

## Advice to decision maker on South Wambo Underground Mine Modification Project

**IESC 2016-077: South Wambo Underground Mine Modification Project (EPBC 2016/7636; State DA 305-7-2003 Mod 12) – Expansion**

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<b>Requesting agency</b>	The Australian Government Department of the Environment and Energy and The New South Wales Department of Planning and Environment
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<b>Date of request</b>	22 June 2016
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<b>Date request accepted</b>	23 June 2016
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<b>Advice stage</b>	Final Assessment
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### Context

The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (the IESC) was requested by the Australian Government Department of the Environment and Energy and the New South Wales Department of Planning and Environment (DPE) to provide advice on Wambo Coal Pty Ltd's (WCPL) Wambo Coal Mine Modification Project (the proposal) in NSW. The proposal is located in the Upper Hunter Valley region. Wollemi National Park lies to the west and south of the project.

The proposal is a modification to the existing South Wambo Underground Mine layout, approved in 2003 prior to the introduction of the Water Trigger. The proposal will include: the realignment and extension of longwall panels within the Woodlands Hill and Arrowfield seams; an increase to the surface development area; extension of the approved open cut operations by 3 years; and extension of the approved underground mine life by 7 years. A further small change was made to the proposal on 13 July 2016, in which the number of roadways in the main headings for access to Area 3 were reduced from six roadways to a minimum of three roadways to avoid extraction beneath privately owned land.

The proposal is within an area of extensive historical, current and approved open cut and underground mining operations. The assessment documentation notes that no underground mining has commenced within longwall panels of the 2003 approved mine layout and it is understood that the proposed modified underground mine layout will replace the approved underground mine layout in its entirety.

The proponent is seeking approval from NSW DPE for a modification to the existing development consent (DA 305-7-2003 Mod 12) and from the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This advice draws upon the

information in the Environment Assessment (EA) in relation to the impacts associated with the proposal only. The IESC notes that the information in the assessment documentation is limited to the difference or change in the impact of the proposal from the mine lay out that was approved in 2003. However given the nature and scale of the proposal, the IESC's advice has considered all potential impacts.

The project documentation and information accessed by the IESC are listed in the source documentation at the end of this advice.

Two critically endangered ecological communities listed under the *Environmental Protection and Biodiversity Conservation Act 1999* occur within the boundaries of the proposal. These are the Central Hunter Valley Eucalypt Forest and Woodland and the Weeping Myall – Coobah – Scrub Wilga Shrubland of the Hunter Valley. Six endangered and one vulnerable ecological community (NSW-listed) also occur within the boundaries of the proposal. These communities, including the EPBC-listed communities, are located in areas above longwalls associated with the proposal.

Key potential impacts of the proposal include:

- Altered hydrology within surface water features due to subsidence, cracking and ponding, groundwater drawdown and potential leakage from South Wambo Dam.
- Impacts to vegetation, especially groundwater-dependent ecosystems (GDEs), overlying longwalls due to subsidence, ponding and potential lowering of the shallow groundwater table.
- Impacts to surface water quality due to the discharge of mine water and increased sedimentation and erosion.
- Impacts to aquatic biota and subsurface fauna (e.g. stygofauna) due to altered groundwater tables, creek hydrology (especially low flows) and impaired water quality (e.g. fine sediments, contaminants).

#### Assessment against information guidelines

The IESC, in line with its Information Guidelines (IESC, 2015), has considered whether the proposal assessment has used the following:

##### *Relevant data and information: key conclusions*

The assessment documentation provides limited relevant surface water and groundwater contextual and baseline data. There is a lack of field data on GDEs (e.g. groundwater dependent vegetation, stygofauna) and aquatic biota (especially that living in remnant pools in ephemeral creeks) and this constrains the IESC's capacity to assess potential impacts.

