Technical Assessment by the NSW Office of Water for the Minister for Lands and Water

West Muswellbrook Project – Application for Gateway Certificate

1 Purpose

To provide comment on the West Muswellbrook Coal Project, in accordance with the NSW Aquifer Interference Policy, with consideration of the advice of the Independent Expert Scientific Committee (IESC).

2 Project background

The West Muswellbrook Project is a proposed new multi-seam open-cut coal mining operation within a portion of Assessment Lease (AL) 19 (greenfield site). The proposed site straddles the Muswellbrook and Upper Hunter Shire Council LGAs and is located approximately 12km north-west of Muswellbrook. The proposal is for open-cut terrace mining to extract up to 621 million tonnes of coal from the Upper Hunter coal Measures over a 30 year life of mine (up to 15 million tonnes per annum of saleable thermal coal for export). The proposal has a planned surface disturbance area of 5621ha.

The Project proposes to mine coal seams in the base of the Lower Wollombi Coal Measures and the top of the Whittingham Coal Measures. The Abbey Green seam is the lowest seam of the Wollombi Coal Measures subcrop on the western side of the deposit. The upper part of the Wittingham Coal Measures, the Jerry's Plains Subgroup, contains 15 formally named coal seams. The top seams (Whybrow, Redbank Creek, Wambo, Whynot and Blakefield), subcrop progressively from the eastern edge of the AL and are suitable for open cut mining.

3 Office of Water comment

- While the estimated take of water has been defined from the various catchments and geology, the relevant water sources have not been identified by the proponent.
- There are a number of parts of the NSW Aquifer Interference Policy (AIP) relating to water sharing plan rules that have not been addressed. The groundwater assessment has not incorporated how the development will integrate with the rules of the Hunter Unregulated and Alluvial Water Sharing Plan.
- The proposal will mine a section of alluvium forming part of the highly connected system as part of the Muswellbrook Water Source. Further assessment against the AIP 10% cumulative excavation limit will need to be undertaken. It is noted however that the salinity within the alluvium of Sandy Creek South is indicated to be already elevated with salinity ranging between 4293 µS/cm to 6575 µS/cm.
- Mining is proposed to pass through the Coal Creek alluvium and replaced with mine spoil, and there is potential this will enhance hydraulic connection between the alluvium and the coal measure post mining.
- No long term impacts have been considered as yet and an independent peer review of the groundwater model will be required prior to the model being finalised.
- There are a number of private properties within the mine lease area with groundwater access licences in the highly productive alluvium that are modelled to

have category 2 impact for water level drawdown. The proponent outlines a land acquisition and make good strategy.

- There is the potential river bank instability where mining progresses through sections of Coal Creek alluvium. Engineering solutions will need to be investigated during the DA and detailed design project phases to address this.

4 Advice from the Independent Expert Scientific Committee

The IESC report recognises that the application addresses the criteria required by the Gateway process, however, notes a number of shortcomings of the Muswellbrook Coal Preliminary Assessment. The IESC report in particular focuses on the lack of model conceptualisation and assessment of Groundwater Dependent Ecosystems (GDEs).

The AIP requires that at the Gateway stage, the groundwater estimates be based on a simple modelling platform, using suitable baseline data that is fit-for-purpose. The level of assessment at this stage draws upon a sufficient data set and the applicant has provided a preliminary assessment of potential impacts. Once the gateway certificate is issued the impact assessment will need to be revised and strengthened as the proponent develops its EIS.

Some of the IESC comments relate to a more advanced state than what the proponent is required to complete for the Gateway Stage, e.g. at points 20 and 21 of the IESC report. However the IESC articulates much of what will need to be done before a complete assessment against the AIP can be completed, so the recommendations are supported. The proponent has already proposed further investigations that will address many of the matters flagged by the IESC.

The IESC's criticism of the lack of a conceptual model is strongly supported. This is a generic requirement to support the design for the numerical model.

5 Recommendations

1. The findings of the IESC are supported.
2. The proponent must undertake a full assessment against the AIP using the Office of Water's assessment framework.
3. Affected water sources (as defined by the relevant water sharing plans) must be identified.
4. An adequate conceptual hydrogeological model must be provided.
5. The proponent must address the rules of the relevant water sharing plans.
6. Further assessment is required in relation to alluvial impacts.
7. Further investigation in relation to river bank stability is required.

