



OUT19/9645

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Dear Ms Evans

**Dendrobium Mine Extension Project (SSD-8194)  
EIS Exhibition**

I refer to your email of 18th July 2019 to the Department of Planning, Industry and Environment (DPIE) – Lands, Water and the Department of Primary Industries (DPI) about the above matter.

There are no Lands or DPI comments in relation to the Environmental Impact Statement (EIS).

DPIE Water Group and the NSW Natural Resources Access Regulator (NRAR) have reviewed the EIS.

We advise there are a number of concerns related to the proposal which include:

- There will be significant drawdown, and recovery to groundwater systems may not occur for 50 to 80 years.
- The proponent has not demonstrated that sufficient surface or groundwater entitlement can be obtained.
- The proposed longwall system will cause considerable impacts.
- The impact of subsidence on the geomorphology of watercourses will be significant.

Please note further explanation about recovery timeframe, groundwater modelling, water take and licensing, groundwater monitoring and geomorphology is provided in **Attachment A**.

Please send any further referrals to DPIE Water by email to [landuse.enquiries@dpi.nsw.gov.au](mailto:landuse.enquiries@dpi.nsw.gov.au). For future projects, please contact DPI and the Housing and Property Group directly for their comments, as DPIE Water no longer coordinates input on their behalf.

Yours sincerely

Jim Bentley  
CEO (Deputy Secretary) Water  
**Department of Planning, Industry and Environment - Water**  
23 October 2019

## **Attachment A**

### **Detailed advice to DPIE Planning & Assessment regarding the Dendrobium Mine Extension Project (SSD-8194)**

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The impacts of longwall mining on surface water and groundwater resources are significant. The proponent has also not demonstrated that the project will be able to acquire the necessary entitlement to account for the predicted water take. This represents a significant risk to the project.

In the absence of a viable trading market, and due to the licensing constraints that we have identified, the proponent should undertake revision of the mine design such as lowering of mining heights and narrowing panel widths. Alternatively a different mining method with fewer subsidence impacts should be proposed. The proponent then needs to demonstrate that the revised design or method limits the take of water to within the amount that can be licensed according to legislation.

#### **1.0 Recovery timeframe**

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Drawdown will be significant and recovery may occur within 50 to 80 years.

##### **1.1 Explanation**

Drawdown will be up to 80 m in the Hawkesbury Sandstone and between 140 to 180 m in the Bulgo Sandstone. The Bulgo Sandstone is a sandstone aquifer located directly above the coal formation mined in Area 6. The lateral extent of the drawdown reaches 7 km for the Bulgo Sandstone.

Recovery is expected to be achieved within 50 to 80 years. There are currently no users in the Bulgo Sandstone and only a few in the Hawkesbury Sandstone which would be severely impacted.

##### **1.2 Recommendation – Prior to Determination**

- DPIE - Planning & Assessment will need to assess the acceptability of the recovery timeframe as pressure on the Sydney water supply resources will grow over time.

#### **2.0 Groundwater Modelling**

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The reported modelling work is highly sophisticated and largely compliant with the Australian Groundwater Modelling Guidelines (AGMG-2012). However a number of improvements are recommended to ascertain the predicted impacts with better certitude. For example, the model needs to improve its estimation of drawdown effects on water users, infrastructure and the environment.

##### **2.1 Explanation**

The modelling report (“Dendrobium Mine – Plan for the Future: Coal for Steelmaking. Groundwater Assessment for South32 – Illawarra Coal by NPM Technical Pty Ltd trading as HydroSimulations. Project number: IWC009. Report: HS2018/67.” dated May 2019) was sighted for review but the model itself was not available for interrogation. The peer review of the model by Dr F Kalf was also reviewed.

It is evident from the reviewed report that a large dataset has been compiled and used in the development of the conceptual and numerical models. However, the groundwater head dataset used in the model calibration has not been thoroughly checked and used without assignment of confidence weights.