Discussion and assessment of the shallow groundwater table outside of the alluvium, within the regolith, is limited. Potential impacts to the shallow water table within the regolith and associated impacts on GDEs as a result of groundwater drawdown are not discussed. The current piezometric surface for the shallow groundwater system including the regolith should be provided.

Limited groundwater and surface water quality information is provided within the assessment documentation. Water quality parameters for groundwater and surface water do not take into consideration other contaminants of concern (e.g. metals, polycyclic aromatic hydrocarbons (PAHs)). Other contaminants of concern should be discussed in the context of the existing environment in order to assess the likelihood and significance of impacts of the proposal.

Flow characterisation of streams within the project area was modelled using a 2009 model developed from flow records of streams in a different catchment and was not calibrated and validated against existing flow data in the catchment.

Subsidence impacts in Area 4 were reportedly reduced in magnitude compared to the 2003 approved mine layout and as such were not considered further in the assessment documentation. Further assessment of subsidence related impacts with Area 4 should be considered as part of the full impact assessment for the proposal in order to determine the extent and magnitude of potential impacts to water resources and water dependent ecosystems.

While the nature and scale of groundwater and surface water impacts from the proposal are largely similar to that of the current 2003 approved mine layout, the existing monitoring and management plans should be updated taking into account likely changes in impacts and ongoing assessment and management of impacts to water dependent ecosystems.

*Application of appropriate methods and interpretation of model outputs: key conclusions*

For the purposes of impact assessment, the alluvium should be separated from the regolith within layer 1 of the groundwater model. Drawdown impacts to the regolith should be considered, particularly in areas associated with GDEs and listed vegetation. The southern boundary of the numerical groundwater model should be extended beyond the zone of predicted drawdown. Further consideration of the Hunter Valley Cross Fault and Redmanvale Fault and their influence on groundwater flow and drawdown should be given, particularly where the Hunter Valley Cross fault intersects the alluvium.

The rationale, frequency, objectives and performance indicators for surface water and groundwater monitoring programs were not described. The assessment of flooding impacts did not consider predicted subsidence and ponding. Significant increases in sediment loads were not considered likely, with mobilised sediment expected to be captured in downstream ponds. Given the significant predicted subsidence impacts to the creeks and landscape, a suitable water quality monitoring program including appropriate performance indicators, triggers and required management actions should be developed and clearly described.

A geochemical assessment to characterise coal reject, waste rock and tailings materials was not provided.

The qualitative risk assessment is limited and did not consider all hazards, such as those associated with mine water discharges and waste management. Planned controls were not detailed; rather reference was made to relevant plans, which were not included in the assessment material.

**Advice**

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

Question 1: Do the subsidence, groundwater and surface water assessments, including numerical modelling therein, provide reasonable estimations of the likely impacts to water resources and water dependent ecosystems? Consideration should include but not necessarily be limited to potential changes to water quality, water quantity, aquifer connectivity, flow regimes and cumulative impacts?
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Response

1. No. Further consideration is required regarding:
  - a. Improved characterisation of water requirements of GDEs associated with impacted alluvial systems and areas of regolith affected by drawdown and ponding.

- b. Groundwater assessment and modelling:
  - i. Improved characterisation of drawdown impacts to the shallow water table within the regolith in the vicinity of listed communities and GDEs.
  - ii. Further consideration of potential impacts to alluvial groundwater systems, particularly in relation to identified GDEs.
  - iii. Further discussion on the adequacy of the numerical groundwater model construction, boundary conditions, parameterisation, calibration, sensitivity and uncertainty analyses.
  - iv. Further consideration of the influence of the Hunter Valley Cross Faults to the north and the Redmanvale Fault to the west on groundwater flow and drawdown.
- c. Surface water assessment and modelling:
  - i. The stream flow modelling is based on stream data in a separate catchment. Further information is required to assess the adequacy of surface water modelling for the affected catchment(s).
  - ii. The surface water assessment does not estimate combined impacts to hydrology and water quality from subsidence, cracking and ponding.
  - iii. Existing and planned water extraction and/or discharge was not described within the surface water assessment.
  - iv. Details on monitoring frequency, location of the monitoring sites, derivation of site-specific water quality guidelines are required. The limited parameters measured and lack of proposed actions when parameters are exceeded, confound the ability to determine potential impacts on surface water quality.
- d. Impact of altered flow regimes associated with stream bed cracking and reduction in groundwater inflow, particularly during low flows, and the ecological implications for aquatic biota and, if present, stygofauna of ephemeral streams and other water dependent ecosystems is required.

