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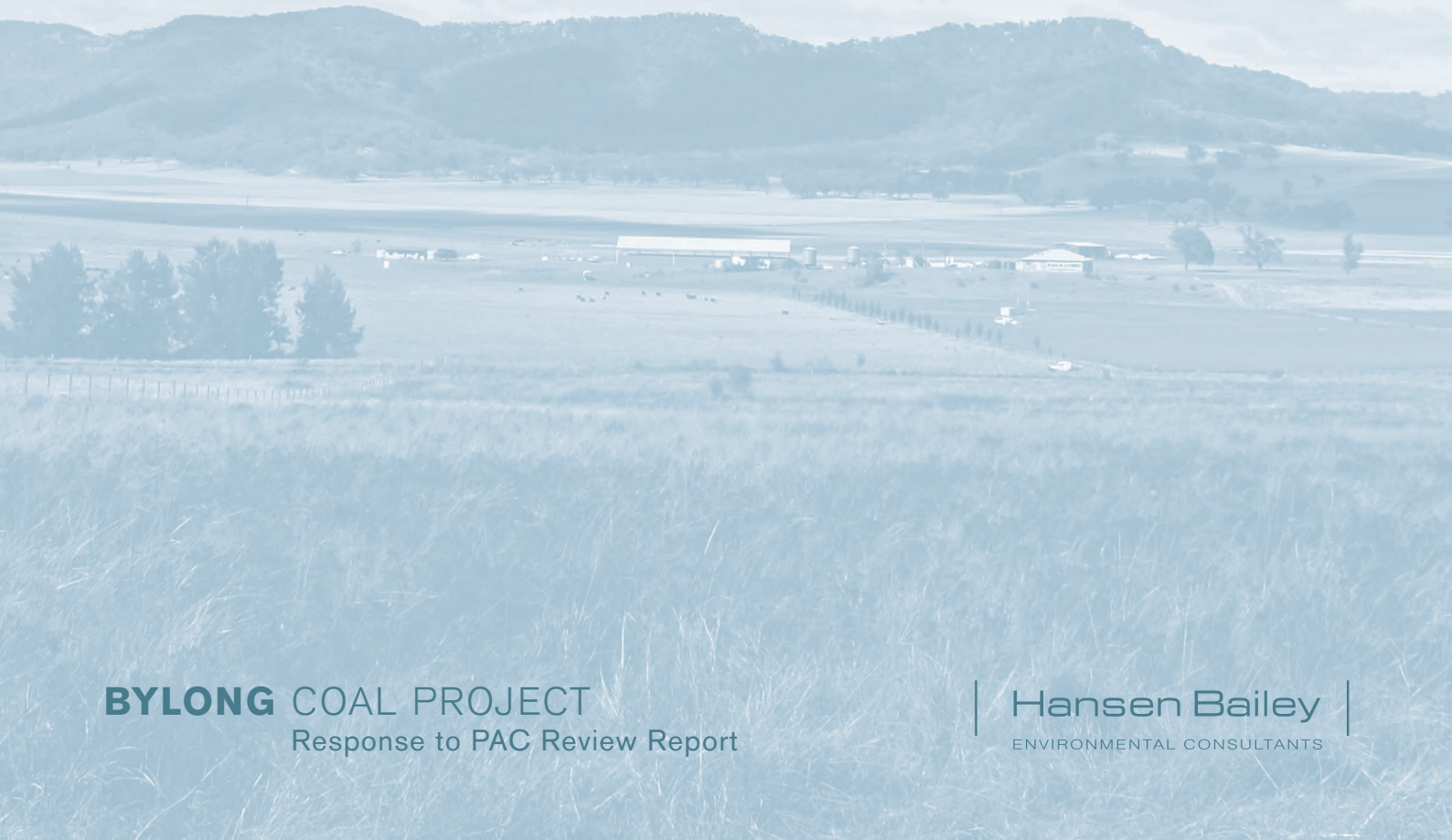
Letter to DPI-Water



BYLONG COAL PROJECT
Response to PAC Review Report

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

17 January 2018

Groundwater Project Manager
NSW DPI-Water
PO Box 340
GOSFORD NSW 2250

Attention: Mr John Williams

Bylong Coal Project Response to PAC Review Report
NSW Department of Primary Industries – Water Issues

1. INTRODUCTION

The '*Bylong Coal Project Environmental Impact Statement*' (EIS) which supported Development Application (SSD) 14_6367 for the Bylong Coal Project (the Project) was placed on public exhibition between 23 September and 6 November 2015.

The *Bylong Coal Project Environmental Impact Statement* (EIS) (Hansen Bailey, 2015) was prepared in accordance with the Secretary's Environmental Assessment Requirements, deemed adequate for public exhibition and was subsequently placed on public exhibition between 23 September 2015 and 6 November 2015. KEPCO lodged the *Bylong Coal Project Response to Submissions* (RTS) (Hansen Bailey, 2016a) in March 2016 which responded to the various stakeholder submissions received in relation to the EIS. The *Bylong Coal Project Supplementary Response to Submissions* (Supplementary RTS) (Hansen Bailey, 2016b) was provided to respond to supplementary submissions received from stakeholders on the RTS. Appendix J of the Supplementary RTS provided a letter dated 17 August 2017 which responded to matters raised by the Department of Primary Industries - Water (DPI-Water) in correspondence dated 12 May 2016. DPI-Water requested further detailed information on the Supplementary RTS groundwater modelling on 13 September 2016. KEPCO provided DPI-Water with the additional requested information from the groundwater modelling on 30 September 2016.

DP&E has provided to the proponent a further submission from DPI (including DPI-Water's comments) dated 7 November 2016 outlining final comments on the Project. KEPCO responded to DPI-Water's comments for DP&E's consideration in correspondence dated 22 November 2016. KEPCO's response letter is provided in **Appendix A** of this letter.

The Department of Planning and Environment's (DP&E's) assessment of the Project ultimately culminated in an Assessment Report, released in March 2017 stating that:

> *"… the Department considers that the Project achieves a reasonable balance between recovering the coal resource and avoiding, minimising and/or offsetting adverse social, amenity and environmental impacts."*

On 9 January 2017, the then Minister for Planning requested that the NSW Planning and Assessment Commission (PAC) conduct a Review of the Project. Despite the regulatory arm of Local and State Government supporting the Project, the PAC found in its Review Report (PAC Review Report) that:

> *"….doubts persist about the potential benefits and impacts of this project, despite the extensive research and peer assessment."*

This letter has been prepared to respond to the matters relevant to DPI-Water which were raised within the PAC Review Report and subsequently discussed at our meeting on 7 November 2017.

2. RESPONSES TO DPI-WATER COMMENTS

2.1 ACCOUNTING FOR LOSS OF ALLUVIAL SURFACE FLOWS

The PAC Review Report raised uncertainties around the potential impacts to alluvium and that surface water losses from the alluvium may not have been correctly accounted for. On this issue, the PAC Review Report notes *"…for example, that loss of surface flow to the alluvium (induced by aquifer pumping) would peak in year nine of the mine's operation, and in the 99th percentile scenario, could amount to 2.7 megalitres per day (i.e. 986 megalitres per year). The applicant's water shares in the alluvial resource would need to account for this additional loss."*

This matter was responded to in KEPCO's response to DPI-Water's concerns as reproduced in **Appendix A**.

The Supplementary RTS for the Project included updated hydraulic properties determined from the alluvial pump testing program to provide further certainty over the potential impacts on the alluvial water resources on privately owned property surrounding the Project. The Supplementary RTS modelling predicted that up to 1,835 ML of water will be taken from the Bylong River Water Source under the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* (Hunter Unregulated and Alluvial WSP). This volume includes takes from both the surface water and alluvial groundwater sources. It is noted that this predicted water take includes the agricultural pumping of 714 ML from KEPCO's bores for use within its agricultural operations which are not Project related.

From our meeting of 7 November 2017, it is understood that that the alluvial and surface water form part of the same water source (i.e. Bylong River Water Source) and that the approach taken within the Supplementary RTS (and subsidiary responses to this mater) to quantify the breakdown between the alluvial water take versus the surface water take was appropriate so as to avoid the potential double accounting of water take from the same water source.

2.2 COMPENSATORY WATER SUPPLY

The Supplementary RTS also included further investigation to confirm whether there was the potential for the Project to result in adverse impacts on concerned neighbouring private landholder bores. The modelling and associated uncertainty analyses confirmed that it was improbable that the Project would adversely impact neighbouring private landholder bores. This finding was verified even under the extremes of drought and low permeability / storages within the aquifers combined to maximise the predicted drawdown within the alluvial aquifer.

Notwithstanding, KEPCO has proactively offered to compensate for any unforeseen impacts in the unlikely event that the water supplies of a neighbouring private landholder are adversely affected by the Project by way of a Compensatory Water Supply Agreement. Procedures for triggering an investigation into whether the Project has potentially resulted in adverse impacts on the water supplies of private landholders will be included in the Water Management Plan prepared for the Project.

2.3 WATER LICENCE ALLOCATIONS

The PAC Review Report also questioned whether Permian water licence allocations would be available for the peak groundwater inflows predicted for the Project.

Under Schedule 4, Conditions 25 and 26 of the Recommended Development Consent from DP&E, KEPCO would be required to demonstrate to DP&E that it has sufficient water access licences available for the maximum predicted volume of water to be used to support each stage of the Project's mining operations.

The Supplementary RTS modelling predicted that up to 1,835 ML of water will be taken from the Bylong River Water Source under the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* (Hunter Unregulated and Alluvial WSP). This includes takes from both the surface water and alluvial groundwater sources. It is noted that this predicted water take includes the agricultural pumping of 714 ML from KEPCO's bores for use within its agricultural operations which are not Project related.

KEPCO currently holds 3,045 units of water allocations under the Hunter Unregulated and Alluvial WSP, including those from the latest purchases of land with the potential to be impacted by the Project. This entitlement provides a substantial allocation in addition to the water licensing requirements for the Project under this Water Sharing Plan.

KEPCO currently holds a licence for 411 units and has previously applied for a water licence for 2,093 units under the *Water Act 1912* to extract groundwater from the Permian strata for the Project from the Sydney Basin – North Coast Groundwater Source (North Coast groundwater source) under the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016* (North Coast WSP). In accordance with the groundwater inflows predicted for the Project within the Supplementary RTS (i.e. 4,099 ML in Project Year 23), KEPCO is required to secure an additional 1,596 units of water allocation from the North Coast Groundwater Source prior to Project Year 23.

From our meeting held on 7 November 2017, it is understood that the water allocations under this water source will be available on the open market into the future and that it may also be available to KEPCO (along with other water users) to apply for a Controlled Allocation Order to secure the water allocations required.

