ATTACHMENT A:





WATERMARK COAL PROJECT

RESPONSE to Planning Assessment Commission Review Report

for

Shenhua Watermark Pty Limited

October 2014

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ENVIRONMENTAL CONSULTANTS

WATERMARK COAL PROJECT

RESPONSE TO PLANNING ASSESSMENT COMMISSION REVIEW REPORT

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3 October 2014

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Shenhua Watermark Pty Limited

1 INTRODUCTION

1.1 BACKGROUND

Shenhua Watermark Pty Limited (Shenhua Watermark) is seeking State Significant Development (SSD) Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the Watermark Coal Project (the Project).

The *Watermark Coal Project Environmental Impact Statement* (EIS) was prepared by Hansen Bailey Environmental Consultants (Hansen Bailey) on behalf of Shenhua Watermark to support the application (Reference: SSD 4975). The EIS was placed on public exhibition between 28 February 2013 and 26 April 2013. The *Watermark Coal Project Response to Submissions* (RTS) was prepared in response to submissions received from various stakeholders during the public exhibition process.

The Department of Planning & the Environment (DP&E) provided the RTS to various regulatory agencies for their review and comment. Regulatory agencies provided responses to the RTS. These were individually responded to via meetings and/or in submissions as required.

DP&E released the *Watermark Coal Project (SSD-4975) Secretary's Environmental Assessment Report* in May 2014 (Secretary's Environmental Assessment Report). This key milestone departmental report determined that the Project is in the public interest and recommended its approval subject to draft Development Consent Conditions (Draft Conditions).

The Project was referred on 8 May 2013 to the Planning Assessment Commission (PAC) by the then Minister for Planning and Infrastructure with Terms of Reference (TOR) to complete a review of the application (including public hearings). The TOR for the PAC were amended by the Minister on 15 November 2013. Ultimately, the PAC was directed to review the Project with a particular focus on agriculture, water, health and amenity and long term land use.

The PAC held public hearings over the Project on 26 and 27 June 2014 and issued the *Watermark Coal Project Review Report* on 5 September 2014 (PAC Review Report). The PAC Review Report concluded that the Project is approvable, subject to some further water modelling to corroborate the predicted level of impact on water. The PAC members have included in the PAC Review Report 25 recommendations that they consider should be applied to any Development Consent issued over the Project.

1.2 DOCUMENT PURPOSE

This document has been prepared by Hansen Bailey (with input from relevant technical specialists) on behalf of Shenhua Watermark to respond to the PAC Review Report.

Specifically, this Document includes responses to each of the PAC Review Report's 25 recommendations and provides a conclusion. It is supported by two specialist technical appendices.

2 RESPONSE TO PAC RECOMMENDATIONS

This section lists each recommendation contained in the PAC Review Report and provides a detailed response to each.

2.1 AGRICULTURE

2.1.1 Recommendation 1

> *The Commission recommends that the NSW Government should amend the boundary of exploration licence EL7223 to remove those areas that intrude into the black soil plains.*

Shenhua Watermark notes it is beyond the scope of the PAC's statutory functions and its TOR to purport to advise the NSW Government on the proper boundaries of any Exploration Licence (EL).

The functions of the PAC are set out at Section 23D of the EP&A Act. They are limited to functions delegated to the PAC under the EP&A Act and specific functions that the Minister for Planning and Infrastructure or the Director-General of the DP&E may request the PAC to carry out.

The grant of and imposition of conditions on an EL are the responsibility of the Minister for Resources and Energy under the *Mining Act 1992* (Mining Act). Review of these matters are not the subject of any delegation under the EP&A Act. Similarly, neither the initial TOR nor the revised TOR request the PAC to review any matter arising under the Mining Act, let alone the proper dimensions of an EL that has already been granted.

Shenhua Watermark also notes that EL 7223 is due to expire on 22 February 2016 and until then contains ample protections for the black soil plains at Conditions 48 and 50, which respectively:

- Completely prohibit longwall mining underneath the deep alluvial irrigation aquifers and the floodplain and open cut mining anywhere on the floodplain; and
- Require a horizontal barrier of natural material with a minimum width of 150 metres between any mining excavations and the Gunnedah Formation.

2.1.2 Recommendation 2

> *The Commission recommends that the NSW Government should follow on from the broader Regional Land Use Plan prepared in 2012, with some more detailed work or refinements to identify and protect those highly valuable, fertile, black soil plains, where mining should be prohibited.*

While this is a matter for the NSW Government, Shenhua Watermark is of the view that "more detailed work or refinements" are already an inherent part of the gateway certification system under the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP).

The Gateway Panel (with the assistance of the Independent Expert Scientific Committee and the NSW Office of Water) has been formed to provide expert and independent advice to the NSW Government on the best ways to properly protect Strategic Agricultural Land, including the black soil plains. The relevant criteria for a gateway certificate already include consideration of impacts on soil fertility and highly productive groundwater – two key aspects of the black soil plains.

As the PAC has correctly observed within Section 4.2 of the PAC Review Report, the gateway certification system does not apply to the present development application. Any further mining developments (whether by Shenhua Watermark or others) potentially affecting the black soil plains would have to go through the gateway process.

Furthermore, an absolute prohibition on mining in certain areas is a blunt instrument response to land use. By its nature, mining for coal is not a portable industry that can be moved to locations where it will have no impact on agriculture. Given this blanket prohibition on mining is not appropriate, Shenhua Watermark notes that it is more appropriate to make such projects permissible with consent and ensure a robust merits-based decision making process for each individual application. With this in mind, the NSW Government already has a rigorous system in place for balancing the needs of coal mining and agriculture in places such as near the black soil plains.

This policy position has been reflected in planning laws for some time, and most recently in clause 7 of the Mining SEPP, making mining permissible on the vast majority of land in NSW. This then allows any "mining" related developments to be considered on their merits rather than subject to blanket exclusions. This position should be continued in the Liverpool Plains, particularly in light of the introduction of the Gateway Process.

2.1.3 Recommendation 3

> *The Commission recommends that the draft condition relating to the agricultural productivity of non-operational land around the project site must be strengthened.*

Shenhua Watermark advises that the PAC's recommendation that Schedule 3 Condition 51 of the Draft Conditions be "strengthened" would be counter-productive and reduce Shenhua Watermark's flexibility to best manage any agricultural land it owns.

The "best endeavours" requirement in the existing draft condition when taken together with Shenhua Watermark's commitment to prepare and implement a Land Management Plan is sufficiently strong.

Schedule 3 Condition 51 of the Draft Conditions uses the term "best endeavours", a term that the PAC does not support. Instead of "best endeavours", the PAC appears to be recommending that the Development Consent contain specific requirements, such as a requirement that Shenhua Watermark lease or on-sell agriculture land outside the disturbance boundary. Any such "one size fits all" approach would significantly limit Shenhua Watermark's ability to enter into the most beneficial agreements with agricultural enterprises either cropping or grazing beef cattle on Shenhua Watermark owned land.

As farming systems change over time, new agricultural technology developed and market returns fluctuate, the flexibility of the present draft condition will allow Shenhua Watermark to adapt to changing circumstances and consistently maintain and enhance agricultural productivity on its land holdings.

The Land Management Plan (and other management plans) that Shenhua Watermark has committed to prepare and implement in its Statement of Commitments (SOC) at Appendix 3 of the Draft Conditions will be a rigorous but still a flexible tool to allow for the best practice management of its agricultural land.

2.1.4 Recommendation 4

> *The Commission recommends that a condition should be included to allow the NSW Land and Water Commissioner to nominate an independent party to resolve the matter, in the event of a disputed impact on agricultural production.*

Section 4.19.11 of the RTS concludes that 'Given the information provided during consultation with relevant experts and the available literature, the predicted dust deposition rates generated by the Project will have minimal impact on the productivity of cotton situated in the immediate vicinity of the Project Boundary." Sections 4.19.9 to 4.19.2 of the RTS address potential changes to impacts to external agricultural enterprises and conclude adverse effects are unlikely.

Further to the above, it is not necessary to appoint an independent party to resolve any disputes regarding the impact of mining activities on agricultural production as:

- Any approval for the Project will include rigorous conditions in respect of off-boundary dust impacts and if there are any breaches of those, any landholder can commence proceedings in the Land and Environment Court to ensure compliance with those conditions; and
- There is an existing compensation scheme already in place under the Mining Act for any compensable loss suffered by adjoining landholders.

In respect of the second point, the Mining Act imposes a longstanding and rigorous compensation requirement on the holder of any mining lease. Under Section 265 of the Mining Act, a landholder of any land, even if that land is not within the boundary of the mining lease, is entitled to compensation for any compensable loss suffered or likely to be suffered because of mining operations.

The definition of compensable loss in the Mining Act is even broader than the potential impacts considered by the PAC within Section 4.4 of the PAC Review Report and covers (among other types of loss):

> *'damage to the surface of land, to crops, trees, grasses or other vegetation (including fruit and vegetables) or to buildings, structures or works, being damage which has been caused by or which may arise from prospecting or mining operations'.*

The independence of the existing compensation framework under the Mining Act is beyond dispute. If the affected landholder and Shenhua Watermark cannot reach agreement on the amount of compensable loss, a mechanism exists where an application can be made to the Land and Environment Court to determine the appropriate compensation amount. If this was to occur, Shenhua Watermark would be bound to pay the quantum of compensation determined by the Land and Environment Court.

Shenhua Watermark's position is that the above regimes adequately provide for the resolution of any disputes in respect of the impacts of the Project on agricultural production.

2.2 WATER

2.2.1 Recommendation 5

> *The additional modelling recommended by Dr Mackie must be completed and considered against the impacts predicted to date, prior to any determination of the application. That is:*
>
> a. *The WST (Watermark Staged Transient) model is to be run with drain cells;*
> b. *The WST model is to be run using the variably saturated 'pseudo soil' option available within Modflow Surfact thereby negating the need for vadose zone parameters (drain reference elevations unchanged);*
> c. *The WST model is to be run using both the pseudo soil option and the adjustments to drain reference elevations; and*
> d. *A steady state recovery model is to be run to assess long term impacts.*

A detailed response to this Recommendation titled "Response to PAC – Dr Colin Mackie Review" has been prepared by Australasian Groundwater and Environmental Consultants Pty Ltd (AG&E) and is presented in **Appendix A**. Comments in response to (a) to (d) are presented below.

a) The EIS groundwater model set the drain reference elevation in the mining areas to the base of the pit floor to introduce conservatism to modelling predictions and to aid model stability for the recovery scenario. Revised modelling shows that setting drain reference elevations to the base of each cell (as requested by Dr Mackie) reduces predicted impacts to surrounding groundwater users and the neighbouring groundwater regime.

b) The revised modelling using a combination of pseudo-soil function and the AGE drain cell elevation approach produced a numerically unstable solution.

c) AG&E adopted the residual saturation function for EIS modelling due to its ability to aid model convergence following desaturation of model cells. AG&E's experience using this function indicates it produces results comparable to using the rewetting function in MODFLOW NWT/USG, at significantly faster runtimes.

d) The steady state recovery model produced results similar to the RTS transient model (2,000 years), which suggests the results from the RTS report are representative of steady state conditions.

The predicted seepage rates to the mining areas are sensitive to the adopted closure criterion. The EIS adopted closure criterion that ensured the model converged to an accurate solution, and provided accurate pit seepage rates. Revised scenarios that were undertaken in response to Dr Mackie's queries used a head closure criteria of less than 0.1 m produced numerically stable results, although non-convergence did occur using the pseudo-soil function in some instances.

This resulted in scenario c) to become numerically unstable at Year 28 (midway through eastern mining area) and scenario b) unstable at Year 21 (midway through the southern mining area). Simulated groundwater levels were found to be insensitive to variances in model closure criterion. No erratic behaviour in heads was observed in any of the scenarios explored.

Fast runtimes (<8 hours) were essential to maintain 50 m x 50 m cell resolution in the mining areas and to perform an uncertainty analysis. AG&E's experience has been that adopting the pseudo soil function further reduces the predicted impacts during both mining and long-term post mining.

Therefore the AG&E Review shows that the EIS model produces conservative impacts when compared to the other approaches suggested by Dr Mackie and can be used as a conservative, functioning predictive baseline that the observed impacts can be compared to once mining commences. The conservative nature of the EIS model provides further comfort that the impacts of the Project will be acceptable.

2.2.2 Recommendation 6

Any differences between the outcomes reported so far and those predicted under the revised modelling required in recommendation 5 will need to be assessed (and should be publicly exhibited if the impacts prove greater those currently predicted by the applicant), prior to determination of the application.

See response to Recommendation 6 in **Section 2.2.1**. As such, no further response to this issue is required as the revised modelling has not demonstrated impacts greater than those currently predicted in the EIS.

2.3 AIR, NOISE AND BLASTING

2.3.1 Recommendation 7

Operations to scale back and/or shut down to ensure compliance with noise and dust limits

The Commission recommends that the operating conditions for noise and dust should be updated to clarify that scaling back and shut down of operations will be required at certain times to ensure compliance with the noise and air quality limits.

Shenhua Watermark supports this recommendation

Schedule 3, conditions 4 and 18 of the Draft Consent set the physical operating conditions for the Project to commit to and when the scaling back and shutdown shall begin from.

Schedule 3, conditions 5 and 19 of the Draft Consent commit to the preparation and implementation of the Noise and Air Quality Management Plans, to the satisfaction of the Secretary that will detail how the operation will be scaled back or shutdown.

This shall include utilisation of a real-time Noise, Blasting and Air Quality monitoring and management system (including predictive meteorological forecasting) to enable the mining operations to be planned in advance according to weather forecasts to ensure that the appropriate noise and air quality criteria are met.

2.3.2 Recommendation 8

The Commission recommends that the conditions should include a requirement that prior to the commencement of mining in each new pit, updated consideration of the impacts of mining is to be provided, to demonstrate that the performance of the mine will comply with the standards of the day and ensure best practice (taking into account the more restricted options available compared to those for a new mine).

Shenhua Watermark cannot accept this recommendation. Without the certainty of being able to carry out the development for all three mining areas as has been assessed in accordance with current requirements, there is insufficient certainty of future production to justify the initial large capital expenditure to develop the mine.

A requirement that defers aspects of the Development Consent, such as mining in each new mining area, is only appropriate for a staged development application under Division 2A of Part 4 of the EP&A Act. A condition which requires Shenhua Watermark to demonstrate it is applying the "standards of the day" in relation to noise and dust mitigation before commencing mining in each mining area is unprecedented and unnecessary.

Schedule 5 Condition 9 of the Draft Conditions provides a mechanism for regular independent auditing of the Project and requires the auditor "(e) recommend measures or actions to improve the environmental performance of the development, and/or any strategy, plan or program required under these approvals."

Further, Shenhua Watermark will have to hold an Environment Protection Licence (EPL) under the *Protection of the Environment Operations Act 1997* (POEO Act) for the Project. An EPL is designed to be updated consistent with changing standards and best practices. We note that under section 89K of the EP&A Act, an EPL can be amended to reflect current standards from 5 years after they are granted.

Duplication of the Functions of an EPL

As the mining of coal is a scheduled activity under the POEO Act, Shenhua Watermark must hold an EPL granted by the Environment Protection Authority. EPLs issued to coal mines impose stringent controls on noise and dust emissions (and other environmental aspects and impacts) as a matter of course.

The flexibility of EPLs to be updated in line with changes in best practice noise and dust mitigation is clear from how they interact with development consents. Under section 89K(e) of the EP&A Act, any EPL granted to Shenhua Watermark must initially be substantially consistent with a development consent. This requirement for consistency, however, is expressly limited under section 89K(2)(c) of the EP&A Act to the period until the first review of the EPL, which is five years at the most (Section 78 of the POEO Act). This is intended to allow changing environmental management practices and standards to be taken into account.

As such, the Environment Protection Authority is the appropriate body to amend the noise and dust mitigation conditions of the EPL in line with changing standards and best practice.

In addition to the above, it is also a standard condition of a mining lease granted under the Mining Act for a leaseholder to prepare and submit a Mining Operations Plan (MOP) (or MREMP process) which must, among other things:

- Detail the staging of specific mining operations and mining purposes, such as the mining of each mining area at Shenhua Watermark; and
- Identify how mining operations will be carried out in order to prevent or minimise harm to the environment.

A MOP under the *ESG3: MOP Guidelines (September 2013)* (MOP Guidelines), must be updated at least every seven years (or sooner at the discretion of the Division of Resources and Energy).

2.3.3 Recommendation 9

Options available for residents predicted to be impacted by exceedances of dust criteria

The Commission recommends that all residences predicted to be impacted by an exceedance of the air quality criteria should be given the following options:

i. To sell their property to the mine and move elsewhere;
ii. To negotiate a mutually agreeable outcome;
iii. To have the applicant provide mitigation measures at the dwelling including enclosure of outdoor entertaining spaces such as decks and installation and upkeep of air conditioning and first flush devices for rainwater tanks;
iv. To have alternative accommodation provided.

Shenhua Watermark cannot support certain aspects of this recommendation. Areas of concern are discussed below.

Enclosure of Existing Spaces & Provision of Alternate Accommodation

Shenhua Watermark notes that item ii provides sufficient scope and flexibility for Shenhua Watermark and its private neighbours to negotiate appropriate dust mitigation outcomes as part of any Private Agreement. The listing of the specific mitigation measures, where they are definitive in scope, such as the installation and upkeep of air conditioning and first flush devices for rainwater tanks are acceptable as examples of appropriate mitigation measures.

The listing of mitigation measures such as the enclosure of outdoor entertaining spaces and the provision of alternative accommodation however are far too open-ended to define within development consent conditions and provide no limit to the liability that might need to be incurred by the proponent. Whilst there may be circumstances where it is appropriate for this type of mitigation to be applied (subject of a mutual agreement), these measures should not be included explicitly within a condition of any Development Consent granted.

Air Quality Criteria

There are two areas in the PAC Review Report in relation to the application of air quality criteria to a Zone of Affectation (ZOA) that are inconsistent with existing precedents for comparable open cut coal mining operations. These being goals for PM_{10} (24 hour average) dust levels at a residence and PM_{10} (24 hour average) dust levels over 25% of vacant land.

DP&E past practice has been to afford acquisition rights to private landholders at determination where there are predicted exceedances above 50 $\mu g/m^3$ for the project alone on more than five days per annum; or a maximum of 150 $\mu g/m^3$ on a cumulative basis.

A recent precedent is shown in the modified Project Approval for the Mt Arthur Coal Mine (PA 09_0062) at Schedule 3, Condition 21 which stipulates the relevant air quality acquisition criteria for PM_{10} (24 hour average) at a private residence on privately owned land as 150 $\mu g/m^3$ (cumulative total impact i.e. project and other sources).

It further stipulates 50 μg/m³ (incremental impact due to the project alone). Both criteria exclude extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed by the Director-General.

The Project Approval for the Maules Creek's Coal Mine and Mangoola Coal Mine (as modified) provides consistent requirements. The above is recognised contemporary NSW Government policy and we are unaware of any other project where the PAC's recommendation has been implemented.

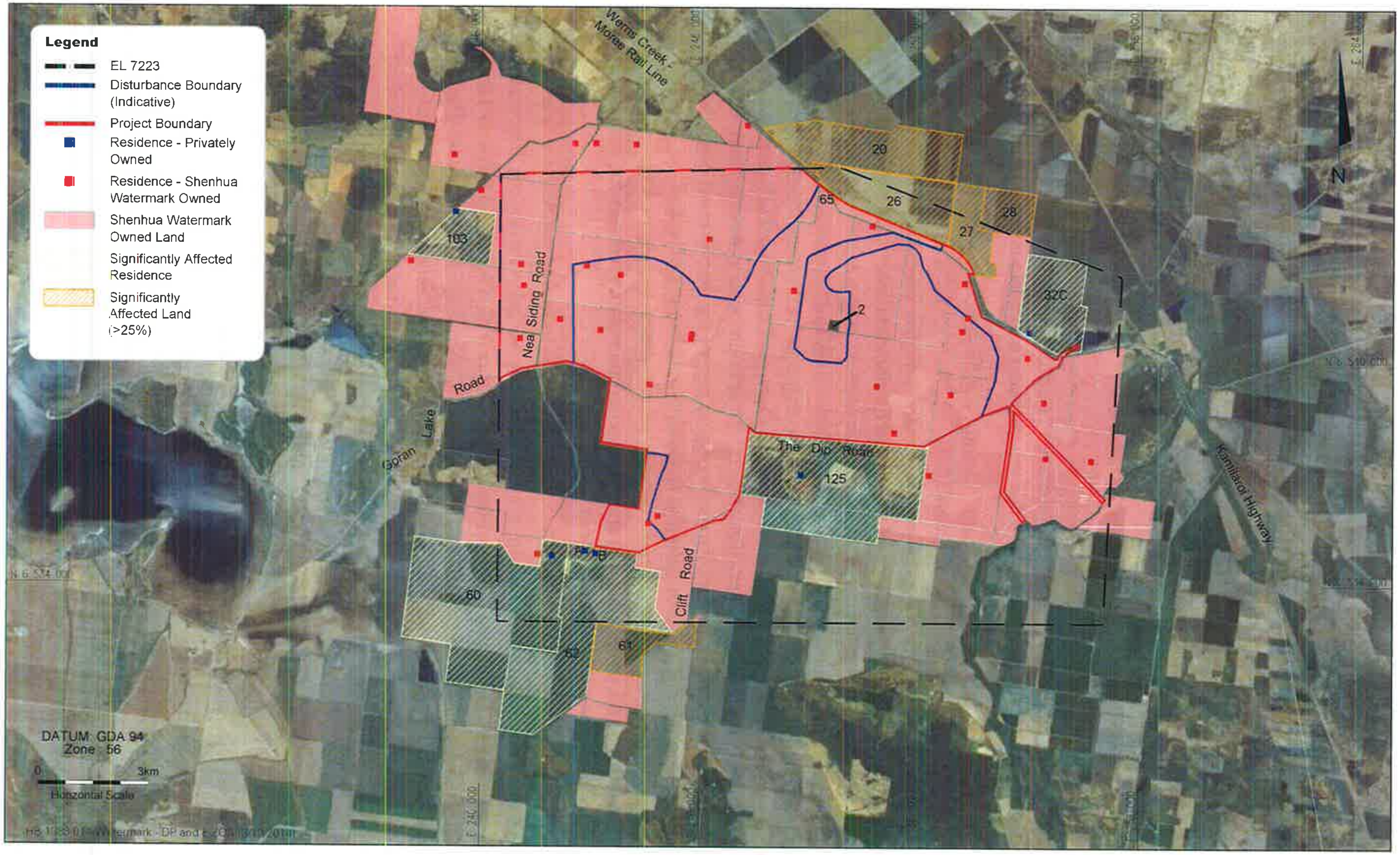
A review of "Table 2 - Number of days the cumulative PM_{10} dust levels are predicted to exceed 50 μg/m³" from the PAC Review Report enables the following conclusions to be reached:

- The values presented for Year 10, Year, 15 and Year 25 are consistent with Table 9.12 of the EIS Air Quality Impact Assessment;
- The values presented for Year 21 are consistent with the predictions in Table 5 of *Briefing Note: Air Quality Modelling of Optimised Equipment Fleet* (Pacific Environment, 2014). However, in this instance the values presented are a significant, worst case cumulative scenario (inclusive of Shenhua Watermark's interpretation of the likely Caroona Coal Project, prior to any detailed information on that project being available). There is currently no certainty over whether the Caroona Coal Project will proceed and if so what form it will take. Clearly that Project, if it is to proceed to assessment, should be assessed with the Watermark Project as being part of the background environment at that time, considering appropriate and realistic cumulative impacts; and
- The values listed are cumulative however with an acquisition criteria of 50 μg/m³ being suggested (not 150 μg/m³ which is the appropriate cumulative criteria for acquisition under contemporary NSW Government policy).

Further, the values presented in "Table 5 – Cumulative PM10 levels predicted to exceed 50 μg/m³ on the more than 25% of a property" appear to have been incorrectly interpreted from Table 9.11 of EIS Air Quality Impact Assessment (Years 2, 5, 10, 15 and 25) and Table 6 (Year 21) of the *Briefing Note: Air Quality Modelling of Optimised Equipment Fleet* (Pacific Environment, 2014). These tables provided information on the properties that were predicted to experience an exceedance of the 24-hour average PM10 criterion of 50 μg/m³ on more than 25% of the land <u>due to the Project only</u>, based on the maximum predicted 24-hour average and also the 98.6th percentile. There has been no cumulative Monte Carlo simulation completed for properties 26, 27, 28, 61 or 116 as there is no residence present.

Shenhua Watermark supports the findings of the Secretary's Environmental Assessment Report in relation to an appropriate ZOA for the Project (see **Figure 1**).

Figure 2 presents the far more extensive ZOA as suggested within the PAC Review Report which if implemented, would include vast areas of black soil plains extending over 8 km from the Project. The proposition that this huge swathe of land will be impacted by dust and or noise beyond recognised amenity levels is inconsistent with contemporary NSW Government policy and the assessments carried out to date.



WATERMARK COAL PROJECT

Department of Planning and Environment ZOA

FIGURE 1

SHENHUA WATERMARK COAL PTY LIMITED

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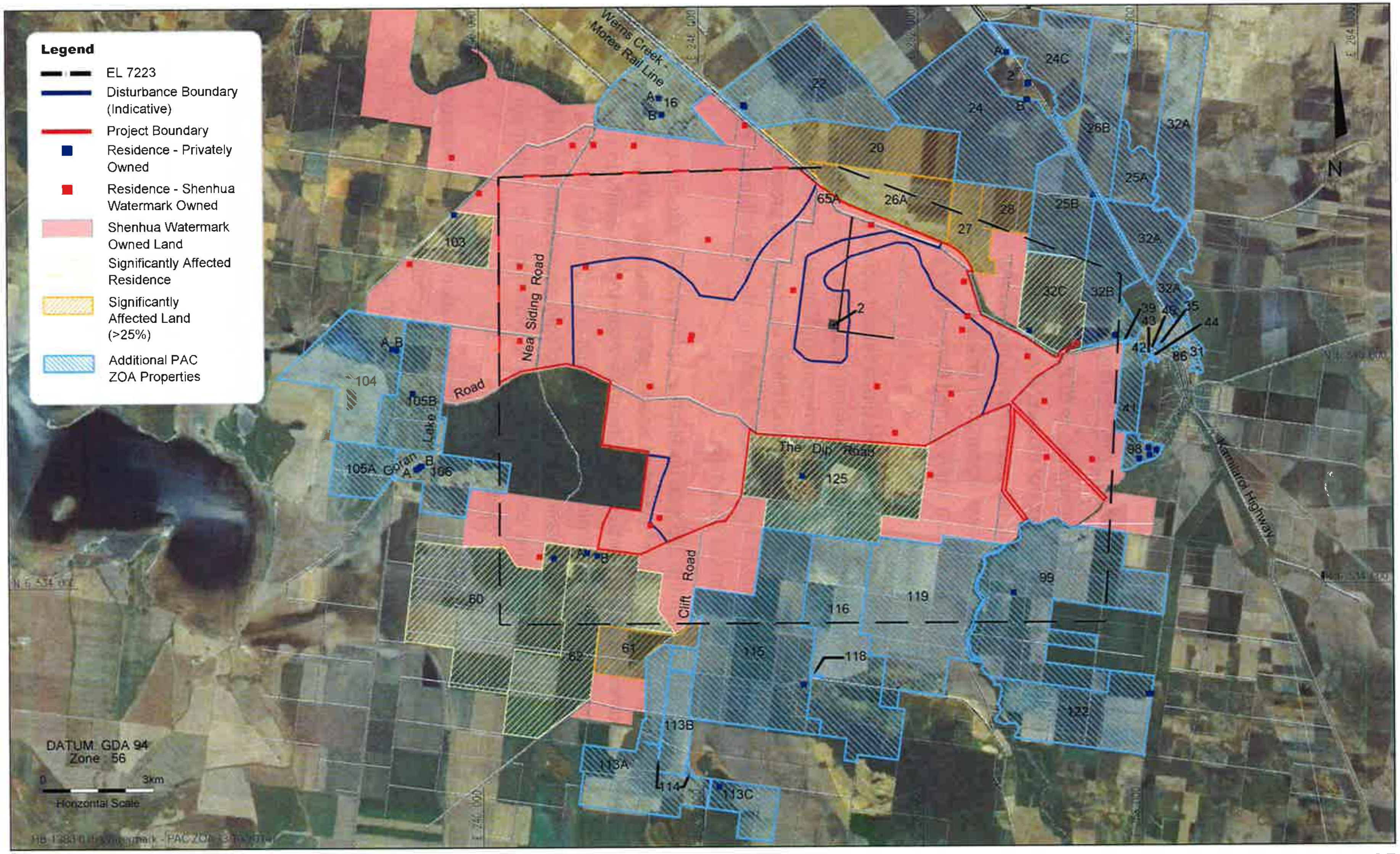

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WATERMARK COAL PROJECT

Planning Assessment Commission ZOA

FIGURE 2

A requirement that the proponent accept the liability for acquisition upon request for such a vast area of land so remote from active mining operations in the absence of demonstrable unacceptable amenity impacts serves no purpose and is inconsistent with current NSW Government policy.

2.3.4 Recommendation 10

Air quality limits should apply at properties where exceedances are predicted

In addition to this the Commission recommends that limits should be included in the conditions to ensure the applicant does not exceed the predicted impacts. This should include limits that vary over the life of the mine in response to the modelled predictions i.e. if a residence is predicted to receive higher dust levels in year 10, but not year 5 or year 15, then the higher limit should not apply during those other stages of mining when the impact is not predicted to occur.

This PAC recommendation is inconsistent with NSW Government policy and unreasonable when compared with other contemporary open cut mining approvals. EIS predictions were undertaken in accordance with relevant NSW Government guidelines and criterion which provide certainty to both the proponent and private landholder as a project progresses. The imposition of variable dust limits would be impractical and highly restrictive to Shenhua Watermark in the operation of its open cut coal mine.

Additionally, air quality modelling for the EIS was undertaken under worst-case meteorological conditions over the life of the mine (under 'assumed scenarios'). Effectively 'fixing' air quality limits to modelled outcomes as at 2013 would limit Shenhua Watermark's ability to apply the principles of adaptive management (as stipulated in Schedule 5 of Condition 2 of the Draft Conditions) as the mining of the Project advances and meteorological conditions are otherwise than worst-case. It would also limit the ability of Shenhua Watermark to implement the practical on-the-ground learnings as the Project proceeds.

Schedule 3, Condition 19 of the Draft Consent requires the preparation and implementation of the Air Quality Management Plan, to the satisfaction of the Secretary that shall include utilisation of a real-time monitoring and management system (including a predictive meteorological forecasting) to enable the mining operations to be planned in advance according to weather forecasts to ensure that the appropriate air quality criteria are met.

2.3.5 Recommendation 11

Options available for residents predicted to be impacted by exceedances of the noise criteria

The Commission recommends that all residences predicted to be impacted by an exceedance of the intrusive noise criteria should be given the following options:

i. To sell their property to the mine and move elsewhere;
ii. To negotiate a mutually agreeable outcome;

iii. *To have the applicant provide mitigation measures at the dwelling including the provision of double glazing.*

Shenhua Watermark supports this recommendation subject to the comments below in relation to the finalisation of appropriate "noise criteria".

Shenhua Watermark would also like to note that any condition reflecting the above recommendation should be drafted such that a landholder can only benefit from one of the options.

Residences

DP&E policy, as demonstrated by a long history of application, is to afford acquisition rights to private landholders at determination where there are predicted exceedances 10 dBA above background (or 5 dBA above intrusive criteria) at a privately owned residence. The applicable criteria in the EIS and RTS is based on an acquisition criterion of 40 $L_{Aeq,15min}$ at residences consistent with NSW Government policy (this being 10 dBA above the minimum background level of noise to be applied as per the INP of 30dBA).

Shenhua Watermark maintains that this is the appropriate noise criteria to apply to the Project and sees no basis for Shenhua Watermark having conditions imposed on it different to other mining projects in NSW.

Land

A relevant precedent is shown in the Project Approval for the Maules Creek Coal Project which lists private properties with a right to acquisition upon request in Schedule 3 Condition 1. Schedule 3, Condition 9 further states the applicable criteria for land is:

> *"If the owners(s) of land containing a privately owned residence, which is not listed in Table 1 , have reason to believe that operational noise from the project is causing noise levels to exceed 40 dBA … over more than 25% of that land …".*

The criteria applied at Maules Creek is consistent with that applied to the Shenhua Watermark EIS, RTS and as presented in Table 8 of the Secretary's Environmental Assessment Report. What the PAC is recommending is not consistent with current NSW Government policy and long standing practice.

Shenhua Watermark supports the DP&E and its conclusions as provided in the Secretary's Environmental Assessment Report in relation to defining an appropriate ZOA for the Project (see Table 8 in that document). There is no justification for substantive variation from contemporary NSW Government policy in regard to setting noise and dust amenity goals for the Project.

2.3.6 Recommendation 12

Noise limits should apply at properties where exceedances are predicted

The commission recommends that limits should be included in the conditions to ensure the applicant does not exceed the predicted impacts. This should include limits that vary over the life of the mine in response to the modelled predictions. i.e. if a residence is predicted to receive higher noise levels in year 10, but not year 5 or year 15, then the higher limit should not apply during those other stages of mining when the impact is not predicted to occur.

This PAC recommendation is inconsistent with contemporary NSW Government policy and unreasonable when compared with other contemporary open cut mining approvals. EIS predictions were undertaken in accordance with relevant NSW Government guidelines and criterion which provide certainty to both the proponent and private landholder as a project progresses. The imposition of variable noise limits would be impractical and highly restrictive to Shenhua Watermark in the operation of its open cut coal mine.

Additionally, noise modelling for the EIS was undertaken under worst-case meteorological conditions over the life of the mine (under 'assumed scenarios'). Effectively 'fixing' noise limits to modelled outcomes as at 2013 would limit Shenhua Watermark's ability to apply the principles of adaptive management (as stipulated in Schedule 5 of Condition 2 of the Draft Conditions) as the mining of the Project advances and meteorological conditions are otherwise than worst-case. It would also limit the ability of Shenhua Watermark to implement the practical on-the-ground learnings as the Project proceeds.

