KALF AND ASSOCIATES Pty Ltd
Hydrogeological, Numerical Modelling Specialists

Phone 61 2 99187478
Fax 61 2 99182667
A.B.N 67 079 152 462

52 York Terrace
BILGOLA NSW 2107
AUSTRALIA

30 September 2013

Cobbora Coal Project - New Mine Plan Proposal
3rd KA Groundwater Adequacy Review

Background

Dr F. Kalf of Kalf and Associates Pty Ltd prepared two previous groundwater adequacy reviews on the 12 August 2012 and 11 February 2013. (KA 2012, 2013). In summary the first review indicated inadequacies with regard to the following: lack of cross-section across the final void and rehabilitated mining areas and associated streams; probability assessment of solute transport migration to adjacent Sandy Creek from rehab zone or final void; reliability of water levels in final void; general comment on field monitoring during mining and post mining; statement on influence of regional drawdown on water pools/springs//baseflow in adjacent Sandy Creek; range of long-term drawdown influence on bores situated west of Sandy creek; statement about and piezometer locations for monitoring/mitigation of any solute seepages from tailings and waste dumps.

Subsequently Parsons Brinkerhoff (PB 2013a) responded to these KA comments. A number of further comments were then provided by KA (2013) that included the following: whether "river losses" estimates included the losses from tributary creeks; error estimate of final void water level; estimate of likely concentrations of any solute migrating through rehab fill towards Sandy Creek; parameters applied to the lake package; what inflows during the model stress period were used for the inflow estimates.

However, the main item of contention in the KA response was related to the cross-sections provided by PB. This section indicated (Fig 5.6D in Appendix H)[1] that drawdown west of the mine site did not propagate beyond the boundary condition modelled for Sandy Creek. This indicated that Sandy Creek would be providing a constant source of leakage surface water into the modelled groundwater system even though it is a ephemeral creek channel. Consequently, such a condition would therefore underestimate the drawdown propagation beneath and beyond the Sandy creek channel and hence very likely create in the long-term much greater drawdown in private and other bores located in this region.

It was suggested that an extreme case (but improbable) be simulated with no leakage from

[1] Appendix H Groundwater Model Technical Report.
File 2162570A PR_6739_part 3 of 3_appendices H to J.pdf; pdf page 88.

the creeks to determine the maximum possible drawdown in private and other bores in the region. For such a simulation the proponent's consultants removed leakage from the Sandy Creek in the model for the entire mining period. The purpose for such a simulation was therefore to establish the upper and lower bounds of drawdown influence. In reality the drawdowns in bores would very likely lie somewhere between the set of results of no stream leakage and constant stream leakage, given that the Sandy creek flows for a period stated to be 60% of the time according to the proponent's consultant.

In a memo on the 4 March (PB 2013b) Phil Towler responded to the KA comments (KA 2013). Apart the other issues for which satisfactory responses were provided the memo tabulates the increased drawdown due to the extreme scenario compared to the original drawdown results using constant stream leakage (i.e. 100% creek flow). As expected the extreme case of no leakage creates more drawdown in designated "private bores" listed in that memo. Table 1 below lists the drawdowns for the two cases.

Table 1 Simulated Drawdown(m) in Private Bores

Bore No.	EA Model (constant creek leakage)	Extreme case (no creek leakage)
PB28	0.99	5.01
PB32	5.02	9.7
PB65	1.30	3.97
GW012551	2.40	3.79
GW027388	0.85	4.62
GW027389	1.30	3.77
GW058162	0.38	2.26

Subsequently a revised mine plan (revised Project Preferred Report) was submitted by the proponent's consultant (EMM 2013b). In that assessment the mine voids are determined to be similar or less extensive than for the previous mine plan and the proponent's consultant has claimed therefore that (EMM 2013b Appendix E, page 2, dot point 1,): *"the volumes of groundwater inflows to the pits will be similar or less, resulting in similar or less impacts on drawdown and river losses".*

The proponent's consultant has also indicated that they would likely include dewatering bores during the mining process. They indicate that this would reduce evaporation from the pit high walls and floor seepage thereby providing additional water availability for the mine operation; secondly, provide more accurate metering of groundwater that would enter the pits and third that pumped groundwater would be cleaner and less saline than pumped seepage water from in pit water storages.

