

Advice to decision maker on coal mining project

IESC 2022-134: Caval Ridge Mine Horse Pit Extension (EPBC 2021/9031) – Expansion

Requesting agency	The Australian Government Department of Climate Change, Energy, the Environment and Water
Date of request	21 July 2022
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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 Climate Change, Energy, the Environment and Water to provide advice on the BM Alliance Coal Operations Pty Ltd's Caval Ridge Mine Horse Pit 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 Caval Ridge Mine Horse Pit Extension (the 'project') is in the Bowen Basin of central Queensland, 5 km southwest of Moranbah. Caval Ridge Mine has been operational since 2014 and consists of two open-cut pits, Horse Pit and Heyford Pit. The project will extend the Horse Pit in an easterly direction, increasing the mine life by approximately 20 years to 2056.

The project will produce hard coking coal for the export market at a rate of up to 15 million tonnes per annum (BMA 2022, p. 21). Much of the required infrastructure already exists such as the rail spur, loadout facilities, stockpiles and the coal handling and preparation plant. Some of this infrastructure will require relocation for the project (BMA 2022, p. 11). The existing water management system will be expanded,

with storage capacity increased, and additional flood bunding of the final void will be constructed (BMA 2022, p. 16). The project proposes to develop an out-of-pit waste dump to the northwest of the existing Horse Pit (BMA 2022, p. 16). Partial backfilling of Horse Pit will occur with excess material being placed in the out-of-pit dump from approximately 2028 (BMA 2022, p. 16). A final void lake will remain in the Horse Pit extension (BMA 2022, Figure 2-14, p. 30).

The project is in the Isaac River Catchment in a region with many coal mines (active, proposed and in care and maintenance) and the proposed Bowen Gas Project. These numerous nearby coal projects imply a high potential for cumulative impacts on the water resources of the region, including alluvial and Permian groundwater resources and the Isaac River, that also support environmental and agricultural uses. Cumulative impacts may affect multiple species listed by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) such as Silver perch (*Bidyanus bidyanus*), White-throated snapping turtles (*Elseya albagula*), Fitzroy River turtles (*Rheodytes leukops*) and several species of groundwater-dependent vegetation.

Key potential impacts from this project are:

- changes to downstream water quality from controlled releases of untreated mine-affected water into Cherwell Creek;
- changes to downstream water quality from uncontrolled releases (potentially including runoff from the out-of-pit waste dump) from sediment dams whose overflow enters Horse, Cherwell, Caval and Nine Mile creeks;
- both of the above are likely to add to the existing cumulative impacts on water quality in the Isaac River from the extensive coal mining operations in the catchment;
- impacts to downstream aquatic biota, including several EPBC Act-listed species, and groundwater-dependent ecosystems (GDEs) from altered surface water quality; and
- changes to the water quality of the alluvial aquifers associated with Horse, Caval, Cherwell and Nine Mile creeks from water releases, with potential impacts to GDEs supported by these aquifers.

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.

- Expanding the surface water quality monitoring program to sample Horse, Caval, Cherwell and Nine Mile creeks where controlled and uncontrolled releases (including spills from sediment dams) may occur. Sampling locations should include the point of release, a downstream sampling point within 500 m of the release point and an appropriate sampling point further downstream. The sampling network should also include suitable reference sites on each creek, monitor all releases or spills to ensure water quality objectives (WQOs) are met, and specify a trigger action response plan (TARP) which is able to initiate timely action to prevent or rectify impacts.
- Derivation and adoption of local WQOs for surface and groundwater quality or the adoption of default guideline values (ANZG 2018) based on the 95% species protection level for 'slightly to moderately disturbed' ecosystems. Current WQOs for some analytes significantly exceed the default values. WQOs based on the laboratory limit of reporting (LOR) are not suitable for some analytes, and analytical techniques with greater sensitivity will need to be adopted.
- Further analysis and assessment are needed of the potential cumulative impacts to surface water quality and downstream biota. The IESC notes that Caval Ridge Mine has an agreement with a number of other mines in the region to share water-related information and thus is well placed to

undertake such work with the partners of the agreement. Potential cumulative surface water impacts at the catchment scale are not clearly understood or managed across multiple mine sites concurrently which increases the risk of cumulative impacts to EPBC Act-listed species within the catchment.

