

Advice to decision maker on coal mining project

Proposed action: Galilee Coal Project (Northern Export Facility), Queensland (EPBC 2009/4737) – New Development

Requesting agency	Department of the Environment
Date of request	09 October 2013
Date request accepted	09 October 2013
Advice stage	Approval

Advice

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the Committee) was requested by the Australian Government Department of the Environment (the Department) to provide advice on the Galilee Coal Project (Northern Export Facility) which is being assessed in accordance with the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Committee was separately requested and provided advice on this project in May 2013 to the Queensland Coordinator-General at the supplementary Environmental Impact Statement stage. A response to the Committee's May advice was provided within the Queensland Coordinator-General's *Evaluation Report on the Environmental Impact Statement*.

This advice draws upon aspects of information in the finalised Environmental Impact Statement, which was submitted to the Australian Government in September 2013, together with the expert deliberations of the Committee. The project documentation and information accessed by the Committee are listed in the source documentation at the end of this advice.

This project is a new coal mine development in Central Queensland, proposing two open cut and four longwall underground mines. The proposal would produce an estimated 40 Million tonnes per annum (Mtpa) of coal and have a mine life of 30 years. The mine site is located approximately 450 km west of Rockhampton and 35 km north-west of the Alpha township. A 453 km standard gauge rail line is also proposed from the mine to the Port of Abbot Point, immediately north of the town of Bowen and is also included within this assessment.

The Committee, in line with its Information Guidelines¹, has considered whether the proposed project assessment has used the following:

Relevant data and information: key conclusions

In general, data and information about the water resources in the Galilee Basin are lacking.

Cumulative Impacts: A cumulative impact assessment was conducted across five significant projects in the area, although the groundwater modelling only considered three of those projects.

The proposed developments within the Galilee Basin have the potential to extend along a distance of over 300km and comprise some of the largest coal mines in Australia. On this basis, the Committee considers that information on predicted cumulative impacts should be commensurate with the scale of the total proposed developments. As a greenfield development area, there is an important opportunity to assess the potential cumulative impacts associated with large coal mines and potential coal seam gas operations in the early stages of development within the Galilee Basin.

The assessment of potential cumulative impacts to Matters of National Environmental Significance (MNES), including water resources, requires a consolidated effort to share data between proponents proposing to operate coal mines within the Galilee Basin. Further collaborative research on potential cumulative impacts would assist to fill critical data gaps and build a clearer understanding of the scale of impacts to the region, rather than assessing potential impacts on a site-by-site basis. This includes the need for:

- A regional cumulative groundwater model that spans relevant areas and stratigraphy of the Galilee Basin and Great Artesian Basin (GAB) to enable a full assessment of the potential impacts to groundwater within the Galilee Basin and the GAB;
- Regional surface water studies to assess impacts to water quality and ecosystems, specifically examining the impacts of the proposed number of creek diversions and waste water discharge points in the headwaters of the Belyando catchment, and the impacts of potential subsidence across the basin to surface water flow and natural flooding regimes; and
- Collaborative research to assess the scale of water related impacts to threatened species and ecological communities resulting from the combined impact of coal mining within the Galilee Basin.

Rewan Formation: The integrity of the Rewan Formation has been interpreted as playing a critical role in mitigating impacts to the GAB from the project. Although the Rewan is generally considered to have low porosity and permeability, there is a lack of evidence to substantiate that this formation acts as a uniform aquitard. Variations in local geology, including faulting, could enhance the permeability and hence connectivity between the aquifers of the Galilee Basin and those of the overlying GAB. Characterising the extent and nature of faulting is needed to reduce uncertainties and understand risks to the GAB and associated MNES assets such as springs.

Barcaldine Springs: There is a lack of information to confirm that all springs within this group are recharge springs, and that no discharge springs are present. Information on spring baseline water levels, sources of water, and ecological attributes is needed to understand potential impacts.

Application of appropriate methodologies: key conclusions

Surface Water: The flow characteristics of the creeks located within the proposed project area are based on gauging data from a location 30km to the south east, which is not likely to adequately represent the site flow.

Subsidence: The methodology for calculating the 180m fracture zone has not been provided and a minimal increase in fracturing would result in connectivity with the Clematis Sandstone, a known GAB aquifer. In addition, predicted subsidence related reductions in stream flows only account for surface water ponding and do not include potential exchange of water between surface water and groundwater systems.

Groundwater Dependent Ecosystems (GDEs): The proponent asserts that the regional groundwater being 20 to 60m below ground level (mbgl) would be too deep to support vegetation dependent on groundwater. Consideration needs to be given to vegetation dependence on groundwater within the shallow alluvium and the ecological relevance of connection between perched groundwater and the deeper regional groundwater.

