PEER REVIEW LETTER

Abel Upgrade Modification Environmental Assessment

ATTACHMENT 5

Resource Strategies

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Donaldson Coal Limited
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Attention: Mr Tony Sutherland, Technical Services Manager, Underground Operations

Dear Tony,

Re: Abel Upgrade Modification – Review of RPS Aquaterra's Groundwater Assessment Report

RPS Aquaterra has been engaged by Donaldson Coal to undertake groundwater studies in relation to a proposed modification to the ongoing Abel underground coal mine operations, and to prepare a groundwater assessment report. I was requested by Resource Strategies Pty Ltd to carry out a review of the final draft of RPS Aquaterra's report, entitled *'Abel Upgrade Modification Groundwater Assessment'* and dated 18 September 2012, and to provide this letter setting out my conclusions.

I have subsequently reviewed a further draft of the RPS Aquaterra report (Revision F) dated February 2013, before finalising my review conclusions set out below.

Scope of Review

I have read the draft Abel Modification groundwater assessment report, and discussed certain aspects with the report's authors, but have not carried out a close examination of the groundwater modelling results.

As you know, I was involved in previous groundwater assessment studies on the Abel project, including the groundwater studies for the original Abel Project EA. I was also involved in an overview capacity on the Tasman Extension groundwater assessment and early stages of the Abel Modification groundwater assessment, which started while I was employed by RPS Aquaterra. I ceased employment with RPS Aquaterra in May 2011, and have since then worked as an independent consultant through Dundon Consulting Pty Ltd. I therefore am quite familiar with the groundwater conditions at Abel and in nearby areas.

I have reviewed the report with reference to the normal requirements of a groundwater assessment report, for accuracy, soundness of approach, reference to the relevant legislation and the specific requirements of the Director-General of Planning.

Abel Modification

The Abel Underground Mine is an underground coal mining operation located approximately 23 kilometres (km) north-west of the Port of Newcastle, NSW in the Newcastle Coalfield. The approval for the Abel Underground Mine permits primary and secondary bord and pillar extraction from the Upper and Lower Donaldson coal seams, and the mine has been in operation since 2009.

The proposed Abel Upgrade Modification provides for an increase in resource recovery within the area and the seams currently approved to be mined, while maintaining prior commitments regarding the management and mitigation of potential impacts to the environment and other stakeholders.

The main activities associated with the development of the Modification relevant to potential groundwater impacts include the:

- Introduction of longwall mining in a section of the Lower Donaldson Seam;
- Introduction of shortwall mining in a section of the Upper Donaldson Seam, and in a section of the Lower Donaldson Seam;
- Extension of mining, using bord and pillar extraction, in a southern section of the Upper Donaldson Seam that overlies the Lower Donaldson Seam within ML1618;
- Development of the modified mine layout to meet the existing approved subsidence management commitments; and
- Increase annual ROM coal production up to 6.1 Mtpa.

The mining operation is proposed to occupy approximately the same area as the original proposal, and the same coal seams. Accordingly, the purpose of the RPS Aquaterra groundwater assessment was primarily to assess the incremental impacts of the above modifications, relative to the assessed impacts of the already approved mining operation.

Overall Approach to Groundwater Assessment

RPS Aquaterra has approached the groundwater assessment by firstly describing the existing groundwater environment, then using the Donaldson Regional Groundwater Model to assess the impact firstly of the currently approved mine plan, and secondly the proposed modified mine plan and comparing the predicted impacts to determine the incremental impact of the modification.

A further simulation was undertaken to determine the cumulative impact of the proposal and the other existing projects in the vicinity, viz the Donaldson open cut, Bloomfield open cut operation, Tasman underground mine, and the West Wallsend operation to the south, as well as the proposed Tasman Extension underground mine.

This approach is appropriate, and I consider the report to be well written, coherent and sufficiently detailed to enable a clear understanding of the potential impacts of the proposal and the likely effectiveness of remedial measures where necessary.

Director-General's Requirements

The Director-General's requirements relating to groundwater are detailed in Table 2.1 on page 4 of the report. This table also references the relevant section of the report where each requirement has been addressed. I consider that each item has been addressed adequately in the report.

The assessment has concluded that the proposed modification will have only a small incremental impact relative to the impacts of the approved Abel project. Further, the mining proposal has been structured in such a way as to minimise impacts on groundwater, for example by the development of zones restricted from secondary extraction beneath watercourses and other features. Notwithstanding, the report also recommends that *"... specific operational responses to any connective cracking through the alluvium above the Modification within these drainage lines should be implemented to minimise the risk of water entering the underground workings following periods of sustained rainfall".*

Groundwater Investigations

No new investigations were undertaken for this project, as an extensive program of monitoring piezometer installation, testing and sampling had been undertaken for the initial Abel Project application, and other projects undertaken by the proponent in the area (Donaldson open cut, Tasman underground mine and proposed Tasman Extension project), as well as work for the neighbouring Bloomfield open cut project. A more extended baseline monitoring data set was available for this proposal, and further adjustments were made to the Donaldson Regional Groundwater Model – principally the splitting of the Donaldson Seam into three layers in the model, representing the Upper and Lower Donaldson Seams and the interburden between them, and re-calibration of the model against the longer baseline monitoring period which led to adjustment to

some of the input hydraulic parameters. The groundwater model domain has also been greatly enlarged from the model used for the original Abel Project application.

