

Advice to decision maker on coal mining project

IESC 2020-116: Isaac Plains East Extension Project (EPBC 2019/8548) Expansion

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

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 Stanmore IP Coal Proprietary Limited's Isaac Plains East Extension Project 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

Isaac Plains East Extension (the 'project') is a proposed extension to the existing Isaac Plains East coal mine, 6 km east of Moranbah, Queensland, that will target the Rangal Coal Measures within the Bowen Basin. Both the project and Isaac Plains East form part of the Isaac Plains Complex. The proponent intends to extract approximately 2 million tonnes per annum (Mtpa) of run-of-mine (ROM) coking coal over four years. The project will use the existing Isaac Plains Complex mine infrastructure, including the coal handling and preparation plant (CHPP), but will require the construction of new haul roads and access roads, including connections to the existing Isaac Plains East road network. The proposed project is close to a number of existing coal mining and coal seam gas operations including Grosvenor Mine, Moranbah North Mine, Moranbah Gas Project, Isaac Plains Mine and Poitrel Mine. Most of these projects have been operational for several years and have already altered the groundwater within the Permian

coal measures, Tertiary sediments and Tertiary basalt, and impacted flows and water quality of the nearby Isaac River.

Key potential impacts from this project are:

- long-term and persistent impacts to the groundwater system post mining. The project's drawdown would contribute to the cumulative impacts of extensive existing drawdown. Groundwater modelling predicts drawdown in the Tertiary basalt of up to 4 m in the Smoky Creek catchment and up to 1 m in the Tertiary sediments near the perched Billy's Gully aquifer. The Leichardt seam, which forms part of the Rangal Coal Measures, is expected to experience a maximum of 100 m drawdown due to the project;
- likely ongoing water quality issues associated with sedimentation and erosion from the proposed haul road crossings;
- loss of Brigalow Threatened Ecological Communities (TEC) and impacts to the riparian corridors (e.g. disruption of longitudinal continuity by 80-m wide haul road crossings) and groundwater-dependent ecosystems (GDEs) which provide habitat for several species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Species potentially impacted include the Koala (*Phascolarctos cinereus*), Squatter Pigeon (*Geophaps scripta scripta*) and Greater Glider (*Petauroides volans*), which have also recently been severely impacted by the 2019-20 bushfires in the region; and,
- long-term legacies associated with the final voids, including ongoing groundwater losses through evaporation from the surface of the voids, poor final void water quality, and, as the final voids are predicted to become regional groundwater sinks, the potential to influence ongoing losses from adjacent alluvial systems with associated impacts to riparian vegetation and their dependent communities.

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

- Improve confidence in groundwater modelling by:
 - exploring the range of predicted drawdowns that may occur for a range of plausible groundwater model parameter values during sensitivity and uncertainty analysis; and,
 - using more than a single model layer to represent the Rewan Formation which is a hydrogeologically complex aquifer. Use of a single layer reduces confidence in groundwater model predictions as the layer may not reflect the physical heterogeneity of the hydraulic properties of the Rewan Formation that are relevant to the drawdown predictions.
- Undertake sufficient surface water quality monitoring (including during events such as floods and heavy rainfall) to provide appropriate baseline data for all watercourses in the project area.
- Undertake an assessment of the composition and condition (health) of riparian vegetation along Smoky Creek and Billy's Gully. This assessment should include the potential repercussions of changes in these water-dependent ecosystems, including impacts of the proposed haul-road crossings, to their habitat values for EPBC Act-listed and other species.

Context

The Stanmore IP Coal Pty Ltd's Isaac Plains East Coal Mine Extension (the 'project') is a proposed extension of the Isaac Plains East Project, which forms part of the Isaac Plains Complex (IPC), located approximately 6 km east of Moranbah and 145 km southwest of Mackay in central Queensland. The project involves the expansion of the Isaac Plains East open cut pits to the east and would allow for continued mining of coal from the Leichardt Seam. No new pits are proposed for the project. The project will extend the mining schedule at Isaac Plains East by approximately 4 years and produce approximately 2 Mtpa of ROM coking coal.

The coal will be transported from the IPC via an off-site rail loop and train load-out facility to the Dalrymple Bay Coal Terminal for export. Although the project will use existing IPC infrastructure (including the CHHP), new infrastructure will be required, including widening of the Billy's Gully and Smoky Creek northern tributary crossings from 40 m to 80 m and construction of a new 80-m wide crossing of Smoky Creek; modular CHHP upgrades; laydown areas; powerlines; stormwater drains; pit water pipelines and six sediment dams. Construction of a levee between Pit 4 and Smoky Creek is also proposed as part of the project to protect against a flood event with a 0.1% Annual Exceedance Probability (AEP).