Schedule 3, Condition 5 of the Draft Consent requires the preparation and implementation of the Noise Management Plan, to the satisfaction of the Secretary that shall include utilisation of a real-time monitoring and management system (including a predictive meteorological forecasting) to enable the mining operations to be planned in advance according to weather forecasts to ensure that the appropriate noise criteria are met.

2.3.7 Recommendation 13

Meteorological Conditions and Compliance Monitoring

The Commission recommends that the Applicable Meteorological Conditions and Compliance Monitoring requirements in Appendix 5 of the draft conditions should be updated to reflect contemporary capabilities in monitoring during rain and hail conditions as well as the gradient wind and temperature inversion features of the area.

Shenhua Watermark supports this Recommendation in relation to inversion and mild wind conditions. However wind above 5 m/s, rain and hail can cause a significant increase in background noise levels at receivers. Mining noise will not be the predominant source under these significant weather conditions.

As such, Shenhua Watermark disagrees with the inclusion of windy, rain and hail components of the recommendation as it will not be able to establish mining level contributions at this time and hence will not be able to confirm compliance.

2.3.8 Recommendation 14

> *Identification of residences*
>
> *The Commission recommends that the final conditions clearly identify or map each residence that is listed as having a higher noise or dust criteria.*

See **Figure 1** and response to Recommendation 9 in **Section 2.3.3**.

2.3.9 Recommendation 15

The PAC recommends that the NSW Government needs to develop a clear policy on the management of health and amenity impacts on land that is not occupied by a dwelling.

Shenhua Watermark notes this recommendation and is of the view that the conditions proposed in the Secretary's Environmental Assessment Report adequately address this issue through the noise and dust limits imposed.

2.3.10 Recommendation 16

> *In the absence of a definitive policy or clear, specific justification, the Commission considers that acquisition rights should be available to those properties identified in Table 4 and Table 5.*

Shenhua Watermark does not support this Recommendation and further disagrees with the inclusion of all properties in Table 4 and 5 of the PAC Review Report. See response to Recommendation 11 (**Section 2.3.5**) for a detailed discussion.

As previously stipulated, Shenhua Watermark supports the ZOA proposed in Table 8 of the Secretary's Environmental Assessment Report (as shown on **Figure 1**) which is consistent with other comparable open cut coal mining developments.

DP&E and Shenhua's position are consistent with Clause 12AB of the Mining SEPP.

2.3.11 Recommendation 17

> *Ground vibration criteria*
>
> *The Commission recommends that the blasting criteria in the conditions should include the applicant's nominated ground vibration criteria of 2mm/s for the Breeza Cemetery.*

Shenhua Watermark supports this recommendation.

2.3.12 Recommendation 18

Long Term Land Use, rehabilitation, landform and final void

Prior to the determination of this application, the Commission recommends that further details of the activities associated with mining the eastern pit should be required. In particular further detail of the dumping patterns, landform and rehabilitation are needed to demonstrate that out of pit disturbance would be minimised; dumping would be scheduled to minimise the size of the active/exposed areas of the site at all times; and rehabilitation would prioritise the establishment of koala feed and shelter habitat corridors and the replacement of agricultural land to meet the criteria for Biophysical Strategic Agricultural Land.

A *Supplementary Mine Plan Report* has been prepared by GHD and is presented in **Appendix B**. GHD's report specifically addresses the PAC's concerns in relation to long term land use impacts including the final landform, final void and rehabilitation strategy. GHD found that best practice mine planning has been implemented for the Project to minimise all impacts including avoiding out of pit Overburden Emplacement Areas (OEA) where possible. As described further in **Appendix B**. There are six key considerations which interact to define the extent of an Out of Pit (OoP) OEA including:

- The availability size of the in pit mining area and transitional arrangements;
- The coal quality of the mining operation, the desired product coal qualities and subsequent coal rejects generated from the CHPP;
- The swell factor of the overburden as it is removed from the mining areas;
- Environmental, economic and land constraints (i.e. "no-go" areas e.g. black soil plains);
- The geotechnical constraints to which the overburden can be emplaced (i.e. height and slope); and
- The need for progressive rehabilitation to minimise the area disturbed at any one time.

Table 1 summarises the outcomes of the factors and parameters outlined above which have determined the extent of the OoP OEAs for the Project.

Table 1
Out of Pit Overburden Emplacement Area Extent

Parameter (Mbcm)	Eastern Mining Area	Southern Mining Area	Western Mining Area
Mining area volume	1,025	417	362
Coal waste volume	41	17	13
Overburden volume (25% swell factor)	1,203	533	389
Out of Pit OEA volume required *	**219**	**133**	**40**

** Calculated as the difference from the mining area volume minus the coal waste and overburden volumes*

Table 1 demonstrates that regardless of working room and safety considerations, the mining area volume in each mining area is not sufficient to accommodate the coal waste and overburden generated. This therefore results in the OoP OEA extents as presented for the Project.

As discussed further in **Appendix B**, the adopted 25% swell factor is considered conservative representing a worst-case scenario as presented in the EIS. **Appendix B** further demonstrates that regardless of the swell factor adopted, the mining area volume in each mining area is not sufficient to accommodate the coal waste and overburden generated (even assuming 18% or 20% swell factors).

In conclusion, irrespective of the overburden swell factor adopted (25% or 18% to 20%), the mining area volume cannot accommodate the coal waste and overburden generated by the Project whilst providing safe and stable areas for the progression of mining operations. For these reasons, OoP OEAs are required for the Project.

All OEAs for the Project (including the OoP OEAs) have been designed to accommodate the necessary excess overburden volumes, whilst meeting mine safety parameters, environmental and land constraints and ensuring a stable final landform is developed which merges with the natural topography and provides 10° slopes for enhanced rehabilitation outcomes.

This represents relatively gentle slopes compared to the majority of mines within NSW and QLD and allows for the potential establishment of Box Gum woodland, koala habitat and land capability Class III on selected areas of the rehabilitated landform. Furthermore these relatively gentle slopes will contain slope lengths and suitable soil depth designed to minimise erosion risk and ensure the land meets criteria for land capability Class III.

An additional key criterion for the mine plan design for the Project was to ensure the OEAs are progressively rehabilitated over the life of the mine as soon as practical. This staged approach will minimise the open cut mining disturbance area at any one time and reduce the environmental impacts from the open cut operations. This staged approach, complimented by the rehabilitation landform design incorporating maximum of 10° rehabilitation slopes, further allows koala habitat and Class III agricultural land to be re-established as a priority in the rehabilitation schedule.

The final landform for the Project has been designed to support productive final land uses, including agriculture and native woodland and grassland, including White Box Grassy Woodland Critically Endangered Ecological Community (CEEC). To achieve this, the landform is designed to be stable, undulating with gentle slopes (as described above) and self-draining. These factors are critical in ensuring the long-term success of the final landform and adopted land uses.

In addition, considerable effort and forethought has been invested in the mine plan to avoid, wherever possible, the creation of final mine voids. As such, the two largest voids created by mining process in the Eastern Mining Area and the Southern Mining Area have been strategically located so that both can be completely backfilled and rehabilitated.

2.3.13 Recommendation 19

> *Prior to allowing any works in each subsequent pit, the applicant should be required to submit a review of the performance of the project against the predictions and best practice; and revised management plans and strategies for the approval of the Secretary of the Department of Planning and Infrastructure. While this is partially covered by the auditing requirements that apply to all mining operations, the Commission considers that a more detailed and comprehensive audit (along with a review of the suitability of the mine plan, management plans and limits in place – against best practice) is warranted, prior to the commencement of each new pit.*
>
> *This staged review work and updated plans would need to address the landform and rehabilitation outcomes for each pit, but should also address other key impacts including the:*
>
> - *Water impacts and water balance;*
> - *Air quality, noise and blasting impacts; and*
> - *Biodiversity management outcomes (see section 8.1 for discussion of impacts on the koala).*
>
> *In relation to the mine plan, landform and land use, the plans would need to demonstrate that:*
>
> - *Best practice mine planning has been implemented to minimise the impacts of the project, including avoiding out of pit emplacement;*
> - *The landform would meet best practice standards; and*
> - *The rehabilitation strategy and land use goals are consistent with best practice and build on the experience both on this mine site and at other mines in the region.*

Shenhua Watermark refers to its response to Recommendation 8 in **Section 2.3.2**.

The PAC's expressed desire at Section 7.4 of the PAC Review Report for a staged development consent forcefully suggests that the PAC is attempting to impose conditions that turn the Shenhua Watermark development application into a staged development application under Division 2A of Part 4 of the EP&A Act. Nowhere is this clearer than when the PAC Review Report states:

> *'The mining application can easily be divided into stages, linked to each pit and the Commission recommends that the performance of the mine should be reviewed and refined to meet best practice and the standards of the day, prior to commencing any work in each new pit.'*

Schedule 5 Condition 9 of the draft Conditions provides a mechanism for regular independent auditing of the Project and requires the auditor *"(e) recommend measures or actions to improve the environmental performance of the development, and/or any strategy, plan or program required under these approvals."*

The various management plans required by the development consent and the MOP that would be required by any mining lease are more than adequate guarantors that best practice methods of achieving landform and rehabilitation outcomes will be utilised.

A MOP which is drafted in line with the MOP Guidelines (published by the Division of Resources and Energy) must contain extensive information on final landform and rehabilitation management.

Further, a MOP has a maximum life of seven years (potentially less) before it must be renewed to the satisfaction of the Division of Resources and Energy. This means that the PAC's concerns regarding the currency of landform and rehabilitation management over the decades-long life of mine will be addressed by Shenhua Watermark's evolving MOP.

2.3.14 Recommendation 20

> *The Commission recommends the government should consider ways to address the long-term nature of proposed mining operations and the options available to ensure the standards of the day are able to be applied to these operations. The level of scrutiny and effort given to the design of a mine plan, final landform, land use and rehabilitation strategy, compared to the relatively permanent landscape outcome and legacy issues produced also warrants some further policy work or guidelines.*

While this is a matter for the NSW Government, Shenhua Watermark is of the view (as expressed above in its response to Recommendation 19 in **Section 2.3.13**), that sufficient controls are already in place in typical mining related approvals and therefore asking the NSW Government to further develop controls would be redundant.

A MOP must be in place before any mining operations under a mining lease are commenced and must contain extensive detail on landform and rehabilitation strategy. These requirements are set out in the MOP Guidelines at pages 15 to 22. Similarly, the MOP Guidelines require that a MOP be updated at least every seven years in line with current best practice, which addresses the PAC's concerns about the application of the 'standards of the day'.

2.4 OTHER

2.4.1 Recommendation 21

Biodiversity

The Commission recommends that monitoring of the koala population should be ongoing and planting of koala feed and shelter trees should be progressed as soon as possible.

Shenhua Watermark supports this recommendation and looks forward to finalising the Koala Plan of Management in consultation with the relevant regulators (where the specifics of these mitigation and monitoring measures will be documented).

2.4.2 Recommendation 22

The Commission recommends that a technical working group of koala experts from government, the scientific community and the local wildlife and veterinary practices must be established of oversee the management of koalas issues associated with the project. This working group must:

a. *Be established in consultation with the NSW Office of Environment and Heritage, and include appropriate expertise as required by the Office of Environment and Heritage;*
b. *Be formed as soon as possible;*
c. *Provide input and comment on the tree planting program, it's progress and future planting priorities;*
d. *Review the koala monitoring program being implemented and provide input and guidance on the development of this monitoring program;*
e. *Provide input into the development of the Koala Plan of Management;*
f. *Have an ongoing monitoring and advisory role in the management of koalas during any mining, which should be included in conditions of any consent for mining.*

Shenhua Watermark supports this recommendation and looks forward to finalising the Koala Plan of Management in consultation with the relevant regulators (where the specifics of these measures will be further developed and documented).

2.4.3 Recommendation 23

Information on koala management, monitoring, incidents and advice of the Koala Technical Working Group should be made publicly available in a timely and efficient manner.

Shenhua Watermark supports this recommendation and looks forward to working with the Koala Technical Working Group following determination.

2.4.4 Recommendation 24

In addition to the speed limit, fencing and underpass measures recommended by the Office of Environment and Heritage, the Commission recommended that shuttle bus services should be provided to reduce the traffic numbers and the associated risks of koala fatalities and injuries from collisions with vehicles around the site.

As part of its assessments, Shenhua Watermark has developed the most appropriate transport mechanism to site, in consideration of the anticipated large spatial distribution of the various origins of its employees and contractors (i.e. Gunnedah, Quirindi, Werris Creek, Tamworth, Boggabri, etc.). This assumption was applied consistently in its specialist assessments including (at least) the Traffic and Transport and Social Impact Assessments (at Appendix 10 and 11 of the EIS respectively).

Consistent with Section 4.26.1 of the RTS and as detailed in the Social Impact Assessment (Appendix AE of the EIS), Shenhua Watermark will provide a workforce bus service between the Accommodation Facility and the Project during the construction phase. This is possible at this point in the life of Project as there will be a concentration of construction vehicles travelling two and from the mine site in daylight hours at the same time from the same location. This will assist in alleviating impacts on the road network during the construction phase of the Project and may potentially reduce impacts on the region's koala population.

In relation to onsite transportation of employees, consistent with the practices of many open cut coal mines, 'troop carriers' will be utilised throughout the production years of the mine life to transport mobile plant operators to and from the Mine Infrastructure Area (MIA) to their start work positions, as far as practical. This initiative will reduce light vehicle movements on the mine site and hence the potential for impact on koalas.

2.4.5 Recommendation 25

Community Consultative Committee

The Commission recommends that the conditions relating to the Community Consultative Committee are amended to clarify that a Liverpool Plains Shire Council representative can be included on the Committee if Council wishes to nominate one.

Shenhua Watermark supports this recommendation.

3 CONCLUSION

This conclusion provides a summary of Shenhua Watermark's response to the recommendations provided in the PAC Review Report and confirms the Project's consistency with Part 3, 12AA and 12AB of the Mining SEPP. It also provides a statement on the approvability of the Project with supporting evidence from the EIS, Secretary's Environmental Assessment Report and PAC Review Report.

3.1 PAC REVIEW REPORT

Shenhua Watermark supports many of the recommendations from the PAC Review Report, subject to a full consideration of the detailed comments in this Report.

Some of the PAC's recommendations are inconsistent with current contemporary NSW Government policy with no precedents for these recommendations being applied (when compared to other contemporary planning approvals granted for comparable open cut coal mines in NSW). This inconsistency with current practice is of concern to Shenhua Watermark which has consistently stated its acceptance of being subject to the most stringent requirements applied to other coal mining related projects across NSW.

The key inconsistencies with contemporary NSW Government Policy and other areas of concern to Shenhua Watermark can be summarised as follows:

- PAC recommendations directly to the NSW Government to amend the boundary of Exploration Licence 7223, final landforms and amending the broader Strategic Regional Land Use Plan (September 2012) as a consequence of Shenhua Watermarks Project;
- Strengthening of DP&E draft Development Consent conditions in relation to: agricultural land and a nomination of an independent party to resolve disputed agricultural production impacts;
- Implementing a staged-approval for each of the three separate mining areas based on performance;
- Unprecedented and unjustified mitigation requirements for privately owned rural residences and vacant agricultural land;
- Unprecedented and unjustified ZOA cumulative 24 hour PM_{10} air quality impacts (including a conceptual Caroona Coal Mine scenario) and based on a criterion that is usually applied on a Project-alone basis;
- Unprecedented and unjustified noise ZOA requiring the acquisition of properties whereby the intrusive criteria is predicted to be exceeded over 25% of vacant agricultural land; and
- Unprecedented and unjustified imposition of variable noise and air quality impact limits consistent with five yearly predictions from impact assessment modelling scenarios.

Shenhua Watermark notes that the imposition of the DP&E proposed conditions of Development Consent reflect best practice contemporary NSW Government policy. These conditions as enunciated in their report would provide appropriate mechanisms through auditing and adaptive management and the address of the various issues raised by the PAC in its PAC Review Report and as such Shenhua Watermark can support these conditions as part of any planning instrument issued over the Project.

3.2 CONSISTENCY WITH PART 3 OF THE MINING SEPP

3.2.1 Mining SEPP Clause 12AA

The Project will maximise the economic and social value from the remaining coal resource through a mine plan that has appropriately addressed the environmental and socio-economic constraints and the objectives of the EP&A Act, including the principles of ESD.

The Project will create up to 600 direct jobs (425 on average) on a regional basis (Gunnedah, Liverpool Plains, Tamworth, Narrabri and Upper Hunter LGAs) in areas with a relatively high unemployment rate.

The Project has a projected capital spend of greater than $1 billion and will continue and extend financial support with royalty benefits of $565 million direct revenue for NSW infrastructure and services.

The recommendations in the PAC Review Report in relation to requiring staged approvals prior to progressing into separate mining areas, if applied, would have a dramatic impact upon the financial justification of the Project.

3.2.2 Consistency with Clause 12AB of the Mining SEPP

The objective of the non-discretionary development standards for mining provided in Clause 12AB of the Mining SEPP is stated as "... to identify development standards on particular matters relating to mining that, if complied with, prevents the consent authority from requiring more onerous standards for those matters".

Further, Clause 12AB(2) of the Mining SEPP sets out matters for the purposes of Sections 79C(2) and (3) of the EP&A Act guiding note and states *"... the development standards do not prevent a consent authority from imposing conditions to regulate project-related noise, air quality, blasting or ground vibration impacts that are not the subject of the development standards"*.

Consistent with discussions in **Section 2.3.3** to **Section 2.3.6**, Shenhua Watermark notes that in recommending the imposition of additional acquisition criteria to private receivers where 24 hour average PM_{10} cumulative levels are applied for Project Alone criterion, the PAC's recommendations in relation to noise and dust amenity are inconsistent with the intent of Clause 12AB of the Mining SEPP.

In consideration of Clause 12AB of the Mining SEPP, the Project as proposed meets these as follows:

- **(3) Cumulative noise level** – The Project will not result in cumulative amenity noise levels greater than the acceptable noise levels (in the absence of appropriate mitigation and management measures including a commitment to acquisition upon request of private properties where exceedances are predicted);
- **(4) Cumulative noise levels** – The Project will not result in predicted cumulative annual average levels greater than 30 µg/m^3 PM_{10} annual average criterion for private dwellings (in the absence of appropriate mitigation and management measures including a commitment to acquisition upon request of private properties where exceedances are predicted);
- **(5&6) Airblast overpressure and Ground vibration** – The development will not exceed overpressure or ground vibration standards at any private dwelling or sensitive receiver; and
- **(7) Aquifer Interference** – Interference with an aquifer on private land caused by the development will not exceed the respective water table, water pressure and water quality requirements specified for item 1 in columns 2, 3 and 4 of Table 1 of the Aquifer Interference Policy.

3.3 PROJECT APPROVABILITY

Shenhua Watermark recognises that there are environmental impacts associated with the Project. The EIS prepared has identified the environmental impacts with certainty.

Extensive mine planning design during the early stages of the Project has resulted in the environmental impacts of it being minimised with any residual impacts being offset by management and mitigation strategies including operational controls, land acquisition, offsetting, real-time predictive monitoring and auditing.

The Project as proposed meets environmental and social requirements and still results in a mine plan and development for which there is a demonstrated need and from which there are material economic, environmental and social benefits.

The Project will serve the essential purpose of providing metallurgical and thermal coal for current and future generations and will generate significant economic benefits in the process. Unacceptable and uncertain environmental effects have been avoided.

The PAC was directed to review the Project with a particular focus on agriculture, water, health and amenity and long term land use.

The PAC Review Report in its Executive Summary states that "*the mine is approvable, subject to some further water modelling to corroborate the predicted level of impact on water*". This further modelling has been undertaken and has confirmed that the groundwater modelling completed within the EIS is robust and provides the most conservative approach to predicting the likely impacts of the Project on the neighbouring groundwater regime.

The PAC Review Report further states "*The commission has made some recommendations relating to conditions that must be applied to any consent for this mine, but the suitability of the Department's draft conditions will need to be further considered in finalising the assessment report for the project*".

The Project's social and environmental costs have been avoided or minimised as far as practicable by implementing all reasonable and feasible management and mitigation measures. As a consequence, the socio-economic benefits of the Project will far outweigh its social and environmental costs. Therefore, it has been concluded by DP&E that the Project is in the public interest and should be approved.

It is Shenhua Watermark's contention that this should occur in the absence of the application of unprecedented and unworkable conditions as suggested in some of the recommendations of the PAC Review Report.

Shenhua Watermark trusts that DP&E will duly consider the information provided within this Report during the preparation of its documentation to be provided to the Determination PAC.

Should you have any queries in relation to this Report or have any further questions on the Watermark Coal Project, please contact Mr Paul Jackson of Shenhua Watermark on 02 6741 8800.

* * *

For
HANSEN BAILEY

Dianne Munro
Principal

James Bailey
Director

APPENDIX A

Response to PAC –

Dr Colin Mackie Review

Memorandum

Project number	G1501
To	Paul Jackson
Company	Shenhua Australia Holdings Ltd
From	Neil Manewell
Date	30th September 2014
RE	**Response to PAC – Dr Colin Mackie Review**

Executive summary

The Planning Assessment Commission (PAC) engaged Dr Colin Mackie to review the Watermark Project groundwater study. Dr Mackie raised a number of questions and requested adjustments to the model so he could examine the effects on the model predictions. AGE made the requested adjustments to the model and ran a number of scenarios to investigate Dr Mackie's concerns.

The Watermark EIS model set the drain reference elevation in the mining areas to the base of the pit floor to introduce conservatism to modelling predictions, and to aid model stability for the recovery scenario. Revised modelling shows that setting drain reference elevations to the base of each cell reduces impacts to surrounding groundwater users and the groundwater regime.

The predicted seepage rates to the mining areas are sensitive to the adopted closure criterion. The EIS adopted closure criterion that ensured the model converged to an accurate solution, and provided accurate pit seepage rates. Revised scenarios using a head closure criteria of less than 0.1 m produced numerically stable results, although non-convergence did occur using the pseudo-soil function in some instances. Simulated groundwater levels are insensitive to variances in model closure criterion. No erratic behaviour in heads was observed in any of the scenarios explored.

AGE adopted the residual saturation function for EIS modelling due to its ability to aid model convergence following desaturation of model cells. Our experience using this function indicates it produces results comparable to using the rewetting function in MODFLOW NWT/USG, at significantly faster runtimes. Fast runtimes (<8 hours) were essential to maintain 50m x 50m cell resolution in the mining areas, and to perform an uncertainty analysis. Our experience has been that adopting the pseudo soil function further reduces the predicted impacts during both mining, and long-term post mining. Therefore this review shows that the EIS model produces conservative impacts when compared to the other approaches suggested and can be used as a functioning predictive baseline that the observed impacts can be compared to once mining commences.

1. Introduction

This memo describes the results of groundwater modelling requested by Dr Colin Mackie who has been engaged by the Planning Assessment Commission (PAC) to review the Watermark Project (the Project) groundwater study which was appended to the Environmental Impact Statement (EIS). Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) have prepared this memo at the request of Shenhua Australia Holdings Ltd.

2. Response to queries

The PAC engaged Dr Colin Mackie to review the Watermark Project groundwater study[1]. During the review process, Dr Mackie raised a number of questions and requested adjustments to the model so he could examine the effects on the model predictions. AGE made the requested adjustment to the model and provided the results in a letter to Shenhua Australia Holdings Ltd dated 22 July 2014.

The PAC's Review Report included a letter from Dr Mackie dated 14 August 2014 in which he raises some additional concerns about the groundwater model, and requests further adjustments. The concerns raised by Dr Mackie in his correspondence can be categorised into:

- the way the groundwater model represents the mining process;
- the potential for numerical instability in the model; and
- the method and parameters the models uses to represent flow within the unsaturated zone.

This memo documents the results of additional model scenarios run to address the above concerns. Table 2-1 summarises the set up for a further 10 permutations to the groundwater model.

Table 2-1 Summary of models

Scenario	Drain elevation	Mining method	Soil saturation	Notes
0	Layer 10 base	Growing drains – no backfill	Residual saturation[1]	
1	Cell base	Growing drains – no backfill	Residual saturation	
2	Layer 10 base	Growing drains – no backfill	Pseudo-soil	
3	Cell base	Growing drains – no backfill	Pseudo-soil	
4	NA	NA	Residual saturation	Steady state recovery
5	NA	NA	Pseudo-soil	Steady state recovery
6	Cell base	Growing drains – no backfill	Pseudo-soil	No faults
7	Cell base	Growing drains – no backfill	Pseudo-soil	High storage
8	Layer 10 base	Growing drains – no backfill	Residual saturation	No faults
9	Cell base	Growing drains – no backfill	Residual/Pseudo-soil	
10	Cell base	Backfilled approach	Residual saturation	
11	Cell base	Backfilled approach	Pseudo-soil	

1. Residual saturation = van Genuchten method

[1] Australasian Groundwater and Environmental Consultants Pty Ltd (2013). Watermark Coal Project, Groundwater Assessment prepared for Hansen Bailey Pty Ltd Project No.G1501 January 2013

2.1 Representation of mining

The predictive model used in the EIS groundwater study was set up with 126 quarterly (each 91.3 days) stress periods which simulated mining (dewatering of mine cells) on a quarterly basis until the end of mining after 30 years.

At the end of each quarter, the model stopped and aquifer parameters in the recently mined areas changed to represent the spoil. These changes were required to represent the resultant increase in the hydraulic conductivity, porosity and recharge rate to the spoil. This approach allows groundwater pressure recovery in the mined workings, and therefore the ability for spoil seepage to flow into the mine workings to be simulated. The version of the model, which used this approach, is referred to as the staged backfilled model in this memo.

Dr Mackie has requested that AGE simulate a worst case (for comparison purposes only), which assumes the mines are not backfilled and dry pits (once mined) remain dry for the remainder of the 30-year mine life. This model abandons the staged approach, and simulates the 30-year mine life using 120 stress periods in a single model run. This version of the model is referred to as the non-backfilled model for the remainder of this memo for which approval is not being sought. Therefore, Scenarios 0 to 3 and Scenarios 6 to 9 represent an unrealistic 'worst case' which is not approvable by DPE as the waste rock is not accounted for. Scenarios 10 and 11 simulate the progression of the active mining area, and the subsequent dumping of waste rock behind the mine, which is a more realistic approach.

2.1.1 Emplacement of spoil

Dr Mackie raised a concern that the EIS model which emplaces spoil behind the active mining area (in line with the Project mine plans) might be buffering the drawdown impacts by allowing water pressures within the mined areas to begin recovering after mining passes through.

The rate of groundwater recovery within the spoils depends on a number of factors including recharge rate, pit geometry, location and hydraulic properties. Table 2-2 summaries the hydraulic parameters used to represent spoils behind the active mining area.

Table 2-2 Hydraulic parameters of waste rock

Geology type	Parameter	Value
Waste Rock	Horizontal Hydraulic Conductivity kh	1 m/day
	Vertical Hydraulic Conductivity kv	0.1 m/day
	Specific Yield Sy	0.1
	Specific Storage Ss	1 x 10^{-3} m^{-1}
	Recharge	5.5% Annual rainfall

The spoils were represented with a relatively high hydraulic conductivity and storage parameters, typical of a productive aquifer. The effect of this is to slow recovery of water levels within the spoils. The parameters within the EIS model are considered likely to be at the upper end of the range in the spoil heaps, and therefore slow recovery and do not significantly impact on the zone of depressurisation around the mining areas. Figure 2-1 shows the groundwater level recovery at points within the emplaced waste rock areas in each mining area from the EIS model.

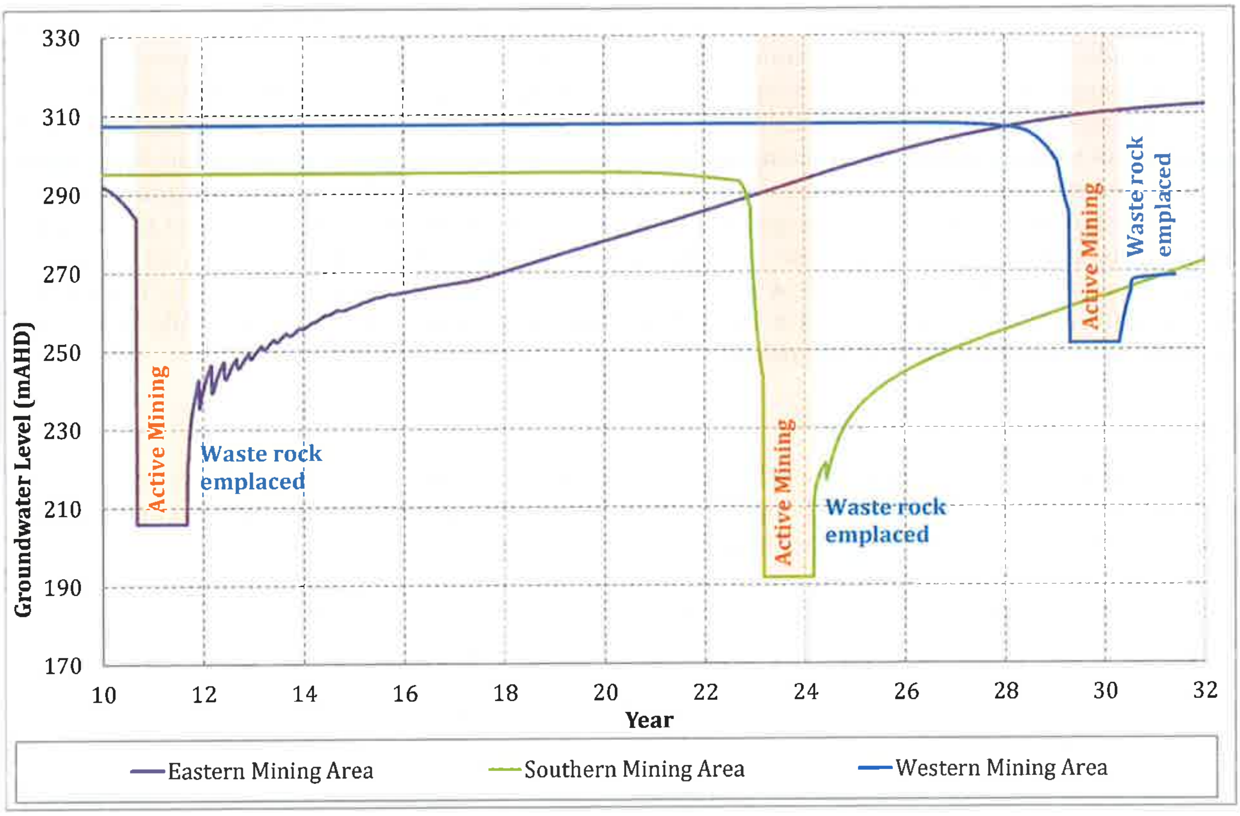


Figure 2-1 Groundwater recovery of the waste rock areas (EIS model)

The results show a rapid recovery following the emplacement of spoil (~30m after 90 days), although a groundwater sink for regional groundwater levels remains for approximately 10 years after the closure of each mining area. For this reason, it is considered the recovery of groundwater levels within the spoil does not overly influence the regional groundwater drawdown predictions, and the staged approach adopted by the EIS model is valid, assuming the mine plan is implemented as proposed.

Dr Mackie commented that if each of the mining areas were to remain open longer than proposed there would be potential for the impacts to be larger than predicted by the EIS model. Dr Mackie proposed the WST model be investigated as a worst case that assumes the open pits remain pumped dry for the entire mine life. Sections below discuss further model runs using both the backfilled and non-backfilled models.

2.1.2 Drain cell elevation method

Following a detailed review of the model files, Dr Mackie noted:

"Inspection of the supplied model data files reveals the reference elevations of the drain cells within each of the mine pits have been set to the lowest drain cell (layer 10 – Melvilles seam) of a vertical column of cells. That is, for all drain cells above layer 10, the reference elevation is below the base of the cells. This is an unconventional use of the drain reference elevations that may lead to quite different outcomes to the conventional assignment of drain elevations. The conventional procedure requires the referenced elevation to be set at or above the bottom of the cell in which a drain boundary is specified. Indeed the popular Graphical User Interfaces (GUI) for Modflow SURFACT normally warn the user if the reference elevation is set below the base of the cell."

Setting the drain reference elevations at the floor of the pits in the EIS model was intentional and is AGE's standard method applied to mining related groundwater models. This was based on AGE's previous experience simulating the re-saturation of pit voids following the removal of drain cells. AGE has observed previously that when using the van Genuchten method in MODFLOW-SURFACT, small quantities of residual saturation remains within the vertical column of cells above the pit floor. Upon changing the storage properties of the very partially saturated cell to reflect that of an open void (Kx-Kz = 1000 m/day, Sy, Sc = 1), convergence issues can occur during the re-saturation of the vertical profile. This issue does not occur when using the pseudo-soil function (see Figure 2-2). This is because this pseudo-soil function does not allow for residual saturation in unsaturated model cells. This means the approach in the EIS is conservative, as it allows more drawdown close in the pit walls than other methods. This is outlined in sections below.

2.1.3 Groundwater level impacts

The backfilled and non-backfilled model have been re-run to demonstrate the sensitivity of the drain reference elevations to the predicted impacts. Figure 2-2 shows the difference in potentiometric heads in layer 2 and layer 10 in the backfilled model at Year 23 using:

- EIS model - drain reference elevations to the bottom of Layer 10 (green);
- Scenario 10 - drain reference elevations to the base of the cell (blue); and
- Scenario 11 - drain reference elevations to the bottom of each cell with the pseudo-soil function (red).

