

Advice to decision maker on Middlemount Southern Extension coal mining project

IESC 2022-131: Middlemount Southern Extension Project (EPBC 2021/8920) – Expansion

Requesting agency	The Australian Government Department of Agriculture, Water and the Environment
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Advice stage	Assessment

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) provides independent, expert, scientific advice to the Australian and state government regulators on the potential impacts of coal seam gas and large coal mining proposals on water resources. The advice is designed to ensure that decisions by regulators on coal seam gas or large coal mining developments are informed by the best available science.

The IESC was requested by the Australian Government Department of Agriculture, Water and the Environment to provide advice on the Middlemount Coal Pty Ltd's Middlemount Southern Extension in Queensland. This document provides the IESC's advice in response to the requesting agency's questions. These questions are directed at matters specific to the project to be considered during the requesting agency's assessment process. This advice draws upon the available assessment documentation, data and methodologies, together with the expert deliberations of the IESC, and is assessed against the IESC Information Guidelines (IESC, 2018).

Summary

The Middlemount Coal Mine was originally approved in 2009, and is located in the Bowen Basin, Queensland (MCPL 2022, p. 1). Middlemount Coal Pty Ltd (the proponent) is proposing to extend the area of mining operation into the southern extent of the mining lease (the project), targeting the Middlemount and Pisces Coal Seams within the Rangal Coal Measures. The project is expected to produce 5.7 million tonnes per annum of run-of-mine coking coal and extend the life of the mine for an additional seven years to 2044 (MCPL 2022, p. 7).

The project will divert a section of Roper Creek around the proposed open-cut pit, realign the southern flood levee and associated water storage, and clear 233.4 ha of vegetation, of which 68.3 ha is remnant vegetation (Biodiversity Australia 2022, pp. 80 – 81). There will be direct impacts on two Threatened Ecological Communities (TECs) listed under the *Environmental Protection and Biodiversity Conservation* (EPBC) Act (1999): 2.3 ha of *Acacia harpophylla* dominant and co-dominant (Brigalow) and 19.4 ha of the Poplar Box Grassy Woodland on Alluvial Plains (Poplar Box) (MCPL 2022, p. 44).

Four EPBC Act-listed threatened species may reside in the project area, including the Koala (*Phascolarctos cinereus*), Great Glider (*Petauroides volans*), Squatter Pigeon (*Geophaps scripta scripta*) and Ornamental Snake (*Denisonia maculata*). These species likely use the area for foraging, shelter and/or breeding, and may potentially be impacted by clearance of their habitat (Biodiversity Australia 2022, Appendix A, pp. 1-8). Disruption of the continuity of the current riparian zone along several km of Roper Creek during and soon after its realignment may particularly impact Koalas and Greater Gliders until trees of sufficient age and height have become established along the diverted channel.

Modelling presented in the proponent's preliminary documentation for the Southern Extension Project leverages off models prepared for the Western Extension Project, indicating a need for further revision and assessment.

Key potential impacts from this project are:

- reduction of riparian habitat and disruption of continuity of the riparian zone along several km of Roper Creek during and soon after its realignment, impacting arboreal and other species and affecting instream ecological processes;
- legacy of two residual voids (becoming increasingly saline) in a floodplain area;
- a potential decrease in surface water quality from controlled discharge and uncontrolled overflow events, for example overtopping of sediment dams releasing contaminated water and sediments downstream; and
- cumulative impacts to groundwaters and surface waters and their dependent ecosystems, including a loss of connectivity resulting in fragmentation of vegetation across the landscape.

The IESC has identified key areas in which additional work is required to address the key potential impacts, as detailed in this advice. These are summarised below.

- Assess sediment regimes and ecohydrological performance of the approved and proposed channel realignments for Roper Creek and Thirteen Mile Gully to assess their ability to be self-sustaining and to support biota, fish passage and ecological processes of the original watercourses.
- Provide more information about mitigation and management strategies regarding bank stability of the approved and proposed realignments, and about re-establishment of sufficient riparian vegetation along diverted channels (e.g., to support EPBC Act-listed species such as Koalas and Greater Gliders).
- Investigate the characteristics of the Jellinbah Fault and associated secondary faults and how these may be affected by mining operations and their potential impact on water resources.
- Ground-truth the groundwater-dependence of riparian and other vegetation that may be affected by groundwater drawdown.
- Provide more comprehensive documentation and an update of the groundwater model to incorporate monitoring data after 2018 and to include this data into model parameterisation.

