

Advice to decision maker on coal mining project

IESC 2015-063: West Muswellbrook Project – New Development

Requesting agency	The New South Wales Mining and Petroleum Gateway Panel
Date of request	27 January 2015
Date request accepted	27 January 2015
Advice stage	Gateway Application

Context

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) was requested by the New South Wales Mining and Petroleum Gateway Panel to provide advice on the Muswellbrook Coal Company's (a subsidiary of Idemitsu Australia Resources) West Muswellbrook Project in New South Wales. The proposed West Muswellbrook Project (the Project) has been referred to the IESC at the 'Gateway' stage due to its location on identified Biophysical Strategic Agricultural Land as regulated under the NSW State Environmental Planning Policy (Mining, petroleum production and extractive industries) 2007.

The Project is located approximately 12 kilometres northwest of Muswellbrook in the Hunter Valley. The Project will target coal resources in the Sydney Basin and produce up to 15 million tonnes per annum of saleable export quality thermal coal, and will operate for 30 years. The Project will directly disturb an area of 5,621 hectares (the Project area), will involve extraction from two open pits, construction of associated infrastructure (e.g. coal handling and preparation plant; transport, water, and mine waste management infrastructure; and power supply) and diversion of a creek, and will result in the formation of a final void lake.

This advice draws upon aspects of information in the Project's Application for a Gateway Certificate (Gateway Application), together with the expert deliberations of the IESC. The project documentation and information accessed by the IESC are listed in the source documentation at the end of this advice.

Assessment against information guidelines

The IESC recognises that the Project's Application for a Gateway Certificate addresses the criteria specified as part of the Gateway process and does not contain the level of detail expected for the subsequent development application and accompanying environmental assessment.

Relevant data and information: key conclusions

The assessment documentation is based around requirements for the 'Gateway' stage and as a result there are generally insufficient relevant data and information to enable the consideration of the potential impacts to water resources. Key information gaps include: groundwater quantity (flow/level/pressure) and quality data for all hydrological strata; identification of water-related ecological assets; identification and assessment of impacts to surface water resources and water-related ecological assets; and risk and cumulative impact assessments.

Application of appropriate methodologies: key conclusions

The assessment documentation lacks overarching conceptual models describing the groundwater and surface water aspects of the mining operation, and the water-related ecological assets.

A preliminary numerical groundwater model has been developed however due to the absence of an overarching, integrated and graphically presented conceptual model it is difficult to determine if the model appropriately represents the system. Other key concerns with the numerical model include the lack of measured data used to determine hydraulic parameters; representation of multiple units as single layers; and the absence of supporting evidence for key assumptions.

Reasonable values and parameters in calculation: key conclusions

Hydraulic parameters used in the preliminary groundwater model have not been demonstrated to be representative of the Project area. The majority of hydraulic parameters (conductivity, yield, storativity) were estimated either through equations or calibration.

Advice

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

Question 1: It would be appreciated if the IESC could advise on the potential likelihood and significance of any impacts of the proposal on water resources, as well as advise on the appropriateness of the proposed mitigation measures.

Response

1. Further information is needed to identify and consider the likelihood and significance of potential impacts of the Project to water resources, which would include impacts on groundwater dependent ecosystems, other water users, and surface water courses. The studies noted in the response to Question 2 along with investigations to meet the information needs of the IESC's Information Guidelines (IESC, 2014) will generate information to guide identification and assessment of potential impacts.
2. Within the assessment documentation identification and consideration of potential impacts to water resources is limited. Based on the available information the IESC considers the following aspects of the Project may impact water resources, however verification is needed through further studies:
 - a. groundwater drawdown and changes to groundwater gradients as a result of groundwater extraction
 - b. removal of alluvium and diversion of Coal Creek
 - c. proximity of mining activities to Sandy Creek North, Sandy Creek South, Coal Creek and Spring Creek and associated ecosystems

- d. creation of a final void and other landforms.

Explanation

Groundwater drawdown and changes to groundwater gradients as a result of extraction

3. Groundwater drawdown in the target coal seams and overlying hydrological units has the potential to impact water levels in private bores, baseflow to local creeks, groundwater dependent riparian and floodplain vegetation, and associated water-dependent ecosystems.
4. Extraction of groundwater due to mining is expected to reduce groundwater inflows to alluvium. Numerical modelling over the life of the mine has predicted groundwater level reductions in the alluvium associated with Sandy Creek North, Sandy Creek South, Spring Creek, and Coal Creek.
5. Preliminary modelling indicates 37 private bores are predicted to be impacted by a drawdown of greater than 1 metre. Of these bores, 16 are located within the mining footprint and will be removed and eight lie outside of the Project area.

Removal of alluvium and diversion of Coal Creek

6. The assessment documentation indicates that Coal Creek traverses the proposed location of the southern pit and will be diverted around the mine site. An area of highly productive alluvium associated with Coal Creek will be removed. This is likely to directly affect any groundwater dependent riparian and floodplain vegetation and associated water-dependent ecosystems (instream, hyporheic and groundwater) in the locality. The diversion may also alter flow regimes in the upper reaches of Sandy Creek South, and the water course that receives the diversion.
7. The design and location, and potential impact pathways associated with the Coal Creek diversion are not detailed within the assessment documentation. The diversion has not been incorporated in preliminary modelling studies.