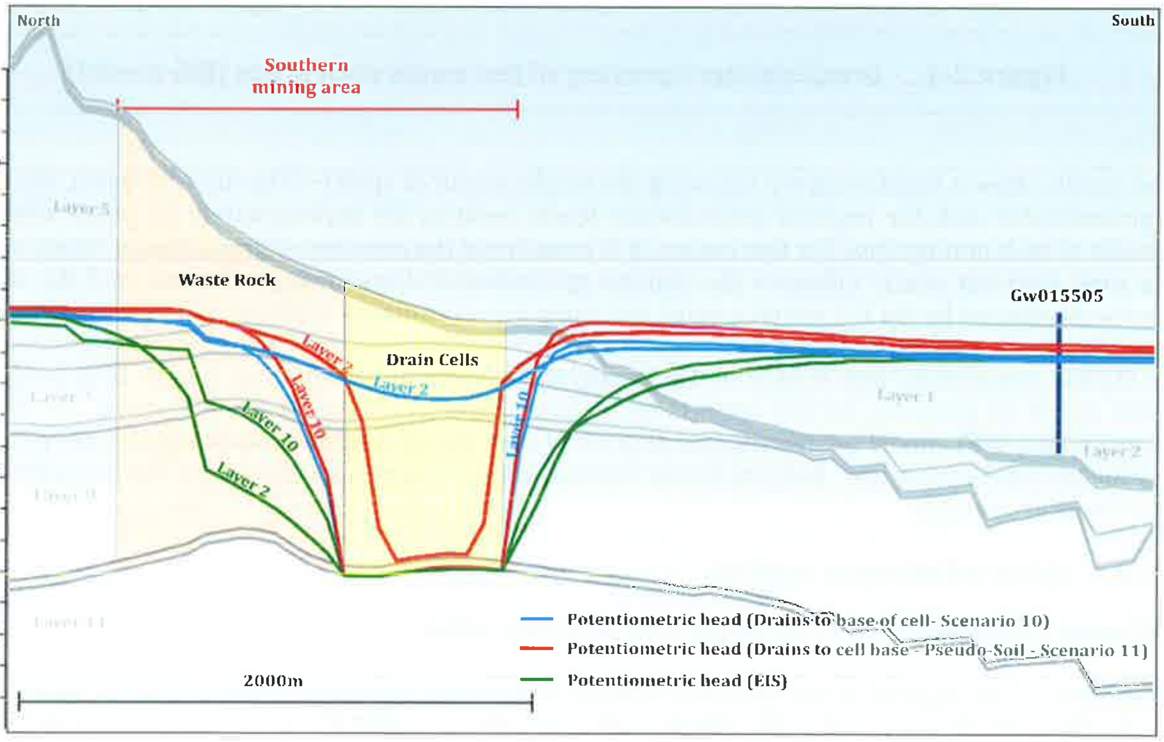


Figure 2-2 Cross-section of potentiometric head vs model layers (Backfilled model drain scenarios)

The results show that varying the drain reference elevation influences the predicted heads using the staged backfilling approach. The method employed in the EIS model results in increased drawdown immediately adjacent to the pit wall, which in turn implies that more water enters the drain cells. Setting drain cell elevations to the base of each cell floor results in steeper hydraulic gradients adjacent to the pit walls, and therefore a more rapid recovery in groundwater levels behind the active mining area, which is progressively backfilled with spoil. This indicates that setting drain cell elevations to the base of each cell reduces the regional groundwater impacts predicted by the model.

Figure 2-3 shows the potentiometric heads in layer 2 and layer 10 model layers in the non-backfilled model at Year 30 using:

- Scenario 0 – drain reference elevations to the base of the pits (blue);
- Scenario 1 - drain reference elevations to the base of the cell (red); and
- Scenario 3 - drain reference elevations to the base of the cell with the pseudo-soil function (green).

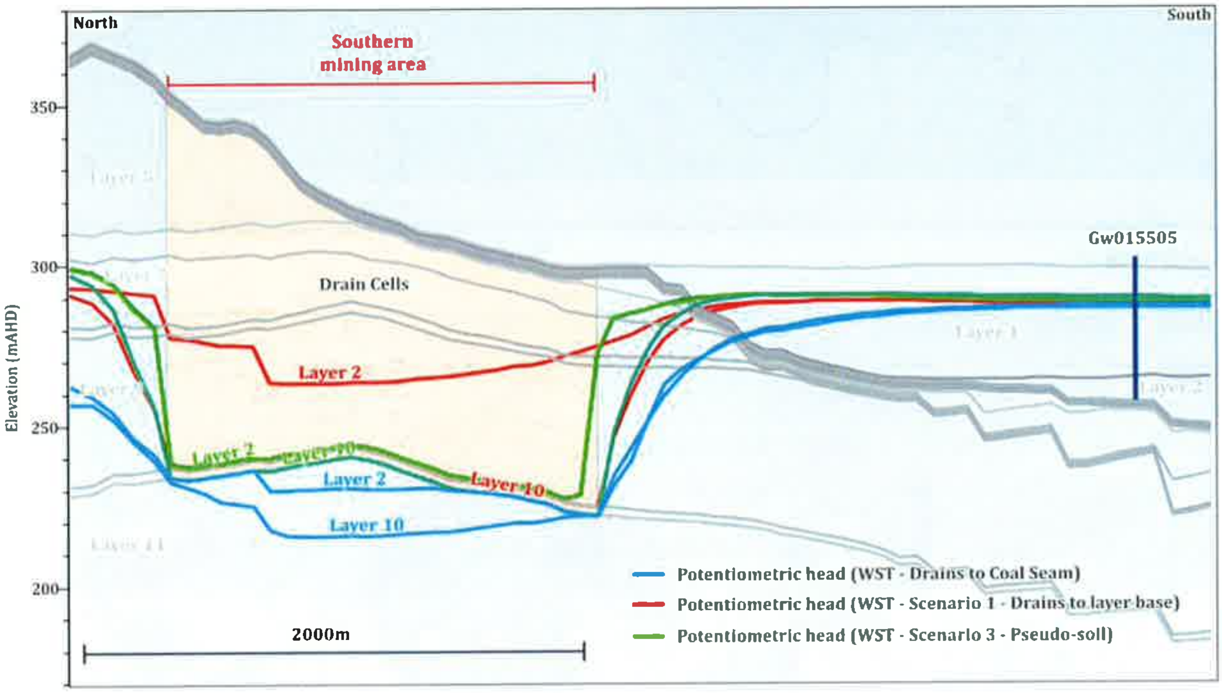
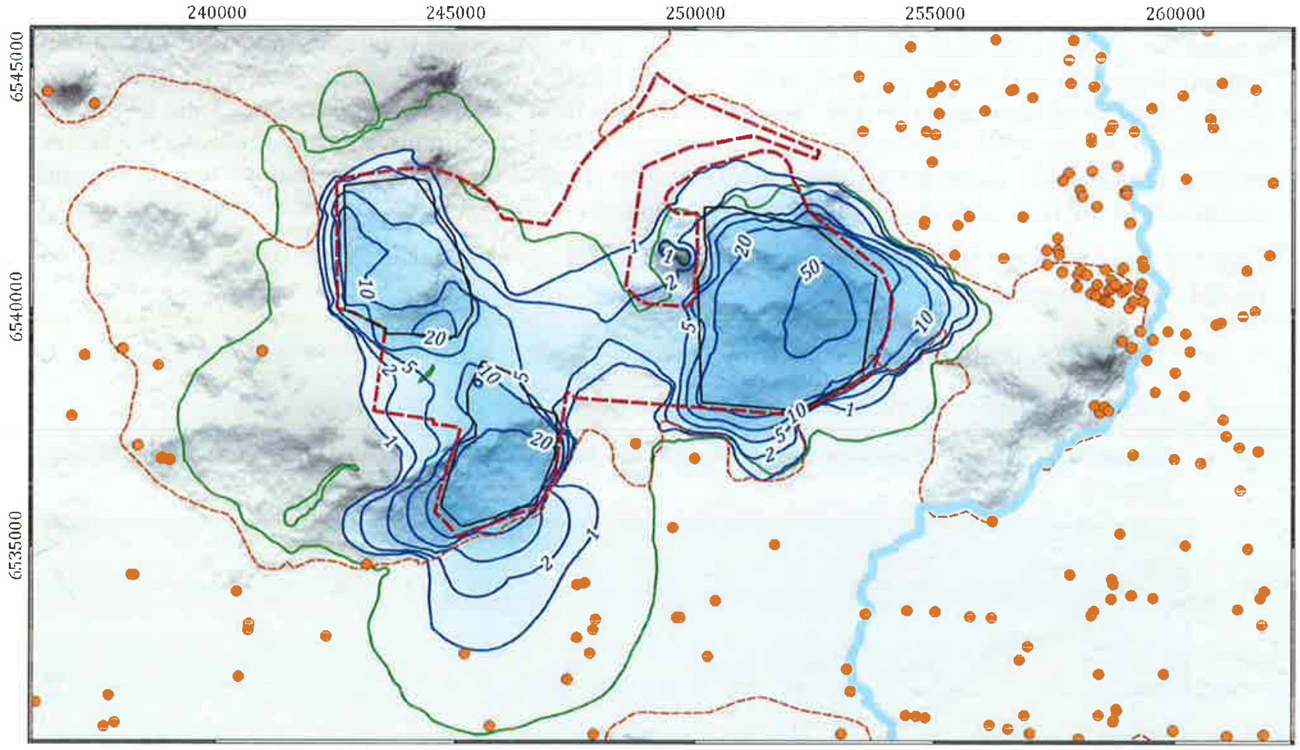


Figure 2-3 Cross-section of Potentiometric head vs model layers (Non-backfilled model scenarios)

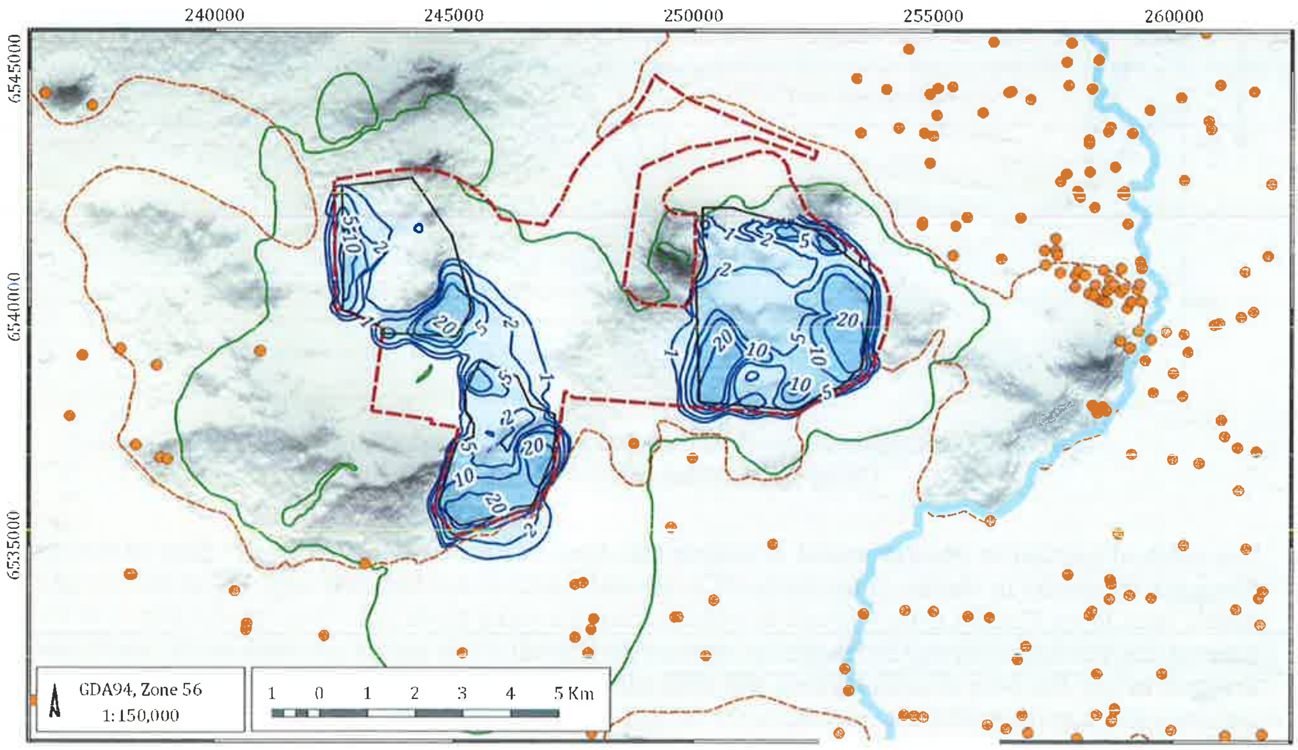
The method applied in the EIS model of setting the drain reference elevation to the floor of the pit (Scenario 0) results in similar potentiometric heads and surfaces immediately adjacent to the pit wall within each layer. Clearly, groundwater drawdown impacts using drain cell reference elevations to the base of the pit floor (layer 10) results in conservative predictions as the potentiometric heads are dragged below the base of each layer in the cells surrounding the pit. The influence of this approach becomes less apparent with distance from the mining areas.

Figure 2-4 shows the maximum drawdown in Layer 2 (Gunnedah Formation and weathered Permian where not present) predicted by the non-backfilled model (Scenario 1) and the backfilled versions of the model (Scenario 10) during the mine life.

Scenario 1



Scenario 10



LEGEND

- Mining area
- PINEENA bore
- Project area
- Mooki river
- Alluvial boundary
- Groundwater Drawdown (m)
- Groundwater Drawdown (m) EIS model (Uncert)

Watermark (G1501)

Groundwater Drawdown – Gunnedah Formation (Scenario 1 and 10)

DATE 30/9/2014

FIGURE No: **2-4**

Figure 2-4 shows the approach to setting the drain reference cell to the floor of the mine pit in the EIS model was conservative.

2.1.4 Impacts on groundwater users

Table 2-3 and Table 2-4 compared the predicted drawdown at each private bores with water entitlements from the backfilled model (Scenario 10) against the non-backfilled model (Scenario 1).

Table 2-3 Groundwater drawdown in bores with entitlements (EIS and Scenario 10)

Work Number	Completed depth (mbgl)	EIS drawdown (m)	Drawdown - (Scenario 10) (m)	Head Available (m)	EIS Percent Change (%)	Percent Change - (Scenario 10) (%)
GW015505	35.1	1.4	0.1	19.2	7.4	0.3
GW967790	70	1.1	0.0	55.9	1.9	0.0
GW029468	64.6	1.1	0.0	48.6	2.3	0.1
GW037713	64	1	0.0	47.7	2.2	0.0
GW060252	148.4	0.6	0.0	136.5	0.5	0.0
GW022622	45.1	0.3	0.0	32.8	0.9	0.0
GW967781	50	0.4	0.0	37.4	1.0	0.0
GW022984	45.1	0.3	0.0	33.4	0.9	0.0
GW022977	148.4	0.3	0.0	136.6	0.2	0.0
GW022620	48.8	0.3	0.0	36.3	0.9	0.0

Table 2-4 Groundwater drawdown in bores with entitlements (EIS and Scenario 1)

Work Number	Completed Depth (mbgl)	EIS Drawdown (m)	Drawdown - (Scenario 1) (m)	Head Available (m)	EIS Percent Change (%)	Percent Change - (Scenario 1) (%)
GW015505	35.1	1.4	0.7	19.2	7.4	3.6
GW967790	70	1.1	0.6	55.9	1.9	1.0
GW029468	64.6	1.1	0.6	48.6	2.3	1.1
GW037713	64	1	0.5	47.7	2.2	1.1
GW060252	148.4	0.6	0.3	136.5	0.5	0.2
GW022622	45.1	0.3	0.2	32.8	0.9	0.6
GW967781	50	0.4	0.2	37.4	1.0	0.5
GW022984	45.1	0.3	0.2	33.4	0.9	0.5
GW022977	148.4	0.3	0.1	136.6	0.2	0.1
GW022620	48.8	0.3	0.1	36.3	0.9	0.4

The results highlight that the drawdown at private bores with water entitlements reduces significantly when the drain reference elevation is set at the base of the cell (Scenario 10). When the drain cells remain open for the mine life with a reference elevation at the base of each cell (Scenario 1) the impact on private bores is about half of that presented in the EIS model.

2.1.5 Pit inflow sensitivity

Figure 2-5 compares the pit seepage rates predicted in the EIS model with Scenario 10 that set the drain reference elevation to the base of the cell.

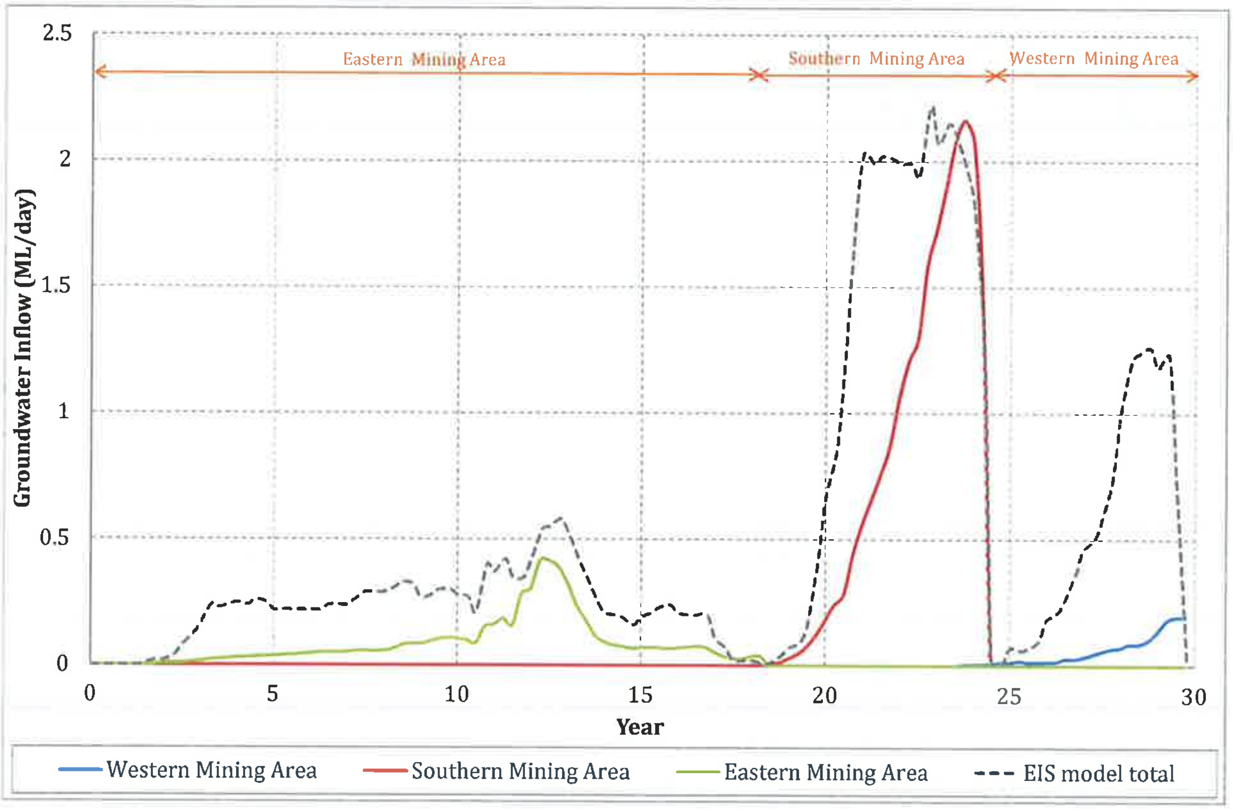


Figure 2-5 Pit seepage rates during mining (Staged Backfill model – Scenario 10)

The results shows that groundwater seepage rates to the mining areas reduce when the drain reference elevation is set to the base of the layer, particularly in the Eastern Mining Area, where inflows are 10% of values presented in the EIS model. This is because of changed hydraulic gradients in the cells surrounding the pit walls. Figure 2-5 highlights the models sensitivity to the drain cell reference elevation.

Figure 2-6 compares the EIS model inflow rates into the mining areas with the non-backfilled approach (Scenario 1).

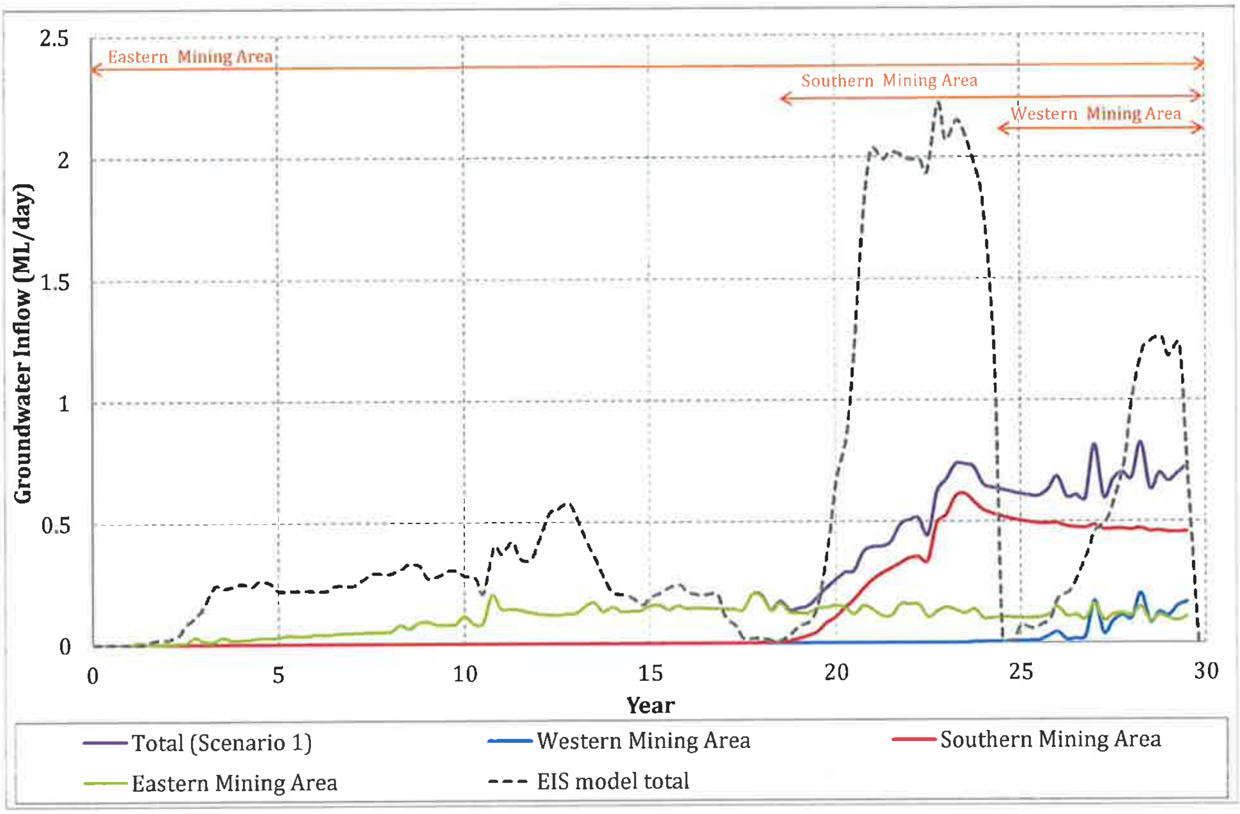


Figure 2-6 Pit seepage rates during mining (Non-backfilled model – Scenario 1)

Figure 2-6 indicates groundwater inflow rates are also lower than presented in the EIS report when the drain reference elevation is set at the base of the cell and the cells remains active for the mine life. Despite the larger footprint of drain cells continuously pumping until mine closure in the WST model, groundwater inflows are predicted to reduce to approximately 20-30% of mining area inflows presented in the EIS. This is because of the reduced hydraulic gradient into the mining areas due to the shallower cells, and the fact that spoils are not represented and therefore do not capture water and contribute to pit seepage. This demonstrates the EIS model provides a more conservative prediction of the groundwater inflows to the mining areas.

2.1.6 Groundwater management zone impacts

The results presented in the preceding sections suggest that 'water take' from the surrounding Groundwater Management Zones would also reduce in the models that represent the drain reference elevation at the base of the cell. Figure 2-7 compares the predicted water take from Zone 7 presented in the EIS, with the results from Scenario 1 (non-backfilled model with drain reference elevation to base of cell). Zone 7 was chosen as it is predicted to experience the highest level of impact due to its proximity to the deepest mining areas.

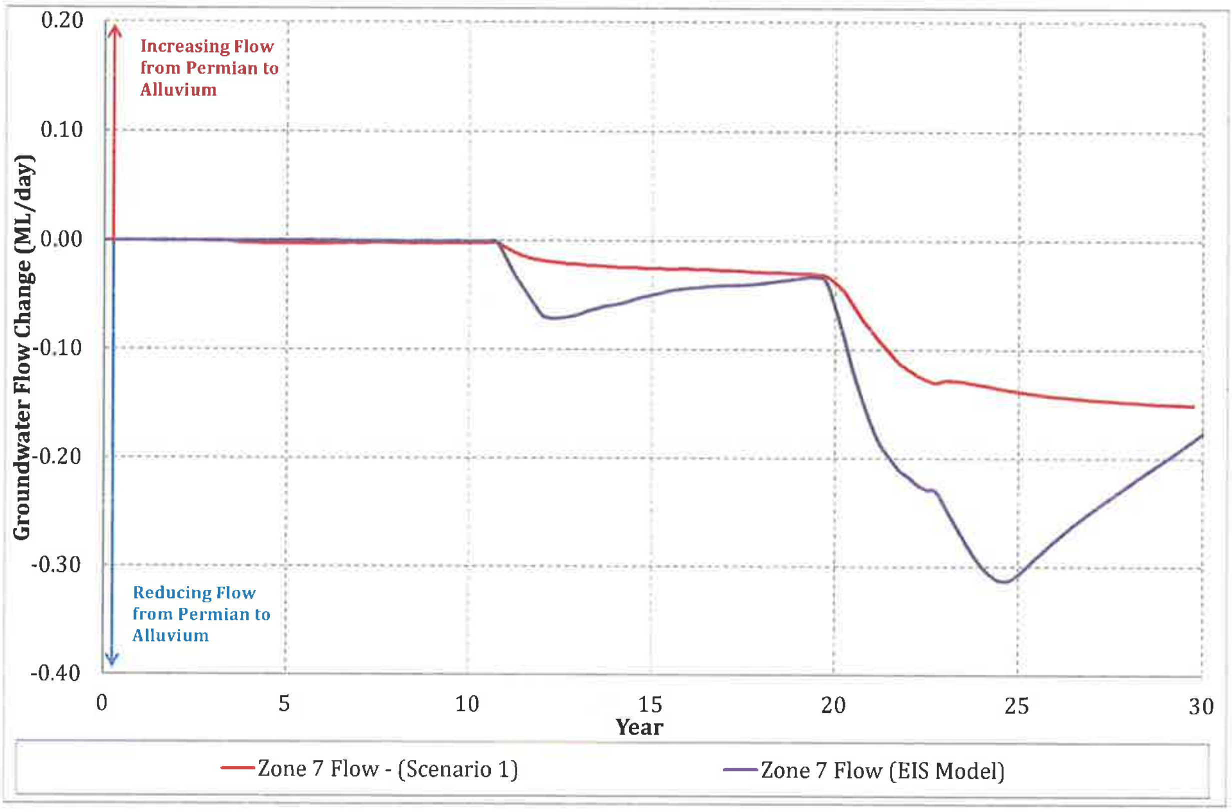


Figure 2-7 Simulated net change in flow from bedrock to alluvium

The EIS model indicated that once mining commences, the Permian strata depressurises. Within the zone of influence (drawdown), upward flow from the Permian strata to the alluvium (Narrabri and Gunnedah Formations) reduces. This is due to changes in vertical gradients between the alluvium and Permian that reduces upward flow, and creates flow reversal to downward flow in areas adjacent to the mining areas. The results show that groundwater flow changes to the groundwater management zones are further reduced when the drain reference elevation is set at the base of the cell. This is because the level of depressurisation underneath the alluvium is less than predicted in the EIS report.

2.2 Model instability

The EIS model made use of the adaptive time stepping package (ATO) and Preconditioned Conjugate-Gradient package (PCG5) to ensure the model ran as quickly as possible, whilst still retaining sufficient accuracy. The EIS model performed well, with limited water budget discrepancies and head change errors. This was due to the lesser number of drain cells active at any one time using the moving drain method. Fast runtimes (<8 hours) during the EIS process were essential to maintain 50m x 50m cell resolution in the mining areas, and to undertake the uncertainty analyses.

2.2.1 *Pit inflow sensitivity*

The non-backfilled model simulates a larger number of drain cells, which interact with horizontal flow barriers applied within the mining areas. This process introduced additional numerical error to the first version of the non-backfilled model (Scenario 0), which simulated drain cell elevations to the coal seam and pit floor (layer 10) floor. During the PAC review process, AGE provided Dr Mackie a working version of the model, with the head closure criteria increased to address the slow model run time. The percent discrepancies were inspected at the time to ensure numerical error was below prescribed Australian modelling guidelines of <2% at any time step (Barnett, 2013)[2].

Dr Mackie noted *"While the EIS inflows exhibit a relatively smooth trend line, the same cannot be said for the WST (non-backfilled) model where highly erratic behaviour is evident for the Eastern and Western pits. This erratic behaviour includes correlatable 'spikes' in the inflows across all three pits simultaneously (red arrows) suggesting underlying instability or abnormal behaviour in the model which needs to be resolved."*

The non-backfilled model (scenario 0) has been re-run using a tighter maximum head change criteria of 0.05 m to assess the changes to the groundwater inflow budgets. Figure 2-8 compares the pit inflow from the EIS model with the non-backfilled model applying two different closure criterion.

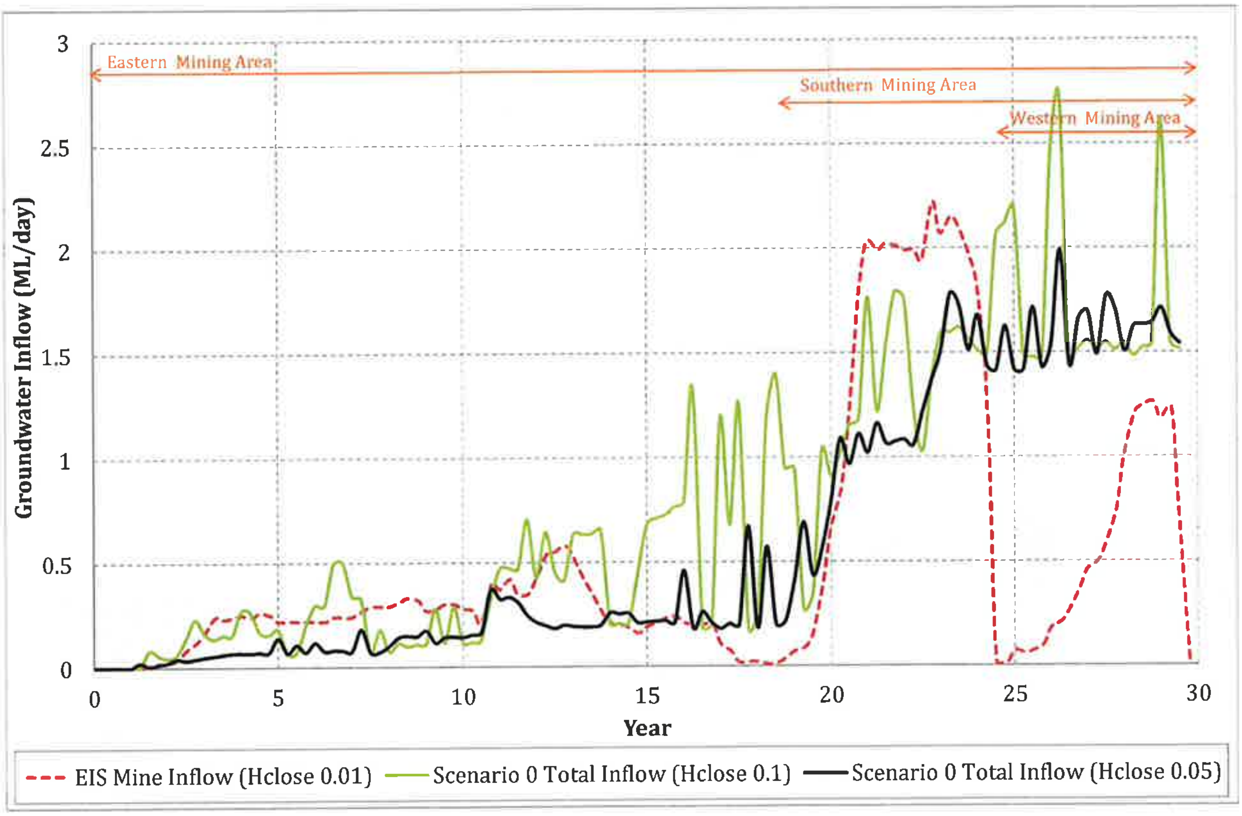


Figure 2-8 Pit seepage sensitivity to Hclose – (Scenario 0)

[2] Barnett et al, 2012, Australian groundwater modelling guidelines, Waterlines report, National Water Commission, Canberra

The results show that pit seepage is sensitive to model solution acceptance criteria. The reason for this is due to the large amounts of groundwater within the model, compared with the relatively low seepage rates in the proposed mining areas.

Table 2-5 presents a snapshot of the budgets in the non-backfilled model using an Hclose value of 0.1 m.

Table 2-5 Maximum numerical error statistics

Feature	Total In (ML/day)	Total Out (ML/day)	Difference (ML/day)	Percent Discrepancy (%)
Entire Model	295.87	296.87	-1.00	-0.34
Drain cells	0.00	2.42	-	-

The results suggest that in order to obtain a pit seepage accuracy of <±0.1ML/day, the percent error at any time step for the Watermark model should not exceed 0.03%. The EIS model produced percent discrepancy errors of less than 0.01% at any time step, and therefore using this loosely based logic relevant to the non-backfilled model, mine inflows could be considered accurate to approximately ±0.03 ML/day.

A practical HClose of 0.05m was chosen for all revised model scenarios presented in this memo where possible, which produced a relatively stable model, with only minor fluctuations in observed inflow predictions (see Figure 2-6). Figure 2-9 shows the percent discrepancies for a selection of scenarios explored in this study.