Attachment: Detailed assessment against the NSW Aquifer Interference Policy

Detailed assessment against the NSW Aquifer Interference Policy

Aquifer Interference Policy Assessment Framework

Table 1: General requirements

AIP Requirement -has the proponent:		Proponent response	NOW Comment
1	Described the water source (s) the activity will take water from?	See Section 5.1 The model predicts the groundwater seepage rate to the proposed mine peaks at 188 ML/year with a long term average for the life of mining from the Permian of 97 ML/year. This water-take being sourced from both the less productive Permian coal seam strata and leakage from highly productive alluvium. A peak annual total of approximately 225 ML/year is calculated to be taken from highly productive groundwater (alluvium) during mining.	Water sources identified and assessment is well advanced.
2	Predicted the total amount of water that will be taken from each connected groundwater or surface water source on an annual basis as a result of the activity?	The predicted mine inflow then fluctuates between 26 ML/year (~2.2 ML/month in year 12) and 318 ML/year (~26.5 ML/month in year 20) with average rate of 109 ML/year (~9.1 ML/month). The Sandy Creek North alluvium (Dartbrook Water Source) will have decreased inflows into the alluvium by approximately 180 m3/day (1.15 ML/year) between years 7 and 9 of mining. The loss of inflow for Coal Creek (Wybong Water Source) alluvium averages at approximately 255 m3/day (93 ML/year). Sandy Creek South alluvium (Wybong Water Source) is being affected indirectly as the mine progresses alongside the creek in a NE to SW direction. Predicted inflows into alluvium start to decrease past mining year 12 with an average decrease in inflow of 15 m3/day (5.7 ML/year). Spring Creek alluvium start to gradually decrease around mining year 25. On average, the loss of	Surfact modelling platform is appropriate. Error noted in EA text 180 m^3/day would equal 65.7 ML/yr, not 1.15 ML/yr as stated (see pg 48 Append C).

AIP Requirement -has the proponent:		Proponent response	NOW Comment
		alluvial inflow represents 30 m3/day (10.9 ML/year) peaking towards the very end of the mining at 163 m3/day (59.6 ML/year). The average combined loss of seepage into all alluvial aquifers is 240 m3/day (87 ML/year), peaking at 616 m3/day (225 ML/year)	Error noted above appears to have been corrected for the total water take estimate.
3	Predicted the total amount of water that will be taken from each connected groundwater or surface water source after the closure of the activity?		Not described.
4	Made these predictions in accordance with Section 3.2.3 of the AIP? (refer to Table 2, below)	The MODFLOW SURFACT code.	No independent review of the model.
5	Described how and in what proportions this take will be assigned to the affected aquifers and connected surface water sources?	As described above in point 2	As described above in point 2
6	Described how any licence exemptions might apply?		Not described
7	Described the characteristics of the water requirements?		Not within the Groundwater Assessment. Note proximity to Hunter Regulated River provides alternative water supply options to groundwater.
8	Determined if there are sufficient water entitlements and water allocations that are able to be obtained for the activity?	Calculated water takes from highly productive alluvium groundwater sources within and adjacent to the PAA will require water licences from the Hunter River Alluvial water source (HRAWS). This water source has been fully allocated through the Water Sharing Plan for the Hunter Regulated River Water Source.	Calculated take of water but not the availability of water entitlements from the relevant WSP.
9	Considered the rules of the relevant water sharing plan and if it		Not described

AIP Requirement -has the proponent:		Proponent response	NOW Comment
	can meet these rules?		
10	Determined how it will obtain the required water?	It is anticipated that the proponent will acquire some proportion of the required water-take through future land acquisition. The proponent will commit to securing any water allocations or licences from existing users to meet the predicted water take, prior to commencement of development. Water-take from the Permian strata is currently allocated under the *Water Act 1912*. The proponent currently holds water licences for existing operations and will investigate the potential for a permanent transfer of the volumetric entitlement attached to those licences. The proponent will also assess whether a new licence is needed to account for the predicted water-take from the Permian sequence at the DA stage	Strategy noted.
11	Considered the effect that activation of existing entitlement may have on future available water determinations?		Not described
12	Considered actions required both during and post-closure to minimize the risk of inflows to a mine void as a result of flooding?	A void will remain in the southern area of the southern pit.	Not described within the Groundwater Assessment.
13	Developed a strategy to account for any water taken beyond the life of the operation of the project?		Not described
	Will uncertainty in the predicted inflows have a significant impact on the environment or other authorized water users? *Items 14-16 must be addressed if so.*	Further work should be undertaken to improve the calibration and predictive capability of the groundwater model. This includes: • analysing the uncertainty of the predictions to model parameters	Future work is proposed for the modelling to lift from Class 1 to Class 2 model.
14	Considered any potential for causing or enhancing hydraulic connections, and		Not at this stage. Deferred to the EA stage.