Schedule 4, Conditions 25 and 26 of the Recommended Development Consent also require the proponent to demonstrate to the satisfaction of the Secretary that sufficient water licences are held to account for the predicted water takes from the relevant water sources at various stages of the Project. A further requirement within any Development Consent for the Project could be for KEPCO to demonstrate to the Secretary that sufficient water licences are held to account for predicted water takes as part of the approval of an Extraction Plan for a particular series of longwall panels. That is, the Extraction Plan would need to demonstrate that appropriate licences are held to account for predicted water takes from each water source for the mining of the proposed longwall panels.

3. WATER BALANCE SENSITIVITY MODELLING

Appendix B provides a copy of the surface water balance sensitivity analyses which have been undertaken in response to concerns raised by the PAC in its Review Report.

This water balance sensitivity modelling was undertaken to improve the certainty of water balance model predictions on the performance of the mine water management system. This sensitivity analysis work has concluded that there is high level of confidence that the mine water management system will be able to be managed over the life of the Project to prevent the discharge of mine water from the site.

4. CONCLUSION

We trust this response addresses the matters raised in the PAC Review Report from the earlier DPI-Water submissions.

Should you have any queries in relation to this letter, please contact me on (02) 6575 2000.

Yours faithfully

HANSEN BAILEY

Nathan Cooper
Principal

APPENDIX A

RESPONSE TO DPI SUBMISSION, DATED 7 NOVEMBER 2016

22 November 2016

Team Leader
Planning Assessment
22-33 Bridge Street
SYDNEY NSW 2000

Attention: Mr Stephen O'Donoghue

Dear Steve,

Bylong Coal Project EIS
Response to Department of Primary Industries Submission, Dated 7 November 2016

1. INTRODUCTION

The '*Bylong Coal Project Environmental Impact Statement*' (EIS) which supported the State Significant Development Application (SSD) 14_6367 for the Bylong Coal Project (the Project) was placed on public exhibition between 23 September and 6 November 2015.

Hansen Bailey prepared the document '*Bylong Coal Project Response to Submissions*' (RTS) dated 23 March 2016 to address comments received from agencies and other stakeholders during the exhibition of the EIS. The RTS included responses to the NSW Department of Primary Industries (DPI) submission dated 11 November 2015 which consolidates submissions from DPI-Water, DPI-Agriculture, DPI-Lands and DPI-Fisheries.

A further submission was received from the DPI dated 12 May 2016 making comment on the information presented within the RTS. KEPCO prepared a response to the DPI-Water and DPI-Agriculture submission in two separate letters dated 17 August 2016 for the Department of Planning and Environment's (DP&E) consideration. These responses were provided as Appendices J and K of the Supplementary RTS report, respectively.

DPI-Water requested further detailed information on the groundwater modelling in an email to Nathan Cooper on 13 September 2016. KEPCO provided DPI-Water with the additional requested information from the groundwater modelling on 30 September 2016.

DP&E has provided to the proponent a further submission from DPI dated 7 November 2016 outlining final comments on the Project. This letter report addresses the comments in DPI's letter for DP&E's consideration.

2. RESPONSE TO NSW DPI SUBMISSION

2.1 GROUNDWATER IMPACT ASSESSMENT

Issue 1

The current prediction for groundwater take requirements from the Sydney Basin-North Coast Groundwater Source is 4100 ML. As the proponent currently holds Water Access Licenses (WALs) for 411 shares and has a valid application equivalent to 2093ML the proponent may need to purchase 1596 shares from the market to make up the shortfall.

Response

KEPCO is disappointed that DPI-Water is not able to amend the current application (not yet determined) for a water licence under the former *Water Act 1912* (Water Act) based on the predictions which have arisen from the latest groundwater modelling. The current water licence application has applied for up to 2,093 Mega Litres (ML) of water take from the Permian and Triassic strata, consistent with the groundwater modelling undertaken for the EIS. The latest groundwater modelling for the Project which has been undertaken in response to queries from various stakeholders (including DPI-Water) has determined that up to 4,099 ML per annum may be affected from this strata.

The introduction of the *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016* (North Coast WSP) in July 2016 has brought the management of this water source under the *Water Management Act 2000* (WM Act). The Sydney Basin-North Coast Groundwater Source (within which the Project is located) under the North Coast WSP has a long term average annual extraction limit of 90,000 ML per annum. As at 1 July 2016, there were 3,453 ML per annum of unassigned water allocation entitlements. None of groundwater modelling scenarios undertaken for the Project to date have identified impacts to any neighbouring registered non-mine owned bores within the fractured and porous rock aquifers. Further, due to the relatively low permeability and general brackish quality of the groundwater within this strata in the vicinity of the Project, it is unlikely that there will be many registered non-mine owned bores which may potentially be impacted. Mine dewatering impacts resulting from open cut and underground mining operations are likely to be a dominant use of this water throughout the Sydney Basin-North Coast Groundwater Source. The closest operating mine to the Project is the Wilpinjong Mine which is more than 24 km to the north west of the Project. The groundwater modelling for the Project has shown that there is unlikely to be any cumulative impacts on groundwater.

Based on the above information, DPI-Water has the information available to amend KEPCO's current water licence application to ensure that sufficient groundwater allocations for the Project are held according to the latest groundwater modelling predictions.

In the case that DPI-Water is unable to amend the current water licence application, it is noted that the current application (i.e. 2,093 ML) will cater the Project's predicted demands based on the base case scenario (RTS2 USG (Upstream weighting – mean)) until Project Year 19.

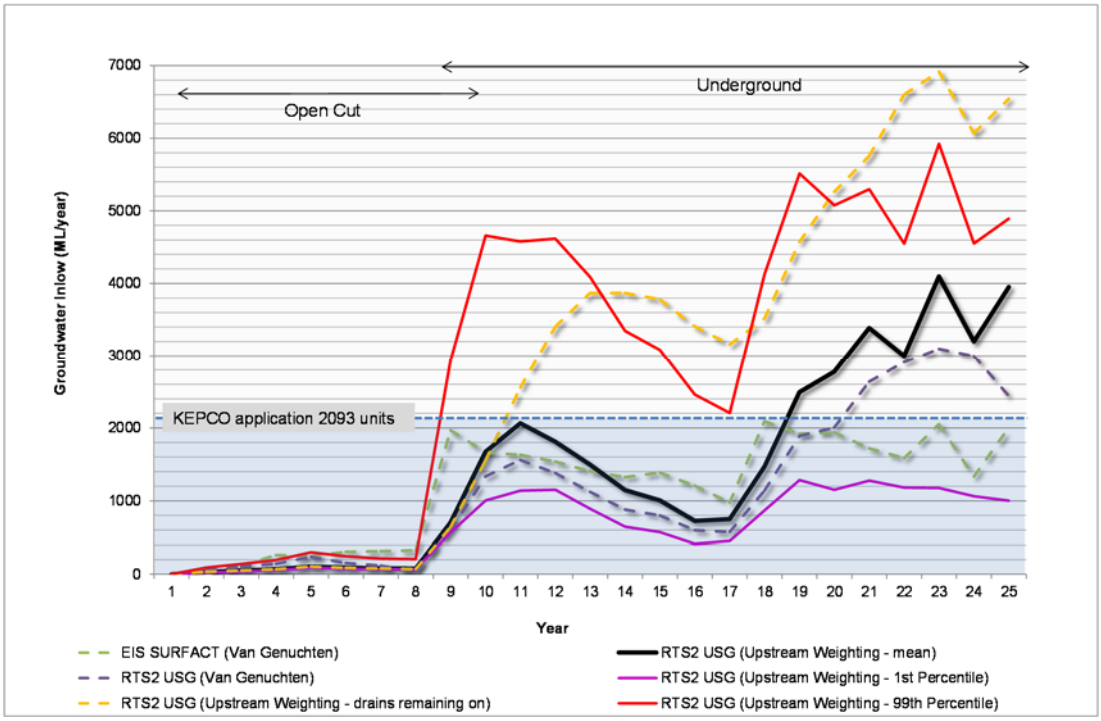
Therefore, it is likely that the additional water shares (up to the 4,099 ML of groundwater inflow predicted for Project Year 23) may be able to be secured from other users within the water source prior to these impacts occurring.

Figure 1 shows the various scenarios predicted by the numerical model in relation to the water licence application for 2,093 ML. It highlights for the base case (RTS2 USG (Upstream weighting – mean)), the mine can operate until Project Year 19 without needing to obtain additional water license units. It is also noted that the groundwater model predictions will be able to be further validated and refined with real data throughout the initial years of mining operations. This process will improve the predictions for the later years of mining within the underground mining area and assist in confirming the maximum water access licence requirements under the North Coast WSP.

Issue 2

The proponent may not have correctly apportioned relevant take from each water source resulting from inflows to the mine, and may have underestimated the shares required in the Bylong River Water Source. The proponent holds 2535 shares in the Bylong River Water Source. It is understood that these shares will contribute to accounting for take of water from the bore field and take of water for agricultural purposes. However these shares will also need to account for passive take of water via alluvial loss and reduction in baseflow. For example the additional information received indicates that peak baseflow loss will occur in year 9 at 2.7 ML/day or 986 ML/year in the 99th percentile scenario. As such in that year this volume of water may not be actively extracted from the Bylong River Water Source and this should be reflected in the site water balance.

Figure 1
Predicted Groundwater Inflow/Seepage into Mining Areas



Response

KEPCO finalised the acquisition of the Tinka Tong property in June 2016. This purchase included the relevant water entitlements held for this property under the Bylong River Water Source of the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* (Hunter Unregulated WSP). When these additional entitlements are considered, KEPCO currently holds 2,644 units of water entitlements for the Bylong River Water Source.

KEPCO is well aware that these water licences are required to account for the water utilised by its agricultural business, the alluvial borefield and water taken indirectly (or 'passively') from the alluvial areas that are not directly excavated for mining.

The groundwater modelling which has been undertaken for the Project has used a consistent and conservative approach to estimate both the direct and indirect take of water from the various water sources throughout the life of the Project. The modelling approach was first developed and reported as part of the Gateway Certificate application. This approach remained consistent throughout the subsequent versions of the groundwater model developed to respond to regulator feedback for the EIS, RTS and Supplementary RTS.