Reasonable values and parameters in calculation: key conclusions

Site Groundwater Model: There is relatively limited data available, and insufficient baseline water level data within the Galilee Basin, to derive statistically robust groundwater model parameters, which reduces the level of confidence in impact predictions.

The Committee's advice, in response to the Department's specific questions, is provided below. In formulating this advice the Committee has referenced the previous advice provided to the Queensland Coordinator-General (QC-G) and the QC-G's response to those comments. A number of the Committee's original points have not been addressed within the finalised Environmental Impact Statement (EIS) and as such, remain issues to be dealt with when considering potential impacts to Matters of National Environmental Significance (MNES).

Question 1: What does the Committee consider are the key uncertainties and risks of the project in relation to water resources that will need to be managed to ensure that related impacts to MNES are acceptable?

1. Water Resources: Groundwater - The key uncertainties and risks to be managed (covered previously in Points 1, 2, 3, 4 and 5 within the May 2013 advice to the QC-G) relate to the role of the Rewan Formation given the proponent's reliance on it as a barrier to the overlying GAB aquifers. Other uncertainties include faulting, whether springs are recharge or discharge springs and the adequacy of the groundwater model parameters. The following points of advice are provided to both re-emphasise aspects of the Committee's previous advice and to identify new uncertainties and risks associated with surface water.
 - a. The Rewan Formation is assessed as playing a critical role in mitigating impacts to the GAB from coal mining, based on an assumption that it acts uniformly as an aquitard to minimise connectivity with the GAB. The Committee emphasises the following uncertainties and risks in applying this interpretation:
 - i. Groundwater model parameters: Clear justification has not been provided to support the adopted values for the parameters used within the groundwater model. It is important that multiple lines of evidence, including reasonably representative field based testing, are drawn upon to derive groundwater model parameters. There is limited discussion on the inherent uncertainties associated with the groundwater model parameters and the implications of these for predicted impacts to groundwater, particularly the GAB. Further recommendations on managing this uncertainty are provided in Question 2, Point 4.

As an example, the initial vertical hydraulic conductivity estimate for the Rewan Formation of 9×10^{-05} m/day (transient model) demonstrates the uncertainty within the adopted values for the groundwater model parameters. There is no clear evidence presented as to why this value was adopted especially given that the testing of four core samples for the Rewan Formation found that this value varied considerably from 1.1×10^{-02} to 7.5×10^{-06} m/day (arithmetic mean of 2.8×10^{-03} m/day) and that fracture flow could create much greater regional conductivity. The range in these numbers suggest that this is may be a highly variable system and should be further characterised using field investigations.

- ii. Impacts on springs: The Barcaldine Springs are located 30 to 40km west of the project site and the proponent interprets these to be recharge springs. Relying on the assumption that the Rewan Formation will restrict connectivity with the GAB results in the risks to these springs being potentially under-estimated. Evidence should be provided to confirm baseline levels, source aquifers (including whether discharge springs are present) and determine the presence of native species that are dependent on natural discharge of groundwater from the GAB; and
 - iii. Faulting: The potential for faulting within the Rewan Formation has not been included within the proponent's groundwater model. Faults were identified within the Kevin's Corner EIS, and it is unlikely that such faulting is only limited to the Kevin's Corner area. The Commonwealth approval conditions for Kevin's Corner require further research to be conducted on faults and fracturing. It would be prudent for a similar understanding to be developed by this project.
- b. A clear methodology for calculating the fracture zone height of 180m has not been provided within the finalised EIS. It is uncertain whether the proponent has considered the potential for variable conditions across the site, including geology, lithology, longwall panel width or where different amounts of subsidence are expected. The proponent predicts that the fracture zone extends into the Rewan Formation but that no subsidence-related impacts will occur within the overlying GAB units. The Committee notes that a marginal increase in the proponent's stated fracture zone height (e.g. due to local conditions and mine design) could result in connectivity with the Clematis Sandstone and therefore potentially impact the GAB.
 - c. The Committee has concerns that the cumulative groundwater model does not appear to include the predicted groundwater recovery levels. These were simulated for the site model over a 200 year period and have identified permanent lowering of groundwater over the proposed mine area. The cumulative model predicts that drawdown will cross into the GAB. Without cumulative recovery levels, uncertainty remains over whether this drawdown will further impact the GAB and if regional groundwater levels will be permanently lowered.
2. Water Resources: Surface water - The key uncertainties and risks to be managed (covered previously within Points 6, 7, 8, 11, 13, 14, 15 and 16 within the May 2013 advice to the QC-G), relate to water balance, discharges, creek diversions, subsidence related surface-groundwater connectivity and void management. The following points of advice are provided to both re-emphasise aspects of the Committee's previous advice and to identify new uncertainties and risks associated with surface water.
- a. The site water balance model has been revised within the finalised EIS to incorporate the groundwater modelling undertaken for the supplementary EIS provided to Queensland. The revised model now predicts an excess of water and as a result the water balance has been updated with a controlled discharge strategy. The Committee has identified the following uncertainties and risks with respect to the water balance and the controlled discharge strategy within the proponent's finalised EIS:
 - i. Flow gauging within Lagoon Creek was raised within the Committee's previous advice to the QC-G (Point 13.b). Following on from this advice, the Committee adds that gauging data from Native Companion Creek, located 30km to the south east, is unlikely to adequately represent the flow characteristics of the Lagoon Creek or Malcolm Creek catchments, which lie within the mine site;
 - ii. A salt balance has not been included within the proponent's analysis of the water management system. The proponent states that published information from the adjacent