In response to the new mine plan and dewatering option NOW has provided comments that were in turn responded to by Phil Towler (DOPI 2013a). The NOW comments relevant to groundwater are underlined below together with a summary of the proponent consultant's responses where available:

a) lack of quantification of differences in inflows for the EA and revised mine plan. The proponent's consultant has responded that the differences were not modelled but would lie within the envelope of the previous EA mine plan estimates. In addition that groundwater modelling would be conducted for the revised mine plan as part of the groundwater management plan to be submitted prior to the commencement of mining.

b) lack of detail regarding bore dewatering operations with regard to borefield's location, operation and impacts in accordance with the Aquifer Interference Policy. The proponent's consultant has indicated that operation of the borefield while creating more drawdown in the short-term will remove a similar volume as pit seepage without dewatering in the long-term. Hence the drawdown distribution is expected to be similar whether dewatering is included or not in the long-term. They indicate access licence shares will be held for any increased volume taken by the borefield.

c) the revised PPR that indicates that borefield yields would be similar to the inflow volumes in the initial PPR requires justification. Revised annual groundwater inflows is requested in addition to inflows into the final void post mining and at equilibrium. The proponent's consultant has responded that these issues could only be addressed by a complete update of the groundwater modelling and that this would require additional time estimated to be two to three months. They indicate that the modelling update can be done as part of the groundwater management plan that would very likely be required before mining commences. They maintain that the assessment in the PPR and results in the PAC responses (EMM 2013b Appendix E) provides sufficient management measures to minimise groundwater impacts to an acceptable level.

d) the revised PPR final void worst case final water level is similar to the previous design and maintains freeboard for overtopping. The final void in void B remains a groundwater sink. The proponent's consultant has agreed with this description.

e) a revised cross-sectional diagram is requested of the final land form to illustrate surface and groundwater features and final void geometry. The proponent's consultant has indicated that these features will not change significantly compared to that illustrated previously and that a cross section of mining area B is presented in Figure 3.15 of the PAC responses report (EMM 2013b Main report).

f) Number of dewatering bores, predicted demands and impact assessment with regard to Aquifer Interference Policy and revised annual groundwater inflows in conjunction with borefield.

KA Assessment Comments

1. With regard to NOW's comments a) to f) above there is agreement with the proponent consultant's response comments with the following additions. With regard to b) it will be necessary to verify this conclusion with an update to the groundwater modelling for the revised mine plan. With regard to e) updated cross-sections could be generated from the updated modelling results proposed as part of the management plan before mining commences. f) would need to be determined as part of the revised modelling proposed by the proponent's consultants.

2. The “pit shell” calculations by the proponent's consultant for estimating how the new revised PPR void(s) will change the drawdown distribution is very approximate (EMM 2013b Appendix E Figures 2 and 3). The proponent consultant's has claimed that such drawdown influence will be the same or less than estimated for the old mine plan (Dec 12 EA Mine Plan). The impact/influence would certainly be less than for the extreme case modelled as described previously and therefore less than the "extreme" drawdowns indicated in Table 1 above. Additional revised verification modelling indicated by the proponent's consultant that will be conducted during the groundwater management plan would no doubt clarify this issue.

3. Introducing dewatering into the new mine plan will change the drawdown response, but the long-term drawdown would probably not propagate a substantially greater distance from the mine compared to the case without dewatering in the long term. The memo report on bore dewatering (EMM 2013c) has also suggested this would be the case as discussed in item 3 *"Potential Impacts"* where the proponent's consultant indicates that during the early phases there will be increased volume pumped compared with the case of only pit seepage and no dewatering but that in the long-term the volume pumped or allowed to seep into the pit without dewatering will be similar. KA is in agreement with this conclusion.

   The corollary is that in the long-term the drawdown distribution would therefore also be similar for both sets of conditions (pumping and non-pumping). But this needs to be verified by modelling at some stage before mining commences as the PB memo also advocates (Item 3 paragraph 2 and Item 4). It is also expected therefore that the drawdown distribution with dewatering active during mining operations would remain significantly less than for the case assessed using the original mine plan assuming no leakage from Sandy and Lahey Creeks. (The extreme case as summarised in Table 1 above).

4. KA understanding of water quality of the proposed dewatering bores based on PB investigation results indicate that pumped groundwater extracted by dewatering bores would likely be in the range 2000 to 3000 microS/cm with a lower bound of about 1300 microS/cm and upper bound salinity of about 5000 microS/cm.