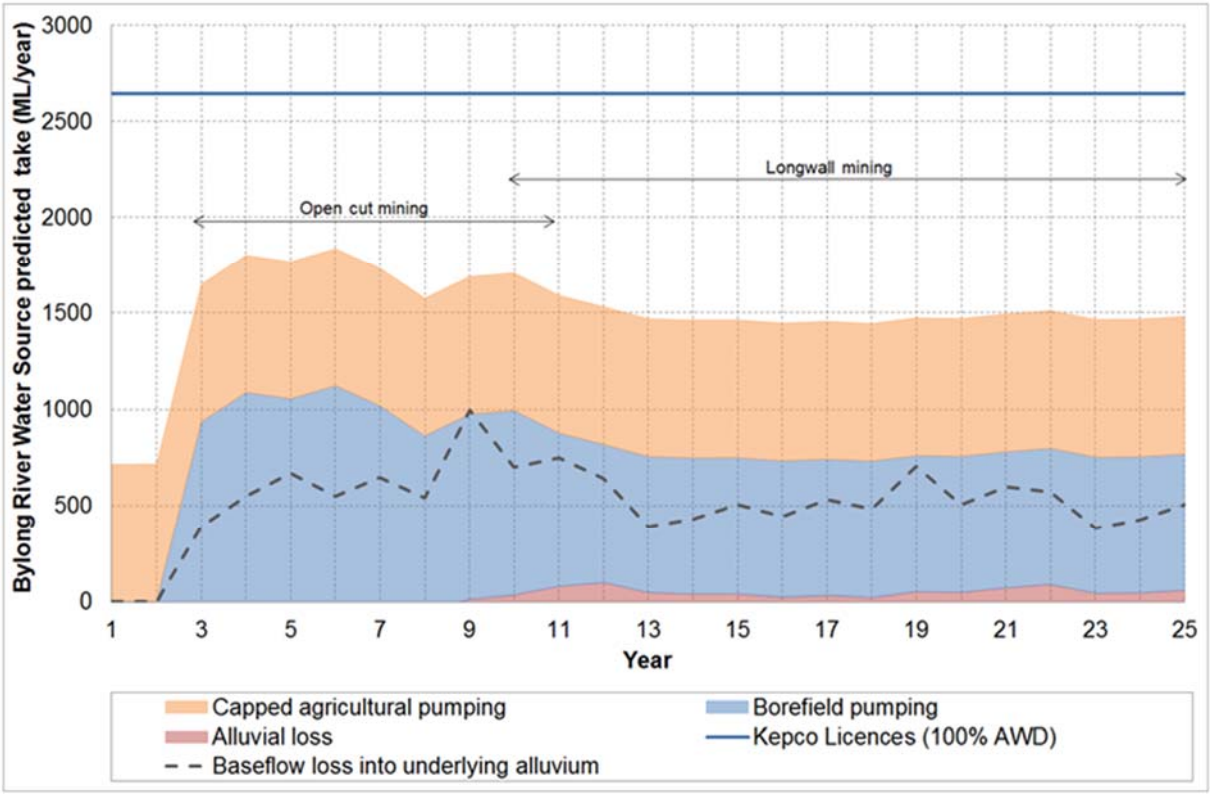
To estimate the indirect take of water from the Bylong River Water Source, two versions of the model were run: one with the proposed mining active; and the second without the proposed mining. The water budgets for the Bylong River Water Source from the two models were then compared to determine the change in flows to the alluvium and the streams due to the proposed mining alone.

Figure 2, which is modified from the Supplementary RTS groundwater report (Appendix J of the Supplementary RTS), shows the direct and indirect water takes from the Bylong River Water Source compared to the water licences held by KEPCO. **Figure 2** illustrates the:

- Direct take of groundwater from the alluvium, due to both the abstraction from the Project borefield and KEPCO's agricultural pumping activities ; and
- Indirect losses from the alluvium due to the depressurisation of the Permian bedrock resulting from the open cut and underground mining activities.

Figure 2 clearly illustrates that the water licences held by KEPCO for the Bylong River Water Source account for both the direct and indirect water takes resulting from the Project. The dashed line in **Figure 2** shows the baseflow loss from the surface water systems induced by the indirect and direct take from the alluvial aquifer. It is important to understand that this line does not necessarily represent flow from the surface systems into the underlying alluvial aquifer. Rather it is calculated as the difference in flow between the two models with and without mining. It therefore represents a reduction in flow of groundwater discharging into the streams as baseflow due to the indirect and direct impacts.

Figure 2
Predicted Base Case Water Take from the Bylong River Water Source



The reduction in flux of groundwater as baseflow into the surface water systems is already accounted for as this water is intercepted by the direct pumping, or the indirect effects of depressurisation on the alluvium. In simple terms, the groundwater that would have left the system as baseflow, now reports to the borefield pumps or the underlying bedrock. For this reason, the change in surface water flux is not included within the licensing required to account for the Project's impacts. This approach prevents the double accounting of water takes from the Bylong River Water Source where the groundwater and surface water are part of the one water source and are highly connected. A step by step calculation of the licenced volume requirements is included in Table 6-9 of the Supplementary RTS groundwater report.

Of course, it is important to acknowledge the inherent uncertainty in groundwater models, and to quantify this uncertainty as much as practicable. The models developed for the EIS, the RTS and the Supplementary RTS have acknowledged this inherent uncertainty and included an analysis with predictions for the more extreme outcomes as represented by the 95th and 99th percentile results.

It is considered inappropriate to use these extremes as the appropriate basis of water licensing, and inconsistent with DPI Water's approach for other mining related projects where 'base case' estimates are used. The amount of water units required to account for water take estimated to be induced by the proposed mining has always been based on the most probable outcome, not the most extreme. KEPCO holds a large entitlement from the Bylong River Water Source.

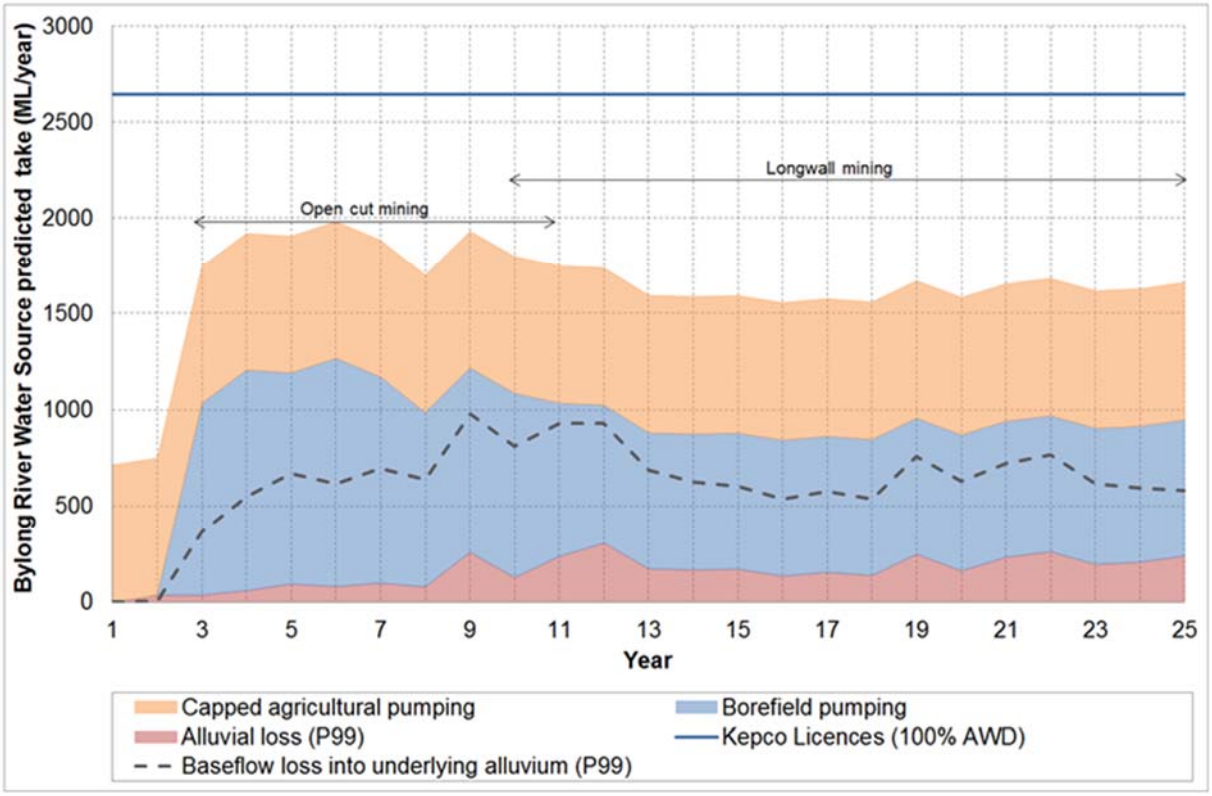
Therefore, even if the predicted 99th percentile baseflow and alluvial losses were included within the water accounting, the Project would still have enough entitlement (at 100% Available Water Determination (AWD)) to account for the water taken, as illustrated in **Figure 3**.

KEPCO acknowledges that if any of the extreme outcomes within the uncertainty modelling were to eventuate, it may impact upon their ability to extract water from each of the water sources for the Project. KEPCO has acknowledged that if water takes were to reach the rates where they may exceed their entitlements, contingency measures will need to be implemented including the purchasing of water allocations on the open water market, redundancy of KEPCO agriculture activities or the progressive reduction in the mining activities that consume water as a last resort.

Issue 3

> *The proponent should investigate alternative sources of water supply for the scenario whereby insufficient shares in the Bylong River Water Source are held or alluvial aquifer depressurisation decreases the yield of the water supply from the bore field. This should be considered to ensure security of water for agricultural purposes and also to source water should make-good provisions be triggered.*

Figure 3
Predicted Water Take (99th Percentile Scenario) from the Bylong River Water Source



Response

The Water Management Plan will outline a program to investigate potential alternative water supplies should these be required. It is important to note that (as explained within Section 2.1 of the response to DPI-Water submission included as part of the Supplementary RTS), the closest private bores within the alluvium in proximity to the Project are located on the Eagle Hill property.

It is important to note that this non-mine owned property is predicted to experience significant noise impacts as a result of the Project and is therefore likely to be afforded the right to acquisition upon request in any Development Consent for the Project. The groundwater modelling has indicated that for all scenarios, impacts will be less than 1 m for these three private bores, with a maximum drawdown of 0.1 m on the Eagle Hill property for the base case. Accordingly, there is no need for 'make good' provisions to be negotiated with this property owner, or any other property owner for all the wide range of scenarios investigated during the approvals process. In the improbable event that impacts were detected, then make good provisions would not be limited to providing an alternative water supply, but would including new or deeper bores or financial compensation. These options will be outlined in the Water Management Plan.

KEPCO has installed a significant groundwater monitoring network in the vicinity of the Project which will be augmented with new bores during the mining phase. The new bores will include sites between the active mining areas and the private bores on Eagle Hill and other private owned bores.

As noted above, KEPCO acknowledges that if any of the extreme outcomes from the uncertainty modelling were to eventuate and impact upon their ability to extract water from each of the water sources, they would need to implement the relevant contingency measures to ensure their entitlements are not exceeded. These contingency measures will be further described within the Water Management Plan and may include the purchasing of water allocations on the water market, scale back KEPCO's agriculture activities or progressively reduce mining activities that consume water as a last resort.

