Submission for the Maules Creek Coal Mine Continuation Project - August 2025

Maules Creek Stock and Domestic Water Pipeline Association Inc (MCSDWPA)

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1.8.2025

About the MCSDWPA:

The MCSDWPA was formed with the express goal of developing an alternative water supply for the residents of Maules Creek after serious impacts to groundwater in the 2017-20 drought left people without water.

The Association has provided information to the Whitehaven coal, the Department of Planning, the Narrabri Shire Council and the Leard Forrest Environmental Trust in hope of support to provide a secure water supply.

Cover Photos: The Baan Baa town pipeline infrastructure constructed and operated by the Narrabri Shire Council. The pipeline has enabled renewed interest in new housing in Baan Baa with a increase in property values and rate revenue.

Introduction

The Maules Creek Stock and Domestic Water Pipeline Association Inc. (MCSDWPA) was formed in response to the ongoing environmental, hydrological and social impacts of the Maules Creek Coal Mine and its proposed expansion to operate through to 2045. The Association represents local landholders and residents who have been adversely affected by groundwater depletion, unreliable domestic water supply, and declining community resilience.

Our Concerns

The Association has documented significant groundwater impacts over the past decade, including widespread bore failures during the 2018–2020 drought, and ongoing aquifer depressurisation linked to coal seam dewatering. Monitoring records, field observations, and third party reviews indicate a likely hydraulic connection between the alluvial aquifer and underlying mining zones. There is concern that continued pit expansion will accelerate the loss of groundwater available for rural, stock and domestic use.

Further, the large scale acquisition of farmland and the lack of long term planning for water security have contributed to rural depopulation, social fragmentation, and declining economic activity in the Maules Creek district. Many residents now face uncertain access to clean water, placing pressure on farming operations, fire response preparedness, and community health.

Our Objectives

The MCSDWPA advocates for the establishment of a dedicated stock and domestic water pipeline to support the Maules Creek district. This infrastructure would provide a secure, climate resilient water supply that offsets mine related depressurisation, enables long term community adaptation, and restores confidence in land use and emergency preparedness.

Our objectives are to facilitate the development of a long term sustainable water supply to benefit the Maules Creek environment and community. The Association does this in order to:

- Offset groundwater loss caused by mining induced drawdown;
- Improve drought preparedness and reduce reliance on bores at risk of failure;
- Support re-population and future agricultural activity on land formerly acquired as offsets;
- Strengthen local resilience to climate change and bushfire emergencies;
- Establish a legacy infrastructure project aligned with the transition to a post coal regional economy.
- Rebuild the housing stock that no longer suitable for human habitation

This submission outlines the scientific, planning, legal and community justification for the Maules Creek Water Pipeline proposal and provides supporting evidence that this project represents a significant and necessary public benefit for the Maules Creek region.

2018 – 2020 Drought

In 2017 groundwater began to draw down before the 2018 drought began. The diagram below demonstrates the head pressure and subsequent groundwater flow from the Maules Creek Alluvium to the deeper coal seams.

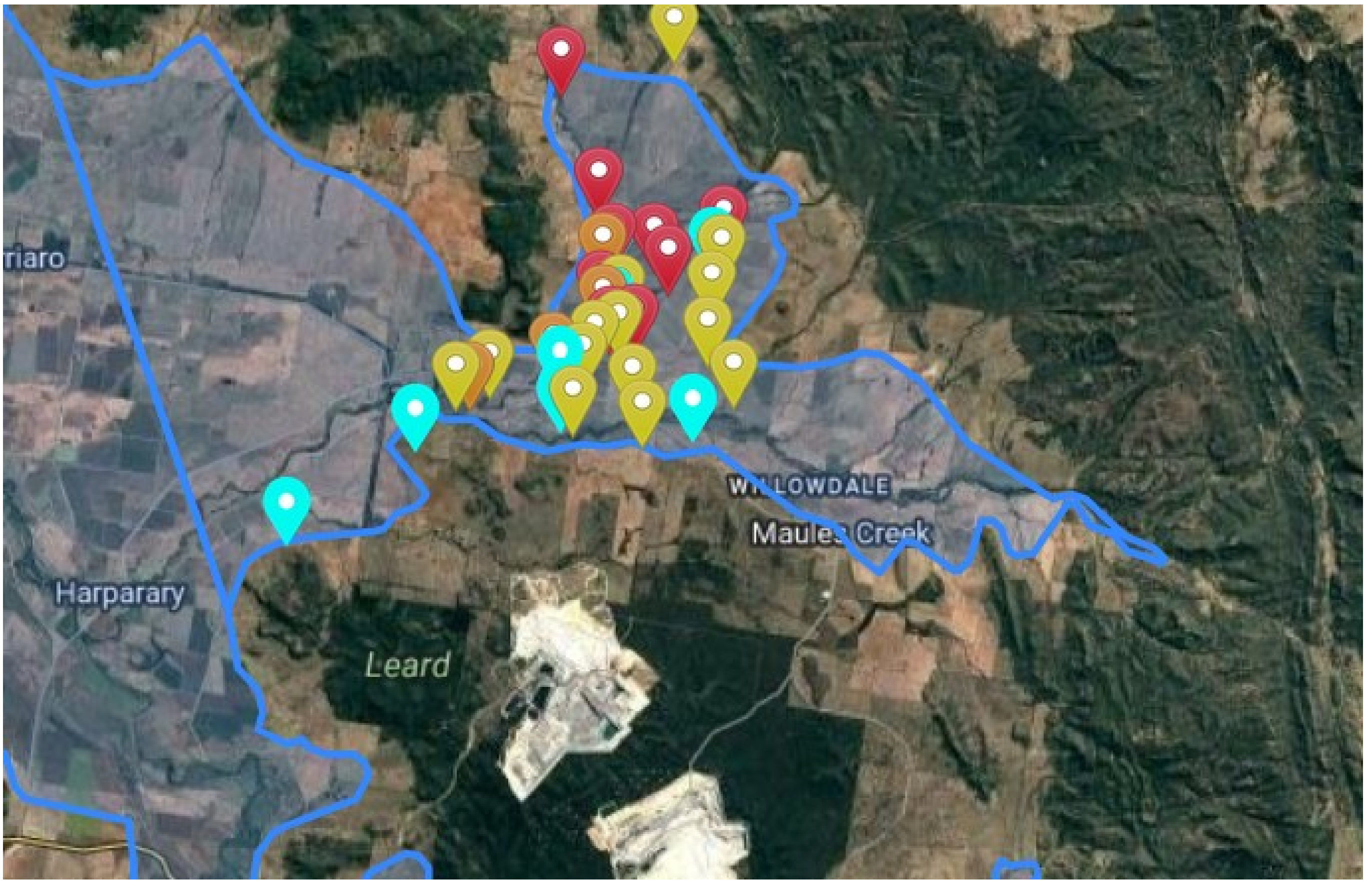
Pressure Head Differentials in the Maules Creek Alluvium

This figure shows a persistent downward hydraulic gradient between the shallow alluvial bore and deep coal seam bore. It strongly supports the concern that groundwater is draining from the alluvium into deeper formations, making the alluvium vulnerable depressurisation caused by mining.

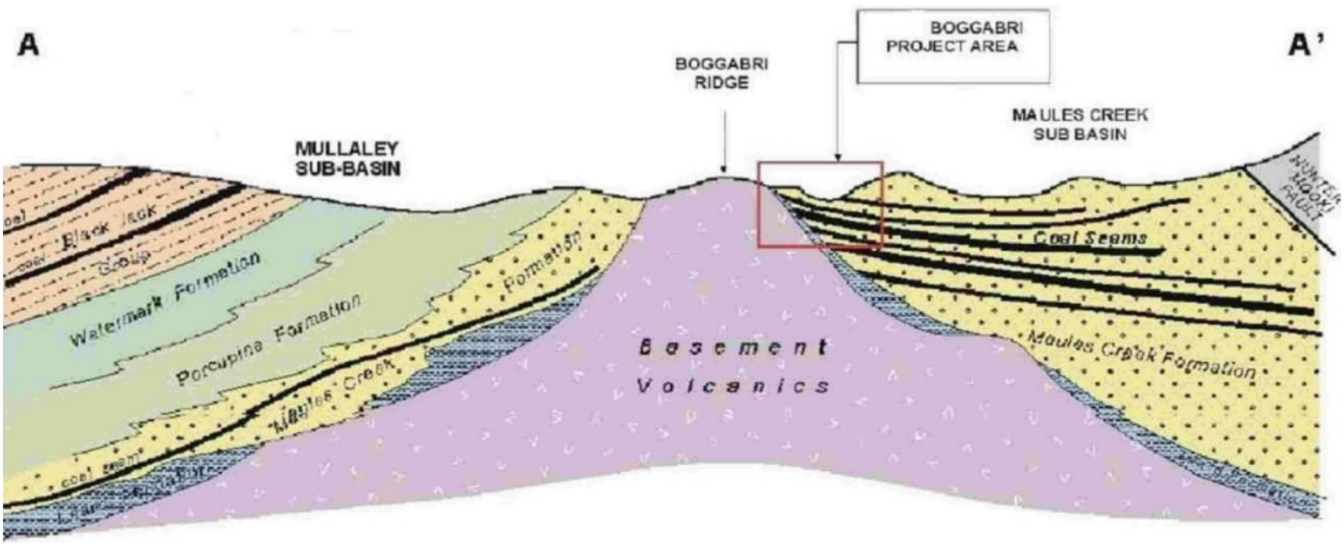
The decline was clearly visible at the surface water – groundwater lens at Elfin Crossing where permanent water completely disappeared within 12 months.

Groundwater Bore Failure Map (2018 - 2020)

In addition to the loss of permanent water at Elfin Crossing, 30+ farm bores that rely on the Maules Creek Alluvium failed.



This map above of bore failures highlights the severity and tight geographic spread of groundwater decline experienced by Maules Creek landholders.



This groundwater conceptual model that includes the Boggabri Volcanics, Maules Creek Alluvium and Leard Formation shows how groundwater must rise up and cross the volcanics to leave Zone 11 and cross into Zone 5. It also shows coal seams “sub-cropping” the Maules Creek Alluvium with the implication that a pathway exists for depressurisation to propagate along the coal seams into the alluvium.

This cross-section illustrates the dependency of surface flows at Elfin Crossing on upstream groundwater pressure , a system vulnerable to mining induced leakage. Boggabri Coal GIA (2012)

Climate Adaptation

The Maules Creek district is increasingly vulnerable to the impacts of climate change, including more frequent and prolonged droughts, reduced aquifer recharge due to altered rainfall patterns, and greater variability in surface water availability. The 2018–2020 drought demonstrated how even short term climatic stress can result in widespread groundwater failure and critical water shortages for landholders. These vulnerabilities are compounded by groundwater drawdown associated with mining activity, placing additional pressure on already stressed water systems.

The proposed community water pipeline represents a strategic, climate resilient adaptation measure. It is designed to provide a secure, off aquifer water source for stock and domestic use, reducing reliance on the shallow alluvial aquifer which has proven highly sensitive to both climate variability and anthropogenic depressurisation. By connecting affected landholders to a stable water supply, the pipeline directly reduces exposure to future drought events and aquifer uncertainty.