The groundwater modelling is discussed in more detail below.

The groundwater monitoring network available to the project is very extensive and covers all the main hydrogeological units in the project vicinity and the piezometers are broadly distributed across the area. The baseline data extends back to 1997 and thus represents 15 years of record. Through a data-sharing arrangement, the proponents also have 5 years of monitoring data from around the neighbouring Bloomfield mine. Limited data has also been sourced from publicly available records from the West Wallsend Project to the south of Abel.

The groundwater assessment report includes a comprehensive analysis of the water level/pressure hydrographs for the piezometers, which has been used to inform the calibration of the groundwater model. The hydrograph analysis has identified a number of hydrograph trends that are difficult to explain in terms of the current and recent mining activity, generally in the region to the south of the Bloomfield project, where mining has been undertaken for well over 100 years with only limited knowledge of old mine plans and timing, and no monitoring data until the last 10 years or so.

The groundwater quality dataset is more limited, as most piezometers are vibrating wire piezometers in fully-grouted boreholes, which only allow water pressures to be monitored and do not permit water quality sampling. However, the dataset is considered more than adequate for the current assessment.

The groundwater in the Permian coal measures is generally saline, ranging from sub-potable in shallow subcrop areas to highly saline at depth (600 to more than 16,000 µS/cm EC). pH is generally close to neutral (range 6.2 to 7.4).

Existing Groundwater Use

The report includes the results of a search of the NSW Office of Water (NOW) groundwater database, and also an account of the main groundwater dependent ecosystems (GDEs) in the project vicinity.

The assessment concludes that there is only limited use of groundwater by landholders in the region of potential impact from the project, and that most of the registered bores close to the project are coal project monitoring or test bores. The assessment also concludes that the proposed Abel modification will not impact any existing landholder's registered bore.

Identified GDEs include protected rainforest communities along stream lines, and localised swamps associated with the stream lines, and Pambalong Nature Reserve. The rainforest and swamp communities are both present in the streams overlying the proposed mining area, and the Pambalong Reserve is located downstream from the project area. The proponent has proposed subsidence control zones in which restrictions on secondary extraction will apply for the purpose of protecting these environmentally sensitive zones. As a result, subsidence effects within these zones are expected to be limited. The groundwater assessment report has concluded that adverse impacts on GDEs from the Abel Modification are unlikely. I concur with this conclusion.

Groundwater Modelling

Following approval of the Abel Underground Mining Project, an improved regional groundwater model was set up, as required by Commitment 8.5 of the Statement of Commitments. This improved model, known as the Donaldson Regional Groundwater Model (DRGM), has been calibrated and progressively updated several times against the observed impacts fro3m existing mining operations at Donaldson and Bloomfield, and the early stages of the Abel Project, and has been used for subsequent assessments for the Tasman Extension and Abel Modification projects.

The model uses the MODFLOW-SURFACT code with variable hydraulic properties which is the current industry standard and is considered appropriate for this project.

The report states that the groundwater modelling was carried out in accordance with the former modelling guideline (MDBC, 2000), which was still current at the time the model was set up. The model was developed as a medium complexity model. The report does however refer to the new guideline (NWC, 2012) which was released only recently. In terms of the new guideline, I believe the model meets the requirements for a Class 2 model, which I consider appropriate for this project.

The model has 20 layers, one for each of the coal seams in which mining is currently active in the mines of the project area, and one or more for each of the interburden zones. Some interburden zones have been subdivided into more than one model layer to facilitate the representation of progressive changes of permeability with height in the subsidence zones above secondary extraction areas. 20 is a large number of model layers and would normally be considered excessive for a mining project of this size and complexity, however, it has been necessary in this case in order to include all the neighbouring mines.

The Abel Modification involves a mining plan which includes a combination of shortwalls, longwalls, thin seam first workings and pillar extraction, in place of the approved bord and pillar operation approach, for part of the approved mining area. The proposed mining plan continues to recognise the mining constraints required beneath sensitive environmental areas and infrastructure features and therefore involves a range of subsidence impacts. The subsidence reports for the original EA and the current proposal (Strata Engineering, 2006; and MESC, 2012) have been used as the basis for developing appropriate heights of connected cracking above each mining area in the modification proposal.

Four zones of subsidence permeability change are represented in the model:

- Strata beneath the mined seam – uniform increase in vertical hydraulic conductivity to 3 times in situ values;
- Caved zone including goaf and immediate roof strata – vertical conductivity increased to 10m/d;
- Zone of continuous connected cracking above the caved zone, in which horizontal conductivity has been increase by a factor of 2 and vertical conductivity has been increased according to a ‘ramp function’, which relates the conductivity increase to height above the seam between pre-set upper and lower limiting values;
- Zone of discontinuous cracking, in which horizontal conductivity has been increased by a factor of 2, but the vertical conductivity is unchanged. This zone extends to the surface in some areas.