It is noted that water security varies at all mines, and ensuring the 100% security of water for all climatic scenarios is simply not practicable. Under these circumstances, it is appropriate for the risk of particular scenarios to be appropriately managed in accordance with the measures outlined within a Water Management Plan.

Issue 4

> *The proponent should consider use of an alternative coupled surface water - groundwater modelling code for subsequent modelling work that partitions rainfall into recharge, overland flow and evapotranspiration using physics-based equations. The modelling is to utilise data obtained from the recommended additional fieldwork and to also include a complete and appropriate input data set as required for this task. This should be part of the Mining Operations Plan process and will increase the understanding of water take requirements from each water source.*

Response

Variants of the MODFLOW modelling code were used to simulate the impact of mining on the regional groundwater regime for the Gateway, EIS, RTS and Supplementary RTS for the Project. The modelling code and associated modelling methodology was refined throughout this process to ensure consistency with contemporary modelling undertaken to address the requests of independent peer reviewers for other mining related projects. Consultation with DPI-Water, other regulators and independent groundwater peer reviewers throughout the groundwater modelling process did not reveal any comments that the chosen codes were inappropriate and there was no request to change the model code.

The MODFLOW packages utilised for the Project modelling represent recharge and evapotranspiration processes, but do not represent the process of surface overland flow. Overland flow is a relatively rapid process which is not well suited to being represented in groundwater models which are aimed at representing the much slower processes which occur over longer timeframes.

Therefore, overland flow that results in surface water flow in the creeks and rivers has been represented in the Project groundwater models using results from a separate AWBM model. In addition, a separate soil moisture balance was used to estimate periods and volumes of recharge for use in the numerical model. This soil moisture balance also estimates runoff and evapotranspiration, however these estimates were not required for the model. Whilst the rainfall runoff processes were not coupled directly within the numerical model, and were also a simplified representation of complex natural processes, this does not necessarily mean they provide a less valid approximation of impacts from mining.

On the contrary, it is considered more appropriate that natural processes be represented in an appropriate but simplified manner and over-elaborate complexity is avoided, to reduce the potential for error. This approach is supported by the Australian Groundwater Modelling Guidelines (Barnett *et al*, 2012) that recommend *"a conceptual model involving surface water–groundwater interaction should be developed to achieve a balance between real-world complexity and simplicity, such that the model includes all those features essential to the representation of the system, and enable predictions to meet objectives. Those features that are unlikely to affect model predictions should be left out"*.

Whilst overland flow was not explicitly represented within the numerical model, a wide range of recharge was explored within the uncertainty analysis and accounts for this component. This included extreme scenarios where the surface water system was not allowed to leak any water into the underlying aquifer, but only remove water from the groundwater system, meaning overland flow was not represented. A numerical model coupling groundwater and surface water systems dynamically would not have represented these extremes which were considered necessary to explore to develop a robust groundwater impact assessment.

The numerical modelling for the Project has undertaken an evolutionary path since it commenced over four years ago in response to new data gathered and to address specific requests from stakeholders and peer review experts.

This model update process will continue during mining with validation modelling undertaken, which will utilise the newly collected data and the most appropriate model code and information available at the time. The model code to be utilised will be at the discretion of the technical groundwater consultants involved in the model validation at the time.

Issue 5

> *Aquifer pump testing should be undertaken in the Permian and Triassic aquifers and the results provided to DPI Water to verify the hydraulic conductivity values adopted in the model.*

Response

It is agreed that aquifer pump testing may be the optimal method to collect information on the properties of aquifers. This is because the results of the tests can be used to estimate both hydraulic conductivity and storage around the test sites. In contrast, other field methods such as packer testing or falling/rising head tests only provide an estimate of hydraulic conductivity, not aquifer volumetric storage. However, aquifer pump testing is only effective for aquifers which can yield sufficient quantities of groundwater to sustain a pump and induce a water level decline in surrounding monitoring bores whilst pumping.

In reality, much of the Triassic and Permian sequence in the vicinity of the Project is closer to an aquitard than an aquifer in terms of permeability. This means that the rate at which water is able to be pumped from boreholes within these formations is very low, or nil. This is evidenced by the distinct lack of private water supply bores within the Triassic and Permian formations within the region.

In low permeability formations with limited groundwater yields, alternative methods such as packer testing are more appropriate. Packer testing can collect multiple estimates of hydraulic conductivity within a single borehole by sealing the test device within different geological zones of uniform properties. This method has been adopted for the collection of baseline data for the Project along with falling/rising head tests to provide estimates of hydraulic conductivity within the bedrock strata. Future work for the operations phase will consider the most appropriate and practical methods, which will be documented within the Water Management Plan. Given the above discussion on the general unsuitability of pump testing on the Permian and Triassic strata, packer testing is likely to be the favoured approach for gaining further hydraulic information.

Issue 6

> *The proponent should implement agreed setback distances from the alluvial boundary and perform ongoing monitoring of the setback during project construction to ensure the setback is maintained.*

Response

The groundwater reports for the Gateway process, the EIS, the RTS and the Supplementary RTS all provided information on the buffer zone to remain between the proposed mining pit limits and the limit of the alluvial sediments.

The methodology used to define the limit of the alluvial sediments was also described. During construction appropriate survey controls will be put in place to ensure the mining pit limits as assessed in the EIS remains at least 150 m back from the identified extent of alluvial sediments.

Issue 7

All works on waterfront land should be conducted in accordance with DPI Water's Guidelines for Controlled Activities on Waterfront Land, as amended from time to time.

Response

Noted, as per Section 2.5 of KEPCO's letter dated 17 August 2016 responding to DPI-Water submission.

Issue 8

Any determination for the project should contain the following condition of approval:

o "The Applicant must ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of operations on site to match its available water supply".

Response

Noted.

2.2 WATER MANAGEMENT PLAN

The Water Management Plan for the project should be developed in consultation with DPI Water. This plan should at least include the following:

Item 1

o Additional assessment of impact of alluvial aquifer depressurisation on flow in the Bylong River should be undertaken. This should include consideration of the ecological impacts and the impacts on basic landholder rights extraction.

Response

The Water Management Plan will outline the validation modelling to be undertaken routinely during mining operations. It is considered that further modelling prior to mining is considered to be of limited value. The Water Management Plan will outline further investment in the baseline monitoring network and field characterisation of aquifer properties which will benefit future validation modelling during mining.

The modelling undertaken to date for the Project has focused on quantifying the impacts of drawdown on other water users, including ecological communities and neighbouring non-mine landholder bores.

The latest round of modelling work has demonstrated that the risks to basic landholder rights were low, with the closest private bores within the alluvium in proximity to the Project located on the Eagle Hill property (refer to Figure 6-17 of the Supplementary RTS groundwater report).

The modelling has indicated that for all modelling scenarios, impacts will be less than 1 m for these three private bores, with a maximum drawdown of 0.1 m on the Eagle Hill property for the base case. Therefore, there is no need for 'make good provisions' with this property owner, or any other property owner for all the wide range of scenarios investigated during the approvals process.

The flood plain along the Bylong River Water Source has been largely cleared for agricultural purposes. Some small isolated stands of riparian vegetation remain intact adjacent to the Bylong River, which have been identified to potentially partially rely on groundwater. These stands of vegetation are within proximity of the proposed mining areas. As explained in Section 4.11.7 of the RTS, KEPCO proposes to carry out monitoring programs prior to and during the life of the Project to monitor water levels and vegetation condition to confirm any adverse impacts on these potential GDEs.

Item 2

> *o Make good commitments for private water users in the Bylong River Water Source whereby a reduction in water level produces an inability to take water for licensed purposes or basic landholder rights. The make-good provisions must occur prior to an investigation regarding the cause in the reduction of water levels. Specific consultation must occur to establish contingency water supply provisions for the "Budden" and "Eagle Hill" properties.*

Response

Make good agreements are appropriate where the approvals process has identified the potential for an impact to occur at a non-mine owned water supply bore. The most recent modelling for the Supplementary RTS did not identify any impacts at the "Budden" and "Eagle Hill" properties more than the 2 m trigger as stipulated within the Aquifer Interference Policy. Despite this, the "Eagle Hill" property is the closest potential private receptor and the Water Management Plan will outline the expansion of the groundwater monitoring program to include additional bores between the mining areas and this property to ensure there is an early warning of any unforeseen impacts. At this time make good agreements would be appropriate.

As explained in Section 5.9.5 of the RTS, the "Budden" property is located to the west of the proposed mining area significantly upstream within the Growee River catchment. No modelling scenarios undertaken to date for the Project have indicated impacts encroaching on this property. This is because the geology and topography serve to isolate the "Budden" property from the area proposed for mining. Despite this very low risk, KEPCO has previously agreed to undertake monitoring on this property, although the property owners have since declined the offer. A make good agreement is not considered to be appropriate given the location of this property in relation to the Project and the findings of the consistent findings of the groundwater studies that there is no potential for impact in this area.

Item 3

o Monitoring of flows, riparian land, bank stability, erosion, scour, water quality and salt load in the Bylong River and surrounding tributaries. This monitoring program should relate to a prescriptive TARP, which includes mitigation and rehabilitation measures.

Response

Noted.

Item 4

o Expansion of the groundwater monitoring network prior to commencement of mining to monitor water level in areas of maximum predicted drawdown and identified groundwater dependent ecosystems. DPI Water should be consulted regarding the proposed expansion of the monitoring network to provide advice on location and target aquifer screening. Additional monitoring bore locations must be included between the:

- *Bore field and other water users*
- *Alluvial aquifer and proximal coal seams*
- *Alluvial aquifer and underground mine*
- *Alluvial aquifer and open cut mine*

Response

KEPCO will consult with DPI Water during the preparation of the Water Management Plan, including selecting sites for any additional monitoring locations.

Whilst it is agreed the sites nominated by DPI Water would provide some benefit, it will be necessary to first consider the existing monitoring bore network and where this adequately monitors the impacts of the proposed mining on the groundwater systems. Additional monitoring can then be integrated with the existing network to efficiently meet the monitoring objectives to be outlined within the Water Management Plan.

2.3 AGRICULTURAL ASSESSMENT

Issue 1

The proponent should provide further clarified information to the public regarding buffers for adjoining BSAL. The proponent should clarify that a 50 metre buffer has been applied, why a 50 metre buffer has been selected and how it will be managed.

Response

Section 4.4.2.5 of the RTS stated that "*since the Gateway Application process, the Project Disturbance Boundary was modified and included an additional standoff from the proposed disturbance. This buffer was included within the EIS in response to the Gateway Panel's recommendations.*"

The buffer is the area between the Project Disturbance Boundary from the indicative locations of the open cut mining areas, overburden emplacement areas and associated infrastructure. The buffer applied to the disturbance areas is demonstrated in the Project Layout Figure (Figure 18 of the EIS). It is noted that the assessments and appropriate mitigation measures for the EIS have considered the impacts from the disturbance within the Project Disturbance Boundary.