Proximity of mining activities to Sandy Creek North, Sandy Creek South, Coal Creek and Spring Creek and associated ecosystems

8. The Project has the potential to impact surface water hydrology by altering discharge patterns as a result of changes to catchment areas, the Coal Creek diversion, and a reduction in groundwater inflow to the alluvium and subsequent reduction in baseflow.
9. Reduced baseflow is expected for all creeks in the Project area, and Spring Creek, due to reduced groundwater inflow to alluvium associated with these creeks. Potential impacts resulting from reductions in baseflow (such as impacts to riparian vegetation and associated ecosystems, reduction in the length of perennial flow in Sandy Creek South, and impacts to other surface water users) have not been discussed in the assessment documentation.
10. There may also be long-term impacts to surface water quality resulting from the movement of saline groundwater from the final void lake to adjacent creeks.

Creation of a final void and other landforms

11. A final void lake is proposed for a portion of the southern pit (adjacent to Spring Creek and within approximately 1 km of Sandy Creek South). The remaining pit areas will be filled with waste rock. Potential impacts of these final landforms to groundwater and surface water (quality and quantity), and associated water-related assets have not been assessed.

Mitigation measures

12. Mitigation measures to address potential impacts to water resources have not been considered, with the exception of:
- a. a 150 metre buffer between proposed mining and the edge of alluvium associated with Sandy Creek South, Sandy Creek North and Spring Creek. It is unclear why this distance was selected
 - b. a commitment to enter into 'make good' arrangements for landholder bores affected by a greater than two metre drawdown.

Question 2: The IESC may also recommend further studies that should be undertaken if relevant.

Response

13. Further studies should be undertaken in line with the IESC's Information Guidelines (IESC, 2014). These guidelines provide a robust framework for the assessment of potential impacts to water resources.
14. The IESC considers the following studies would improve consideration of the Project's potential impacts to water resources:
- a. conceptual models
 - b. monitoring programme/baseline data
 - c. improvements to groundwater modelling
 - d. assessment of impacts to surface water resources
 - e. water balance
 - f. final landforms modelling
 - g. identification and assessment of impacts on water-related ecological assets
 - h. risk assessment
 - i. cumulative impact assessment.

Explanation

Conceptual models

15. The development of conceptual models at a range of geographical and temporal scales will improve the portrayal of water resources, water-related assets supported by those resources, and potential impact pathways associated with the Project. Conceptual models should demonstrate an understanding of key hydrogeological, hydrological and associated ecological features and processes, and be used to inform numerical groundwater and surface water models.

Monitoring programme/baseline data

16. Future assessment documentation will be strengthened by the inclusion of a surface water and groundwater monitoring and management programme. This programme should consider baseline conditions across the site and include an outline of the proposed measures to monitor, manage

and mitigate potential impacts during the operational phase and following the completion of mining activities.

17. The current monitoring network would need expansion to better inform baseline conditions, improve the conceptual understanding of groundwater and surface water resources that may be impacted by the Project, and inform surface water and groundwater models. In particular:
 - a. groundwater quantity (flow/level/pressure) and quality data is needed for all hydrogeological strata to inform conceptual models and refine the preliminary groundwater model
 - b. sampling period and frequency for surface water monitoring should be designed so that data collected reflects the natural variability associated with ephemeral creeks
 - c. stream flow measurements within the Project area are needed to assess potential impacts to flow regimes (e.g. impacts resulting from reduced baseflow, altered catchment area, and creek diversions) and should accompany data on surface water quality.
18. Assessment documentation identifies springs at the base of the Triassic sandstone escarpment located to the west of the Project area. To inform the assessment of potential impacts to these springs and associated ecosystems studies should be undertaken to determine and characterise source aquifers.
19. Commitments for surface water and groundwater monitoring should be presented as part of a water monitoring plan and be consistent with the National Water Quality Management Strategy.

Improvements to groundwater modelling

20. The preliminary groundwater model has been developed with limited measured data to inform hydraulic parameters and as a result it is a relatively simplistic representation of the groundwater system. To improve confidence in the predictions of potential impacts to groundwater levels and flow, the model should be revised as additional data are obtained and conceptual models are updated. Where parameters are updated based on new information, additional sensitivity and uncertainty testing should be undertaken.
21. The proponent has identified a number of additional improvements that can be made to the preliminary groundwater model, which include:
 - a. calibrating to transient water level records for current/new bores
 - b. improved representation of measured stage heights in the creek systems
 - c. updating geological data
 - d. introducing structural features
 - e. simulating backfilling
 - f. analysing uncertainty predictions
 - g. increasing the model confidence class from level 1 to 2
 - h. seeking peer review of the model.

The IESC considers these improvements should be undertaken.