*Groundwater*

- 2. Layer 1 in the numerical groundwater model combines the alluvium and regolith. Given the significance of the alluvium in the region, these units should be separated for the purposes of assessing impacts to the alluvium and shallow water table within the regolith. It is unclear from the assessment documentation whether there is a water table within the regolith, thus further characterisation and discussion is needed.
- 3. The Redmanvale Fault and Hunter Valley Cross Faults are stated to be major geological structures within the Wambo area. The southern Hunter Valley Cross Fault appears to be present within the northern boundary of the mine lease and intersecting the alluvium in this region (EA, App B, Figure 6). It is stated that the influence of these geological structures on groundwater flow is not known with certainty (EA, App B, pg 20), however the proponent also states that faults are likely to act as barriers to local groundwater flow rather than conduits. This assumption needs to be justified and validated with assessment data and strategically positioned monitoring bores so that the influence of faults on groundwater head and flow can be determined.
- 4. To provide confidence in the numerical groundwater model predictions, further consideration and discussion is required on:

- a. Model assumptions and limitations.
  - b. The hydraulic parameters used for all model layers. While laboratory core testing has been performed on Permian horizons to determine hydraulic conductivity, these results should be supported with direct field measurements.
  - c. The derivation of recharge and evapotranspiration rates, including the justification for the 3m extinction depth.
  - d. The influence of the southern boundary condition on predicted drawdown.
  - e. Inclusion of sensitivity and uncertainty analyses to enable determination of parameters that are most important in controlling model predictions, including an assessment of how uncertainties in those parameters affect model predictions. This should also include a sensitivity analysis of faults and their influence on groundwater drawdown predictions and groundwater flow patterns.
5. There is limited discussion on groundwater quality and potential impacts to GDEs including stygofauna if present. Improved understanding of existing groundwater quality conditions, including greater understanding of water quality requirements of all potentially affected GDEs would assist in developing suitable management triggers.

#### *Surface Water*

6. Limited flow data was available for creeks in the area of the proposal. Creek flow was modelled based on a Gilbert & Associates (2009) AWBM model developed for Doyles and Appletree creeks, which are located in a separate catchment to the west of North Wambo Creek and adjusted “to take account of” North Wambo creek flow data (EA, App. C, pp. 15–19). The following limitations with the surface water model were identified within the EA:
- a. Doyles and Appletree creeks were not mapped or described.
  - b. The surface water model was not described in detail, however the assessment documentation stated that the model was adjusted to take account of flow data at only one monitoring site (FM3) at North Wambo Creek. While this site was considered by the proponent to be the longest, most representative flow record, additional monitoring points would be beneficial to calibrate the model.
  - c. Only one year of data (Feb 2014 to Jan 2015) from FM3 appears to have been used to calibrate the model (EA, App. C, p. 17, para 1). However, the data summary in the assessment documentation (EA, App. C, p. B-3, Table B1) does not include the entire time period, and does not clearly indicate that it is the most representative available flow record.
  - d. Model representativeness was not demonstrated by comparison with available flow data. On-site flow monitoring sites were established in late 2008. The model should be updated with current and recent measured data.
7. Predicted impacts to Wollombi Brook were only discussed in the context of mean annual flow (EA, App. C, p. 45). Impacts are likely to be greater in periods of low flow as relative losses in creeks on-site due to cracking and ponding will be greater in low-flow periods. Impacts to Wollombi Brook should be compared across a range of flow conditions including low flows.
8. The diverted North Wambo Creek has elevated pH, salinity and total suspended solids (TSS). Potential sources and reasons for the observed water quality were not discussed, nor were the consequences of exceedences. Management actions associated with exceedence of water quality guideline levels, if determined, are not clearly described.