Issue 2

During the life of the project the proponent should manage any lands used for irrigated agriculture to retain this potential post project.

Response

As explained in Section 2.2 of the letter dated 17 August 2016 in response to DPI-Agriculture's submission dated 12 May 2016, it is not reasonable for KEPCO to make a binding undertaking to keep a certain area under irrigated agriculture due to the time frame of the Project (25 years) and the potential for changes in agricultural economics and technology during this period.

Notwithstanding this, KEPCO undertakes to retain its non-mine agricultural land in productive agriculture. The areas of land which have been specifically excluded from the Project's Biodiversity Offset Strategy will continue to be managed for agricultural activities.

2.4 ATTACHMENT A

Issue 1

The proponent has provided information about multiple, distinct Bylong regional groundwater models that were constructed using two mathematically different, separate modelling codes. These models have differences in the mesh design, input parameters, unsaturated zone equations, conceptual model and mathematical settings. The predicted levels of impacts varied between the models however all seven model scenarios resulted in a minimum drawdown of 2 m in the Bylong alluvium, which then effects surface flow in the Bylong River. It is considered that the likely scenario based on the model results provided is the 99th percentile or 'worst case'.

Response

As described within the RTS and Supplementary RTS groundwater reports, the numerical modelling for the Project has undertaken an evolutionary path since it was commenced over four years ago. In this regard, the numerical modelling has been continually updated in response to new data, requests from stakeholders and peer review experts. It is not considered that this process invalidates any previous work, rather that it shows that groundwater models have some inherent uncertainty.

This inherent uncertainty can be addressed by considering the potential range of outcomes and gradually refining models over time.

As noted by DPI Water, the models have consistently predicted the potential for drawdown within the alluvium adjacent to the proposed mining areas to exceed 2 m, although no non-mine owned bores will be within this predicted drawdown extent. However, it appears that DPI Water have concluded that the most extreme drawdown impacts predicted by the modelling as represented by the 99th percentile results are likely to be the most probable. It is unclear how this conclusion has been reached, particularly in the absence of any modelling undertaken by DPI Water. However despite this difference, it does indicate that DPI Water have concluded the impacts of the Project have been identified within the uncertainty analysis. This is considered positive as KEPCO have planned to operate the mine in a manner that will ensure water extraction and drawdown do not exceed licenced limits should extreme scenarios occur.

This will be managed by advanced monitoring and if necessary implementing measures including the purchasing water on the water market, redundancy of KEPCO agriculture activities to progressive reduction in the mining activities that consume water as a last resort.

Issue 2

It is accepted that the Independent Model Review classed the model as fit for purpose however there are numerous elements which result in a lack of certainty regarding the impacts of the proposed project. Hence the recommendation for an alternative modelling code to be used as part of the Mining Operations Plan process. The reasons for this recommendation are as follows.

- *Conductivity values used for the coal seams were not representative of the higher conductivity values from the packer testing results. These high conductivity values were also not used in the uncertainty analysis.*

- *Lack of pumped aquifer testing information from the Permian and Triassic aquifers to inform appropriate hydraulic conductivity values.*

- *Assumptions used to generate estimates on the volumes of WAL requirements may underestimate the quantity of required shares in the Bylong River. For example section 6.4.7 of the additional RTS states "For the purposes of water licensing, it has been assumed all the water predicted to be intercepted by the model drain cells is from the Permian or Triassic strata. Therefore, this water should be accounted for with water access licences under the North Coast Porous and Fractured Rock Water Sharing Plan."*

- *The three dimensional models identified no aquiclude between the coal seam and alluvium. It is expected that alluvial aquifer water leakage will be induced to flow into the sub-cropping Permian aquifers that will be exposed in the open cut and underground mine void. This will result in water originating from the alluvial aquifer to also be taken in the open cut and the underground mine void.*

Response

The modelling code is not considered the primary source of uncertainty in relation to the predicted impacts of the Project on the groundwater regime. It is the conceptual understanding of how the groundwater regime operates and the most appropriate way to represent this within a numerical model that creates uncertainty in predictions from models. The four reasons DPI Water provide to base their recommendation upon do not justify changing the model code. The four reasons are simply a request for more information on aquifer properties and adjustments to the physical setup of the model.

The field investigation programs conducted for the Project show (what is typical for most hydrogeological studies) that the aquifer properties vary widely spatially, along with the hydrologic processes of recharge and discharge. These widely varying properties and processes must be simplified to be represented within a computer based model. However representing the natural processes with more complexity in numerical models does not necessarily result in models that produce more certain predictions. On the contrary, it is considered more appropriate that processes be represented in numerical model in an appropriate but simplified manner and over-elaborate complexity is avoided, to reduce the potential for error. This is supported by the Australian Groundwater Modelling Guidelines that recommend *"the modeller should find a balance between simplicity (parsimony) and complexity (highly parameterised spatial distribution of some properties)."*

As acknowledged by DPI Water, the third party reviews of the modelling conducted by Independent Peer Reviewer (HydroSimulations) and also by DP&E's Peer Reviewer (Kalf & Associates) did not conclude the modelling code was inappropriate and did not recommend any future changes to the code utilised. The MODFLOW USG code (utilised for the EIS, RTS and Supplementary RTS) is considered to remain superior to other codes in this geological environment as it allows layers represented by coal seams to be terminated where they subcrop and connect with the alluvial aquifer. Other finite element codes such as FEFLOW do not support this pinching out of layers.

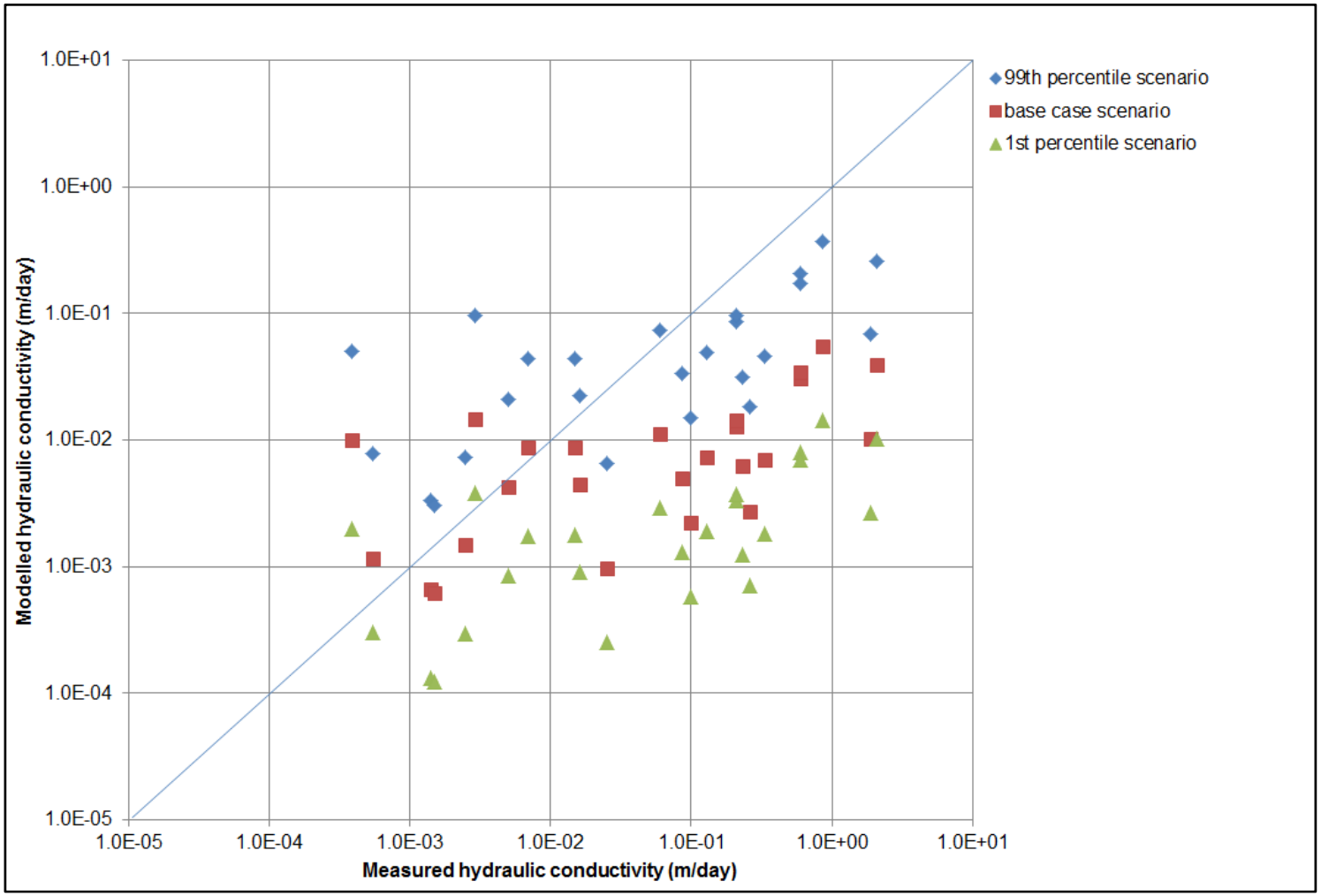
In response to the four comments provided as reasons to justify changing the model code, the following response is provided:

- The uncertainty analysis tested the influence of varying hydraulic conductivity values within the coal seams on the predicted impacts. **Table 1** presents the value of hydraulic conductivity measured using packer tests and the values adopted within the model in the uncertainty analysis for the various scenarios. The data is also presented graphically in **Figure 4**.