5. NOW has indicated with reference to their Attachment A (DOPI 2013a) that a dewatering borefield will result in a greater drawdown and potentially result in longer flow paths for any contaminants leaking from the tailings storages. It is not clear what is meant by "longer flow paths" specifically but may refer to a greater drawdown "reach", that is, drawdown distance due to dewatering that would either establish a gradient or increase the gradient away from a tailings storage that may mobilise solute migration from any existing tailing storages. However, this may not be the case as indicated in point 2 above. Again it would need verification by model simulation at some stage before mining begins.

6. The proponent's consultant indicates (EMM 2013b Main report, page 113 Table 16.1 Item 7) that there would be a key commitment for “corrective action” should private bores be impacted by more than 2m during mining operations. The proponent's consultant should indicate what specific action or actions are intended.

7. The proponent consultant's indicates (EMM 2013b Main report, page 113 Table 16.1 Item 9) that groundwater would be monitored during and after the life of the mine. However, no details are provided what monitoring is to be conducted nor for what period of time after the mine closes.

8. The revised plan tailings assessment (EMM 2013b part 2 page 10 Appendix C Section 9.2.1, 9.2.2) has indicated initial down gradient monitoring of the tailings storage(s) is to be achieved using one nested bore positioned down gradient of a TS. However, there should be at least three such bores positioned down gradient between each of the tailings storages and Sandy Creek within the rehabilitated mine pit A to establish watertable gradients and set up to monitor solute concentration levels. Three bores at each site should be situated at distances of 5m, 15m and 30m from the down gradient edge of the two tailings storages in mine pit area A. Model simulation should be an activity to be applied in the event of any detection of tailings

solute in any of these bores. Model prediction can then be applied to determine likely solute future migration distances and concentrations and to guide the placement of any additional monitoring bore network that might be required. This work should be conducted in addition to the commitments outlined in section 9.3 (EMM 2013b Part 2 Appendix B page 11, Tailings Management) in the section titled *"Response to Groundwater Impacts*".

References consulted (in date order)

Kalf and Associates Pty Ltd (KA) 2012 *Cobbora Coal Project KA Groundwater Adequacy Review. Report prepared by Dr F. Kalf. 23 August*.

Parsons Brinckerhoff Aust. Pty Ltd (PB). 2013a *Cobbora Coal Project. Groundwater Assessment. Main report Vol 1 and Vol 2 . January 2013*

Kalf and Associates Pty Ltd (KA) 2013 *Cobbora Coal Project 2nd KA Groundwater Adequacy Review. Report prepared by Dr F. Kalf. 11 February.*

Parsons Brinckerhoff Aust. Pty Ltd (PB). 2013b *PB responses to Kalf and Associates Feb 2013 comments on Groundwater Assessment. Memo dated 4 March.*

Parsons Brinkerhoff Aust. Pty Ltd (PB)2013c. *Cobbora Coal Project- Water Balance and Surface Water Management System Addendum. 18 March.*

Planning Assessment Commission 2013. *Cobbora Coal Mine Project. Review Report. April.*

Parsons Brinkerhoff 2013d. *Cobbora Coal Project-Responses to PAC Review of Water Modelling.14 May.*

Cobbora Holding Co. Pty Ltd. 2013. *Cobbora Coal Project- Tailings Management Review. 15 May.*

EMM 2013a *Planning Assessment Commission Review - Responses to Recommendations Cobbora Coal project. 17 May.*

Parsons Brinkerhoff 2013e. *Cobbora Coal project -* [proposal] *Assessment of revised mine plan in response to PAC recommendations [4 June. Letter from PB Team manager Water Resources to P Towler EMM*

EMM 2013b *Cobbora Coal project - Response to PAC Review and revised PPR. Part 1 main report; Part 2 Appendices A (revised mine plan),B (Tails management),C (Tails storage management),D (Response re water modelling) and E (Revised mine plan groundwater and surface assessment); Part 3 Appendix G,H. 13 August.*

DOPI 2013a. *Cobbora Coal - revised PPR. Email from S. O'Donoghue DOPI to KA and S Perrens from P. Towler. Comments from NOW; Fisheries; Crown Lands and Ag Departments. Includes Attachment A from NOW. 9 September.*

DOPI 2013b. *Cobbora - responses to water queries (from S Perrens). Email from P Towler Assoc. Director sent to S. O'Donoghue DOPI together with spreadsheet on final void water balance; groundwater Assessment wetted perimeter calculations and Appendix E Addendum March 2013 pdf file. 4 September (two separate emails at time 15.04 and 15.24)*

EMM 2013c. *Cobbora Coal project borefield. Memo report from L Webb to S. O'Donoghue . 12 September.*