Beyond drought mitigation, the pipeline enhances the region’s long term adaptive capacity by enabling:

- Continuity of agricultural operations during dry periods;
- Greater bushfire preparedness through reliable water access;
- Re-population and economic recovery of mine acquired or offset land;
- Community confidence in water reliability as a foundation for planning and investment;
- Local government capacity to manage water infrastructure in alignment with post coal transition planning.

The pipeline aligns with NSW Government climate adaptation strategies that call for investment in resilient infrastructure, community led responses, and proactive planning for regional water security. It also meets the objectives of the Water Management Act 2000 and the EP&A Act 1979 by promoting long term water sustainability, ecological integrity, and public benefit.

Community Benefits

State Significant Development (SSD) projects under the Environmental Planning and Assessment Act 1979 carry an explicit obligation to deliver enduring public benefits. Clause 8A of the State Environmental Planning Policy (Planning Systems) 2021 emphasises that SSD projects must demonstrate how adverse impacts will be mitigated and how benefits to affected communities will be realised over time. Given the scale and duration of the Maules Creek Coal Mine Continuation Project (MCCM), these expectations are heightened.

The Third Party Review of the Social Impact Assessment (SIA) found that the MCCM Continuation Project fails to satisfy these obligations. Specific gaps include:

- No post mining transition or re-population framework;
- No legacy infrastructure proposals or community transition strategy;
- Lack of climate adaptation or water resilience measures in mitigation plans;
- Absence of measurable performance benchmarks within the SIMP.

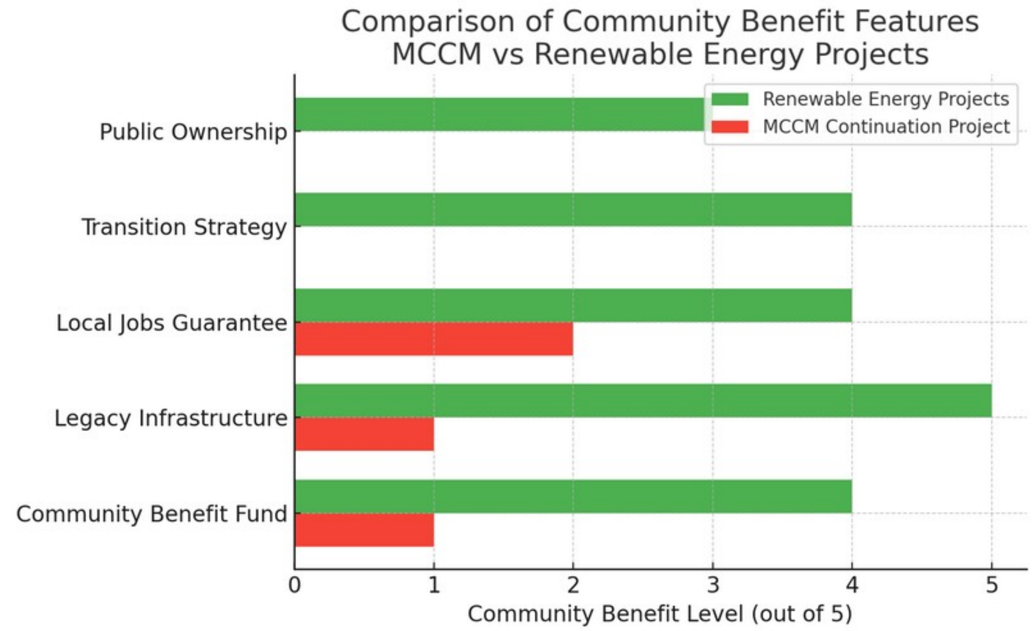
(Appendix 1 - Third Party Review Report, pp. 6–8)

Public attitudes are shifting in relation to large scale resource and infrastructure projects. Increasingly, communities expect that projects with significant environmental footprints, deliver tangible, measurable benefits to the regions in which they operate. This expectation is already being reflected in the renewable energy sector, where community benefit sharing, local ownership models, and regional reinvestment funds are becoming standard practice. The MCCM Continuation Project must now meet this evolving standard if it is to retain social legitimacy and its social licence to operate through to 2045. Since the MCCM commenced mining at Maules Creek, the mine has produced saleable coal in excess of $14 billion dollars. More than $10 billion since the groundwater was impacted in 2018. Clearly there is scope to provide long term community benefit for the impacted community of Maules Creek.

The proposed Maules Creek Stock and Domestic Water Pipeline is a clear and measurable community benefit aligned with SSD obligations and contemporary public expectations. It directly addresses the lack of long term legacy planning in the proponent's current proposal. The pipeline would:

- Provide reliable, drought resilient water access for affected landholders;
- Offset long term groundwater loss due to mining depressurisation;
- Enable re population and reuse of mine acquired land;
- Restore confidence in local agricultural and emergency water security;
- Serve as a long term legacy investment, transferred to public ownership via the Narrabri Shire Council.

As the mine seeks approval for a 20 year continuation, it is both reasonable and necessary to condition the project's approval on the delivery of a tangible community legacy. The pipeline provides a fit for purpose, scalable infrastructure investment that supports the transition to a post coal future while delivering immediate resilience benefits to the Maules Creek district.



Comparison of Community Benefit Features: MCCM Continuation Project vs Renewable Energy Projects. This comparison highlights increasing public and policy expectations that major infrastructure and resource projects deliver measurable, regionally anchored benefits. While renewable energy projects typically include benefit sharing schemes, legacy infrastructure, and local reinvestment programs, the Maules Creek Continuation Project lacks equivalent mechanisms in its Social Impact Management Plan (SIMP) (Third Party SIA Review, pp. 6–8).[1] [2]

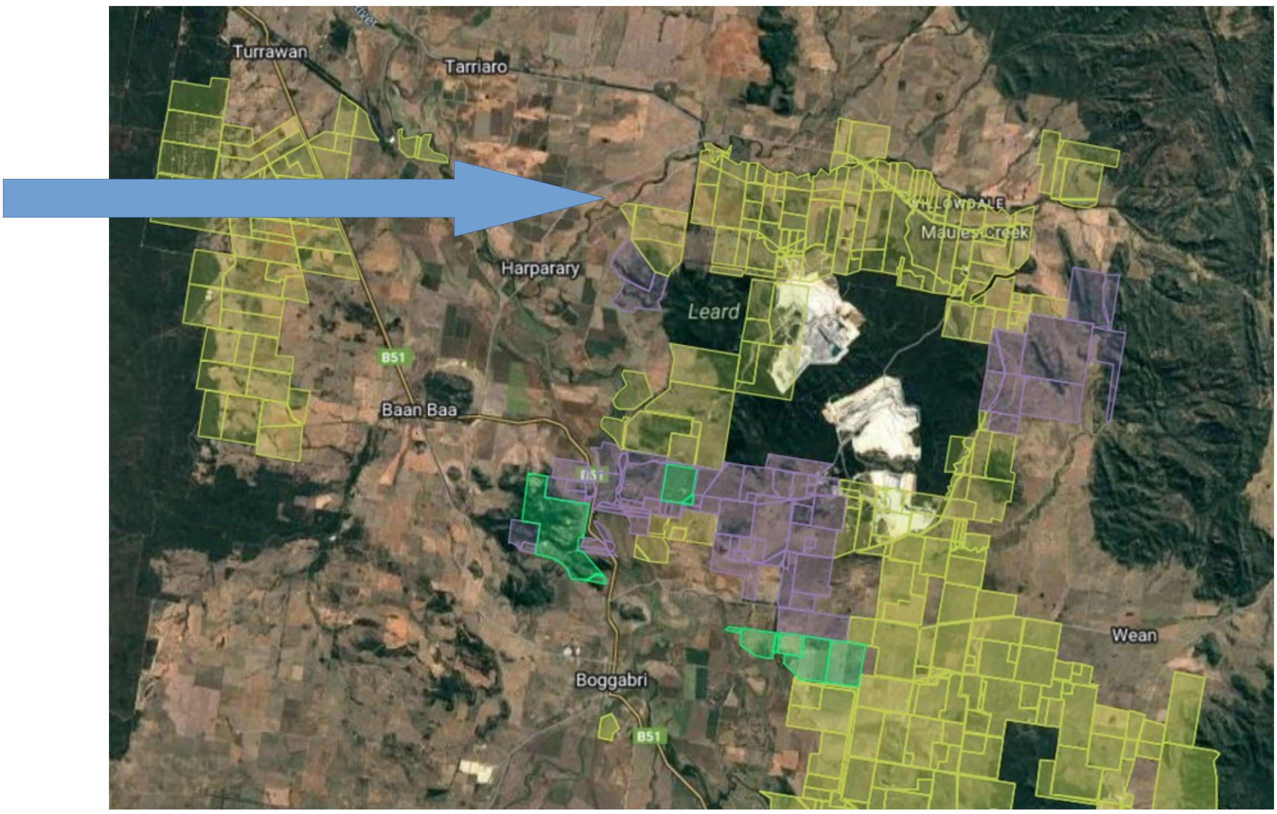
1 *Community Benefits Handbook – NSW REZ Projects*, EnergyCo, 2022
2 *Community Engagement Best Practice Guideline for REZs*, DPIE (now DCCEEW), 2021

Post Coal Mining Re-population and Community Planning

As the Maules Creek Coal Mine approaches its proposed closure horizon in 2045, the region must begin preparing for a post mining future. The successful transition of mining affected areas depends on restoring key services, reinvigorating land use, and creating conditions for long term economic renewal. The proposed Maules Creek Stock and Domestic Water Pipeline is a critical enabler of this transition.

Access to reliable domestic water is a prerequisite for re-populating the Maules Creek district, much of which has been depopulated due to land acquisitions for offsets or zone of affectation land purchases. The pipeline would provide an assured off aquifer water source to support residential return and future development on lands previously held by Whitehaven Coal or used as biodiversity offset areas. This would reinstate population density, increase local demand for goods and services, and support school and community service viability.