The project is located within the Isaac Connors Groundwater Management Area. The project area is traversed by Smoky Creek and its northern tributary and Billy's Gully to the south. Both Billy's Gully and Smoky Creek intersect the project area, and join the Isaac River approximately 7 km downstream of the project. The Isaac River, Smoky Creek and its northern tributary, and Billy's Gully are ephemeral, with surface flows generally restricted to periods during and after rainfall. Approximately 466 ha of vegetation will be cleared, including 182 ha of remnant vegetation and 4.0 ha of endangered (under the EPBC Act) high-value regrowth vegetation which includes Brigalow Threatened Ecological Communities (TEC). Approximately 0.6 ha will also be cleared for the Billy's Gully haul road crossing expansion. Clearing, groundwater drawdown and altered flooding regimes could result in impacts to the riparian corridors which provide habitat for several EPBC Act-listed threatened species.

The IESC has previously provided advice for the Isaac Plains East Mine (IESC 2017-083), and the Isaac Downs Project (IESC 2020-114) which is located approximately 7 km south of the project.

Response to questions

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

Question 1: Can the Committee provide comment on whether the information provided in the PER, particularly the baseline and modelled data, and the conclusions drawn by the proponent, are sufficient to assess the project's impacts to surface and ground water resources, GDEs and cumulative impacts with other proposed and existing projects?

Question 2: Can the Committee identify and discuss what additional information could be provided to assist in the assessment of impacts on surface and ground water resources?

1. The IESC's responses to these two related questions are combined below to make it easier for the reader to follow links between where information provided in the PER (Public Environment Report) is deemed by the IESC to be insufficient to assess the project's impacts (Question 1) and the additional information that could be provided to assist in the impact assessment (Question 2).

Groundwater

Groundwater modelling

2. The groundwater model predicts limited drawdown of the Tertiary sediments and Tertiary basalt. However, the numerical groundwater model was informed by limited site-specific monitoring data, with the majority of groundwater head level data used for history-matching being derived from only 11 monitoring bores (Klohn Crippen Berger 2020, Appendix IV, p. 10). The proponent has provided the groundwater level hydrographs used for transient calibration, which consist of manual dip and automatic logging measurements (Klohn Crippen Berger 2020, Appendix III, pp. 1-6). Only two bores provided data from January 2016 and June 2018 to April 2020 for the Tertiary sediments (MB4a and MB4b), one bore provided data from June 2018 to April 2020 for the Tertiary basalt (MB10), and two bores provided data from June 2008 to April 2020 for the Rewan Formation (Swamp Bore 2 and Burton Coal Bore 2). Seven out of the 12 hydrographs used for transient model calibration were from bores screened within the Rangal Coal Measures. No hydrographs from bores screened in the alluvium were used during model calibration.
3. The influence of these limited data on the non-unique and correlated estimates of parameter values (e.g. the calibrated hydraulic properties in Table 2.3 and calibrated recharge rates in Table 2.4 of Appendix IV (Klohn Crippen Berger 2020)) and the uncertainty of the model predictions should be quantified. Estimations of these parameter values have implications for predicting potential impacts of groundwater drawdown, especially if errors in estimated recharge rates and/or assumed specific storage may lead to unrealistic predictions of the range of drawdowns.
4. Further limitations of the data and field monitoring program include that:
 - a. the uncertainty analysis of the numerical groundwater model was limited to a sensitivity analysis which varied horizontal and vertical hydraulic conductivity, specific storage, specific yield, recharge rates and horizontal and vertical hydraulic conductivities of the Isaac Thrust Fault Splay by 100% above and below the calibrated values. Model parameters should be varied spatially and across a plausible range of values as these hydraulic properties likely vary spatially by several orders of magnitude across the project area and within individual formations. Varying model parameters, which are defined by parameter constancy, by $\pm 100\%$ is not sufficient for assessing sensitivity of hydraulic conductivity, specific storage and recharge rates. This is particularly true for the Tertiary basalt which has a highly heterogenous distribution of fractures and may be the main hydraulic control of groundwater flow within this aquifer (Reach Environmental 2020, Chapter 5, p. 20).
 - b. although alluvium is included as a layer within the groundwater model, it is unclear whether this alluvium represented the Billy's Gully alluvium or the Isaac River alluvium. Additionally, although the proponent has discounted the possibility of hydraulic connection between the alluvium at