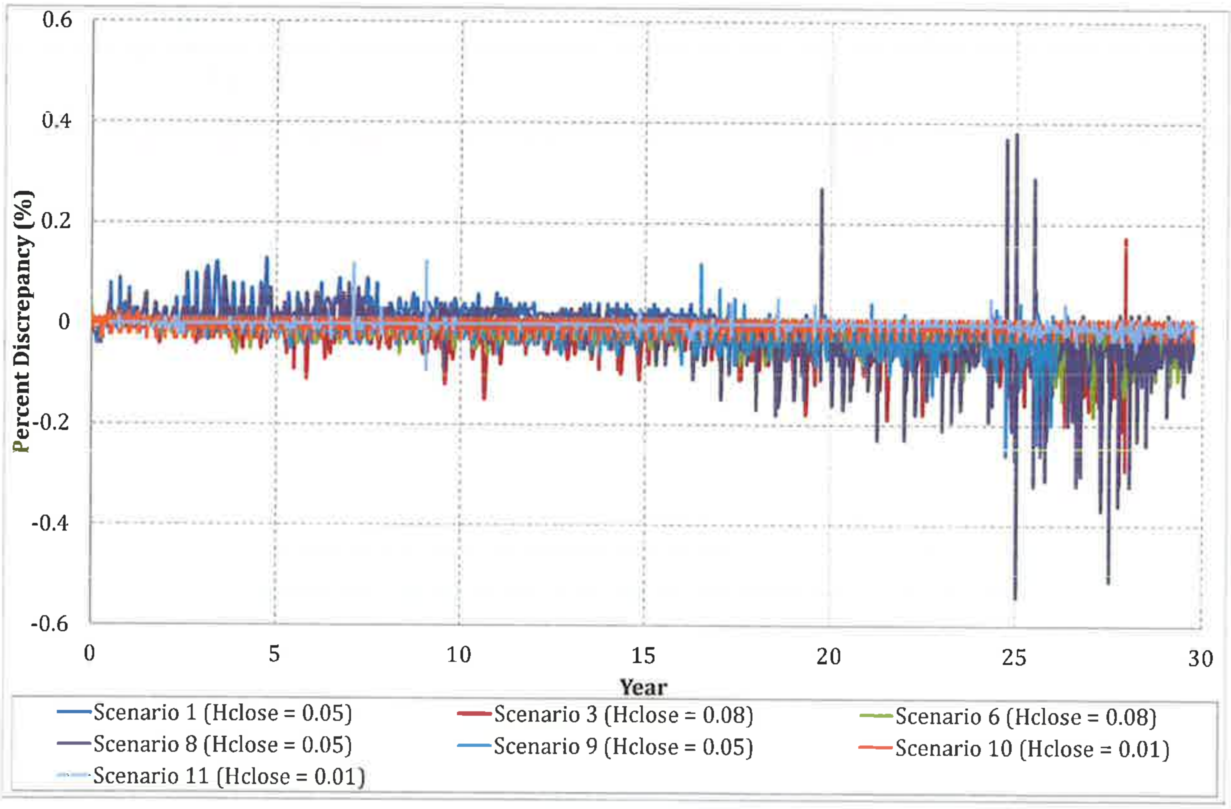


Figure 2-9 Percent discrepancy error

The results show that generally a sufficient precent discrepancy is maintained, although some time steps show fluctuations of less than ±0.6%. These percent discrepancy peaks cause small 'wobbles' in the pit seepage inflow calculations, which could be misinterpreted as an artificially high groundwater inflow peaks. Similar to the EIS model, Scenarios 10 and 11 are generally less than ±0.02%, which is reflected in the smoother predicted pit inflows. Results also suggest that high percent discrepancies are directly related to the number of drain cells in the non-backfilled model, when all three mining areas are active.

2.2.2 Groundwater head behaviour

The above sections show the predicted pit seepage rate is sensitive to solution acceptance criteria. Several model scenarios were tested using varying Hclose settings to explore the influence of this on groundwater levels. Table 2-6 shows the head differences at year 30 for Scenario 0 and 1 using different Hclose values.

Table 2-6 Potentiometric head difference vs Hclose settings (Year 30)

Scenario	Hclose 1 (m)	Hclose 2 (m)	Max head difference at Year 30 (m)
Scenario 0	0.1	0.05	0.033
Scenario 1	0.1	0.05	0.027

The table indicates the solution criteria settings have limited impact upon the predicted heads. It should be noted that the maximum difference in heads occurred to the east of the Watermark project area, and variance within the Project area was generally less than 0.01 m.

Dr Mackie noted that large maximum head changes occurred during the models iterative process of finding an acceptable solution.

AGE have analysed the output files in scenarios 1 and 2 to identify the location of the cells that experience large maximum head changes during the predictive simulation. Analysis of the output files reveal the majority of the larger errors (>10m) occur during the first time-step. This is because the model begins to 'warm up' after having adopted the averaged stress parameters carrying over from the transient calibration model. Errors of up to 60m can also occur during the first time step of a new stress period as the drain cells progress.

AGE anticipated that the source of head change error during the predictive model simulation is the drain cells interacting with the horizontal flow barrier walls. It should be noted that these maximum head changes must eventually reach less than the Hclose settings before the model can converge and progress to the next time step.

Figure 2-10 shows a 3d representation of model cells that experience maximum head change errors of greater than ±1 m at any time during the simulation. Model cells with maximum head change of less than ±1 m have been made translucent to highlight problem cells in three dimensions.

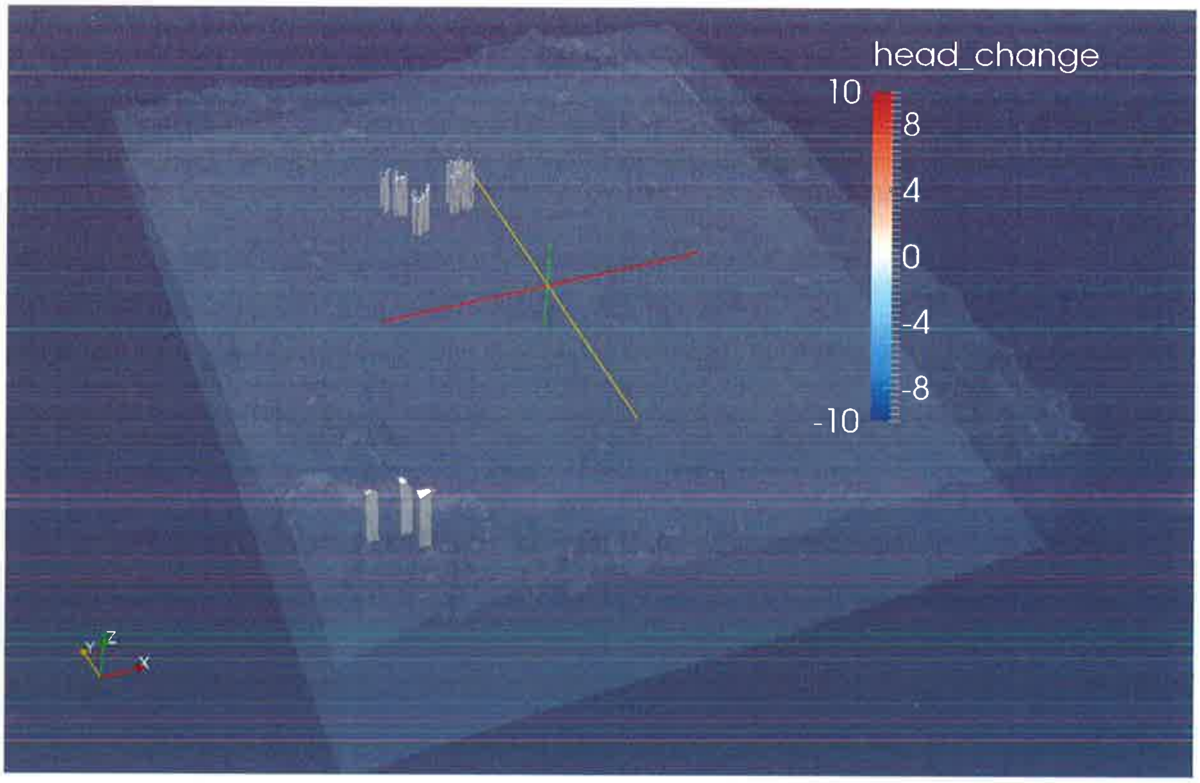


Figure 2-10 Maximum head change error locations (Scenario 1)

The results show that the majority of problem cells which struggle to reach the specified Hclose settings during the simulation are directly associated with the drain cells from layers 1 to 11, particularly in the pit cell boundaries and surrounding Horizontal Flow Barrier (HFB) walls.

Figure 2-11 shows the location of model cells that experience continual maximum head change errors in the Scenario 3 model, which employs the pseudo-soil function.

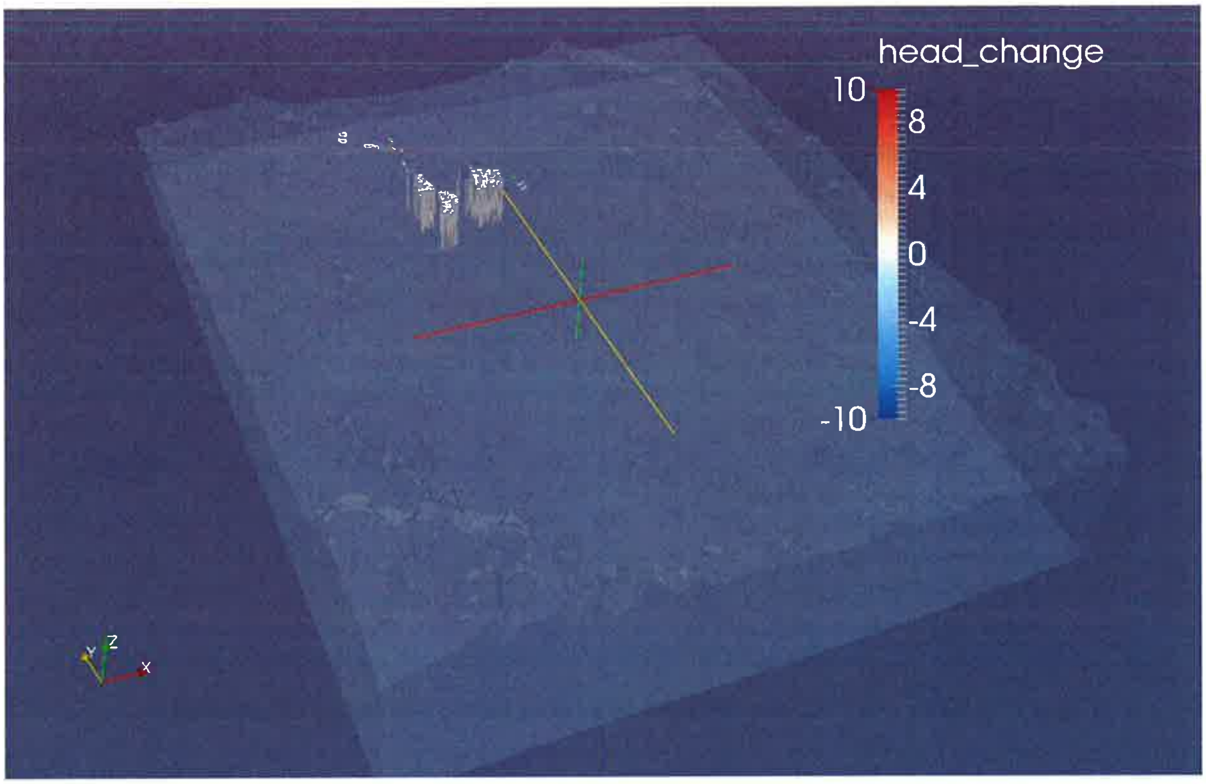


Figure 2-11 Maximum head change error locations (Scenario 3)

Similar to the Scenario 1 version, the majority of problem cells which struggle to reach the specified Hclose settings during the simulation are directly associated with the drain cells from layers 1 to 10. A patch of cells North West of the mining area within layers1 to 3 also exhibits struggles with model convergence criteria, which is caused by a combination of high break of slope recharge rates over a relatively low permeable outcrop. This is further exacerbated by a high groundwater level surface, resulting in interaction with the Evapotranspiration surface in these cells.

Dr Mackie also noted that: *"Figure 6 represents the EIS model with pore pressures indicated by the white contours. Close inspection of the zero pore pressure (water table) contour in the Southern Pit shows a highly erratic surface. Normally are relatively smooth surface that reflects the floor of the mined coal seam, would be expected (see Figure 7 for dewatered pit profile). The erratic surface identified in Figure 6 may be indicative of more general problems probably associated with recharge to spoils, or to unconventional assignment of drain cells or possibly discretisation issues. It is important to identify the reason for this behaviour since it may have implications for regional water table drawdown and mine water inflows."*

Upon analysis of the groundwater potentiometric heads, there is no visible erratic behaviour of the groundwater potentiometric surface throughout the model run. AGE provided Dr Mackie a figure which represented a model cell pressure head , which was contoured against the finite difference cell centres in the groundwater model. As such, the zero pressure contour represented an interpolated saturation surface, which was intended to display absolute saturation extents rather than represent the saturation surface. Graphical user interfaces (e.g. Groundwater Vistas 6) perform additional corrections in cells experiencing unconfined conditions ensure the zero pressure head contour is equal to the water table.

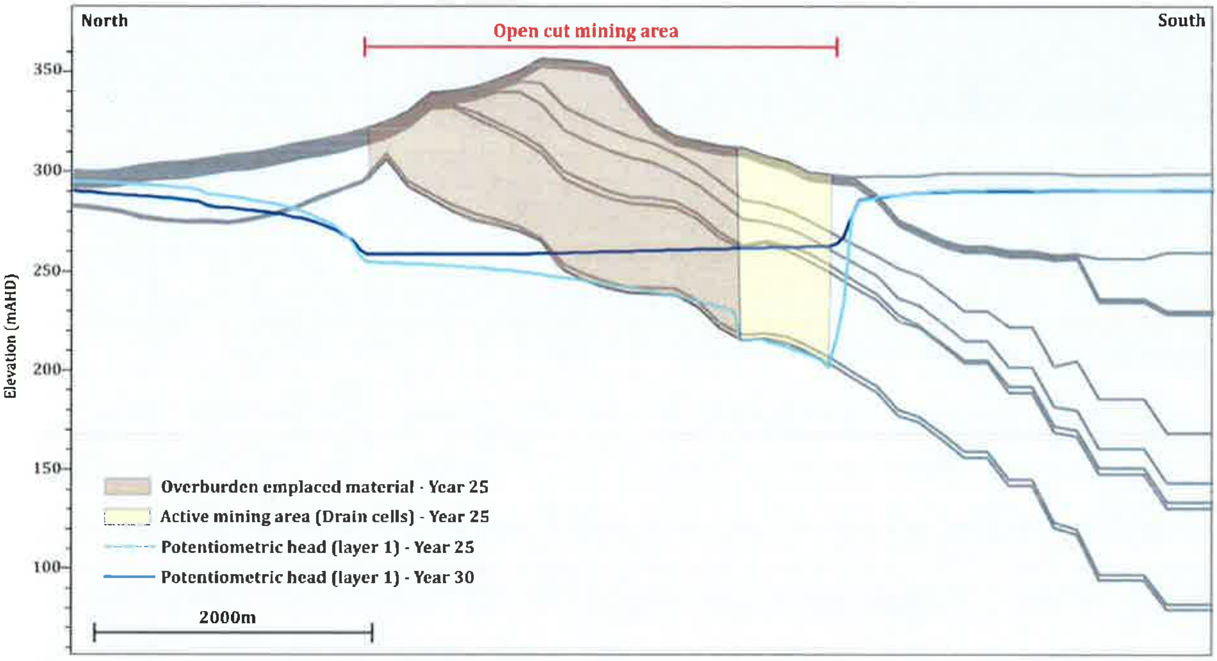


Figure 2-12 Cross section of water table surface (EIS model)

Figure 2-12 shows the water table surface at years 25 and 30 for the EIS model. Clearly, there is no erratic behaviour in the groundwater levels, and the re-saturation of groundwater levels in the waste rock appears realistic.

2.2.3 Model variants

Our experience indicates using the van Genuchten method and applying unsaturated zone parameters result in models to generally solve quickly. Scenarios using the pseudo-soil function resulted in slower model run times. Combining the pseudo-soil function with the method where drain cells were set to the base of the pit floor (layer 10) introduced significant instability, causing extremely long run times (days), and ultimately non convergence using tight convergence acceptance settings.

Table 2-7 summaries the performance of the models.

Table 2-7 Summary of predictive model convergence

Scenario	Drain elevation	Mining Method	Soil saturation	Notes	HCLOSE	Convergence
1	Cell base	Non-backfill	Residual saturation		0.05	-
2	Layer 10 base	Non-backfill	Pseudo-soil		0.10	Non-conv. @ SP86
3	Cell base	Non-backfill	Pseudo-soil		0.08	Non-conv. @ SP112
6	Cell base	Non-backfill	Pseudo-soil	No faults	0.08	-
7	Cell base	Non-backfill	Pseudo-soil	High storage	0.08	Non-conv. @ SP117
8	Layer 10 base	Non-backfill	Residual saturation	No faults	0.05	-
9	Cell base	Non-backfill	Residual/Pseudo-soil		0.05	Non-conv. @ SP104
10	Cell base	Staged Backfill	Residual saturation		0.01	-
11	Cell base	Staged Backfill	Pseudo-soil		0.01	-

Model non-convergence generally occurred in scenarios using the pseudo-soil function, typically when the Eastern Mining area was being actively mined, which is when the number of active drain cells is at a maximum. Scenarios using residual saturation parameters and/or a staged modelling approach did not experience model convergence issues, with the exception of Scenario 3.

It should be noted that all variants of the model where mining was removed from the simulation performed well, resulting in quick run times with minimal convergence error.

2.3 Unsaturated zone modelling

The EIS model simulated unsaturated soil properties (α, β, and Rs) to allow for residual saturation and improve groundwater model stability.

The pseudo-soil function is an add-on to MODFLOW SURFACT which doesnot allow for residual saturation of soil. It is based on a gravitational based function, which relates to transmissivity being a function of the saturated thickness. The pseudo-soil function has no parameters as it is assumed linear between the top and bottom of a cell.

Dr Mackie noted: *"In contrast to the saturated zone properties, there is no reference anywhere in the EIS to the vadose zone parameters yet they are fundamental to the operation of the model and the prediction of the water table. The same parameter values have also been assigned to all layers of the model, which seems counter-intuitive since there are notable differences in lithologies in the measured hydraulic properties of different strata under saturated conditions. I am not aware of any testing pertaining to the Namoi alluvial aquifer to support the adopted vadose zone values, nor any data to support these same properties in consolidated rocks like the Clare Sandstone or the coal seams. The adopted values are considered to be based entirely on conjecture while the use of the same properties for all strata has no factual basis."*

Often EIS level models have a total cell count of over 1-3 million cells to meet the resolution requirements of the project. The selection of uniform saturated zone properties was based primarily on model stability. The pseudo-soil function was not used as previous experience indicated slower run times and convergence issues. Our experience using the residual saturation function indicates it produces results comparable to using the rewetting function in MODFLOW NWT/USG, at significantly faster runtimes. As detailed in our previous correspondence, we have varied the van Genuchten parameters and concluded that groundwater impacts are relatively insensitive to these parameters.

The sections below outline in more detail the impacts of the adopted unsaturated zone simulation method on the predicted impacts.

2.3.1 Model calibration

The EIS model was calibrated over the period 1980 to 2011. This model simulated historical groundwater pumping from bores with entitlements and the response the groundwater system in the absence of mining. The unsaturated zone parameters in the calibration model were also applied without change to the predictive model. Figure 2-13 shows the performance of the EIS model. Figure 2-14 shows the calibration statistics for the same calibration model using the pseudo-soil function.

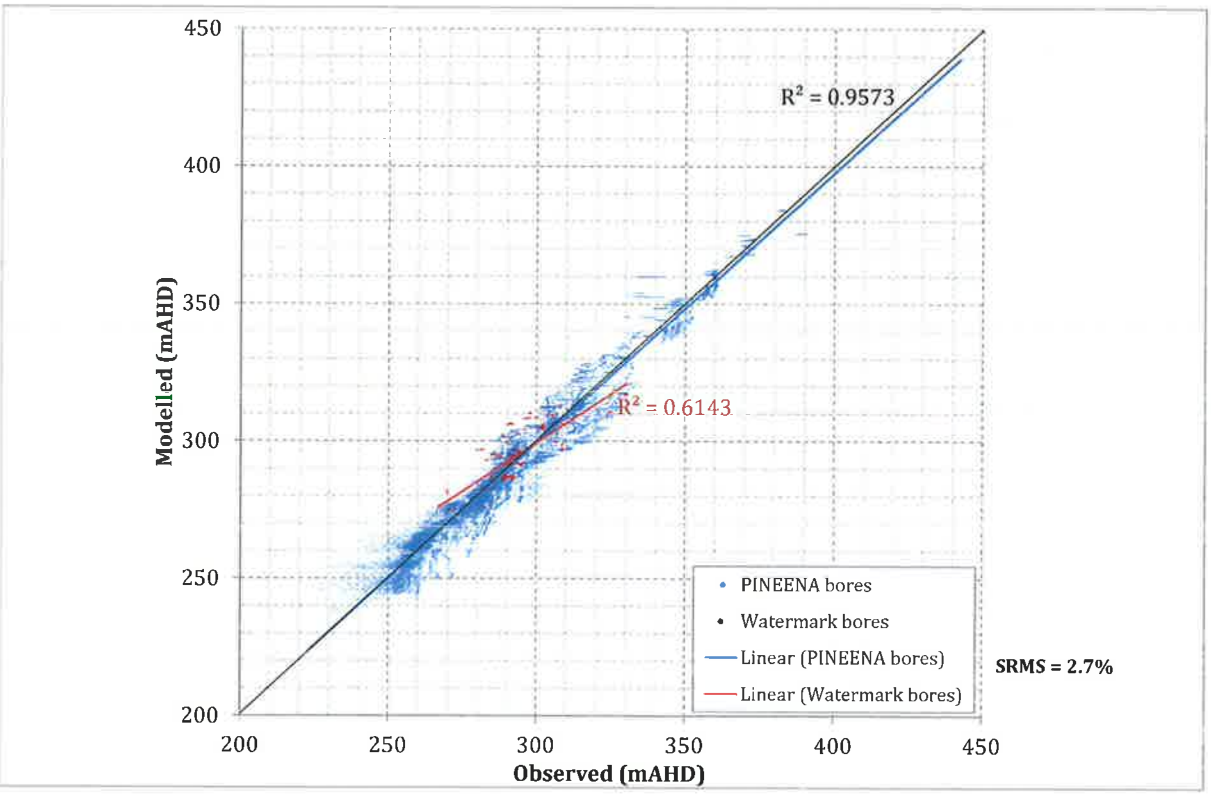


Figure 2-13 Measured vs modelled heads – EIS transient model

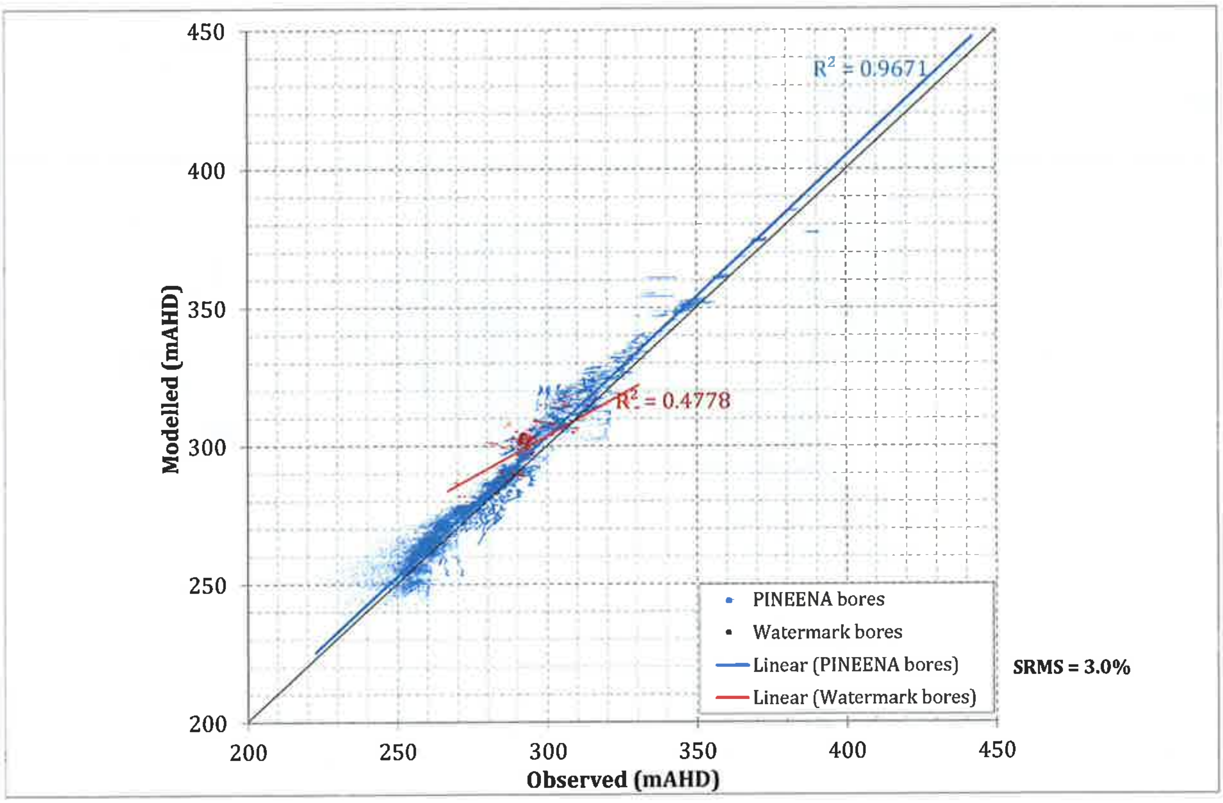


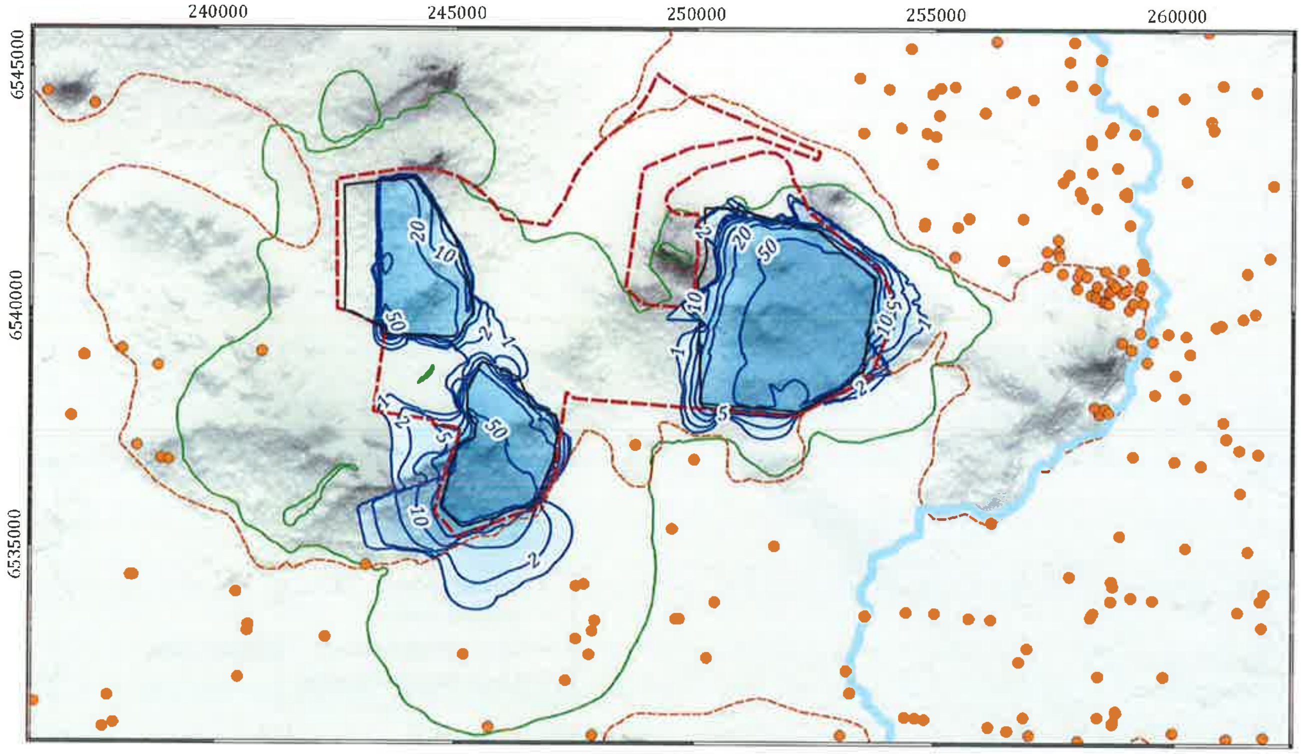
Figure 2-14 Measured vs modelled heads - Pseudo soil transient model

The results show that no significant de-calibration of the model occurs when using the pseudo-soil function. The pseudo-soil function increases the SRMS marginally from 2.7% in the EIS to 3%, which is within the prescribed calibration limits recommended by Barnett (2013) of 5.0%.

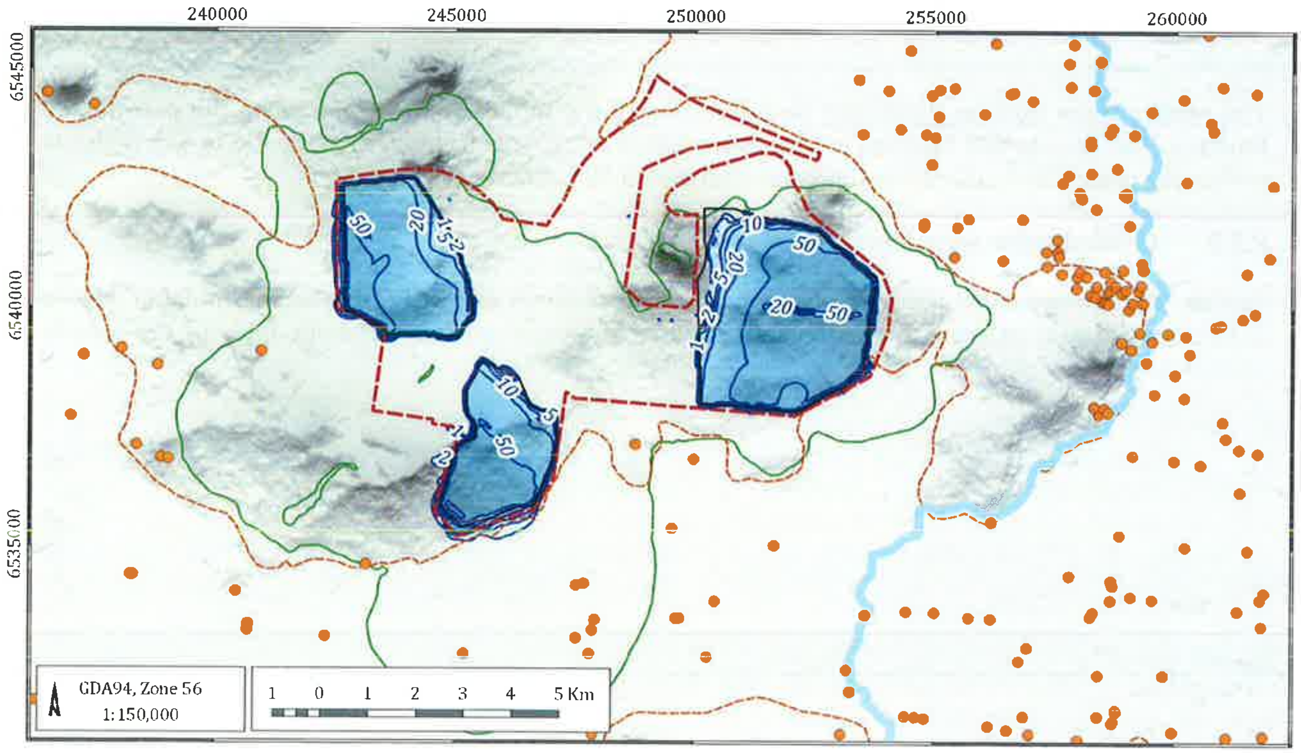
2.3.2 Groundwater level impacts

Section 2.1.3 shows cross-sections of groundwater drawdown using the pseudo soil function. Figure 2-15 shows maximum groundwater level drawdown for scenarios 3 and 11 both applying the pseudo soil function.

Scenario 3



Scenario 11



LEGEND

- Mining area
- PINEENA bore
- Project area
- Mooki river
- Alluvial boundary
- Groundwater Drawdown (m) EIS model (Uncert)
- Groundwater Drawdown (m)

Watermark (G1501)

Groundwater Drawdown Impacts – Gunnedah Fm – Pseudos-soil (Scenarios 3 and 11)

DATE 30/9/2014

FIGURE No. **2-15**

Figure 2-15 shows groundwater drawdown is less extensive than when residual saturation parameters are applied. Scenario 11, which uses the staged approach with moving drain cells and waste rock emplacement, shows almost no impact to the alluvium.

2.3.3 Impacts on groundwater users

Table 2-8 and Table 2-9 compared the predicted drawdown from the EIS at each private bore with water entitlement, against the revised model scenarios that apply pseudo-soil function (Scenario 3 and 11).

Table 2-8 Groundwater drawdown in bores with entitlements (Backfilled)

Work Number	Completed Depth (mbgl)	EIS Drawdown (m)	Drawdown - (Scenario 11) (m)	Head Available (m)	EIS Percent Change (%)	Percent Change - (Scenario 11) (%)
GW015505	35.1	1.4	0.0	19.2	7.4	0.0
GW967790	70	1.1	0.0	55.9	1.9	0.0
GW029468	64.6	1.1	0.0	48.6	2.3	0.0
GW037713	64	1	0.0	47.7	2.2	0.0
GW060252	148.4	0.6	0.0	136.5	0.5	0.0
GW022622	45.1	0.3	0.1	32.8	0.9	0.2
GW967781	50	0.4	0.1	37.4	1.0	0.2
GW022984	45.1	0.3	0.1	33.4	0.9	0.2
GW022977	148.4	0.3	0.0	136.6	0.2	0.0
GW022620	48.8	0.3	0.0	36.3	0.9	0.1

Table 2-9 Groundwater drawdown in bores with entitlements (Non-backfilled)

Work Number	Completed Depth (mbgl)	EIS Drawdown (m)	Drawdown - (Scenario 3) (m)	Head Available (m)	EIS Percent Change (%)	Percent Change - (Scenario 3) (%)
GW015505	35.1	1.4	0.5	19.2	7.4	2.3
GW967790	70	1.1	0.4	55.9	1.9	0.7
GW029468	64.6	1.1	0.4	48.6	2.3	0.8
GW037713	64	1	0.4	47.7	2.2	0.7
GW060252	148.4	0.6	0.1	136.5	0.5	0.1
GW022622	45.1	0.3	0.1	32.8	0.9	0.2
GW967781	50	0.4	0.1	37.4	1.0	0.2
GW022984	45.1	0.3	0.1	33.4	0.9	0.2
GW022977	148.4	0.3	0.0	136.6	0.2	0.0
GW022620	48.8	0.3	0.0	36.3	0.9	0.1

The results indicate the groundwater impacts on surrounding groundwater users are reduced from the results presented in the EIS report when the pseudo soil function is adopted. This is most significant when the pit is continually backfilled during mining (Scenario 11).

