to explore the likelihood of maximum drawdown extent and various possibilities.
- There is substantial uncertainty in the estimated licensable takes.
- The model appraisal table indicates recharge and discharge datasets have not been adequately analysed for their groundwater response.

- The model appraisal table indicates that the model predictions “maybe” plausible.
- The model mostly [not fully] meets Class 2 confidence level according to the classification criteria in the Australian Groundwater Modelling Guidelines (2012)[3].

The independent review does not comment on whether Class 2 model confidence level is commensurate to the size and nature of the operations for which the modelling is required, particularly in terms of being able to provide reasonably accurate predictions of potential impacts (individual and cumulative) and licensing requirements.

Furthermore, the independent review does not make notice of that the modelling report (AGE, 2018) does not specifically define the new model (AGE, 2017) objectives and, hence, its suitability to meet mining operations requirements cannot be evaluated. Section 2 of the report (AGE, 2018) presents the objectives and scope of work for the “project”, not the model.

The model (AGE, 2017) appraisal table in the independent review indicates that the conceptual model is consistent with project objectives and the required model complexity, clearly described in Section 3.3 of the report (AGE, 2018), presented graphically very well, and not unnecessarily simple or complex (major processes are included, evapotranspiration is considered active, and stratigraphy is sufficiently represented by layer aggregation).

Nevertheless, the independent review does not comment on that there is no specific section on conceptualisation in the report (AGE, 2018), evapotranspiration may be misrepresented redundantly considered in the numerical model (AGE, 2017) and the soil moisture balance mentioned in sections 3.2 and 8.2.6 in the report (AGE, 2018), and the appropriateness of assignment of observed data to numerical model layers.

The independent review makes repeated reference to Heritage Computing model (2012), and use it to assess the performance of the reviewed model (AGE, 2017). This is acceptable but future reviews should not be biased towards a particular previous model.

Lands and Water recommends the following for groundwater model reviews in the BTM Complex area:

i. Systematic review according to agreed guidelines (e.g. the Australian Groundwater Modelling Guidelines, 2012).

ii. Progressive review of all future models.

iii. All future models should aim at meetings as many Class 3 model confidence level criteria as defined in the Australian Groundwater Modelling Guidelines (2012) as much as possible.

iv. The review of any auxiliary models used, e.g. stratigraphic and soil moisture balance models.

v. Reviews should include an assessment of the assignment of observation datasets used in model calibration and verification to numerical model layers.

vi. Reviews should look at modelling objectives in addition to any overarching project objectives.

vii. Detailed assessment of the conceptual model, which should be clearly presented in a special section in future model reports.

viii. If previous model verification is required, the review should assess the adequacy of the verification methodology, the reasonability of the verification process outcomes and that updated models provide improved simulation and predictions based on the verification of preceding models.

ix. The review should consider all previous models adequately.

[3] Barnett et al, (2012). Australian Groundwater Modelling Guidelines. Waterlines Report. National Water Commission. Canberra.

2. Have previous model predictions been adequately verified?

Appendix B in the report (AGE, 2018) clearly shows that groundwater level predictions only from the AGE (2014) model were verified using observations made over the period 2013-2016. Groundwater flow predictions from all other models have not been considered.

If a combined model is to be used for all three mining operations, then predictions of all previous models, including models not listed in this assessment, should be verified with the explicit objective of identifying previous modelling shortcoming and setting up a strategy to avoid them in new modelling.

Lands and Water recommends completing the verification reported in AGE (2018) by including all previous models related to the BTM Complex area.

3. What is the outcome of the previous model predictions verification?

The reviewed report is not clear about the objectives of the verification process. It is assumed that the objective of the verification exercise is to see where and why previous models performed well or badly and use this knowledge to enhance future model performance and predictions. Section 7 in the AGE (2018) report clarifies that the verification process involved comparing [AGE, 2014] model predictions to observed groundwater levels and trends, and estimates of pit inflow from site water balances.

The report (AGE, 2018) attributes the noticed disagreements between AGE (2014) model predictions and observations to a range of possible reasons including: (1) variability in hydraulic properties that is not represented in the model, (2) inappropriate hydraulic parameters or recharge rates in the model, and (3) not representing enhanced infiltration from water storage facilities. However, the report (AGE, 2018) does not explain whether such matters have been addressed in the new model (AGE, 2017) and, if not, why.

It seems that the use of MODFLOW-USG in the new AGE (2017) model instead of MODFLOW SURFACT used in AGE (2014) and other model completed for mines in the BTM Complex area is based on a decision to use unstructured grid rather than rectangular grid. Section 8 of the AGE (2018) report notes that the use of unstructured mesh in the new model enables better representation of areas of interest, geological elements, boundary conditions and mining voids with an optimal model grid, aiding numerical stability and limiting the number of cells.

However, inflexibility of rectangular grids was not identified as a problem in the model verification exercise, so adaption of the new modelling engine and gridding method is not clearly related to previous model verification. Similarly, it is not clear how the previous model verification has led to the adoption of the extent of the 2014 Maules Creek model with minor changes, the addition of seven layers to better represent the base of the Tarrawonga Mine, and splitting each interburden layer in the previous model into two layers of equal thickness.

The report (AGE, 2018) also does not clarify any links between the previous model verification exercise and any of the model components including recharge, evapotranspiration, wells, abstraction, rivers, creeks, drains, and the calibration approach (single-material layers and properties determined for materials, as presented in Table 8.2 of the report).

In conclusion, there is no evidence that the updated model is based on or benefited from verification of previous model predictions.

Lands and Water recommends undertaking comprehensive analysis of previous model verification data and presenting the results in a special section in the modelling report. The modelling report should clearly demonstrate that the new model has benefited from previous model verification in terms of improved simulation and predictions.

4. Is the updated model adequate to reliably update predictions for drawdowns and takes of entitlement from all water sources?

AGE (2018) report notes a potential for using the AGE (2017) model for all three mines in the BTM Complex. This is encouraged as it will provide consistency across the entire BTM Complex area and will enable more effective assessment and management of cumulative effects. However, it also means that the combined model would have greater influence over environmental and resource management in the area, which would require it to have the highest possible level of confidence and reliability.

As noted above, it seems that the AGE (2018) modelling project has only verified groundwater level predictions by the AGE (2014) model using observations made over the period 2013-2016 (Appendix B of the report) and ignored all other models completed in the area.

Benefits from the verification process are not evident or discussed in the reviewed report. There is not much evidence of enhanced performance in the new model (AGE, 2017) in terms of fitness between observed and modelled heads (calibration).

Figure 2 shows that an old model (AGE, 2014) has in some cases simulated groundwater level more closely than the new model (AGE, 2017). Figure 3 shows that the new model (AGE, 2017) simulation of seasonality in some cases is poorer than the older model (AGE, 2014). There are also examples of poorer simulation of trend (AGE, 2017).

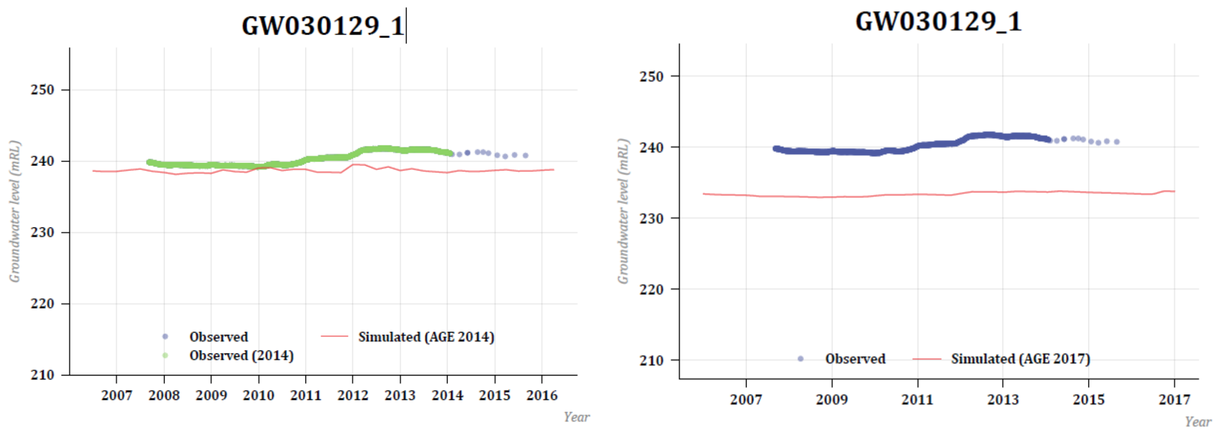

Figure 2. Goodness of fit between observed and modelled data. Right: AGE 2014 old model. Left: AGE 2017 updated model.

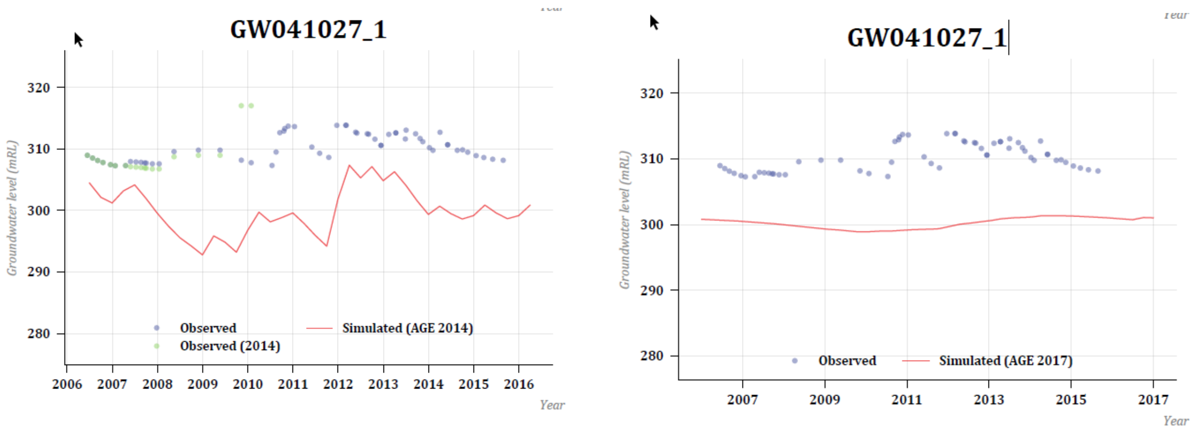

Figure 3. Representation of seasonality in the old and new models. Right: AGE 2014 old model. Left: AGE 2017 updated model.

There is also evidence that the new model (AGE, 2017) has performed poorer than previous models (e.g. AGE, 2014) in terms of simulating groundwater exchanges between various strata, e.g. the alluvium and bedrock.

Inspection of hydrographs presented in appendices B and C for monitoring sites GW967138 and REG1 (also referred to as REG01 and REG_01 in the report) reveal that observed data indicate persisting downward gradient. The two sites are approximately 60 m apart. The observations presented in Figure 4 (Left) show that groundwater head decreases with depth in the alluvium, and that the heads in the underlying strata are lower.

The groundwater head observations presented in Figure 4 (Left) show decrease in head with depth in the strata that underlie the alluvium. So, groundwater head observations in the area indicate downward hydraulic gradient and, subsequently, downwards groundwater flow.

Figure 4 shows that the old model (AGE, 2017) generally successfully simulates observed field conditions. However, the new model (AGE, 2017) completely reverses hydraulic gradient and the groundwater flow direction (Figure 5). This shortcoming in the model simulation critically affects its ability to serve as a prediction tool for licensing and impact prediction purposes.

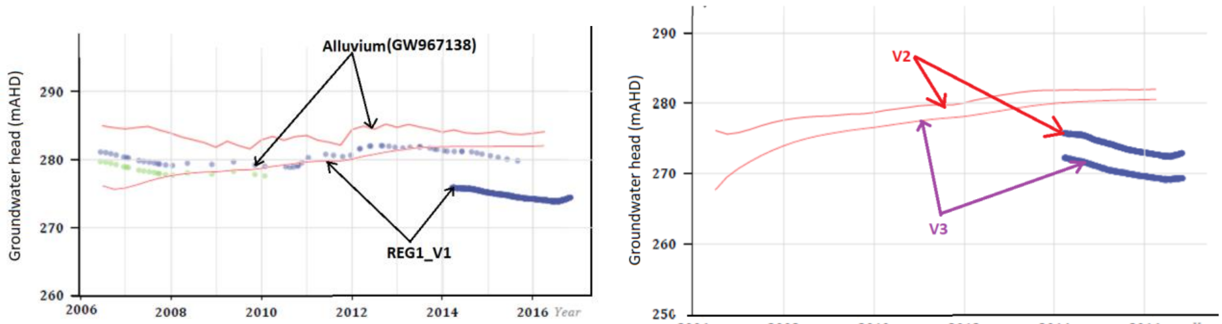

Figure 4. Observed and AGE (2014) Model calculated groundwater heads at different depths. Left: Alluvium (GW967138: shallower) vs Jeralong (v1: deeper). Right: Merriown (V2: shallower) vs Nagero (V3: deeper)[4], indicating downward hydraulic gradient and groundwater flow (see Figure 1 for location).

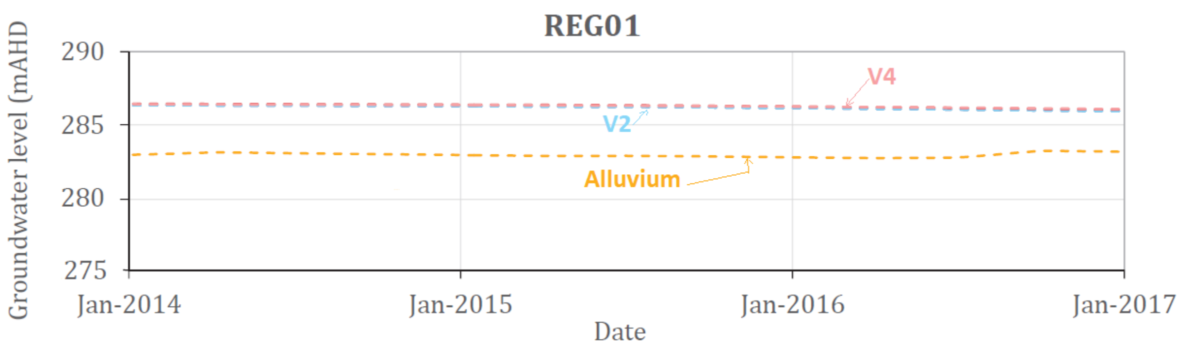

Figure 5. AGE (2017) Model calculated groundwater heads at different depths (Alluvium: shallowest, V2: in-between, V4: deepest)[5] suggesting upward hydraulic gradient and groundwater flow (see Figure 1 for location).

It appears that the AGE (2017) model may be combining geological units into numerical model layers ineffectively, e.g. lumping the Jeralong, and Merriown coal seams into numerical model layer 8, missing the chance for better model representation and calibration

[4] Figure compiled from the hydrographs presented in AGE (2018) report, specifically GW967138_2, REG1_V1, REG1_V2 and REG1_V3 in Appendix B.

[5] Figure extracted from hydrograph REG01 presented Appendix C in AGE (2018) report.

using data from observation points in each individual unit, e.g. REG1_V1 in Jeralong Coal Seam and REG1_V2 in Merriown Coal Seam. Revising the numerical layer assignment and representation to hydrostratigraphic units will help with model calibration through providing more appropriate correlation between observations and model calculations. It will also enable more reliable assessments of flows and licensing requirements.

