

Advice to decision maker on coal mining project

IESC 2014-058: Russell Vale Colliery Longwall 6 Project (EPBC 2014/7259)

Requesting agency	The Australian Government Department of the Environment
Date of request	9 September 2014
Date request accepted	9 September 2014
Advice stage	Assessment

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 (the Department) to provide advice on the Wollongong Coal Ltd Russell Vale Colliery Longwall 6 Project (Longwall 6) in New South Wales.

Extraction of the first 400 m of Longwall 6 in the Wongawilli seam is proposed, adjacent to the Russell Vale Underground Expansion Project (Russell Vale Expansion, EPBC 2014/7268). The IESC provided advice on the Russell Vale Expansion on 11 September 2014 (IESC 2014-057, Attachment A), based on mainly information in the Preferred Project Report and Residual Matters Report. This advice on Longwall 6 draws mainly upon information specific to Longwall 6 only, including relevant sections of the Environmental Assessment and Submissions Report, additional information regarding swamps provided to the Department on 14 August 2014 by the proponent, 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.

The Longwall 6 proposal includes extraction of 0.26 Mt of run-of-mine coal from a 400 m section of Longwall 6. The proposed project area is located approximately 8 km north of Wollongong, within the catchment of Lake Cataract, a Sydney drinking water reservoir and also within a Sydney Catchment Authority Metropolitan Special Area, proclaimed under the NSW *Sydney Water Catchment Management Act 1998*. The proposed project area lies within the Woronora Plateau, a sandstone plateau, which is host to approximately 83% of the estimated 1003 swamps of Coastal Upland Swamp ecological communities listed (17 July 2014) as endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Two swamps, CCUS4 and CRUS1, partially underlie Longwall 6, while swamps CCUS3, CCUS5 and CCUS23 are located within 250 m of Longwall 6.

Key potential impacts

The key potential impacts as a result of Longwall 6 include:

- Irreversible localised impacts to structural integrity of overlying and adjacent swamps and associated impacts to dependent species.
- Cumulative impacts to water resources and associated ecological communities when considered in conjunction with the proposed Russell Vale Expansion project at Wonga East and further proposed mining at Wonga West.

Assessment against information guidelines

The IESC, in line with its Information Guidelines¹, has considered whether the proposed project assessment has used relevant data, appropriate methodologies and reasonable values and parameters in calculations. The IESC highlights the inadequate project-specific data, information and values used in the proposal documentation for Longwall 6. The proponent's assessment has mostly relied upon data, methods and models developed for the proposed Russell Vale Expansion, which the IESC has previously considered (refer to Attachment A).

Advice

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

Question 1: Do the subsidence, groundwater assessment and surface water assessments, including numerical modelling therein, provide reasonable estimations of the risk (including likelihood, extent and significance) of impacts on overlying and adjacent swamps?

Response

1. The Environmental Assessment predicts subsidence induced cracking to the base of swamps CRUS1 and CCUS4 which may result in loss of water to the subsurface and potential impacts to the swamps. However, the final risk assessment underestimates the overall risk to these swamps. Further, neither the Environmental Assessment nor the Submissions Report considers potential impacts to nearby swamps CCUS3, CCUS5 and CCUS23.
2. The Longwall 6 Coastal Upland Swamp Impact Assessment Report² concludes that any impacts from Longwall 6 are likely to be localised and affect a small occurrence of the endangered ecological community. The IESC considers there is a high likelihood of localised impact to overlying swamps such as bedrock cracking, consistent with the proponent's Environmental Assessment, and highlights the significant potential for cumulative impacts to swamps and the endangered ecological community in the wider project area if the proposed additional mining at Wonga East and Wonga West is undertaken.
3. The proponent's groundwater assessment for Longwall 6³ is based on modelling developed for the Russell Vale Expansion and is at a scale unsuitable for estimating the risk of impacts to overlying and adjacent swamps.
4. The proponent's assessment of subsidence for Longwall 6 does not generate subsidence parameters for overlying and adjacent swamps related specifically to the 400 m section of Longwall 6. This limits the ability to predict subsidence effects from Longwall 6 independent of the broader Russell Vale Expansion.