2.3.4 *Pit inflow sensitivity*

Figure 2-16 shows the sensitivity of the backfilled model to using the pseudo-soil function. Figure 2-17 compares the EIS model with the non-backfilled model using the pseudo-soil function.

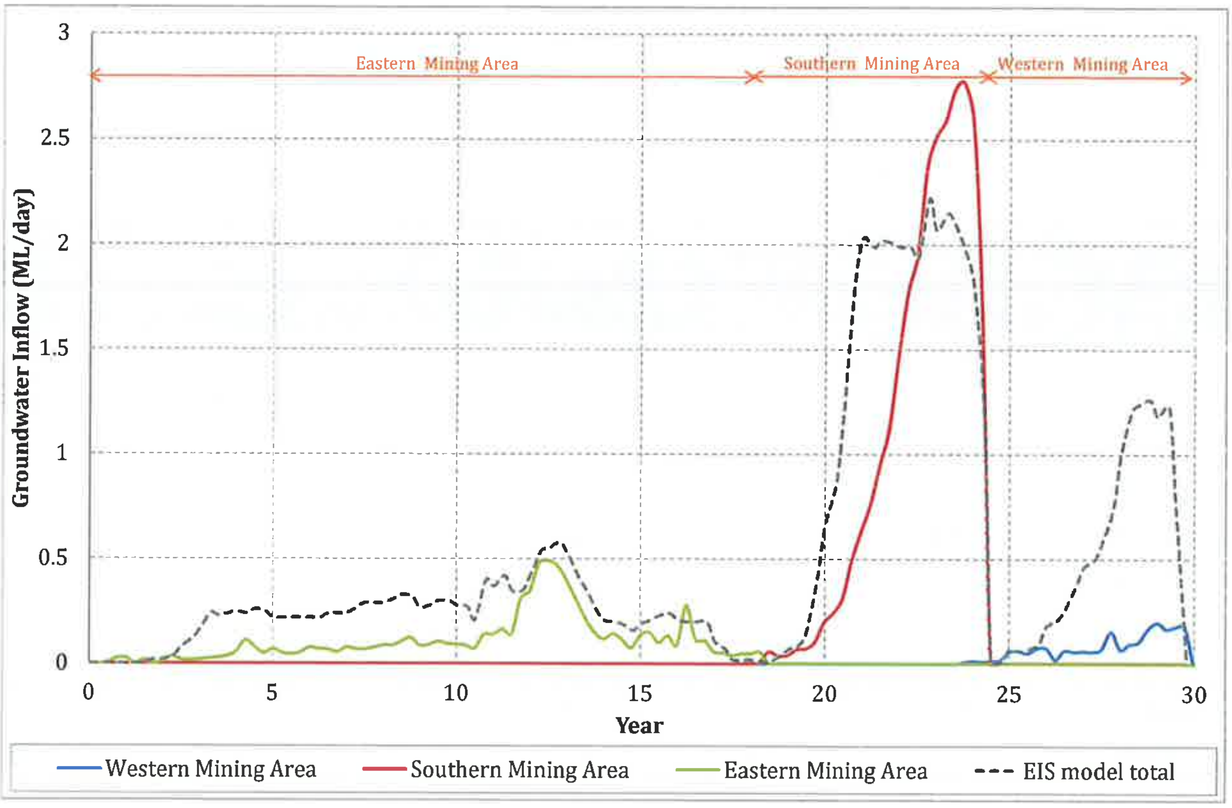


Figure 2-16 Pit seepage rates – backfilled (Scenario 11)

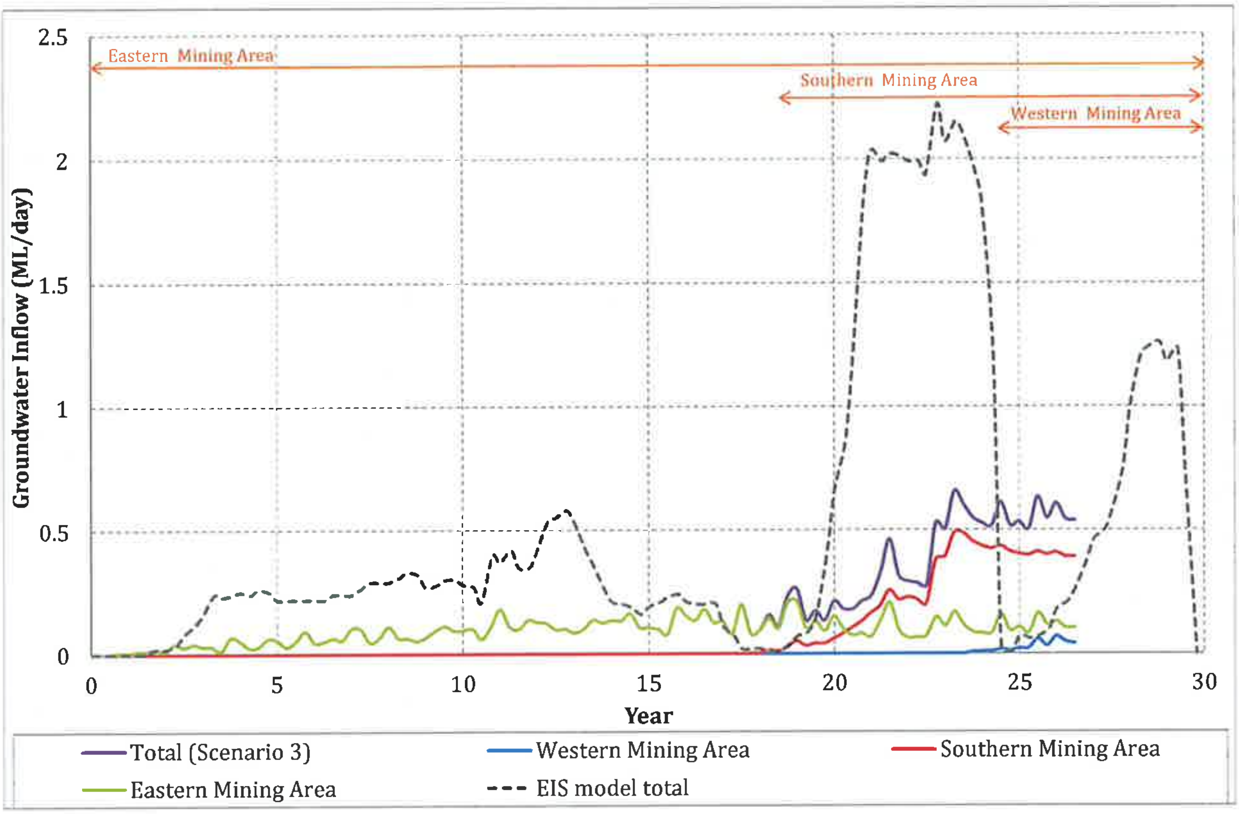


Figure 2-17 **Pit seepage – Non-backfilled (Scenario 3)**

When the backfilled model adopts the pseudo-soil function, the groundwater inflow rates are similar to results using the residual saturation function. The non-backfilled model using the pseudo-soil function predicts significant lower seepage rates. As discussed previously, this model does not include spoil backfilling and therefore seepage from the spoils that report to the pits.

2.3.5 Groundwater management zone impacts

Figure 2-18 compares the 'water take' from Groundwater Management Zone 7 predicted by the backfilled model and the same model using the pseudo-soil function. The figure indicates the predicted water take is reduced (Gunnedah Formation/Permian drawdown) when the pseudo-soil function is applied to the model. The small wobble in the data is directly related to the percent discrepancy error, which reaches 0.1% during this time step (see Figure 2-9).

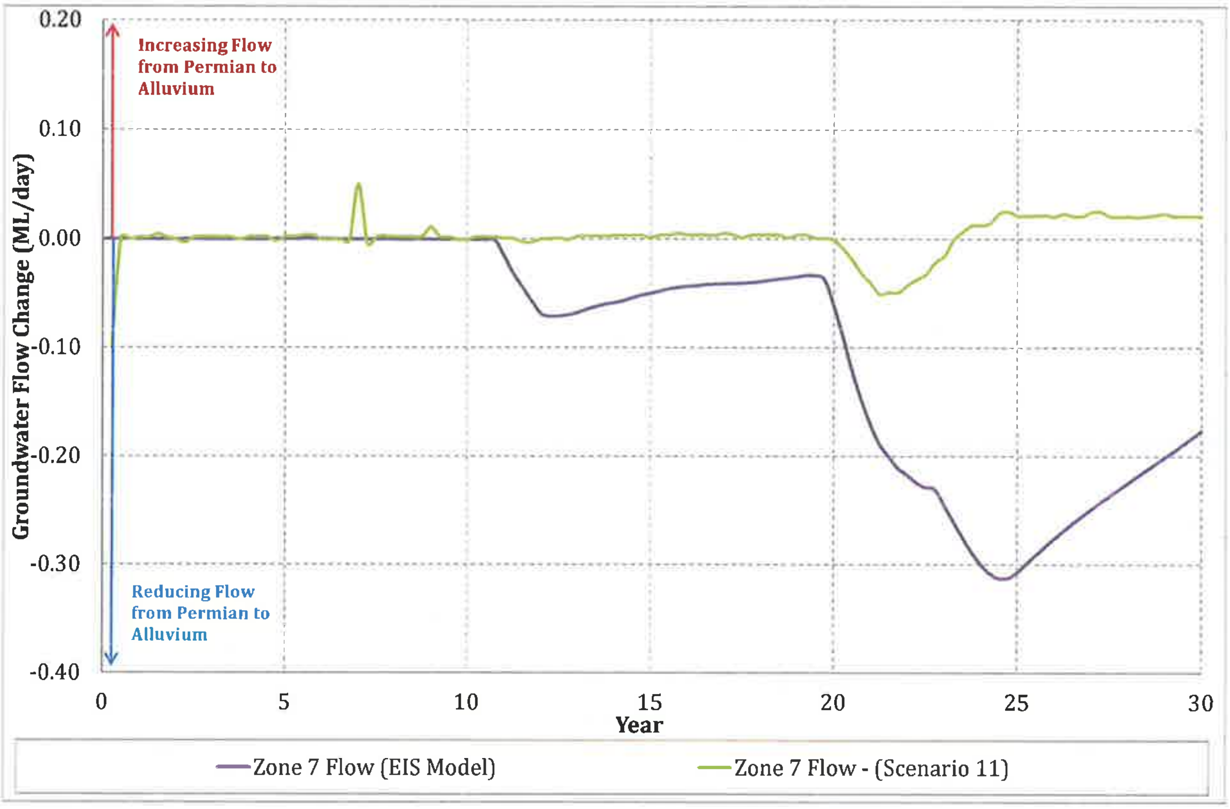


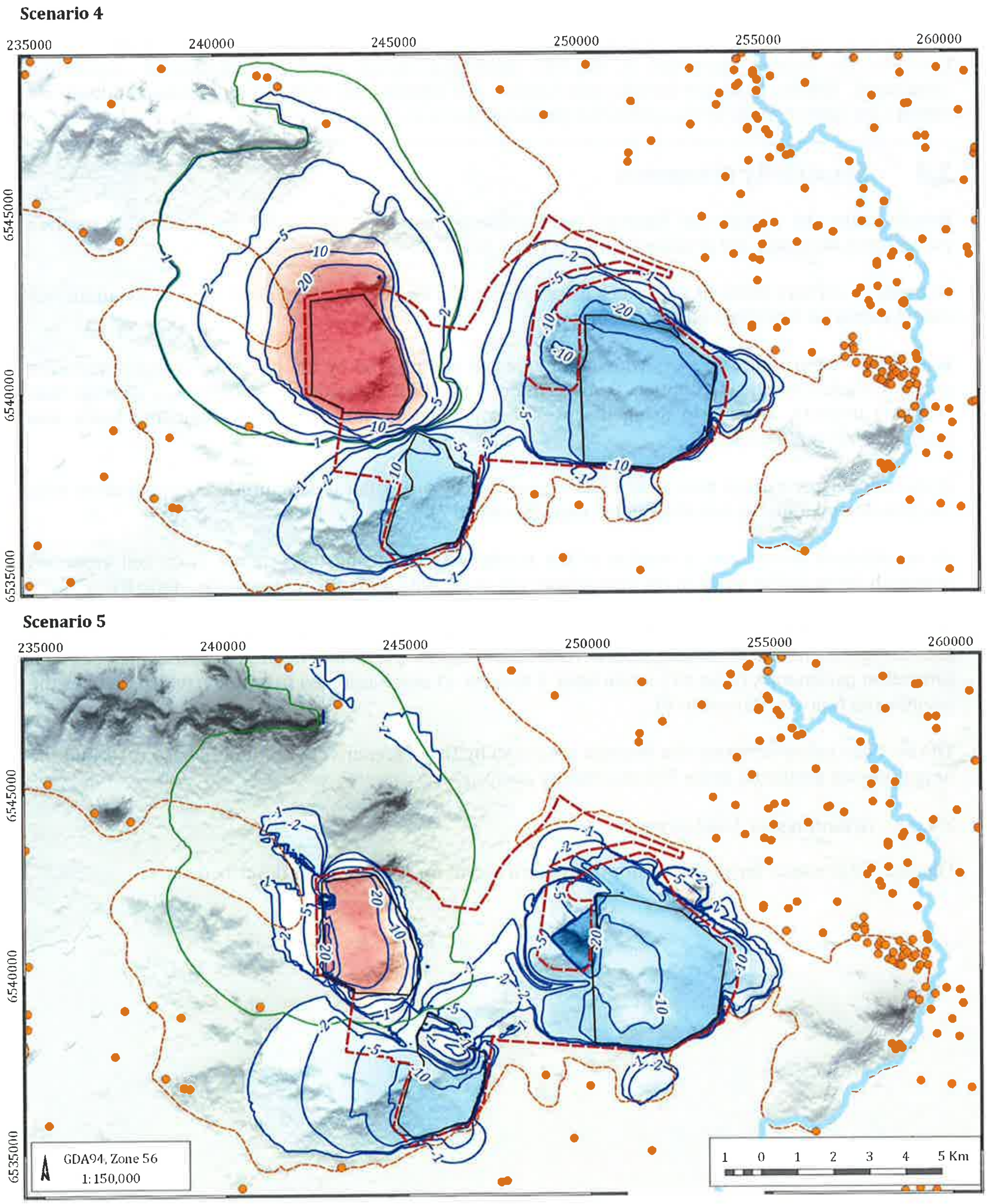
Figure 2-18 **Flow change to groundwater management zone (Scenario 11)**

2.3.6 Steady state recovery model

Following mine closure, the EIS model (and subsequent RTS model) changed hydraulic parameters, recharge and evapotranspiration rates in the mining area to represent the mined final landform. This model was run in transient mode for a total of 2,000 years to assess the rate of groundwater recovery, and the time to reach equilibrium.

Dr Mackie requested AGE to re-run the RTS model in steady state conditions to ensure that year 2,000 conditions represent true equilibrium conditions. For completeness, a second version of the steady state recovery model was constructed, using the pseudo-soil function to compare predicted impacts with the residual saturation recovery model.

Figure 2-19 shows the extent of the post-mining groundwater mounding around the backfilled Southern and Eastern Mining Areas, and the depressurisation around the open Western Mining Area. Negative contours represent mounding of groundwater levels above pre-mining.



LEGEND

- Mining area
- PINEENA Bore
- Project area
- Mooki river
- Alluvial boundary
- Groundwater Drawdown (m) EIS model (Uncert)
- Groundwater Drawdown (m)

Watermark (G1501)

Post-mining groundwater drawdown extents – Sensitivity – Layer 2

DATE 30/9/2014

FIGURE No: **2-19**

The results show that year 2,000 conditions are almost identical to steady state conditions, and therefore the results presented in the RTS modelling report are representative of equilibrium conditions. Results using the pseudo-soil function are significantly different and residual drawdown extents are limited to the areas within the emplaced waste rock areas.

2.4 Sensitivity scenarios

Results using the pseudo-soil function were different to model runs using the residual saturation parameters. Generally the predicted impacts were reduced.

In order to explore some of the issues raised by Dr Mackie further, AGE developed some additional model scenarios described in sections below.

It is noted that groundwater drawdown appeared to be impeded by the presence of faults when the pseudo-soil function was adopted. To determine if the HFB (horizontal flow barrier) package was reducing impacts, a scenario using the pseudo-soil function and completely removing faults was undertaken (Scenario 6).

A scenario where storage parameters were increased by one order of magnitude in combination with the pseudo-soil function was also undertaken (Scenario 7).

As an absolute worst case, a version of the model was run using the original drain cell elevation approach using drains down to the base of the coal seam, with all faults removed (Scenario 8).

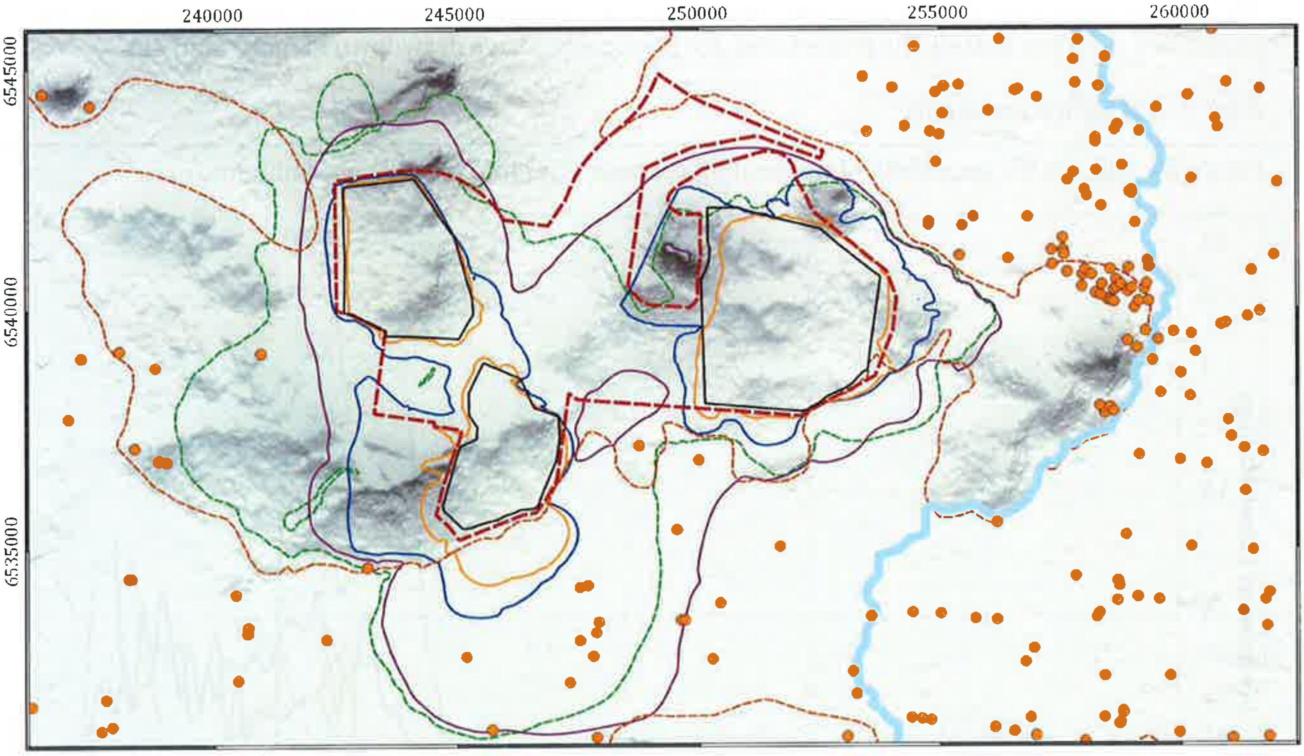
MODFLOW SURFACT has a function in which it allows a combination of pseudo-soil and residual saturation parameters in varying layers. As an experiment, layer 1 and layer 2 were assigned residual saturation parameters (type 43), while layer 3 to layer 11 were assigned to type 44, which invokes the pseudo-soil function (Scenario 9).

The sections below compare the impacts predicted by these scenarios with the EIS base case, and the upper bounds predicted in the EIS uncertainty analysis.

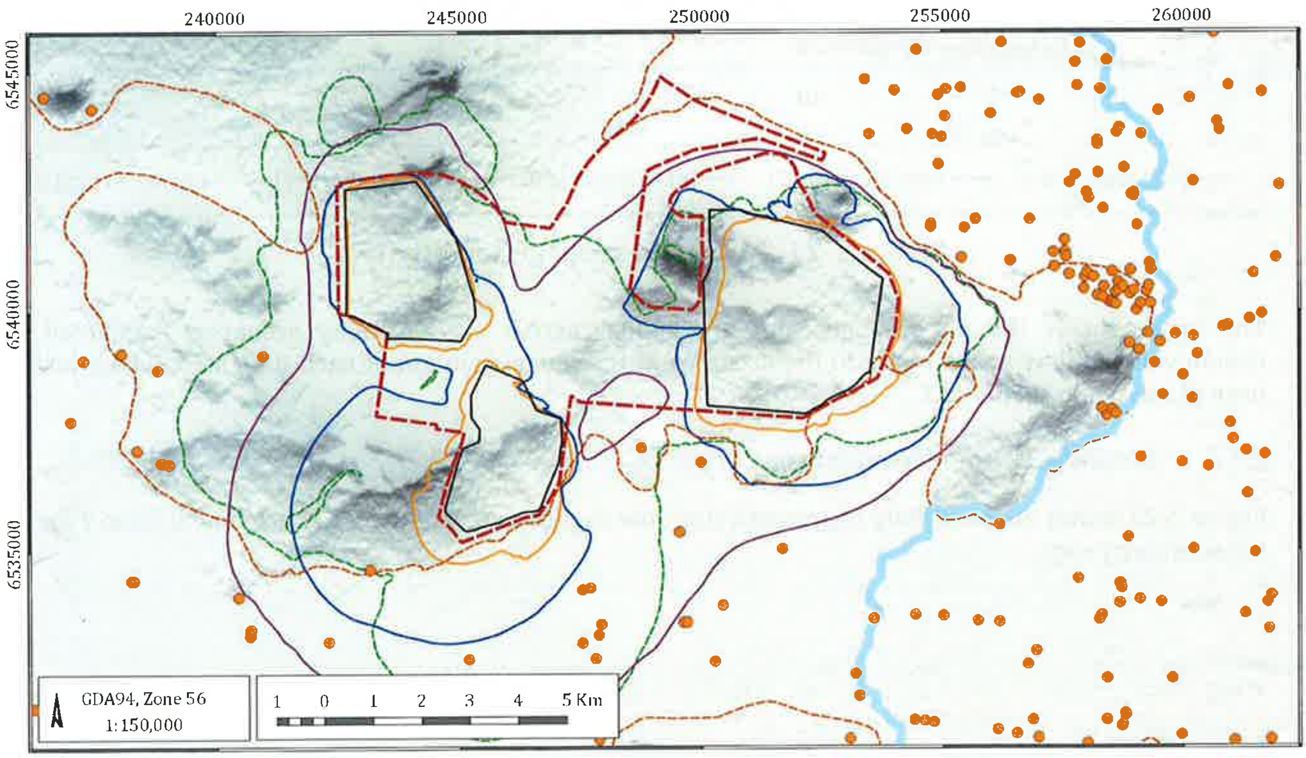
2.4.1 Groundwater level impacts

Figure 2-20 presents the groundwater drawdown extent for the scenarios described above.

Layer 2 - Gunnedah Formation



Layer 10 - Mellvilles Coal Seam



LEGEND

- Mining area
- PINEENA bore
- Project area
- Mooki river
- Alluvial boundary
- Groundwater Drawdown (m) EIS model (Uncert)
- Groundwater Drawdown (1m) Scenario 6
- Groundwater Drawdown (1m) Scenario 7
- Groundwater Drawdown (1m) Scenario 8

Watermark (G1501)

Groundwater Drawdown Impacts – Sensitivity Scenarios

DATE: 30/9/2014

FIGURE No: **2-20**

The results show that all the scenarios are within the depressurization zone presented in the EIS report, and no bores outside the project area are predicted to have drawdown of more than 2m.

2.4.2 Pit inflow sensitivity

Figure 2-21 shows the sensitivity of the total pit seepage rates into the proposed mining areas.

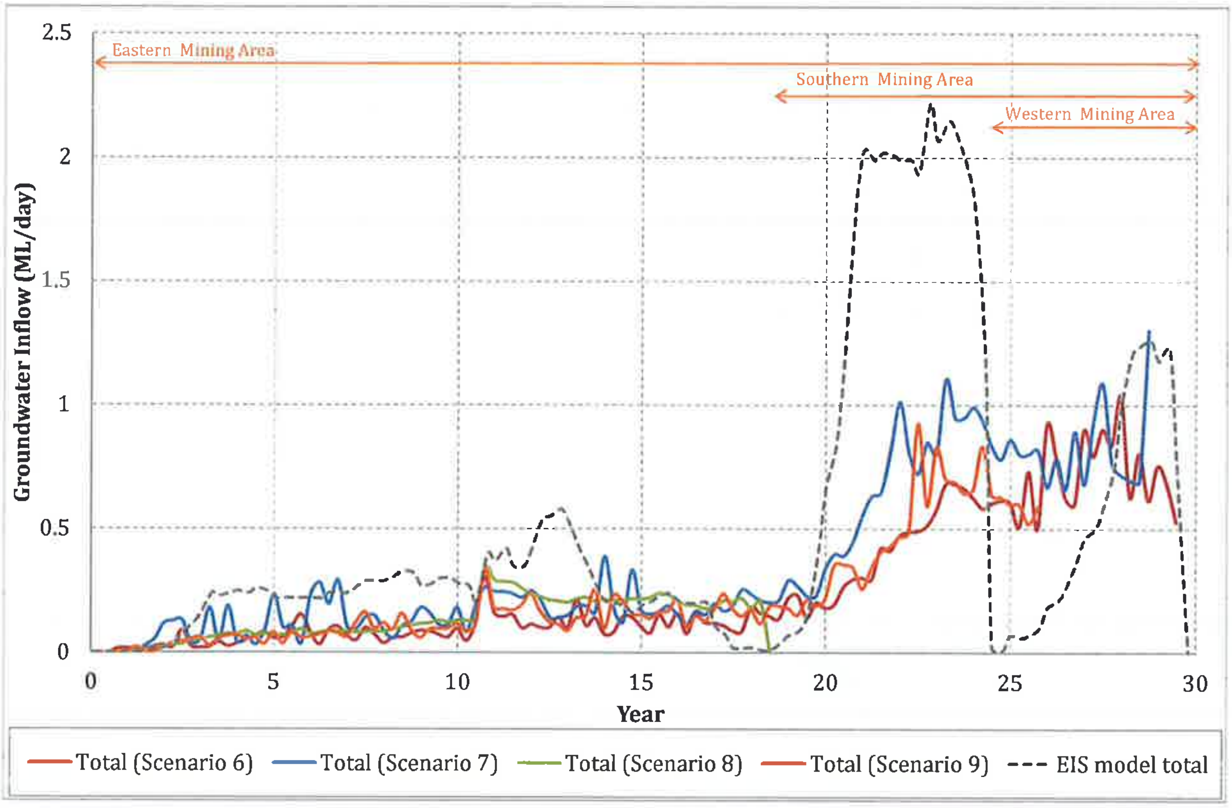


Figure 2-21 Pit seepage sensitivity

The figure shows the pit seepage rates are similar across all sensitivity scenarios completed. Groundwater inflow peaks relate to the accuracy of the model solution at each time step, which has been discussed in section 2.2.

2.4.3 Groundwater management zone impacts

Figure 2-22 shows the sensitivity of groundwater flow change to Groundwater Management Zone 7 for the sensitivity runs.

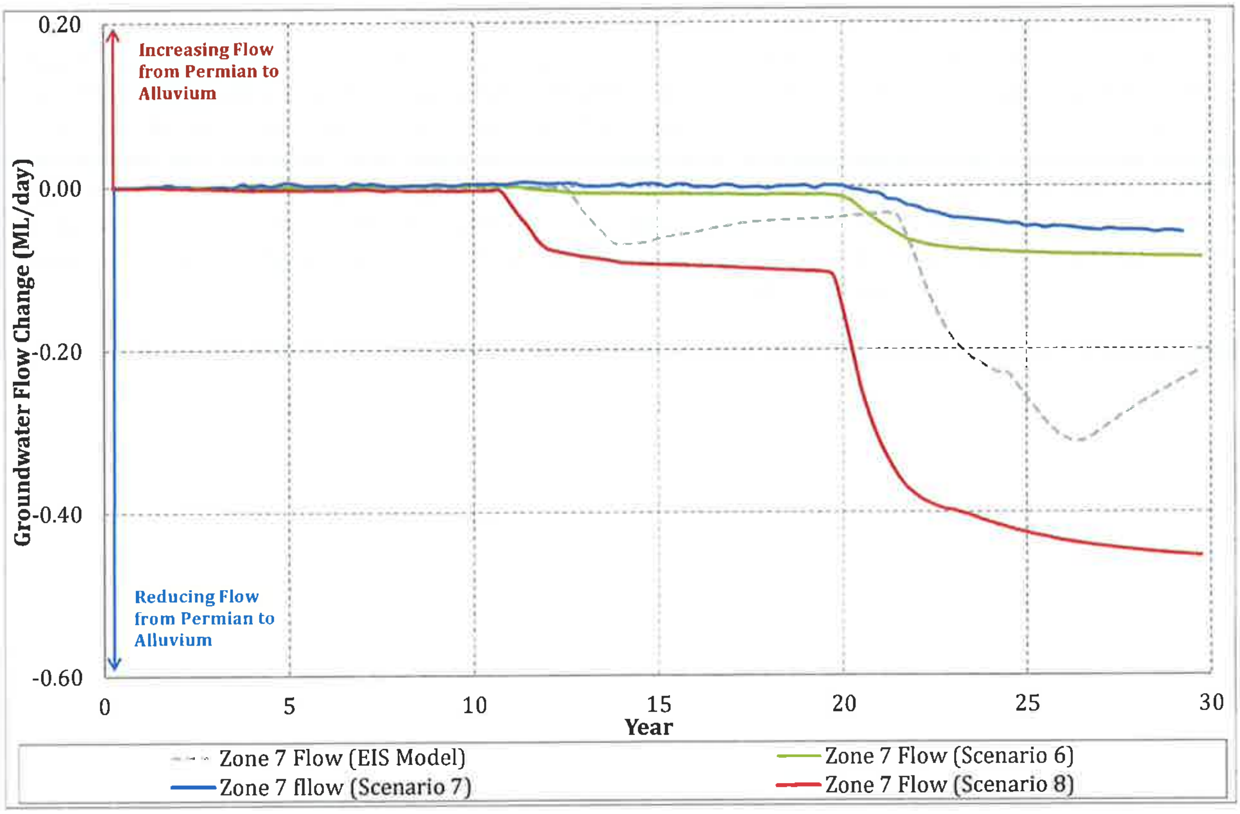


Figure 2-22 Groundwater management zone 7 flow change sensitivity

The graph shows that the scenarios setting the drain elevation to the base of the cell produces impacts less than using the method used in the EIS model.

Removing faults from the model and using the EIS drain cell elevation with 'growing drains' results in more impacts than presented in the EIS model. However, these impacts are less than the worst case predictions presented in the uncertainty and sensitivity sections of the EIS report.

3. Conclusions

The EIS model applied AGE's standard methodology and set the drain reference elevation in the mining areas to the base of the pit floor to introduce conservatism to modelling predictions, and to aid model stability for the recovery scenario. This memo presents results demonstrating that setting drain reference elevations to the base of each cell further reduces predicted impacts to surrounding groundwater users and the groundwater regime.

The predicted seepage rates to the mining areas was also found to be sensitive to the closure criterion adopted. The EIS model adopted closure criterion that ensured the model converged to an accurate solution, and provided accurate pit seepage rates. Simulated groundwater levels are insensitive to variances in model closure criterion. No erratic behaviour in heads was observed in any of the scenarios explored.

The residual saturation function adopted by AGE for the EIS modelling due to its ability to aid model convergence following desaturation of model cells. Our experience using this function produces results comparable to using the rewetting function in MODFLOW NWT/USG, at significantly faster runtimes. Fast runtimes (<8 hours) were essential to maintain 50m x 50m cell resolution in the mining areas, and to perform an uncertainty analysis. Our experience has been that adopting the pseudo soil function reduces the predicted impacts both during mining, and long term post mining. Therefore, this review shows that the EIS model produces conservative impacts when compared to the other approaches suggested and can be used as a functioning predictive baseline that the observed impacts can be compared to once mining commences.

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APPENDIX B

Supplementary Mine Plan Report

Shenhua Watermark Pty Limited

Watermark Coal Project

Supplementary Mine Plan Report

October 2014

Executive summary

The NSW Planning Assessment Commission (PAC) conducted a review of the Watermark Coal Project (the Project) according to the terms of reference specified by the NSW Minister for Planning and Environment on 15 November 2013 (as modified). The PAC held public hearings on the Project on 26 June 2014, which continued on 27 June 2014. The PAC released its Review Report of the Project in August 2014 inclusive of a variety of recommendations and additional considerations for the determining authority.

This Supplementary Mine Plan report has been prepared by GHD on behalf of Shenhua Watermark to address Section 7 of the PAC Review Report for the Project, specifically in relation to long term land use impacts including the final landform, final void and rehabilitation strategy.