AIP Requirement -has the proponent:		Proponent response	NOW Comment
	quantified the risk?		
15	Quantified any other uncertainties in the groundwater or surface water impact modeling conducted for the activity?		Future work is proposed for the modelling to lift from Class 1 to Class 2 model.
16	Considered strategies for monitoring actual and reassessing any predicted take of water throughout the life of the project, and how these requirements will be accounted for?		Not described.

Table 2: Determining water predictions in accordance with Section 3.2.3

AIP Requirement		Proponent response	NOW Comment
1	For the *Gateway* process: Is the estimate based on a simple modelling platform, using suitable baseline data, that is fit-for-purpose?	A numerical groundwater flow model was developed to assess the influence of the Project on the groundwater regime. The model simulated the behaviour of the entire groundwater system within the Study Area prior to and during proposed mining. The pre-mining period was used to calibrate the model using measured rainfall, streamflow and groundwater levels. Once calibrated the model simulated the influence of mining on the mapped highly productive groundwater regime.	Appropriate
2	For *SSD* or *mining* or *CSG production*, is the estimate based on a complex modelling platform that is: • Calibrated against suitable baseline data, and in the case of a *reliable water source*, over at least two years? • Consistent with the Australian Modelling Guidelines? • Independently reviewed, robust and reliable, and deemed fit-for-purpose?	Data collected as part of routine quarterly monitoring, commenced in 2003, has been used in this assessment. This routine monitoring consists of the measurement and recording of field water quality parameters at 18 surface water monitoring locations; and groundwater levels and field water quality parameters at 30 groundwater monitoring locations.	Based on calibrated model. Note further development is required, sensitivity analysis and peer review still to be undertaken prior to the DA.

AIP Requirement		Proponent response	NOW Comment
		Further work should be undertaken to improve the calibration and predictive capability of the groundwater model. This includes: • calibrating the model to transient water level records collected from the current and any newly installed monitoring bores and/or pressure measurements from newly installed VWP installations • increasing the model confidence class from Level 1 to Level 2 as described in the Australian Groundwater Modelling Guidelines (Barnett et al, 2012); • having the model peer reviewed	

Other requirements to be reported on under Section 3.2.3

Table 3: Has the proponent provided details on:

AIP Requirement		Proponent response	NOW Comment
1	Establishment of baseline groundwater conditions?	Baseline groundwater conditions were established by visiting the Study Area, conducting a bore census and reviewing geological and hydrogeological data collected by MCC. The bore census focussed on the area potentially impacted by the proposed mining activities. Whilst it was not possible to visit all private bores, as land access was not always granted, the census did establish the level of reliance on groundwater resources in the Study Area. MCC have also been monitoring water levels and quality in a network of monitoring bores at 12 private landholder bores within alluvial aquifers, which provided excellent long term baseline data. At some sites, ten years of baseline data is available. This is well in excess of the two year	Appropriate level of investigation for this stage of the assessment.

		minimum defined in the AIP.	
2	A strategy for complying with any water access rules?		WSP rules not reviewed.
3	Potential water level, quality or pressure drawdown impacts on nearby basic landholder rights water users?	The modelling indicates potential for drawdown in a number of private bores to exceed the Level 1 minimal impact considerations. Further studies will be undertaken during the DA phase to improve the accuracy of the model predictions. If predictions are confirmed by future monitoring data, the proponent will consider purchasing the land or entering into a 'make good agreement' with landowners.	Groundwater users impacted by the development have been identified.
4	Potential water level, quality or pressure drawdown impacts on nearby licensed water users in connected groundwater and surface water sources?	Table 5-4 shows 19 bores within highly productive alluvium that are predicted to have drawdowns greater than 2.0 m. 12 of these bores are situated along Coal Creek and are proposed to be removed by mining. The maximum drawdown at the seven remaining bores is predicated to between 2.0 m to 5.9 m.	Groundwater users impacted by the development have been identified.
5	Potential water level, quality or pressure drawdown impacts on groundwater dependent ecosystems?	Figure 5.3 shows the BOM mapped GDEs surrounding the PAA and this figure also shows predicted maximum extent of 1m and 2m drawdown from the water table aquifer. The available information suggests limited or no GDEs and no wetlands are present within the 1m drawdown extent of highly productive groundwater. During detailed design it is proposed to conduct targeted GDE assessment to confirm the initial assessment.	Noted and strategy accepted.
6	Potential for increased saline or contaminated water inflows to aquifers and highly connected river systems?	Any reduction in groundwater seepage to the alluvium during mining would therefore not increase stream salinity. Although not specifically	Mining of Coal Creek and associated alluvium and replacement of mine spoil is an area of concern. Noted that the average baseline EC downstream of the PAA in Sandy Creek South is