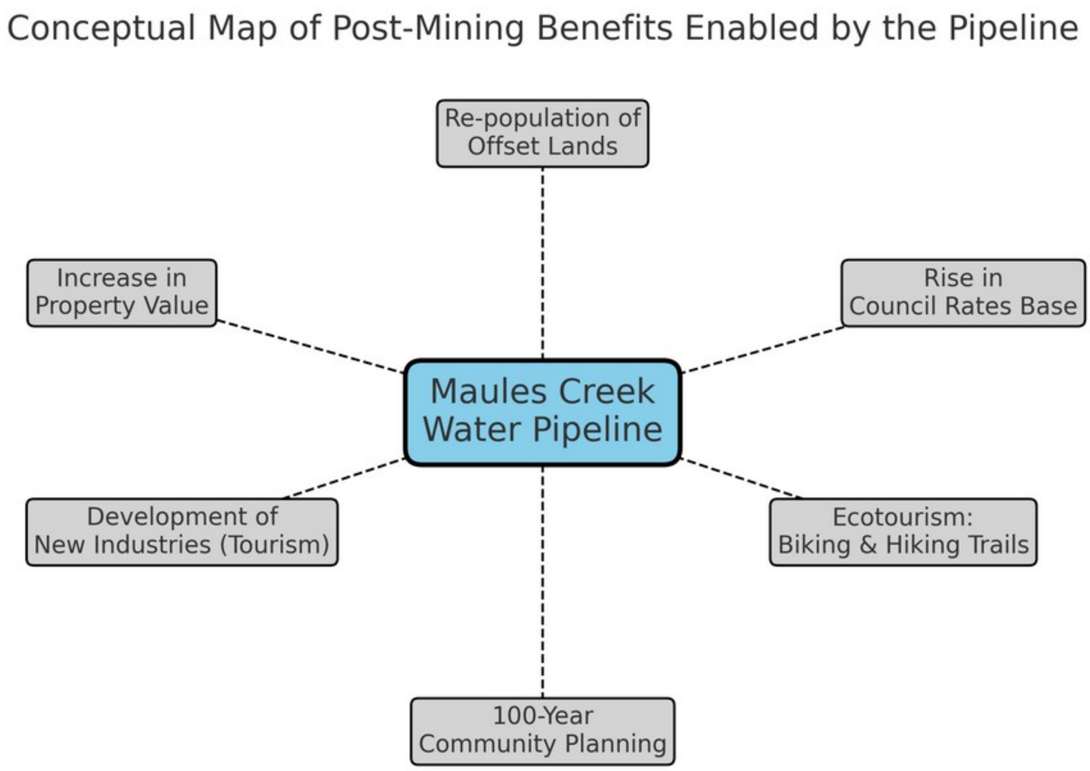
Regionally, mining companies own approximately 70,000 Ha or 19% of the land between Gunnedah and Narrabri. Lot ownership analysis shows that 28.2% of land in the Maules Creek area is owned by mining companies. Whitehaven Coal (yellow)11,734 Ha or 22%, Boggabri Coal (purple) 3,236 Ha or 6.2%. [Reference]



Mining companies own 19.2% of land between Gunnedah and Narrabri

Much of the mine owned land is at high risk of groundwater depressurisation, so that the only way water can be securely provided once land is returned to agriculture is via a pipeline.

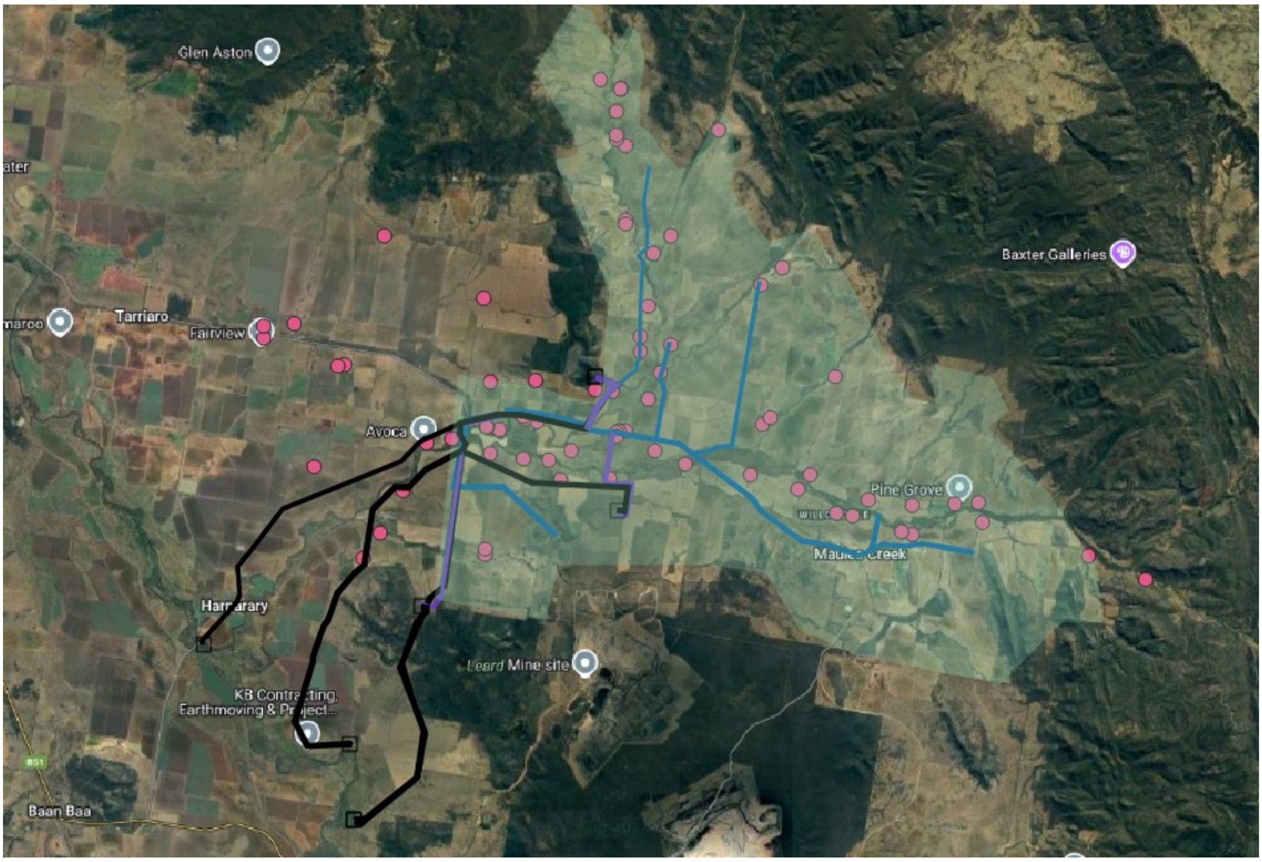
A reliable water supply would also enhance the market value of rural properties, raising the revenue base for Narrabri Shire Council through increased rates. This, in turn, could unlock future investment in local infrastructure and services. As land values improve, more people may be drawn to re-establish farming, lifestyle or business ventures in the district, reversing the trend of decline.



The pipeline would also support the development of new industries in a post coal landscape. For example, re-vegetated overburden waste dumps could be repurposed for tourism and outdoor recreation, including horse riding and mountain bike trails, hiking loops, and wildlife corridors. These activities could be integrated into regional ecotourism packages linked to the Pilliga Forest and Namoi River systems, creating employment and diversifying the local economy.

Over a 100 year horizon, the stock and domestic water pipeline would serve as important infrastructure that enables forward looking community planning. It provides the foundation needed to re-establish a functioning, resilient settlement pattern and helps avoid a legacy of stranded, unviable land. It also builds adaptive capacity against future climatic stress, including drought and bushfire risk, ensuring that community services, agriculture and recreation can co-exist sustainably beyond mining.

Example Pipeline Route Options



Example Maules Creek Stock and Domestic Water Pipeline Routes

The above map shows pipeline options. The three black lines represent main line options from potential bore sites to a elevated reservoir. The blue line represents the distribution line, with the shaded area representing the supply area.

Conclusion and Next Steps

The Maules Creek Stock and Domestic Water Pipeline proposal represents a practical, shovel ready, and forward looking response to the cumulative groundwater and social impacts of the Maules Creek Coal Mine Continuation Project. It addresses not only historical bore failures and climate vulnerability, but also enables post mining re-population, economic diversification, and long term planning for the region. With NSW Planning conditioning, the pipeline is a strategic investment in public benefit and regional resilience.

The Maules Creek community is not seeking public funding at this stage. Instead, we urge the Department of Planning and Environment (DPE) to condition the approval of the MCCM Continuation Project on the proponent’s commitment to construct and deliver this essential infrastructure with operational and maintenance budget until the post coal community becomes self-sustaining. This reflects a fair, proportionate, and fit for purpose offset given the scale and duration of the mine’s impacts through to 2045.

Recommended Condition of Consent

The following wording is proposed for inclusion in the project’s conditions of consent:

"Prior to the commencement of mining beyond 2030, the proponent must construct and commission a stock and domestic water pipeline to supply landholders within the Maules Creek district. The infrastructure must be sized and located in accordance with a delivery plan prepared in consultation with Narrabri Shire Council and affected landholders, and approved by the Planning Secretary. The pipeline must be operational by 2030, with an operational and maintenance budget until the population is self-sustaining and restored to pre-mining levels. A bond must be in place to maintain the pipeline and decommission it at the end of the assets life."

The Pipeline Association has included the following documents to support the submission.

- Social Impact Study – Dr Richard Parsons
- Hydrological Study – Daniel Barclay
- Quotation for Scoping Study – Alluvium Consultants

Next Steps

To support this condition, the proponent, the community and Narrabri Shire Council will co-design the pipeline proposal through the following steps:

- Finalisation of pipeline feasibility and alignment study;
- Preparation of a delivery framework with costings and landholder engagement strategy;
- Coordination with Narrabri Shire Council and regional water utilities;
- Submission of pipeline plan as a condition linked appendix to the project EIS or SIMP.

Bibliography

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7. NSW Department of Planning and Environment. (2021). *State Environmental Planning Policy (Planning Systems) 2021*.
8. NSW Government. (2022). *Community Benefits Handbook – NSW Renewable Energy Zones*. EnergyCo.
9. NSW Government. (2021). *Community Engagement Best Practice Guideline for REZs*. DPIE.
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11. Whitehaven Coal. (2025). *Maules Creek Continuation Project Environmental Impact Statement – Appendices*.

List of Abbreviations

Abbreviation	Meaning
BC Act	Biodiversity Conservation Act 2016
DPE	Department of Planning and Environment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979
GDE	Groundwater-Dependent Ecosystem
GIA	Groundwater Impact Assessment
MCSDWPA	Maules Creek Stock and Domestic Water Pipeline Association Inc.
MCCM	Maules Creek Coal Mine
NSW	New South Wales
REZ	Renewable Energy Zone
SEARs	Secretary’s Environmental Assessment Requirements
SIA	Social Impact Assessment
SIMP	Social Impact Management Plan
SSD	State Significant Development
WMA	Water Management Act 2000

Appendix 1 – Third Party Review of the Social Impact Assessment – Richard Parsens

Appendix 2 – Third Party Review of the Groundwater Impacts

Appendix 3 – Alluvium Proposal for a Scoping Study

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 and 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

[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.

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

1/149 Boundary Road, Bardon. QLD. 4065 P.O. Box 378, Mount Ommaney. QLD. 4074

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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.