In addition to the above discussed numerical model simulation inaccuracies, there are conceptual shortcomings in the new model (AGE, 2017) that most probably affects its simulation and prediction capabilities. The new model (AGE, 2017) does not adequately simulate hydraulic properties spatial variability (heterogeneity), recharge, evapotranspiration, mining progression, hydraulic conductivity-depth relationship, geological structure, and leakage from water storage facilities.

The new model (AGE, 2017) neglects important characteristics of the simulated groundwater system like the faults that occur to the north and south of the BTM complex, which can act as groundwater flow barriers. These prominent structures can have profound impact on the model predictions. Their importance can increase with mining progression as they can amplify drawdown in certain areas, and stop its progression to other areas.

Recharge and evapotranspiration rates in the new model (AGE, 2017) need to be reconsidered. Incorrect estimates will affect model calibration for hydraulic conductivity and, subsequently, will impact groundwater level drawdown and flux estimates. Noticeably, the report states that recharge estimates are based on soil moisture balance (SMB) modelling, which normally accounts for evapotranspiration. The report does not clarify if the additional evapotranspiration included in the model is from the groundwater directly or the vadose zone.

The reviewed report (AGE, 2018) notes many of the shortcomings in the new model (AGE, 2017) but does not explain why they have not been mitigated. An example on this is the mismatch between measured and modelled groundwater levels at the Maules Creek monitoring bores that the report attributes to inaccurate representation of mining progression in the model. However, a solution has not been attempted.

The independent review generally endorses the model (AGEM, 2017) and report (AGE, 2018) methodology for apportionment of cumulative effects between mines in the BTM Complex. However, it notes that it produces counter-intuitive results. The report (AGE, 2018) does not describe any work to verify the model (AGE, 2017) apportionment of cumulative effects by comparing it to other methods (e.g. zone budgets) or previous model calculations. The holistic water budgets presented in the AGE (2018) report, e.g.

Table 8.3 and Figure 8.8, are not particularly useful to understand impacts of mining on groundwater levels and fluxes. The abstraction and impact apportionment methodology described in sections 8.3.5 and 8.3.6 are unrealistic, overly complicated and subjective. They are required to be replaced by or at least verified against other methods such as by zone budget calculations. Special attention is required to be given to predictions relating to the alluvial aquifers and licensing requirements in general.

The report (AGE, 2018) does not present any information about initial conditions used in the new model (AGE, 2017). Being a transient model, initial conditions can influence the new model (AGE, 2017) results (estimates and predictions). It is important to know whether the new model (AGE, 2017) initial conditions are based on new steady-state model calibration using unstructured grid and MODFLOW-USG or have been obtained from a previous model, e.g. AGE (2014).

The report (AGE, 2018) states that the new model (AGE, 2017) "*generally achieves aspects of Class 2 and Class 3 confidence level criteria. It does this by simulating a similar calibration period to the predictive model, replicating seasonal responses to surface water/rainfall interaction (where included), and meeting calibration and model error statistics.*"

AGE (2017) model does not meet Class 3 confidence level criteria as clarified below:

1. **Data**

- There is a data gap area to the south-east of TA60 and south-west of TA65 which is an important area for model calibration.
- It does not demonstrate proper use of bore logs and associated stratigraphic interpretations clearly define aquifer geometry.
- Reliable metered groundwater extraction and injection data are not available
- There is no evidence of utilising aquifer-testing data in defining key parameters such as hydraulic conductivity.
- Streamflow, stage measurements and reliable baseflow estimates are either not available or not demonstrated to have been used in the model.
- The model report does not indicate the use of suitable digital elevation model (DEM) data. Use of DEM is noted in Table 8011 twice, but ambiguously.

2. **Calibration**

- The model calibration does not account for spatial variability (i.e. heterogeneity) due to the use of single zones for geological material rather than pilot points. Also, it is not known if the same hydraulic conductivity values have been used for the same material that are represented in two separate units or model layers, or if it was varied.
- The model has not been adequately validated (no verification undertaken).
- In areas, long-term trends are not adequately (even in some cases totally reversed) and seasonal fluctuations is not replicated.

3. **Prediction**

- The model has not been adequately validated/verified to indicate that calibration is appropriate for locations and/or times outside the calibration model.

  The Australian Groundwater Modelling Guidelines defines explains that "*Verification involves comparing the predictions of the calibrated model to a set of measurements that were not used to calibrate the model. The aim is to confirm that the model is suitable for use as a predictive tool.*"

4. **Key indicators**

- The report does not show that model parameters and stresses (e.g. mining operation progress) are consistent with conceptualisation.
- The model review by "*an experienced, independent hydrogeologist with modelling experience*" deems it fit for purpose, it highlights important issues that need attention.

Reviewing the model report (AGE, 2018) suggests that the new model (AGE, 2017) may even not fully meet some Class 2 confidence level criteria. This assessment is of the opinion that new models in the BTM Complex area should be intended to achieve Class 3 model confidence level as much as possible.

The independent review indicates that the predictions of the new model (AGE, 2017) "maybe" plausible and that "there is considered to be substantial uncertainty in the estimated licensable takes". Lands and Water's view is that the new model (AGE, 2017) needs important enhancements to make it adequate to reliably update predictions for drawdowns and takes of entitlement from all water sources.

Lands and Water recommends thorough and careful review of the conceptual and numerical model to be able to fulfil the approval requirements for the Boggabri and or other mines in the BTM Complex area. Previous model verification and progressive model review must be integrated in the process. The revised model should be considerate of all comments provided in this assessment and in the independent review.

5. Does the groundwater monitoring program require improvements to enable ongoing model validation/recalibration?

The independent review highlighted a data gap area, which needs to be addresses to improve future model calibration and enhance prediction reliability. Lands and Water recommends filling this data gap as soon as possible.

Lands and Water also recommends utilising numerical modelling and sensitivity analysis techniques in assessment of the adequacy of the monitoring network to meet technical and operational requirements of the mines in the BTM Complex. Any identified essential enhancements must be implemented to enhance the network's ability to provide data for modelling purposes.

Some hydrographs presented in appendices B and C display questionable data from vibrating wire piezometers (VWP), e.g. REG2 and REG9. While some VWP data suggest malfunction of the VWP setup, some hydrographs indicate high level of hydraulic connection between the alluvium and the coal basin. The proponent is required to validate the accuracy of all the VWP data and confirm that the data are representative of the formations they are supposed to be representing. Lands and Water recommends reviewing the suitability of VWP methods and data gathered so far from VWPs in the area specifically for model calibration and verification purposes.

6. Are any meetings required to discuss further?

This assessment identifies many technical modelling issues that are deemed inadequate. A Lands and Water is prepared to meet the proponent and/or their consultants to discuss such matters.

7. Does the report clearly describe and quantify pre- and post-mining groundwater exchanges between the bedrock and alluvium?

The reviewed report (AGE, 2018) does not present an adequate description or quantification of hydraulic relationships between various formations prior to or post commencement of mining operations in the BTM Complex area. Special water budget analytical and numerical model calculations are required to explore the relationships between the alluvium and other strata.

It is important to note that the new model (AGE, 2017) sets constant head (CHD) boundaries in layers 1 and 2 along the southern and western edges of the model to represent groundwater flow into the model and groundwater flow out of the model, respectively. The conceptual assumptions have important implications on the numerical model calculations. The reported model verification process (AGE, 2018) has not checked the effects of these assumptions on previous model predictions. In addition, the new modelling (AGE, 2017) did not include sensitivity analysis of these boundary conditions.

There may be a need to refine the model grid and/or build local-scale models to adequately simulate and make prediction for certain areas and/or purposes like the exchange of groundwater between the alluvium and the bedrock.

Lands and Water recommends:

i. Undertaking hydrogeological assessment and numerical modelling sensitivity and uncertainty analysis to validate the appropriateness of the constant head (CHD) boundaries defined in the alluvial aquifer.

ii. Considering the need for refining the model grid and/or building local scale models to adequately simulate and make prediction for certain areas or purposes (e.g. alluvium-bedrock groundwater exchanges in specific a zone).

iii. Preparation of water budgets using analytical and numerical modelling techniques to adequately describe and quantify hydraulic relationships between various formations prior to and post commencement of mining operations in the BTM

Complex area. Budget calculations must be prepared for well-identified agreed units and should comprise cumulative effects analysis.

8. **Does the report include plans for the three mining operations with regards to how, when and frequency of undertaking combined model verification and updating to meet the similar requirements of individual approvals and the common Leard Forest Mining Precinct Water Management Strategy, particularly with regards to cumulative impacts of the three mines on groundwater? This includes plans for information sharing.**

The reviewed modelling report (AEG, 2018) does not include individual or combined plans to undertake individual, coordinated or combined model verification or updating work as required from the BTM Complex mines through individual approvals and the Leard Forest Mining Precinct Water Management Strategy.

The reviewed report (AEG, 2018) clearly states it has been prepared for the Boggabri coal mining operation. There is no evidence or indication to that the model, the modelling report or any plans in it are endorsed or embraced by the other two operations. The report (AGE, 2017) does not represent a commitment from the Boggabri Mine to coordinate or collaborate with the other two operators in the area.

The report (AGE, 2018) merely presents recommendations for collaboration between the BTM Complex mines, including alignment of model verification and updating times, data sharing and exchange of entitlements. The "Draft Water Management Strategy for Boggabri – Tarrawonga – Maules Creek Complex", dated June 2018 (WMS) also does not present any plans for individual or collaborative periodic model verification and updating.

Lands and Water recommends that the Boggabri Mine produces model collaboration, verification, updating, data sharing and cumulative impacts assessment and management plan/s individually or jointly with the other two mines in the BTM Complex area in fulfilment to the requirements of relevant consent conditions.

9. **Does the report clearly outline a plan to use results of model updates to inform updates of the water management strategies for the three mining operations, specifically in terms of improvements and updates of the management triggers and responses?**

The model report does not include any plans for future model verification, updating or contributions to water management plans in the BTM Complex area.

C. Additional comments

AGE (2018) groundwater modelling report is generally well-structured and useful. However, some enhancements and corrections are needed to make it more useful and fit-for-purpose. Lands and Water noticed the following issues that require attention in the report and the modelling project in general. They are not listed in any particular order.

- The new model (AGE, 2017) is not an update of a previous model (e.g. AGE, 2014). It is a totally new model that covers the same area with some commonalities between the two models.
- The report does not include a summary. A concise, informative summary is required to be added to the modelling report.
- The report contains unexplained abbreviations and acronyms. Explanation is required where first mentioned and in a list or table.
- There are some inconsistencies that need to be emended, e.g. Table 8.1 makes reference to "2016 model', which has not been mentioned elsewhere in the report. Also, it is not clear if the previous model should be referred to as AGE 2013 or 2014.

- The y-axis scale of the hydrographs in the appendices does not provide for easy comparisons between observed and modelled heads.
- Graphical presentation of the simulated heads produced by the old (AGE, 2014) and new (AGE, 2017) models in two separate appendices (B and C) makes is difficult to compare modelling results at specified sites, or correlate simulated and observed data between different sites.
- A summary/inventory of all previous models is needed. This should include but not be limited to AGE (2011), Schlumberger (2012), Heritage Computing (2012), AGE (2014), Parsons Brinkerhoff (2015), etc.
- A section is needed on the findings of previous model verification and corresponding improvements made in the new model.
- A special conceptual model section is needed (not as part of geology).
- Report must be checked for consistency, e.g. the mention of a "2016 model" in a table which is not mentioned anywhere else in the report, mixed reference to the previous AGE model as 2014 and 2013, confusing reference to monitoring sites, e.g. REG1, REG01, REG_01.
- Merging appendices B and C and combining figures for monitoring sites to allow easy comparison between results of the new model with those of previous models. Colour and/or line symbol coding will be required.
- Representing pre and post AGE (2014) model observations graphically in Appendix B as two datasets and distinguishing them by different colours is not very helpful. A vertical line can be drawn to distinguishing pre and post AGE (2014) model observations (i.e. simulation and verification). This data are better presented together with old and new model simulation/prediction results.
- The presentation of two observation data sets in the L01 North - Alluvium hydrographs in Appendix B is confusing (Figure 6). A "useful" legend is needed to relate data to their respective piezometers. Also, clarification is needed to which dataset is used to calibrate the model.

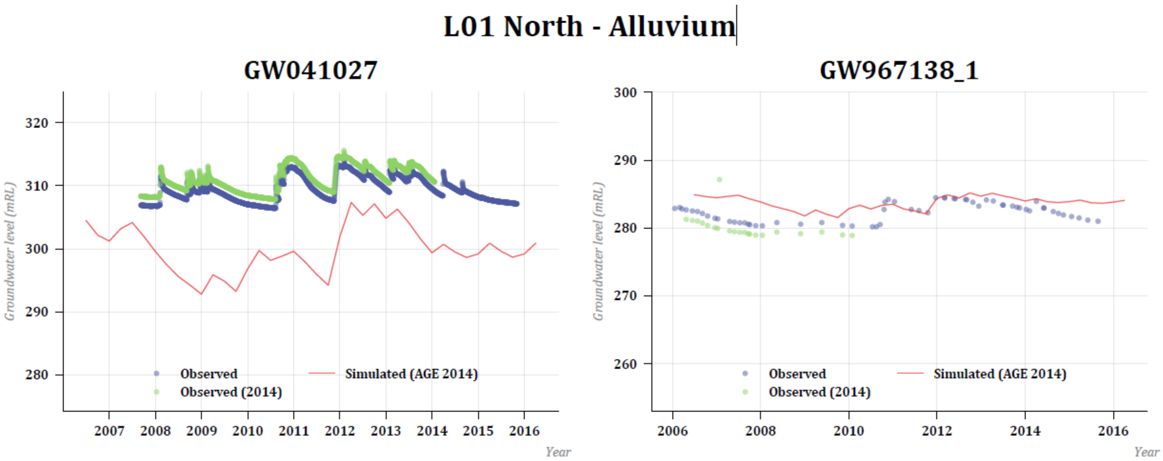

Figure 6. Two sets of observation data from the same monitoring site.

- The combined section on topography, drainage and land use is useful. However, it is very short and does not discuss relationships, or lack thereof, between the mining operations and surface water features in the area, particularly that at least some of the interference will involve groundwater.
- The report does not make reference to the DEM used in the model (source, resolution, accuracy).
- It would be useful to indicate the screened formation or aquifer in Figure 3.9.