Explanation

5. The Submissions Report estimates the risk of fracturing and drainage of Swamp CCUS4 as high (consistent with Appendix G of the Residual Matters Report). However, the more recent swamp assessment² contradicts this by downgrading the risk associated with compressive tilts and strains and the final risk assessment for CCUS4 to moderate. There is a predicted 1-20% risk of a sandstone formation that forms a rockbar at the downstream extent of CCUS4 collapsing due to Longwall 6². Any rock fall or ground stress that impacts on the integrity of the sandstone formation or causes cracking of the swamp bed will result in significant impacts to the water holding capacity of Swamp CCUS4.
6. The Longwall 6 swamp assessment² states that apart from CCUS4, no other swamps are anticipated to undergo sufficient compressional or extentional strains to generate cracks in the underlying sandstone. This is not supported by evidence or predictions of specific subsidence parameters or a statement to the contrary made in the Environmental Assessment. Subsidence predictions developed for the Russell Vale Expansion indicate overlying or adjacent swamps CRUS1, CCUS3, CCUS5 and CCUS23 will all undergo strains greater than that predicted by the proponent to fracture sandstone beneath swamps.

Question 2: If not, what is a reasonable assessment of the likelihood, extent and significance of impacts on overlying and adjacent swamps?

Response

7. The likelihood of cracking to the base of swamps CCUS4 and CRUS1, and their subsequent drainage, is high, consistent with the proponent's Environmental Assessment. The possible fracturing of the rock bar at the downstream extent of CCUS4 is likely to result in significant changes in swamp hydrology and subsequent impacts to the ecological community and dependent species.
8. The proponent reports the presence of shallow sandy soils containing limited perched water in the areas of CRUS1 predicted to be impacted by Longwall 6, thereby reducing the risks of significant impacts. However, reductions in available perched water and soil moisture content resulting from cracking and drainage can lead to dessication and erosion. This can make swamps more susceptible to external stressors such as fire⁴, potentially resulting in progressive negative impacts within the larger downgradient area of the swamp.
9. The risk of impacts to nearby swamps CCUS3, CCUS5 and CCUS23 from Longwall 6 cannot be confidently assessed from the information provided, as stand-alone subsidence parameters for Longwall 6 have not been reported.
10. Where fracturing and drainage does occur within swamps, threatened flora and fauna associated with these swamps would be expected to be negatively impacted. Such impacts to swamps and dependent species are likely to be permanent and irreversible, as there is no known scientific literature which demonstrates the successful remediation or rehabilitation of swamps⁴.

Explanation

Perched water

11. The proponent notes² that prior assessment of swamp hydrographs indicates that water retention characteristics of some swamps within the project area have been adversely affected by past mining activities, consistent with fracturing of underlying bedrock. However, as noted by the proponent, a paucity of suitable ecological monitoring data limits the precise prediction of resultant ecological impacts.

12. The swamp hydrograph PCc4, located within Swamp CCUS4 indicates a loss of water holding capacity in the vicinity of the piezometer at the time (approximately mid-2012) of Longwall 4 extraction². Additional mining in the area will increase the likelihood of further cracking of the bedrock underlying swamps, and resultant reductions in the swamp water holding capacity.