In its Review Report, the PAC sought greater justification relating to the out of pit overburden emplacement areas as proposed for the Project, and also queried if there was opportunity to reduce the extent of the out of pit overburden emplacement areas.

This Supplementary Mine Plan report has demonstrated that best practice mine planning has been implemented for the Project to minimise all impacts including avoiding out of pit overburden emplacement areas where possible. The key issue is that the volume of open pit cannot accommodate the coal waste and overburden generated by the Project whilst providing safe and stable areas for the progression of mining operations. For these reasons, out of pit overburden emplacement areas are required.

All overburden emplacement areas for the Project (including the out of pit overburden emplacement areas) have been designed to accommodate the necessary excess overburden volumes, whilst meeting mine safety parameters, environmental and land constraint considerations, and ensuring that a stable final landform is developed which merges with the natural topography and provides a maximum of 10° slopes for enhanced rehabilitation outcomes.

The mine plans has been specifically designed to provide relatively gentle slopes when compared to the majority of coal mines within NSW and QLD, and allows for the establishment of box gum woodland, koala habitat and land capability Class III on the rehabilitated landform. Furthermore, these relatively gentle slopes will contain slope lengths and suitable soil depth designed to minimise erosion risk and ensure that the land meets criteria for land capability Class III.

An additional key criterion for the mine plan design for the Project was to ensure the overburden emplacement areas are progressively rehabilitated over the life of the mine as soon as practical. This staged approach will minimise the open cut mining disturbance area at any one time and reduce the environmental impacts from the open cut operations.

Considerable effort and forethought has been invested in the mine plan to avoid, wherever possible, the creation of final mine voids. As such, the two largest voids created by the mining process in the Eastern Mining Area and the Southern Mining Area have been strategically located so that both can be completely backfilled and rehabilitated.

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Appendices

1. Introduction

1.1 Background

In October 2008, Shenhua Watermark Coal Pty Ltd (Shenhua Watermark), a subsidiary of the Shenhua Group, was granted Exploration Licence (EL) 7223 by the New South Wales (NSW) Minister for Mineral Resources.

The Project is located within EL 7223, approximately 25 kilometres (km) south south-east of the township of Gunnedah, and to the immediate west of the village of Breeza within the Gunnedah Local Government Area (LGA). The Project is approximately 282 km by rail from the export Port of Newcastle.

The Project involves:

- The development of an open cut mining operation extracting up to 10 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal from the Hoskissons and Melvilles seams over a period of 30 years.
- Utilising a standard mining equipment fleet of excavators and shovels, supported by haul trucks, dozers, graders, drill rigs and water carts.
- Progressive rehabilitation of all disturbed areas.
- The co-disposal of tailings and coarse reject within the Overburden Emplacement Areas (OEA).
- The construction and operation of a Mine Access Road.
- The construction and operation of administration, workshop and related facilities.
- The construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput of 10 Mtpa of ROM coal.
- The construction and operation of a rail spur, rail loop, Kamilaroi Highway rail overpass, associated train load out facility and connection to the Werris Creek to Moree Railway Line.
- Transportation of product coal by rail via the Werris Creek to Moree Railway Line and the Main Northern Railway Line to the Port of Newcastle for export.
- The construction and operation of surface and groundwater management and reticulation infrastructure including pipelines, pumping stations/bore field and associated infrastructure for access to water from the groundwater aquifers in the vicinity of the Project, the Mooki River and private dams to the north-east of the Project Boundary.
- The closure of Court Lane, Rowarth Road, Whitby Road, part of The Dip Road (from the intersection of Clift Road to Nea Siding Road) and other unnamed paper roads within the Project Boundary.
- The installation of communications and electricity infrastructure.
- A workforce of approximately 600 full-time equivalent employees during construction and up to approximately 600 full-time equivalent employees and associated contractors during operation of the Project at full production.

1.2 Development consent status

Shenhua Watermark is seeking State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). A request for Director-General's Requirements (DGRs) was made to the NSW Department of Planning and Environment (DP&E) under Part 2 of Schedule 2 of the *Environmental Planning & Assessment Regulation 2000* (EP&A Regulation) in October 2011. This was supported by the Watermark Coal Project Background Document (Hansen Bailey, 2011). Subsequently, DGRs were issued by DP&I on 19 April 2012.

The Watermark Coal Project Environmental Impact Statement (EIS) was prepared by Hansen Bailey Environmental Consultants (Hansen Bailey) (2013) on behalf of Shenhua Watermark to support the application for State Significant Development Consent (SSD 4975). The EIS was placed on public exhibition between 28 February and 26 April 2013 (a period of approximately eight weeks).

Following public exhibition of the EIS, DP&E provided to Shenhua Watermark a total of 139 submissions from various stakeholders, including regulatory agencies, special interest groups and individual members of the public, in relation to the Project. The Watermark Coal Project Response to Submissions (RTS) was subsequently prepared by Hansen Bailey on behalf of Shenhua Watermark in November 2013.

The Planning Assessment Commission (PAC) was then requested to conduct a review of the Project according to the terms of reference specified by the Minister for Planning and Environment on 15 November 2013 (as modified). The PAC held public hearings on the Project on 26 June 2014, which continued on 27 June 2014.

The PAC released its Review Report of the Project in August 2014, and subsequently, the recommendations of that report are the focus of this Supplementary Mine Plan report.

1.3 Document purpose and structure

This Supplementary Mine Plan report has been prepared by GHD on behalf of Shenhua Watermark to address Section 7 of the PAC report for the Project, specifically in relation to long term land use impacts including the final landform, final void and rehabilitation strategy.

This Supplementary Mine Plan report outlines the concerns raised by the PAC in regard to each issue and subsequently provides a response to each concern.

2. Mine plan description

2.1 Mine layout overview

The conceptual mine plan sequencing for the Project is illustrated on Figure 2.1 to Figure 2.8 inclusive, as well as in Appendix A for selected transition sequencing plans.

The mine plan has been designed to ensure that coal production from the each individual Mining Area will replace the coal production from the preceding Mining Area and provide a consistent coal feed to the CHPP, whilst minimising out of pit OEA and maximising in pit backfilling. Mining operations will commence with an initial box cut in the northwest of the Eastern Mining Area. Overburden will be removed by excavators/shovels and haul trucks. Coal seams will be uncovered and are planned to be selectively mined using excavators, front end loaders and haul trucks.

Overburden from the Eastern Mining Area will be initially placed in an out of pit OEA to the south-west and immediate north and east of Mt Watermark and the mined open pit and rehabilitated so as to visually shield the mining operation from the Kamilaroi Highway.

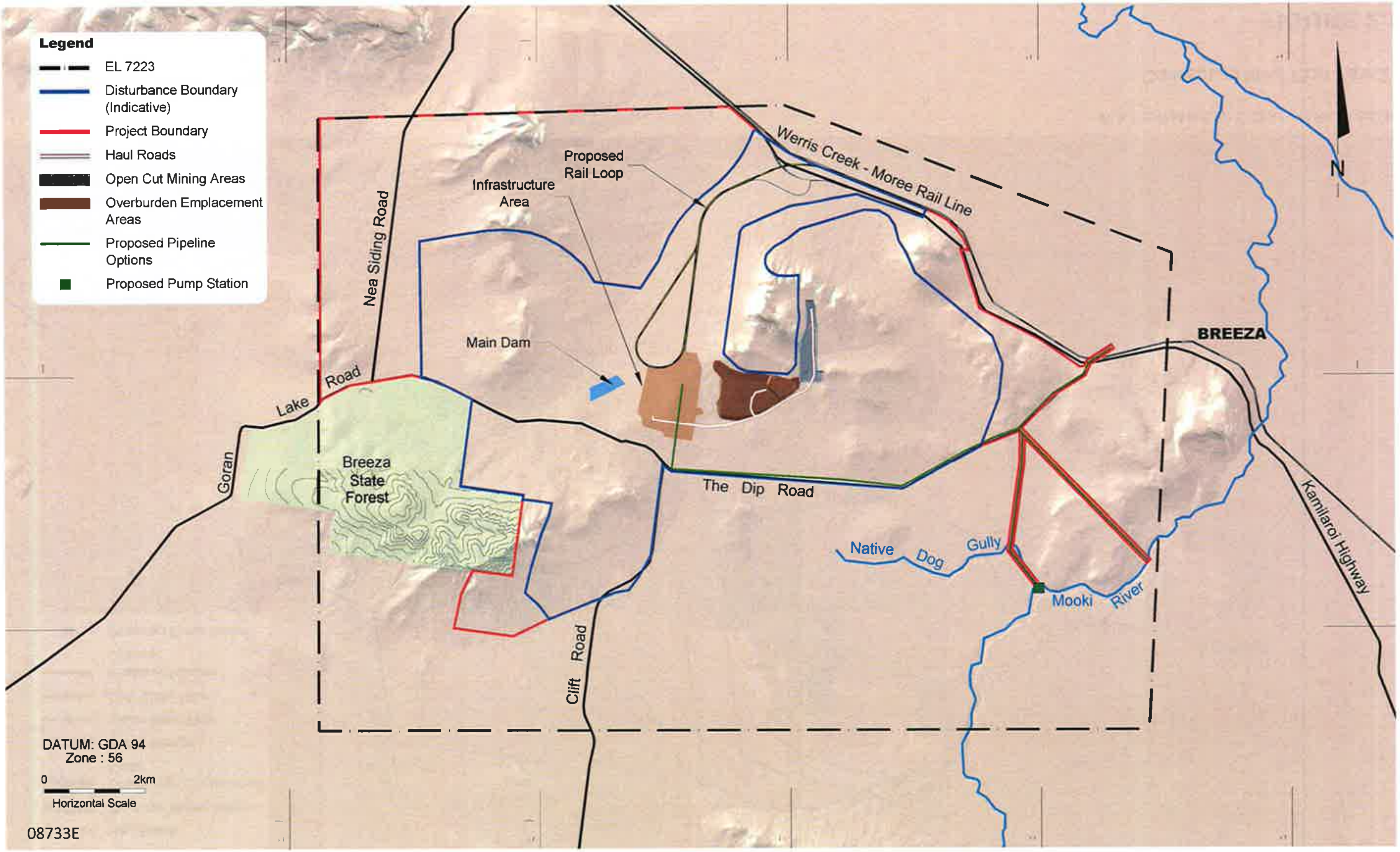
Mining will continue down-dip of the coal seams towards the south eastern extent of the Project Boundary. Overburden will then be progressively placed in the pit and rehabilitated behind the active mining area, up to RL 380 m. By approximately Year 18, active mining will be completed in the Eastern Mining Area.

In Year 17, mining operations will commence in the northern end of the Southern Mining Area, progressing to the south-west. In order to ensure consistent coal production, the Southern Mining Area will commence development whilst the Eastern Mining Area is completing its available coal production. This will ensure that coal production from the Southern Mining Area will replace the coal production from the Eastern Mining Area and provide a consistent coal feed to the CHPP.

Overburden from the Southern Mining Area will be concurrently placed in the Eastern Mining Area mining void and the Southern Mining Area out of pit OEA for a period of approximately 18 months until sufficient room is available to commence backfilling in the Southern Mining Area. By approximately Year 21, the Eastern Mining Area will be completely rehabilitated up to RL 380 m and by Year 24, active mining will be completed in the Southern Mining Area.

By approximately Year 22, mining operations will commence in the eastern edge of the Western Mining Area. Once again, in order to ensure consistent coal production, the Western Mining Area will commence development whilst the Southern Mining Area is completing its available coal production.

Overburden from the Western Mining Area will be utilised initially develop an out of pit OEA adjacent to the Western Mining Area and then backfill the Southern Mining Area void. By Year 26, the Southern Mining Area is expected to be completely backfilled and rehabilitated up to RL 330 m. Overburden from the Western Mining Area will then be backfilled in the Western Mining Area. By Year 30, active mining in this area is completed leaving a final void in the north western portion of the Western Mining Area.

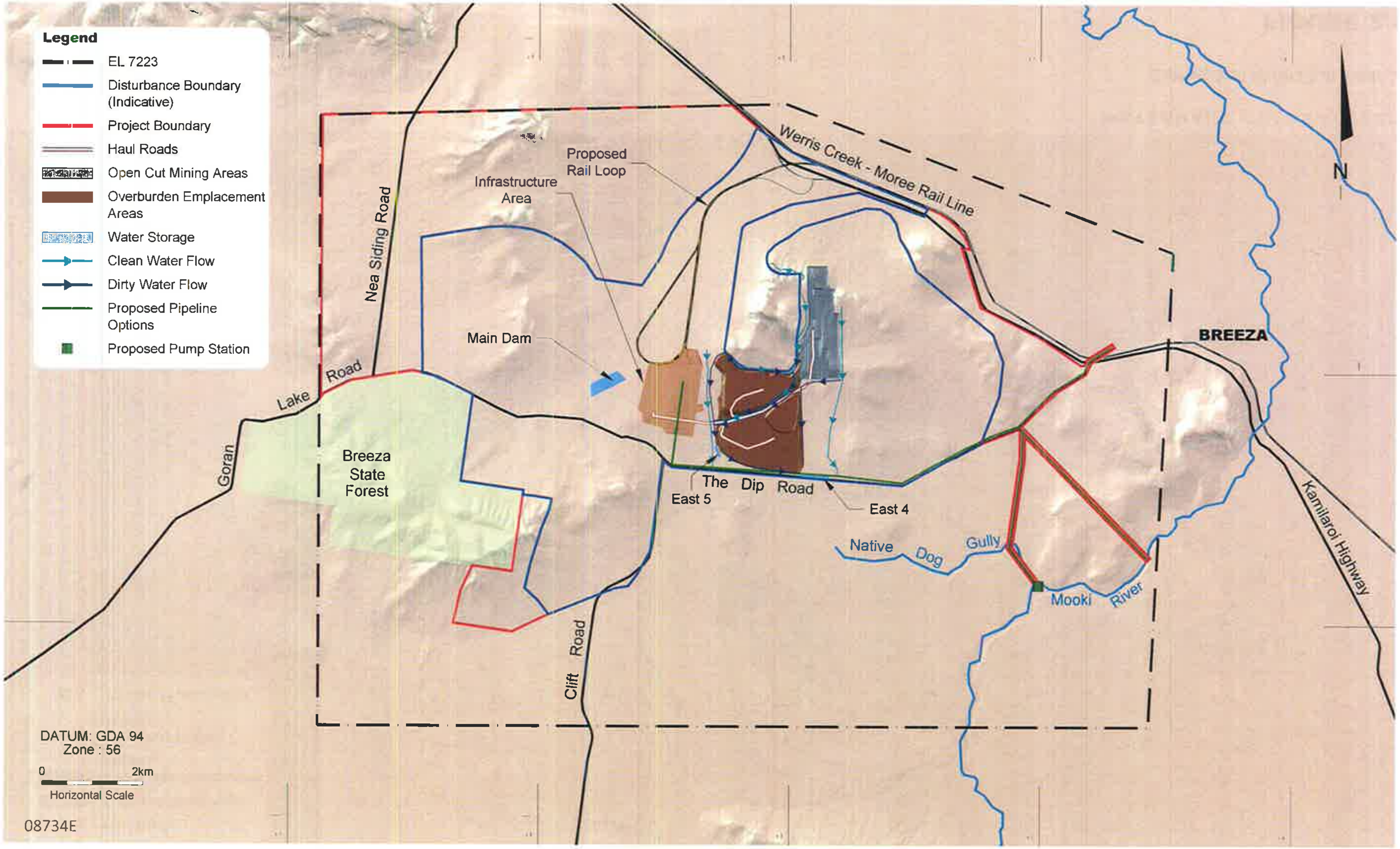


SHENHUA WATERMARK COAL PTY LIMITED | Hansen Bailey ENVIRONMENTAL CONSULTANTS

WATERMARK COAL PROJECT

Conceptual Mine Plan Year 1

FIGURE 2.1



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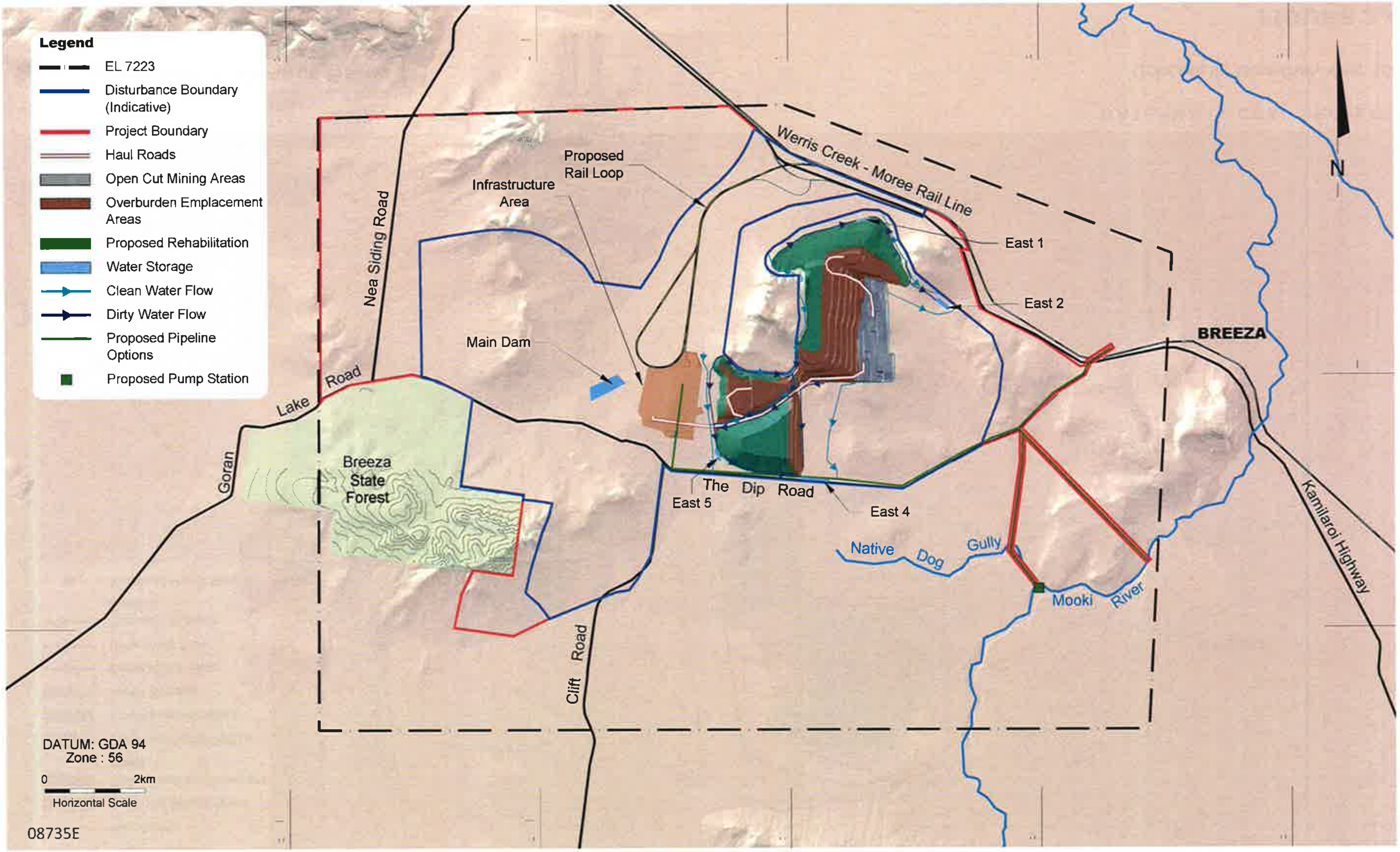
WATERMARK COAL PROJECT

Conceptual Mine Plan Year 2

FIGURE 2.2



WATERMARK COAL PROJECT

Conceptual Mine Plan Year 5

FIGURE 2.3

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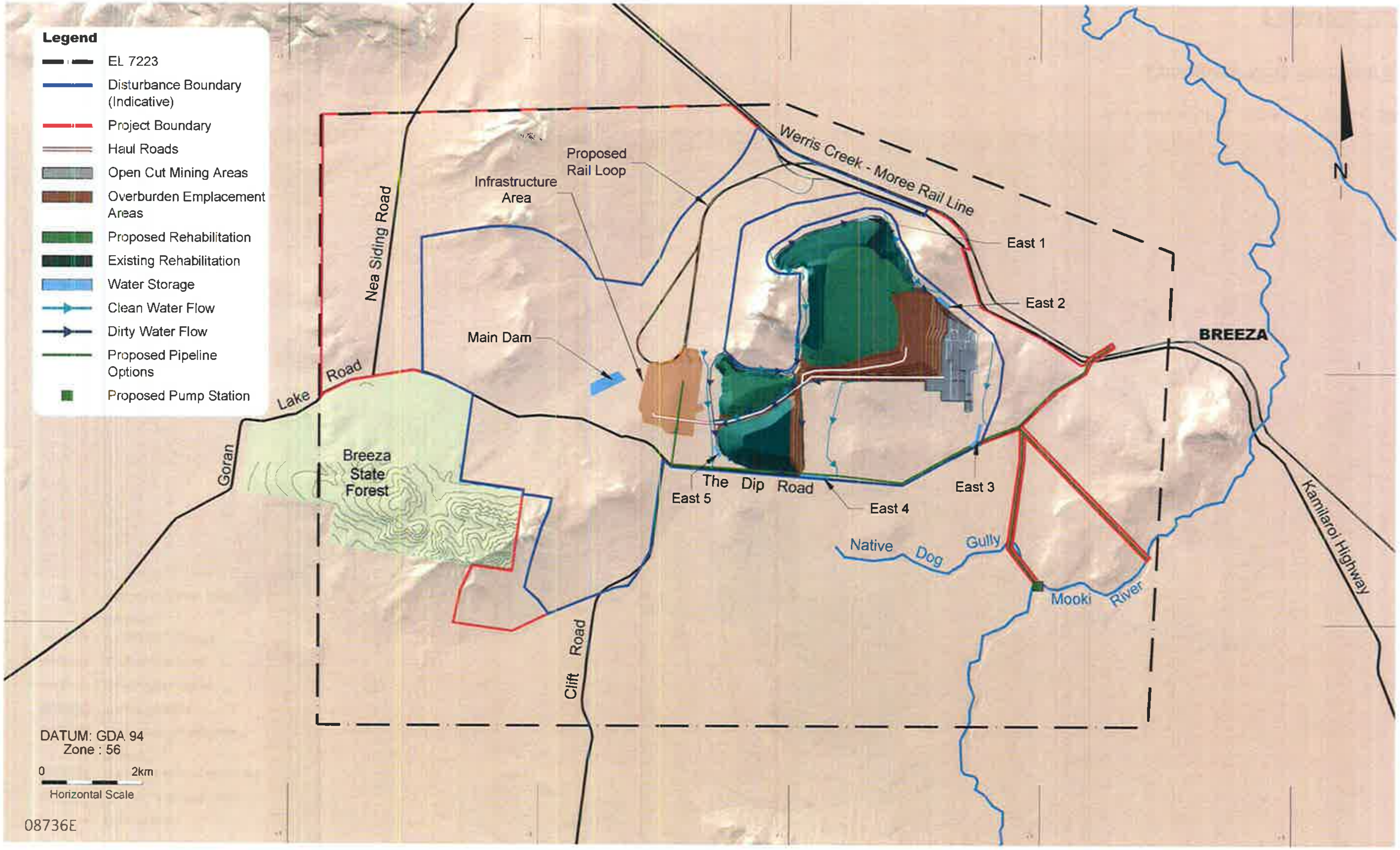

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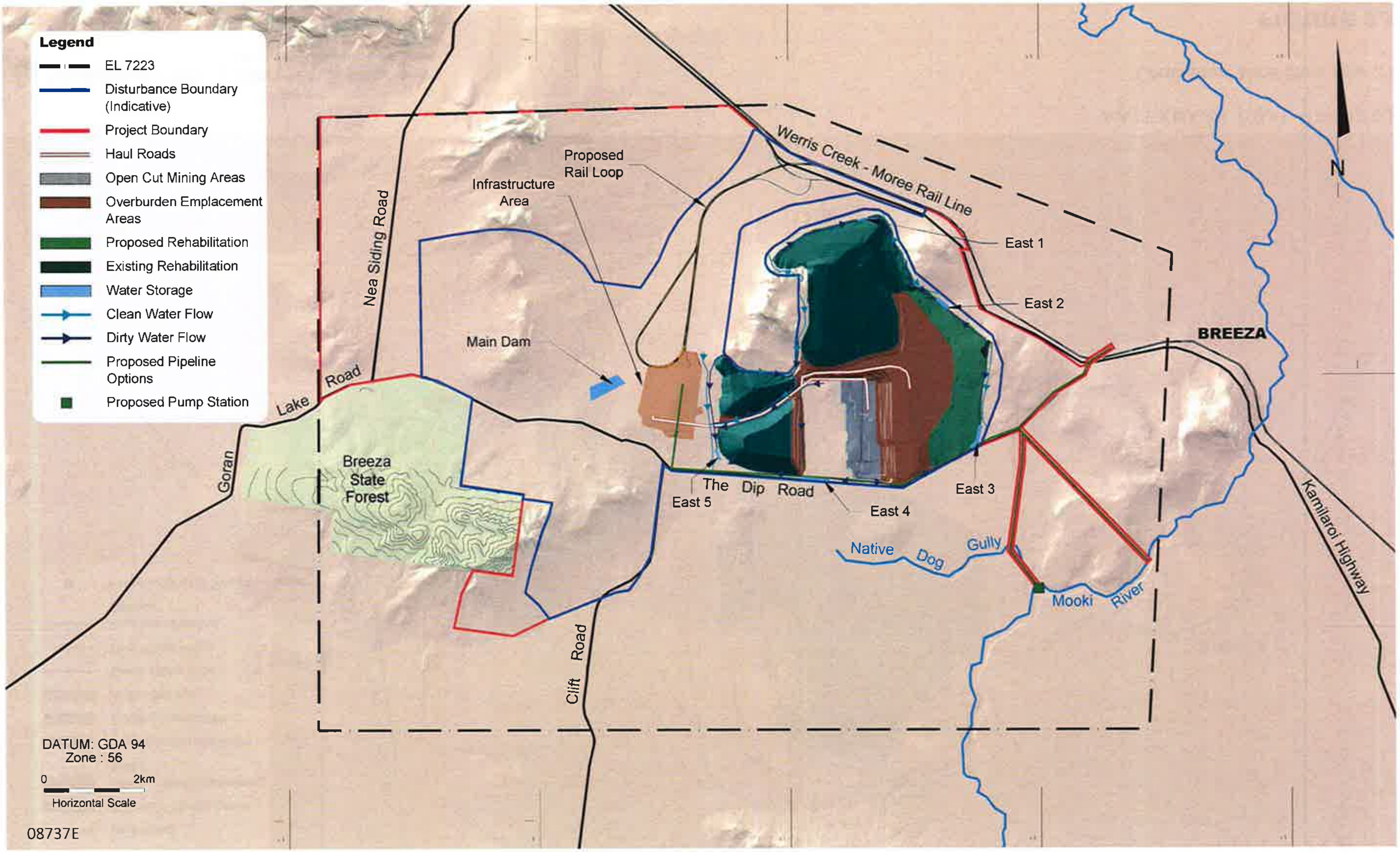
WATERMARK COAL PROJECT

Conceptual Mine Plan Year 10

FIGURE 2.4



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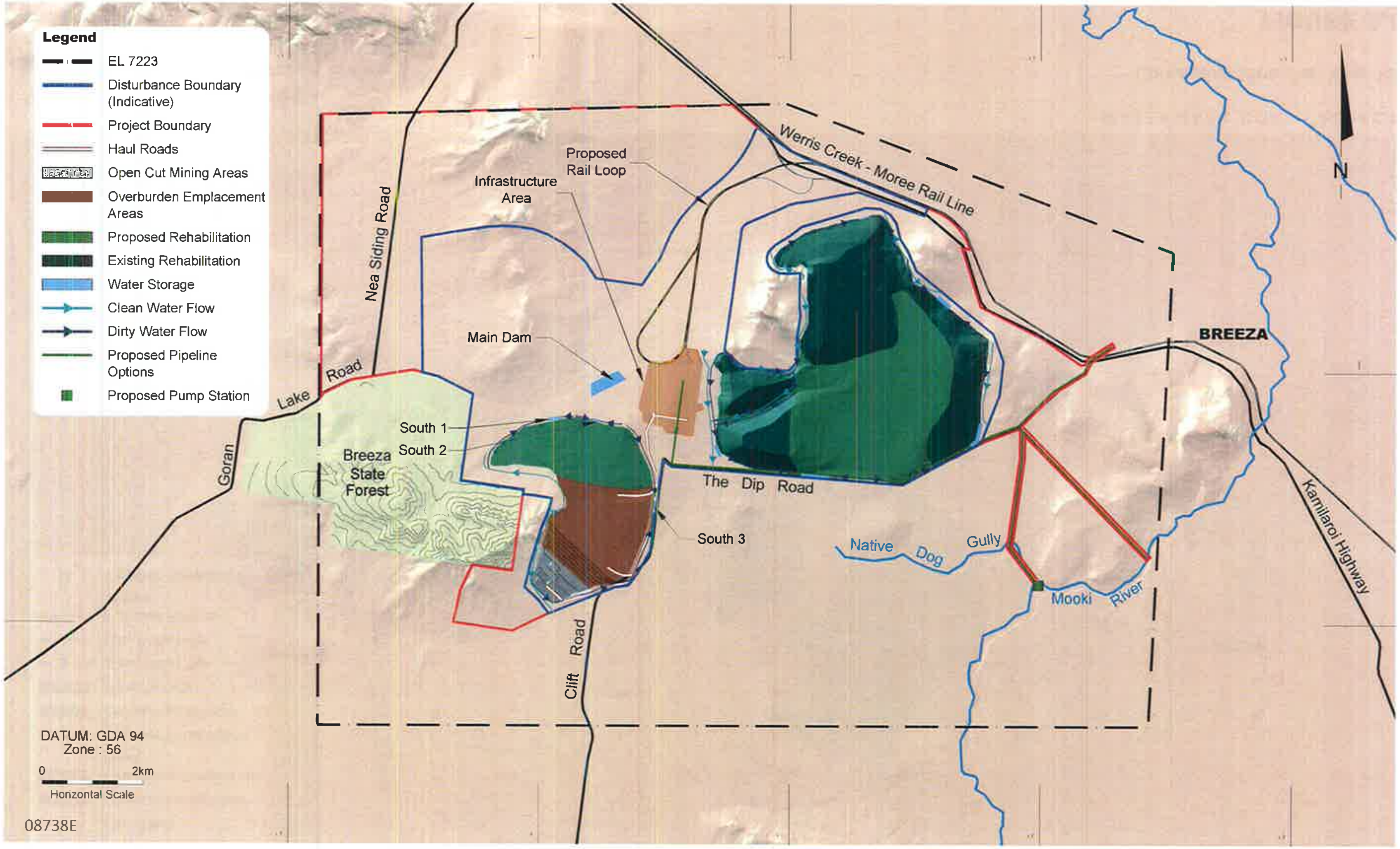
WATERMARK COAL PROJECT

Conceptual Mine Plan Year 15

FIGURE 2.5



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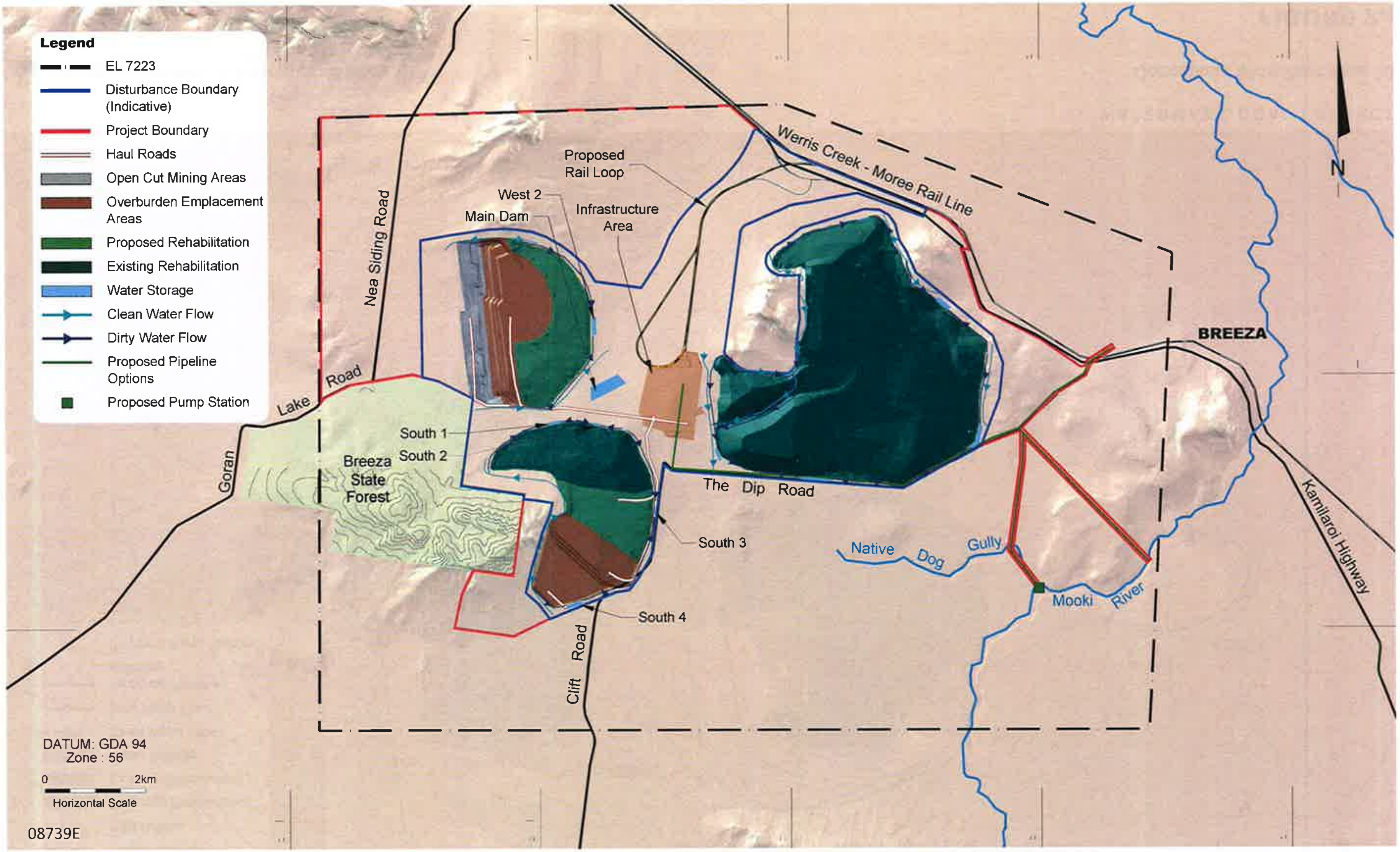
WATERMARK COAL PROJECT

Conceptual Mine Plan Year 21

FIGURE 2.6



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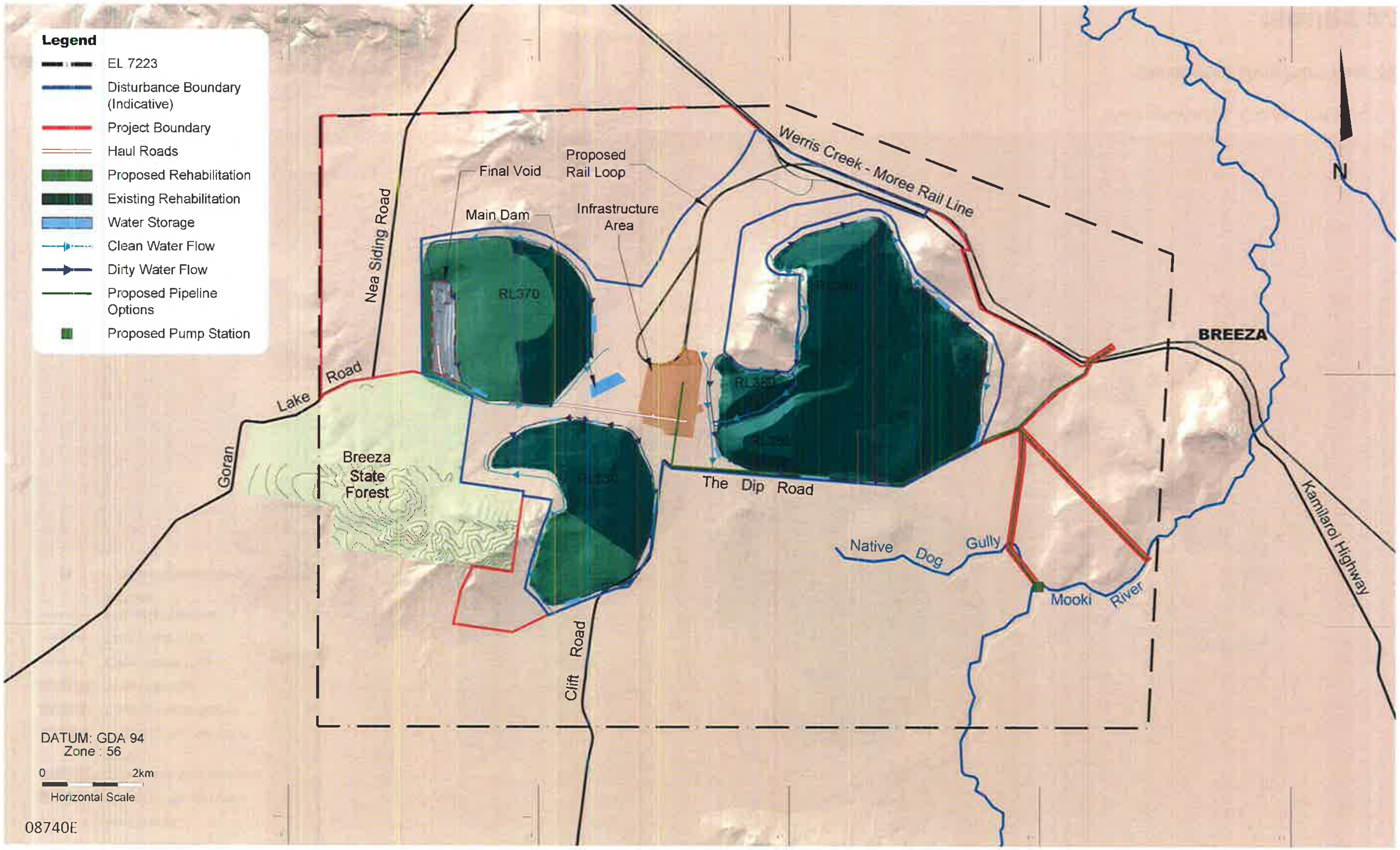
WATERMARK COAL PROJECT

Conceptual Mine Plan Year 25

FIGURE 2.7



WATERMARK COAL PROJECT

Conceptual Mine Plan Year 30

FIGURE 2.8

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2.3 Final voids

As outlined in Section 4 of the EIS, the mine plan for the Project has been specifically designed to ensure the final void is located in the north-west of the Project Boundary remote from the black soil plains.