- Additional work is needed on assessment of the presence and susceptibility of GDEs to impacts from the project. This work includes (i) assessment of how the uncertainty in the groundwater modelling predictions of drawdown may alter evaluation of the project's potential impacts on terrestrial GDEs, and (ii) stygofauna sampling within the alluvial sediments of the Isaac River and the lower reaches of Cherwell Creek to assess risks of project-specific and cumulative impacts on this subterranean GDE.

Context

The Caval Ridge Mine Horse Pit Extension (the 'project') is in the Isaac River catchment in central Queensland. Several tributaries of the Isaac River flow through the project area, and include Horse, Caval, Cherwell and Nine Mile creeks. The project is located in an area of extensive coal mining activity, with some mines in the area operating since the 1970s (SLR 2021a, Table 3-6, pp. 31-32). The project will target the Moranbah Coal Measures which are also mined by adjacent mines Peak Downs and Saraji and will be targeted by the proposed Bowen Gas Project (SLR 2021a, Table 3-6, pp. 31-32).

Caval Ridge Mine commenced operations in 2014 under EPBC 2008/4417 and the Queensland Environmental Authority (EA) EPML00562013 (BMA 2022, p. 11). An EA amendment is currently being assessed by the Queensland Government (BMA 2022, p. 11) (see Paragraphs 5-7).

The project proposes controlled releases of mine-affected water into Cherwell Creek. Additionally, uncontrolled spills are anticipated from several sediment dams and dams containing mine-affected water into Horse, Caval, Cherwell and Nine Mile creeks (SLR 2021b, Figure 3-2, p. 42). These releases will change water quality in the receiving environment which may impact EPBC Act-listed species possibly present in the creeks and downstream in the Isaac River, including Silver perch, the White-throated snapping turtle and the Fitzroy River turtle.

Additionally, given that all creeks in the project area are ephemeral with predominantly losing conditions (i.e., surface water flows will recharge underlying local alluvial aquifers) (SLR 2021a, p. 97), there is also the potential for releases to alter the water quality of the local alluvial aquifer systems of these creeks. Changed water quality could affect GDEs supported by the local alluvial aquifers, especially riparian vegetation. If the water quality of the Isaac River alluvium were also impacted, then stygofauna likely present in that aquifer (SLR 2021a, p. 117) may also be impacted.

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 quality objectives, water management information and requirements associated with the Environmental Authority, can the Committee provide comment on likely scale and extent of potential downstream impacts to Horse Creek, Cherwell Creek catchments and Isaac River water resources resulting from the proposed water releases?

1. The project proposes controlled releases of mine-affected water to Cherwell Creek, with uncontrolled spills possible from multiple sediment dams and mine-affected water dams to Horse, Caval, Cherwell and Nine Mile creeks (SLR 2021b, Figure 3-2, p. 42). Releases of mine-affected and/or sediment-laden water will alter the water quality of these creeks. The scale and extent of these impacts, and the potential to affect water quality within the Isaac River, remain unclear from the information provided. Controlled releases are likely to average approximately 50 ML/year but may be over 1,000 ML/year under unusually wet conditions. Uncontrolled releases are only expected under

unusually wet conditions and may also be over 1,000 ML/ year (SLR 2021b, Figures 5-4 and 5-5, p. 59). The proportional impacts that these event releases may have on the receiving environment have not been discussed, nor have their expected duration and potential impacts on the downstream flow regime. This information is needed to assess the likely scale and extent of impacts from the proposed releases on water resources.