Alpha Coal project indicates that mining spoil has the potential to mobilise salt during rainy conditions;

- iii. The water balance outputs have not been subject to a statistical sensitivity analysis; and
 - iv. The 'controlled discharge strategy' within the finalised EIS contains minimal detail. The proponent plans to provide detail in the design phase. The Committee considers that the details pertaining to the location of discharge points, water quality trigger values, discharge scenarios and monitoring (including water quality monitoring) are critical to the assessment of potential downstream impacts and should not be delayed until later design phases.
- b. The creek diversion design has been revised within the finalised EIS to minimise the reduction in the length of Malcolm Creek. This design improves the meandering of Malcolm Creek at low flows, but will provide a large straight section of waterway during high flow periods. This has the potential to increase velocities and promote large-scale erosion and scouring. The impact could be further exacerbated after mine completion, as the proponent does not intend to rehabilitate Malcolm Creek to pre-mining conditions due to the location of the final voids.
 - c. Surface water ponding mitigation has been revised within the finalised EIS, with options that reduce the percentage of flow capture. The Committee notes that the:
 - i. Predicted reductions in stream flows due to subsidence only account for surface water ponding. They do not take into account surface-groundwater interactions, particularly across the critical fracture zone where surface fractures could present flow paths from surface to underground mine-workings; and
 - ii. Proponent was unable to combine the 'creek diversion and flood model' with the subsidence ponding model due to large discrepancies identified between the different digital elevation data used for each model. This should be addressed through more accurate elevation modeling.
3. Groundwater Dependent Ecosystems and Species: The proponent asserts that the regional groundwater being 20 to 60 meters below ground level (mbgl) would be too deep to support vegetation dependent on groundwater. The proponent needs to give consideration to:
- a. Vegetation dependence on groundwater within the shallow alluvium and the ecological relevance of connection between perched groundwater and the deeper regional groundwater. The alluvial groundwater is reported to be at a depth of 10m below ground level. There is an implied assumption that the only GDEs of interest are those directly dependent on the deep regional groundwater. In addition, the influence of connectivity between the alluvial groundwater and the deeper groundwater on GDEs is unclear, with the groundwater assessment describing the potential for upward leakage, recharge to underlying strata and contribution to base flow after high flows.
 - b. Identifying the species of the recorded stygofauna so that conclusions can be drawn regarding the occurrence of the taxa, locally or regionally, outside the mining lease and any further monitoring that may be needed. The Committee refers to the Western Australia *Guidance for the Assessment of Environmental Factors (2003)*² as leading practice in the consideration of subterranean fauna.

Question 2: What does the Committee consider are the features of a monitoring and management framework that would address the uncertainties and risks of the project identified by the Committee to ensure environmental outcomes for MNES are achieved?