This required a reconfiguration of the mine plan sequencing to facilitate backfilling of the Eastern and Southern Mining Area voids, leaving a final void in the Western Mining Area remote from the black soil plains.

The mine plan reconfiguration for the Project has resulted in significant costs of over $340 Million being incurred by Shenhua Watermark to ensure only one final void remains at the end of mining. This includes:

- Estimation of the cost to completely backfill the Eastern Mining Area void (using material from the Southern Mining Area) is approximately $130 Million, in conjunction with the use of 50% of the Project's annual mining capacity for over six months. In addition to this cost, an allowance of $5 Million has also been provided for final rehabilitation (topsoil spreading, water management and revegetation).
- Estimation of the cost to completely backfill the Southern Mining Area void (using material from the Western Mining Area) is approximately $210 Million, in conjunction with the use of 50% of the Project's annual mining capacity for a year. In addition to this cost, an allowance of $5 Million has also been provided for final rehabilitation (topsoil spreading, water management and revegetation).

2.4 Mine plan considerations

The mine plan for the Project has been designed specifically to incorporate the following environment and social benefits, which are described in greater detail below (as relevant) and in Section 3.12.8 of the EIS (Hansen Bailey, 2013):

- The protection of the groundwater regime of the black soil plains with a minimum 900 m horizontal barrier of natural material between active mining areas and the highly productive Gunnedah Formation aquifer.
- A minimum 150 m buffer to alluvial black soils and black soil plains.
- Disturbance of only land owned by Shenhua Watermark.
- No disturbance of Mt Watermark.
- No disturbance of Breeza State Forest.
- There is only one final void which is distant from the black soil plains and Gunnedah Formation.
- The OEA merges into the natural topography (such as Mt Watermark and Black Mountain).
- Reduced slopes of the OEA to facilitate the re-establishment of Box Gum Woodland on the rehabilitated areas and to achieve the maximum post-mining land capability classification practicable.
- Reconfiguration of the Eastern Mining Area OEA to avoid 143 ha of Critically Endangered Ecological Community (CEEC) Box Gum Woodland.
- Avoidance of four Aboriginal archaeological sites of high, moderate and low significance within the Eastern Mining Area.
- Early and progressive rehabilitation of the OEAs.

- Early development and rehabilitation of the northern OEA in the Eastern Mining Area to assist as a visual screen.
- Allocating night mining activities to locations deeper in the open cut mining area to enhance light, noise and air quality shielding effects.
- Haul routes designed to reduce visual exposure in elevated areas and to reduce the overall haul distance.
- Utilising large equipment to reduce the number of mobile equipment operating at any one time.
- Implementation of best-practice sound power levels on all of the equipment fleet to reduce noise impacts.
- The CHPP ROM bins and conveyors include shielding to reduce air and noise impacts.
- Rail loop with minimum grade to reduce the grade and thus locomotive power and noise while loading.
- Minimal drop height to/from equipment during loading/unloading activities to reduce noise and air quality impacts.
- Haul routes and active exposed mining areas will be suppressed with water and/or chemical surface crusting agents to reduce air quality impacts.
- The train load out water spray system will have the ability to apply a dust suppressant to the loaded coal wagons if deemed necessary.
- Avoidance of 351 ha of land conforming to Class II land capability.
- A rehabilitation strategy to reinstate approximately 3,233 ha of land to Class III rural land capability, of which approximately 1,000 ha is to be dedicated for agricultural purposes.
- Situating the Mine Infrastructure Area to avoid EEC where possible and to obtain maximum natural shielding from private receivers.

3. Mine plan design

3.1 PAC Concerns

Page 25, Paragraph 3 "*The mine plan and mine scheduling influence certain aspects of the rehabilitation of the site, particularly the final landform and overall disturbance area to be rehabilitated…this sequential mining of pits has a number of advantages. For example… it should allow the disturbance associated with out of pit emplacement of overburden to be avoided for the second and third pit, as overburden can be used to backfill the previous pit.*"

Page 25 Paragraph 4 "The Commission accepts that disturbance of the mine pits is a necessary part of open cut mining, but considers there may be some scope to reduce the disturbance of areas outside the pit boundaries."

Page 25 Paragraph 6 "The text in the applicant's Environmental Impact Statement suggests that no out of pit emplacement of overburden would be required for the second and third pits (the southern and western pits). However the project layout plans show out of pit emplacement areas adjoining each pit (Hansen Bailey, 2013a, p.26). Mining activities are scheduled to move from the eastern to the southern pit in year 17 and from the southern to the western pit in year 24 (Hansen Bailey, 2013a, p. C22), no drawings of either of these years were available to the commission. Based on the conceptual mine plan drawing from year 25 it appears that overburden emplacement will be occurring in the southern pit and in the western pit concurrently, with out of pit emplacement adjoining the western pit already completed."

Page 26 Paragraph 2 "The commission has not been able to find any justification for these out of pit emplacement areas adjoining the southern and western pits. Some shaping around the pit edges may be necessary to provide a final landform that is not only safe and stable, but also in keeping with the surrounding topography."

Page 26 Paragraph 2 "Nonetheless, the extent of the out of pit emplacement areas proposed across the site is considered excessive and should be reviewed with a view to minimising the area disturbed due to the out of pit emplacements, particularly avoiding class II agricultural land and minimising impacts on class III agricultural land and Endangered Ecological Communities in these areas of the site."

Interpretation of concerns

The PAC is seeking greater understanding and justification relating to the out of pit OEAs as proposed for the Project and further believes that there is opportunity for reducing the extent of out of pit OEA as nominated by Shenhua Watermark. The PAC would further like to see demonstration of the Shenhua Watermark's consideration with respect to nominating the OEA zones and volumes.

3.2 Response to PAC concerns

To address these concerns, we have described below:

1. Why Out of Pit OEAs are required for the Project.
2. What defines the extent of the Out of Pit OEAs required for the Project.
3. Confirm the reasons for why the Out of Pit OEAs in the Eastern Mining Area to the east and south of Mt Watermark are both required.
4. Confirm the reasons for why an OEA is concurrently required in the Eastern Mining Area, Southern Mining Area and Western Mining Area.

3.2.1 Why is an Out of Pit Overburden Emplacement Area required?

As described above, the mine plan for the Project has been specifically designed to avoid a final void in the Eastern and Southern Mining Areas. This in turn, means that overburden generated by the Project is preferentially placed back within the mining areas to backfill the voids. However, for the reasons described below, areas of out of pit OEA are required to facilitate safe and efficient mining operations.

Eastern Mining Area

Mining for the Project commences with an initial box cut in the Eastern Mining Area. As shown on Figure 2.1 and Figure 2.2, the active mining area of the Eastern Mining Area is limited in its extent as the mine walls, pit floor and benches are developed. The limited extent of the mining area means that there is insufficient room in the pit to backfill with overburden and maintain safe and efficient working room. For this reason, the overburden generated from the Eastern Mining Area is placed within an out of pit OEA until Year 11 upon which time sufficient room becomes available in the mining area to accommodate backfilling (see Figure 2.3, Figure 2.4, Figure 2.5). From this point onwards, all overburden generated from the Eastern Mining Area is backfilled in pit within the mining area. As active mining concludes in the Eastern Mining Area, approximately 57 Million bank cubic metres (Mbcm) of overburden is required to complete backfilling of the Eastern Mining Area, and therefore, remove the final void.

Southern Mining Area

From Year 17 overburden from the Southern Mining Area will be concurrently placed in the Eastern Mining Area mining void and the Southern Mining Area out of pit overburden emplacement area for a period of approximately 18 months until sufficient room is available to commence backfilling in the Southern Mining Area. By approximately Year 21, the Eastern Mining Area will be completely rehabilitated up to RL 380 m and by Year 24, active mining will be completed in the Southern Mining Area.

As shown on Figure 2.6, the Southern Mining Area is considerably narrow with mining progressing in a southerly direction. Similar to the initial box cut in the Eastern Mining Area, this means that there is insufficient room in the pit to backfill with overburden and maintain safe and efficient working room. For this reason, approximately 18 Mbcm of overburden generated from the Southern Mining Area would be placed within an adjacent out of pit OEA for approximately 18 months until Year 19, upon which time sufficient room becomes available in the in pit mining area to accommodate backfilling (refer to section 3.2 below for detail on the volume calculations). From this point onwards, all overburden generated from the Southern Mining Area is backfilled within the in pit mining area. As active mining concludes in the Southern Mining Area in Year 24, approximately 23 Million bcm of overburden is required to complete backfilling of the Southern Mining Area and therefore remove the final void adjacent to the black soil plains and productive Gunnedah Formation groundwater aquifer.

Western Mining Area

Overburden from the Western Mining Area will be utilised to initially develop an out of pit overburden emplacement area adjacent to the Western Mining Area and then backfill the Southern Mining Area void. By Year 26, the Southern Mining Area is expected to be completely backfilled and rehabilitated up to RL 330 m. Overburden from the Western Mining Area will then be backfilled in the Western Mining Area. By Year 30, active mining in this area is completed leaving a final void in the north western portion of the Western Mining Area.

The out of pit OEA adjacent to the mining area is primarily required because as the Southern Mining Area is progressively backfilled, the available safe working room exponentially decreases and therefore the overburden cannot be emplaced quickly enough to match that generated in the Western Mining Area. In addition, safe benching, lift heights and compaction is critical throughout the backfilling process to ensure a stable final landform, which also limits the rate at which the overburden can be emplaced to match that being generated in the Western Mining Area.

3.2.2 What defines the extent of an Out of Pit Overburden Emplacement Area?

There are six key considerations which interact to define the extent of an out of pit OEA including:

- The available size of the in pit mining area, including transitional arrangements.
- The coal quality of the mining operation, the desired product coal qualities and subsequent coal rejects generated from the CHPP.
- The swell factor of the overburden as it is removed from the mining areas.
- Environmental, social, economic and land constraints (i.e. "no-go" areas such as the black soil plains).
- The geotechnical constraints to which the overburden can be emplaced (i.e. height and maximum 10° rehabilitation slope).
- The need for progressive rehabilitation to minimise to area disturbed at any one time.

Each of these considerations and their role in defining the out of pit OEA for the Project are described below.

Mining area size

The extent of the mining area is defined by geological and geotechnical (and therefore financial) conditions including coal extent and accessibility (i.e. depth). Based on detailed geological data and geotechnical studies, the following parameters were adopted for the pit wall design:

- 55 degree angle on the overlying weather material.
- 70 degree angle on fresh rock material.
- An overall slope angle of 45 - 55 degrees.

The resulting volume (Mbcm) of each mining area (i.e. once all overburden and coal is removed) is presented below in Table 3-1.

Table 3-1 Mining area volumes

Mining Area	Mining Area Volume (Mbcm^3)
Eastern Mining Area	1,025
Southern Mining Area	417
Western Mining Area	362

Coal waste

The CHPP for the Project will generate coarse rock and fine tailings rejects representing the waste products of the coal preparation process. To avoid the need for a tailings dam for the Project, Shenhua Watermark committed to dewatering the coarse rejects and fine tailings so that they can be safely co-disposed of within the OEA.

The amount of coal waste generated by the Project is dependent on the yield, coal quality and desired characteristics of the product coal and market.

The resulting volume of coal waste to be co-disposed of in each mining area over the life of mine is presented below in Table 3-2.

Table 3-2 Coal waste volumes

Mining area	Coal waste volume (Mbcm^3)
Eastern Mining Area	41
Southern Mining Area	17
Western Mining Area	13

It should be noted that as coal processing technology continually develops, the yield recovery from coal processing for the Project may be increased, therefore reducing the amount of coal waste generated for co-disposal in the OEA. Shenhua Watermark will continually review such technological advances and apply them to the Project where feasible.

Overburden swell factor

As the overburden is removed from the active mining area to uncover the coal seams, the material properties are changed following excavation. One of these changes is an increase in volume from its original *in situ* volume, known as the 'swell (or bulking) factor'.

There are a range of variables affecting the amount of overburden swelling. For a greenfield project, such as the Watermark Coal Project, these are predicted using exploration data and geological modelling. Different drill patterns and blast engineering techniques including the desired fragmentation size and maximum cast, desired vibration and overpressure levels and rock strength all affect a change in the overburden swell factor. However, it is accepted practice within the NSW mining industry that the swell factor is continually reviewed and refined once mining operations commence and at which time, real-time data specific to the site is relied upon.

A 25% swell factor was assumed for the Project as part of the mine plan development. This is a conservative factor and therefore, the amount of overburden generated as presented in the EIS is considered to be a worst-case scenario.

The resulting volume of overburden generated from each mining area over the life of mine (assuming a 25% swell factor and removal of all product coal) is presented below in Table 3-3.

Table 3-3 Overburden volumes (25% swell factor)

Mining area	Overburden volume (Mbcm^3)
Eastern Mining Area	1,203
Southern Mining Area	533
Western Mining Area	389
TOTAL	**2,125**

A less conservative swell factor, more in keeping with benchmarked Hunter Valley operations, shows values in the range of 18% to 20% could be realised. If this was adopted within the current mine plan the resulting reduction in volume of overburden generated from each mining area is presented below in Table 3-4.

Table 3-4 Overburden volumes (18% & 20% swell factor)

Mining area	Overburden volume (Mbcm^3)	
	18% swell factor	20% swell factor
Eastern Mining Area	1,135	1,154
Southern Mining Area	503	511
Western Mining Area	367	373
TOTAL	**2,005**	**2,038**
Difference to 25% swell factor volume	***Reduction of 120***	***Reduction of 87***

Environmental constraints

As noted in Section 2.4, the out of pit OEAs for the Project were designed to meet key environmental, social, and land constraints, including most relevantly:

- A minimum 150 m horizontal buffer to alluvial black soils and black soil plains.
- Disturbance of only land owned by Shenhua Watermark.
- No disturbance of Mt Watermark.
- No disturbance of Breeza State Forest.
- The final landform merges into the natural topography (such as Mt Watermark and Black Mountain).
- Reduced slopes of the OEA to facilitate the re-establishment of Box Gum Woodland on the mine rehabilitation and to achieve the maximum post-mining land capability classification practicable.
- Reconfiguration of the Eastern Mining Area OEA to avoid 143 ha of CEEC Box Gum Woodland.
- Early development and rehabilitation of the northern OEA in the Eastern Mining Area to assist as a visual screen from the Kamilaroi Highway.

The constraints all combined to limit the available extent of the out of pit OEAs for the Project.

Design constraints

Based on detailed geotechnical studies, the following parameters were adopted for the overburden emplacement design:

- 20 m lifts.
- 37° overall angle of repose.
- 40 m berms to allow for truck access and alternative dumping levels.
- 20 m berm every second bench for stability.

The shape and heights of the out of pit OEA were designed to merge into the surrounding topography, and were therefore designed to be undulating, natural looking landforms.

In addition, the OEAs were designed to have a maximum final rehabilitation slope of 10° to enhance the success of recreating Class III land capability and Box Gum Woodland during the mine rehabilitation process.

Progressive rehabilitation

The mine plan was designed to ensure the OEAs are progressively rehabilitated over the life of the mine as soon as practical. This staged approach will minimise the open cut mining disturbance area at any one time and reduce the environmental impacts from the open cut operations.

Conclusion

Table 3-5 summarises the outcomes of the factors and parameters outlined above which have determined the extent of the out of pit OEA for the Project.

Table 3-5 Out of Pit Overburden Emplacement Area extent

Parameter	Eastern Mining Area	Southern Mining Area	Western Mining Area
Mining area volume (Mbcm)	1,025	417	362
Coal waste volume (Mbcm)	41	17	13
Overburden volume (Mbcm) (25% swell factor)	1,203	533	389
Out of pit OEA volume required (Mbcm)*	**219**	**133**	**40**

** Calculated as the difference from the in pit mining area volume minus the coal waste and overburden volumes*

Table 3-5 demonstrates that regardless of working room and safety considerations, the in pit mining area volume, or available air space, in each mining area is not sufficient to accommodate the coal waste and overburden generated. This therefore results in the out of pit OEA extents as presented for the Project.

As discussed above, the adopted 25% swell factor is considered conservative representing a worst-case scenario as presented in the EIS. Table 3-6 and Table 3-7 below further demonstrate that regardless of the swell factor adopted, the in pit mining area volume in each mining area is not sufficient to accommodate the coal waste and overburden generated; even assuming 18% or 20% swell factors.

Table 3-6 Out of Pit Overburden Emplacement Area extent – 20% swell factor

Parameter	Eastern Mining Area	Southern Mining Area	Western Mining Area
Mining area volume (Mbcm)	1,025	417	362
Coal waste volume (Mbcm)	41	17	13
Overburden volume (Mbcm) (20% swell factor)	1,154	511	373
Out of pit OEA volume required (Mbcm)*	**170**	**111**	**24**

Table 3-7 Out of Pit Overburden Emplacement Area extent – 18% swell factor

Parameter	Eastern Mining Area	Southern Mining Area	Western Mining Area
Mining area volume (Mbcm)	1,025	417	362
Coal waste volume (Mbcm)	41	17	13
Overburden volume (Mbcm) (18% swell factor)	1,135	503	367
Out of pit OEA volume required (Mbcm)*	**151**	**103**	**18**

In conclusion, irrespective of the overburden swell factor adopted (25% or 18% to 20%), the in pit mining area volume cannot accommodate the coal waste and overburden generated by the Project. For these reasons, out of pit OEAs are required for the Project.

The out of pit OEAs have been designed to accommodate the necessary excess overburden volumes, whilst meeting mine safety parameters, environmental, social and land constraints, and also ensuring that a stable final landform merges with the natural topography whilst providing 10° slopes for enhanced rehabilitation outcomes.

It is important to reiterate that the key parameters considered in the design of out of pit OEA for the Project will be continually reviewed and refined once mining operations commence and at which time, real-time data specific to the site is relied upon. Notwithstanding this, the extent of mining and OEA disturbance as assessed in the EIS is conservative and presents a worst case scenario.

3.2.3 Why are the Out of Pit Overburden Emplacement Areas in the Eastern Mining Area to the east and south of Mt Watermark both required?

As described above in Section 3.1.1, the limited extent of available in pit mining area within the Eastern Mining Area for mine waste disposal means that there is insufficient room in the pit to backfill overburden and maintain safe and efficient working room. For this reason, the overburden generated from the Eastern Mining Area is placed within an out of pit OEA until Year 11 upon which time sufficient room would become available in the in pit mining area to accommodate backfilling.

The out of pit OEA were designed to accommodate the necessary overburden volume whilst meeting specific environmental, social and land constraints, including minimising impacts to EEC and land conforming to Class II land capability, incorporating a maximum rehabilitation slope of 10° and ensuring the landform merges within the surrounding topography (such as Mt Watermark or Black Mountain).

As noted above, the mine plan for the Project is designed to extract two key coal seams, being the Hoskissons and Melville seams. This means there are two different mining levels, each associated with a respective coal seam. Subsequently, the large 292 tonne dump trucks removing the overburden to uncover the coal seams are travelling from deep within the pit (from the Melville seam) and also from the middle of the pit (from the shallower Hoskissons seam).

Safety considerations in haul ramp design from the pit floor have necessitated that trucks removing overburden from the deeper Melville seam are directed to emplace the overburden on the out of pit OEA to the south of Mt Watermark, as it is a closer out of pit OEA. Similarly, the trucks removing overburden from the shallower Hoskissons seam are directed to emplace the overburden on the out of pit OEA to the east of Mt Watermark. This is to ensure that each overburden fleet is travelling up and down a minimum number of high grade ramps, thereby reducing haul lengths but most importantly, minimising safety issues associated with slippage and truck accidents.

Secondly, approximately 219 Mbcm of overburden is required to be emplaced within the out of pit OEA until backfilling of the Eastern Mining Area can commence (as specified above in Section 3.1.1). Therefore, in order to ensure the out of pit OEA merges with the surrounding topography and provides a maximum rehabilitation slope of 10°, the two out of pit OEA to the east and south of Mt Watermark are required to accommodate the excess overburden.

For example, if all overburden required for emplacement within out of pit OEA from the Eastern Mining Area was directed solely to the out of pit OEA to the east of Mt Watermark (whilst maintaining the current out of pit OEA footprint), the overall height of the out of pit OEA would increase by approximately 80 m. In turn, the out of pit OEA would not merge with the existing topography and would be a considerable visual intrusion to the surrounding landscape. This scenario would also create significant safety issues associated with the overall overburden truck haul length and exposure to additional high grade ramps.

Conversely, in order for the out of pit OEA to merge with the surrounding topography and provide a maximum rehabilitation slope of 10°, the footprint of the OEA would need to be significantly extended thereby interacting with the blacksoil plains, CEEC and Class II agricultural land which have been identified as key constraints to be avoided in the design of the mine plan for the Project.

3.2.4 Why is overburden emplacement concurrently required in the Eastern Mining Area, Southern Mining Area and Western Mining Area in Year 25?

As described above in Section 3.1.1, a significant amount of overburden is generated in the Mining Areas due to geological swell conditions and the depth of coal resources. For these reasons, whilst overburden from the Southern Mining Area is being placed within the Eastern Mining Area to complete backfilling, excess overburden generated is concurrently placed within an out of pit OEA adjacent to the Southern Mining Area. Similarly, whilst the Western Mining Area is being placed within the Southern Mining Area to complete backfilling, excess overburden generated is concurrently placed within an out of pit OEA adjacent to the Western Mining Area. This is primarily required because as the mining areas are progressively backfilled, the available safe working room exponentially decreases and therefore the overburden cannot be emplaced quickly enough to match that generated in the active mining areas. In addition, safe benching, lift heights and compaction are critical throughout the backfilling process to ensure a stable final landform which also limits the rate at which the overburden can be emplaced to match that being generated in the active mining areas.

Furthermore, a key mine plan design constraint was to ensure the final landform merges with the surrounding topography and provides a maximum rehabilitation slope of 10°. Once again, this dictates the design (i.e. shape, height and extent) of overburden emplacement particularly in the Southern and Western Mining Areas. Even if the working room requirements outlined above were not considered, the total volume of overburden to be placed within the mining areas would exceed the available in pit mining area. This would result in a landform that did not meet the rehabilitation slope constraints and would not merge with the surrounding topography. It should also be noted that the out of pit OEA for the Southern Mining Area is located to the north of the mining area so as to avoid any overburden emplacement to the south adjacent to the blacksoil plains.

However, it is important to reiterate that this scenario is proposed to occur between Year 17 and 25 into the development of the Project. As mining commences, the extent and sequencing of the out of pit OEA will be continually reviewed and refined through the Mining Rehabilitation and Environmental Management Plan (MREMP – formerly termed Mining Operations Plan) process to minimise environmental impacts as site specific swell factors are developed.

4. Final landform

4.1 PAC concerns

Page 26 Paragraph 1 "The applicant has not provided any clear explanation or justification of the final landform across the site."

Page 26 Paragraph 2 "The visual assessment does not give any indication or consideration to how the landform will fit with the existing landscape on site..."

Page 26, Paragraph 1 "The plans available to the Commission show contour lines without heights markings, in some places these are so closely spaced it is virtually impossible to tell the direction of the slope."

Page 26, Paragraph 1 "Little, if any, consideration appears to have been given to how the landform might fit within the landscape, both onsite or further afield."

Page 26 Paragraph 3 "The commission considers that there may be some scope to reduce the impact of the mine plan and final landform, although it is difficult to tell given the lack of clear, detailed contours and landform plans. From the plans available to the Commission it appears that the out of pit emplacement, which would intrude into vegetated areas to the north of Mount Watermark, may be able to be rationalised or refined to reduce this intrusion. With relocation of the haul road it may also be possible to improve the final landform to the south of Mount Watermark. These options need to be explored."

Page 26 Paragraph 4 "Nonetheless relatively little information is available on how or why the general landform is designed in its current form and placement of overburden from the commencement of mining will have long term implications for the final landform"

Page 27, Paragraph 1 "The Commission recommends that some more detailed consideration of the options to improve the final landform and minimise out of pit disturbance associated with the eastern pit must be considered prior to determination of the application."

Interpretation of concerns

The commission requires clear definition of the final landform as proposed by the Shenhua Watermark with a focus on the earliest mine sections being the eastern pit. Consideration of the future pits being the southern and western pits is to be considered as the mine develops however with sufficient time to address prior to any commencement of works in these areas.

4.2 Response to concerns

The final landform design for the Project is primarily dictated by the extent of the mining area (considering geological and geotechnical requirements) and the volume of overburden generated, as described above in Section 3.1.2. Notwithstanding this, a key component of the final landform design for the Project has been ensuring that the final landform is designed to a maximum 10° slope.

This represents relatively gentle slopes compared to the majority of mines within NSW and QLD and allows for the potential establishment of Box Gum Woodland EEC, koala habitat and land capability Class III on the rehabilitated landform. Furthermore these relatively gentle slopes will contain slope lengths and suitable soil depth designed to minimise erosion risk and ensure the land meets criteria for land capability Class III.

Shenhua Watermark will maximise opportunities for a post-mining landscape that is generally consistent with pre-mining land use biodiversity. All mine areas will be rehabilitated except for the final void which will be shaped appropriately. A conceptual final landform is shown on Figure 4.1.

Approximately 3,233 ha of class III land will be reinstated as part of the final landform, of which approximately 1,000 ha will be dedicated for agriculture in order to maintain the high value production of the area. The indicative areas to be reserved for agricultural purposes and native revegetation are shown on Figure 4.1.

A slope analysis of the conceptual final landform is presented in Figure 4.2 further demonstrating the maximum 10° slopes incorporated in the design.

Prior to the re-establishment of vegetation cover, temporary control measures will be utilised for erosion and sediment control, including sediment fences, sand bag sediment traps and rip rap scour protection. Surface water management structures, such as contour banks and drains, will also be progressively installed on the conceptual final landform as shown in Figure 4.1 in a manner which minimises erosion and stability issues and safely disposes of surface water runoff down slope.

In particular, as shown on Figure 4.1, a clean water diversion drain is established at the commencement of mining to divert runoff from the north and east of Mt Watermark, away from the mining area, to the south between the two out of pit OEA and then offsite. This is a key drainage feature which is to be maintained throughout the life of the Project (over 30 years) and is retained as part of the post-mining landform. For this reason, backfilling of haul route and drainage line upon completion of the Eastern Mining Area is not proposed.

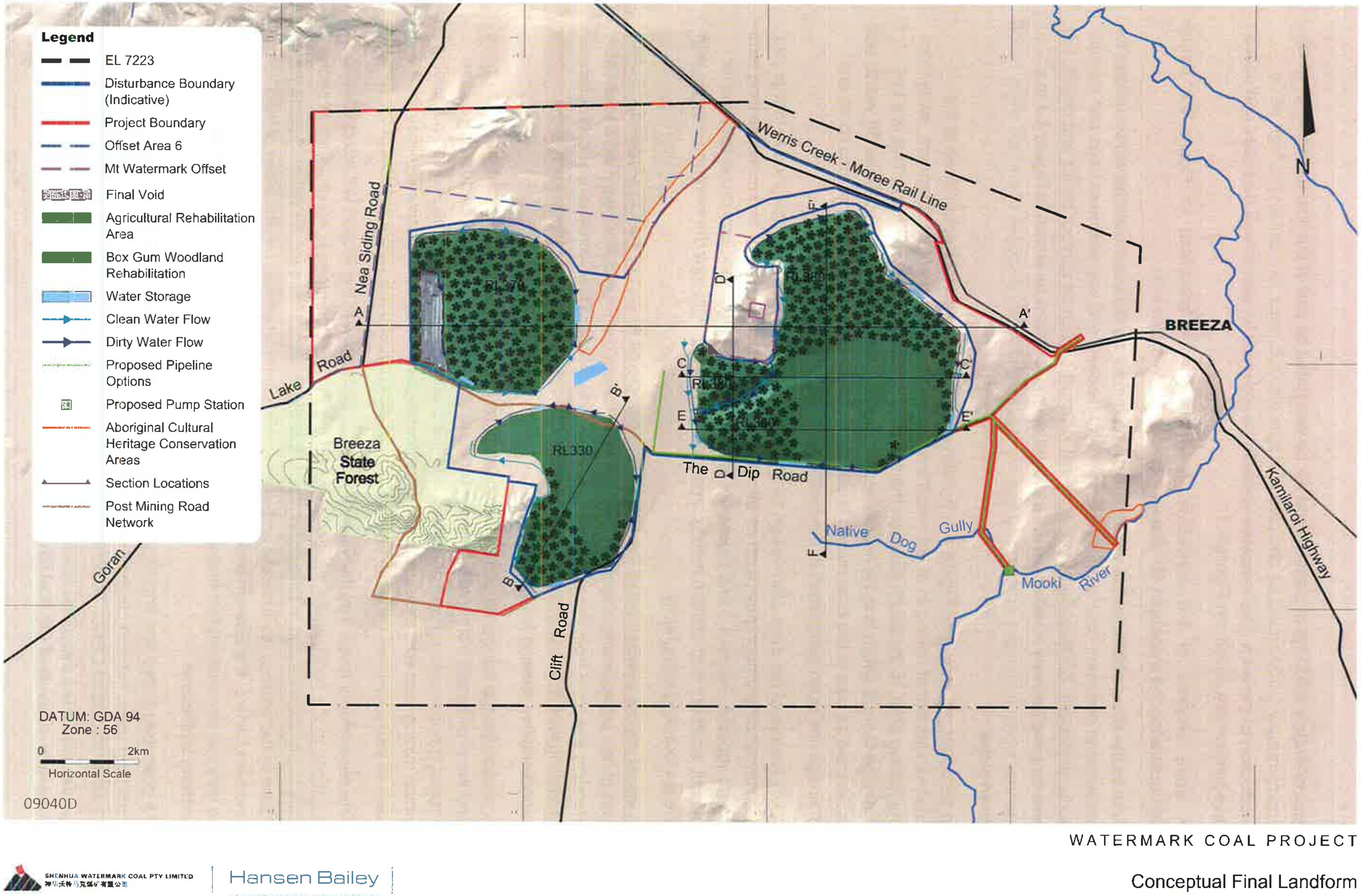
A key feature of the mine plan design for the Project is that it has been designed to merge into the surrounding topography (such as Mt watermark or Black Mountain) and minimise long term visual impacts. Figure 4.3 and Figure 4.4 provide indicative final landform cross sections for overall, southern and eastern mining areas and further highlight how the landform merges with the surrounding topography.