- It is unknown if the “regional” flow pattern presented in Figure 3.9 is meant to represent certain hydrostratigraphic unit/s or the entire flow system.
- The depth to water is not noted in the text or presented graphically. A depth to water [table] map would be useful.
- It is not clear whether surface water stage has been used in the groundwater level mapping presented in Figure 3.9.
- The report does not discuss groundwater-surface water interaction.
- Important structural geology features (e.g. faults) and their potential effects on the groundwater flow system are not discussed in the geology section.
- The hydrogeology section needs to be expanded. It will be useful to include some information on groundwater quality, data availability (e.g. pumping tests), expected hydraulic properties values and ranges from field tests, brief assessment of aquifer vulnerability, possible pollution sources, and potential effects of the mining operations on groundwater quantity and quality.
- The use of the term “Mining inflows” in the second paragraph in Section 7.3 is inappropriate.
- Mine inflows data in various units (ML/d and ML/y) and for various periods (2014, 2015, 2014/2015) are scattered across various sections of the report (AGE, 2018) in different formats, which make them difficult to understand. They are provided in bullet point format in Section 7.3.1 (daily and yearly averages), text in Sections 7.3.2 and 7.3.3 but in a mix of daily and yearly averages, as ranges in bullet points and table in Section 7.3.4, and a graph and ranges in bullet points in Section 8.2.4. In addition, the calculation year is not clear (i.e. calendar or water year).
- Apparently, a single hydraulic conductivity value was used in the updated model (AGE, 2017) for the two layers that represent each interburden layer in the AGE (2014) model. This suggests that the purpose of the layer subdivision was to increase the model’s vertical resolution, which should make it easier to discuss vertical flows and gradients in the report.
- Despite designating 19 layer in the model (AGE, 2017), vertical groundwater flows and gradients are not noted or discussed at all in the report (e.g. not shown in Figure 3.8 which presents a conceptual geological cross section).

  This information is needed and inter-formation flows need to be investigated. The report indicate that “each of the 2014 model layers representing interburden layers were split into two layers of equal thickness”, but does not provide the rational for doing this (shouldn’t be limited to better geological unit representation).
- The maximum evapotranspiration rate of 1,821 mm/yr seems excessive, especially in relation to the average rainfall and evapotranspiration data presented in Table 3.1.
- The soil moisture balance (SMB) model mentioned in Section 3.2 is not described. Normally, SMB models account for evapotranspiration in their calculations and, consequently, estimation of groundwater recharge. If this is the case with the used model, then there may be no need to represent evapotranspiration in the groundwater flow model (Section 8.1.3.1) as this could represent double accounting unless if it is taken from the aquifer (i.e. direct evapotranspiration from the water table).
- A map is needed to show final [average] recharge and evapotranspiration estimates across the model domain.
- Section 8.2.6 does not provide explanation for the application of recharge calculated from SMB modelling at differing rates to different material in layer 1 of the model. Also, it does not clarify whether recharge was applied as average daily values or as calculated over various stress periods. In addition, recharge and evapotranspiration values have been changed during calibration, which raises questions on the validity

of recharge values in the model and the adequacy of the reported SMB model. Overall, recharge and evapotranspiration incorporation in the model seems to be arbitrary.

- The report does not clarify how the abstraction was incorporated into the model (e.g. by specifying layers, specifying points, or using screen information).
- The use of zonal calibration and assuming constant hydraulic properties for each layer needs rational. Ignoring spatial variability (heterogeneity) has been noted as a possible shortcoming in the independent review and at least exploring the need to represent it is considered essential here. It seems that hydraulic properties have also been kept the same for various numerical model layers representing the same stratigraphic units.
- Hydraulic property values for the new (AGE, 2017) and old (AGE, 2014) models presented in Section 8.2.5 are not easy to compare. Table format is preferred (could expand Table 8.2). The combined table should also include layer numbers provided separately in Table 8.1. Vertical anisotropy (KH/KV) needs to be presented for the old and new models.
- There is a need to comment on horizontal anisotropy (Kx/Ky) for various lithostratigraphic units in the old and new models.
- The numerical model implementation needs to be better described to enable effective model vetting and future verification and updates. This includes clarification of numerical layer extents, how real geological layers were matched to numerical model layers, etc. Additional maps, cross-sections and possibly fence-diagrams will be needed to clearly present the model.
- The representativeness of groundwater level observations is not clear and, accordingly, model calibration results cannot be fully understood. This is important to understand the goodness of the calibration. The report needs to clarify how observations were assigned to model cells (e.g. by layer, z value or screen extent).
- It would be useful to include a table to compare hydraulic property values used in all previous models and the current model including AGE (2011), Schlumberger (2012), Heritage Computing (2012), AGE (2014), Parsons Brinkerhoff (2015) and all other relevant work. It would also be useful to discuss how parameterisation differences may have affected modelling results.
- Goodness of fit between observed and measured values should be presented in additional forms, including per geological material and per layer model not only "*according to their origin*" as presented in Figure 8.4. The term "*origin*" is not appropriate to refer to monitoring network.
- Section 8.2.4 on inflows is ambiguous in terms of the calibration targets obtained from water balance calculations. It is unknown whether the estimates presented for each of the mines are long-term averages or reprehensive of a certain period. Calibration targets are not marked on Figure 8.5 to enable easy comparison. In addition, the total inflow value in Figure 8.5 is not particularly useful for practical reasons.
- In Section 8.2.4, the statement that "The modelled inflows are close to the observed inflows …" is misleading and should be corrected. This section compares results of two modelling methods, not model calculations against real observations.
- Groundwater level and/or depth to water data (e.g. average, median, min and/or max) must be added to the tables in appendix A.
- Indicate measurement point and/or land elevation in the figures in appendices B and C.
- The report notes the introduction of a small separate recharge zone within the alluvium around the Boggabri-Tarrawonga Coal handling and preparation plant (CHPP) to represent conceptual increase in the recharge generated by the

construction of several shallow ponds in this area of the site. It notes that automated calibration reduced recharge in this area and that conceptualisation of this area will require further review before the next model recalibration. However, it does not clarify why this has not been made in this model or discuss numerical model options to represent this perceived stress/boundary condition.

- Section 8.2.7 provides a holistic average water budget obtained from the model (Table 8.3) and holistic quarterly water budget obtained from the model (Figure 8.8). However, it does not discuss, quantify or predict the exchange of groundwater between bedrock and alluvium before and during Maules Creek Mine operation, which is important for licensing purposes.
- The report notes that the model predict reduction in the "*Permian* [rock] *inflows*" to the alluvium rather than flow out of the alluvium into the Permian strata. This needs to be reconsidered after making the required modifications in the model.
- The report indicates that the new model predicts more extensive drawdown within the coal seams, but only limited and localised drawdown within the alluvium, stated to be consistent with previous versions of the model. This conclusion must be revised following the required model revision.
- The report notes that the model predicts drawdown in the Merriown coal seams to reach the eastern and northern boundaries by 2019, but the predicted drawdown is different than drawdown predictions in the AGE (2011) and AGE (2014) models. The new drawdown prediction is less extensive to the west and does not extend into the Boggabri Volcanics.

  However, it is more extensive towards the east reaching the model boundary. The report presents possible reasons for the differences in predictions. It argues that the new MODFLOW-USG (erroneously written as MODFLOW SURFACT in the report, page 49, line 19) is a better representation of reality but does not provide supporting evidence. However, no analytical or numerical evidence is provided in support to this claim.
- The report includes an uncertainty analysis section that assesses the influence of simultaneously changing multiple parameters within the model, rather than the standard sensitivity analysis where only one parameter is changed at a time. The assessment indicates average uncertainty of +40% to -80% of the calibrated base case model, which according to the report means that the volume of groundwater intercepted each year could be one and a half times or four fifths of the predicted volume. The report must discuss the implications of this uncertainty on mine water take licensing and operational management.
- Uncertainty in the predicted extent of drawdown is presented graphically in Appendix F of the report. However, it is not adequately discussed in the text (Section 8.4.3).
- The report presents an assessment of the model confidence level classification claimed to be according to the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). Table 8.11 in the report is inspired by Table 2-1 in the guidelines but misses on some details. The report suggests that the model generally meets Class 2 and Class 3 confidence level criteria as defined in the Australian Groundwater Modelling Guidelines (2012). However, it does not specify the confidence level class required from the updated model. The updated model should ideally meet Class 3 confidence level criteria as much as possible because it should be able to:

  1. Adequately predict groundwater responses to changes in applied stress anywhere within the model domain (e.g. predicting groundwater levels in the alluvial aquifers and groundwater exchanges between them and other formations as mining progresses).
  2. Provide information for sustainable yield assessments for high value regional aquifer systems (e.g. estimates for licensing requirements).

3. Be used in evaluation and management of potentially high-risk impacts (e.g. effects on alluvial aquifers).
4. Be used to design complex mine dewatering schemes (such as the BTM Complex).
5. Provide reliable basis for apportionment of cumulative effects.
6. Simulate the interaction between groundwater and surface water bodies to a level of reliability required for dynamic linkage to surface water models.

Summary of independent review by Dr Noel Merrick

Independent review by Dr Noel Merrick of Hydro Simulations is provided as a memo dated 28 August 2018. The review is stated to have been undertaken in accordance with national groundwater modelling guidelines. It clearly explains the context and the review scope.

The reviewer notes that he had reviewed a previous model for the Maules Creek Coal Mine (AGE, 2011) and co-authored a hydrogeological assessment of the Tarrawonga Coal Project (Heritage Computing, 2012).

The review outlines the reviewed document contents and make reference to the review methodology. It states that it has been generally conducted according to the 2-page Model Appraisal Checklist in MDBC (2001)[6].

The review can be summarised as follows:

1. It was not conducted progressively as recommended in relevant guidelines.
2. It is based solely on the material reported the modelling report. The actual computer implementation of the model has not been checked.
3. The report is a standalone document, well structured, well written and high-quality graphics.
4. Clarification needed on changes made to the AGE 2011 model in the AGE 2014 model.
5. Direct comparison of performance between the previous model and the current model update provided in Section 7.4 is not possible.
6. Omissions that require attention in the report (text, tables and figures) are well outlined.
7. In Table 8.5 (Section 8.3.4), it is noted that no production bore is predicted to incur more than 2 m drawdown.
8. Changes to the model are generally appropriate, including updating historical data records, inclusion of data from new bores, conversion from MODFLOW-SURFACT to MODFLOW-USG, conversion from a structured grid to an unstructured grid, minor changes to eastern model extent, increasing layers from 12 to 19, incorporation of actual progression for Boggabri and Tarrawonga mines, delayed commencement for Maules Creek Mine, inclusion of Goonbri Creek diversion and low permeability barrier.
9. Actual progression for the Maules Creek Mine was unchanged.
10. Modelling assumptions are generally appropriate, including adoption of regional geology, 19 model layers, quarterly stress periods, aggregation of Braymont, Jeralong and Merriown coal seams into one layer, aggregation of Velyama to Flixton coal seams into one layer, setting Boggabri Volcanics as base layer 19, varied grid spacing for different features, future private abstraction at 2003-2005 average rates, unified hydraulic conductivity for all interburden layers, unified hydraulic conductivity for all coal seam layers, rainfall recharge for Boggabri Volcanics and Permian outcrop lower than value adopted by Heritage Computing (2012), active mine drain cells to end of mining
11. The review seems to disagree with some of the assumptions.

[6] MDBC (2001). Groundwater flow modelling guideline. Murray-Darling Basin Commission.

12. Calibration for groundwater levels vary across the model domain from very good to poor.
13. Seasonality is poorly simulated.
14. The review notes general very good agreement in terms of magnitude between observed and simulated water levels at distant alluvial monitoring sites but rather poor east of Tarrawonga Mine and some Maules Creek Mine monitoring sites.
15. The review notes agreement between spatial drawdown predictions in the reviewed model and the Heritage Computing (2012) model, except to the south-east of Tarrawonga Mine, attributing this to not presenting faults in this area in the new model.
16. The review notes the completeness of the uncertainty analysis and its adequacy to explore the likelihood of maximum drawdown extent and various possibilities.
17. The review notes that temporal trends in the simulated groundwater level hydrographs in Appendix C lack seasonal detail for shallow bores, but generally show declining trends at sites where mining effects have been observed.
18. The review highlights that groundwater models can only aim to comply with order-of-magnitude inflow estimates, generally derived as the balancing term in site water balance models.
19. The review considers model estimates of mine inflow to be in the right order of magnitude and attributes overestimation of Maules Creek inflows for 2017 to shallower depths than anticipated in the model.
20. The review notes substantial increase in predicted mine inflow at Tarrawonga Mine from 2024 when mining first enters the Goonbri Creek alluvium, which suggests that the additional inflow is from the alluvium.
21. Disagreement in inflow predictions between the updated model and Heritage Computing (2012) indicates uncertainty with regards to the alluvial water volumes that require licensing.
22. The review indicates that partitioned contributions to drawdown in Layers 1, 2 and 8 based on single-mine simulations show some counter-intuitive results but it suggests the approach seems reasonable.
23. The review notes that substantial increase in predicted porous rock water take at Tarrawonga Mine from 2024 when mining first enters the Goonbri Creek alluvium could be due to the deepening of the mined coal seams but would be counteracted by decreasing hydraulic conductivities with depth, which is not represented in the model. The review also notes that the model performs poorly in this area by severely overestimating heads.
24. The review highlights the unreliability of the estimates of porous rock water volumes that require licensing.
25. The review notes that uncertainty analysis has not been conducted for spatial variability of layer properties and considers this to be the mostly likely parameterisation required to improve the poor calibration to the east of the Tarrawonga Mine where the predicted mine inflows are likely to be exaggerated.
26. The review also notes the need to explore the sensitivity to mine drain duration and progressive emplacement with spoil.
27. The review concludes that change in the used modelling code and grid structure is appropriate. It highlights the need to represent spatial variability of hydraulic conductivity (heterogeneity) in the model and that there is a data gap area where additional monitoring would be informative.

28. The review recommends that the next update of the model should incorporate actual progression in the Maules Creek Mine and decreasing hydraulic conductivities of interburden and coal seam with depth.
29. Additional recommendations are made to address other matters noted in the review.
30. The model appraisal table indicates recharge and discharge datasets have not been adequately analysed for their groundwater response. With all other criteria being met to varying degrees. Comments provided in the table contain suggestions to improve the model, which the review deems to be overall fit for purpose. The review implies mostly Class 2 confidence classification as presented in the Australian Groundwater Modelling Guidelines of 2012.
31. The model predictions “maybe” plausible.
32. There is considered to be substantial uncertainty in the estimated licensable takes.

Acronyms and Abbreviations

3D	Three dimension
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
BTM	Boggabri, Tarrawonga, Maules Creek coal mines (complex)
CHPP	Coal handling and preparation plant
Ck	Creek
DEM	Digital elevation model
DPE	Department of Planning and Environment
Km	Kilometre
Kv/Kh	Vertical hydraulic conductivity anisotropy
Ky/Kx	Horizontal hydraulic conductivity anisotropy
MDBC	Murray-Darling Basin Commission
ML/d	Million litres per day
ML/y	Million litres per year
mm/yr	Millimetre per year
MODFLOW-SURFACT	Modelling software name
MODFLOW-USG	Modelling software name
NRAR	Natural Resources Access Regulator
NSW	New South Wales
SMB	Soil moisture balance
VWP	Vibrating Wire Piezometer
WMS	Water Management Strategy
WSP	Water sharing plan

Document 2

File Reference: 27612 in WAMS

NSW GOVERNMENT | Department of Primary Industries

Memorandum

Groundwater & Surface Water Assessment – State Significant Development

Proposed activity	Maules Creek coal mine (MCCM)
Due date	17 October 2018
Context	Revised Annual Review
Water Regulation Officer	Tim Baker

Advice request

The request for assessment of the original 2017 Annual Review was (refer to Attachment A for full details):

- Review of presented surface water, water quality and groundwater level data and water take figures and assess against recent years data, the approved impacts and updated groundwater model outputs in the WMP.
- Review of surface water, water quality and groundwater level data against the potential for impacts to surface water flows in local watercourses (Back Creek and Maules Creek). Note: A Ministerial has been received complaining about loss of flow in Maules Creek at Elfin Crossing.
- Comment on the findings in the Annual Review.
- Adequacy of Annual Review in addressing reporting requirements of the WMP.
- Adequacy of current groundwater, surface water and water quality monitoring network.
- Adequacy of water balance to understand water take and interpret impacts.