### *Flooding*

9. The 2016 flood study prepared for the proposal was not provided, only referenced and summarised. Information in relation to flood volume, depth, duration, extent and velocity were not provided. These details as well as details of the flood assessment itself, are required to assess adequacy of the flood assessment.
10. Potential impacts to flood behaviour in the area of the proposal were only considered in the context of a levee to be constructed near the surface infrastructure area (EA, App. C, p. 45). Potential changes to flood extent due to subsidence and ponding impacts should be considered.

### *Subsidence*

11. Fracturing is predicted to reach the surface in some areas. The proponent's statement that mining induced fracturing does not have long-term adverse effects on ephemeral streams with natural soil beds (EA, App. A, p. 52) requires justification. Some of the ephemeral streams (e.g. Stony Creek) in the potential subsidence zones have large areas of bedrock or coarse rocky streambeds.
12. The proponent indicates it will be necessary to remediate some sections of creeks, using regrading and infilling methods, and expects no long-term adverse impacts on the creeks after remediation. The success or otherwise of these techniques will need to be assessed and exceedance triggers developed to inform ongoing management options.
13. Potential subsidence impacts on South Wambo Dam, including fracturing and buckling of the uppermost bedrock and cracking of the base of the dam or dam wall, require further consideration regarding potential impacts to surface and groundwater from leakage.

### *Water dependent ecosystems*

14. North Wambo Creek, Stony Creek and Wambo Creek are ephemeral and originate in the Wollemi National Park. Many of the creeks support persistent pools (some of which are large, for example in North Wambo Creek there is a pool approximately 250–300 m long). Further consideration of the complexity and value of ecosystems associated with the ephemeral creeks and associated pools is required to adequately assess impacts. These pools are likely a legacy of previous mining but may now constitute important refuges for aquatic biota in these modified systems. These refuges may be vulnerable to sedimentation from altered geomorphology. It is also unclear whether the frequency and duration of low flows in the ephemeral creeks will be changed with potential impacts on aquatic biota and water quality.
15. Potential subsidence impacts such as soil cracking, ponding and loss of surface water flows, were not adequately assessed for listed flora.

Question 2: Has WCPL provided reasonable strategies to avoid, mitigate or reduce the likelihood, extent and significance of impacts?
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### Response

16. The assessment documentation only presents a summary of the approved Management Plans. The proponent states that impacts associated with the proposal will be managed in accordance with these plans. Limited by the information provided in the assessment documentation and in light of the issues raised in response to Question 1, the IESC is not able to formulate advice with regards to whether the strategies to avoid, mitigate or reduce the likelihood of impacts are reasonable.

## Explanation

17. Existing strategies within monitoring and management plans should take into consideration:

- a. Changes to drawdown within the alluvium and regolith.
- b. Altered flood hydrology and hydraulic characteristics, given the change in subsidence-related impacts.
- c. Updates to the mine water balance with particular regard to increased groundwater inflows, storage and the requirement for discharge of surface water.
- d. Groundwater drawdown and subsidence impacts to GDEs and terrestrial vegetation overlying mine workings and in areas of predicted drawdown. Potential GDEs and aquatic ecosystems, other than Parnell Spring, were not adequately characterised and assessed in the groundwater assessment report (EA, App. B).
- e. Surface water flow and quality monitoring requirements for all creeks including the unnamed tributaries of Wollombi Brook. This baseline information can be used to set trigger levels and to assess the success of mitigation strategies.
- f. Surface water quality (including additional parameters such as aquatic invertebrate community composition) in dams and creeks to enable a baseline to be assessed and performance indicators and management triggers to be determined.