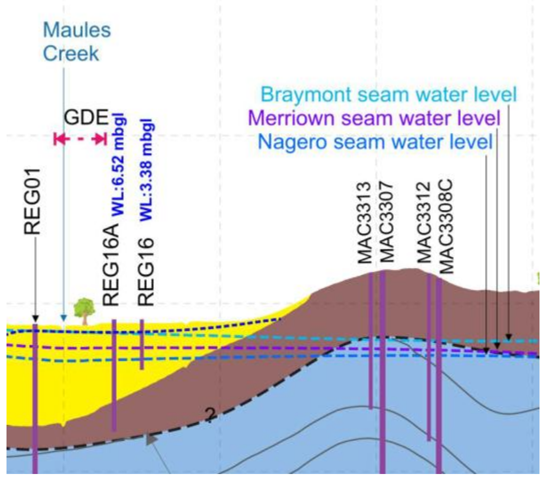

Figure 7.48 Hydrogeological conceptualisation D-D' Does not include any groundwater bores within the conceptual model. This limits the ability to validate interpreted water levels and lithological boundaries. The volcanic water level appears disconnected from the weathered zone towards the alluvium but 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>
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<tr><th>Review questions</th><th>Yes/No</th><th>Comment</th></tr>
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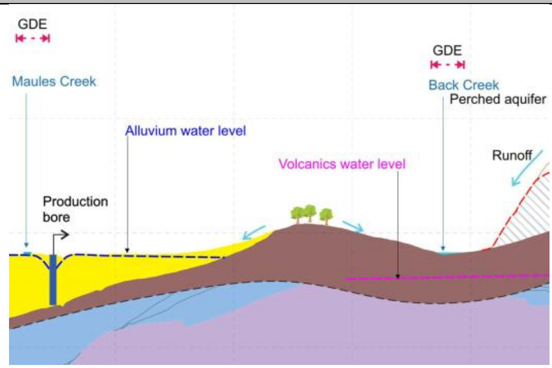
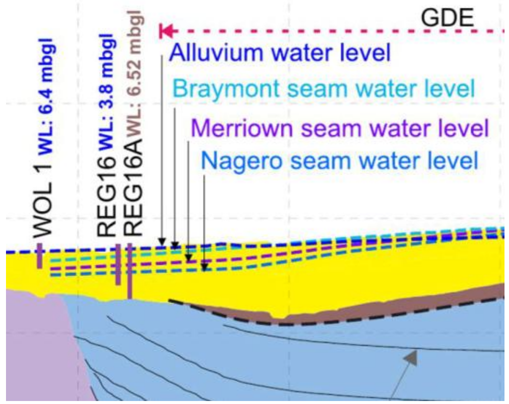


Figure 7.49 Hydrogeological conceptualisation B-B' Shows limited groundwater bores penetrating the full thickness of the alluvium. This reduces confidence in interpreted stratigraphy and connectivity. The data source for the Boggabri Volcanics is unknown and is represented as steeply dipping with subcropping 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.



</td></tr>
<tr><td>2.8.2 Is the conceptual model based on all available, relevant data?</td><td>Y</td><td>The main hydrostratigraphic units and conceptual model elements have been presented. Further data and better presentation would improve the conceptual model.</td></tr>
<tr><td>2.9 Is the conceptual model consistent with the model objectives and target model confidence level classification?</td><td>Y</td><td>The conceptual model could be further refined to be consistent with the model objectives. Confidence level classification is not considered relevant.</td></tr>
</table>

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.

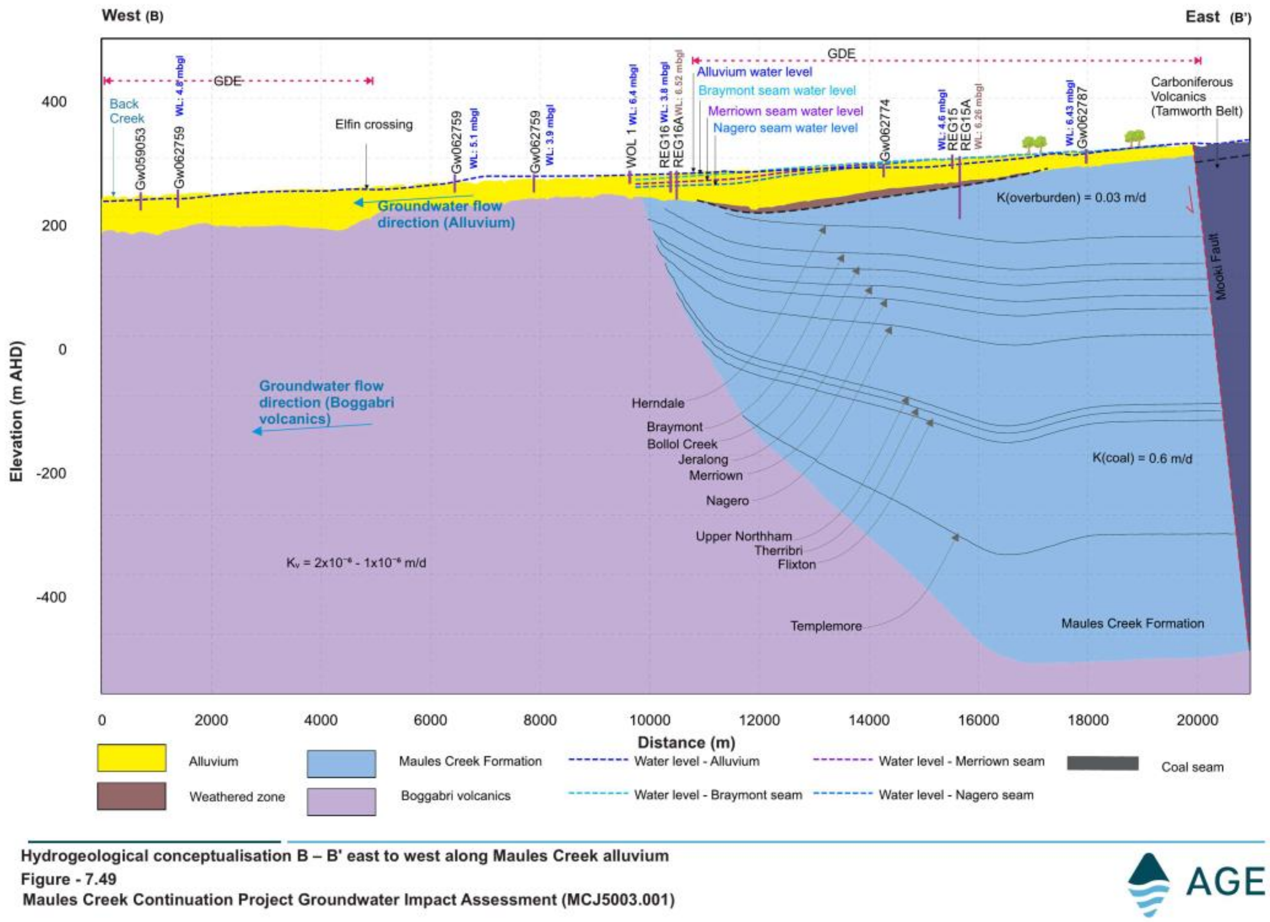


Figure 5-1 Hydrogeological conceptualisation B-B’ (AGE, 2025)

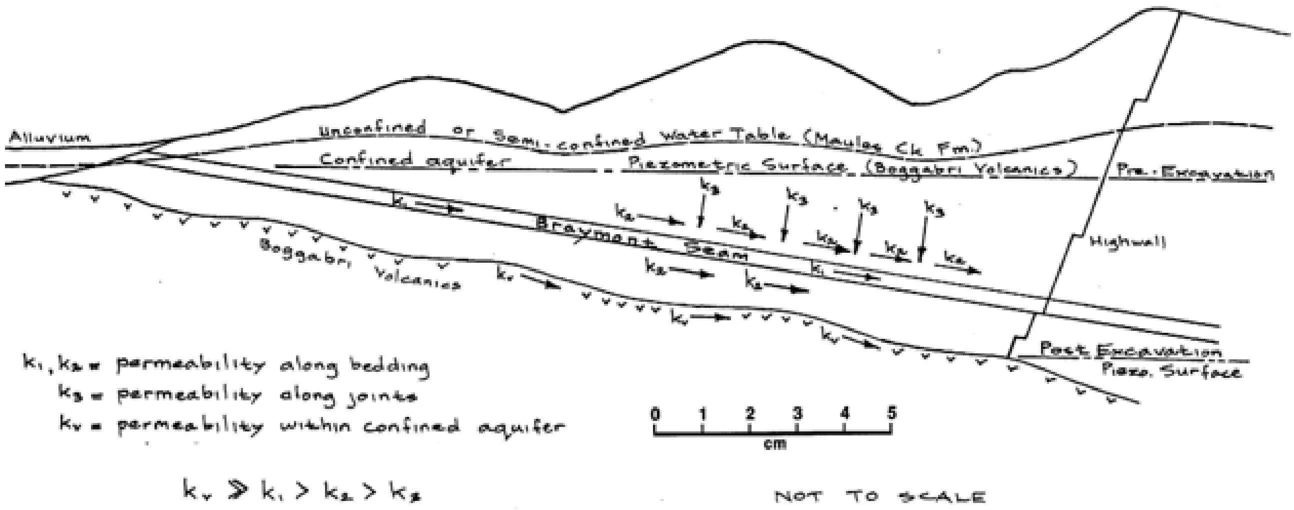


Figure 5-2 Alternative conceptual model schematic (Pacific Coal, 1982)

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.

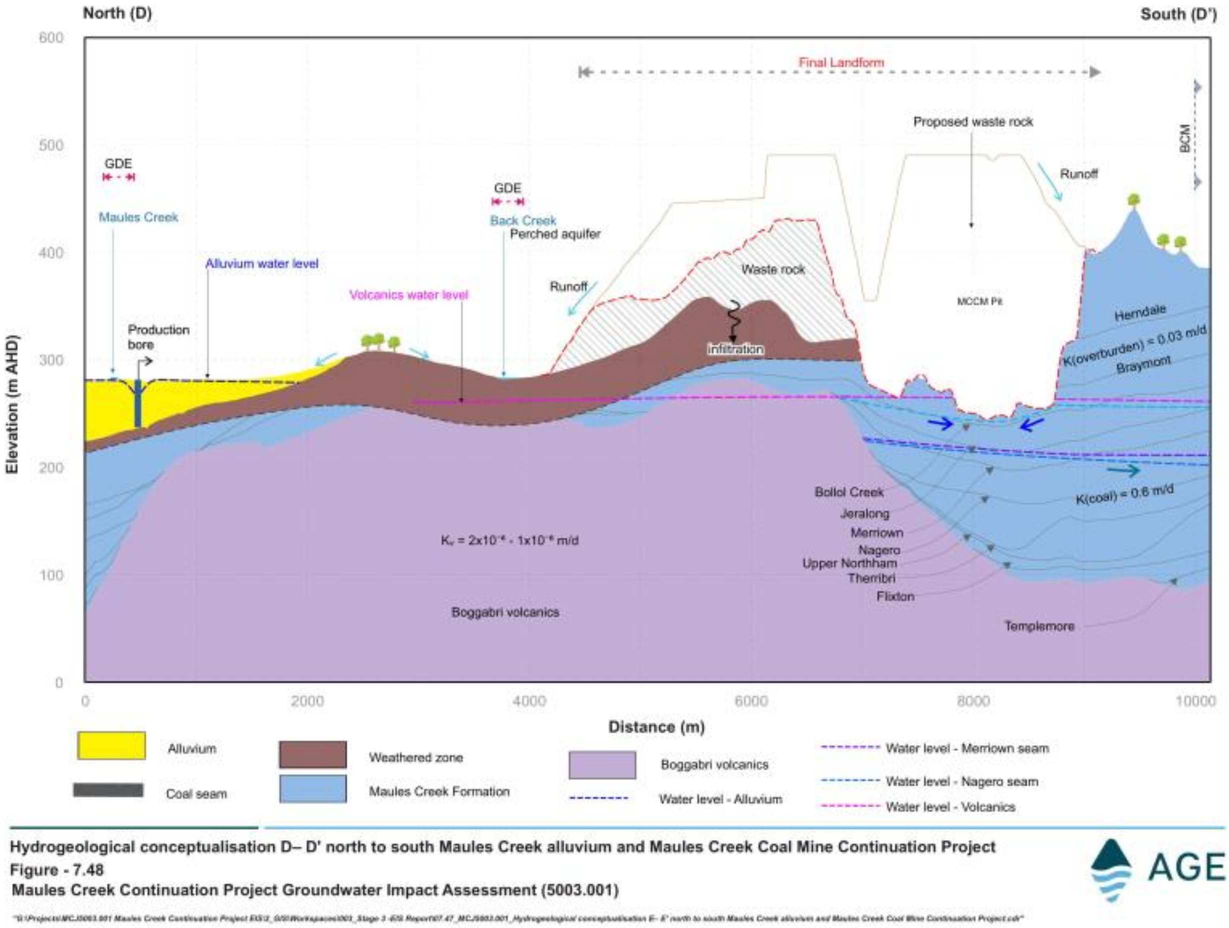


Figure 5-3 Hydrogeological conceptualisation D-D' (AGE, 2025)

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.