Threatened species

13. The swamps overlying and adjacent to Longwall 6 provide important habitats for a number of threatened species, including the EPBC listed vulnerable green and gold bell frog (*Litoria aurea*) and giant burrowing frog (*Heleioporus australiacus*). The red-crowned toadlet (*Pseudophryne australis*), which is listed as vulnerable in NSW, is also known to be present. The swamps also provide habitat for the NSW listed endangered giant dragonfly (*Petalura gigantea*) which is now uncommon in the coastal regions of NSW⁵. The proponent's biodiversity assessment identified the giant burrowing frog (tadpoles), the red-crowned toadlet, and the giant dragonfly onsite, with suitable habitats for the stuttering frog (*Mixophyes balbus*). Where these threatened species occur, the loss or severe decline of swamps within the greater project area would be expected to impact negatively the reproductive cycle and thus the long term viability of these species.
14. The possible fracturing of Swamp CCUS4, a tributary of Cataract Creek, when combined with the possible disruption to flow from other tributaries as part of the proposed Russell Vale Expansion project, may result in decreased inflows to Cataract Creek, which has the potential to have an impact on threatened aquatic fauna and habitats, including the EPBC-listed Macquarie perch (*Macquaria australasica*), silver perch (*Bidyanus bidyanus*) and Murray cod (*Maccullochella peelii*).

Question 3: Has the proponent provided strategies to effectively avoid and mitigate, or reduce the likelihood, extent and significance of these impacts?

Response

15. The proponent has proposed an upland swamp monitoring plan with the aim of determining whether subsidence associated with the proposed longwall mining will result in impacts to the ecological functioning of upland swamps. While this strategy will better enable identification of impacts to swamps it will not effectively avoid, mitigate or reduce the actual impacts to overlying or adjacent swamps. Where triggers are exceeded, an Offset Strategy is proposed.

Question 4: Are there any strategies available to avoid, mitigate, reduce or remediate the likelihood, extent and significance of these impacts? If so, what are these?

Response

16. The most effective way to reduce the risk of negative environmental consequences to swamps is to alter the mine layout to ensure swamps are not subjected to strains in excess of the established criteria outlined by the NSW Planning Assessment Commission⁶ and referenced in the Conservation Advice for Coastal Upland Swamps in the Sydney Basin Bioregion⁵.
17. The irreversible nature of impacts to swamps in combination with the potential delay prior to the identification of impacts diminishes the likelihood of successful adaptive management measures.

Explanation

18. A recent evaluation of remediation techniques was not able to identify any examples of mitigation or remediation of undermined peat swamps, and in instances where impacts have occurred there have been no signs of self-amelioration in swamps impacted more than 25 years ago⁴.

19. Remediation strategies such as sealing fracture networks of exposed rock in creeks and tributaries have been found to be costly, risky and likely to have a limited lifespan⁴. The successful use of this approach is likely to be limited due to presence of overlying sediments, issues with detection of fracture networks, and potential significant impacts to swamps associated with the remediation process such as clearance of vegetation and swamp substrate in order to determine the extent of cracking.

Question 5: Which, if any, of the strategies does the IESC recommend, and why?

Response

20. Given the variable nature of impacts to swamps and difficulties in their accurate and confident prediction, the most effective strategy to mitigate the risk of impact to swamp communities within the proposed project area would be to alter the mine layout such that swamps are not subjected to strains in excess of the established criteria^{5,6}. Further, surface flows and seepage from shallow perched groundwater systems that contribute water to swamps should not be disrupted. There is no scientific evidence to demonstrate that remediation activities are able to successfully restore the hydraulic and ecological functions of these ecological communities to pre-impact condition⁴.

Question 6: The Residual Matters Report recognises the limitations of adaptive management to address potential impacts on individual upland swamps due to the short timeframes to manage longwall retreat. What measures or triggers could be used to minimize impacts and address uncertainty in impact prediction?

Response

21. Adaptive management is not a suitable approach to minimise impacts to swamps due to the irreversible nature of impacts and the potential for long time delays before identification of irreversible ecological impacts. The only currently known measures to successfully minimise impacts to swamps involve modification of mine layout to prevent stresses greater than established criteria^{5,6}.
22. Measures to reduce uncertainty in impact prediction include:
- a. Detailed swamp water balance studies assessing extent and temporal distribution of standing water and soil moisture within swamps, including identification of all water inputs and outputs. Assessment of water sources should consider but not be limited to potential contributions from catchment run-off and seepage from shallow perched groundwater systems.
 - b. The development of long term Before-After Control-Impact studies which enable identification and quantification of cracking and tilting, altered flowpaths and changes to water quality, subsequent erosion and ecological responses of flora and fauna.