The main issues identified with the reported model are:

**1 Model parameterisation:**

- The modelling work is focused on representation of detailed characteristics and processes rather than the representation of the behaviour of the hydrological system (groundwater and interconnected surface water).
- The model attempts to represent subsidence effects predicted through various geotechnical methods in as much detail as possible. This has resulted in a “highly parameterised” detailed model, in which every model cell has been assigned unique hydraulic properties based on theory and subjective expert opinion.
- The model parameterisation (set up of hydraulic properties) is based on complex theoretical assumptions. No parametric sensitivity analysis of hydraulic properties has been undertaken to identify the most important parameters in model performance.

**2 Model calibration:**

- The basis for manual calibration is not clearly presented (including reasons for definition of zones referenced in Table 7-1). The manual transient calibration was started using unrealistic initial groundwater heads. No automated calibration (e.g. using PEST) has been attempted. Transient simulation is not based on satisfactorily calibrated steady-state model. This has resulted in starting transient calibration based on unrealistic initial conditions as can be seen in the hydrographs presented in Figures 7-4 through 7-20. Transient modelling is very sensitive to initial conditions.
- As a result, the mismatch between observed and model calculated groundwater heads is unacceptably large (commonly greater than 25 m). Such models cannot be used to predict effects on users where no more than 2 m drawdown at water supply works is acceptable (e.g. Sec 8.4.4) or effects on surface water features.
- The model-calculated mine inflows achieve a better match with mine inflows calculated using other methods. Because the mine inflow data used as calibration targets are not direct (real) measurements (but are derived from a calculated water balance), they should be given less weight in the overall model calibration process.

**3 Model predictions:**

- The model [regional] scale and resolution [in space and time] are not suitable for predicting effects on significant natural and manmade surface water features (wetlands, dam lakes, streams, etc.). In addition, potentially affected surface water features have not been adequately characterised and the no sensitivity or uncertainty analysis has been undertaken on relevant parameters, e.g. bed conductance (C) that controls leakage.
- Unsatisfactory simulation of the groundwater system behaviour and responses to historical mining stresses degrades confidence in the model’s ability to predict effects of the proposed activity (drawdowns for effects on users, strategic infrastructure and the environment, and inflows for licencing purposes).

**4 In addition, the mismatch between model calibrated inflows and calibration targets is still generally large.**

**5 Sensitivity analysis and uncertainty analysis:**

- The work does not include parametric sensitivity analysis that is required to help focus of efforts on the refinement of important parameters in the model.
- Furthermore, the reported sensitivity and uncertainty analyses are focused on the potential effects of changing parameters on predictions without sufficient consideration of the effects of the varying of the parameters on the model’s capability to match observations (history).

- The reported sensitivity and uncertainty analyses are inadequate. Better information is needed to enable well informed decision making about the acceptability of effects and licencing requirements of the proposed mine expansion.

## 2.2 Recommendation – Prior to Determination

The proponent should:

- Review the compiled dataset to enable better model calibration. This must include systematic elimination of errors and assignment of confidence weights for the remaining data.
- Reach agreement with stakeholders and relevant agencies on model acceptability measures, e.g. acceptable maximum difference between observed and model calculated groundwater heads.
- Consider more detailed models (finer 3D space and/or temporal resolution) and/or smaller models (thinner and/or smaller area) to assess effects on natural and manmade surface water features.
- Revise the numerical model and modelling report taking into consideration the above remarks. Additional detailed comments on the modelling are not included here but can be provided if necessary to assist the proponent to address the concerns raised.

Once the proponent revises the modelling as per the recommendations above, DPIE Water will assess the predicted impacts in accordance with the minimal impact considerations of the NSW Aquifer Interference Policy.

## 2.3 Recommendation – Post Determination

- The proponent should provide a modelling plan which ensures:
  - a. the model is updated and this is reported throughout the life of the project.
  - b. the model is used for assessing the adequacy of the monitoring network and determining enhancement requirements.

These recommendations should be developed in consultation with DPIE Water and to the satisfaction of the DPIE Secretary.

## 3.0 Water Take and Licencing

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Insufficient entitlement is held across all water sources and connected water sources where water take is predicted. The inflow of water from surface water systems including the reservoirs from the Sydney water supply are significant. Obtaining licences for this volume will be extremely difficult.