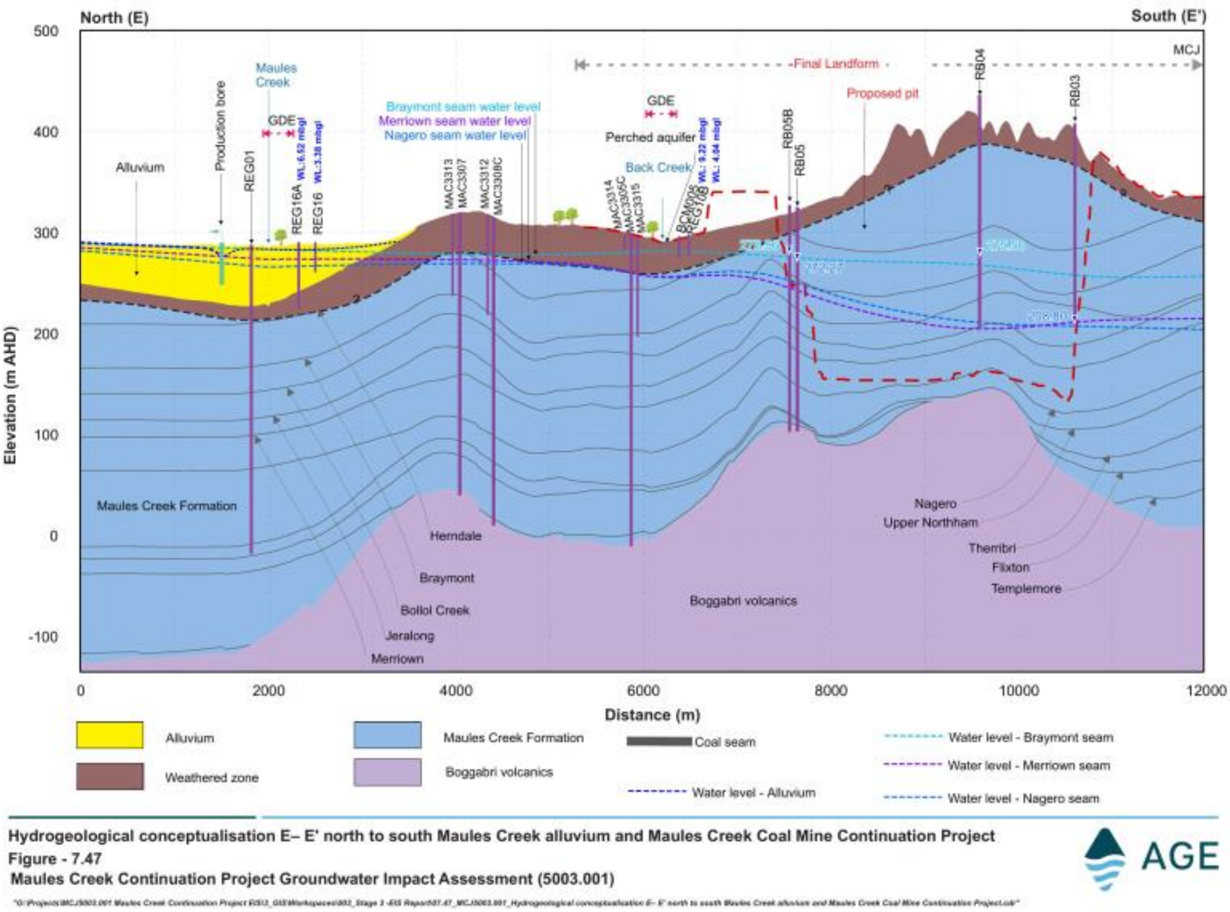


Figure 5-4 Hydrogeological conceptualisation E-E' (AGE, 2025)

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 5.7 - Elevation of Boggabri Volcanics (2021)

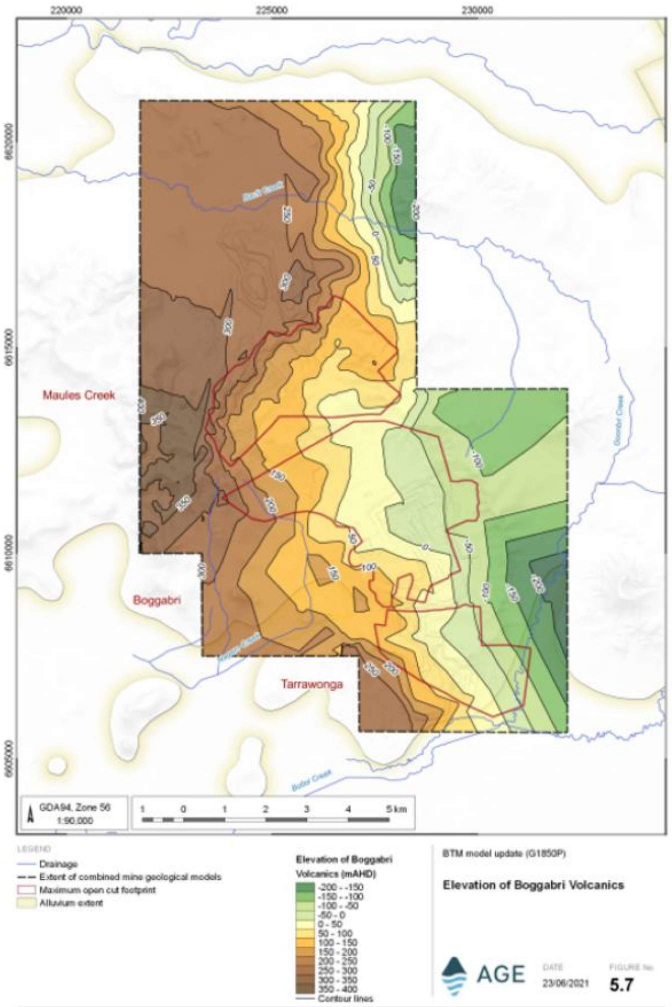


Figure 5.10 - Top of Boggabri Volcanics (2025)

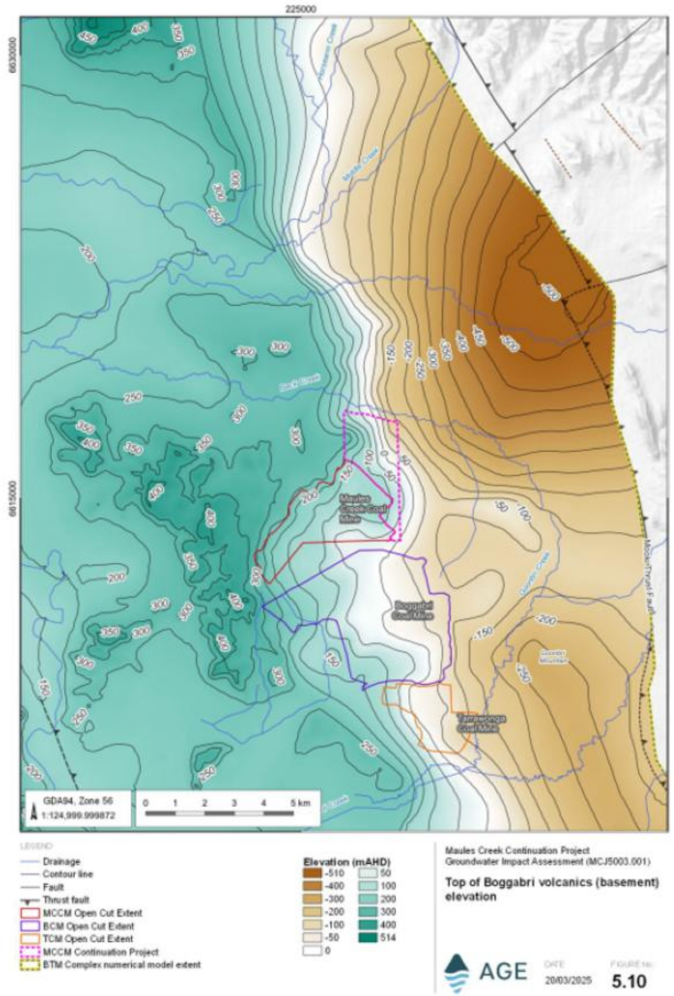


Figure 5-5 Top of Boggabri volcanics (AGE 2021 and 2025)