This assessment is of the revised 2017 Annual Review. A separate advice request was not received for this re-review.

Assessment overview

Water Assessments has re-reviewed the groundwater content of the 2017 Annual Review (and associated documentation) for the Maules Creek Coal Mine (MCCM). Noting this document was assessed in conjunction with the MCCM updated Water Management Plan, the Boggabri, Tarrawonga, Maules Creek Complex (BTM) Water Management Strategy and the 2018 BTM Cumulative Groundwater Model update.

The conditions of consent require that the Annual Review: "include[s] a *comprehensive review* of the monitoring results….includ[ing] a comparison of these results against ... requirements…monitoring results of previous years…predictions in the EA".

However, there remains a lack of interpretation of the data and lack of comparison against historic monitoring data, modelled predictions and trigger levels.

Furthermore, many of the matters raised in the previous assessment have not been adequately addressed, if at all.

Consequently, the 2017 Annual Review is again found to be deficient in a number of areas (refer to Table 1 below).

Author: Andrew McCallum, 02 8838 7827 **Reviewer: Cate Barrett, 02 6363 1424**

The overall review of the assessed documents has raised concern regarding the conceptualisation of the connectivity between the alluvium of the Upper Namoi (specifically Zone 11 (Maules Creek)) and the underlying Gunnedah-Oxley Basin in the numerical model on which impact assessment is based.

The observed data generally indicates a downward gradient from the alluvium to the underlying coal basin however the model has hydraulic gradient going from the coal basin to the alluvium.

The report indicates validation of the groundwater model was undertaken comparing the 2014 model to the observed data however no comment is included on the generally poor correlation between modelled and observed data as shown in Appendix E.

There is reference to a MCCM 2017 "significantly updated and recalibrated" model which "does achieve" the requirements for model validation. It is unclear if the MCCM 2017 model is the same as the 2018 AGE BTM cumulative numerical model reviewed as part of this assessment.

Noting this same error in conceptualisation of the hydraulic gradient and model calibration is also present in the 2018 AGE BTM cumulative numerical model.

This inconsistency between the observed data and the modelled data is not addressed in any of the reviewed documents or captured by the trigger level response management.

The surface water review found the original request for trend analysis of the data not addressed.

The recommendations made below regarding the revised MCCM Annual Review address these matters.

Recommendations

With respect to the Annual Review, it is recommended DPE require the proponent to the updated the document to include:

1. An assessment of all bores where the 'triggers' have been breached as per the requirement of the Water Management Plan. This assessment is to be provided to Lands and Water and further action may need to be taken.
2. In Table 11, add the methods by which water take was measured/estimated for both passive and active water take per year from all intercepted and connected water sources.

   For example for the river extraction, state 'flow meter' (suggest including the meter reading in the document), for passive take, state 'modelled estimate', etc.

   Where the volume was estimated state how it was estimated, where modelled data is used, state the version of the model used.
3. Measurement/estimation and analysis of all inputs and outputs to the pit including rainfall, runoff, groundwater inflows, pumping and evaporation. Including all data collected via the pit seepage monitoring program as described on page 89 of the revised Water Monitoring Plan. Where modeled data is used, state the version of the model used.
4. Groundwater levels interpreted via maps showing hydraulic head contours and in cross sections (as well as hydrographs) showing vertical and horizontal gradients for the alluvial groundwater sources and multiple formations of the Gunnedah – Oxley Basin. This to be updated each year as new data is collected – the purpose of this data is to show trends over time.
5. Thorough trend analysis of all the collected data, updated each year and compared to the long term data, including graphic representation for transparency and easier visualization of the data.
6. An analysis of measured groundwater levels compared with modelled predictions as per the requirements for groundwater model validation. The data shown in Appendix E

generally shows a poor correlation between observed and modeled data in terms of hydraulic relationships between formations and in some cases water level trends.

Clarification is also required regarding if the 2017 updated model referenced in section 7.3.2 is the same as the '2018 AGE BTM cumulative numerical model'. Noting it is a condition of consent for all mines in the BTM complex to "coordinate modelling programs for validation, recalibration and re-running of the groundwater and surface water models using approved mine operation plans".

7 Analyse the accuracy of all the vibrating wire piezometer data and validate that the data is representative of the formations it is monitoring.

Lands and Water recommend:

- Tables 2 and 3 below are provided to the proponent, and **all** matters contained in them are addressed.
- The proponent engages a duly qualified hydrogeologist to update the Annual Review.

Lands and Water technical staff will make themselves available for a meeting with the proponent to address the recommendations regarding the annual review and issue with the modelling.

➡ **Manager Water Assessment endorsement: FH** **Date: 30/10/2018**

Comments:

Background

The Maules Creek Coal Mine (MCCM) is an existing coal mine owned and operated by Whitehaven Coal. The project was originally approved by Department of Planning & Environment (DPE) in October 2012 with subsequent modification approvals in 2013, 2014 and 2017.

The proponent has prepared an Annual Review (AR) for 2016-17 in accordance with Condition 4 of Schedule 5 of the project approval (PA 10_0138).

Department of Industry – Lands and Water Division (Lands and Water) and the Natural Resources Access Regulator (NRAR) has had extensive involvement during project development and ongoing review and management of this project.

DPE requested Lands and Water review the 2017 Annual Review (dated 26/3/18) to assist in ongoing compliance of the site. Lands and Water made a series of four recommendations, and an additional eight sub-recommendations specifically about the Annual Review (see memorandum from Water Assessment to Natural Resources Access Regulator dated 4 May 2018). The proponent has since revised the Annual Review (not dated). This assessment is of the revised 2017 Annual Review.

The open cut mining area is located within the catchment of Back Creek. In this region, Quaternary alluvium associated with the Namoi River, and smaller creeks, form a productive aquifer system (the Upper Namoi Groundwater Sources). This is underlain by the Permian Maules Creek Formation consisting of interbedded siltstone, sandstone and coal seams of the Gunnedah-Oxley Basin.

Seepage at the mine is via direct and indirect take of groundwater from these hydrostratigraphic units. Underlying these units is the Boggabri Volacnics basement.

Groundwater and surface water hydrology issues have been raised by the community in recent times with ongoing management of this site. A key issue has been the potential impact to local surface water systems due to groundwater take associated with the mine.

This has been highlighted by recent media and ministerial requests (complaints of ceasing flow at Elfin Crossing on Maules Creek - 419051). It is requested this review consider the adequacy of the WMP to inform verification of impacts on adjacent water sources.

Assessment

DoI Water's assessment relies on the following documentation:

- Proponents 2017 Annual Review (dated 26/3/18)
- Proponents 2017 Annual Review (revised version, no date provided, for period ending 31 December 2017)
- Proponents Water Management Plan (Edition 3, Revision 3, dated 2018)
- Proponents updated numerical model report (August 2018)
- Department of Planning and Environment Development Consent[1]
- Office of Environment and Heritage Environment Protection Licence[2]
- Planning Assessment Commission (PAC) review[3]
- Proponents Response to submissions[3]
- Departmental submissions[3]
- Proponents original Environmental Assessment[3]

Lands and Water has a number of concerns as outlined in Table 1 below. The recommendations made above, address the most significant of these concerns. The proponent should also address all matters raised in Table 1.

Included as Table 2 and 3 is Lands and Water assessment of the original 2017 Annual Review. It is recommended that these tables are provided to the proponent, and **all** matters contained in them are addressed.

[1] Available at: https://majorprojects.accelo.com/public/2ee28e5c4d4042429b4b078771643b35/10.%20Maules%20Creek%20Coal%20Project%20-%20Conditions%20of%20Approval.pdf
[2] Available at: http://www.whitehavennews.com.au/sustainability/environmental-management/maules-creek-mine/
[3] Available at: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=4142

Table 1: Recommendations

DoI Water recommendations for original Annual Review	MCCM response	DoI Water comments on revised Annual Review
1 Revise the 2017 Annual Review by 30 June 2018 or within two months of notification of not-suitability and submit to Lands and Water for further review. The revised Annual Review must include: a. Measurement/estimation of passive and active water take per year from all intercepted and connected water sources along with their method of measurement/estimation and details of the pit seepage monitoring program.	*Measurement/estimation of passive and active water take….* The 2017 volumes of water take are already included in Table 11 and 12. We note the low volumes of passive and active take against licenced allocation, and the small percentages within total WSP allowance. Table 11 format aligns with the DP&E Annual Review Guideline. Additional notes are inserted to Table 12 to explain measurement/source in relation to pit seepage monitoring that addresses this request. Given mining depth was higher than originally modelled above the water table, passive take of porous rock source is negligible, and no reportable interception of other connected sources is reportable based on independent consultant review of the AR.	Recommendation not addressed satisfactorily. The footnotes added to page 57 do not provide the requested information, additionally the footnotes do not specify which model the version was used for the predictions. Add a column in Table 11 stating the method by which water take was measured/estimated for both passive and active water take per year from all intercepted and connected water sources. E.g. flow meter, modelled estimate etc. Meter reads for actual measure take should be included in the document. It is not stated against which model the site water balance data is based on given MCCM has referenced three versions of the model, this is significant given the Lands and Water have concerns regarding the conceptualisation and calibration of the model from the modelled data presented in the documents reviewed (see e. for further comment).
b. Measurement/estimation and analysis of all inputs and outputs to the pit including rainfall, runoff, groundwater inflows, pumping and evaporation (the proponent explains lack of inflows is due to evaporations – this needs to be qualified).	*Measurement/estimation and analysis of inputs and outputs to the pit…….* This is already included within Table 12 'Site Water Balance'. Additional footnotes were added to provide clarity and additional detail.	Recommendation not addressed satisfactorily. The footnotes added to page 57 do not provide the requested information. Noting page 89 of the revised MCCM WMP references a pit seepage monitoring plan listing numerous methods for collection of pit seepage data – this data should be tabulated and included in the Annual Review.
c. A summary of all groundwater monitoring points in the network presented in figure form, as well as a table listing coordinates, depth, type of monitoring installation and monitoring target formation details for each monitoring bore included in the report.	*A summary of all groundwater monitoring points in the network presented in figure form, as well as a table listing coordinates, depth, type of monitoring installation and monitoring target formation details for each bore….*A figure of monitoring points is shown within the Annual Review – Figure 9, and additional details included in Appendix E. The reviewer should also note bore details are already provided within the WMP, and MCC query why duplication is required in the AR document (noting the same level of detail is not required for other environmental monitoring points). Bore details have been inserted in Appendix E.	Recommendation not addressed satisfactorily. There is not a one to one match between Figure 9, the figure on page E-124 and the table on page E-101-103.
d. All monitoring data included in the annual review (hydrograph) i.e. not just the current years data. New data to be added each year and the trend analysis updated each year. A short term graphic representation may be necessary for better visualization.	*All monitoring data included in the annual review (hydrograph), ie not just the current years data….*The Annual Review already summarises a review against EA predictions and baseline and data is already provided in tabled format within the appendices. To address the additional information request, hydrographs and commentary are now entered into the document (refer Appendix E) including previous years for comparison purposes.	Recommendation partially addressed. Current and prior data included. Trend analysis not included. It is noted the hydrograph shown on page E-118 for REG02 is showing questionable results i.e. the vibrating wire piezometers (VWP) data from the Gunnedah-Oxley Basin formations strongly mimic the alluvial water level response indicated a high level of hydraulic connection between the alluvium and the coal basin at this location. The proponent is required to validate the accuracy of all the VWP data to show the VWP data is representative of the formations it is monitoring.

e. Groundwater levels compared against modelled predictions and trigger levels each year.	*Groundwater levels compared against modelled predictions and trigger levels each year* – refer amended text and triggers also included in Appendix E.	Recommendation partially addressed. Trigger levels and model predictions included. It is noted that at some locations water levels vary significantly from predictions and are outside trigger levels. Commentary on these deviations is not included (see Section 7.3.2, pages 53-54). For example RB05 (page E-108) and Reg13 (page E-110) significantly deviate outside the trigger boundaries over a prolonged period (>1 year) with no mention of an investigation as per the requirement of the WMP – this must be addressed. Additionally, the Annual Report indicates validation of the groundwater model was undertaken comparing the 2014 model to the observed data however no comment is included on the generally poor correlation between modelled and observed data as shown in Appendix E. There is reference to a MCCM 2017 AGE “significantly updated and recalibrated” model which “does achieve” the requirements for model validation. It is unclear if the ‘2017 MCCM model’ is the same as the 2018 AGE BTM cumulative numerical model reviewed as part of this assessment. It is noted the modelled vertical flux and gradients between the Gunnedah-Oxley Basin and Alluvium has been modelled as upward gradient with the Groundwater Impact Assessment (appendix M) of the GIS stating “The seepage will result in a reduction in the volume of groundwater from the Permian bedrock into the alluvial aquifer.” The actual measured data generally indicates downward gradient from the Upper Namoi alluvium to the Gunnedah-Oxley Basin (page E-118 as an example). This apparent error in the modelling has significant implications re potential impacts, licensing requirements and the water balance and hence is specifically relevant to this requirement and must be addressed. Noting this same error in conceptualisation and model calibration is also present in the updated BTM cumulative groundwater model developed by AGE 2018 for Boggabri Coal mine.

f. Groundwater levels interpreted via maps showing hydraulic head contours and in cross sections showing vertical and horizontal gradients. These to be updated each year as new data is collected.	*Groundwater levels interpreted via maps showing hydraulic head contours and in cross sections showing vertical and horizontal gradients, these to be updated each year….*this is not requested, or appear to be provided, by a selection of other operations Annual Reviews that were accessed. Text has been inserted into section 7.3.2 of the document stating… *The monitoring network targets a range of different groundwater systems at differing levels and therefore it is not appropriate to prepare water level contour lines when water level data is measured in different aquifer units. Despite this the available water level hydrographs can be interpreted to assess hydraulic gradients vertically and spatially.*	Recommendation not addressed satisfactorily. The requested information was not provided. The Department was not implying that water levels from different units should be contoured together. To be more explicit the recommendation requires that a contour map of the shallow alluvial groundwater sources (most relevant to the project) and individual maps for a number of coal basin formations be presented. Given this confusion it is suggest a qualified hydrogeologist is employed to address the groundwater aspects of all the reporting and assessment requirements of the project. Department technical staff will be available for further clarification. The reason for this recommendation is because there is insufficient *review* of the monitoring results by the proponent. It is noted that the conditions of consent require that the Annual Review: "include[s] a *comprehensive review* of the monitoring results….includ[ing] a comparison of these results against ... requirements…monitoring results of previous years…predictions in the EA". Presently, the annual review does not provide the explicitly required "comprehensive review of the monitoring results".
g. Greater time series graphical presentation of monitoring data and time series trend analyses and statistical testing of monitoring data to enhance interpretability of any emerging time series trends for surface water monitoring data.		Recommendation not addressed satisfactorily. Trend analysis etc not completed for surface water data.
h. Presentation of the water quality data in graphical format including historical data would allow improved comparison with trigger levels and trend analysis.	*Presentation of the water quality data in graphical format*……Note comment above regarding MCC's position on the duplication of data. Graphical presentation of data inserted into Appendix E to address this request.	Recommendation partially addressed. Surface water quality data not presented as requested (see Appendix D). Groundwater quality data has been updated (see Appendix E).
2 In Table 4 it is stated that groundwater samples were unable to be taken from two locations from early 2017 onwards as they were removed due of the progression of monitoring. This is ranked with a risk level of "Administrative non-compliance". DoI Water notes that not only were samples not collected but groundwater levels were not recorded. DoI Water disputes the assigned risk level of "Administrative non-compliance" (which is applicable to such events as submitting a report late). DoI Water recommends this item be addressed in a review of the monitoring network.		Response not explicitly given by MCCM. Unknown if this is because DPE passed on recommendation or not. Refer to separate review of Water Management Plan.
3 The proponent equips all monitoring bores in the network with pressure loggers, recording pressure, temperature and EC where possible.		Refer to separate review of Water Management Plan.
4 The revised Water Monitoring Plan must ensure the recommendations made by the Planning Assessment Commission (PAC) are addressed and previous commitment of monitoring implemented.		Refer to separate review of Water Management Plan.