Table 1 Predicted Water Take (99th Percentile Scenario) from the Bylong River Water Source

Test Bore	Coal seam tested	Depth (m)	Hydraulic Conductivity (m/day)			
			Measured	Modelled 99th percentile	Modelled base case	Modelled 1st percentile
CP035	Coggan	100	6.0E-02	7.4E-02	1.1E-02	2.9E-03
CP028	Coggan	164	2.6E-01	1.8E-02	2.7E-03	7.0E-04
CP014	Coggan	136	8.6E-02	3.4E-02	5.0E-03	1.3E-03
BY0011CH	Coggan	202.395	5.5E-04	7.8E-03	1.2E-03	3.0E-04
CP027	Coggan	53.2	6.0E-01	2.1E-01	3.1E-02	8.1E-03
CP009	Coggan	93	2.1E-01	8.7E-02	1.3E-02	3.4E-03
CP045	Coggan	42.8	2.1E+00	2.6E-01	3.9E-02	1.0E-02
BY0077CH	Coggan	118.84	1.3E-01	4.9E-02	7.3E-03	1.9E-03
BY0080CH	Coggan	210.68	2.5E-02	6.5E-03	9.7E-04	2.5E-04
BY0091CH	Coggan	172.52	1.0E-01	1.5E-02	2.2E-03	5.8E-04
A06	Coggan Seam	26.705	8.6E-01	3.7E-01	5.6E-02	1.4E-02
BY0207CH	Coggan Seam	88.295	2.1E-01	9.6E-02	1.4E-02	3.7E-03
AGE02	Coggan Seam	103.53	1.9E+00	6.9E-02	1.0E-02	2.7E-03
BY0208CH	Coggan Seam	87.705	2.9E-03	9.7E-02	1.5E-02	3.8E-03
B3	Coggan Seam	121.275	3.3E-01	4.6E-02	6.9E-03	1.8E-03
BY0011CH	Ulan	196.395	1.4E-03	3.3E-03	6.6E-04	1.3E-04
BY0077CH	Ulan	112.33	5.0E-03	2.1E-02	4.2E-03	8.4E-04
BY0080CH	Ulan	200	1.5E-03	3.1E-03	6.1E-04	1.2E-04
BY0091CH	Ulan	160.195	2.5E-03	7.4E-03	1.5E-03	2.9E-04
BY0208CH	Ulan Seam	79.225	6.9E-03	4.4E-02	8.8E-03	1.8E-03
B3	Ulan Seam	109.375	1.6E-02	2.3E-02	4.5E-03	9.0E-04
BY0207CH	Ulan Seam	78.785	1.5E-02	4.4E-02	8.8E-03	1.8E-03
A06	Ulan Seam/Tuff	16.725	6.0E-01	1.7E-01	3.5E-02	6.9E-03
AGE02	Ulan Seam/Tuff	94.525	2.3E-01	3.1E-02	6.2E-03	1.2E-03
BY0207CH	Ulan Upper	73.285	3.9E-04	5.0E-02	1.0E-02	2.0E-03

Figure 4
Scatter Plot of Hydraulic Conductivity Measured Versus Modelled



- **Table 1** and **Figure 4** show the range of hydraulic conductivity adopted within the uncertainty analysis covers the median hydraulic conductivity, but not the extremes of the field measurements. Ultimately the range adopted and considered appropriate is based on the experience of the modeller with complex numerical models. The modeller does not automatically assume that the point source testing through boreholes has correctly characterised the hydraulic properties of a large spatially varying region, but rather draws upon experience, particularly for greenfield sites and exercises some judgement to determine the most appropriate range in the aquifer properties to quantify uncertainty. In this case, the range was selected to exclude the extremes in the test results that would have resulted in many orders of magnitude difference in permeability between the Ulan and Coggan coal seams that was considered highly unlikely.

- As noted earlier, it is agreed that aquifer pump testing is the optimal method to collect information on the properties of aquifers. However this method is only effective for aquifers which can yield sufficient quantities of groundwater to sustain a pump and induce a water level decline in surrounding monitoring bores whilst pumping.

  Much of the Triassic and Permian sequence in the area proposed for mining is closer to an aquitard than an aquifer in terms of permeability, and this means that the volumes of water pumped from boreholes within these formations is very low, or nil. This is evidenced by the distinct lack of private water supply bores within the Triassic and Permian formations within the region. In low permeability formations with limited borehole yields alternative methods such as packer testing are more appropriate under these circumstances. Packer testing was part of the testing program which has been undertaken for the Project. Future work for the operations phase will consider the most appropriate and practical methods for any additional testing, which will be documented within the Water Management Plan.

- A detailed description of the methodology utilised for estimating the water take from water sources is provided in **Section 2.1** Issue 2 above. This method is conservative and has been considered appropriate by DPI Water earlier within the approvals process and also on other mining related projects.

- Direct connection between the coal seams and the alluvial aquifer occurs only where erosion along the stream bed has cut into the underlying coal seam. This is a thin and limited zone known as the subcrop line. This direct physical connection has been identified within the groundwater assessments since the Gateway process and has been represented within the numerical models that have been developed for the Project to date. Elsewhere, the overlying less permeable sedimentary rocks do form an aquiclude between the base of the alluvial aquifer and the coal seam, retarding the hydraulic connectivity between these units. Again, this physical architecture of the geological units has been represented in the various numerical models for the Project.

The Supplementary RTS groundwater report (Appendix J of the Supplementary RTS) discussed this connectivity and provides a map (see Figure 5-19) showing where the coal encroaches closer to the base of the alluvium. Since the numerical models represented the connectivity created by the geological units (particularly in the case of the MODFLOW USG model which allows the pinching out of layers) the alluvial aquifer water is allowed to leak into the areas of sub-cropping Permian aquifers which are connected to the exposed faces within the open cut and underground mine areas.

The modelling results have therefore appropriately captured the impacts of this process and the results provided encompass this impact. The reason the alluvial groundwater system is not predicted to be completely drained by the proposed mining is that the recharge processes including stream leakage, diffuse rainfall and lateral through flow from upstream within the alluvium serve to replenish the water lost from the alluvial aquifer due to mining.

3. CONCLUSION

We trust this response addresses the issues raised in the latest NSW DPI correspondence and that DP&E is able to appropriate address these items within its Assessment Report.

Should you have any queries in relation to this letter, please contact us on 6575 2000.

Yours faithfully

HANSEN BAILEY

Nathan Cooper
Principal

James Bailey
Director

APPENDIX B

BYLONG COAL PROJECT – WATER BALANCE MODELLING FOR REVISED GROUNDWATER INFLOWS

0887-07-B5

Nathan Cooper
Hansen Bailey
Singleton NSW
Via email: ncooper@hansenbailey.com.au

12 January 2018

Subject: Bylong Coal Project - Response to PAC report

Dear Nathan,

Please find below our response to the various surface water concerns for the Bylong Coal Project (the Project) which have been raised in the Planning Assessment Commission (PAC) Review Report (SSD 6367, 25 July 2017). This response should be read in conjunction with the EIS Surface Water Impact Assessment (WRM 2015a), the surface water sections of the Response to Submissions (RTS) (Hansen Bailey 2016a) and the surface water matters provided within the Supplementary Response to Submissions (Supplementary RTS) (Hansen Bailey 2016b).

1 OVERVIEW

The key surface water matters raised in the PAC Review Report relate to:

- the risk that mine water on the site will exceed the available storage capacities, resulting in the need for controlled or uncontrolled water releases from the mine water system; and
- potential impacts of mine water releases (notwithstanding that releases of mine water are not proposed) on the flow volumes and salinity in the Goulburn River.

These issues are addressed below.

2 ON-SITE WATER CONTAINMENT

The water balance modelling completed for the EIS included an assessment of the storage required within the site water management system to prevent spills (or the need for releases) of mine water as a result of the Project. The water balance assessment was subsequently revised with different assumptions about groundwater inflows for the Supplementary RTS (WRM 2016).

Figure 1 shows an updated plot of the likely range of potential water storage volumes required in the open cut mining area to prevent spills from the mine water system, depending on climatic conditions. The results shown in Figure 1 are based on the revised groundwater inflows shown in Table 1, with inflows varied from year to year, rather than averaged across mine stages as assumed in the assessments from the EIS and the Supplementary RTS.

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Figure 1 also shows the total water storage capacity of the open cut pits (mostly provided by East Pit), as well as indicative storage in the underground goaf (attributed to the 100 series longwall panels) which will be available from the latest PY 18. The reduction in water storage capacity over time from Year 11 is due to the placement of coal reject material within the open cut void such that at the end of underground mining it can be capped and rehabilitated. This will enable the entire open cut mining area being rehabilitated to a free draining landform and unlike most open cut mines will not comprise a final void.

Figure 1 shows that over most of the Project life, the available storage capacity within the open cut pits is significantly higher than the 1st percentile prediction (very wet conditions) of the required water storage volume. Even if very wet climatic conditions occur, the available storage volume at the very end of Project life exceeds the required storage volume by more than 3,400 ML. Once the 200 series longwall panels are extracted, the entire underground mine will become available for storage which will further increase the available storage volume.

The first 20 years of operation of the Project will provide a large amount of data to significantly improve the accuracy of estimated groundwater inflows. Hence, many years lead time will be available to make any necessary adjustments to site water storage capacities, or implement other measures, to ensure that the mine water is able to be retained within the site water management system.

In the unlikely event that further contingencies for excess water storage are required, the following measures could be implemented:

1 Sealing of the gateroads between the 100 series and the 200 series would create an enormous storage volume more than capable of containing the potential volume of excess water;

2 The capacity of the Eastern void will be determined by the final years of open cut mining (i.e. Project Year 7 to Project Year 10). The performance of the water management system throughout the initial open cut operations, as well as groundwater inflows, will be closely monitored to validate model assumptions and improve the predictions for the excess mine water requiring storage. This updated modelling will assist short term mine planners to determine whether the mining operations plan requires modification to retain a larger void at the completion of open cut mining operations. This would potentially require the development of mounded areas on the Eastern overburden emplacement area to assist in providing additional capacity for the reject materials and excess mine water. Under this scenario, KEPCO would still be committed to developing a final landform with no final void in the landscape, as is currently proposed.

3 Further contingency measures which could be considered prior to commencing mining of the 200 series longwall panels may include adjustments to the proposed mine plan, such as:

a. Adjustments to longwall mining widths to minimise hydraulic fracturing and hence potential groundwater inflows;
b. Modifications to the sequencing and timing of mining the 200 series longwall panels;
c. Reorientation of the 200 series longwall panels; or
d. Sealing additional longwall panels within the 200 series to retain further underground capacity.