Question 3: Are there further strategies the IESC would recommend to avoid, mitigate or reduce the likelihood, extent and significance of impacts on water resources? And if so, why?

## Response

18. A strategy to avoid, mitigate or reduce impacts of longwall mining is to alter the mine layout, including narrower longwalls and wider inter-panel pillars. In this light, consideration could be given to reduce longwall extents and altering configurations in the vicinity of Stoney and Wollombi creeks to reduce subsidence impacts.

Question 4: In addition to the proposed monitoring and management regime recommendations in the EA, does the IESC recommend additional monitoring and management measures to minimise the risks of the project to water resources?

## Response

19. Additional monitoring and management measures may include:

- a. Regular review and updates to the numerical groundwater model to validate predictions and inform ongoing monitoring and management measures.
- b. Additional groundwater monitoring locations in Area 4 and Area 3 to monitor groundwater levels within areas of subsidence, including determination of groundwater level and quality requirements of GDEs.
- c. Nested piezometers to the west and south of the South Wambo Dam to monitor the high salinity zone observed in monitoring bores P114 and P116.
- d. Groundwater sampling to include metals and other potential contaminants of concern. It is unclear from the EA whether these are considered or included in the current water quality sampling regime.

- e. Surface water sampling for metals and ionic composition (see paragraph 20 below), including development of trigger values associated with ecotoxicological effects, and required response actions where triggers are exceeded.
  - f. Upgrading surface water gauges and updating the surface water model with recent data to achieve adequate calibration and inform ongoing management strategies.
  - g. Further consideration of the three unnamed drainage lines to the south east of the proposal that drain to Wollombi Brook. This may include continuous data loggers.
  - h. Geochemical testing of coal reject, waste rock and tailings materials to characterise and inform ongoing management strategies.
  - i. Ecological monitoring in Wollombi Brook, downstream of discharge sites and in persistent pools of ephemeral creeks for aquatic biota as biomonitors of ecological responses to altered flows (especially low flows) and water quality.
20. Further assessment of the potential impacts of physical and chemical composition of discharge water, including the impacts of metals and PAHs, on downstream ecosystems and environments would improve understanding of potential regional cumulative impacts of mining. This is consistent with the findings of Krogh et al. (2013) which recommends experimental studies to fully understand the effects of different components of saline water including metals/metalloids and ionic compositions discharged to the Hunter River.
21. The Northern Sydney Basin, which includes the Hunter Subregion, has been identified as a Bioregional Assessment priority region. Data and relevant information from the proposal should be made accessible to this Bioregional Assessment and related research projects.

<b>Date of advice</b>	4 August 2016
<b>Source documentation available to the IESC in the formulation of this advice</b>	ANZECC/ARMCANZ 2000. Australian Guidelines for Water Quality Monitoring and Reporting. <i>National Water Quality Management Strategy (NWQMS)</i> . Canberra: Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.  Wambo Coal Pty Ltd, 2016. <i>South Wambo Underground Mine Modification, Environmental Assessment</i> . April 2016, Wambo Coal Pty Ltd.  Wambo Coal Pty Ltd, 2015. <i>2015 Annual Review</i> , Wambo Coal Pty Ltd.
<b>References cited within the IESC's advice</b>	IESC. 2015. <i>Information Guidelines for the Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals</i> [Online]. Available: <a href="http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-oct-2015.pdf">http://www.iesc.environment.gov.au/system/files/resources/012fa918-ee79-4131-9c8d-02c9b2de65cf/files/iesc-information-guidelines-oct-2015.pdf</a> .  Krogh, M., Dorani, F., Foulsham, E., McSorley, A., and Hoey, D. 2013. Hunter Catchment Salinity Assessment. Final Report. NSW Environment Protection Authority.