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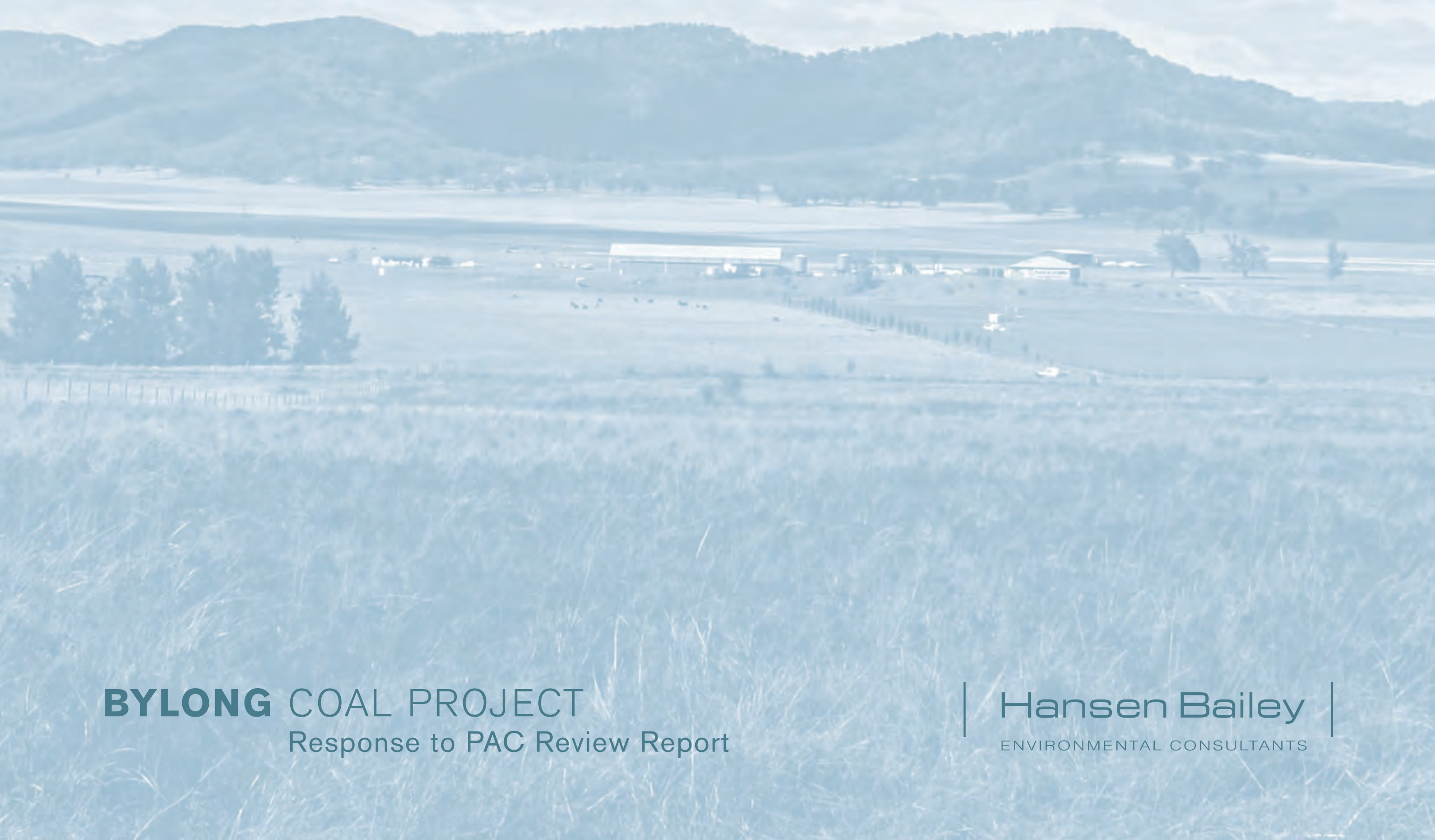
Surface Water Response to PAC Report



BYLONG COAL PROJECT
Response to PAC Review Report

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

0887-07-B5

Nathan Cooper
Hansen Bailey
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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.