2. Aquatic biota, stygofauna in the saturated alluvial sediments of Isaac River, terrestrial GDEs and EPBC Act-listed fish (Silver perch) and turtle species (White-throated snapping turtle and Fitzroy River turtle) could potentially be affected by altered water quality and/or flow regimes due to the controlled and uncontrolled releases. Further information and assessment are needed to understand the likely scale and extent of downstream impacts from releases of mine-affected and/or sediment-laden water as detailed below in Paragraphs 3-5, 8-10, 14, 16-18 and 24.
3. The proponent's water management system pumps all water, both mine-affected and clean water, into separate dams situated together to be released at the same location (SLR 2021b, Figure 3-2, p. 42). Information about the volume and frequency of predicted releases, past release events, and emergency releases is limited. The proponent should provide more detailed information on all potential release types as this is needed to understand the likely scale of potential impacts from releases on water levels, flow and quality and the possible extent of impacts downstream. For example, runoff from the out-of-pit waste rock dump may potentially carry contaminated sediments to sediment dams N3H and N3G that may have uncontrolled releases into Horse Creek.
4. The proponent has provided water quality data for sampling undertaken in December 2019 and April 2020 (ESP 2021, Table 4-1, p. 43), noting that the water quality frequently exceeded the WQOs (ESP 2021, p. 42). The EA specifies a flow trigger of ≥ 0.5 m³/s to commence release of mine-affected water. However, it is unclear whether this dilution is sufficient to prevent exceedances of all WQOs. The IESC notes that these exceedances could have adverse impacts on aquatic biota, GDEs and EPBC Act-listed species downstream. The proponent should derive and adopt appropriate site-specific WQOs (Huynh and Hobbs 2019) or adopt the ANZG (2018) default guideline values for 95% species protection level (or 99% species protection level for toxicants that bioaccumulate).
5. Table F4 of the current EA states that "Low flow releases provide for releases on the tail end of a natural flow event. The low flow release window commences the moment the natural flow recedes below the flow trigger and spans a period of 28 days only." The proponent does not provide any analysis of event-release conditions, including typical durations of flow and durations of recession limbs needed to assess whether these releases may result in contamination of downstream water and sediments during low-flow conditions. The IESC is concerned that the greater risks of contamination during low or receding flows in the receiving creek are not adequately addressed.
6. The current WQOs for toxicants based on the laboratory LOR (see Table F3 of the current EA) require revision given the presence or likely presence of EPBC Act-listed species in receiving waters and classification of the site as 'moderately disturbed' by the Queensland Government in the applicable water plan (Queensland Government 2013). For some analytes, these WQOs are equivalent to (or less protective than) the 80% species protection level (representing 'highly disturbed' ecosystems) and the higher level (95%) of species protection is needed. Adopting these more stringent WQOs will mean that the sensitivity of some of the analytical techniques used in water quality analysis will need to be improved.
7. All water management dams have emergency releases into different creeks around the project area (SLR 2021b, Figure 3-2, p. 42). However, the water quality monitoring points specified in the EA (which is currently under review at the time of this advice) do not provide adequate coverage of all potentially impacted creeks (BMA 2022, Figure 4-4, p. 86).