5	It is requested a reference be made to the applicability of the Harvestable Right Dam Policy to the current extent of mine surface water catchments and whether all runoff sourced from minor streams is being captured in dams that fit within the exclusion provisions of Schedule 1 of the Water Management Regulation 2011. Confirmation is also requested of runoff being captured from third order or higher order streams where water entitlement would need to be considered.	*Include commentary to the applicability of the Harvestable Right Dam Policy to the current extent of the mine surface water catchments and whether all runoff sources from minor streams…….*Commentary related to Harvestable Right policy is not typically a condition for inclusion in an Annual Review document, and has not been specified within previous Annual Reviews. MCC question the relevance as this is addressed within an environmental assessment stage for SSD and its footprint, and disturbance footprint approved. Notwithstanding, text has been inserted in section 7.2.2 to address NSW L&W request. *Confirmation is also requested of runoff being captured from third order or higher order streams where water entitlement would need to be considered….*as above, refer to 7.2.2	NRAR to advise regarding harvestable rights, etc.
6	In regards to the licenses and approvals listed in Table 5 the following comments are provided: a. 90WA801901 is linked to WAL13050. It is recommended this WAL be referred to. b. A number of the work approvals listed are for bores authorised for stock, or stock and domestic use. It is recommended this purpose be listed in this table to assist in understanding the works relevant to use for the mining activities. Relevant bores include 90WA809078, 90WA809079, 90WA809300, 90WA809127, 90WA820120. c. Approval 90WA822412 is a bore authorised for mining and industrial purposes and is linked to WAL29467. It is recommended this purpose and WAL be referred to. d. WAL12811, WAL29467, WAL27385 and WAL12479 are all linked to a miscellaneous work (an administrative number used to relate to the SSD approval) to account for groundwater take from the excavation. It is recognised these 4 WALs are not linked to a water supply work approval due to that requirement being excluded from an approved SSD. It is recommended a reference be made to these WALs as being held for predicted groundwater take from the excavation to assist in interpreting water accounting at the site. This would also be useful to see in Table 11.	*Update Table 5 to include all WAL's….* The WAL's listed with water use during the reporting period are related to mining activities as noted within the footnote of Table 11, with water take assigned accordingly to the necessary licences. Table 2 has been revised to align with other listed WAL's in tables in the document. Row with WAL13050 already includes reference to the works approval '*3000 ML water licence from Lower Namoi Regulated River Water under works approval 90WA801901.*' No further detail is considered to be required. *Update Table 11 Water Take to include WAL12811, WAL29467, WAL27385 and WAL12479…..*MCC note these WAL's are already included in Table 11. MCC request clarification in this instance. Note as above, MCC has revised Table 2 to insert WAL's for consistency with other tables.	NRAR to advise regarding licensing requirements.

7	Revise the Water Management Plan by end July 2018 and submit to Lands and Water for review. The revised Water Management Plan must include: a. Ensure all previous comments/recommendations provided in a letter by NSW Office of Water dated 20 November 2014 on the WMP have been addressed b. A revised monitoring network, including consideration of which bores will be removed/replaced due to expansion of the pit. c. An updated site water balance model. d. An updated groundwater model as previously committed to.	[With respect to 7d:] MCC note this is already addressed within section 7.3 of the submitted version. To address *NSW Land & Water* request, additional detail is added in section 7.3.2. *As required by Schedule 3, condition 40 (c) of PA10_0138, a review of the measured groundwater monitoring results against predictions made within the 2014 groundwater model was undertaken by AGE commencing in 2016 as part of a wider review of groundwater processes occurring in the Maules Creek area. The validation/verification process involved comparing…..* *The model was significantly updated and recalibrated in 2017. The review indicated that the model does achieve these requirements and improvements will continue to occur as data and models progressively develop with future validation. Following a peer review, a report will be submitted to the government in the next reporting period.* The independent review/validation is undertaken consistent with commitments in the WMP.	Refer to separate review of Water Management Plan.
8	Finalise the Leard Forest Mining Precinct Water Monitoring Strategy by 30 June 2018 and submit to Lands and Water for review. It is understood this strategy requires development with the other mines, however it is recognised as an outstanding matter in the consent conditions.		Refer to separate review of Water Management Strategy.

Table 2: Groundwater and surface water assessments done for original Annual Review

No.	Issue	DoI Water comments on original Annual Review	DoI Water comments on revised Annual Review
1	Water take	The Annual Review has tabulated the relevant water access licences (page 1, 10-12). The Annual Review has also tabulated the water take per water access licence and per water source (page 46). The passive take/inflows are listed as 0 ML for all water sources but the *NSW Murray Darling Basin Porous Rock Groundwater Sources* where it is shown as <10 ML. It is not clear how these numbers have been derived. The Annual Review (page 55) makes the point that predicted inflows for year 6 were about 1.9ML/day (695 ML/yr), whereas the actual inflows have been negligible. Doi Water Notes that. there appears to be some confusion of year 5 vs year 6 in the text. It is also noted that these figure appear to differ from the predicted inflows in the site water balance (see WMP, pages 80 and 85). Evaporation is mentioned as a reason for limited inflow (page 55) however, this statement is not qualified, an estimate of how much evaporation has occurred is not provided. The WMP (page 81) states there is an in-pit pump and in addition states (page 120) that there is a pit seepage monitoring program. DoI Water recommends that the Annual Review is revised such that: • Both passive and active water take are documented along with their method of measurement/estimation and details of the pit seepage monitoring program. • Measurement/estimation and analysis of evaporation from the pits is documented. The water take is compared against historical data and modelled predictions, on a year-by-year basis.	Response not explicitly given by MCCM. Unknown if this is because DPE passed on table or not. DoI Water recommends that this table is provided to the proponent, and **all** matters contained in it are addressed.
2	Groundwater level data	DoI Water has a number of concerns about the groundwater level data presented in the Annual Review (page E99-E112): • Figure 9 (page 54) does not include all monitoring points, but only those reported on for the last year • The symbols used Figure 9 are unclear for Reg7, Reg7a, Reg10, Reg10a, RB05 and RB05a and possibly missing for Reg1 (elsewhere called Reg01). • Data for the regional and private bores is presented in tabular rather than figure form • Data for the VWPs is presented with varying y-axis scales, making comparisons difficult • Only data from 2017 is presented • Depths are not provided for the regional bores, private bores or vibrating wire piezometers (VWP) • The monitoring depth/formation is not presented for the regional or private bores • Declining trends of 5+ meters evident in some of the VWP data – trend analysis not included • Apparent data errors (e.g. step changes) evident in some of the VWP data – error analysis not included • Groundwater level data are not synthesized (e.g. in maps showing hydraulic head contours, or in cross sections showing vertical and horizontal gradients) or set it the larger regional hydrogeological context • Groundwater level data are not compared against historic data, modelled predictions or trigger levels (n.b. the groundwater trigger levels in the WMP (page 121-122) need to be clarified) – long term trend analysis not included. DoI Water recommends Annual Review is revised to include: • Groundwater level data is presented for all monitoring points in the network, not just those monitored in 2017, and presented in figure form • Groundwater levels are not limited to the reporting year but to the full dataset, groundwater levels are to be quantitatively analyzed for trends • Groundwater levels are compared against modelled predictions and trigger levels • Groundwater levels are interpreted via maps showing hydraulic head contours and in cross sections showing vertical and horizontal gradient DoI Water further suggests the Annual Review is revised to also address all other concerns raised above.	Response not explicitly given by MCCM. Unknown if this is because DPE passed on table or not. DoI Water recommends that this table is provided to the proponent, and **all** matters contained in it are addressed.
3	Potential impacts to Back and Maules Creeks	The 2017 Annual Review satisfactorily addresses the specific points that are required to be addressed as outlined in Attachment B. However the proponent should note the requirement to identify any trends in monitoring data over the life of the development. The 2017 Annual Report is currently deficient in this regard. Presentation of water level and water quality monitoring data in graphical format, together with appropriate time series trend analyses and other statistical analyses, would enhance the interpretability of any emerging trends in surface water and groundwater monitoring data. The current surface water monitoring network in Maules Creek with the single long-term active station equipped with continuously recorded water levels located at Elfin Crossing is sufficient to assess the effects of mining activities on the	Response not explicitly given by MCCM. Unknown if this is because DPE passed on table or not. DoI Water recommends that this table is provided to the proponent, and **all** matters contained in it are addressed.

No.	Issue	DoI Water comments on original Annual Review	DoI Water comments on revised Annual Review
		hydrology of the lower reaches of Maules Creek. There are currently no active gauging stations on the smaller Back Creek. Back Creek is likely to be even more intermittent than Maules Creek which presents technical difficulties in monitoring flow. There are no long term surface water hydrology data with which to assess trends in Back Creek prior to and after the commencement of mining activity. As a part of the monitoring system for the mining development, there are a reasonable number of groundwater monitoring bores situated along the length of Back Creek, including private landholder bores that are being monitored for water level and water quality. Any potential mining impacts on surface water hydrology in Back Creek that are related to mining disturbance of aquifers are likely to be registered first in these groundwater monitoring bores. None of the groundwater level data in monitoring bores along Back Creek presented as tables in the Annual Report showed fluctuations of the magnitude of monitoring bores in the agricultural area.	
4	Findings of Annual Review	DoI Water does not consider the Annual Review provides sufficient evidence to adequately determine if impacts are occurring to groundwater, and at what magnitude. Also, Tables 2-4 summarise the status of compliance for the project (pages 1-4). In Table 4 it is stated that groundwater samples were unable to be taken from two locations from early 2017 onwards as they were removed due of the progression of monitoring. This is ranked with a risk level of "Administrative non-compliance". DoI Water notes that not only were samples not collected but groundwater levels were not recorded. DoI Water disputes the assigned risk level of "Administrative non-compliance" (which is applicable to such events as submitting a report late).	Response not explicitly given by MCCM. Unknown if this is because DPE passed on table or not. DoI Water recommends that this table is provided to the proponent, and **all** matters contained in it are addressed.
5	Adequacy of groundwater monitoring network	The groundwater monitoring network, as presented in the WMP, consists of: • A baseline monitoring network (refer Table 6.1 on page 96 and Figure 6-1 on page 98) • A wider monitoring bore network inclusive of monitoring at three mines sites and nearby government monitoring points (refer to Figure 6-7 on page 107) • Replacements bores (refer to Table 6.3 on page 110 and Figure6-8 on page 111) • Cumulative impact groundwater monitoring locations (refer to Table 6.4 on page 113 and Figure 6-9 on page 115) • Some of the registered bores near the mine site (refer to Table 6.5 on page 117). DoI Water has previously had input into the design of this monitoring network. As presented in the WMP, the monitoring network is satisfactory. However, the groundwater monitoring network, as presented in the Annual Review, consists of: • 13 regional monitoring bores – a mix of the baseline monitoring network, replacements bores and cumulative impact groundwater monitoring locations • 12 private bores (although 4 are 'capped' which appears to prevent groundwater level monitoring) • 32 VWPs in 9 locations. It appears that only those bores monitored in 2017 are presented in the Annual Review. The Annual Review states that the regional monitoring bores are measured monthly (page 53). DoI Water recommends that all regional monitoring bores are equipped with pressure loggers, recording pressure/temperature and possible EC) daily. Appendix 6 of the Approval of Consent (page 55) included the recommendations from the Planning Assessment Commission for additional groundwater monitoring. This included the recommendation that the 17 additional monitoring bores proposed be equipped with water level or pore pressure transducers. It is unclear if this, and the other three recommendation, has been complied with. DoI Water notes that in the WMP (page 123) there is a stated commitment to address the PAC commitment within 5 years of approval. The updated WMP should address this. DoI Water recommends that the monitoring network (including consideration of which bores will be removed/replaced due to expansion of the pit) is reviewed as part of an updated Water Management Plan (WMP)	Response regarding additional monitoring bores given as: "The additional bores were installed, and also reviewed as part of the recent IEA. Bore details are included in Appendix E and text inserted on page 52. " A response to the remainder is not explicitly given by MCCM. Unknown if this is because DPE passed on table or not. DoI Water recommends that this table is provided to the proponent, and **all** matters contained in it are addressed.
6	Adequacy of reporting	The WMP (page 120) states that "monitoring results of previous years", "identification any trends in the monitoring data over the life of the development" and "identification any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies" would be included in the Annual Review. As noted above, these were not satisfactorily done in the 2017 Annual Review. DoI Water notes that it is unclear from the Annual Review if reporting under the EPBC Act 1999 has been completed.	Response not explicitly given by MCCM. Unknown if this is because DPE passed on table or not. DoI Water recommends that this table is provided to the proponent, and **all** matters contained in it are addressed.