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

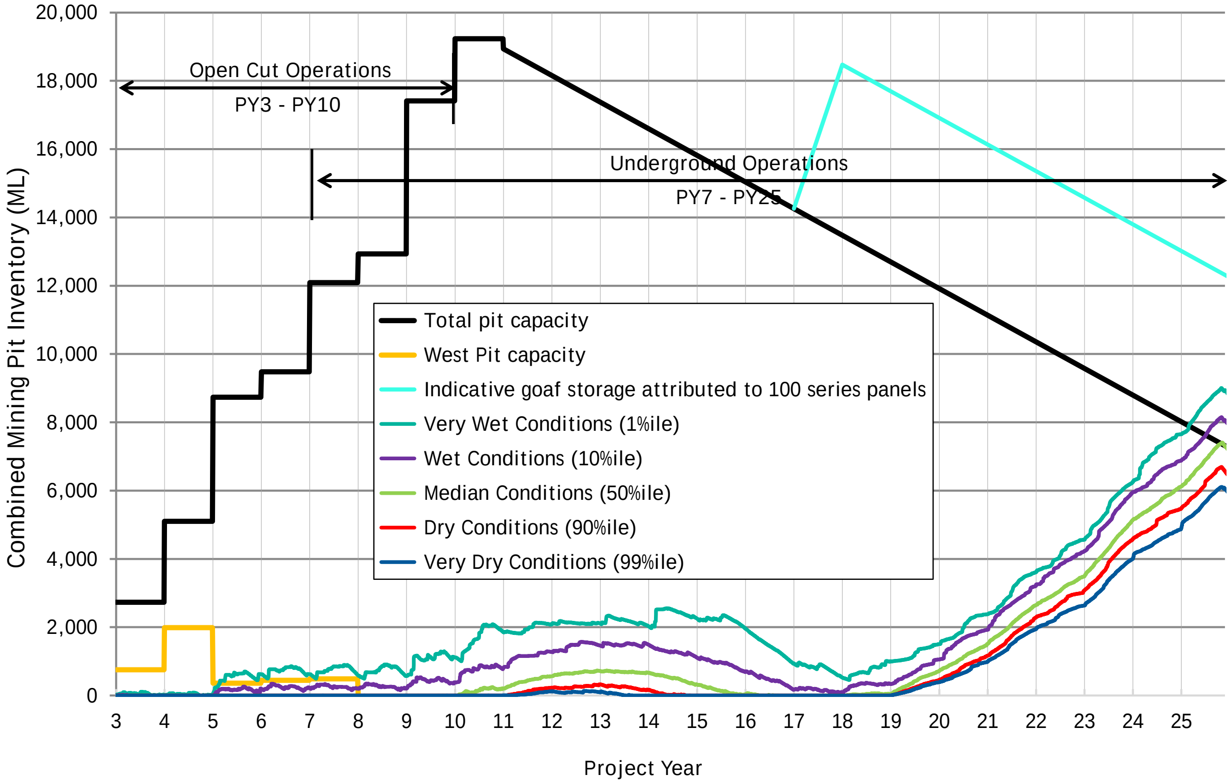

Figure 1 - Combined open cut mining area stored inventory

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

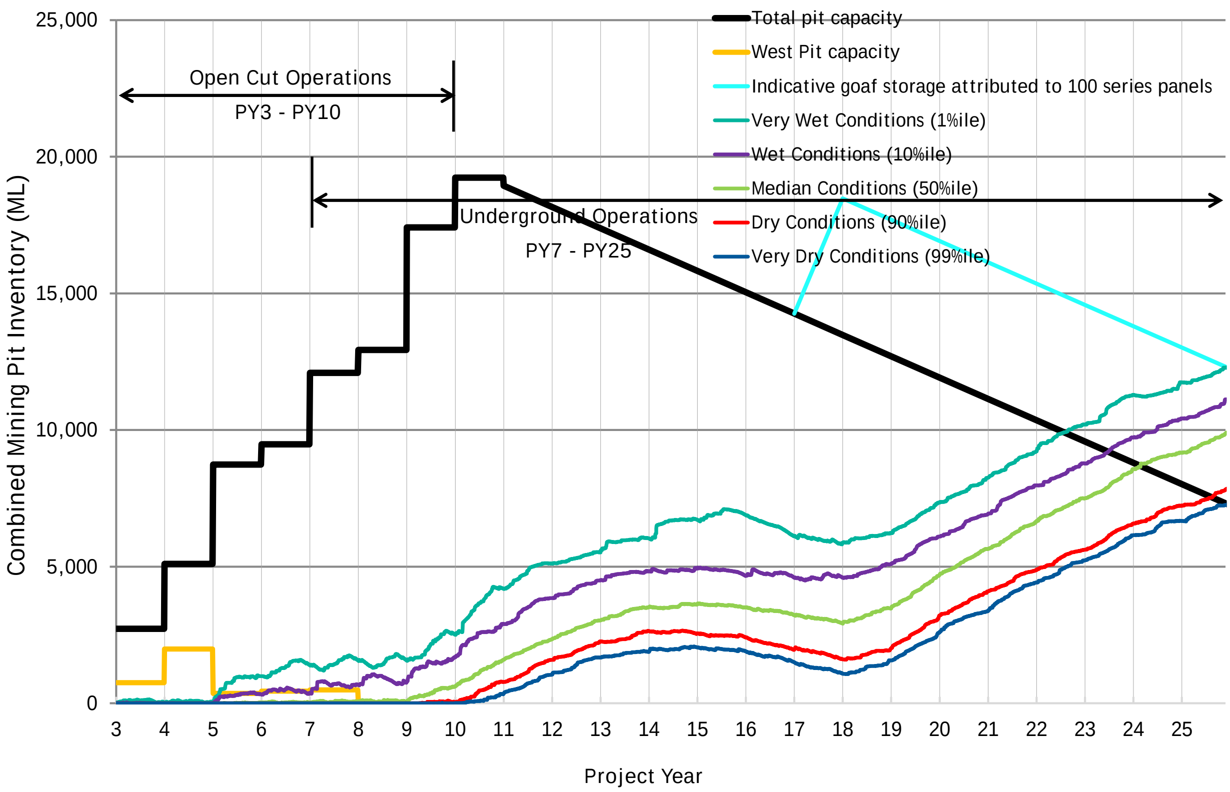