Question 7: Are the groundwater and surface water models suitably robust for the quantitative predictions provided?

Response

23. No. The key shortcomings of the groundwater model are related to the hydraulic and spatial characteristics of the fracture zone and its unsuitability to predict impacts at a scale relevant to swamp hydrology. Key shortcomings in the surface water model include the lack of justification for predicted streamflow loss scenarios, and lack of streamflow data for calibration in Cataract Creek.

24. The models used to assess groundwater and surface water impacts are the same as those discussed in previous advice. See discussion in paragraphs 31 & 32 of IESC advice on the Russell Vale Expansion (Attachment A).

Question 8: Do the subsidence, groundwater assessment and surface water assessments provide reasonable estimations of likely impacts to water resource, with particular reference to Cataract Creek and the Cataract Reservoir?

Response

25. The proponent's assessment that the impacts to Cataract Creek and Cataract River are unlikely to be significant as a result of extraction of Longwall 6 is reasonable. However, cumulative impacts to surface flows as a result of Longwall 6, the Russell Vale Expansion and proposed mining at Wonga West are likely to be significant. Longwall 6 presents a particular risk to surface water flows in small tributaries to Cataract River and Cataract Creek as a result of loss of baseflow from headwater swamps CRUS1 and CCUS4. This risk has not been adequately addressed by the proponent. Impacts to Cataract Reservoir, both direct and as a result of impacts to its contributing catchment, are discussed in response to Question 11.

Explanation

Surface water

26. Despite the estimation of no observable impact on streamflow in Cataract Creek from Longwall 6, cumulative impacts to surface water resources as a result of Longwall 6 and proposed mining at Russell Vale Expansion and Wonga West should be quantified. This assessment should consider impacts to surface water flow and quality in both Cataract Creek and Cataract River as a result of: loss of baseflow from swamps in the headwaters; shallow subsidence effects; deep connective cracking; and groundwater drawdown. For discussion of these mechanisms, refer to paragraphs 33-39 of the IESC advice on the Russell Vale Expansion (Attachment A).

Swamps

27. The proponent identifies the potential for surface flow to be lost due to leakage from swamps, but the loss is not quantified in the Submissions Report. There is particular risk to swamp outflow from CCUS4, which is located over a sandstone shelf with a small waterfall. The proponent considers that any further fracturing will change the hydrology of the swamp. The resultant impacts on swamp outflow and the first order tributary have not been considered.

Question 9: The subsidence assessment indicates the likelihood of minor fracturing of creek beds and creek catchments with resultant diversion of stream flow and runoff. Does the Residual Matters Report provide a reasonable estimation of the potential changes in stream flow and runoff volume, and the impacts to water dependent ecosystems? Is there adequate monitoring to enable these impacts to be assessed? What measures or triggers could be used to monitor and minimise impacts into the future?

Response

28. The Submissions Report considers the combined surface water impacts of Longwall 6 and the Russell Vale Expansion (as does the Residual Matters Report), and in doing so does not provide a reasonable estimation of impacts to streamflow in Cataract Creek as a result of Longwall 6 related subsidence. The assessment does not quantify the potential loss of streamflow to Cataract River, including as a result of loss of baseflow from Swamp CRUS1. The resultant impacts on aquatic ecosystems of predicted extended cease to flow periods, or the potential draining of pools, including loss of refugial habitat and stream connectivity, are not assessed.

29. The surface water assessment for Longwall 6 is the same as that for the Russell Vale Expansion. IESC advice on the estimation of streamflow impacts, adequacy of monitoring and mitigation measures is provided in paragraphs 40-50 of the advice on the Russell Vale Expansion (Attachment A).
30. With regards to mitigating impacts to creeks and tributaries, measures within the Trigger Action Response Plan (TARP) for Longwall 5 could be used in future, but triggers need to be justified and more clearly defined. Evidence needs to be provided demonstrating that impacts less than the identified trigger values will not have adverse impacts on Cataract Creek. Subsidence measures related to valley closure are considered reasonable, particularly the stated action to stop mining if valley closure exceeds the trigger of 150 mm.