No.	Issue	DoI Water comments on original Annual Review	DoI Water comments on revised Annual Review
		Section 8.3 in the WMP (page 131) states that "In accordance with Schedule 5, Condition 9 of PA 10_0138, MCC will regularly (at least every six months) prepare a summary of monitoring results and make these publicly available at the mine site and on the Maules Creek website." The site http://www.whitehavennews.com.au/maules-creek-site-monitoring/ does not include water monitoring. DoI Water recommends that the proponent's website is updated to include monitoring data every 6 months.	
7	Adequacy of site water balance	The site groundwater balance is presented in Table 12 (page 55) of the Annual Review. The balance is shown with each line-item to the nearest ML (with the exception of groundwater seepage and miscellaneous). The water balance would be strengthened by inclusion of the uncertainty (e.g. +/- 10%) associated with each figure, and information about the method(s) used to compute each item. The WMP (page 79) says that a predictive water balance model was prepared for the first 5 years of mine life only. As per Section 5.4 in the WMP (page 94), the site water balance needs to be updated and validated as new information becomes available. DoI Water recommends that the updated WMP revises the site water balance, and includes years 6-10 also.	Response not explicitly given by MCCM. Unknown if this is because DPE passed on table or not. DoI Water recommends that this table is provided to the proponent, and **all** matters contained in it are addressed.
8	Water Management Strategy and Plan	The WMP sits within the larger Leard Forest Mining Precinct Water Monitoring Strategy (WMS). The objectives of the strategy are to (WMP, page 22): • minimise potential cumulative water quality impacts associated with the BTM Complex • review opportunities for water sharing/water transfers within the BTM Complex • co-ordinate water quality monitoring strategies between BTM Complex operations as far as practicable • undertake joint investigations/studies between BTM Complex operations in response to • complaints/exceedances of trigger levels where cumulative impacts are considered likely • co-ordinate modelling programs between BTM Complex operations for validation, re-calibration and rerunning of the groundwater and surface water models using approved mine operation plans DoI Water notes that this document was not referenced in the Annual Review, nor is it available online. DoI Water recommends that the Leard Forest Mining Precinct Water Monitoring Strategy is submitted to DoI Water for review. DoI Water notes that the Water Management Plan (WMP) is dated March 2014 and is therefore more than 4 years old Further, DoI Water has previously written to the proponent with a series of recommendations to improve the WMP on 20 November 2014. DoI Water recommends that the WMP is updated. The updated WMP should address all previous advice provided by DoI Water (formerly NSW Office of Water).	Refer to separate review of Water Management Strategy.
9	Groundwater model(s)	The groundwater model appears to have been last updated in 2014 (WMP, page 119). Further, it is stated in the WMP (page 55) that "Additional BTM complex wide groundwater modelling will also be finalized [during the next reporting period] to ensure calibration and review of modelled predictions". This appears not to have been completed. It is also noted that seepage into the mine is expected to rapidly increase around year 7 (WMP, page 120), thereby potentially causing impacts to surrounding aquifers/creeks. A revised model is imperative at this juncture of the mine life. DoI Water recommends that the updated WMP also includes an updated groundwater model.	Refer to separate review of numerical model.

Table 2: Water quality assessment done for original Annual Review

No.	Issue	DoI Water comments on original Annual Review	DoI Water comments on revised Annual Review
1	The planning approval 40(b) requires a surface water management plan that includes detailed baseline data on surface water flows and quality in the water bodies that could be potentially affected by the project. trigger levels to investigate any potentially adverse impacts on downstream water quality a plan to monitor surface water flows and quality in the water courses that could be affected by the project	The water management plan shows data collected between 2010 and 2014 as well as historical data. These were used to develop trigger levels, when insufficient data was available the trigger level from the ANZECC (2000) guidelines were used. In some cases the trigger levels from the baseline data differ from those in the ANZECC guidelines, however they are generally consistent with ambient water quality data in this catchment. A monitoring program is outlined in the plan which includes upstream and downstream sites. The monitoring program tests for water quality indicators such as EC, pH, solids, major ions, metals and nutrients. This program appears to be adequate to assess potential impacts on water quality in surrounding water courses.	No further comments
2	The planning approval 40(c) requires a ground water management plan that includes Detailed baseline data of groundwater levels, yield and quality in the region and privately owned groundwater bores including a detailed survey / schedule of groundwater dependant ecosystems. Groundwater assessment criteria including trigger levels for investigating any potentially adverse groundwater impacts	The water management plan shows data collected between 2010 and 2014 from 8 monitoring bores. Samples were analysed on a monthly to two monthly basis for a range of parameters including major ions, nutrients and trace metals. A result summary is shown and compared to guideline values. Trigger levels based on EC values are included. An on going monitoring program for samples on a 3-6 monthly basis is included. No survey of groundwater dependant ecosystems has been sighted. This program appears to be adequate to assess potential impacts on ground water quality.	No further comments
3	The development approval requires an annual review that includes A comprehensive review of the monitoring results including a comparison of these results against the relevant statutory requirements, previous years and predictions in the EA Identify non compliances Identify any trends	The surface water quality program was carried out as planned in the water management plan. The results are detailed in the 2017 report. There are some exceedances of the trigger levels but these are in line with results from surrounding water courses. There were 3 instances of discharge from a sedimentation dam and in one case the suspended solid result exceeded the trigger level. The result was similar to those obtained both upstream and downstream in the Namoi river but this was not discussed in the text. Groundwater quality was monitored on a three monthly basis. The results appear consistent with historical values. Results from previous years monitoring are not included so on going trends cannot be easily assessed. The 2017 report indicates that there have not been significant impacts on surrounding water quality during the reporting period. Presentation of the data in graphical format including historical data would allow improved comparison with trigger levels and trend analysis.	Trigger levels and control charts have been added to Appendix E (groundwater data) but no historical data or current trigger levels have been provided in A. See recommendation 1. h above.

Approvals

Position	Signature	Date
Author, GW: Andrew McCallum, Senior Hydrogeologist		17/10/18
Author, SW and WQ: John Brayan, Water Quality Specialist		19/10/2018
Reviewer: Cate Barrett, Lead Hydrogeologist		

Attachments

Attachment	Title
A	Advice Request
B	Figures

Attachment A

Advice Request

Advice request – major projects and developments

BACKGROUND

Contact Officer	Tim Baker (6841 7403)	
SSD Number	**Project Name**	
PA10_0138	Maules Creek Coal Mine	
Proponent	**Location**	**Project Stage**
Whitehaven Coal	18km north-east Boggabri	Annual Review

Project description

The Maules Creek Coal Mine is an existing coal mine owned and operated by Whitehaven Coal. The project was originally approved by Department of Planning & Environment in October 2012 with subsequent modification approvals in 2013, 2014 and 2017. A fourth modification related to noise aspects of the project remains pending with DP&E.

DoI Water has had extensive involvement during project development and ongoing review and management. The proponent has prepared an Annual Review (AR) for 2016-17 in accordance with Condition 4 of Schedule 5 of the project approval (PA 10_0138).

DP&E has requested DoI Water review the Annual Review to assist in ongoing compliance of the site. This is in terms of verifying predicted versus actual impacts and whether water management at the site is consistent with the Water Management Plan and is in accordance with the conditions and entitlements of water licences.

Groundwater and surface water hydrology issues have been raised with ongoing management of this site. A key issue has been the potential impact to local surface water systems due to groundwater take associated with the mine. This has been highlighted by recent media and ministerial requests (complaints of ceasing flow at Elfin Crossing on Maules Creek - 419051). To assist in clarifying this issue this advice request seeks to obtain a review from both the groundwater and surface water hydrology groups of the Water Assessments group.

Known WSP & water source(s)

Gunnedah Oxley Basin Water Source
Maules Creek Groundwater source
Lower Namoi Regulated River Water Source
Maules Creek Unregulated Water Source
Upper Namoi Groundwater source

Known licences or approvals

WAL12811 – 135 units – Upper Namoi Zone 5
WAL27385 – 38 units – Upper Namoi Zone 4
WAL12479 – 78 units – Upper Namoi Zone 11

WAL29467 – 306 units – Gunnedah Oxley Basin WAL36641 – 800 units – Gunnedah Oxley Basin WAL12491 – 77 units - Upper Namoi Zone 11 WAL12480 – 215 units - Upper Namoi Zone 11 WAL13050 – 3000 units – Lower Namoi Regulated River (HS) WAL41585 – 30 units – Maules Creek water source - unreg		
Advice requested from	**Requested date**	**Due date**
Groundwater and Hydrology	18/04/18	04/05/18
Specific advice requests		
Please provide the following: Groundwater Review • Review the presented groundwater level data and water take figures and assess against recent years data, the approved impacts (EIS) and updated groundwater model outputs in the WMP. • Review the groundwater level data against the potential for impacts to surface water flows in local watercourses (Back Creek and Maules Creek). Note: A Ministerial has been received complaining about loss of flow in Maules Creek at Elfin Crossing (419051). • Comment on the findings in the Annual Review. • Adequacy of Annual review to address reporting requirements in the WMP. • Adequacy of current groundwater monitoring network. • Adequacy of water balance to understand water take and interpret impacts. Surface Water Hydrology Review • Review the current and historic flow data of nearby watercourses (Back Creek and Maules Creek) and consider the potential impact of mining activity on current flow. Note: A Ministerial has been received complaining about cease of flow in Maules Creek at Elfin Crossing (419051). A review of the baseline data and triggers in the WMP would assist, in addition to the EIS if required. • Adequacy of Annual review to address reporting requirements in the WMP. • Adequacy of current surface water monitoring network to assess impacts.		
Relevant section(s) or pages of (EA / Management Plan / Other document)		
Annual Review Water Management Plan http://www.whitehavennews.com.au/sustainability/environmental-management/maules-creek-mine/ Original EIS http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=4142		

Attachment B

Figures

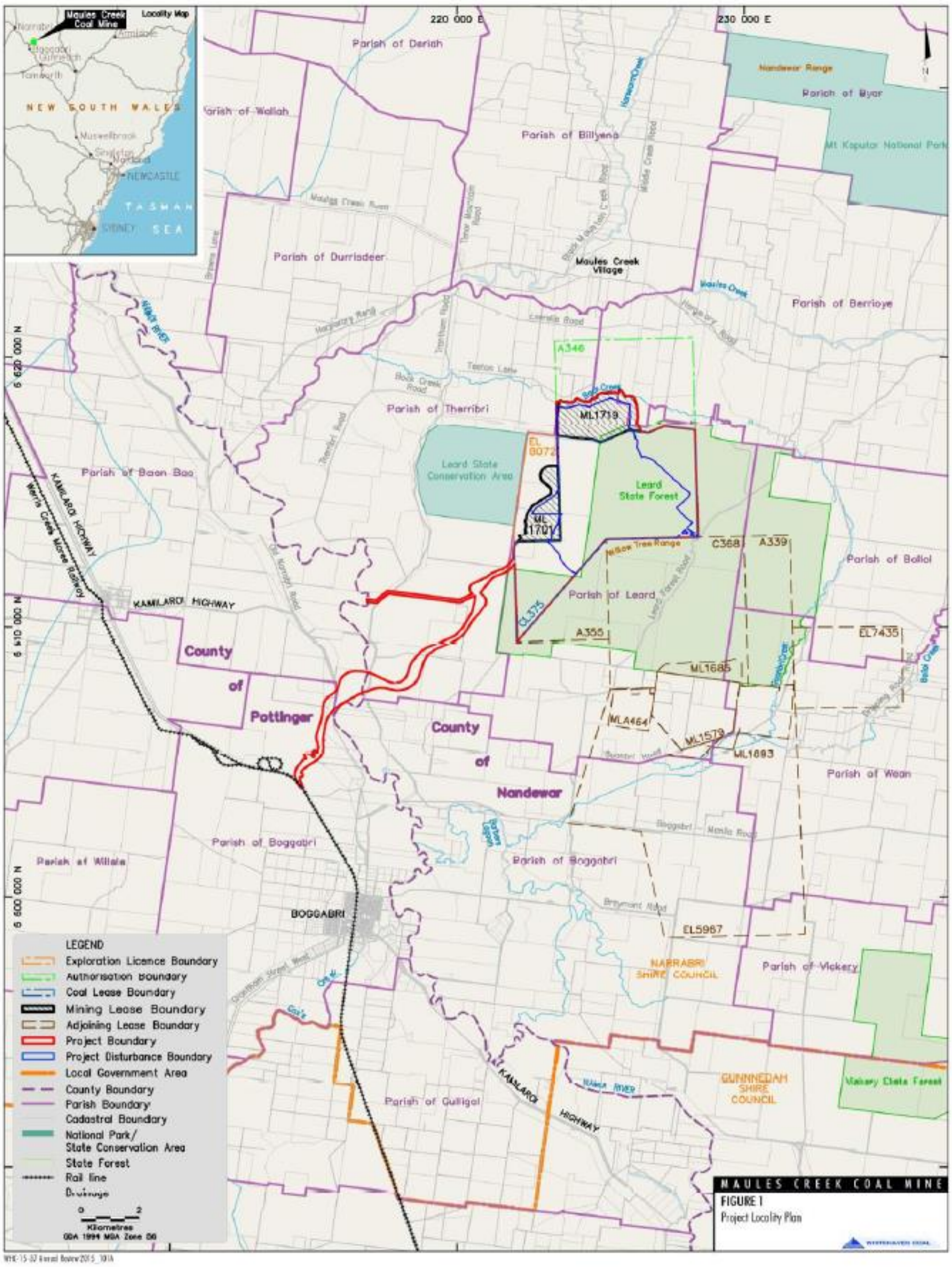

Figure 1 Project Locality Plan

Figure 1: Site location (taken from Annual Review, page 7)

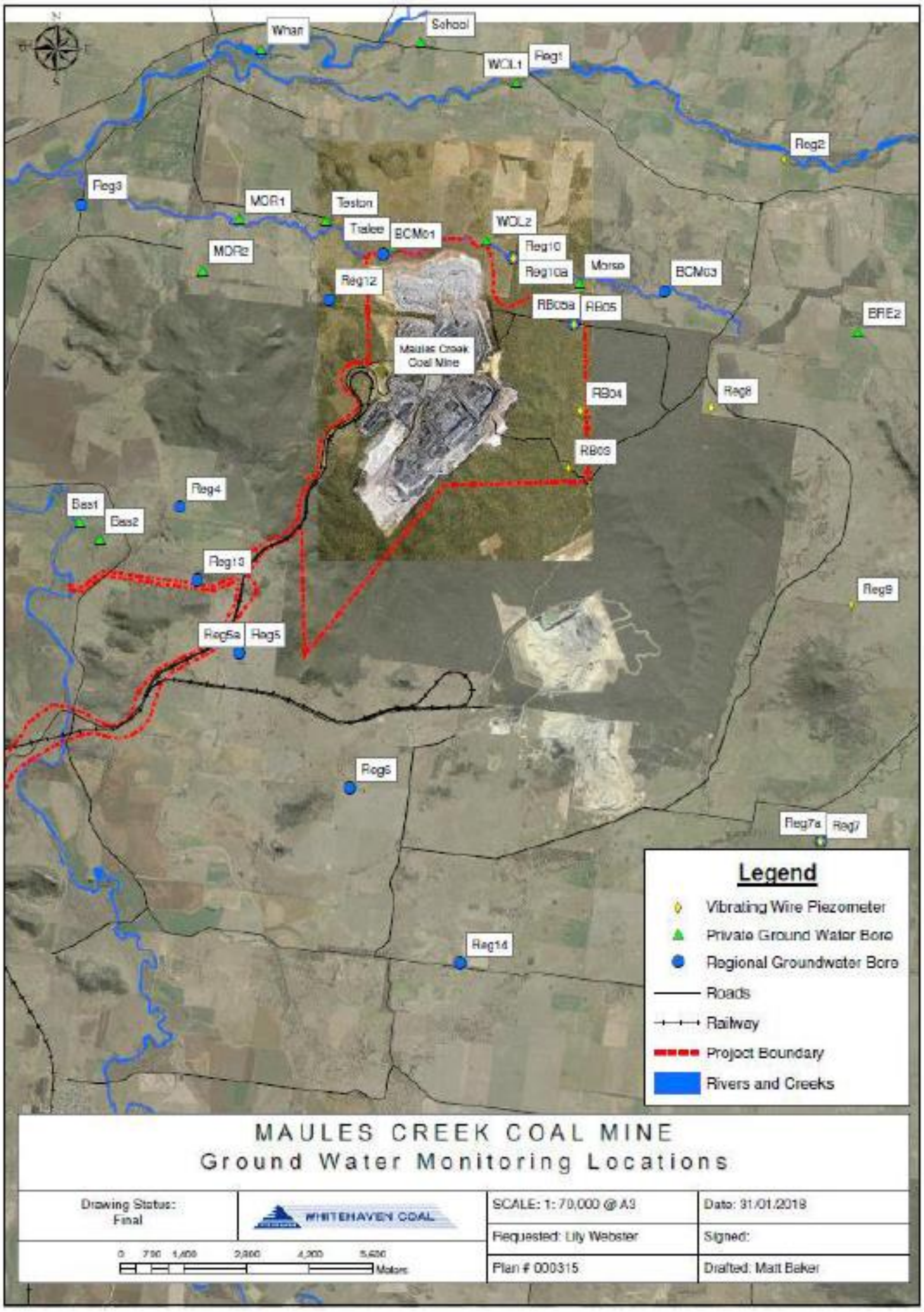

Figure 9 Groundwater Monitoring Locations

Figure 2: Groundwater monitoring locations (taken from Annual Review, page 55)

Phil Laird,
“Middle Creek”,
302 Middle Creek Road,
Maules Creek,
NSW. 2382.
12.12.2023

Kiersten Fishburn,
The Secretary,
Department of Planning and Environment,
4 Parramatta Square,
12 Darcy St,
Parramatta, NSW, 2150.

c/- Louise.Higgins@dpi.nsw.gov.au

re: Compensatory Water - Maules Creek Coal Mine

Dear Kiersten;

I’m writing on behalf of myself and my brothers Rick and Andy Laird in relation to the Maules Creek Coal Mine (MCCM) and its impact on groundwater. We are requesting that you trigger S37 of Planning Approval 10_0138 to begin planning for a long term water supply for all residents of Maules Creek. The facts as we see them are as follows;

The Maules Creek district only just slipped into drought in October 2023[1]. The groundwater well at “Middle Creek” would normally have 3 – 4 meters of water in it at the start of a dry period, but now has less than 30 centimetres. This low level is reflected in other nearby bores on our property.