Figure 2 - Sensitivity Case 1 results for stored water inventory (Revised runoff)

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.

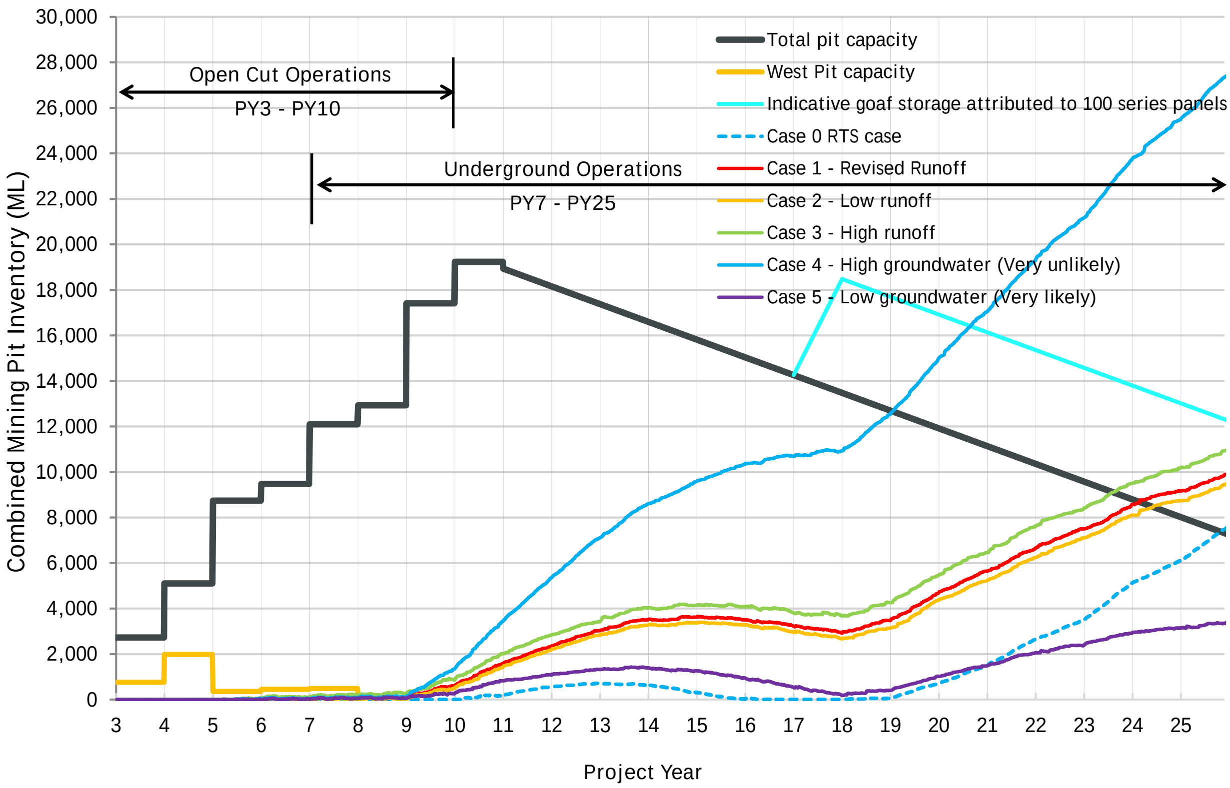

Figure 3 - Sensitivity case results for stored water inventory (50th percentile)