- a. The scale and extent of the impacts to downstream water resources will not be able to be measured due to limited water quality monitoring along Horse Creek, Cherwell Creek, Nine Mile Creek and Caval Creek.
 - b. The proponent should expand the monitoring network to include all creeks where emergency releases from the water management system can occur.
 - c. The expansion of the network to monitor potential impacts from uncontrolled releases should include suitable reference sites on each creek, a site at the point of spill, a site within 500 m downstream, and a site further downstream within each creek. These should be sampled during and immediately following uncontrolled releases.
 - d. For controlled releases, the monitoring program should be revised to include monitoring:
 - i. within 500 m downstream of the release point identified in the EA (RP1), and further downstream within Cherwell Creek (i.e., more monitoring is needed upstream of the confluence with the Isaac River);
 - ii. within Isaac River, but upstream of the current monitoring point (DMP1) identified in the EA. DMP1 is over 30 km downstream of the Cherwell Creek confluence with Isaac River which may mean that a significant length of waterway could be impacted before detection. DMP3 and DMP4 should be core monitoring sites and not used only at times when access to DMP1 is limited; and
 - iii. within the dam containing mine-affected water (12N) and at the release point.
 - e. All surface water monitoring needs to include analysis of metal concentrations, with the WQOs derived as per Paragraphs 4 and 6 used to trigger mitigation and management actions under a TARP.
 - f. The TARP needs to enable timely action should any WQOs be exceeded to ensure that potential impacts are prevented or rectified.
8. Further analysis and assessment are needed of the potential cumulative impacts to surface water quality and downstream biota. As several mines discharge into the Isaac River (e.g., Norwich Park Mine, Peak Downs Mine, Saraji Mine (BHP 2019, p. 23)), there is potential for cumulative impacts to water quality and flow regimes in the Isaac River catchment. The IESC notes that Caval Ridge Mine has an agreement with a number of other mines in the region to share water-related information and thus are well placed to undertake such collaborative work with the partners of the agreement. Potential cumulative surface water impacts at the catchment scale are not clearly understood or managed across multiple mine sites currently which increases the risk of cumulative impacts to water resources and EPBC Act-listed species within the catchment.
9. Caval Ridge Mine is party to a water-transfer agreement including Norwich Park Mine, Peak Downs Mine and Saraji Mine (BHP 2019, p. 23). These mines transfer water between mine sites, and although they commit to meeting the requirements of their respective EAs, information is limited on how the system operates. While it is commendable to manage water across multiple sites to minimise potential impacts, it can also increase risks or allow opportunistic release of water if there are sites with less stringent EA requirements and approval conditions which could potentially worsen environmental outcomes. Further information is needed about the operationalisation of the transfer agreement, and the requirements of the EAs for each mine included in the arrangement, to understand potential risks. The proponent should also assess potential downstream impacts of a 'worst-case' scenario where a large release from the least-stringently conditioned site occurs, especially given the likely cumulative impacts.

10. The proposed out-of-pit waste dump has the potential to influence surface water and groundwater quality through run-off and leachate generation. It is unclear what material will be placed in the out-of-pit waste dump and whether this may include coal rejects which have a much greater potential for generating potentially acid-forming (PAF) leachate and run-off (Terrenus Earth Sciences 2021, p. 35). Further information is needed on the placement of PAF material, both within the pit and in the out-of-pit waste dump, and any selective handling of material to be placed in the out-of-pit waste dump to understand the potential risks to surface water and groundwater water quality.
11. Given the predominance of sandy bed material in the creeks and rivers onsite and downstream, it is less likely that contaminants in the water releases will accumulate in sediments compared with, for example, finer silts and clays. However, the IESC notes that some sites that were sampled for sediment quality (including upstream of the project) where silty and/or clayey materials were recorded had high levels of chromium and nickel (ESP 2021, Table 4-2, pp. 48-50 and Table 4-3, pp. 50-52). Regular sediment sampling downstream of release points is suggested, targeting sites with silty and/or clayey materials to monitor for potential accumulation of contaminants in the sediments. The proponent should also develop a TARP so that if excessive sediment contamination is detected, timely action can occur to limit and rectify impacts.
12. The proponent is considering two alternative locations for the relocation of the blasting compound. The IESC considers that Option A would pose lower environmental risks to nearby surface waters and require less vegetation clearance than Option B.

Question 2: Can the committee provide comment on the likely scale and extent of impacts to downstream GDE's as a result of changes to hydrological regime and water quality associated with the proposed water releases?