Billy's Gully and the underlying Tertiary sediments, recharge between the two formations appears in the conceptual site model for Billy's Gully (Figure 32b, 3d Environmental 2020, p. 67). The proponent should:

- i. clarify whether flow from Billy's Gully alluvium to the Tertiary sediments is predicted to occur by the groundwater model; and,
 - ii. quantify the implications for the lack of calibration to groundwater levels within the alluvium for the groundwater drawdowns.
- c. surface water features have been represented as drains within the groundwater model (Klohn Crippen Berger 2020, Appendix IV, p. 8). This condition implies groundwater recharge by surface water is not occurring which contradicts the conceptual models (Figure 31a, 31b, 32a, 32b, Reach Environmental 2020). The implications of this discrepancy on predicted groundwater drawdown should be discussed by the proponent.
5. It is not clear from the numerical model what geological units are represented by the 'weathered sediments', as presented in the groundwater depressurisation predictions (Figure 16, Figure 22 and Figure 25, Klohn Crippen Berger 2020). Although the proponent does describe the surface geology within the project area as consisting of "*a veneer of recent weathered sediments comprising the Suttor Formation and associated colluvium and regolith*" (Klohn Crippen Berger 2020, p. 19), it is not clear whether this geological formation is the 'weathered sediments' to which the proponent refers in the groundwater drawdown predictions. In order to assess potential impacts of groundwater drawdown from the project, the proponent should clarify what geological formation represents these 'weathered sediments'.
 6. Further information on the influence of the Isaac Thrust Fault splay on groundwater dynamics in the project area is required. Although the proponent expects faults to limit depressurisation of the Permian coal measures and Rewan Formation (on the basis that faults within the vicinity of the project are typically sealed by clay smearing, mineralisation or displacement with less-permeable material) (Reach Environmental 2020, Chapter 5, pp. 21-22), no consideration is given to the potential for these faults to provide a pathway for leakage to deeper aquifers and/or seepage from the final voids. Additional uncertainty scenarios should be used to explore the effects on predictions of a range of credible fault conceptualisations (including varying strata displacements with more-permeable material) and associated hydraulic parameters within the project area.
 7. Swamp Bore 1, an operational water supply bore screened in the Rewan Formation, is predicted not to be impacted by the project as drawdown or depressurisation of the Rewan Formation in the vicinity of Swamp Bore 1 is not predicted to occur (Reach Environmental 2020, Chapter 5, p. 53). Although the Rewan Formation is generally a low-permeability formation, abstraction from it is possible. For example, the proponent notes that the highest recorded yield from this bore is approximately 1.1 L/s (Klohn Crippen Berger 2020, p. 34). Swamp Bore 1 lies to the east of the Isaac Thrust Fault Splay, where the Rewan Formation was modelled as a single layer with a single set of calibrated parameters (Table 2-3, Klohn Crippen Berger 2020, Appendix IV, p. 11). No acknowledgement of lithological heterogeneity or hydraulic variability within the Rewan Formation is made by the proponent, either in the PER (Reach Environmental 2020, Chapter 5) or in the numerical groundwater model. Justification for simplifying the Rewan Formation to a single model layer, given it is modelled as five layers to the west of the splay, and the impact of this simplification on predicted groundwater drawdown near Swamp Bore 1, should be discussed and assessed as part of the uncertainty analysis.
 8. The proponent should seek an independent review of the groundwater model to improve confidence in the modelling process and its predictions.

Groundwater quality

9. Potential impacts to groundwater quality have not been fully assessed by the proponent. It is unclear when the baseline groundwater quality data were collected (Klohn Crippen Berger 2020, Appendix II, pp. 1-2). The proponent sampled groundwater quality for only pH, EC and major ions, collecting data at an unknown frequency from 14 monitoring bores (two bores screened in the Tertiary sediments, two in the Tertiary basalt, three in the Rewan Formation and seven in the Rangal Coal Measures). These data are insufficient to characterise temporal and spatial variability in baseline groundwater quality at the project site. Further baseline data, including metals and metalloids, should be collected over a sufficient period to encompass seasonal and interannual variability (Paragraph 27).
10. The baseline groundwater quality data presented by Klohn Crippen Berger (2020, Appendix II, pp. 1-2) have not been assessed against water quality objectives (WQOs). Furthermore, these baseline groundwater quality data do not include the analytes in the groundwater contaminant triggers list (in Table 12 of the Environmental Authority (EA) EPML00932713). In order to assess potential future impacts to groundwater quality, all baseline data should include the analytes as required by the EA, as well as copper, cadmium, lead, nickel and zinc, and be compared to the groundwater contaminant trigger values. These additional analytes are routinely measured and should be added because they are not currently reported in the baseline data.