Table 1 - Adopted groundwater inflows for results shown in Figure 1

Project Year	Total groundwater intercepted (ML/a)
PY2	22
PY3	36
PY4	48
PY5	74
PY6	63
PY7	56
PY8	56
PY9	491
PY10	1,173
PY11	1,446
PY12	1,268
PY13	1,049
PY14	804
PY15	704
PY16	508
PY17	526
PY18	1,030
PY19	1,744
PY20	1,943
PY21	2,371
PY22	2,099
PY23	2,869
PY24	2,241
PY25	2,766

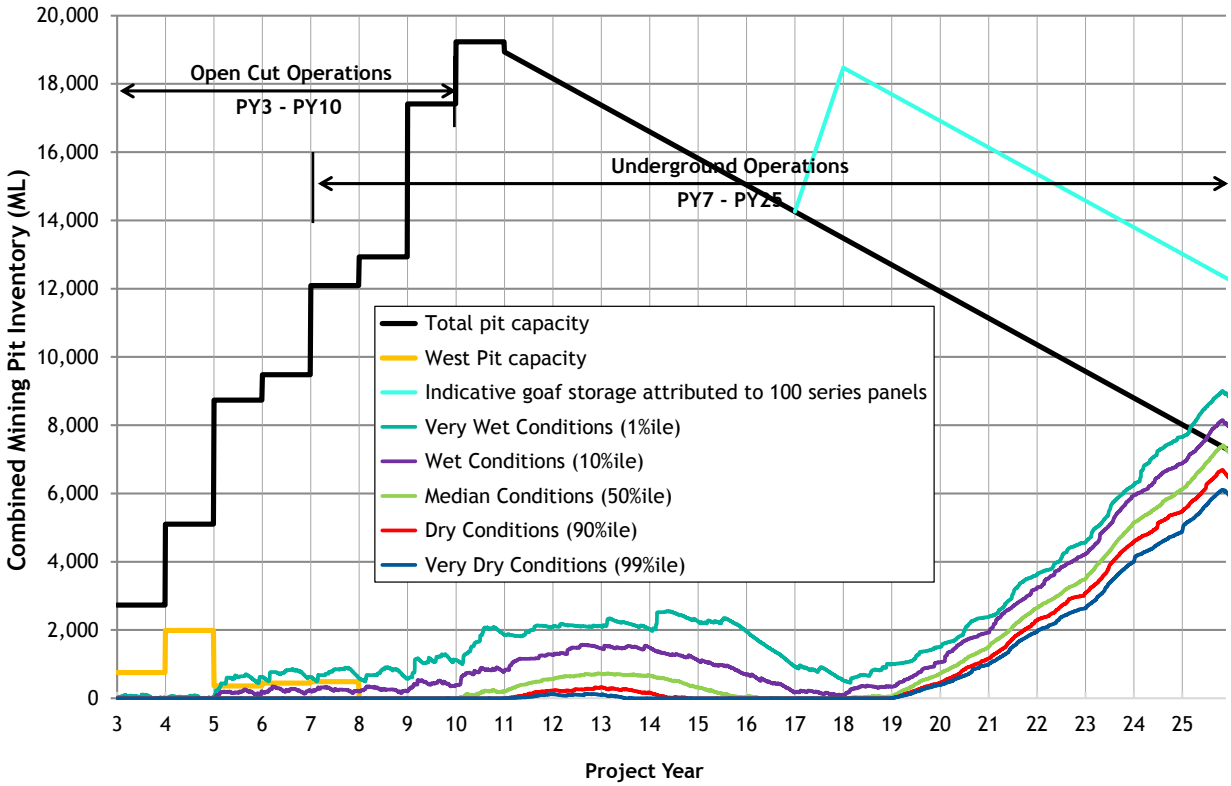


Figure 1 - Combined open cut mining area stored inventory

3 SENSITIVITY ANALYSIS

In response to a peer review of the water balance modelling completed within the EIS by Hydro Engineering & Consulting (HEC), an additional five water balance modelling cases have been assessed with different assumptions for surface runoff and groundwater inflows. The adopted cases are summarised in Table 2. The approach for selecting the sensitivity cases is described as follows:

- Runoff:
  - Calibrated runoff model parameters for the Australian Water Balance Model (AWBM) from the nearby Wilpinjong mine have been adopted (WRM 2015b). These parameters have been verified by comparing site data at the Wilpinjong operation against the model results. Note that these parameters relate to surface runoff only and do not affect groundwater predictions.
  - The sensitivity of the water balance to runoff inflows has been assessed by increasing the depths of conceptual catchment storage (C) in the runoff model by 20% (low runoff case) and decreasing them by 30% (high runoff case).
- Groundwater inflows:
  - Groundwater modelling for the Supplementary RTS by Australasian Groundwater and Environmental Consultants (AGE) includes a likelihood assessment of different groundwater inflow rates. The

uncertainty assessment that was undertaken by AGE has considered inflows that are:

- "Very Likely" 90% probability
- "Most Likely" 33% probability
- "Very Unlikely" 10% probability

- AGE has provided the groundwater inflows which will be available for use within the mine water management system.

Table 2 – Water balance sensitivity cases

Case	Description	Runoff parameters	Groundwater inflows
1	Revised runoff	Wilpinjong	Most likely (33% probability (most likely))
2	Low runoff	1.2 x Wilpinjong C values	Most likely (33% probability (most likely))
3	High runoff	0.7 x Wilpinjong C values	Most likely (33% probability (most likely))
4	High groundwater	Wilpinjong	High (10% probability (very unlikely))
5	Low groundwater	Wilpinjong	Low (90% probability (very likely))

The sensitivity results for the stored water inventories are shown in Figure 2 for the Revised Runoff sensitivity case (Case 1). The revised runoff parameters and groundwater inflows result in generally higher stored water volumes over the life of the Project when compared to the Supplementary RTS case. The available storage capacities (shown in Figure 2) would be sufficient to contain water volumes under this scenario over the Project life. As noted above, many years of mining operations will be available to validate the groundwater model and refine the groundwater inflows and the performance of the water management system and make any necessary changes to the sites water storage capacities to ensure the containment of mine water in the later years of the Project. In addition, inclusion of goaf storage for the 200 series longwall panels will provide additional storage capacity.

Table 3 - Groundwater inflows for sensitivity cases

Project Year	Total groundwater intercepted (ML/a)		
	Low	Most likely	High
PY2	31	40	60
PY3	48	63	92
PY4	65	86	128
PY5	93	121	187
PY6	77	99	153
PY7	72	89	135
PY8	72	91	135
PY9	723	1,157	1,912
PY10	1,233	1,784	2,983
PY11	1,281	1,817	2,978
PY12	1,276	1,810	3,008
PY13	1,058	1,499	2,603
PY14	847	1,194	2,116
PY15	736	1,052	1,979
PY16	539	823	1,571
PY17	493	732	1,378
PY18	1,047	1,557	2,645
PY19	1,561	2,263	3,575
PY20	1,429	2,014	3,240
PY21	1,572	2,146	3,420
PY22	1,402	1,932	2,940
PY23	1,517	2,193	3,721
PY24	1,232	1,808	2,947
PY25	1,245	1,850	3,135

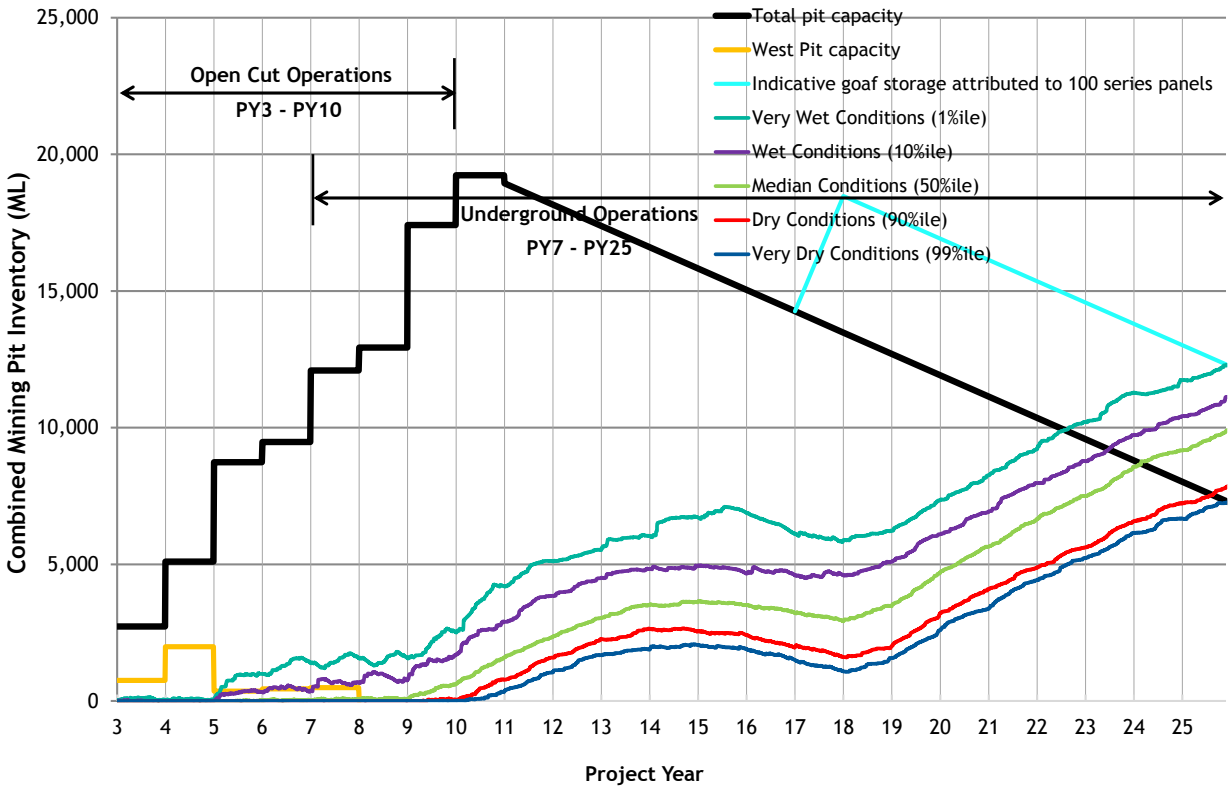


Figure 2 – Sensitivity Case 1 results for stored water inventory (Revised runoff)

The results for stored water inventories (50th percentile) for all sensitivity cases are shown in Figure 3. As anticipated, the Wilpinjong runoff parameters (Sensitivity Case 1) produces higher surface runoff than the Supplementary RTS case.

It is important to note that the water balance model combines results from the groundwater and rainfall runoff models that have differing probabilities of occurring. In this case the probability of these outcomes occurring simultaneously is significantly reduced as the combined probability is represented by the product of the probabilities. For example, Case 4 which is the most extreme of the outcomes tested in the sensitivity analysis, is very unlikely as it is based on the 50th percentile for rainfall runoff and the 10th percentile for groundwater inflow, which results in a combined probability of 5%.

The "Very Unlikely" high groundwater case (Case 4) produces very much higher stored water volumes (refer Figure 3). It should be recognised that this case does not reflect anticipated groundwater inflows. This case represents a very unlikely overestimate of inflows to assess the theoretical impact on the water management system. The model results show that even in this extreme scenario, available mine water storage capacities would be more than sufficient up to Project Year 20. As stated above for the revised runoff scenario, there will be many years of mining operations prior to capacities being exceeded under these unlikely scenarios.

Additional assessment and validation could therefore be undertaken prior to Year 18 (i.e. prior to the commencement of the north-western longwall panels), say

commencing at Year 15, to determine if this extreme eventuality could possibly occur and if so, what would be the appropriate modifications to the mine plan, site water storages or management systems to prevent the need for discharge of mine water from the site. Potential contingency measures for management of excess mine water are discussed in Section 2 above.