4. Water Resources: Groundwater – The following points of advice directly relate to the uncertainties and risks that were identified in Question 1, above.
- a. The proponent would need to revise the groundwater model regularly during the development to incorporate additional water level and subsidence data as it becomes available. The proponent should undertake additional field based testing of the groundwater model parameters and update the model as new information becomes available. The groundwater monitoring program should then be revised to reflect the updated model.
 - b. Given that there is evidence for faulting within the Kevin's Corner project, the Committee recommends that the proponent re-examines the potential for faulting when reviewing geological information during the design stage of the longwall mine or as part of the longwall mine plan. The groundwater model, monitoring and mitigation measures should be revised once this information becomes available.
 - c. A Groundwater Monitoring Plan needs to be developed to address the uncertainties that exist within the groundwater model network (discussed in Question 1) and proposed monitoring program. The Plan should consider the following:
 - i. Additional groundwater monitoring locations are needed to the west of the mine site specifically to monitor the predicted drawdown in the Triassic GAB units (including the Rewan Formation) and the Barcardine Springs. Should drawdown levels alter from the predictions then the proponent should undertake additional studies to determine the source of groundwater model error, and re-assess the potential impacts and required mitigation measures;
 - ii. Additional groundwater quality monitoring locations, to provide early warning of likely adverse impacts on groundwater in timeframes to mitigate against them; and
 - iii. Information to detect changes to groundwater level and quality, and connectivity between geological formations resulting from subsidence is needed. This should include validation of predictions around fractured zone permeability, flow rates and directions, with specific attention to areas where surface water or perched water tables are likely to be affected;
 - d. The Committee supports the Queensland approval condition that requires the proponent to contribute to a regional groundwater monitoring program with inputs reviewed routinely by the relevant regulator. Important additional preventative measures include:
 - i. The development of a regional cumulative groundwater model which utilises shared data through the collaboration of proponents proposing to operate within the Galilee Basin;
 - ii. Collaborative scientific research to target the largest areas of uncertainty within the groundwater model, e.g. permeability of Rewan Formation.
 - e. The proponent has committed to developing a Subsidence Management Plan which will provide detail on mitigation strategies and the subsidence monitoring program. This Plan should incorporate the following management and mitigation measures to address the uncertainties and risks outlined in Question 1 (Points 1b. and 2c.):
 - i. The inclusion of calculations for determining the fracture zone height. These should address the local mining conditions and multi-seam mining areas;

- ii. Improved elevation models for the subsidence modelling. Combined flood modelling should then be undertaken and include the proposed diversion and flood protection works in relation to subsided landforms, potential channelisation of flows and mitigation measures;
 - iii. A commitment to undertake subsidence monitoring during early stages of long-wall mining to determine the heights of the fracture zone prior to long-wall mining beneath GAB aquifers; and
 - iv. Validation of predictions regarding surface-groundwater interactions, particularly the prediction that soils will be self-healing with limited fracturing.
- f. Subsidence impacts are predicted to occur in all underground coal mining developments currently proposed within Galilee Basin. The cumulative impacts of subsidence should be addressed through the following:
- i. A requirement for the proponents proposing coal mining within the Galilee Basin to share data on fracture zone monitoring and impacts. The data should be used to validate subsidence predictions and inform their Subsidence Management Plan;
 - ii. Modelling of fracture zone impacts on regional groundwater drawdown, permeability, flow rates and directions should be incorporated into regional groundwater modelling to assess cumulative impacts; and
 - iii. A cumulative plan for the post-mine remediation of surface water ponding and other surface impacts of subsidence. Many of the proposed mines within the Galilee will be developed concurrently over a 30 to 40 year lifetime and therefore would benefit from a cumulative plan for the post-mine rehabilitation for surface water catchments and groundwater. This will ensure that the maximum possible outcomes are achieved for the future needs of these water resources.
- g. The Committee's previous advice to the QC-G highlights the importance of the proponent undertaking a thorough spring survey (Point 5a.). The Office of Water Science has since commissioned research into the Lake Eyre Basin springs. The springs within the Galilee Basin (including the Barcaldine springs) will be addressed as a priority, with this work scheduled for completion in mid 2014. This research aims to establish the source aquifer (including whether discharge springs are present), movement of groundwater and the ecological species reliant on these springs. The Committee suggests that once this research is complete, the proponent should utilise the research results to update their ecological and groundwater risk assessment/s and where necessary, develop mitigation measures to protect springs.
5. Water Resources: Surface water – The following points of advice directly relate to the uncertainties and risks that were identified in Question 1, above.
- a. A regional water balance should be developed and the results should be incorporated into the required water management plans. The regional water balance should extend across the regional surface and groundwater systems to defined monitoring points, beyond which there are predicted to be no measurable impacts from the proposed project or the associated cumulative impacts. It should assess the flow of water between water stores at all stages of mining (e.g. pre-mining, during and post-mining), undergo a sensitivity analysis and be presented for a range of foreseeable climatic scenarios.
 - b. The site water balance could incorporate the following additional management measures to address the uncertainties outlined in Question 1:

- i. That a time-series hydrometric monitoring station, which includes rainfall monitoring, be installed within the proposed development area to provide a clear understanding of the local hydrometric system, which would increase certainty within the site based runoff models. This should aim to represent the hydrology of Lagoon Creek and Malcolm Creek to improve the accuracy of the water balance and site water management measures;
 - ii. Details of contingency measures, in the event of greater rainfall events, e.g. 1 in 1000, that could result in overtopping of dams, be provided;
 - iii. A sensitivity analysis be run on the water balance model and presented within the mine water management plans that are developed;
 - iv. Inclusion of the calculations of fracture zone flow rates and surface losses due to increased infiltration. Implications should be considered across all stages of mining from active goafing to post-closure water table equilibrium; and
 - v. A salt balance be provided and be based on a conceptual salt model that covers all aspects of water processes and spoil management.
- c. The Committee acknowledges the conditions set by the QC-G regarding discharges to receiving waters. Fully implemented approval conditions should be adequate to manage the potential impacts in relation to discharge. However, to reduce uncertainties relating to salinity and water quality, the following additional management aspects would be useful:
- i. Monitoring be carried out by the proponent regarding the disposal of excess water from the site; and
 - ii. Due to climate variability, 24 months of baseline sampling be undertaken, particularly at proposed discharge locations, to inform the development of local Water Quality Objectives and discharge trigger values and replace the surrogate Alpha Objectives initially being used for this project.
- d. The Committee considers that the proposed diversions monitoring program set-up by the proponent provides a good management tool for assessing the long-term performance of the proposed stream diversions and recommends the following additional actions with respect to the management or monitoring of creek diversions:
- i. The Index of Diversion Condition method is currently proposed for the baseline monitoring, to identify potential management issues. Scientific monitoring and assessment are also critical components to assessing the performance of a stream diversion in relation to potential impacts to the surrounding environment and should be included within any monitoring program; and
 - ii. The re-design of the Malcolm Creek diversion better replicates the natural length and meander characteristics of this creek at 'low flow', however the proponent should also consider the potential risks associated with erosion and scouring of the Malcolm Creek diversion during high flow periods. The Committee agrees with the QC-G recommendation for the implementation of a long-term post mining management strategy for Malcolm Creek.
- e. Each of the currently proposed developments within the Galilee Basin includes a void in the final landform, and therefore consideration should be given to the potential cumulative impacts on water resources. Four voids are expected from the Galilee Coal project, which will add to the number of saline lakes that will need to be managed in perpetuity. In the Final Void Management Plan, the proponent should demonstrate that impacts to water resources

are mitigated and managed in perpetuity where backfilled voids are not part of the final landform.

6. *Groundwater Dependent Ecosystems and Species:* The proponent should provide an assessment of the potential impact of regional groundwater drawdown on alluvial groundwater. This should identify the consequent impacts on dependent vegetation and creek base-flows, particularly in relation to drainage lines where groundwater depth can be as shallow as 10m.

Question 3: What does the Committee consider are the likely impacts of the proposed action on surface and groundwater resources, in particular, changes to surface and/or groundwater dynamics and resources that may support surface habitat for listed threatened species and communities?

7. The Committee has covered this question within the response to Questions 1 and 2 above, which asked for advice to minimise impacts to MNES. Following recent amendments to the *EPBC Act*, surface and groundwater resources associated with large coal mine developments and coal seam gas developments are now considered as a Matter of National Environmental Significance. The advice provided in Question 1 (Points 1 and 3), also covers vegetation that are potentially groundwater dependent and that further confirmation is required on whether the Barcaldine Spring group contains any discharge springs. The finalised EIS indicates that no EPBC listed fauna, flora or threatened ecological communities were identified in the site surveys.

Question 4: Are there additional measures and commitments required to mitigate and manage impacts to listed threatened species and communities?

8. In addition to the management and mitigation measures to address risks to MNES that were outlined within Question 2, the Committee recommends that proponents operating within the Galilee Basin commit resources towards collaborative research in order to improve the understanding of water resources and related impacts.
9. Bioregional Assessments: The Committee notes that the Galilee Basin has been identified as a priority sub-region for completion of a Bioregional Assessment. Given that the proposal is located within this region, the Committee considers that data and relevant information from this project should be made accessible for this Bioregional Assessments.

Date of advice	14 November 2013
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Source documentation available to the Committee in the formulation of this advice	Waratah Coal, 2013, finalised Environmental Impact Statement. Queensland Coordinator General, 2013, Evaluation Report on the Environmental Impact, Galilee Coal (Northern Export Facility) project.
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References cited within the Committee's advice	¹ Information Guidelines for Proposals Relating to the Development of Coal Seam Gas and Large Coal Mines where there is a Significant Impact on Water Resources available at: http://www.environment.gov.au/coal-seam-gas-mining/project-advice/pubs/iesc-information-guidelines.pdf ² Western Australia (December 2003), Guidance for the Assessment of Environmental Factors, Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia, No. 54.
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