A fifth zone of subsidence impact, the zone of surface cracking which extends down from the ground surface for a limited depth, is noted in the report, but has not been represented in the groundwater model. I do not consider this a problem, as I believe the groundwater model is not the best means of predicting impacts from near-surface fracturing anyway, due to the discontinuous and localised nature of groundwater in the regolith layer, and because the proposed subsidence control zones in the mine plan are intended to limit impacts in sensitive areas.

Both steady state and transient calibration of the model was carried out. The report indicates that a good overall calibration has been achieved with the model, however there are some parts of the model domain where calibration is not so good, as the monitoring hydrographs include some trends that cannot be related to known mining activity. Some hydrographs in the region south of the Bloomfield mine in particular have not been calibrated well. The report suggests that this may be due to the residual effects of past mining (which at Bloomfield has included underground mining down to at least the Rathluba Seam) and the ongoing practice of disposing of tailings from the Bloomfield CHPP into abandoned Rathluba underground workings and into various open cut voids, and recovering water from the old workings to supplement the CHPP water supply. The degree of interconnection between the abandoned workings and the current active mine areas is apparently not well understood, and it is likely that some form of interconnection exists across all 20 layers in the model, including the basement layer, through open mine shafts and subsided strata. The Rathluba Seam lies within the basement layer of the Abel model (Layer 20).

This has highlighted the difficulty of calibrating a groundwater model in an area where there has been a long history of mining with limited knowledge of mine plans and no historical monitoring data

until the last 10 years or so. The proponent has made a commendable attempt to achieve a good model calibration, and the reported calibration statistics show that overall the model calibration is acceptable. It is a common feature of groundwater models that good calibration is difficult to achieve in all parts of the model domain.

I consider that the areas where the model is less well calibrated do not affect the utility of the model for prediction of impacts from the Abel Modification.

The mine inflow calibration plotted on Figure 7.12 indicates a reasonable calibration with observed inflows. It is recommended that as more data on mine water inflow rates is collected as mining proceeds, the model should be regularly re-calibrated in order to improve the reliability of longer-term predictions of future inflow rates.

Prediction modelling has been undertaken for the modification by running the model through the mining and post-mining recovery phases. The post-mining recovery simulation period was 100 years. Two simulations were carried out – one of the current approved bord and pillar mine plan and the other of the proposed modification mine plan. Both simulations assumed the same mine plans for the neighbouring mining operations. The results of the two simulations have been compared, and the difference taken to be the impacts of the proposed modification. This is considered appropriate.

From the Abel Modification model, mine inflows are predicted to peak at 6.3 ML/d in 2015-2016. The comparative figure for the approved mine plan is 7.0 ML/d in the same year. Figure 7.18 in the RPS Aquaterra report shows that there is a 5-year period (2016 to 2021) when groundwater inflows are predicted to be noticeably higher with the modification mine plan compared with the approved mine plan. This results from the proposal to mine simultaneously from the Upper and Lower Donaldson Seams in the modification mine plan. However, towards the end of the project, between 2025 and 2029, the inflows are predicted to be much lower with the modification than with the approved mine plan. At other times, the inflow rates predicted by the two simulations are not greatly different.

Comparison of predicted baseflow/stream leakage impacts shows that only small additional impacts are expected from the proposed Abel Modification in Blue Gum Creek, Hexham Swamp and Viney Creek, compared with the approved mine plan. Slightly reduced impacts are predicted in Buttai Creek, Minmi Creek and Viney Creek during post-mining recovery.

Uncertainty modelling has been carried out to assess the effects on predicted impacts of uncertainty in key hydraulic parameters identified as sensitive in the steady state sensitivity analysis, viz horizontal and vertical hydraulic conductivity in the alluvium/regolith (all of Layer 1 apart from the streamlines and mine backfill areas), and recharge rate to the Mt Sugarloaf ridgeline and the regolith within the coal measures subcrop zone (Zones 9 and 6 respectively). Uncertainty in each case was tested for 10-fold increases and decreases of the model calibrated values The report states that the uncertainty analysis indicates minimal effect on mine inflows, but some baseflow impacts are affected. Higher recharge rate leads to increased baseflows to the watercourses near the Abel mine, while increasing horizontal conductivity of Layer 1 leads to higher predicted leakage losses from Hexham Swamp.

Potential Impacts

The report concludes that the modification will have only minimal impact on baseflows compared to the approved mine plan, with slightly greater impacts in some areas and slightly reduced impacts in other areas. The report concludes that there will be no adverse impacts on any GDEs, including Hexham swamp, and no impact on any current groundwater user.

Aquifer Interference Policy (AIP)

The proponent has concluded that the project lies outside of any Biophysical Strategic Agricultural Land, and therefore the “gateway process” will not apply to the proposal. It is recommended that future roll-out of the AIP be monitored to determine if any future requirement should arise.

Overall Review Conclusions

I consider that the groundwater assessment has been competently carried out and I generally concur with the conclusions that the Abel Modification proposal will have only limited incremental impact relative to the current approved mine plan.

Please contact me if you wish to discuss any of the findings of this review.

Yours faithfully.

Peter Dundon