A visual impact assessment of the Project was completed as part of the EIS (Appendix J). As part of this assessment, photographs of the view toward the Project Boundary were taken at standing eye level from the representative viewing locations. Three-dimensional computer modelling was then used to generate a conceptual view of the Project from each of the representative viewing locations.

A photomontage brings the computer model of the Project as seen from a particular view point and the photograph from that view point together (photomontage). A conceptual view of the Project (photomontage) was generated with the proposed landform of the Project, depending on which mining year was assessed. The photomontages were used to accurately illustrate the level of visual contrast between the existing environment and the visible aspects of the Project.

The assessment found that the visual impacts associated with the Project will affect viewing locations to the north, south, east and west of the Project Boundary; however, such impacts vary in significance and in time during the life of the Project. However, all visual impacts were found to be reduced to moderate and low following completion and rehabilitation of the OEA and backfilling of the Eastern and Southern Mining Areas. These impacts will further be reduced to very low as rehabilitation matures. By Year 30, the final landform will be integrated within the existing landscape.

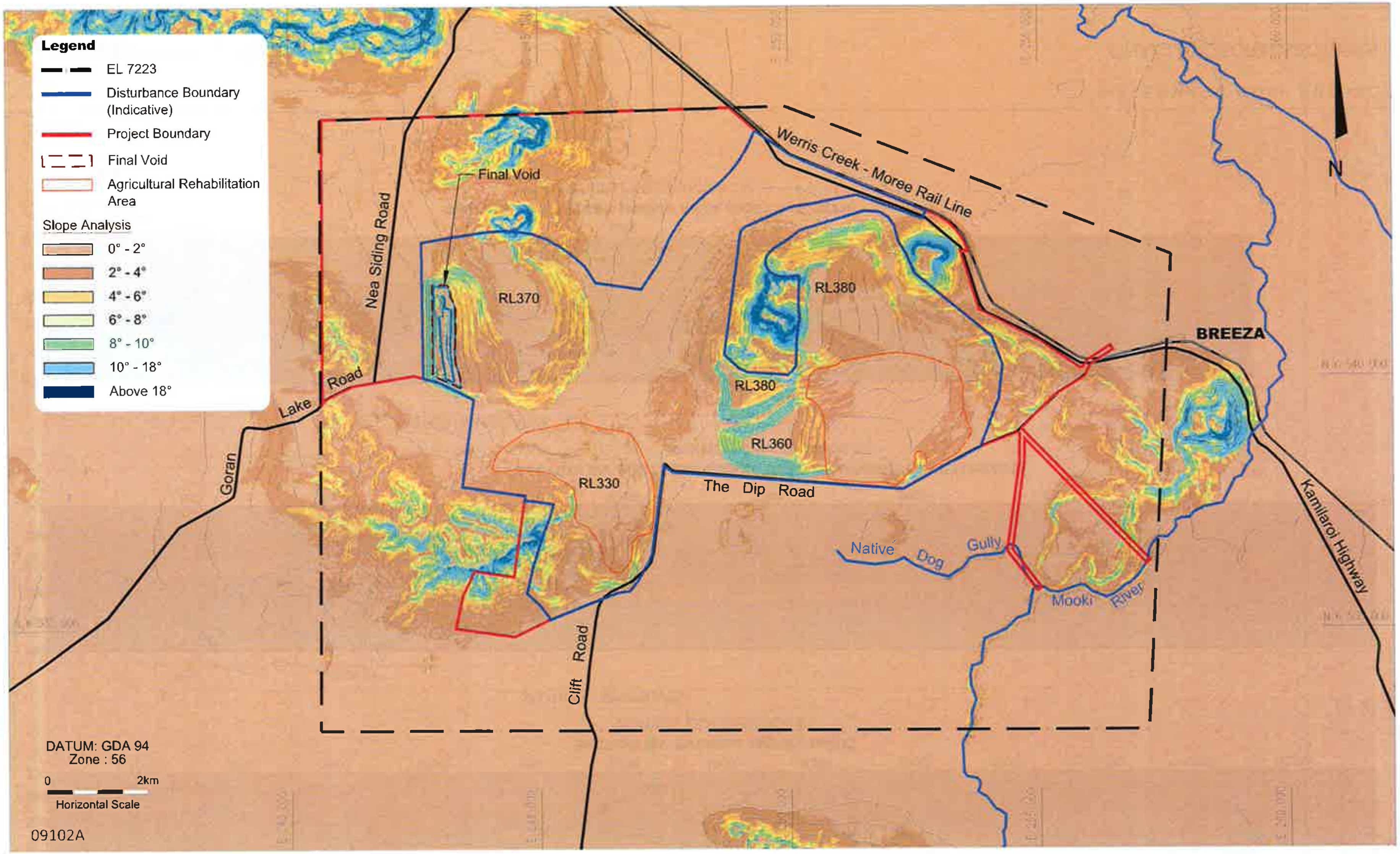
As described above, the final landform for the Project has been designed to support productive final land uses, including agriculture and native woodland and grassland, including White Box Grassy Woodland CEEC. To achieve this, the landform is designed to be stable, undulating with gentle slopes (as described above) and self-draining. These factors are critical in ensuring the long-term success of the final landform and adopted land uses.



WATERMARK COAL PROJECT

Conceptual Final Landform

FIGURE 4.1



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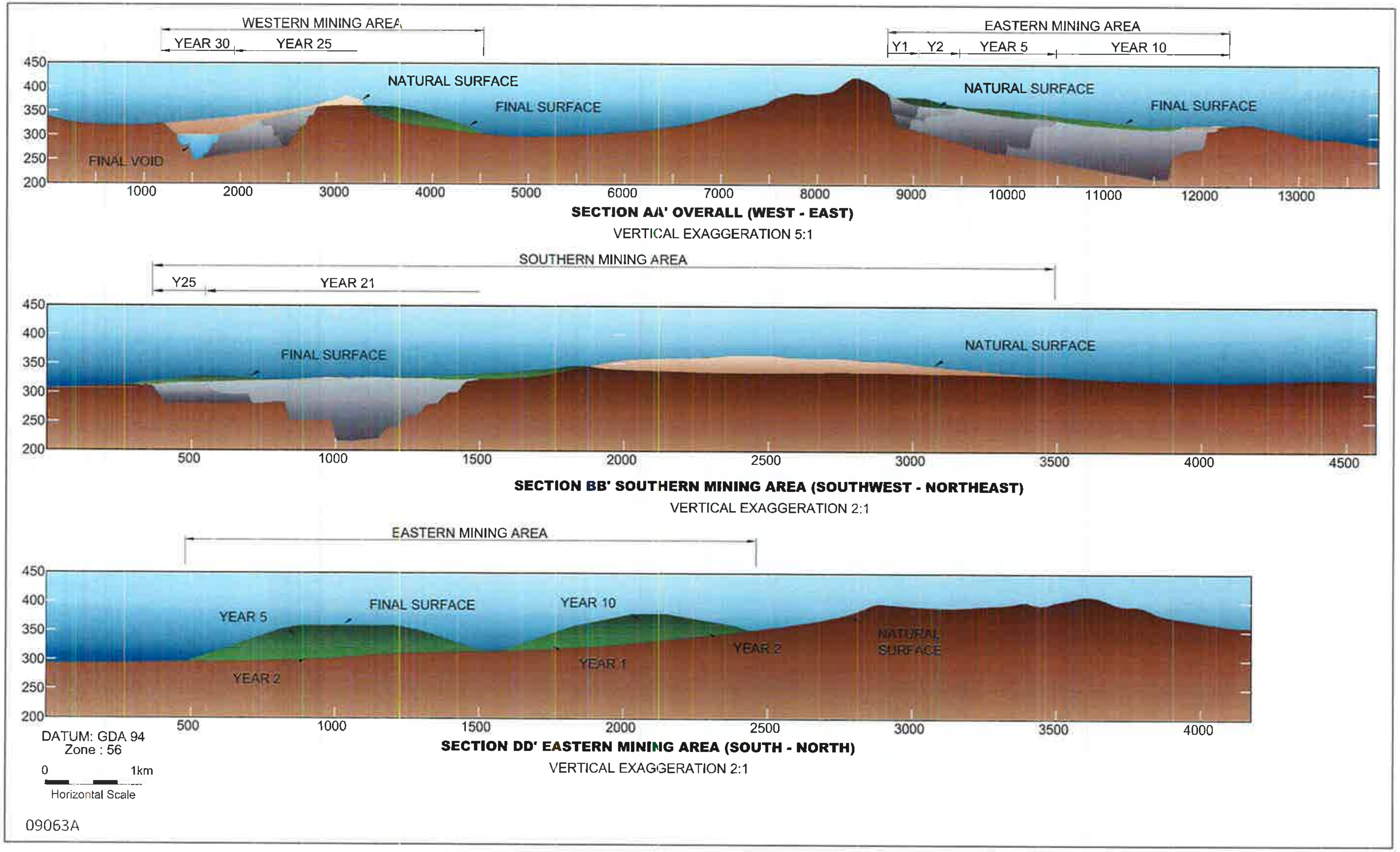
Conceptual Final Landform Slope Analysis

FIGURE 4.2



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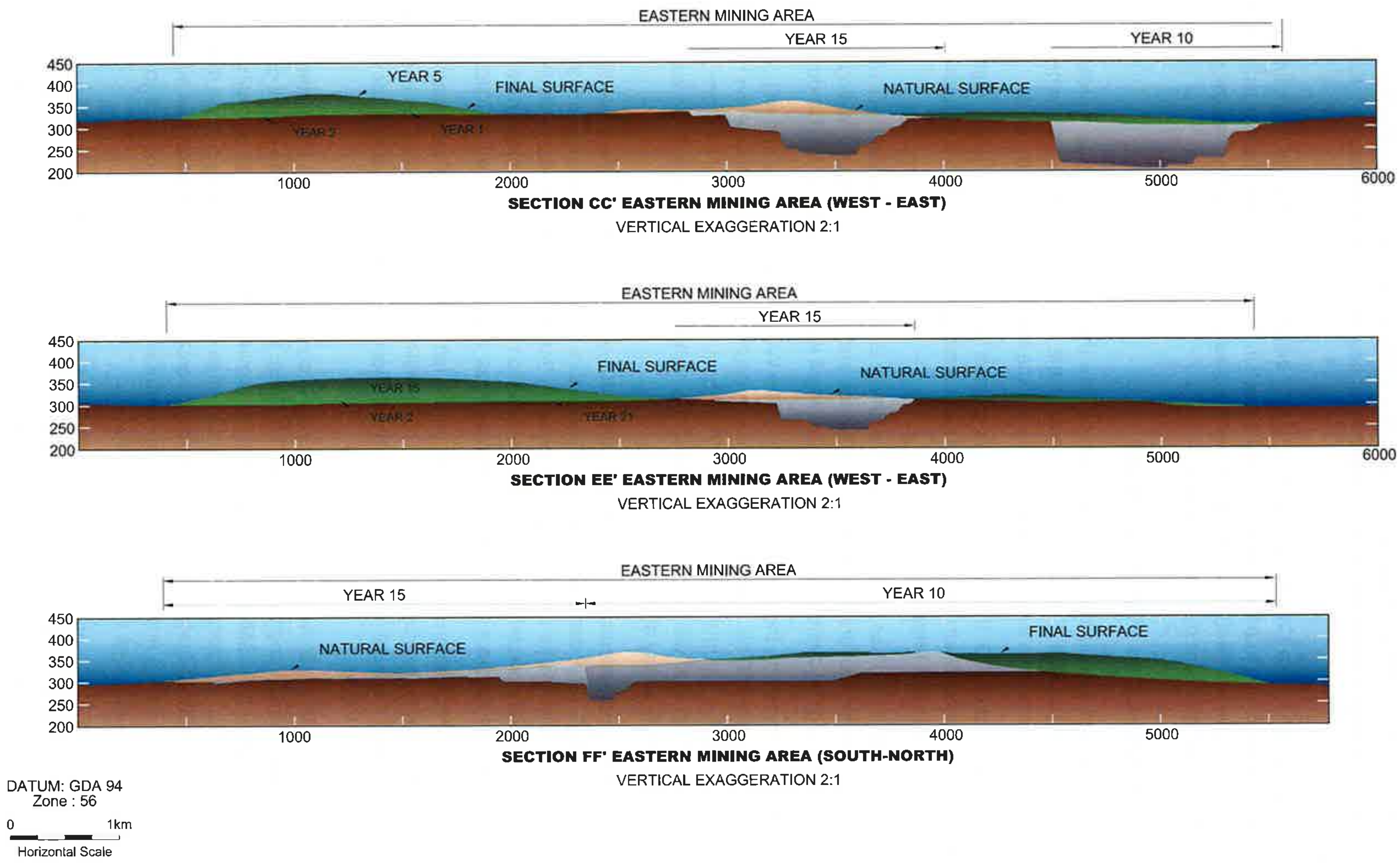
FINAL LANDFORM SECTIONS 1

FIGURE 4.3



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FINAL LANDFORM SECTIONS 2

FIGURE 4.4

5. Final void

5.1 PAC concerns

Page 27 Paragraph 1 "The Committee considers that voids are a long term environmental legacy and backfilling of voids and pit lakes represents best environmental practice" (IESC, 2013)."

Page 27 Paragraph 3 "The Commission acknowledges that in this instance the applicant has made some concessions to ensure that no voids are left in the eastern and southern mining pits. There may be further scope to refine the design of the western pit to minimise the size and impact of the final void over the next 20 years…"

5.2 Response to PAC Concerns

Shenhua Watermark appreciates the Commission's view that backfilling of voids represents best environmental practice. For this reason, considerable effort and forethought has been invested in the mine plan to avoid, wherever possible, the creation of final mine voids.

As discussed in Section 2.3, the two largest voids created by mining process in the Eastern Mining Area and the Southern Mining Area have been strategically located so that both can be completely backfilled and rehabilitated.

A third much smaller void has been engineered so that it is remote from the black soil plains and valuable groundwater aquifers. It is strategically placed such that if underground mining is entertained following the completion of open cut mining it will provide access for this purpose.

This void will be located on the western extremity of the Western Mining Area and will cover an area of approximately 100 ha. It will have a maximum depth of around 80 m below the natural ground surface, with a volume of approximately 76 M bcm. As part of the final landform, it is planned that the final void will have the majority of the highwall blasted back and low wall graded to improve its safety and stability.

There are deeper coal resources present beyond the 30 year mining limit of the Project. Shenhua Watermark may, depending upon market factors and resource confirmation, seek further relevant approvals for the extraction of these. In this instance, the Western Mining Area final void will be ideally placed for underground access to this coal resource. Nonetheless, two approaches for the treatment of the Western Mining Area void were considered as follows:

- Option 1 – The Western Mining Area final void is left partly backfilled. Partial backfilling and rehabilitation represents a total cost of $42 Million, in conjunction with the use of 50% of the Project's annual mining capacity of the Project for an additional extra year of dozing and ancillary works.
- Option 2 – The Western Mining Area final void is completely backfilled. Estimated costs to completely backfill and rehabilitate a total 76 Mbcm final void represents a total cost of approximately $461 Million. This total includes provision for $438 Million operating cost and $23 Million in capital cost. This option assumes the removal of overburden material from existing rehabilitated OEAs. One hundred percent of the Project's annual mining capacity and dozing and ancillary works will be utilised for more than one year to complete the activities required under Option 2.

In recognition of the further potential coal resources and the ability of the Western Mining Area void highwall to provide access to these resources, the cost / benefit analysis found that the retention of a safe and stable final void in the Western Mining Area (Option 1) was the most appropriate outcome.

6. Rehabilitation strategy

6.1 PAC concerns

Page 27 Paragraph 1 "Rehabilitation is proposed to occur progressively across the site as mining and dumping activities are concluded in each area. It is not possible to confirm whether this will be undertaken in the most sensible and efficient way possible as plans for the various stages are limited to broad whole of site diagrams, which only show the mining (and rehabilitation) progress at approximate 5 year intervals."

Page 27 Paragraph 1 "Even with these limited drawings some details suggest that there may be ways to improve the dumping patterns to allow rehabilitation of some areas to commence earlier than currently proposed. To give one example of this, it is not clear why overburden dumping commences on the northern of the two Dip Road dumps and then moves to the southern dump, before the first dump is completed and able to be rehabilitated."

Page 28 Paragraph 1 "While the Commission acknowledges that this is a fairly small area of the overall mine site and there may be a reason why the dumping must alternative across both sides of the haul road, these are not immediately apparent to the Commission."

Page 28 Paragraph 1 "It will be important to minimise the disturbance outside the pit boundaries and to ensure that rehabilitation is progressed in a timely and efficient manner."

Page 28 Paragraph 2 "The Commission considers that a more detailed strategy will need to be developed to demonstrate that disturbance areas have been minimised and to ensure that rehabilitation meets best practice standards."

Page 29 Paragraph 2 "The Commission considers that it would be preferable to commence trials for rehabilitation to an agricultural land use earlier in the life of this first pit, so that this early experience can inform and adaptive rehabilitation and program."

6.2 Response to PAC Concerns

A key criterion for the mine plan design for the Project was to ensure the OEAs are progressively rehabilitated over the life of the mine as soon as practical. This staged approach will minimise the open cut mining disturbance area at any one time and reduce the environmental impacts from the open cut operations. This is a key commitment and one which drive the air quality predictions of the Project.

The conceptual mine plan layout figures (see Figure 2.1 to Figure 2.8) demonstrate the general progression of rehabilitation activities across the mine life. In accordance with the draft development consent, detailed annual rehabilitation plans will be provided in MREMP. These annual rehabilitation plans will be developed in accordance with the overlying principles as outlined within the EIS for the Project, with an understanding of real data obtained during the various years of mining operations.

Notwithstanding this, Shenhua Watermark acknowledge that a more detailed strategy is required to be developed to demonstrate that disturbance areas have been minimised and to ensure that rehabilitation meets best practice standards. In this regard, Shenhua Watermark has commenced the preparation of a draft Rehabilitation Management Plan for the Project. Although the plan is still in a draft form, it outlines in detail the rehabilitation strategies which meet best practice standards and mining the disturbance areas for the Project.

7. Recommendations

7.1 PAC concerns

Page 30 Paragraph 1 Point 18. "The Commission recommends that further details of the activities associated with mining the eastern pit should be required. In particular, further detail of the dumping patterns, landform and rehabilitation are needed to demonstrate that out of pit disturbance would be minimised;…"

7.2 Response to PAC Concerns

This report has described in detail the need for out of pit OEAs for the Project and the dumping patterns, landform design and rehabilitation which contribute to the overall final landform design.

The out of pit OEAs have been designed to accommodate the necessary excess overburden volumes, whilst meeting mine safety parameters, environmental and land constraints and ensuring a stable final landform is developed which merges with the natural topography and provides a maximum 10° slopes for enhanced rehabilitation outcomes.

It is important to reiterate that the key parameters considered in the design of out of pit OEA for the Project will be continually reviewed and refined once mining operations commence and at which time, real-time swell data specific to the site is relied upon. Notwithstanding this, the extent of mining and OEA disturbance as assessed in the EIS is conservative and presents a worst case scenario.

8. Conclusion

Page 31 Paragraph 3 Point 19. "In relation to the mine plan, landform and land use, the plans would need to demonstrate that:

- *Best practice mine planning has been implemented to minimise the impacts of the project, including avoiding out of pit emplacement.*
- *The landform would meet best practice standards.*
- *The rehabilitation strategy and land use goals are consistent with best practice and build on the experience both on this mine and at other mines in the region."*

This report has confirmed that best practice mine planning has been implemented for the Project (and thus, assessed in the EIS) to minimise all impacts including avoiding out of pit OEA where possible. The key issue is that the mining area volume cannot accommodate the coal waste and overburden generated by the Project whilst providing safe and stable areas for the progression of mining operations. For these reasons, out of pit OEAs are required for the Project.

As described above, the final landform for the Project is primarily dictated by the extent of the mining area (considering geological and geotechnical requirements) and the volume of overburden generated. Notwithstanding this, a key component of the final landform design for the Project has been ensuring that the final landform is designed to a maximum 10° slope.

This represents relatively gentle slopes compared to the majority of mines within NSW and QLD and allows for the potential establishment of Box Gum Woodland EEC, koala habitat and land capability Class III on the rehabilitated landform. Furthermore these relatively gentle slopes will contain slope lengths and suitable soil depth designed to minimise erosion risk and ensure the land meets criteria for land capability Class III.

In conclusion, the final landform design, rehabilitation strategy and adopted land use goals are consistent with best practice and build on the experience both on this mine and at other mines in the region.

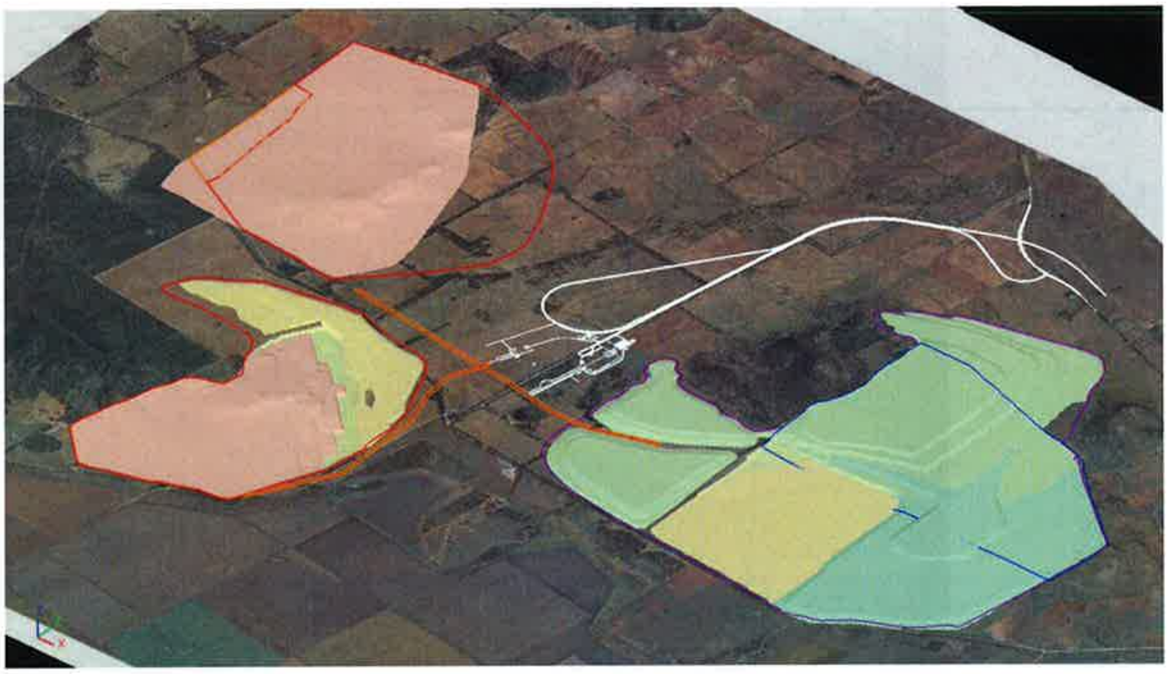
Appendices

Appendix A – Mine Plan model snapshots

Year 16

Year 16-17

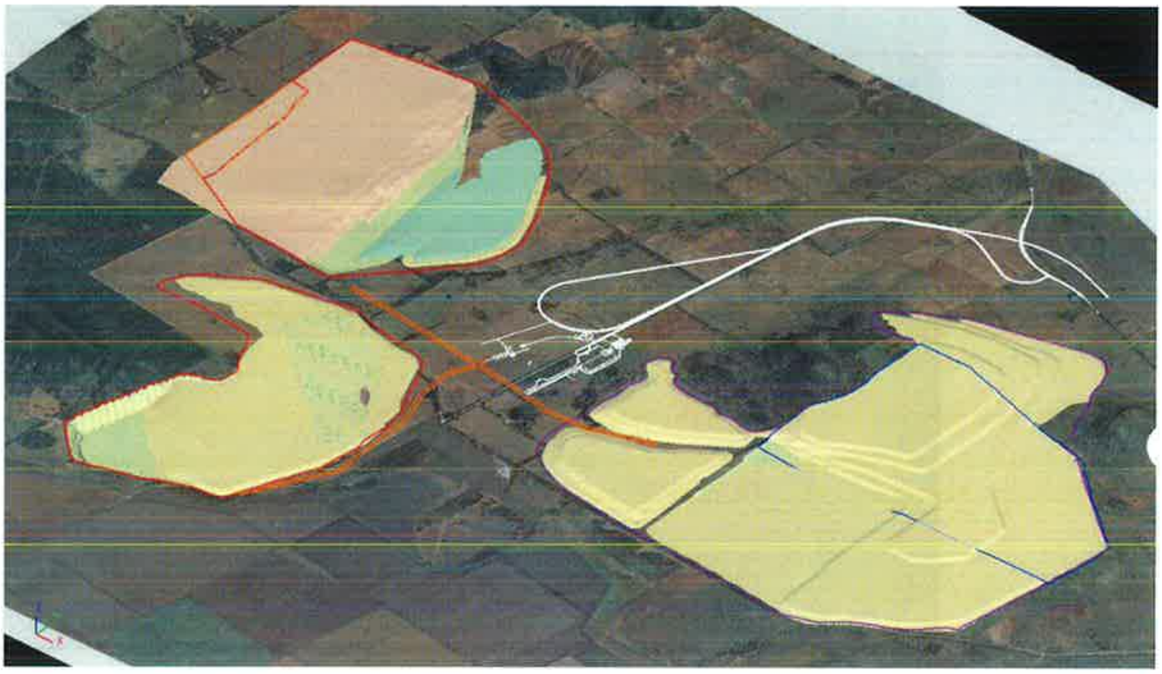
Year 17-18



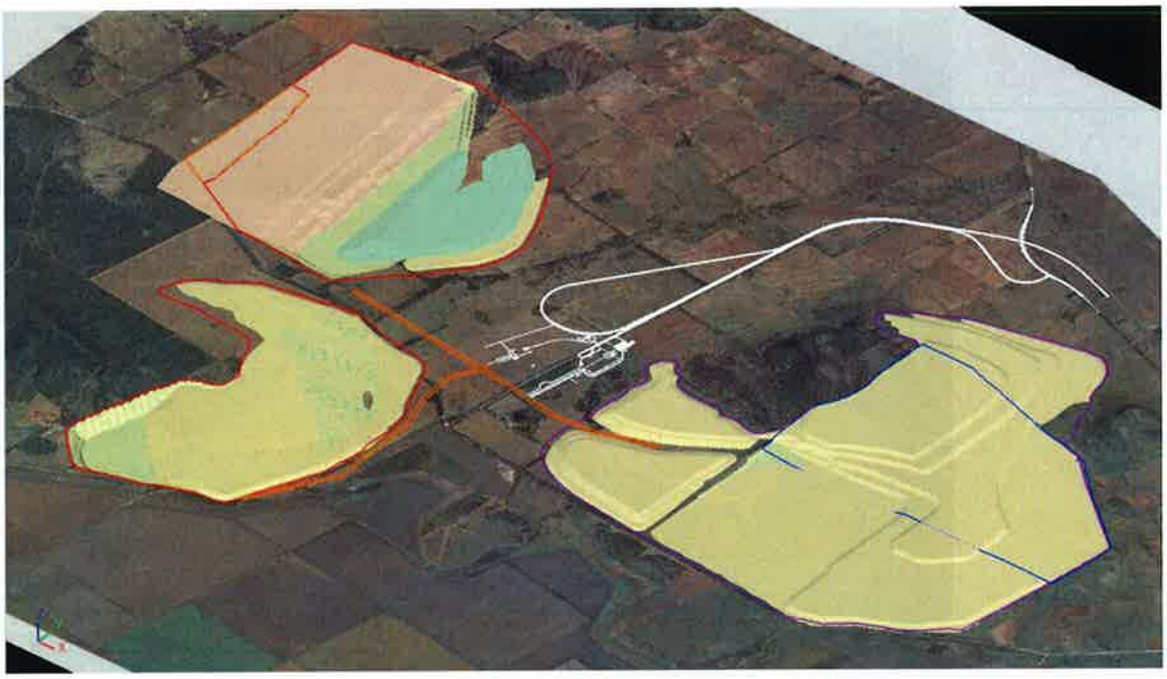
Year 18-19

Year 21-22

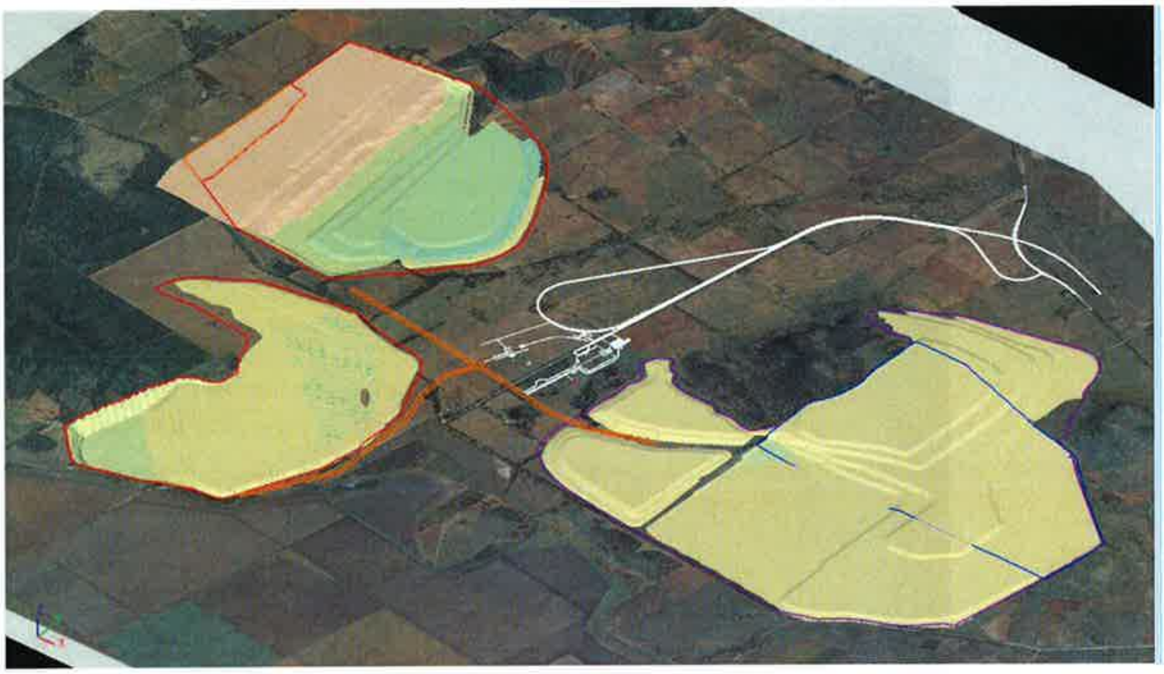
Year 22-23



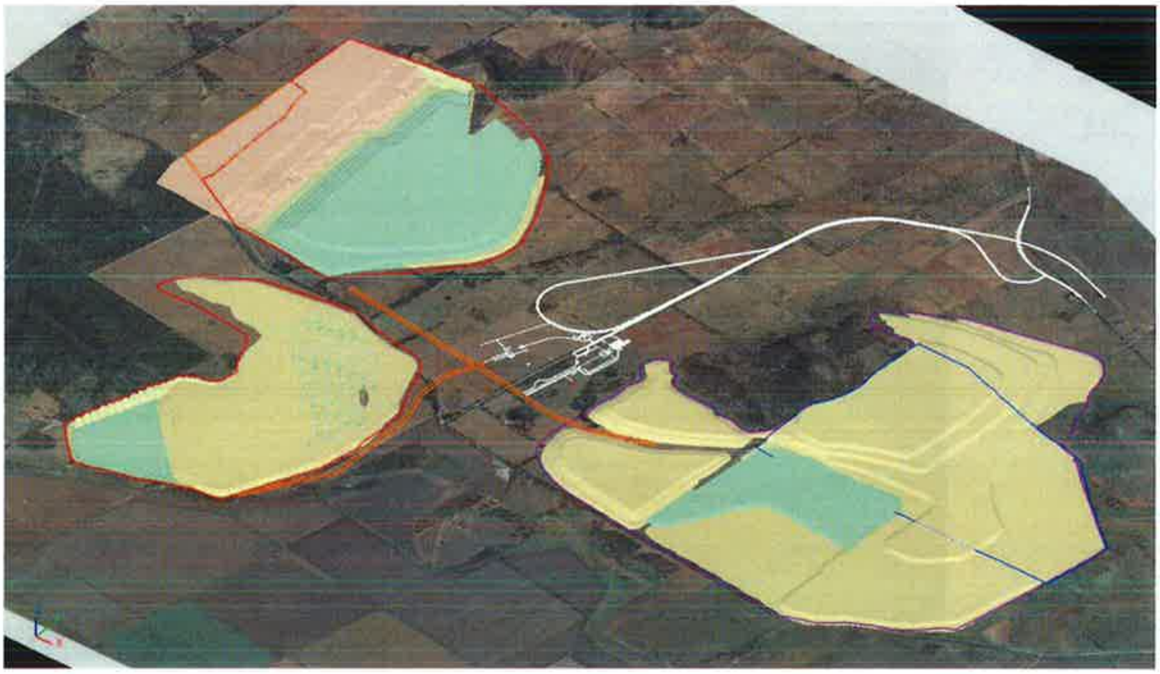
Year 23-24



Year 24-25



Year 26



Year 30

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