Assessment of impacts to surface water resources

22. While undertaking further studies that relate to the assessment of impacts to surface water resources the proponent should ensure the following information gaps are addressed:

- a. Characterisation of flow regimes for potentially affected creeks to support the assessment of potential impacts to these water courses. This should include characterisation of creeks outside of the Project area that may be affected (e.g. Spring Creek).
 - b. Consideration and quantification of downstream impacts such as a reduction in surface water flows and the potential release of sediment, salt and other contaminants to Sandy Creek South, Dart Brook and the Hunter River.
 - c. Description and comparison of the various design options for the diversion of Coal Creek which includes comparison of the potential impacts of each option (e.g. increased sediment loads, and impacts to hydrology and geomorphology of receiving surface water courses).
23. Where studies include surface water modelling, models should be designed using appropriate temporal and spatial resolution to enable potential impacts to water resources and associated water-related assets to be adequately assessed.

Water balance

24. Studies should include a water balance and a water monitoring and management plan to quantify and describe changes in stores and flows between hydrological units including between surface waters, alluvium and underlying hydrogeological units. This will help inform impacts arising from reduced catchment runoff, spillages from water storages and discharges.

Final landforms modelling

25. To support the assessment of the Project's potential impacts on water resources further studies should consider the long-term (i.e. post-mining) impacts to groundwater and surface water resources (quality and quantity) posed by the various design options for final landforms.
26. Long-term groundwater quality modelling across a range of climatic scenarios is needed to inform the potential for accumulation of salts and other contaminants in the final void and groundwater systems, and to identify potential pathways for the transport of contaminants and water resources (groundwater systems and surface water courses) that may be affected.

Identification and assessment of impacts on water-related ecological assets

27. Studies need to identify water-related ecological assets that may be impacted by the Project. Studies should identify: fauna, including stygofauna (the IESC notes that studies by Watts *et al.* (2007) have identified novel stygofauna within the region), macroinvertebrates, frogs and fish; flora; and habitat. Potential impacts on all identified water-related assets should be documented, including monitoring, mitigation and management options to address potential impacts.
28. A systematic approach to the identification and assessment of groundwater dependent ecosystems (GDEs) should be used, which involves:
- a. hydrogeological conceptualisation to identify areas of shallow groundwater (less than 20 m below ground level) and groundwater discharge
 - b. investigation of vegetation overlying areas of shallow groundwater to determine potential groundwater dependence
 - c. confirmation of groundwater use by vegetation and groundwater discharge to surface water bodies using techniques from the Australian GDE Toolbox (Richardson *et al.*, 2011).
29. The assessment of impacts on water-related ecological assets should follow the approach outlined in Commonwealth of Australia (2015). This includes constructing ecological models and

supporting narrative tables that specify the pathways of hydrological impacts and hypothesised ecological response with supporting evidence.

30. As noted in paragraph 18 springs and associated ecosystems are evident along the western boundary of the Project area, and source aquifers for these should be confirmed. Existing information and conceptualisation should be presented, and surveys undertaken (if required) to allow an assessment of potential impacts to springs. If required, a monitoring and management programme should be designed to monitor and mitigate impacts to springs.

Risk assessment

31. To improve the consideration of potential impacts to water resources a stand-alone risk assessment should be conducted. This assessment should quantitatively assess the likelihood and consequence of identified impacts and the residual risk following application of proposed mitigation measures.

Cumulative impact assessment

32. A cumulative impact assessment should be undertaken in line with the IESC's Information Guidelines.
33. Given the close proximity of other mines to the Project a sub-regional groundwater model including all mines and major water users in the vicinity would better assess spatial and temporal cumulative impacts to water resources and water-dependant ecosystems. The model would need to be updated on a regular basis and be informed by ongoing dedicated monitoring to validate and reduce uncertainty in model predictions.

Other considerations

34. The Northern Sydney Basin bioregion which includes the Hunter subregion has been identified as a Bioregional Assessment priority region. It is anticipated that the Bioregional Assessment programme will deliver a groundwater model for the Hunter subregion, which will include coal mine hydrogeological processes. Data and relevant information from the Project should be made accessible to this Bioregional Assessment and related research projects.

Date of advice	11 March 2015
Source documentation available to the IESC in the formulation of this advice	Muswellbrook Coal Company Limited, 2014. West Muswellbrook Project, Gateway Application, Supporting Document (including appendices A-C). A report prepared for Muswellbrook Coal Company Limited by La Tierra Pty Limited, Brisbane, 10 December 2014.
References cited within the IESC's advice	<p>Commonwealth of Australia, 2015, <i>Modelling water-related ecological responses to coal seam gas extraction and coal mining</i>, prepared by Auricht Projects and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) for the Department of the Environment, Commonwealth of Australia.</p> <p>IESC, 2014. Information Guidelines for Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals. April 2014. Available at: http://iesc.environment.gov.au/pubs/iesc-information-guidelines.pdf</p> <p>Richardson <i>et al.</i>, 2011. The Australian Groundwater Dependent Ecosystems Toolbox.</p>

National Water Commission, Canberra

Watts, C. H. S., Hancock, P. J. and Leys, R. (2007), A stygobitic *Carabhydrus* Watts (Dytiscidae, Coleoptera) from the Hunter Valley in New South Wales, Australia. Australian Journal of Entomology, 46: 56–59.