Surface water

11. The proponent asserts that there will be negligible impacts to the flows in Billy's Gully and Smoky Creek due to the changes of the catchment area during and post operation. However, the potential impacts from erosion and altered sediment loads as a result of the construction of a haul road crossing at Smoky Creek and the widening of the haul road crossing at Billy's Gully have not been adequately considered by the proponent. To assess the likely impacts of increasing erosion and altered sediment loads, appropriately designed monitoring of the haul-road crossings is required, to confirm that water quality and erosion management measures are effective.

Water balance model

12. In constructing the water balance, the proponent included the operating Isaac Plains East Mine; Isaac Plains Mine which ceased operation in 2018; the Isaac Plains Underground development project and operating assets including the dragline, coal handling plant, infrastructure facilities and train load-out area. It is unclear why the proponent included the future underground operations but not the Isaac Downs Mine. Although neither project has been approved by the regulator, the Isaac Downs referral documentation highlighted that the project would utilise the existing Isaac Plains Mine water storage infrastructure (this project was assessed by the IESC in May 2020 (IESC Advice 2020-114)). The proponent has stated that, based on the results from the water balance modelling, there is sufficient capacity available within the mine water storage system for all mine-affected water over the life of the IPC operations (Reach Environmental 2020, Chapter 4, p. 27). However, based on modelling under very wet climatic conditions (1%ile) from January 2023 to January 2030, the forecasted mine-affected water inventory for the S2 pit is close to capacity (10,230 ML with the capacity of S2 Pit at 10,310 ML) (WRM Water & Environment 2020, p. 98). In order to provide assurances in the water balance model presented, the proponent should provide an updated water balance model which considers two scenarios and includes a sensitivity analysis of the assumptions:
 - a. the first scenario to include all future operations proceeding (both the Isaac Plains Underground development project and the Isaac Downs Mine); and,
 - b. the second scenario where future projects are excluded and not proceeding.

Flood modelling

13. The flood modelling has been undertaken to a high standard that is consistent with the most recent edition of the national flood guidelines (Ball et al. 2019). The project requires a new creek crossing at Smoky Creek, with associated culverts for the haul roads and a dragline between Pit 4 and Pit 5. Allowance has been made for constructing an 80-m wide crossing which includes the required surface width for the dragline (approximately 40 m) plus embankments. The widths of the haul road crossings of the northern tributary of Smoky Creek and Billy's Gully are proposed to be expanded from 40 m (allowed under current approvals) to 80 m to allow the dragline to be walked across the creeks in these locations. The potential impacts from the expansion of these haul road crossings are discussed further in Paragraph 34.
14. Although the proponent considered the potential impacts of flooding for Smoky Creek, Billy's Gully and the Isaac River, only the flood modelling simulation outcomes concentrating on the dragline, haul road crossings for Smoky Creek and Billy's Gully, and Pits 1, 2, 4 and 5 are presented. The flood impacts are presented only as cumulative impacts, with the proponent stating that the impacts of flooding, in particular for the 10% AEP to 0.1% AEP events, are confined to small areas around the haul road crossing alterations and the flood protection levee on Smoky Creek. It is predicted that impacts will dissipate before reaching the existing project area of the Isaac Plains East Mine (WRM Water & Environment 2020, pp. 143-144). However, the proponent should provide the simulated flood predictions for the whole Isaac Plains East project area to provide confidence that there will not be impacts on the infrastructure which the proposed project will utilise and the final voids at project completion.