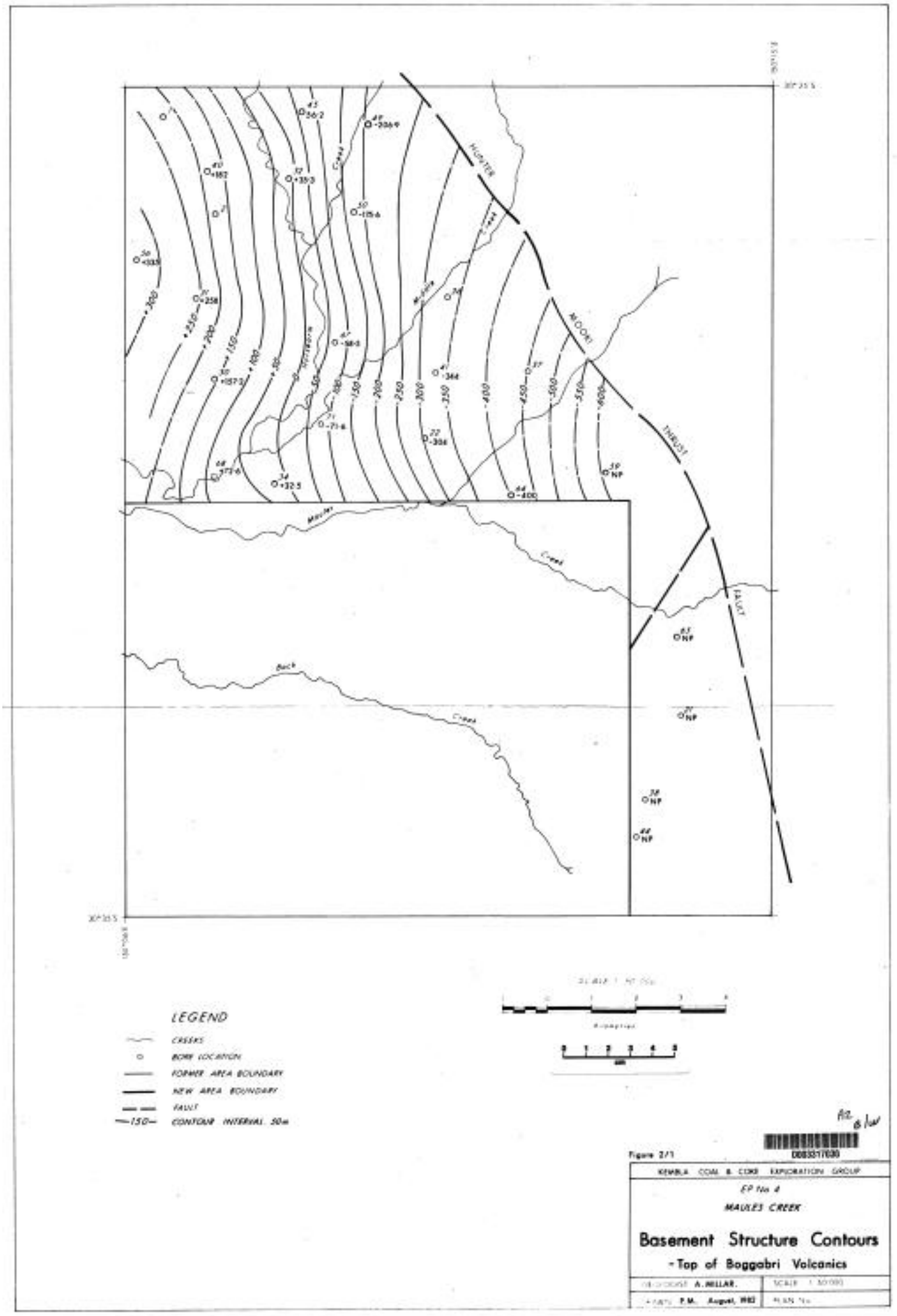


Figure 5-6 Top of Boggabri Volcanics (Pacific Coal, 1982)

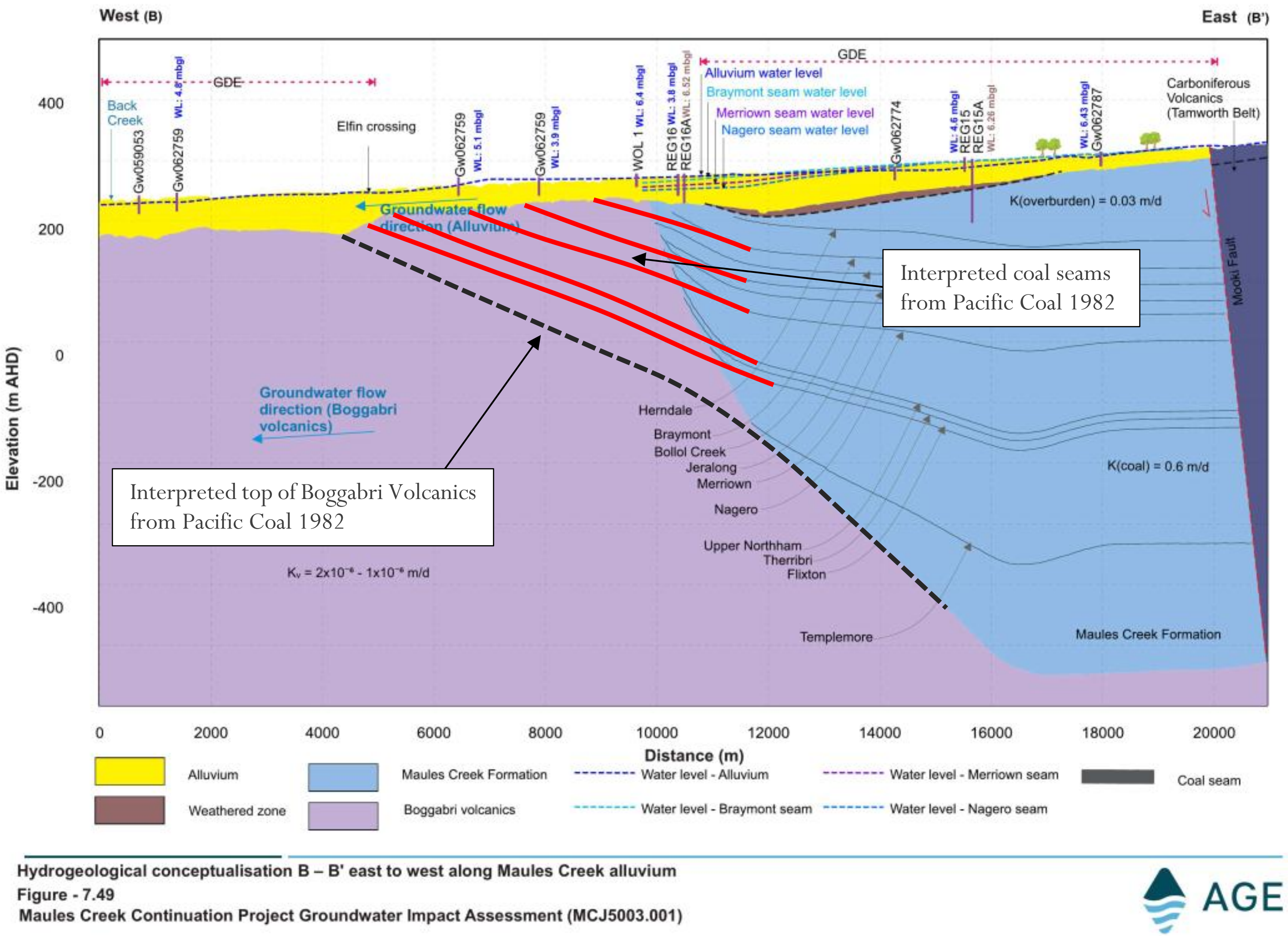


Figure 5-7 Markup of hydrogeological conceptualisation B-B' (AGE, 2025)

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.

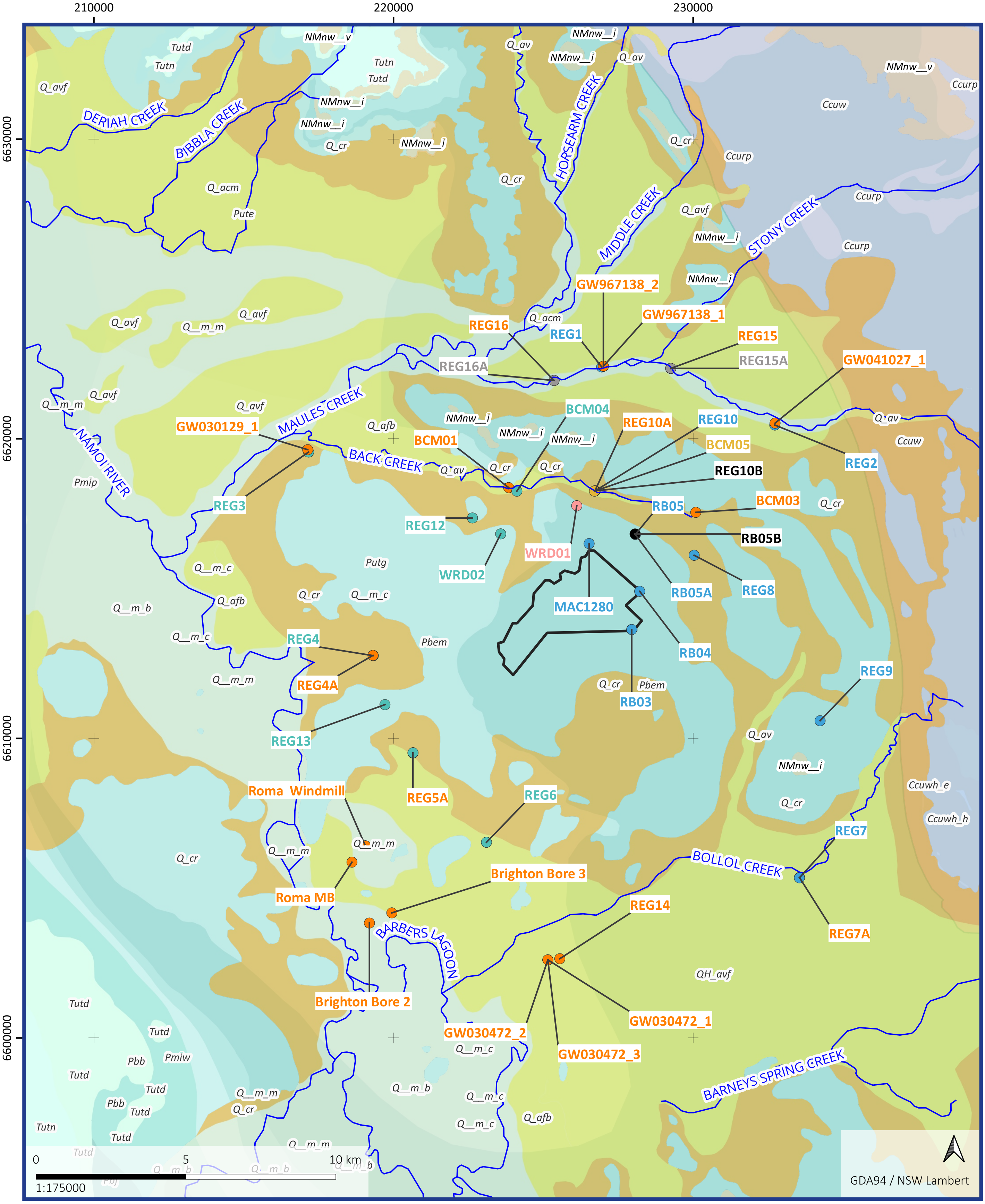
All alluvium monitoring bores should be drilled through the full thickness of the alluvium and not partially through the alluvium. This will ensure the monitoring bores define the full thickness of alluvial sediments, captures the complete saturated profile of the aquifer, avoids underestimating groundwater 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



©2025 Oasis Hydrogeology Pty Ltd - trading as hydrogeologist.com.au | Sources: 1 second SRTM Derived DEM-S - © Commonwealth of Australia (Geoscience Australia) 2011.; GEODATA TOPO 250K Series 3 - © Commonwealth of Australia (Geoscience Australia) 2006.