Explanation

Measures and triggers

31. It is proposed that a monitoring programme and TARP will be developed to minimise impacts to Cataract Creek from mining at Longwall 6 in line with that developed for Longwall 5. While adaptive management measures such as TARPs are not considered appropriate for mitigating impacts to swamps (as noted in paragraphs 20-22), they may be a suitable management approach to mitigating impacts to creeks and rivers where they have early warning trigger values, and clear, enforceable response measures capable of mitigating impacts.
32. Water-related aspects covered in the TARP for Longwall 5 include swamp discharge, swamp groundwater level and quality, groundwater level and pressure, mine water inflow, surface water level and quality and visual stream observation. It is noted that:
 - a. Terms used to define triggers for each measure should be clearly defined or quantified by the proponent, for example quantifying what is meant by a 'significant' recharge event, and a two year ARI rainfall event.
 - b. Triggers in the TARP for Longwall 5 generally allow for exceedences outside of the recorded natural variability for a period of time. Where these exceedences occur, water dependent ecosystems are potentially at risk unless the proponent can provide evidence to demonstrate that their condition and integrity are not impacted by variations outside of the determined existing variability.
 - c. Despite the monitoring programme that has been underway since 2008, data relating to swamp discharge and stream flow has not been presented in the project assessment documentation. Further, a comprehensive visual and photographic survey of Cataract River is yet to be completed. Such information is necessary to determine the baseline variability from which exceedences can be assessed.
 - d. The TARP for Longwall 5 outlines a variety of management actions, including reporting, investigation, consultation, and potential mitigation or remediation action, which could be considered if a trigger is exceeded. Instead, mitigation actions and contingency measures should be defined for each trigger exceedence prior to project commencement, to avoid delays in developing an agreed management response.
 - e. The high risk trigger value for valley closure of 150 mm and subsequent action of stopping longwall mining immediately (taking into account safety considerations) is considered a reasonable approach. Valley closure for first, second and third order streams will be managed using an adaptive management approach, however this approach is not defined.

- f. While surface cracking of greater than 10 mm is considered a high risk, there is no associated mitigation action to stop mining, only management actions to increase monitoring, stakeholder engagement and reporting. Consideration should be given to including an action to cease mining where surface cracking is identified within third and fourth order reaches of Cataract Creek.

Question 10: The Residual Matters Report indicates an increase in iron rich seepage in Cataract Creek due to impacts of previous mining subsidence. Does it adequately consider the potential for further increases in iron rich discharges to creeks and the significance of any resulting impacts to water quality and the downstream environment? If not, what is the potential?

Response

33. No, neither the Residual Matters Report, nor any of the Longwall 6 specific reports supplied by the proponent adequately consider the potential for further increases in iron rich discharges to creeks or its potential impact to water quality and the downstream environment due to Longwall 6. However, the potential for significant negative effects on water quality within Cataract Creek from newly induced iron seepages resulting from Longwall 6 is considered low.

Explanation

34. With respect to the current proposal for Longwall 6, while bed fracturing is predicted within the first order tributary downgradient of CCUS4, there is no consideration of specific potential for iron seepages in tributaries within or downgradient of subsidence affected areas.
35. The proponent briefly considers the potential for iron rich seepages in discussing groundwater quality in the Longwall 6 Submissions Report, concluding that outside isolated iron hydroxide seepages, no adverse groundwater quality impacts are anticipated from the proposed Longwall 6 subsidence areas. While there is no consideration of impacts to surface water, it is considered unlikely that Longwall 6 will result in significant additional impacts to surface water quality from iron seepages.

Question 11: Is the information provided sufficient to predict any changes to either water quality or water quantity in the Cataract Reservoir which would arise as a result of the mining operations? What are the consequences for stored waters within Cataract Reservoir?