This level represents a serious, abnormal decline in groundwater at “Middle Creek” that is far greater, relatively speaking, to the network of government monitoring bores in the district.

For example the above mentioned well at “Middle Creek” has fallen by <u>4 meters</u> since the recorded peak on July 18, 2022, 400% more than the 1 meter decline at the nearby Water NSW monitoring station at Green Gully over the same timeframe (see Fig 1 below), and 2,352% more than the 17 centimetre fall recorded at the monitoring station at Elfin Crossing (see Fig 2).

When the opencut mine was approved in 2012 the water models in the Groundwater Assessment estimated that <u>there would be less than a 1 meter drawdown</u> in all years where our farms are located[2].

However this estimate has proved false. In 2018 when the mine “intercepted the regional groundwater table”[3] it went from extracting <10 ML/year to 576 ML/year. Despite not being in drought in March 2018[4], there was a dramatic and unexpected decline in the groundwater (See composite image below). The community had to scramble to find water and in roughly 6 - 12 months 37 local bores had to be either cleaned out, deepened or newly drilled at significant expense. For the first time in living memory, the permanent water in the Maules Creek at Elfin Crossing dried up impacting the bird life, aquatic species and the groundwater dependent ecosystems that reside there.

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1 NSW DPI, Seasonal Outlook Sept 2023, https://www.dpi.nsw.gov.au/climate-landing/ssu/nsw-state-seasonal-update-september-2023
2 AGE, Maules Creek coal mine Groundwater Impact Assessment, MCC-Environmental Assessment-Appendix M - Groundwater Assessment Part 2.pdf (p14)
3 AGE, BTM Groundwater Model Report, Ch 6.7.1.3 (p75)
4 NSW DPI, Seasonal Outlook March 2018, https://www.dpi.nsw.gov.au/climate-landing/ssu/march-2018

Photo: Unprecedented decline of surface water at Elfin Crossing. By 17.9 2019 the water was completely gone. (Image: Phil Laird)

A Department of Water hydrologist report from Oct 17 2018[5] that was requested by Resource Assessments, confirmed what we were thinking - that the water modelling was conceptually flawed.

The hydrologists report said that the model was inconsistent with the observed data regarding the connectivity of the alluvium to the underlying coal and that there was a “lack of interpretation” inferring that decision making and management actions being undertaken were without basis. The hydrologist said;

> *“The overall review of the assessed documents has raised concern regarding the conceptualisation of the connectivity between the alluvium of the Upper Namoi (specifically Zone 11 (Maules Creek)) and the underlying Gunnedah-Oxley Basin in the numerical model on which impact assessment is based.”*
>
> *“The observed data generally indicates a downward gradient from the alluvium to the underlying coal basin however the model has hydraulic gradient going from the coal basin to the alluvium.”*
>
> *“This inconsistency between the observed data and the modelled data is not addressed in any of the reviewed documents or captured by the trigger level response management.”*

Furthermore, the false and misleading information (i.e. *the inconsistency*) was repeated in the cumulative groundwater model for the entire Leard Forest mining precinct.

> *“Noting this same error in conceptualisation of the hydraulic gradient and model calibration is also present in the 2018 AGE BTM cumulative numerical model.”*

Baseline data in our area was not collected to input into the original groundwater model. Only now, nearly 12 years after the original determination, and after permanent groundwater impacts have been experienced is the mining company engaging the very same modelling company to collect “baseline” readings in our area and even then it is mainly obtaining water samples not water levels.

In 2022 I approached the company via Federal MP for Parkes, Mark Coulton, to develop a proposal for Maules Creek residents and their groundwater prior to the next drought. We had one Zoom meeting on the 8.9.2022 and despite staff being initially open to hearing the proposal, no further contact has been made after repeated attempts to engage. The last request was on the 29.3.2023.

The proposal discussed was for the company to voluntarily construct a pipeline from the Namoi aquifer to a distribution network for stock and domestic purposes. The pipeline could be placed along roadsides or more directly on mine owned land. The project would leverage Murray Darling Basin (MDB) funding in exchange for the community and the company handing back dormant Maules Creek surface water and Zone 11 groundwater licences. The company would make up the balance of the funds and provide 70 ML of water from its existing and purchased Namoi water licences.

I met with DPI and DCCEEW water officials who were very keen to develop such a project to return MDB water in exchange for infrastructure via the *State Led, Off Farm Efficiency Program.* The Federal Water Minister Tanya Plibersek was keen to meet the MDB Sustainable Diversion Limit, particularly in the Namoi.

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5 NSW DPI, Groundwater & Surface Water Assessment – State Significant Development, Oct 2018, https://drive.google.com/file/d/1PXufdgKt9WktHTYNm1wB4at9dCQStsQX/view

Things gathered momentum, however on the 22.8.2022 I was notified by email that the proposal did not meet the guidelines.

During that period I approached Barwon MP Roy Butler, who wrote to Kevin Anderson, the MP for Tamworth and the then Water Minister, seeking his support. Unfortunately the suggested arrangement in the reply was for residents to buy water licenses at market value and fund the pipeline. Such a solution is not fair as residents have not brought this situation about and it is inequitable that residents pay the price for flawed groundwater modelling.

Since then the company has lodged it's own pipeline proposal ***to pipe water out of the Maules Creek district*** to the Vickery mine[6]. This is clearly unacceptable following the disaster of the last drought and the inevitability that the next one will be worse. Residents strongly oppose such a pipeline, and given that the entire BTM complex has relied on false and misleading assumptions on which to base its groundwater modelling to garner planning modifications, this idea should never see the light of day.

After all this history, we are deeply concerned that the current rate of decline in our groundwater compared to the previous drought event is steeper and is earlier in the drought cycle. The size and trajectory of the declines has us very concerned that the emergency stock and domestic water supply activities undertaken by landholders in the last drought event is only a temporary fix. Without an alternative water supply individual landowners are out of options, as we cannot drill any deeper because if we do so we would be through the aquifer and into the coal.

Because my original approach to the company has not been able to resolve this issue and government programs can not apply, I am writing to request that as Secretary, you trigger the compensatory water scheme under S37 of the Planning Approval 10_0138. It is important that action is taken prior to the full impacts of the next drought and for a long term solution to be in place before the mine progresses further.

I also am requesting that no water can be allowed to be diverted from the Maules Creek coal mine via pipelines to other coal mines when the district is in drought or when there is no visible water flowing across the Elfin Crossing.

Residents would argue that the company has made plenty of money on the back of conceptually flawed water models and that some of this money should be used to provide certainty for residents, to ensure the long term viability of the community, avoid livestock welfare issues and ensure water for the environment. The funding for the alternate water supply should be sufficient to cover long term operation and maintenance so that Maules Creek residents are not out of pocket any further than they already are.

The company will argue that its not good value for money, but it will always do that, and the damage that it has wrought will last for ever. If truth be told this is a cheap solution and there should be no quibbles given the many billions that have been earned.

I would be happy to discuss next steps. Please give me a call on 0428 712622 to arrange a time.

Kind regards,

Phil Laird

6 MCCM Continuation Project – Scoping Report (p5), 2023, https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=PDA-62741206%2120231011T194756.589%20GMT

Fig 1: Green Gully groundwater monitoring station compared to Middle Creek South Well

Fig1: Green Gully GW967138.1.1 (top in red) has fallen 1 meter compared to nearly 4 meters at Middle Creek South Well (bottom in blue) since it peaked on August 24 2022. Note that the differences in scale on the y axis

Fig 2: Elfin Crossing groundwater monitoring station compared to Middle Creek South Well

Fig2: Elfin Crossing GW967137.1.1 (top in red) has only fallen 17 centimetres compared to nearly 4 meters at Middle Creek South Well (bottom in blue) since it peaked on July 18 2022. Note that the differences in scale on the y axis

NB: MCSW data collected by Rick Laird. Water NSW monitoring data https://realtimedata.waternsw.com.au

MCCM coal sales

Year	Tonnes (000)	Sale Price (Thermal Coal)	AUD-USD (June 30)	AUD/Tonne	Sales Value AUD (000)	Reference Link
2015						Ramp up – not included
2016	7400	**$56.00**	$0.76	$73.68	$545,263.16	https://whitehavencoal.com.au/wp-content/uploads/2019/07/160715-June-2016-Quarter-Report.pdf
2017	8986	**$83.00**	$0.80	$103.75	$932,297.50	https://whitehavencoal.com.au/wp-content/uploads/2019/07/June-2017-Quarter-Report-1.pdf
2018	9700	**$94.00**	$0.74	$126.51	$1,227,187.08	https://whitehavencoal.com.au/wp-content/uploads/2019/07/180713-June-2018-Quarter-Report-Master.pdf
2019	9200	**$115.00**	$0.69	$167.88	$1,544,525.55	https://whitehavencoal.com.au/wp-content/uploads/2019/09/20190711-June-Quarter-Report.pdf
2020	8190	**$85.00**	$0.71	$119.05	$975,000.00	https://whitehavencoal.com.au/wp-content/uploads/2020/07/200714-June-2020-Quarterly-Report-FINAL.pdf
2021	9340	**$84.00**	$0.73	$114.44	$1,068,882.83	https://whitehavencoal.com.au/wp-content/uploads/2021/07/210715-June-2021-Quarterly-Report-Final.pdf
2022	9372	$325.00	$1.00	$325.00	$3,045,900.00	https://whitehavencoal.com.au/wp-content/uploads/2022/07/WHC_June_2022_Quarterly_Report.pdf
2023	7259	$445.00	$1.00	$445.00	$3,230,255.00	https://www.listcorp.com/asx/whc/whitehaven-coal/news/june-2023-quarterly-report-2898234.html
2024	8819	$217.00	$1.00	$217.00	$1,913,723.00	https://company-announcements.afr.com/asx/whc/39fd8af9-4558-11ef-b51d-b681c1fa9655.pdf
Total	**78,266**				**$14,483,034.12**	

Emergency Groundwater Actions Taken by Maules Creek Residents 2018-20[1]

1	Cliff Wallace, “Wando”	Contractor deepened a cottage well with new bore and it’s almost failed again. Irrigation well failed
2	Joan Bradshaw, “Glenelg”	RL cleaned out house bore, 1.5 m of water
3	Steve Bradshaw, “Old Glenelg”	Drilled one new bore after total bore failure. Cleaned out 5 stock bores, 2 have water, 3 are dry
4	Donald Holmes, “Billyena”	Deepened house well, RL cleaned out 2 stock bores
5	Glenn Holmes, “Billyena”	Cleaned out house bore
6	Andy Laird, “Roslyn”	Drilled new bore, capacity declined to 50%, cleaned out 4 stock bores
7	Phil Laird, “Middle Creek”	RL cleaned out 2 stock bores
8	Peter Todd, “East Lynne”	House well gone dry, complete failure. Drilled new bore
9	Tony Nobilo	Deepened bore
10	Mark Dampney “Hampton Downs”	RL cleaned out stock bore, Deepened well with new bore
11	Rick Laird “Middle Creek South”	Well failure, Cleaned out stock bore, little water
12	Alistair Todd “East Lynne”	Drilled new bore
13	Annemarie Rasmussen	Bore dry, no water
14	Chris Smith “El Rancho”	Bore dropped to record low levels, spring failed
15	Keith Greenaway “Glencoe”	2 bores dropped
16	Doug Whan “Trumby”	Bore dropped 1.5 metres
17	Skillicorn “Kyden Park”	Bore dropped 2 metres
18	John Hallman “Lynburn”	Supply failed. Carting water
19	C. Starkey “Green Gully”	RL cleaned out house bore, paddock bore
20	M. Smith – “Montanna”	RL cleaned out house bore, 2 m of water
21	Graham Leys “Kumbogie”	Bore dropped.
22	Campbell Leitch	Supply failure. Drilling now

1 This schedule does not include water supplies on mine controlled farmland.

STYGOFAUNA

December 5, 2012

Groundwater Dependent Ecosystems of the Maules Creek Alluvial Aquifer. Ref No.: 2011/01583

Submission by: **Maules Creek Community Council Inc**
upthecreek2382@gmail.com

Lead Researcher Peter Serov
stygoeco@gmail.com

Contents

Title Photo:

Stygofauna being sampled from a bore in Maules Ck, Alluvial Aquifer.
http://www.aabio.com.au/tag/peter-serov/

Introduction

The Maules Creek Community Council Inc has nominated in 2011 the Ecological Community known as *Groundwater Dependent Ecosystems of the Maules Creek Alluvial Aquifer* for consideration by the Threatened Species Scientific Committee (the committee). The committee chose not to list the ecological community in 2012 due to a shortage of information about the community. (See Appendix 1)

This ruling however, does not diminish either the significant environmental/conservation value or ecosystem function values of this aquifer on a local, regional or national level. This small ecologically isolated aquifer provides habitat for a groundwater biodiversity hotspot in a region that is already impacted by clearing, over extraction, river regulation, and is at risk of complete alteration and loss due to potential of excessive drawdown of the aquifer and surface water/ groundwater contamination. It represents the only major water supply for the riverine, terrestrial and subterranean groundwater ecosystems and contains a unique community that consists of highly endemic species, the most North West range limits of highly specialized genera and families of aquatic/subterranean invertebrates and threatened terrestrial ecological community. The aquifer also supports the most comprehensive range of Groundwater dependent ecosystem types within the Namoi Region.