13. The IESC notes that the proponent's assessment of the likely scale and extent of potential impacts to GDEs is limited. Stygofauna were not identified in the immediate vicinity in local alluvial aquifers, although acknowledged as likely to occur in the Isaac River alluvium (SLR 2021a, p. 117). Aquatic GDEs were considered to not occur but this was based on very limited assessment (SLR 2021a, p. 116). Potential terrestrial GDEs were identified in the project area and downstream. However, the inferred area of potential impact was based on groundwater model predictions with no apparent consideration of the uncertainty associated with the model predictions (App. B in SLR 2021a, p. 23). Additionally, the area of potential impact and the scale of the impacts to terrestrial GDEs were further discounted on the assumption that the key species in these ecosystems were likely to be facultative users of groundwater (e2m 2021, p. 30). This process did not consider that groundwater is usually the last available water source for such ecosystems during drought, and therefore loss of access to groundwater can have serious adverse effects at these times of considerable stress on the biota. Furthermore, facultative GDEs are a water resource under the 'water trigger.' Further work is outlined below for the proponent to better address these limitations in assessing the likely scale and extent of impacts to downstream GDEs as a result of changes to the hydrological regime and water quality associated with the proposed water releases.
14. Decreased surface water quality during and soon after releases is likely to directly impact aquatic biota at the release point and downstream, although the likely spatial extent for downstream potential impacts is unclear, especially for connected GDEs (e.g., alluvial sediments, bankside vegetation accessing alluvial and stream water). Impacts to GDEs will arise where there is surface water-groundwater connectivity, even transiently. One likely pathway is if contaminated surface water recharges the alluvial aquifers associated with Horse, Caval, Cherwell and Nine Mile creeks. This pathway is likely given that losing conditions dominate in these ephemeral streams and the larger Isaac River (SLR 2021a, pp. 75, 77 and 97). The proponent should evaluate the likelihood of each possible impact pathway and the potential impacts on GDEs, and may find it useful to portray these pathways and their interactions on an ecohydrological conceptual model. This conceptual model

could be used as the basis for an impact pathway diagram and subsequent formal risk analysis. It would also illustrate where knowledge gaps exist for some of the inferred pathways and their possible consequences for GDEs and other water resources.

15. Due to the dilution of the mine-affected and/or sediment-laden water being unknown, contaminant concentrations may occur at levels that could potentially affect aquatic biota, GDEs and EPBC Act-listed species. The provided water quality data (ESP 2021, p. 43, Table 4-1) showed frequent exceedances of the ANZG (2018) default guideline values for 95% species protection ('slightly and moderate disturbed' ecosystems). Appropriately derived local site-specific values (Huynh and Hobbs 2019) or default values for 95% species protection should be adopted (Paragraphs 4 and 6) to mitigate and manage potential impacts to downstream GDEs and other water resources.
16. The proponent states that there could potentially be stygofauna within the unconsolidated Quaternary alluvial sediments of the Isaac River (ESP 2021, p. 87). Further investigations are needed to confirm whether stygofauna are present in the Isaac River alluvium downstream of Cherwell Creek and possibly the lower reaches of Cherwell Creek. Although the proponent sampled 13 bores in April 2020 and 10 bores in November 2020 (ESP 2021, pp. 32-34), there were no bores sampled near the confluence of Cherwell Creek and Isaac River or in the saturated sediments of the Isaac River downstream. If stygofauna are detected, the proponent should assess the potential for water quality-driven changes from the project or its cumulative impacts to adversely affect this GDE.
17. In addition to the changes that may arise from the water releases, some GDEs at the project may be impacted by groundwater drawdown. As noted in Paragraph 13, this impact pathway has not been fully explored and there has been inadequate consideration of the uncertainties associated with the groundwater modelling predictions. While some areas of potential GDEs are predicted to experience only small amounts of drawdown, or a level of drawdown hypothesised to keep the water table within the vegetation rooting depth (e2m 2021, Table 9, pp. 35-36), overestimation of water levels (i.e., underestimation of drawdown) by only a few metres could considerably alter the total area of GDEs adversely impacted. This could result in impacts being greater than predicted by the proponent to terrestrial GDEs or groundwater-dependent riparian vegetation that provides habitat for EPBC Act-listed species. Further consideration of the uncertainty in the groundwater model predictions, field verification of the existing depth to the water table and assessment of the 'worst-case' scenario of the impacts of drawdown on terrestrial GDEs are needed to fully understand the potential scale and extent of impacts to these GDEs and the EPBC Act-listed species that they support at the project site and downstream.
18. From the information provided, it is unclear whether there will be direct impacts to terrestrial GDEs at the project site through vegetation clearance. The proponent simply states that terrestrial GDEs will be largely avoided (e2m 2021, p. 37). More information is required on what terrestrial GDEs, if any, will be directly cleared and how this, in addition to any loss or impairment from drawdown, might have repercussions for dependent wildlife, some of which is likely to be EPBC Act-listed.
19. The proponent has estimated that the project will require offsets for significant residual impacts (from vegetation clearing) to Matters of National Environmental Significance (MNES – 191.24 ha) and Matters of State Environmental Significance (MSES – 107.59 ha) (e2m 2022, Table 23, p. 54). Offsets are proposed on two properties (Inderi and Croydon Station) to acquit the impacts (based on area cleared) to Ornamental snake habitat (MNES/MSES), King bluegrass habitat (*Dichanthium queenslandicum*, MNES/MSES), Regulated Vegetation containing an Of Concern Regional Ecosystem (MSES) and Connectivity Areas (MSES) (e2m 2022, p. 53). Given concerns that evidence for the effectiveness of offsets is lacking (e.g., Sophus et al. 2019), the IESC recommends that further consideration be given to reducing the extent of clearing to avoid direct impacts on the four prescribed environmental matters, especially where they relate to associated water resources.