### 3.1 Explanation

The EIS has not demonstrated that the project will be able to acquire the 1935 units of entitlement necessary to account for the predicted water take resulting from the proposed expansion in the Upper Nepean Tributaries Headwaters Management Zone of the Upper Nepean and Upstream Warragamba Water Source. This is due to inadequate entitlement currently available for purchase and no viable options available for additional entitlement to become available. This represents a significant risk to the ability of the project to be in compliance with water policy and legislation and this needs to be addressed prior to project determination.

The ability to acquire entitlement to account for the predicted take resulting from the proposed expansion of 3ML/yr in the Illawarra Rivers Water Source and 7ML/yr in the Sydney Basin – Nepean (Management Zone 1) is at risk due to limitations on entitlement in these water sources.

Further information is required to confirm the ability to acquire this entitlement and to comply with the relevant water sharing plan rules to trade the entitlement to this project.

The maximum predicted inflow (based on numbers presented in the EIS – see modelling section for comments on adequacy) to the mine including Area 5 and Area 6 contributions is 26 ML/d (equivalent to 9,490 ML/y) in 2032 and 2036. It is not expected that this volume will be able to be licenced.

The EIS demonstrates that adequate entitlement is held to account for the predicted groundwater take in the Sydney Basin – Nepean Management Zone 2 and Sydney Basin – South water source.

The summary of allocation held by SOUTH32 in Table A7-2 is incorrect. It reads 9455 for the Sydney Basin – Nepean (MZ2); Table A7-1 within the EIS shows a total of 9755.

The EIS details that within the Metropolitan Special Areas there is no water licence market for some groundwater and surface water sources/zones that are largely or wholly located within the protected catchments. The project is therefore restricted on the number of licences available within the applicable Water Sharing Plan management areas and zones to account for modelled indicated takes from adjoining sources.

### 3.2 Recommendation - Prior to Determination

The proponent should:

- Ensure that sufficient licensed water entitlement can be obtained prior to approval or seek to modify the project accordingly. This is to address the current inability to acquire all necessary entitlement to facilitate the development of the Project in the applicable surface water and groundwater sources. The entitlements that need to be acquired for the proposed expansion include the following:
  - 1935 units in the Upper Nepean and Upstream Warragamba Water Source of the WSP for the *Greater Metropolitan Region Unregulated River Water Source*.
  - 3 units in the Illawarra Rivers Water Source of the WSP for the *Greater Metropolitan Region Unregulated River Water Source*.
  - 7 units in the Sydney Management Zone 1 of the WSP for the *Greater Metropolitan Region Groundwater Source*.

### 3.3 Recommendation – Post Determination

The proponent should:

- Obtain relevant approvals and licences under the *Water Management Act 2000* before commencing any works which intercept or extract groundwater or surface water, including incidental or induced take from adjacent groundwater sources.
- Prepare a Construction Environmental Management Plan (incorporating an Erosion and Sediment Control Plan) prior to commencement of activities. It is requested that this be undertaken in consultation with the Natural Resources Access Regulator.

## 4.0 Groundwater Monitoring and Trigger Action Plan

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As the proposed longwall panel configurations are the same as some of those that have recently caused observable and serious adverse impacts in the Area 3B domain, we believe that similar impacts will occur in Areas 5 and 6. These are a continuation of the impacts that have exceeded precautionary trigger levels in the case of current mining activity such as creek bed cracking.

### 4.1 Explanation

#### ***Suitable Trigger Action Response Plans (TARPs) are required***

The TARPs currently in place for the Dendrobium Mine were found to be ineffective by the Independent Expert Panel for Mining in the Catchment for both surface water flows (page 116 of

the interim report) and for upland swamps (page 117 of the interim report). The proponent does not appear to have refined the triggers during the period over which the mine has been operating (and, in particular, recently when significant impacts have been widely reported), to attempt to better manage the consequences of mining.

Due to the differences in geology and topography between the existing and proposed mining areas, new location-specific plans need to be documented that more appropriately respond to detected adverse impacts. Because of the inadequacies identified by the independent expert panel of the current TARPs, the new versions should be prepared and made available for review prior to any determination of the project.

The development of new TARPs will also need to be informed by the results of the comparative monitoring analysis described above.