- Investigate the potential flood overtopping of water management storage and sediment dams.
- Describe the potential cumulative impacts to GDEs and surface water resources, identify the impact pathways in a suitable ecohydrological conceptual model and propose management measures to mitigate these impacts.

Context

The Middlemount Coal Mine was originally approved in 2009, and is located in the Bowen Basin, Queensland. The mine is approximately 3 km south-west of the township of Middlemount, Queensland (MCPL 2022, p. 1). The proponent is seeking to extend operations at the current extraction rate for an additional seven years to 2044. The proposed extension will extract up to 5.7 million tonnes per annum of run-of-mine coking coal from the target Middlemount and Pisces Coal Seams of the Rangal Coal Measures (MCPL 2022, p. 7).

The proposal primarily includes an extension of the open-cut pit, realignment and extension of the approved (but not yet constructed) eastern diversion of Roper Creek, re-positioning of the approved southern flood levee and water management infrastructure, and extensions to the waste rock emplacement footprints (MCPL 2022, p. 7).

Direct impacts from clearing are predicted on two EPBC Act-listed TECs (*Acacia harpophylla* dominant and co-dominant and Poplar Box Grassy Woodland on Alluvial Plains (MCPL 2022, p. 44)). Clearing and other activities may also affect four EPBC Act-listed threatened species (Koala, Great Glider, Squatter Pigeon and Ornamental Snake) in the project area (Biodiversity Australia 2022, Appendix A, pp. 1-8). Extension of the diverted channel of Roper Creek by several kilometres will substantially increase the disruption of the current riparian zone's continuity and impair its ecological functions (e.g., use by Koalas and Greater Gliders) until suitable vegetation becomes established.

The IESC has previously provided advice on the Middlemount Coal Project Stage 2 (IESC 2012-021, EPBC 2010/5394) and the Middlemount Coal Mine Western Extension (IESC 2018-097, EPBC 2017/8130).

Response to questions

The IESC's advice, in response to the requesting agency's specific questions is provided below.

Question 1: Noting the relevant water management information and requirements associated with the updated Environmental Authority, can the Committee provide comment on likely scale and extent of potential downstream impacts to Roper Creek water resources resulting from the proposed diversion?

1. The IESC can only provide a high-level assessment on the likely scale and extent of potential downstream impacts to Roper Creek water resources from the diversion due to the incomplete information provided in the documentation for surface water modelling, mitigation, and management.
2. Further information is required on geomorphic, hydrological and ecological features of the proposed realignments of Roper Creek and Thirteen Mile Gully so that the proponent can more reliably predict the likely scale and extent of potential downstream impacts to Roper Creek water resources.
3. More details are needed on characteristics of the bank and channel sediments of the pre-diverted Roper Creek and Thirteen Mile Gully. The characteristics include the distribution of sediment particle sizes, their predicted mobility (under different flows) and how these vary longitudinally through the project area and downstream. This information can be used to guide the composition and

heterogeneity of instream sediments in the diversion channels so that they can be constructed to closely approximate the natural ones and share similar hydraulic properties. The proponent should also specify any risks for potential sodic or acid-forming sediments to occur within the proposed stream diversion, potentially impacting downstream water quality. Further, risks of erosion and bank instability should be evaluated for a range of flows to guide the design of the diverted channels and to minimise unnatural increases in erosion and downstream sedimentation.