Response

36. While the information provided is not sufficient to accurately predict changes to water quality and quantity in Cataract Reservoir associated with Longwall 6, the consequences for Cataract Reservoir are not likely to be significant based on current water quality and flow volumes.
37. There is a low likelihood that mining induced cracking could impact bedrock underlying Cataract Reservoir, due to setback distances from Longwall 6. If such cracking were to occur the potential consequences for Cataract Reservoir could be severe.

Explanation

38. Streamflow losses as a result of Longwall 6 are estimated by the proponent to not have an observable effect on Cataract Reservoir.
39. The modelled transfer of stored water within Cataract Reservoir to the underlying groundwater system due to depressurisation of the regional groundwater system in the vicinity of the reservoir due to extraction of Longwall 6 is predicted to be 0.33 ML/year.

40. The proponent considers it unlikely that pathways for flow or leakage from the reservoir into the mine workings will be generated as a result of the Longwall 6 workings. This assessment is based on a setback distance of 35 degree angle of draw (0.7 times the depth of cover) from the full supply level and the lack of connected hydraulically conductive geological structures (i.e. dykes or faults). Further justification for the suitability of the 35 degree angle of draw as a mitigation measure, including quantitative uncertainty predictions for impacts within the full supply level of Cataract Reservoir would improve confidence in proposed setback distances and risk assessment. See additional discussion on setback distances in the advice on the Russell Vale Expansion (Attachment A).

Question 12: Are the questions adequately targeted to the greatest risks of impacts to water resources for the preferred project? If not, what are the greatest foreseeable risks to water resources associated with the project and how could they be mitigated?

Response

41. The greatest risks of impacts to water resources are the cumulative impacts from Longwall 6, the Russell Vale Expansion and the additional proposed mining at Wonga West. The project assessment documentation is not adequate to accurately assess these cumulative impacts; however it is considered very likely that there will be significant impacts to water resources, particularly with respect to Coastal Upland Swamps and Cataract Reservoir.
42. Risks can be mitigated through modification of mine design to ensure water resources and associated water related assets are not subjected to ground movement and strains which are likely to generate negative structural impacts.
43. The Southern Sydney Basin, which includes the Hawkesbury-Nepean subregion, has been identified as a Bioregional Assessment priority region. Data and relevant information from the proposed project should be made accessible for research and to the Bioregional Assessment to assist the knowledge base for regional scale assessments.

Date of advice 23 September 2014

Source documentation available to the IESC in the formulation of this advice Environmental Assessment – Russell Vale Colliery Commencement of Long Wall 6, April 2014. AECOM

Submissions Report – Russell Vale Colliery Commencement of Long Wall 6, July 2014. AECOM

Underground Expansion Project Residual Matters Report, June 2014. Hanson Bailey Environmental Consultants.

Gujarat NRE Coking Coal Pty Ltd, 2013. Underground Expansion Project Preferred Project Report including Response to Submissions.

**References
cited within the
IESC's advice**

- 1 Information Guidelines for Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals available at: <http://iesc.environment.gov.au/pubs/iesc-information-guidelines.pdf>
 - 2 Biosis, 2014. Russell Vale Colliery Longwall 6 Referral (EPBC2014/7259): Coastal Upland Swamp Impact Assessment Report. Final Report, 14 August 2014.
 - 3 GeoTerra & GES, 2014. Russell Vale Colliery Underground Expansion Project Longwall 6 (400m Extraction) Wonga East Groundwater Assessment Addendum.
 - 4 Commonwealth of Australia, 2014a. Temperate Highland Peat Swamps on Sandstone: evaluation of mitigation and remediation techniques, report prepared by the Water Research Laboratory, University of New South Wales, for the Department of the Environment.
 - 5 Threatened Species Scientific Committee, 2014. Environment Protection and Biodiversity Conservation Act 1999 (s266B) Conservation Advice (including listing advice) for Coastal Upland Swamps in the Sydney Basin Bioregion. Available at: <http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=140>
 - 6 NSW Planning Assessment Commission, 2010. Bulli seam operations. PAC Report. NSW Planning and Assessment Commission, Sydney.
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