1. What are Groundwater Dependent Ecosystems?

Groundwater Dependent Ecosystems are those ecosystems that have "*their species composition and natural ecological processes wholly or partially determined by groundwater*". WMA (2000) amendment (Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources, 2008, Order Schedule 1, Dictionary, Department of Water and Energy 2008), The GDE Atlas 2012, Risk Assessment Guidelines for Groundwater Dependent Ecosystems 2012.

The Maules Creek Aquifer is one of the only alluvial aquifers that have been thus far surveyed, to support a complete range of GDE types excluding only karst and marine estuarine ecosystems. It is the only aquifer west of Tamworth in the Namoi River Valley to support perennial pools and the associated surface water ecosystem, a shallow, sand/cobble river bed with a deep Hyporheic zone which is directly connected to the alluvial aquifer. Groundwater fauna have been collected at less than 10cm depth in the river bed.

These GDE types include;

i. **Subsurface Ecosystems – Underground Ecosystems**
   - Subsurface Phreatic Aquifer Ecosystems. (Stygofauna - an assemblage of subterranean aquatic invertebrates);
   - Baseflow Stream (Hyporheic or subsurface riverine water ecosystems);

ii. **Surface Ecosystems – Above ground ecosystems**
   - Groundwater Dependent Wetlands such as springs;
   - Baseflow (Groundwater fed) surface water Streams such perennial stream sections and permanent pool ecosystems);

- Phreatophytes - Groundwater Dependent Terrestrial (vegetation) Ecosystems.

2. What are Stygofauna?

Stygofauna is a broad term that encompasses a diverse, highly endemic, morphologically specialized assemblage of subterranean aquatic invertebrates. This groundwater ecosystem type has been used extensively in Western Australia for over a decade to regulate and monitor the impact of mining and developments, due to the ecological features it possesses. These unique features include:

- *A high proportion of either phylogenetic or distributional relicts as well as short range endemic species.*

-*They are extremely sensitive to the environmental characteristics of the water they inhabit and, thus, potentially are useful indicators of groundwater health.*

- *Some are rare or unique.*

- *The ecosystems surviving in aquifers, caves and springs are amongst the oldest surviving on earth.*

- *They have water quality benefits, biodiversity value and add to the ecological diversity in a region.*

The Maules Creek stygofauna community has one of the highest subterranean biodiversity thus far encountered in NSW and a number of unique species and groups that have only been found sporadically across eastern Australia. Some of the fauna that highlight the significance of this community include the extreme NW range of crustaceans including Syncarida, Amphipoda, 3 species (at least) and two families of aquatic, blind water beetles, Oligochaetes (aquatic worms).

Below are a series of species types that have been collected from the Maules Creek Alluvium.

Photo 1. Synarida, Psammaspididae, *Psammaspides* n. sp. (©P.Serov 2011)

Photo 2. Amphipoda, Neoniphargidae n. sp. (©P.Serov 2011)

Photo 3. Isopoda, Janiridae, *Heterias* n. sp. (©P.Serov 2011)

3. What do Stygofauna do for water quality?

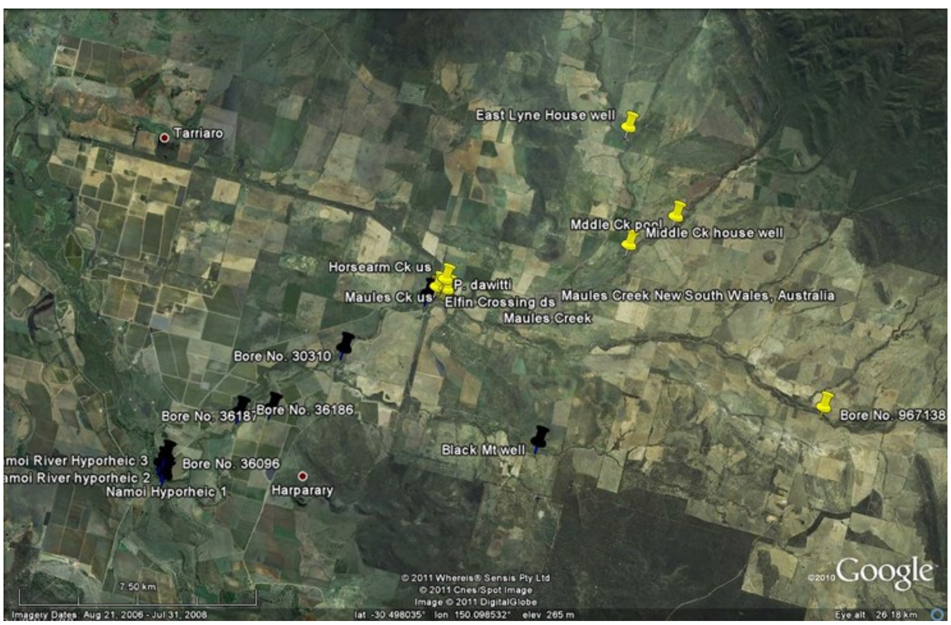
Humphries (2006) reports that “groundwater fauna contribute substantially to the biodiversity of Australia. In addition**, they may be functionally important in aquifers and, especially, in hyporheic zones**, that zone of interaction between river water and the groundwater present in the banks and beds of rivers (Boulton 2000; Hancock 2002)”. The significance of the groundwater/surface water interconnectivity was presented at the Australia Society of Limnology at the 2009 Annual Conference.

Furthermore, Stygofauna can be used as biological tracers of groundwater discharges and recharge and this has major implications for the management of both surface ecosystems and groundwater ecosystems.

4. Where are Stygofauna found at Maules Creek?

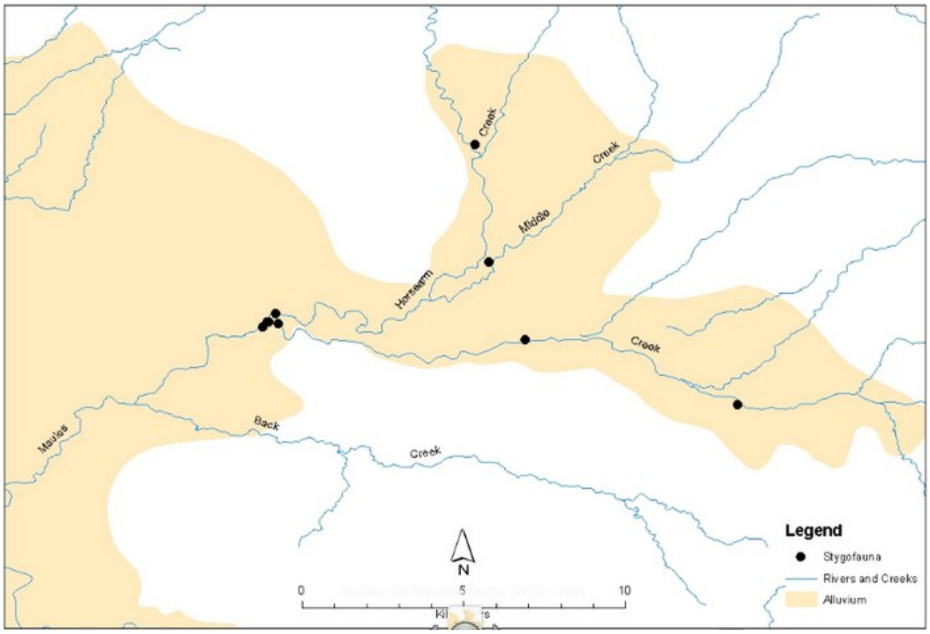
Stygofauna surveys within and around the Maules Creek Catchment (also known as Zone 11 in the Namoi Catchment Water Sharing Plan) as well as the Namoi River from Tamworth to the west of Wee Waa, have identified that the Maules Creek alluvial aquifer contains an isolated, diverse and highly endemic stygofauna community.

This site map taken from the original nomination shows where stygofauna have been located in the area. Yellow pins are positive stygofauna sites and black pins are negative - no stygofauna.



(©P.Serov 2011)

The successful sampling locations are located on the below map of the Maules Creek Alluvial Aquifer.



(©P.Serov 2012)

It is clear from this map the isolated nature of this community. Although a similar fauna is known from the Cockburn River and the upper Peel River east of Tamworth, the communities contain different species assemblages and no overlapping species. Therefore the communities are completely separate.

5. Threats to Stygofauna

"Groundwater fauna, especially stygofauna are extremely sensitive to the environmental characteristics of the water they inhabit and thus potentially are useful indicators of groundwater health (Tomlinson & Boulton, 2008, Serov *et al,* 2009)." These environmental characteristics include;

i. Water Chemistry Balance

These invertebrate communities are adapted (e.g. no eyes or skin pigment) entirely to these very specialised environments such as that within the alluvial aquifer. They are highly susceptible to changes in water chemistry. (Serov P, 2011)

iii. Water Table Levels

Drawdowns of groundwater in excess of 1 meter threaten the viability of Stygofauna due to sensitivity to dissolved oxygen levels (Serov P 2011). As the aquifer also supports perennial pools and a highly connected Hyporheic community as well as terrestrial vegetation communities that are entirely dependent on the natural range of water level fluctuations. All estimated water level drawdown will have a detrimental impoact on these communities. Scenario 2 of the Namoi Water Study (drawdown map shown below) and the latest mine groundwater study from the Tarrawonga mine (Merrick & Alkhatib 2012) confirms that the drawdown will be in excess of 1 meter and will average 5 meters in the area. This is well below the stream, pools and Hyporheic level, which would therefore indicate and automatic loss of these communities.

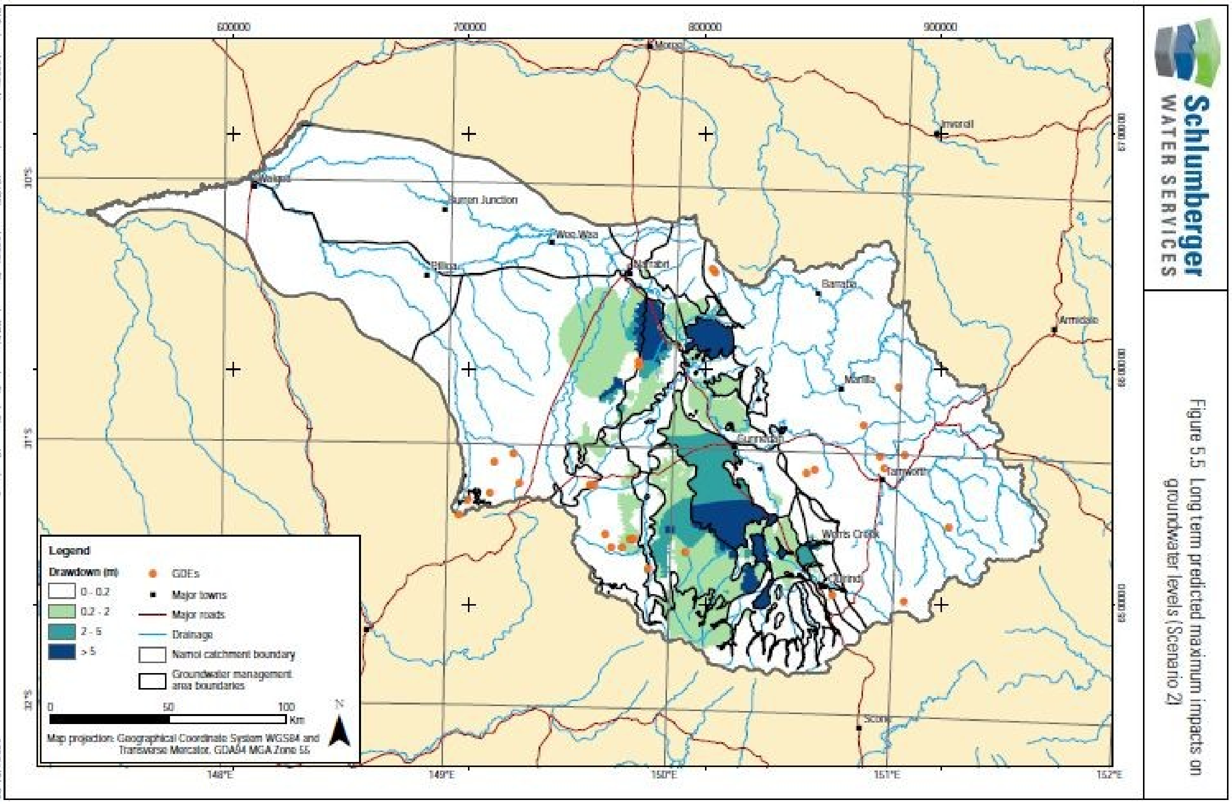


Figure 5.5 Long term predicted maximum impacts on groundwater levels (Scenario 2)

iv. Insufficient State Legislative Protection

Although the NSW government has a GDE Policy and a process for delineating and ranking High Priority GDE's they have not and will not appropriately considered subterranean ecosystems and stygofauna and do not have a current system for public listing of any GDEs for high ecological value listing of GDE's even though an assessment process has recently been completed, endorsed and published by the National Water Commission. This assessment process includes a background brief and methodology for assigning ecological value and current and potential risk from development all GDEs, including stygofauna See Serov 2012 at http://www.water.nsw.gov.au/Water-management/Water-availability/Risk-assessment/Groundwater-dependent-ecosystems/Risk-assessment-guidelines-for-groundwater-dependent-ecosystems). It is imperative that an open and transparent process be urgently developed to allow the general public to add highly sensitive and ecologically valuable groundwater ecosystems to the high priority listing and that protection measures are increased to cover more than simply water levels. A holistic landscape approach is needed to protect the complete range of Groundwater dependent Ecosystems. This is currently lacking.

6. Conclusion

It is the view of the MCCC that the GDE of the Maules Creek Alluvial Aquifer are under imminent threat as there are;

1. A fine balance between existing groundwater extraction and recharge
2. Approvals of massive new coal mines and coal mine expansions in the area that are yet to commence groundwater extraction.
3. Modeled cumulative impacts in the shallow alluvial aquifer of a 5m drawdown adjacent to Maules Creek and 1m drawdown further up the valley due to that mining
4. Existing and new coal and CSG exploration leases that overlay the entire alluvial aquifer
5. Further identification of potential coal mines in the Maules Creek Alluvial Aquifer contained in the Strategic Regional Land Use Policy (SRLUP) and the Namoi Catchment Water Study.
6. Insufficient quantity and quality of the underlying science in relation to the planning conditions imposed by the Planning NSW regarding GDE of the Maules Creek alluvial Aquifer. For example, ***GDE's were not mentioned at all in the Maules Creek Coal PAC Report. (PAC 2012)***

These facts confirm that there is an imminent threat to the GDE of the Maules Creek Alluvial Aquifer.

7. Recommendations

1. Emergency consideration of the listing due to immediate threats from open-cut coal mining
2. Special consideration and application of the precautionary principle given that the listing has been held back to date only by lack of knowledge
3. That the IESC is required to fully and thoroughly assess the impacts of proposed mines on the endemic Stygofauna of Maules Ck.

8. References

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See also Original 2011 Nomination for listing of the Ecological Community.