4. Information is required on likely infiltration rates in the diverted channels, especially soon after construction. The bed sediments of the diverted channels may have higher infiltration rates which could extend the periods of low- and zero-flows downstream with consequences for aquatic biota, fish passage and ecological processes such as nutrient spiralling.
5. The proponent should provide convincing evidence that the several kilometres of diverted channels will maintain the pre-existing hydrological and ecological functions of the current natural channels of Roper Creek and Thirteen Mile Gully. When saturated, channel sediments of many rivers act like sand-bed filters whose large surface area supports microbial assemblages that mediate crucial biogeochemical processes involved in nutrient spiralling (Boulton 1999), and it is important that this role is maintained, even in ephemeral streams (Burrows et al. 2017). Other relevant ecological functions that should be assessed include organic matter retention, suitability for fish and aquatic invertebrate dispersal, and lateral biogeochemical interactions between the channel and riparian zone.
6. The proponent does not specify the extent to which riparian vegetation will be established along the diverted channels before they become operational. Given the substantial importance of riparian vegetation (e.g., organic matter inputs, promoting bank stability, providing ecological corridors and habitats for wildlife such as Greater Gliders and Koalas), it is essential that vegetation of sufficient species composition, condition and age is established in the diverted channels to replace the roles of the riparian vegetation that will be removed. The IESC recommends that the proponent prioritises revegetation of the diversion channel banks and does not remove the existing vegetation until a suitably intact riparian corridor is established. This may take some years but will help mitigate the disruption in riparian continuity that will occur when the existing Roper Creek vegetation is cleared.
7. As part of the proponent's rehabilitation plan, the flood levee protecting the project area will be removed (WRM 2020, p. 123). The IESC strongly recommends that the proponent should fill in the southern void post operations. This would also address the Queensland Government's Mined Land Rehabilitation Policy (2019) that final voids should not remain on a floodplain (DES 2017, p. 24). Over time, the voids will become groundwater sinks that become hypersaline due to evapo-concentration (WRM 2020, p. 69). Unnaturally saline standing waters pose a risk to mobile wildlife seeking fresh waters in this semi-arid landscape. By removing the flood levee and having a void in the floodplain, water from the southern void may be flushed downstream during flooding events, causing a change in Roper Creek water quality. Although there is a very low likelihood of the southern void overtopping, the consequences to downstream water resources could be serious (e.g., transient salinisation).
8. Part of the Thirteen Mile Gully Diversion stream is expected to be constructed post-operation through the middle of the two final waste embankments (MCPL 2022, Figure 2, p. 3). This is the area where the Jellinbah Fault is located (Figure 22 MCPL 2022, p. 73). Limited information about the fault characteristics suggests that there could be a connection between the constructed stream and the fault. The proponent's conceptual model assumes that the Jellinbah Fault does not propagate in the overlying sediment (Figures 5.3 and 6.9 AGE 2020, p. 26 and p. 59). However, the fault apparently exerts an influence on the geomorphology. The IESC recommends that the proponent assess the potential for the Jellinbah Fault to reduce streamflow and to alter downstream flow regimes (see Paragraph 20c).