Question 3: Can the Committee provide comment on likely scale and extent of potential impacts to surrounding groundwater resources resulting from the proposed water releases through interactions between surface water and groundwater resources?

20. Impacts of the proposed releases to the alluvial aquifers underlying Horse, Caval, Cherwell and Nine Mile creeks are likely because losing conditions dominate in these surface water systems and within the larger Isaac River catchment (SLR 2021a, pp. 75, 77 and 97). However, the likely extent and scale of potential changes to groundwater quality caused by interactions with surface water during and after releases are not clear from the information provided. These potential impacts and their consequences will depend on the adopted water management practices and WQOs as discussed in Paragraphs 4, 6 and 15.
21. Additional groundwater monitoring is needed to allow the scale and extent of potential impacts on shallow groundwater quality to be accurately monitored, and suitable mitigation and management to be implemented if impacts are detected. The extent of the proposed monitoring network differs between the figures presented (cf. BMA 2022, Figure 4-1, p. 76 and SLR2021a, Figure 8-1, p. 168) and has limited coverage, with several existing monitoring bores likely to be lost as the project progresses, and no clear commitment for these bores to be replaced. Monitoring bores that will be lost as the mine progresses should be replaced, with the new bores installed at least two years prior to loss of the original bore (or longer if monitoring frequency is less than quarterly and/or data are highly variable) to collect sufficient data to enable comparison of trends.
22. As discussed in Paragraph 10, the out-of-pit waste dump could be a source of contamination to groundwater either directly or via surface water recharge of shallow alluvial aquifers. Several monitoring bores should be installed around the out-of-pit waste dump to identify whether groundwater contamination is occurring and, if so, trigger suitable management actions to prevent further contamination or its mobilisation.
23. Further to expanding the monitoring network, appropriately derived local WQOs or the ANZG (2018) default guideline values for 95% species protection levels should be adopted to protect water resources including GDEs (Paragraphs 4, 6 and 15). A TARP should be developed to complement the groundwater monitoring program and guide the timely identification of exceedances of WQOs and suitable follow-up actions to limit and rectify impacts.
24. The management of poor water quality in the post-mining stage is primarily reliant on the final void lake acting as a perpetual groundwater sink and no releases of this accumulated poor-quality water to the surface water or groundwater systems. The following requires clarification.
 - a. Numerous mines currently exist in the region, some very close (nearest active 17 km, nearest proposed 5 km (SLR 2021a, Table 3-6, pp. 31-32)) to the project area, and it is likely that many of these mines will leave final voids in the landscape. Further information is needed to understand if there is the potential for interactions between neighbouring voids that may affect groundwater quality by facilitating recharge to the Permian groundwater system from void lakes.
 - b. There are many uncertainties regarding equilibrated water levels in both the backfill and the final void. For example, recharge to the backfilled spoil has been assumed as approximately 1% of actual rainfall (App. B in SLR 2021a, p. 15). The IESC considers that this recharge estimate appears unrealistically low and requires justification. It is also unclear whether this is appropriate for the particle size of the spoil. If the spoil is of mixed particle size, then a range of plausible parameter values should be explored and the effects of these on predictions of the void lake level post-mining, and groundwater dynamics, discussed.