Z:\4000_Projects\4184_Maules CC_Continuation Project_ITPR\3_GIS\3_11_Workspaces_QGIS\Figure 6-1_Monitoring bore network.qgs | layout: Fig 6-1_Existing groundwater monitoring network

Existing groundwater monitoring network

Figure 6 - 1

4184 – Maules Creek Continuation Project - ITPR

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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

Offer of services

Subject	Offer of Services for Maules Creek Water Pipeline Scoping Report EOI
Distribution	Phil Laird (LFPET)
Date	22 June 2024
Project	Maules Creek Water Pipeline Scoping Report
Contacts	Neal Albert 0428 267 278 neal.alber@alluvium.com.au

1 Our project understanding

Maules Creek is located amidst the foothills of Mt Kaputar National Park, east of Narrabri. Accessible from Narrabri via Old Gunnedah Road, it is concealed within the rugged landscape with rich soil, ideal for agriculture, making the area home to some of the nation's premier cattle studs. Meandering water from the mountains, also present numerous picturesque spots along the riverbanks and offer inviting settings for picnics or tranquil moments immersed in nature's embrace. To the south lies Leard Forest, characterised by a blend of pine, ironbark, and gum trees. Maules Creek also known for their high-grade coal reserves.

The region is predominantly rural with agricultural production and allied industries playing a significant role in the economy — the agricultural sector accounts for around 25% (Moree) and 16% (Narrabri) of employment respectively. The region boasts productive black soils and is a major cotton producer, as well as cereals, pulses, pork, lamb and beef. The mining sector is a strong employer in Narrabri (22%). Growth sectors include transport and logistics, manufacturing, health care, tourism, renewable energy and support services for the Inland Rail project.

Of all the climate challenges Australia faces, drought is the most feared and costly. Drought impacts are often felt at a local, regional and national scale. Severe and long duration droughts not only cause mass crop failure and potential stock losses but also set the scene for dust storms, land degradation and life-threatening bushfires. Drought impacts regional communities in all aspects of life: reduced income from agriculture impacts on local economic activity, and individual and community wellbeing is also at risk if drought preparedness is lacking. Drought also impacts the natural environment and the range of services it provides (such as erosion control, amenity, pollination, and soil productivity). Building drought resilience will improve the ability to cope with and recover from these impacts, across the triple bottom-line, and contribute to the long-term viability of the region.

Local residents in the Maules Creek district have been addressing the challenges of climate change and shifting patterns in groundwater demand with mixed results. During the recent 2019 drought, there were unparalleled decreases in both surface water and groundwater levels, causing notable disruptions to livestock farming and heightening concerns for animal welfare. With proposed expansions in mining operations, the demand for groundwater is projected to rise. While residents have taken individual measures to safeguard supplies of water for livestock and domestic use, such as cleaning out existing bores or drilling deeper wells and constructing larger dams, other regions in Australia are implementing water pipelines to aid entire communities in adapting to these changes.

The proposed pipeline project presents numerous benefits for Maules Creek residents, the surrounding ecosystem, and the wider community, fostering environmental sustainability and bolstering economic prosperity. By curbing the reliance on groundwater extraction for consumption during drought periods and conserving water across the Murray Darling Basin, the project aids in environmental preservation. Additionally, by bolstering water security within the region, the initiative facilitates economic growth by supporting water-efficient industries and infrastructure, thereby enhancing productivity. Moreover, the project holds the potential to generate local employment opportunities and enhance housing and property values in the district through the assurance of reliable water supply.

An Expression of Interest (EOI) has been sought to prepare a scoping report for the proposed Maules Creek Water Pipeline Project. The Leard Forest Precinct Environment Trust (LFPET) will determine the funding of the scoping report for the purpose "enhance the natural environment, protect the natural environment, or provide a sustainable environmental solution". The grant proposal must consider the following objectives:

1. Produce a report that describes the scope of the Maules Creek Water Pipeline project according to the Terms of Reference
2. Provide direct input into the planning process for the Maules Creek coal mine continuation project
3. Enable the development of a Concept Design and Budget to be included in an Expressions of Interest
4. Help protect the Maules Creek environment and ensure that the community remains viable and productive, attracting new generations to the area

Alluvium is pleased to present this EOI to LFPET for preparing a scoping report for the proposed Maules Creek Water Pipeline Project.

2 Why Alluvium

Alluvium Consulting is part of the Alluvium Group. Together with the other specialist companies in our structure, we are focused on the best possible technical and stakeholder outcomes. We truly believe that this model drives independent and better decision making and delivers better technical outcomes and improved customer service for our clients.

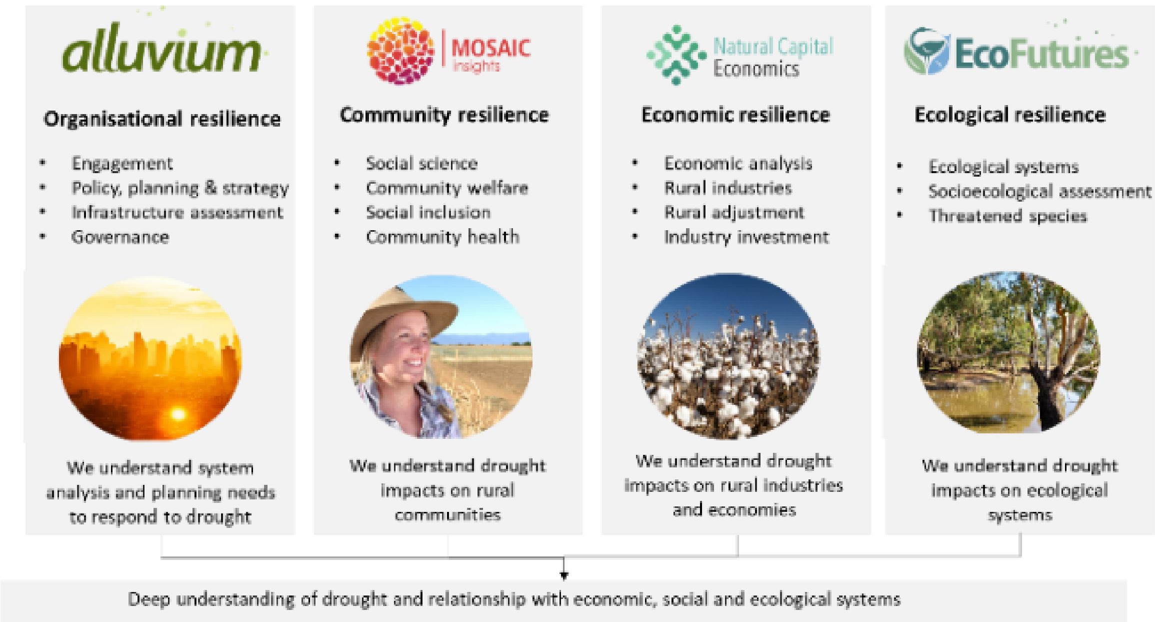

Figure 1. *Overview of the integrated service offering of the Alluvium Group*

Relevant experience
With respect to drought, Alluvium has extensive experience across Victoria, NSW, ACT and Queensland in water planning, catchment management and drought resilience planning, in addition to core skills in stakeholder engagement and developing management plans for local governments to better understand risks to infrastructure, community, health and wellbeing, environment and local economies. Alluvium is also highly skilled at developing strong relationships with Traditional Owner groups. From Mosaic Insights, a

multidisciplinary team of social scientists, geographers and governance experts, we leverage skills and experience in social systems and community impacts from drought, extending to physical and mental health outcomes. From Natural Capital Economics, we draw experience in rural economics, labour market understanding and rural structural adjustment as well as options analysis. For delivery of this project, all of these skills are packaged under Alluvium Consulting.

Strengths we bring to this project

Technical understanding

Our team of engineers provide the technical understanding and depth to understand the issues and provide a practical and cost-effective solutions to the proposed project. We are able to consider all the constraints that will evolve as part of the project and adapt the approach to suit the landholders involved.

Understanding drought resilience. We have a deep understanding of drought management and resilience, together with extensive experience in preparation of strategic plans and resilience frameworks (e.g., to respond to a changing and more variable climate) and economic development strategies that incorporate climate change risks.

Regional communities, economies & agriculture. We understand rural and regional economies including insights into regions' competitive advantages, industry prospects under climate change and socio-economic status. Our extensive experience in agriculture projects includes economic analysis prospects for pastoral, irrigated broadacre cropping, intensive horticulture and intensive livestock industries. This ranges from global market developments down to agricultural investment at the farm scale. We have extensive experience across the east coast in working with landholders to advance farm planning to maximise NRM and profit outcomes.

Engagement and co-design to inform strategy. We bring 17 years of experience working with local people to create meaningful opportunities to participate in decision making. This in turn improves the capacity of the community and other stakeholders to become involved in important planning processes. We work with local and state government, as well as non-government groups including community groups, First Nations people and NRM groups. We have extensive experience facilitating in person and online engagement and delivering collaborative, participatory and co-design approaches. Our interest in engagement is always to inform project outcomes and to gather robust evidence to contribute to the understanding of complex problems and deliberate project outcomes.

Current/recent projects

Together, we have delivered more than 4,500 separate projects over 17 years, many of which focused on biophysical, social and economic resilience of rural and urban communities. Working with rural communities is a core part of our business DNA and we do it well. Increasingly our work has a focus on natural hazards including drought and climate change.

We have worked extensively with local governments. We understand the strong community connections councils have, community reliance on the services councils provide and the challenges councils face in trying to balance competing values and prioritise in local communities.

Alluvium have assembled a team in including the consulting company **Aquatech Consulting** of Narrabri which include local people (Neal Albert and Jim Purcell), who have been undertaking resource management plans and extensive community consultation for over 30 years in the district and Narrabri Shire.

3 Scope

We have prepared a draft scope of works based on our understanding of the project needs, as presented below.

3.1 Stage 1

Task 1 Inception meeting
We will hold a project inception meeting with the client over Microsoft Teams. At the inception meeting, we would discuss:

- Key project expectations
- Communication arrangements
- Project objectives
- Delivery timeframes
- Community consultation planning and dates
- Data transfer
- Invoicing.

Task 2 Community consultation

We have allowed for a series of engagement meetings with key community interest groups. The purpose of these sessions is to understand the needs of the community and to determine their appetite for a joint water supply scheme, and to collect important background project information. We have allowed for 1 day of meetings and included online follow up meetings with the following parties:

- Local farmers and water users
- Narrabri Shire Council
- Industry representatives (Whitehaven Coal Mine)
- Leard Forest Precinct Environmental Trust (the Trust)
- Local Aboriginal Land Councils

Meeting arrangements will be confirmed at inception. We will keep meeting notes and outcomes and summarise the findings in final project reporting and the funding proposal for the Trust. The meetings will be attended by Neal Albert and Jim Purcell.

Task 3. Methods development and documentation
We recognise the importance of developing a robust method to determine eligible and/or willing participants to the proposed joint water authority arrangement. We would work with the project team to develop the criteria and methods for determining eligibility for access to water in the Upper Namoi Zone 11 Groundwater Source, as a result of the mining activities (The footprint). The methods development process will be informed by the information collected during the community consultation (task 1).

Once we have identified the most appropriate method for determining eligibility in task 3, we would document the methods, including any conceptual models and diagrams to assist in the data analysis exercise.

Task 4. Data analysis and reporting
Establish pipeline water demand and availability/source

To better understand the groundwater needs in the district, we would analyse available information to establish both current and future water demand for the proposed pipeline. For this task we would use a combination of land holder requirements, statistical and qualitative information to assess water issues and rank the differing 'needs' of the district. This would be supported by information gathered during the engagements, involving in-depth exploration of issues using inclusive and collective learning processes.