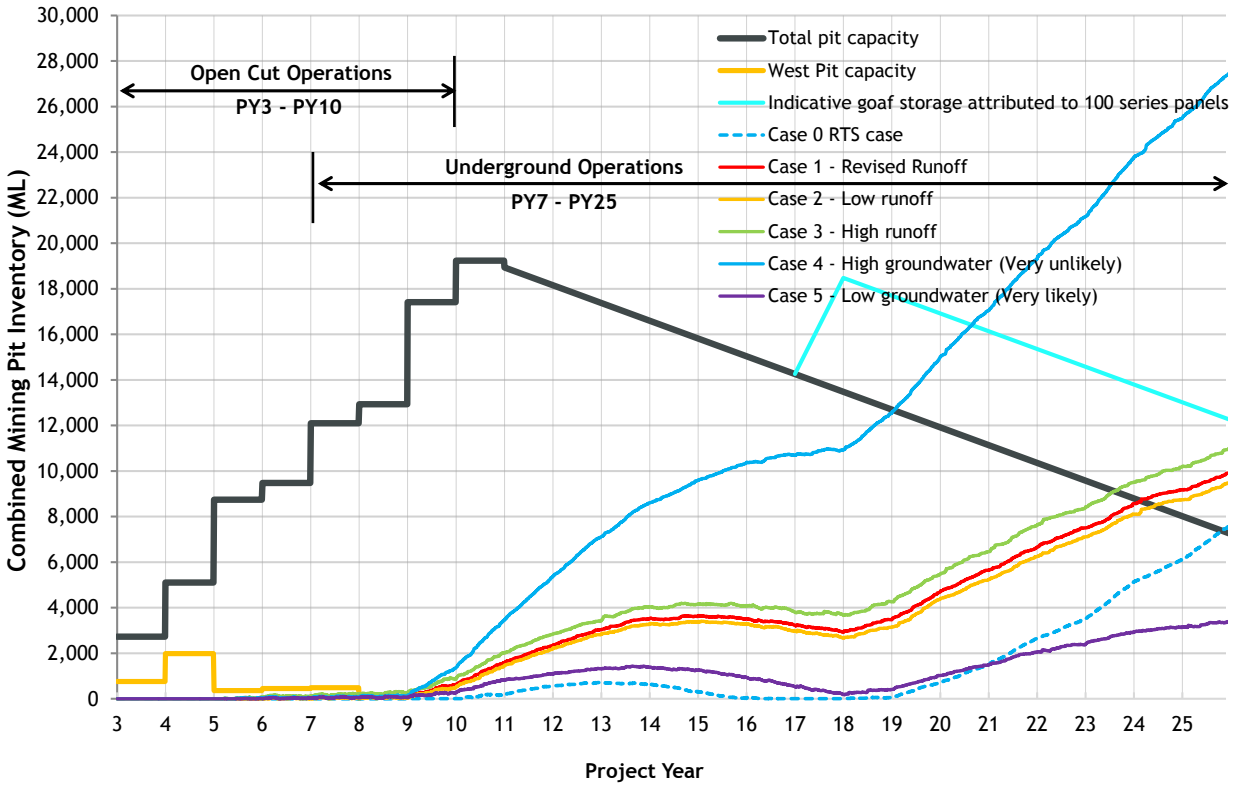


Figure 3 - Sensitivity case results for stored water inventory (50th percentile)

4 IMPACTS ON THE GOULBURN RIVER

The key potential surface water impacts of the Project on the Goulburn River relate to:

- the loss of flow due to capture within the mine water management system; and
- adverse impacts on water quality through discharge of water with elevated salinity.

4.1 Loss of flow

The potential loss of surface flow volume was addressed in the EIS (Section 9.4 of the Surface Water Impact Assessment). The impacts of capturing surface runoff are proportional to catchment area. As discussed in the EIS, clean water diversion drains will be used to minimise capture of clean water runoff and the maximum captured catchment area represents less than 1.3% of the wider Bylong River catchment. This worst-case loss is temporary, as the progressive rehabilitation of the open cut mining areas will quickly reduce the amount of area disturbed at any

one time and facilitate the release of treated storm water runoff. A loss of catchment area this small would have an undetectably small impact on streamflow. The impacts on the Goulburn River would be even smaller.

4.2 Salinity

A presentation to the PAC at its public hearing from the Mudgee District Environment Group claimed that the Goulburn River was subject to increasing salinity from land clearing for agriculture, and more recently from open cut mining.

Details of the three closest stream gauging stations on the Goulburn River downstream of the Bylong River confluence are provided in Table 4. Figures 4, 5 and 6 show time series plots of salinity (Electrical Conductivity (EC)) for the available period of record at each of these three gauges. Inspection of the historical time series EC data does not indicate an obvious increasing trend. Hence, the available historical data does not provide strong evidence that the Goulburn River salinity, downstream of the Bylong River, is increasing in response to mining or other land use impacts.

Water within the proposed Bylong mine water management system that may have elevated salinity levels will be recycled within the site water management system and managed to prevent any discharge. Hence, operation of the Project will have no measureable impact on the salinity in the Bylong River or the Goulburn River.

Table 4 – Goulburn River stream gauges downstream of Bylong River confluence

Gauge no.	Gauge name	Catchment area (km^2)	Period of record for EC
210006	Coggan	3,340	2012-2017
210016	Kerrabee	4,950	2002-2017
210031	Sandy Hollow	6,810	1992-2017

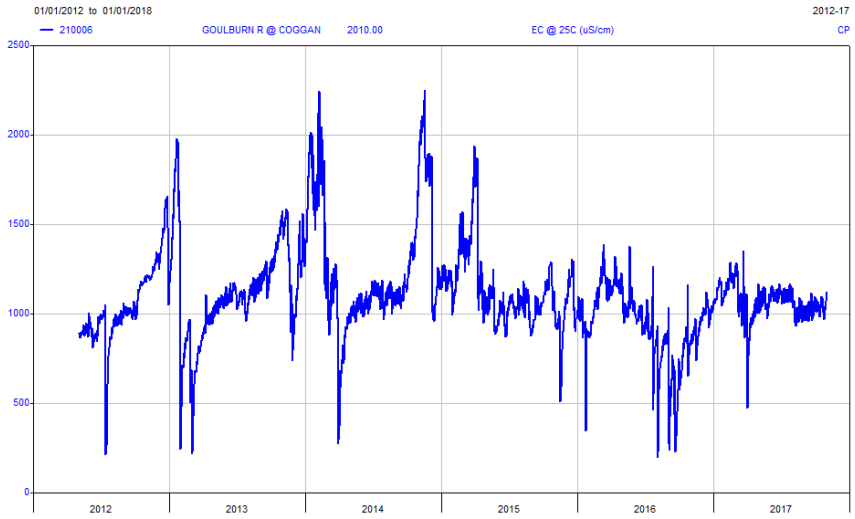


Figure 4 - Goulburn River at Coggan - EC

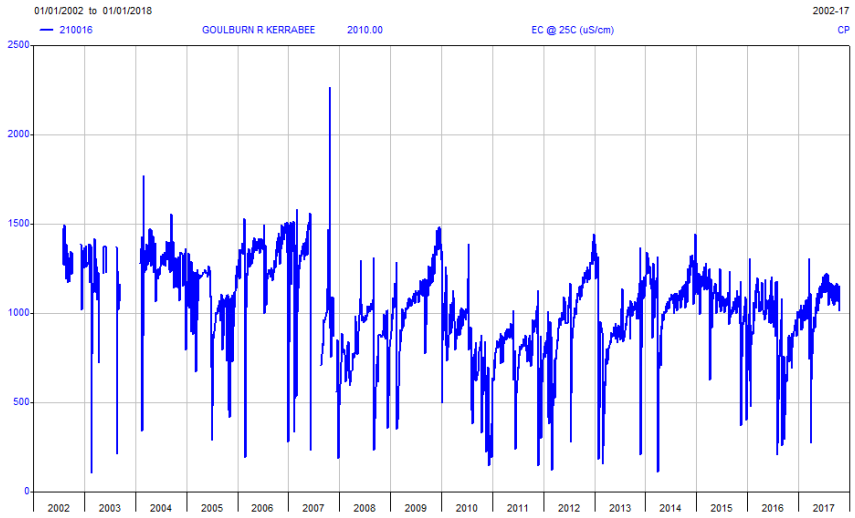


Figure 5 - Goulburn River at Kerrabee - EC

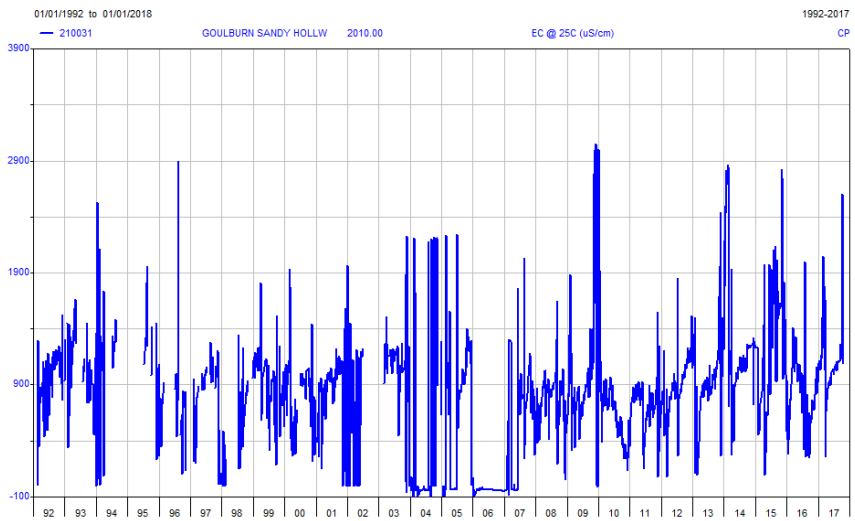


Figure 6 - Goulburn River at Sandy Hollow - EC

5 CONCLUSIONS

The containment of mine-affected water is a key component of the water management strategy for the proposed Bylong Coal Mine.

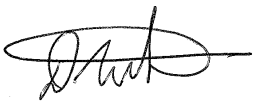
The results of the sensitivity analysis show that even with unrealistically high estimates of potential surface water and groundwater inflows, the available water storage capacities within the mine water management system will be more than sufficient for full containment for at least the first 20 years of the Project. This provides an extended period over which to monitor and validate the performance of the system and many years lead time to adaptively manage the site water storage through modifications to the water management system and/or mine plan. Hence, there is high confidence that the system can be managed over the life of the Project life to prevent discharge of mine-affected water.

The effective containment of mine-affected water on the site will prevent adverse impacts of the Project on water quality in the Bylong River and the downstream Goulburn River system.

Please do not hesitate to contact me if you require further information.

For and on behalf of

WRM Water & Environment Pty Ltd



David Newton, Director

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