### ***Reliability of monitoring remains in question***

There remains a high degree of uncertainty around the accuracy of vibrating wire piezometers that has not been resolved by the additional information provided by the consultants. Additional co-located stations (standpipe monitoring bores next to vibrating wire piezometers measuring the same subsurface depth intervals in isolation) are required, as are the collection of an adequate baseline period of data and a comprehensive analysis of the results from both approaches.

## **4.2 Recommendation – Prior to Determination**

The proponent should:

- Develop a suitable Trigger Action Response Plan using the baseline data gathered across Area 5 and Area 6 to demonstrate that potential future impacts can and will be satisfactorily mitigated or remediated if mining impacts were to occur.
- Demonstrate the reliability of vibrating wire piezometers through the correlation of water level measurements with co-located standpipe monitoring bores measuring the same subsurface depth intervals in isolation.

## **5.0 Geomorphology**

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The impact of subsidence on the geomorphology of watercourses is significant noting subsidence will not affect all watercourses at the same level. The submission lacks explanation on criteria used to assign significance to watercourses and on the assignment of setback distances.

### **5.1 Explanation**

Subsidence limits have been developed for watercourses adjacent to Areas 5 and 6 minimum subsidence zones as a result of the 'Independent inquiry into impacts of underground coal mining on natural features in the southern coalfield 2008'. These subsidence limits seek to reduce valley closure on watercourses to below 200 mm as an interim measure until such time further research addresses individual and cumulative mining impacts on river rock bars and river courses.

Protective setbacks and other measures are proposed for the Avon River, Cordeaux River and Donalds Castle Creek. Other watercourses, including five 3<sup>rd</sup> order watercourses in Area 5 and three 3<sup>rd</sup> order watercourses in Area 6 are not protected to the same level. The effectiveness of the proposed protection is uncertain. These other watercourses are predicted to have valley closure impacts of between 275-1150 mm and upsidence impacts of between 400-875 mm.

We are concerned about the criteria used to assign significance to watercourses overlying or adjacent to the predicted subsidence zone for Dendrobium Areas 5 and 6. The EIS does not provide geomorphic or hydrologic justification for the use of the 'Key' stream features of pools with holding capacities greater than 100m<sup>3</sup> capacity or waterfalls greater than 5 m height. These criteria may reduce any obligation to reduce longwall lengths to avoid direct subsidence of overlying swamps and connected watercourses.



Given the important social and ecological values of watercourses and uplands swamps in the Special Area (drinking water catchment conservation zone), the EIS does not adequately explain the reason to choose the above figures to establish significance. DPIE Water recommends that all watercourses are assigned high social and ecological value consistent with their inclusion in the Special Area. This would require derivation of a more precautionary set of geomorphic units that are likely to be affected by mining subsidence due to induced strains, upsidence and valley closure.

## 5.2 Recommendation – Prior to Determination

The proponent should:

- Revise the geomorphologic criteria used to nominate significance in relation to watercourses and upland wetlands and identify key threats to geomorphic features that form controls on pool form, wetland outlets and elevated chutes, cascades or waterfalls.

## 6.0 Aquatic ecology

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### 5.1 Explanation

#### ***Baseline description***

##### Macroinvertebrates

There is insufficient information provided in the EIS. DPIE Water does not consider the advice that the assemblage of macroinvertebrates is impaired due to natural factors has been justified. There is a reasonable likelihood that the assemblage has been affected by other mining activities in the catchment.

The proponent should use a more appropriate model than the OE50 model. DPIE Water recommends that a regional AUSRIVAS model should be used which accounts for taxa found in this region or the proponent undertake a comprehensive assessment of regional macroinvertebrate diversity at relevant sites identifying organisms to at least genus level with the exception of the taxa listed in 4.2.2.4.1 of Appendix E - Aquatic Ecology Assessment.

##### Fish and Threatened Aquatic Species

As Macquarie perch have been recorded previously within this area, the survey methods are insufficient. This cryptic species would have been best surveyed with the addition of Baited Remote Underwater Videos, night surveys, and more extensive surveys using the methods already incorporated. Further, the identification of *Euastacus* to only genus is inappropriate. The freshwater crayfish *Euastacus hirsutus* is listed as Critically Endangered by the IUCN and occurs in ephemeral streams within the catchment. The proponent should identify a genus to species if there is a threatened species within that genus.

