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21 January 2011

Mr Howard Reed
Manager Mining and Extractive Industries
Department of Planning
23-33 Bridge Street
SYDNEY, NSW 2000

Re: Carrington West Wing Modification (DA 450-10-2003 MOD 3) – Response to Independent Groundwater Review

Dear Howard

In November 2010, the Department of Planning engaged Dr Frans Kalf of Kalf & Associates Pty Ltd to undertake an independent review of the groundwater assessment prepared by Dr Colin Mackie of Mackie Environmental Research Pty Ltd (MER) for the Carrington West Wing Modification. A copy of the review was provided to Coal & Allied by the Department on the 23rd December 2010.

Dr Kalf's report provided a technical review of the groundwater assessment and considered that:

"provided it can be demonstrated that the ultimate magnitude of seepage of groundwater from the more recent alluvium close the river and that derived from the river itself is small in comparison to dry weather flows, then this would constitute minimal harm";

"given the presence of the mine will arrest moderately saline to brackish groundwater seepage to the river, this would seem to be more than enough compensation for the likely relatively modest flow (yet to be demonstrated) that would be directed away from the river".

The review recommended consideration of alternative permeability values for the groundwater barrier wall and interburden materials. Consequently, the Department of Planning has requested a response from Coal & Allied with respect to the following matters:

1. Updated groundwater modelling assessment:
    a. Using Dr Kalf's recommended permeabilities for the groundwater barrier (or further evidence to demonstrate a permeability of 10^{-6} m/day could be achieved);
    b. Consideration of secondary (fractured) permeability within interburden materials; and
2. A copy of the groundwater barrier design report for the constructed eastern paleo-channel barrier wall.

The parameters utilised in the groundwater study are considered to be appropriate and within reasonable probability. However, to consider the matters raised in item 1, the existing groundwater model has been utilised employing higher groundwater barrier wall

and interburden material permeability values. The requisite report prepared by MER is enclosed.

Coal & Allied's experience to date with barrier walls at the Alluvial Lands area and for the Carrington Pit eastern paleo-channel indicates that specified permeabilities were met or bettered. For instance, sampling of the barrier wall for the Carrington Pit eastern channel indicates that a mean permeability of 5.8×10^{-5} m/day was achieved for a design specification of 8.6×10^{-5} m/day. The groundwater assessment for the Carrington Pit Statement of Environmental Effects (ERM 2005) was based on a maximum barrier wall permeability of 1×10^{-4} m/day, which is more permeable than the specified and as-constructed barrier wall.

The Carrington West Wing Environmental Assessment was based on specifying a barrier wall permeability of 1×10^{-6} m/day for the western channel in the form of a slurry curtain bedded into the hard rock. The MER letter report assesses a scenario for a barrier wall permeability equivalent to the recently constructed eastern channel barrier wall of 5.8×10^{-6} m/day. For this scenario, the results indicate that river losses in the Carrington West Wing Extension of 0.14 ML/day compared to 0.05 ML/day for the permeability assessed in the Environmental Assessment. The permeability of the eastern channel based on the as-constructed permeability is predicted to result in a loss of 0.1 ML/day.

If the western barrier wall was constructed to the same permeability as the eastern barrier wall, an increase in losses of 0.04 ML/day in the western channel compared to the eastern channel (i.e. 0.14 ML/day – 0.1 ML/day) could occur. However, if the constructed permeability of the western channel is specified and constructed to achieve the permeability of 1×10^{-6} m/day as outlined in the Environmental Assessment, there would be a net reduction in the losses compared to the eastern channel with the as-constructed barrier wall permeability, by 0.05 ML/day (i.e. 0.05 ML/day – 0.1 ML/day).

The MER letter report assesses the impact of the worst case losses (i.e. if the western barrier wall was constructed to a similar permeability as the constructed eastern channel barrier wall) to still be quite low; some 0.7% of the 99 percentile low river flow, compared to 0.3% reported in the Environmental Assessment.

With respect to secondary (fractured) permeability within interburden materials, the MER letter report considers that while this may be possible, observations in the eastern channel indicates a weakly connected joint network that provides limited enhancement to strata conductivities. The report notes however that there may be jointing that may be more of less connected than assessed in the Environmental Assessment. As discussed above, it is intended that the western barrier wall would be constructed in the form of a slurry curtain bedded into the hard rock.

An uncertainty analysis was undertaken by MER by increasing the horizontal and vertical permeabilities of the layers beneath the barrier wall by 1 and 2 orders of magnitude (a reduced permeability analysis was not undertaken given it would result in a reduction in losses, i.e. not a worst case). The results of the analysis indicate an increase in leakage losses at a rate that would be visible, especially during winter months when evaporation is lowest. However, experience with the eastern channel (conditions which are likely to be similar in the western channel) suggests that such observations do not occur.

Notwithstanding the above, Coal & Allied is committed to additional secondary permeability field-testing of interburden strata at three bores to the south of the barrier wall, as recommended. A revised Statement of Commitments including this commitment is enclosed.

In response to item 2, a copy of the barrier wall design report undertaken by Parsons-Brinkerhoff was provided to the Department on the 24th December 2010.
We trust that the above and enclosed addresses the information requested.

Should you have any queries or require any additional information, please do not hesitate to contact Mark Nolan on (02) 6570 0301 or myself on the details below.

Yours sincerely

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Enclosures: Letter Report (Mackie Environmental Research, January 2011)
Carrington West Wing revised Statement of commitments (January 2011)