9. Information about mine water discharge events has not been clearly discussed within the documentation. Under the Environmental Authority permit (EMPL00716913), mine-water discharge can only be performed under certain water quality and flow conditions (WRM 2020, p. 49). However, the proponent has not included a full discussion about whether mine-water discharge events are occurring or planned to occur once these conditions are satisfied.
 - a. Furthermore, the site water balance model is unclear in demonstrating discharge events. Mine water discharge is set at 0 ML/year within the proponent's site water balance (WRM 2020, p. 53) implying that mine water discharge events are not currently planned to occur. However, Figure 21 in MCPL (2022, p. 71) shows monitoring and release sites for mine water discharge. The documentation has conflicting information about controlled mine-affected water release.
 - b. If discharges are planned, more details are required about potential water quality impacts (e.g., increased instream salinity and/or metal concentrations) to downstream users and on justifying the adequacy of mitigation and management plans in addressing any impacts.
10. As part of the proponent's site water management system, stormwater runoff drains into sediment dams and water is pumped into another sediment dam (MCPL 2022, p.97). This sediment dam spills freely into the Thirteen Mile Gully Diversion (MCPL 2022, p. 97). Information about the drainage of this dam and potential overflow from flood water into the sediment dam and into the voids has not been explicitly discussed in the documentation. IESC suggests that the proponent provides clarification on the scale and extent of impacts, as well as potential mitigation measures to prevent overflow from flooding.
11. The proponent also plans to regularly clean out the sediment dams to maintain their capacity (WRM 2020, p. 118). Noting that information about this management measure has not been provided, IESC suggests the proponent provide further information about the disposal of the sediments and how cleaning of the sediment dams will be conducted. Further monitoring of sediment dam water quality should also be carried out to better assess the likelihood of downstream impacts to Roper Creek.
12. Deficiencies in the surface water modelling include possible under-estimation of flood risk and use of a lower climate Representative Concentration Pathway (RCP) over higher climate RCPs, and currently hinder evaluation of potential impacts to surface water quality and quantity. Further work is suggested below (Paragraphs 12a – 12b).
 - a. A Unified River Basin Simulator (URBS) hydrological model and a two-dimensional unsteady flow (TUFLOW) hydraulic model was used to simulate flood behaviour of Roper Creek and Thirteen Mile Gully (MCPL 2022, p. 84). The use of local data to calibrate the URBS model to the January 2013 Oswald event provides useful information; however, evaluation of the design estimates suggest that the model is perhaps under-estimating flood risk. This is because the design estimates imply that the flood resulting from Cyclone Oswald was an event with an Annual Exceedance Probability (AEP) of 0.1% (i.e., around a "1 in 1000" chance of being exceeded in any one year) which is perhaps an order of magnitude more extreme than the AEP of the associated rainfalls. Comparison with regional flood estimates (Book 3 of ARR, Ball et al. 2019) and world flood maxima (Malone 2011; Herschy 2001) would also suggest the estimates are below regional expectations.
 - b. A sensitivity analysis for climate change was conducted for simulation of residual void behaviour (WRM 2020, p. 68). RCP 4.5 was used for modelling 'best case', 'maximum consensus' case and 'worst case' scenarios (WRM 2020, p. 68). If the proponent models the 'worst case' scenario using RCP 8.5, it will provide a more extreme climate change event (not inconsistent with recent trends) to better appreciate the potential impacts from more extreme rainfall or drying climate events.

Question 2: Can the Committee provide comment on the likely scale and extent of impacts to downstream GDEs as a result of groundwater drawdown associated with the proposed mine extension?

13. The lack of field surveys assessing groundwater-dependence of potential terrestrial GDEs, and of the depth to water in the alluvium and tertiary strata along Roper Creek, coupled with limited confidence in the groundwater drawdown modelling and uncertainty analysis hamper the IESC's capacity to comment on the likely scale and extent of impacts to downstream GDEs. These constraints are discussed in more detail below, along with suggestions for addressing them.
14. The proponent states that the Western Extension model was updated for the Southern Extension project to assess impacts on groundwater. However, it is unclear how the model has been updated from the version developed in 2018 to assess impacts of the Middlemount Southern Extension project, beyond reflecting changes in the mine plan. The IESC recommends that the updates to both the underpinning conceptual model and the groundwater model are more clearly specified.
15. Calibration hydrographs indicate an approximately 15-m underprediction of drawdown near Roper Creek (MW14A and MW15A) and vegetated areas to the north-west of the existing mine (MW10A) (AGE 2020, Appendix F). The proponent should investigate why there has been this underprediction and undertake any extra work required to correct it (for example, improve the calibration by including heterogeneity of hydraulic parameters into the model or including an additional monitoring bore).
16. The proponent has not provided uncertainty analysis results for Southern Extension groundwater modelling and has instead compared predicted inflow and maximum drawdown for the proposal with the Western Extension uncertainty analysis results (AGE 2020, Appendix F, p.22). The IESC considers this is an inappropriate comparison because the predicted drawdown for Pisces Coal Seam extends out of the uncertainty range presented for the Western Extension, indicating a larger potential impact than has been considered by the proponent (AGE 2020, Appendix F, p.24). Observation data from the past four years (including the cumulative impacts of the Western Extension Project approval) should be included in the analysis, and the uncertainty analysis for groundwater model for the Southern Extension project should be undertaken incorporating a greater range of climate variability.
17. Desktop mapping of GDEs using the Bureau of Meteorology GDE Atlas identifies vegetation associated with Thirteen Mile Gully, Roper Creek and the palustrine wetlands north of the project area as low-potential terrestrial GDEs (AGE 2020, p. 53). The proponent assumes that these low potential GDEs are unlikely to be affected by groundwater drawdown because the depth to groundwater exceeds 12 metres below ground level (mbgl) within the Tertiary sediments and around 20 mbgl near Roper Creek. Thirteen Mile Gully and Roper Creek are ephemeral, and vegetation dieback has not been observed in the mined areas. These assumptions may not be robust. Based on data from 118 sites in eastern Australia, Kath et al. (2014) reported groundwater depth thresholds from 12.1–22.6 m for River Redgum (*Eucalyptus camaldulensis*) and 12.6–26.6 m for Poplar Box (*E. populnea*), implying that these two species, both of which occur in the project area, can use groundwater deeper than 20 mbgl. Groundwater-dependent vegetation can occur along ephemeral streams (Stromberg et al. 2017) and vegetation die-back in response to drawdown may be delayed or only evident after prolonged drought. The IESC recommends that the proponent directly assesses potential groundwater dependence of riparian vegetation along Roper Creek and Thirteen Mile Gully using ground-truthing techniques outlined by Doody et al. (2019). Results from this assessment will enable the proponent to more reliably evaluate potential impacts of drawdown on riparian vegetation, including that established along the diverted channel. Similar analyses are suggested for potential groundwater-dependent vegetation fringing the palustrine wetlands to the north of the project area where drawdown is predicted.
18. The extension will remove 233.4 ha of riparian vegetation in the project area, including along Roper Creek (MCPL 2022, p. 29). As noted by the proponent, this vegetation includes EPBC Act-listed