Surface water quality

15. The proponent has provided baseline surface water quality data which were collected in March-April 2019 from the Isaac Downs Mine, located 10 km south of the IPC. Most of the water samples were taken from standing water during periods of no flow. The proponent acknowledges that the water quality samples are based on a small number of water quality samples (1-3 samples per site) due to the limited periods of flow (WRM Water & Environment 2020, Table 3.4 and Table 3.5, p. 51-56). Water quality data for Smoky Creek upstream and downstream of the existing Isaac Plains East mine indicate the pH to be slightly alkaline, with recorded concentrations of aluminium and copper higher than the default guideline values for aquatic ecosystem protection (WRM Water & Environment 2020, Table 3.6 and Table 3.7, pp. 57-60). The proponent has stated that Billy's Gully has limited scope for water quality sampling due to it being highly ephemeral (WRM Water & Environment 2020, p. 51). As a result, no water quality data for Billy's Gully are presented by the proponent. It is unclear when the surface water quality monitoring data were obtained for Smoky Creek and whether any sampling periods coincided with discharges from RP1 to Smoky Creek. The proponent should undertake sufficient surface water quality monitoring, including during events such as floods and heavy rainfall, to provide appropriate baseline data for the Isaac River, Smoky Creek and Billy's Gully.
16. The water quality data provided for the site storages only included pH, EC, sulfate, turbidity and suspended solids. Under the EA (DES 2020, p. 17), the proponent is required to also monitor aluminium, arsenic, cadmium, cobalt, copper, fluoride, lead, nickel and zinc but these results were not provided. At times, the site water storages exhibit EC values which exceed 5,000 $\mu\text{S}/\text{cm}$ and pH values > 9 . Other potential contaminants for the water quality data (e.g. metals) have not been provided. The proponent has stated that the mine-affected water will be used for dust suppression, with the annual estimates of the required volumes of water varying between 20 and 500 ML/a (Reach Environmental 2020, Chapter 4, p. 2). As it is not clear which storage(s) will provide the water for dust suppression, the proponent should provide:
 - a. monitoring data from the raw water dam, N1 Pit, S3 Pit, S2 Sediment Dam, Release Dams 1 and 2 and the CHPP Process Pond for all contaminants, including metals; and,

- b. further information on the potential impacts of using mine-affected water on the site, including cumulative impacts.
17. The proponent has outlined that the sediment dams will be cleaned out on a regular basis to maintain available storage (WRM Water & Environmental, 2020, p.180). Information is needed on where the material removed from the sediment dams will be placed and stored and whether the material is likely to contain contaminants which could leach into the surrounding environment.

Groundwater-dependent ecosystems

18. During March 2020, the proponent measured soil moisture potentials, stable isotopes and leaf water potentials of trees at four sites (GDE Areas 1-4) to assess their likely groundwater-dependence, and is to be commended for this assessment. From this work, it was concluded that trees along Smoky Creek and its northern tributary in GDE Areas 1, 2 and 3 are interacting with moisture within the upper soil profile, whereas along Billy's Gully in GDE Area 4, trees nearer the stream interacted more with a shallow, unconfined and potentially seasonal source of groundwater within the saturated portion of the soil profile. The proponent acknowledges the limited spatial extent of the sampling which was only done once. Although this information on groundwater-dependence of trees in these four areas is very useful to inform conceptual models and predict likely impacts of groundwater drawdown, it would be helpful to repeat this sampling in these four areas during peak dry periods and also after mining commences to see whether there are any changes in groundwater-dependence by riparian vegetation along the creeks traversing the project area.
19. The IESC supports the consultant's recommendation (3d Environmental 2020, p. 76) that the biannual riparian ecological monitoring program that has commenced along Smoky Creek should be extended to Billy's Gully. As well as assessing vegetation composition and condition, this proposed program is to include ongoing monitoring of leaf water potential, soil moisture potential and stable isotopes for selected sites over a two-year period with biannual surveys to capture post wet and dry conditions. A further round of surveys is recommended if there is a period of extended drought and at the end of the mining operation to assess whether there have been any changes in groundwater-dependence of the vegetation and its health.
20. The proponent has identified the riparian vegetation along the Billy's Gully alluvium as the only GDE in the project area. This GDE is considered to rely on an alluvial surface-fed perched aquifer system that is disconnected from the underlying Tertiary sediments and hence is considered by the proponent to not be subject to the predicted drawdown from the project. However, it is not clear whether the proposed widening of the haul road crossing and its subsequent use may interfere with the integrity of the low-permeability strata underlying this perched aquifer, as well as recharge or other characteristics that would impair its use by GDEs. The proponent should fully assess the risks of this construction on the perched aquifer, and specify plans to avoid or mitigate any potential impacts.
21. The proponent also notes that flows in Billy's Gully are regulated by surface runoff rather than baseflow due to the perched nature of the stream; however, no data are provided by the proponent to support this conclusion (Reach Environmental 2020, Chapter 5, p. 55). Furthermore, the reduction of the area of the Billy's Gully catchment and its potential impact on GDEs (e.g. via recharge of the perched aquifer system) along the stream has also not been considered by the proponent, and more information is needed to assess this possibility.
22. The proponent acknowledges the possibility that deep-rooted riparian vegetation may penetrate through Billy's Gully alluvium into the lower Tertiary clays and sediments (Reach Environmental 2020, Chapter 5, p. 32). If so, drawdown in these Tertiary clays and sediments may impact the riparian vegetation along Billy's Gully and associated species (e.g. EPBC Act-listed species such as Greater Glider (*Petauroides volans*) and Koala (*Phascolarctos cinereus*)) that move along this corridor and

use it for habitat and foraging. This has not been considered by the proponent. Further discussion of these potential impacts should be provided to guide mitigation strategies (see Paragraph 32).