		modelled, it is common in the Upper Hunter for pit lakes to form below the regional water table, forming sinks in the local groundwater environment. In such a case, there would be a low likelihood of transfer of saline water from any pit lake to the surrounding environment. Groundwater levels will not fully recover to pre-mining levels, if average evaporation losses exceed rainfall and runoff inflow, which will result in a permanent cone of depression in the pit area. Post closure monitoring will assist in assessing the permanence of a cone of depression and if mitigation measures are needed. The north pit is proposed to be completely backfilled and may recover close to, or even above the original groundwater level pre-mining. Further post closure modelling will be completed as part of the detailed design phase of the DA and final landforms design will include measures to reduce groundwater seepage from previously mined areas, if this is considered problematic. ... appears at this early stage a low likelihood of problematic changes in salinity in either highly productive groundwater or interconnected surface water. During the detailed design stage of the project integration of refined post closure plans, further geochemistry analysis and refined modelling will be used to mitigate changes in surface water salinity post	brackish, with the average ranging at the three downstream sites between 4293 µS/cm to 6575 µS/cm. This aspect will need to be a targeted area with the ongoing groundwater monitoring program.

		closure.	
7	Potential to cause or enhance hydraulic connection between aquifers?	Underground mining is not proposed and therefore fracturing creating hydraulic connections between aquifers will not occur. Mining is proposed to pass through the Coal Creek alluvium, and there is potential this will enhance hydraulic connection between the alluvium and the coal measure post mining. The DA and detailed design phases will need to investigate the need for engineering solutions if the hydraulic interconnection is shown to be problematic.	Will need to consider how this is addressed in the EA and proposed monitoring.
8	Potential for river bank instability, or high wall instability or failure to occur?	The mine plan has been designed to remain 150 m from the edge of the other neighbouring alluvium associated with Sandy Creek South, Sandy Creek North and Spring Creek to ensure that interconnection to the alluvial system is minimised as far as possible. There is the potential river bank instability where mining progresses through sections of Coal Creek alluvium. Engineering solutions will need to be investigated during the DA and detailed design project phases to address this.	Further consideration required in EA

Table 4: Minimal impact considerations

Aquifer	Alluvial aquifer
Category	Highly Productive

Level 1 Minimal Impact Consideration	**Assessment**
<u>Water Table</u> Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. **OR** A maximum of a 2 m water table decline cumulatively at any water supply work.	No GDEs present within drawdown in highly productive aquifers. **Level 1 impact** Drawdowns greater 2m at water supply works in highly productive aquifers calculated. **Level 2 impact**
<u>Water pressure</u> A cumulative pressure head decline of not more than 40% of the "post-water sharing plan" pressure head above the base of the water source to a maximum of a 2m decline, at any water supply work. **OR**, for the Lower Murrumbidgee Deep Groundwater Source: A cumulative pressure head decline of not more than 40% of the "post-water sharing plan" pressure head above the top of the relevant aquifer to a maximum of a 3m decline, at any water supply work.	Pressure head decline calculated for highly productive aquifers and water supply works.
<u>Water quality</u> Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity. No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity. No mining activity to be below the natural ground	Mining will occur within alluvial system of Coal Creek. The alluvium forms part of the Sandy Creek South Water Source The alluvium associated with Coal Creek and Sandy Creek South form part of the Muswellbrook Water Source within the

surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial water source - whichever is the lesser distance) of a highly connected surface water source that is defined as a "reliable water supply". Not more than 10% cumulatively of the three dimensional extent of the alluvial material in this water source to be excavated by mining activities beyond 200m laterally from the top of high bank and 100m vertically beneath a highly connected surface water source that is defined as a "reliable water supply".	Hunter Unregulated and Alluvial Water Sources Plan. Alluvium associated with the Muswellbrook Water Source will be mined out and replaced with mine spoil as part of this development. The 10% cumulative excavation rule is yet to be assessed. **Further assessment required**

Note: Proponent has not yet undertaken assessment against the Aquifer Interference Policy for less productive groundwater, or for proposed remedial actions where impacts are greater than predicted