species (including Brigalow and Poplar Box TECs), and likely provides habitat for Greater Gliders and Koalas (MCPL 2022, p. 27). As much of the area surrounding the project site is highly degraded, with a number of mines south of the Middlemount Coal Mine (Biodiversity Australia 2022, p. 57), remnant vegetation is disproportionately important. Removal or impaired condition of riparian vegetation is likely to result in the loss of ecological corridors (especially for arboreal wildlife) and contribute to edge effects (Biodiversity Australia 2022, p. 55) that will cause additional stress to an already vulnerable community. Furthermore, there may be downstream impacts on riparian vegetation arising from a combination of altered flow regimes (due to catchment excision and channel diversion), increased instream sedimentation (e.g., from bank instability), reduced water quality and, potentially, drawdown. These impacts, coupled with the loss of riparian connectivity along the diverted channel until adequate streamside vegetation is established, represent substantial disruption of a key component of Roper Creek and may adversely affect its ecological functions (e.g., fish passage, organic matter cycling). The proponent needs to characterise the collective impacts of this disruption and describe how these impacts might be monitored and mitigated.

19. Cumulative impacts to downstream GDEs may arise from a combination of vegetation removal, drawdown, altered alluvial recharge (due to catchment excision and channel diversion) and reduced water quality. These cumulative impacts from the current mine and the planned extension have not been described nor have feasible mitigation measures been proposed with appropriate justification. Such justification could be guided by the inclusion of an ecohydrological conceptual model of the project's likely changes to regimes and physico-chemistry of surface water and groundwater within and downstream of the project area, and the potential cumulative impacts on GDEs and surface water resources.

Question 3: Can the Committee provide comment on likely scale, extent and intensity of potential impacts to surrounding groundwater resources resulting from groundwater interaction with fault lines through the proposed extension site, both during and post mining?