23. A single stygofauna pilot survey of ten bores was undertaken for the proponent as part of the PER. Field results identified a single species in two bores located to the north of the project area (FRC Environmental 2020, Appendix A, p. 16). The stygofauna community was assessed by the proponent as having low environmental value due to the limited occurrence of a single stygoxene taxon and poor water quality of most of the groundwater. Although this information indicates a depauperate stygofauna, previous studies have indicated multiple stygofaunal species occur in the region (Hose et al. 2015, p. 14). The IESC recommends at least one further round of sampling, especially in any alluvial bores with electrical conductivity values below 10,000 $\mu\text{S}/\text{cm}$ and concentrations of total dissolved solids below 1,000 mg/L, to confirm whether the stygofauna in the project area are sparse and species-poor. Any new bores installed to monitor groundwater could also be sampled for stygofauna, including the proposed monitoring bore on Billy's Gully floodplain (3d Environmental 2020, p. 76).

Final voids

24. A climate change sensitivity analysis was undertaken to determine potential impacts on the water levels of the final voids. Steady-state water levels are predicted to be lower than the base case scenario due to the lower expected rainfall rates and higher expected evaporation rates associated with predicted climate change patterns (Kohn Crippen Berger 2020, p. 39). However, lower-than-expected rainfall rates are predicted using only the 'best case' climate change scenario (WRM Water & Environment 2020, p. 109, Table 7.3). To increase confidence in the risks posed by stored water in the final voids, the proponent should consider the impacts of climate change on the simulations of long-term (at least 100 years) water level and salinity behaviour. While it is recognised that there is uncertainty around the likelihood of different representative concentration pathway (RCP) projections, current opinion (e.g. Schwalm et al., 2020) is that RCP8.5 is in close agreement with historical and current CO₂ emissions and thus is useful for quantifying climate risks. Consequently, it would be preferable to use the median RCP8.5 projection as a 'worst case' emissions scenario and the median RCP4.5 projection as a 'moderate' emissions scenario.

Cumulative impacts

25. The proponent has predicted limited cumulative groundwater drawdown within the weathered sediments and Tertiary basalt, with the majority of drawdown predicted to occur within the project area (Klohn Crippen Berger 2020, Figure 25 and Figure 26). The proponent has also modelled the percentage contribution of the project to these cumulative groundwater drawdowns, which is generally between 10% and 50% within the weathered sediments (see Paragraph 5) and 25% and 75% for the Tertiary basalt (Klohn Crippen Berger 2020, Figure 22 and Figure 23). Further clarification is required to fully assess the potential impacts of these cumulative drawdowns on groundwater resources as no explanation is provided by the proponent for the:
- a. spatial distribution of predicted cumulative groundwater drawdown within the weathered sediments and Tertiary basalt. The structural and stratigraphic mechanisms that could influence the cumulative drawdown contours predicted within the Tertiary basalt (Klohn Crippen Berger 2020, Figure 26) are not discussed by the proponent. The proponent should address the potential for faults or jointing within the Tertiary basalt to provide pathways for leakage to adjacent aquifers and/or seepage from the final voids. Additional uncertainty scenarios could be used to explore the effects on predictions of a range of plausible fault and hydraulic parameter conceptualisations within the project area; and,
 - b. range of percentage contributions of the project on predicted cumulative groundwater drawdown within the weathered sediments and Tertiary basalt. The project's contribution to cumulative

drawdown within the weathered sediments is predicted to be between 10% and 50% (Klohn Crippen Berger 2020, Figure 22), while its contribution to cumulative drawdown within the Tertiary basalt is predicted to be between 25% and 75% (Klohn Crippen Berger 2020, Figure 23). The relatively large range, and differences in the project's contribution to cumulative drawdowns, particularly given the relatively short distances between the areas of predicted cumulative drawdowns, should be explained and justified.

Question 3: Can the Committee provide comment on the adequacy of the proposed mitigation, management and monitoring measures? Does the Committee consider that any additional measures are needed to remain within the projected levels of impact or reduce the risks to surface and groundwater resources, GDEs and cumulative impacts with other proposed and existing projects?