Date of advice	3 September 2022
Source documentation provided to the IESC for the formulation of this advice	BMA 2022. <i>Horse Pit extension project. Preliminary documentation (EPBC 2021/9031)</i> . Final for submission. Version 3.0 (18 July 2022).
References cited within the IESC's advice	<p>ANZG 2018. <i>Australian and New Zealand guidelines for fresh and marine water quality</i>. Australian and New Zealand Governments and Australian state and territory governments. Available [online]: Water Quality Guidelines Home Accessed 1 September 2022.</p> <p>BHP 2019. <i>Coal HSE. CVM water management plan</i>. 30 September 2019. (Part of Appendix O of Horse Pit extension project PD, Version 3.0).</p> <p>e2m 2021. <i>Groundwater dependent ecosystem report. Horse Pit extension project – Caval Ridge Mine</i>. Prepared for SLR Consulting Australia Pty Ltd. Issue Date 23 August 2021. (Appendix E of Horse Pit extension project PD, Version 3.0).</p> <p>e2m 2022. <i>Environmental offsets strategy. Horse Pit extension project – Caval Ridge Mine</i>. Prepared for SLR Consulting Australia Pty Ltd. Issue Date 30 May 2022. (Appendix L of Horse Pit extension project PD, Version 3.0).</p> <p>ESP 2021. <i>Caval Ridge Mine. Horse Pit extension project aquatic ecology assessment</i>. Prepared for SLR Consulting Australia Pty Ltd on behalf of BM Alliance Coal Operations Pty Ltd. August 2021. (Appendix H of Horse Pit extension project PD, Version 3.0).</p> <p>Huynh T and Hobbs D 2019. <i>Deriving site-specific guideline values for physico-chemical parameters and toxicants</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. Available [online]: Information Guidelines Explanatory Note - Deriving site-specific guideline values for physico-chemical parameters and toxicants Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (environment.gov.au) Accessed 1 September 2022.</p> <p>IESC 2018. <i>Information Guidelines for proponents preparing coal seam gas and large coal mining development proposals</i>. Available [online]: http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-may-2018.pdf. Accessed 1 September 2022.</p> <p>Queensland Government 2013. <i>Environmental Protection (Water) Policy 2009. Isaac River sub-basin environmental values and water quality objectives. Basin No. 130 (part), including all water of the Isaac River sub-basin (including Connors River)</i>. September 2011. Available [online]: Fitzroy basins Environment Department of Environment and Science, Queensland (des.qld.gov.au) Accessed 1 September 2022.</p> <p>SLR 2021a. <i>Caval Ridge Mine Horse Pit extension project groundwater assessment</i>. Prepared for BMA. Version 8.0. December 2021. (Appendix F of Horse Pit extension project PD, Version 3.0).</p>

SLR 2021b. *Caval Ridge Mine Horse Pit extension project surface water impact assessment*. Prepared for BHP. Version 4.0. August 2021. (Appendix G of Horse Pit extension project PD, Version 3.0).

Sophus OSE, Baker J, Griffiths RA, Strange N, Struebig MJ, Bull JW (2019). The ecological outcomes of biodiversity offsets under “no net loss” policies: A global review. *Conservation Letters* (2019) 12(6) e12664.
<https://doi.org/10.1111/conl.12664>

Terrenus Earth Sciences 2021. *Geochemical assessment of potential spoil, coal and coal rejects materials. Caval Ridge Mine: Horse Pit extension project*. Prepared for BM Alliance Coal Operations Pty Ltd. Report number 20-031-123 / R001. (Appendix I of Horse Pit extension project PD, Version 3.0).