20. There is insufficient information provided by the proponent for the IESC to confidently comment on the likely scale, extent and intensity of potential impact on surrounding groundwater resources from interaction with fault lines. Further information that is required on the influence of faults on groundwater resources during and post mining are suggested as follows.
 - a. The geology conceptual model and groundwater conceptual model should be revised for the Jellinbah Fault and should also show the thrust complex with secondary faults. Conceptual models in Figures 5.3 and 6.9 (AGE 2020, p. 26 and p. 59) indicate that the Jellinbah Fault terminates at the top of the Fort Cooper Coal Measures. However, it appears that the Jellinbah Fault propagates through the Tertiary sediments to the surface. The mapped fault appears to coincide with the location and orientation of surface drainage, particularly the confluence of Roper Creek and Drainage 1, and downstream beyond the mining lease.
 - b. The Jellinbah Fault, its associated fractures, and secondary faults in the thrust complex should be characterised using site-specific data from the project area (Murray and Power 2022). Details of drilling locations and hydraulic testing of each new borehole to characterise the Jellinbah Fault are not adequately documented. Also, there is no consideration of the potential for this fault to be affected by mining operations and to propagate drawdown parallel to the fault line. There is insufficient justification for not including faults in groundwater modelling, except for strata that is juxtaposed by the Jellinbah Fault.
 - c. If surface water from Thirteen Mile Gully seeps into the Jellinbah Fault zone, this may increase local groundwater recharge but have ecological impacts on surface-water biota and processes. The proponent should provide multiple lines of evidence (Murray and Power 2022) to evaluate and discuss these potential impacts and how they might be mitigated.

- d. The proponent should assess the potential for seepage of saline water from the southern pit and void to the Jellinbah Fault zone and discuss any potential impacts of the leakage, including legacy impacts and effective mitigations. The southern pit, and eventually the southern void, is projected to extend over an area where there are major faults trending northeast-southwest and northwest-southeast (AGE 2020, p. 3, Figure 1.2 and p. 29, Figure 5.4).

Date of advice	7 June 2022
Source documentation provided to the IESC for the formulation of this advice	Middlemount Coal Party Limited (MCPL) 2022a. <i>Middlemount Coal Mine Southern Extension Project (EPBC 2021/8920) EPBC Act Preliminary Assessment Documentation</i> , Project No. MCPL-19-03, Document No. 01130382. Middlemount Coal Pty Ltd. March 2022.
References cited within the IESC's advice	<p>AGE 2020. <i>Middlemount Coal Mine Southern Extension Project – Groundwater Impact Assessment</i>. Prepared for Middlemount Coal Pty Ltd. November 2020.</p> <p>Ball J, Weinmann E, Kuczera G 2019. <i>Book 3 of Australian Rainfall and Runoff Peak Flow Estimation</i>. Australian Rainfall and Runoff A Guide to Flood Estimation. Available: ARR: A guide to flood estimation (au.s3-website-ap-southeast-2.amazonaws.com).</p> <p>Biodiversity Australia 2022. <i>Commonwealth Threatened Species and Communities Assessment</i>. Biodiversity Australia Pty Ltd for Middlemount Coal Pty Ltd. Marc 2022.</p> <p>Boulton AJ 1999. <i>The role of subsurface biological filters in gravel-bed river rehabilitation strategies</i>. In: Second Australian Stream Management Conference: The Challenge of Rehabilitating Australia's Streams (Eds I Rutherford & R Bartley), pp. 81–86, Cooperative Research Centre for Catchment Hydrology, Melbourne.</p> <p>Bureau of Meteorology (BoM) 2022. <i>Annual Climate Summary for Queensland</i> [Online]. Available: http://www.bom.gov.au/climate/current/annual/qld/summary.shtml.</p> <p>Burrows R, Rutledge H, Bond N, Eberhard SM, Auhl A, Andersen MS and Kennard M 2017. <i>High rates of organic carbon processing in the hyporheic zone of intermittent streams</i>. Scientific Reports, 7, Article number: 13198.</p> <p>Department of Environment and Science (DES) 2017. <i>Mined Land Rehabilitation Policy</i>. Queensland Government. Available [online]: Mined Land Rehabilitation Policy (des.qld.gov.au)</p> <p>Doody TM, Hancock PJ, Pritchard JL 2019. <i>Information Guidelines Explanatory Note: Assessing groundwater-dependent ecosystems</i>. Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2019.</p> <p>Herschy REG 2001. <i>The world's maximum observed floods</i>. In The extremes of the extremes: extraordinary floods. IAHS Publ No. 271 (pp. 355–360).</p>

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