26. The IESC notes several limitations of the proposed mitigation, management and monitoring for this project. Some of these limitations have been discussed in the responses to Questions 1 and 2 and others are outlined below. Additional measures to reduce risks are also suggested.

Groundwater

27. The proponent has provided an adequate Groundwater Monitoring and Management Plan for the IPC which includes the project (Klohn Crippen Berger 2020, Appendix V). However, as discussed in Paragraph 10, the dataset presented for baseline groundwater quality does not include the full suite of analytes as listed in Table 12 of EA EPML00932713 (DES 2020) nor does it provide the requirement to monitor cadmium, copper, lead, nickel and zinc which should be included to effectively measure potential future impacts to groundwater quality.

28. The IESC supports the recommendation (Reach Environmental 2020, Chapter 5, p. 59) of an additional groundwater monitoring bore that will be screened within the perched groundwater system in Billy's Gully and managed under the existing EA EPML00932713 (DES 2020). Data on water levels and groundwater quality from this bore will be relevant for interpreting the results of the recommended surveys of community composition, condition and groundwater-dependence of riparian zone vegetation (Paragraphs 18 and 19) along Billy's Gully. This bore could also be sampled for stygofauna (Paragraph 23).

29. Additional monitoring bores should be strategically located to detect potential leaching from storages of mine-affected water.

Surface water management and monitoring

30. The proponent states that the Surface Water Management System will ensure that the project maintains compliance with EA conditions and that regional WQOs are achieved. Under the EA conditions, the proponent is required to develop a receiving environment monitoring program (REMP). The IESC agrees that a REMP should be developed by the proponent. Sediment quality monitoring, as required in the EA, should also be included in the REMP.

31. Using baseline data on water quality and the community composition and condition of riparian zone vegetation and aquatic biota, the proponent should propose appropriate mitigation and management strategies to avoid and minimise potential impacts of higher sediment loads and/or altered water quality on riparian vegetation and aquatic biota in the Isaac River, Smoky Creek and Billy's Gully. A suitable monitoring strategy, including sampling appropriate reference sites, should be outlined that allows the proponent to demonstrate the effectiveness of these mitigation strategies in protecting the ecological integrity of the ephemeral streams and the Isaac River into which they flow.

Water-dependent ecosystems

32. Although the proponent has highlighted the site water management system and erosion and sediment control plans as mitigation measures to protect GDEs, mitigation of any unpredicted groundwater drawdown is focussed on monitoring (3d Environmental 2020, pp. 74-77). This is presumably because the proponent predicts groundwater drawdown impacts on the Billy's Gully GDE to be negligible. Although the proposed monitoring measures are commendable, there are no proposed mitigation measures should the monitoring reveal impacts due to groundwater drawdown. Therefore, specific management and mitigation plans are needed that describe how the proponent will avoid or reduce impacts of the proposed project on GDEs in the area surrounding and/or downstream of the project area. These plans should justify the measures to be used to mitigate the likely impacts of drawdown on groundwater-dependent riparian vegetation and other riparian ecology. Such mitigation plans will be guided by the ecohydrological conceptual models presented in 3d Environmental (2020, pp. 62-67) and appropriate monitoring (as discussed in Paragraph 18). The plans should also describe what remediation measures will be taken if the monitoring indicates impacts of drawdown on water-dependent ecosystems and their associated biota, and how the effectiveness of these measures will be monitored.
33. As stygofauna were considered by the proponent to be of low environmental value, limited management measures to protect this GDE are proposed (Reach Environmental 2020, Chapter 5, p. 59) and no further sampling is planned. Should further stygofaunal taxa be identified during the recommended additional round of stygofauna sampling (Paragraph 23), then more stringent mitigation and management measures should be proposed, and their effectiveness assessed with annual monitoring of stygofauna.
34. The proposed new 80-m wide haul-road crossing over Smoky Creek and the widening of two others over Billy's Gully and the northern tributary of Smoky Creek to 80 m are likely to severely disrupt movement by animals (including some EPBC-listed species such as Greater Gliders (*Petauroides Volans*) and Koalas (*Phascolarctos cinereus*)) that potentially use the riparian zone corridor to move about and as habitat. Although the proponent plans to rehabilitate the crossings after use, the period of disruption will span the life of the mine plus the time it takes for restoration of mature riparian vegetation. Appropriate monitoring of riparian zone condition and fauna within and near these crossings is needed before, during and after mine operations to assess the effects of these disruptions of longitudinal riparian zone continuity, and to measure the effectiveness of proposed mitigation and rehabilitation measures. This includes establishing the success of the rehabilitation of riparian zone structure and function post mining when the crossings have been decommissioned.
35. The 2019 - 2020 bushfires affected part of the Isaac River catchment but not the project area. Consequently, the Isaac River riparian corridor and other habitats within and around the project area are likely to be providing crucial refugial areas for many species, including EPBC Act-listed species, that either escaped the fire or are potential colonists of burnt areas after they recover. Therefore, maintenance of this habitat and its connectivity to adjacent riparian and floodplain vegetation is particularly important while surrounding burnt bushland recovers and should be a priority in the mitigation and management strategies of the project.