Once we have established the water demand for the proposed pipeline, using both publicly available information and information gathered in previous tasks, we would then establish the groundwater source and volume available for use. This would include analysis of primary and secondary information, including current groundwater maps and model outputs to understand the potential source and volume of water available for the joint water supply scheme. This information will then be checked against the water demands to determine the potential water availability and source.

Mapping of groundwater resources in the district

An overlay of the groundwater sources within the district will be presented as GIS maps in an ArcGIS shapefile or PDF format. We would also visually present the surrounding properties and landholder details who would potentially benefit from the proposed pipeline development in the district.

Prepare and present a draft scoping report

We will present our findings and results from all investigation and data analysis tasks in the form of a consolidated draft scoping report. The draft scoping report will consist of key information required for the project team and potential funding agencies to determine the suitability of the pipeline project for going ahead for further funding.

Hold point: prior to commencement of Stage 2 if the project is considered to go ahead and a more detailed report is developed. We have allowed for one round of consolidated comments on the Draft scoping report.

3.2 Stage 2:

Task 5. Concept civil design and costing estimation

Based on the outcomes of the Draft scoping report stage and learnings through the stakeholder consultation process, Alluvium engineers will assess the most likely method for the pipeline development. Consideration will be given to whether a similar approach elsewhere could be adopted for this project.
Following the design consideration exercise, the project team will calculate a high-level cost estimate for the works based on similar past projects and published construction cost rates. As it will be based on a very preliminary level of design consideration, the cost estimate will have associated uncertainty, however this will be reflected through the inclusion of an appropriate contingency cost.

Task 6. Draft funding proposal

The information obtained and developed through the scoping report will be used to prepare a draft Funding Proposal. The proposal will be addressed to the Trust who it is understood are the potential project funders. The proposal will address the Trust criteria to the extent feasible with available information, desktop review and consultation within the time and budget of this proposal.

We will provide the draft Proposal to the client for review. We request that feedback is provided in a single consolidated format.

Task 7. Final funding proposal

Upon receipt of feedback on the draft Proposal, the project team will finalise the application, ready for submission to the Trust, and as key input to the Department of Planning, and Federal and State agencies and relevant funding agencies for maintenance

Fortnightly progress meetings with Client.

We have allowed for one-hour fortnightly project meetings with the representatives of Leard Forrest Precinct Environment Trust. We have allowed for all meetings to be attended by Neal Albert and Jim Purcell.

4 Budget & Timeframe

We propose our services for the delivery of the proposed scope for a lump sum fee of **$48,975 (ex GST)**. The fee consists of the following components which we are happy to sperate into separate packages dependent of the outcome of each Stage.

- Stage 1 - $26,290
- Stage 1 + preliminary design &costings - $36,795
- Stage 1 & 2 - $48,975

It is envisaged that the project will take approximately 3 months to complete which allows for community consultation and review.

Task	Description	TOTAL (ex GST)
Task	**Stage 1**	
1	**Project Inception**	**$1,485**
	Inception meeting	$1,485
2	**Community consultation**	**$10,109**
	External stakeholder engagement	$9,108
	Funding agency engagement	$1,001
3	**Method development and documentation**	**$4,114**
	Developing method for determining water access eligibility	$4,114
4	**Data analysis and reporting**	**$10,582**
	Establish pipeline water demand and availability/source	$4,004
	Mapping of groundwater sources in the district	$1,958
	Prepare and present a draft scoping report	$4,620
	HOLD POINT	**$26,290**
	Stage 2	
5	**Concept civil design and cost estimation**	**$10,505**
	Concept design	$7,865
	Preliminary cost estimating	$2,640
6	**Draft funding proposal**	**$3,982**
	Draft funding proposal	$3,982
7	**Final final funding proposal**	**$3,278**
	Final funding proposal	$3,278
	Fortnightly progress meetings	**$4,920**
	Ex GST	**$48,975**
	Incl GST	**$53,873**

5 Assumptions

5.1 Standard assumptions

The standard assumptions at ATTACHMENT A are also a part of this proposal.

6 Proposed team

This project will be led by Project Manager Neal Albert, who will provide the primary point of contact. for the project.

The following sections provide a short biography of this project leadership group as well as the remainder of the project team. Full CVs are available upon request.

Neal Albert – Project Manager/Engineer

Neal is an outcome focused professional combining management, technical, business, financial and interpersonal skills with over 30 years of experience and achievements in the water and agricultural industry. An experienced practitioner in the fields of water, hydrological investigations, floodplain management; construction management (including Project, Program and Contract management); and innovative pragmatic solutions. He has worked previously in the Maules Creek area and in his early career worked as a farm water supplies engineer covering inland NSW.

Neal will be our Project Manager, providing oversight to the team with direction during the project delivery phase and reviewing key deliverables.

Jim Purcell – Water Resource Engineer

Jim is a Nationally and Internationally Registered Professional Civil Engineer with over 40 years' experience in Australia, Mongolia, China, Ethiopia and Papua New Guinea in all aspects of water resources and irrigation engineering including stock and domestic water supply schemes. He is managing director of Aquatech Consulting in Narrabri NSW and has been consulting from Narrabri since 1983.

Jim will provide the local experience and technical advice to the project

Gretel Flemming – Technical Support

Gretel graduated from the Australian National University in 2022 with a Bachelor of Science and Bachelor of Commerce and has worked for Alluvium since July 2022.

She is skilled in sustainable development, environmental and social research, understanding complex environmental problems, environmental modelling and monitoring and participatory resource management and stakeholder engagement. Since working with Alluvium, Gretel has employed her critical thinking and practiced communication skills to help deliver projects such as the Review of Environmental Factors for bank stabilisation works in Cattai National Park for the NSW National Parks and Wildlife Service, the Basin Plan Review Regulatory Re-design for the Murray-Darling Basin Authority, and the Water Compliance Performance Reporting Framework for the Inspector General's Water Compliance.

Gretel will provide technical assistance to the project

ATTACHMENT A. Standard Assumptions which apply to this proposal.

Assumption	Why we have this assumption
Technical assumptions	
If the client requires deliverables in specific organisational templates, these will be provided shortly after inception.	We assumed that any deliverable will be drafted directly into our reporting templates and not need to be transferred into different template (e.g., the client's organisational templates). If this is required, we have assumed the client will provide relevant reporting and presentation templates in the first instance, which we will use for our deliverables. Transferring material across templates can take significant amount of effort, which we have not budgeted for. If the client requires transferring of reports/presentations/models into a different template without advance notice, we will require an extension to milestone deadlines and/or variation to the proposed fees.
Where discussions lead to material differences in the approach, we would seek to discuss any impact on timelines and budget to ensure the robustness of findings are not compromised,.	We have developed our proposed fee and delivery schedule using on a bottom-up approach based on the individual tasks of our approach. We consider this provides our clients with the most cost-efficient estimate and value for money, in addition to allowing us to plan our internal resources to deliver the best outcome for clients. Material changes in the approach that have not been accounted for can impact our financial and technical performance for a particular project. While we can accommodate some changes to the approach, within reason, we would seek to discuss any material changes and any potential impact to budget and timelines as necessary.
Project Management	
Where the client has a change in Project Manager and if there is a need to bring the new PM up to speed, or a new direction provided with the new PM, a variation may be needed to capture costs incurred.	A change in the client Project Manager is one of the bigger risks for us and can have a substantial impact on the project delivery. Often time is required to bring the new Project Manager up to speed on the project and there is the risk that the new Project Manager has a different view of the approach and wishes to make changes, in some cases deviating substantially from the original request for services. While this can always be accommodated, it can have an impact on time to explain the project to date and to restructure the method, resourcing and timelines.
Meetings and consultation	
For workshop-related engagement, any change to dates after arrangements have been made, costs will be charged to reschedule the workshop.	Organising workshops with multiple stakeholders takes substantial effort. Where a client or key participant seeks to move a meeting after all parties have agreed on a date and time, we incur costs associated with reorganising our team and participants, and other arrangements (e.g., travel, accommodation, venue hire, etc) which have not been budgeted for. Some costs can be absorbed within reason (e.g., where engagement is online or can be rescheduled to minimise/avoid losses). Where this is not possible, we would seek to discuss and negotiate with the client on cost recovery.
We have made explicit allowances for the number of meetings we will attend. If additional meetings are required, we assume that we will have the ability to discuss and agree a variation.	Our most successful projects are those where we work closely with our clients. We allow for as many meetings as possible within the scope and budget of projects, and can facilitate some additional meetings, within reason. However, if a large number of additional meetings are required, we need to either consider a variation, or reduce the time spent on technical analysis.
Project timeframes	
We have assumed the project will be completed within the timeframe nominated in this proposal.	We budget for projects based on the nominated timeframes and/or timeframes documented in our proposal. Delays which are not of our making (e.g., because reports are not reviewed by clients within scheduled timeframes) may materially

Assumption	Why we have this assumption
	impact on delivery of other projects and likely result in additional project management costs, which have not been budgeted for. Any changes required to timelines or costs through variation will be agreed beforehand with the client.
Review and feedback	
Unless specified otherwise in our method, we have allowed time for addressing one round of feedback on our draft reports—we are however very happy to discuss this further in the inception meeting	Reporting can be a large portion of the overall budget. It is important for us that comments of draft documents are consolidated, clear and comprehensive. We appreciate there may be additional feedback through the expression of the information, but we have assumed there will be no major, materially new content provided after the first set of consolidated comments, as this has substantial impacts on the time we have budgeted for reporting.
Where the client Project Manager seeks comments on draft reports or draft products from peers who have not been involved in the project, we have assumed they will be adequately briefed on the original request for tender and any project delivery negotiations between us and the client project manager.	In some cases, the first time some client reviewers see the products of our work is at the draft report stage. These people often have not been privy to the request for tender documentation, our submission, or any contract negotiations in terms of budget and deliverables.
Where comments are provided which are outside of the agreed deliverables it is assumed the client Project Manager will remove the comments and provide internal feedback to the individual who has provided the comments.	A lack of understanding of budget constraints and agreements between us and the client Project Manager can result in some reviewers having very different expectations to the client Project Manager and providing comments and suggestions that are out of scope.
Where there are multiple people providing comments on any products or reports, it has been assumed that the client project manager will consolidate all comments into one document in (in margin comments and / or track-changes) and resolve any internal conflicts.	It is not uncommon that different people in one organisation can have different views on a particular issue and the result is we can receive comments from individuals that conflict with one another. In such cases, we are often unsure what is the agreed or primary client perspective. We therefore seek one consolidated set of comments from each entity where all differing views have been discussed, and an organisational position agreed, before comments are issued to us.
Where there has been a delay to provision of feedback on our deliverables, a change in timelines or variation of fees will be negotiated.	Where the client has not nominated a proposed duration for reviewing reports and providing feedback, we have assumed that the client will be able to provide consolidated comments within a two-week review period for each deliverable, in order to meet milestone deadlines. Where the client has experienced a delay in receiving comments from reviewers, we will need to factor in either an extension to the delivery of the final version or propose a variation to fees to account for extra professional input hours required to deliver the milestone according to the prevailing deadline.