#### ***Impacts on Aquatic Ecology***

The surface water assessment (Page 6-51 of Section 6 - Environmental Assessment) identifies the following losses in drainage lines overlying Areas 5 & 6:

- 63-100% for dry and 6-22% for median climate periods in Area 5
- 19-51% for dry and 1-5% for median climate periods in Area 6

These reduced surface flows in intermittent drainage lines will increase the low flow and zero flow periods and reduce pool volumes significantly in this region. This will also have a cumulative effect on downstream streams (e.g. Avon and Cordeaux Rivers) below Area 5 and 6 which have previous records of Macquarie Perch. It is likely that shallow foraging habitat and possibly spawning grounds for this species will be reduced due to these surface water losses.

#### ***Monitoring design***

The proposed monitoring plan broadly covers the appropriate aquatic variables. However the design is considered unsatisfactory as discussed below.

##### Macroinvertebrates

Section 6.2.3.4 Appendix E - Aquatic Ecology Assessment provides insufficient sampling design to detect change due to the proposed mine.

Assessment of macroinvertebrates to genus level should be incorporated into the design. In particular, sensitive taxa from Ephemeroptera, Plecoptera and Trichoptera (EPT). The OE50 model is inappropriate and outdated. Baseline data should establish a pool of regional taxa for the area and for each river. This pool of regional taxa can then be used to track changes at each site throughout the mines life. Where possible, the monitoring design should sample flowing habitat (e.g. runs or riffles) separately to pool habitat. The details of site location and number of sites should be provided. Samples in the 24 month baseline study need to be collected every season (4 samples a year) across this period to accurately describe the macroinvertebrate assemblage.

Section 6.2.3.4.2 details artificial sampling which to quantify macroinvertebrate density changes. The method is flawed as it is an assessment of colonisation, not changes in density/abundance through time. The proposed design will identify the density of macroinvertebrates on the artificial substrate after each period. Once a sample is collected, the artificial substrate is reset and the assemblage needs to recolonise the substrate before the next sample. This is not an assessment of macroinvertebrate density changes. We suggest that the proponent reviews this method and considers using either a benthic suction sampler or surber sampler to measure quantitative changes to macroinvertebrates.

#### Fish and Threatened Aquatic Species

Fish monitoring needs to be targeted for Macquarie perch and identify impacts on critical habitat for this species in Avon and Cordeaux Rivers. As stated above, sections below Area 5 and 6 in the Avon and Cordeaux Rivers have previous records of this threatened species. Additional surveys are required to ensure that this species has not been overlooked due to its cryptic nature. Baited Remote Underwater Videos (BRUVs) should be employed and should include a minimum of 4 replicates per site each day for three days. Night surveys can also be considered. If BRUVs cannot be sourced, more intensive sampling using the original survey techniques is required.

#### Hydrology

Monitoring the changes in water level fluctuations and impacts on shallow water foraging habitat throughout the mines life is critical. We propose water depth loggers be used at all key sites including downstream sites in the Avon and Cordeaux Rivers to assess cumulative impacts. Reference sites should also be included to identify the impacts of the mine on base and low flows. This is particularly important for Macquarie perch.

## **5.2 Recommendations – Prior to Determination**

The proponent should provide the following:

- A baseline description of existing environment so impacts of reduced baseflow can be monitored. This should include reassessing the macroinvertebrate assemblage using more appropriate methods
- Identification of the closest population of Macquarie perch in the Avon or Cordeaux Rivers.
- The monitoring design for macroinvertebrates and native fish to be revised to ensure appropriate baseline is collected.

## **7.0 Erosion and sediment control**

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### **7.1 Explanation**

The EIS states that site-specific Erosion and Sediment Control Management Plans would be developed for construction activities for the Project where required. This is supported and it is requested that this be undertaken in consultation with the Natural Resources Access Regulator.



## **7.2 Recommendation – Post Determination**

- The proponent should prepare a Construction Environmental Management Plan (incorporating an Erosion and Sediment Control Plan) prior to commencement of activities. It is requested that this be undertaken in consultation with the Natural Resources Access Regulator.