Final voids and landform

36. The proponent indicates that there will be three final voids at the existing Isaac Plains East mine and two final voids as a result of the project. The proponent states that these five final voids will gradually accumulate water and remain a perpetual groundwater sink, with groundwater expected to flow from the eastern pit voids (Pit 5, Pit 4/4N and Pit 2/3) to the western pit voids (Pit S2 and N1). These voids will pose multiple and ongoing risks to the environment. Water within all five voids is predicted to become hypersaline. Consideration should be given to how this higher-density saline water may

affect groundwater flow (e.g. the void may no longer behave as a groundwater sink due to the density contrast between void water and underlying groundwater) and quality.

37. Final voids usually have long-term impacts on local groundwater levels and quality. The five final voids pose long-term risks to biota (e.g. water birds, mobile aquatic insects such as dragonflies, mayflies and some water beetles) from deteriorating water quality, especially increasing salinity, as well as leachate seepage from overburden emplacement to groundwater systems. The proponent needs to provide mitigation plans to deal with these risks. These mitigation plans should be informed by water quality monitoring and solute transport modelling (e.g. Hamann et al. 2015; Salmon et al. 2017). The IESC recommends that various options for further backfilling (including partial backfilling) of the final voids should be investigated. Appropriate monitoring and management measures should ensure impacts are minimised.

Cumulative impacts

38. Given the proximity and number of mining operations near the project area (17 projects in the vicinity of the project boundary area), cumulative impacts associated with nearby past, current and planned mining operations are highly likely. The five final voids are predicted to become a regional groundwater sink in perpetuity once final equilibrium is reached, predicted by the proponent to be approximately 700 years after mining ceases. Therefore, appropriate strategies should be described by the proponent to mitigate and manage the cumulative ecological impacts of this persistent drawdown. A risk assessment of these cumulative impacts is needed, along with reliable baseline data against which to judge the effectiveness of proposed mitigation and management plans.

Date of advice	31 August 2020
Source documentation provided to the IESC for the formulation of this advice	<p>3d Environmental 2020. <i>Isaac Plains East Extension Project Groundwater Dependent Ecosystem Assessment</i>. Prepared by 3d Environmental on behalf of Stanmore IP Coal Pty Ltd. Project No. 2020_231.</p> <p>C&R Consulting 2020. <i>Isaac Plains East Extension Project Aquatic Ecology Report</i>. Prepared by C&R Consulting Geochemical and Hydrobiological Solutions Pty Ltd on behalf of Stanmore IP Coal Pty Ltd. Project number: 20035.</p> <p>DES 2020. <i>Environmental Authority EPML00932713 – Isaac Plains East Extension</i>. Prepared by the Queensland Government Department of Environment and Science.</p> <p>Ecological Survey & Management 2020. <i>Isaac Plains East Extension Project – Terrestrial Ecology Impact Assessment for Commonwealth Matters of National Environmental Significance</i>. Prepared by Ecological Survey and Management on behalf of Stanmore IP Coal Pty Ltd. Document Version. 20014_Rpt01d.</p> <p>FRC Environmental 2020. <i>Appendix 10 – Isaac Plains East Extension: Stygofauna Pilot Study</i>. Prepared by FRC Environmental on behalf of Stanmore IP Coal Pty Ltd.</p> <p>Klohn Crippen Berger 2020. <i>Isaac Plains East Extension Project Groundwater Report</i>. Prepared by Klohn Crippen Berger on behalf of Stanmore IP Coal Pty Ltd. Report Reference D10175A08.</p> <p>Reach Environmental 2020. <i>Isaac Plains East Extension PER</i>. Prepared by Reach Environmental on behalf of Stanmore IP Coal Pty Ltd.</p> <p>Terrenus Earth Sciences 2020. <i>Geochemical Assessment of Potential Spoil and Coal Reject Materials. Isaac Plains East Extension</i>. Prepared by Terrenus Earth Sciences on behalf of Stanmore IP Coal Pty Ltd. Report Number 20-049-127 / R001.</p>

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