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

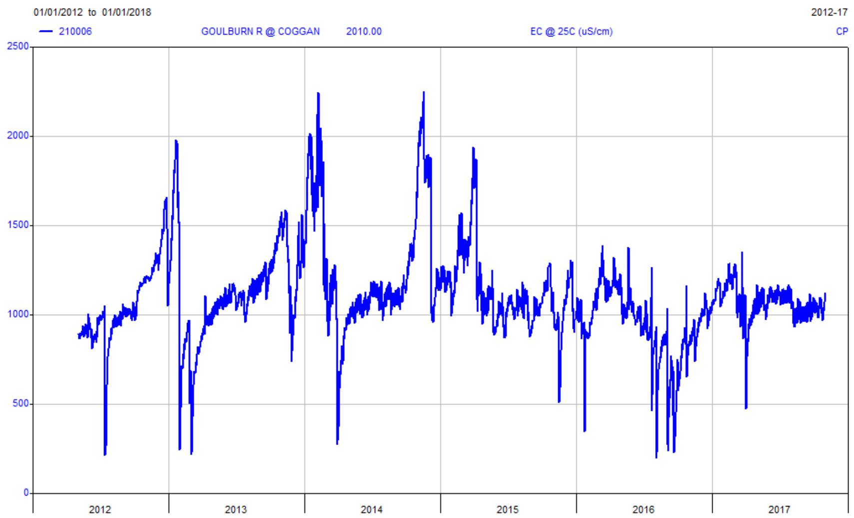

Figure 4 - Goulburn River at Coggan - EC

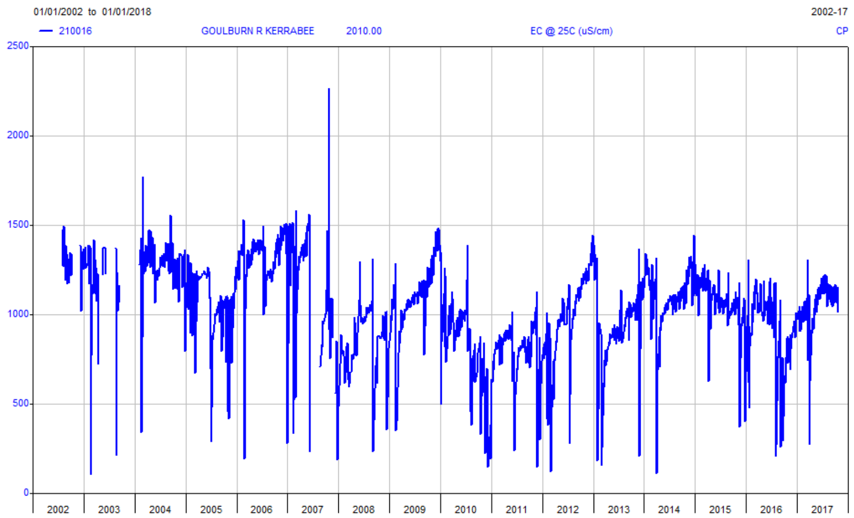

Figure 5 - Goulburn River at Kerrabee - EC

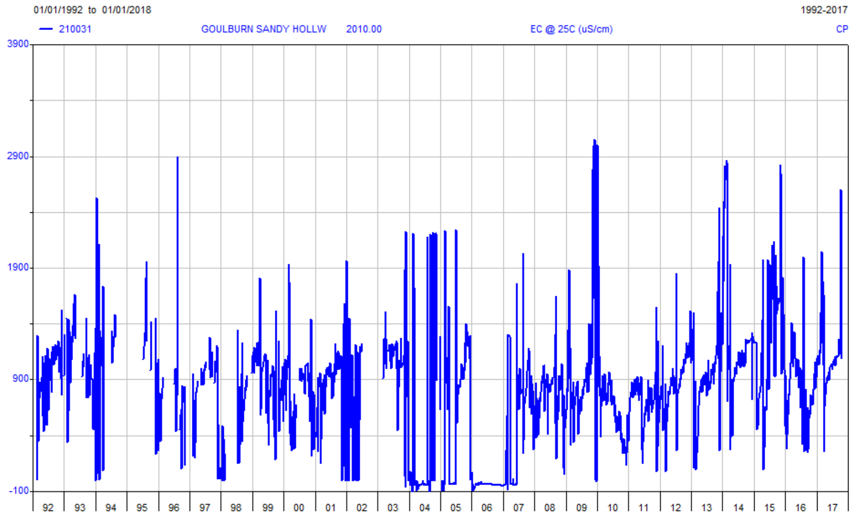

Figure 6 - Goulburn River at Sandy Hollow - EC

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

References:

Hansen Bailey, 2016a	"Bylong Coal Project, Response to Submissions", Hansen Bailey, 23 March 2016
Hansen Bailey, 2016b	"Bylong Coal Project, Supplementary Response to Submissions", Hansen Bailey, 19 August 2016
WRM, 2015a	"Bylong Coal Project, Surface Water and Flooding Impact Assessment", WRM Water & Environment, Ref. 0887-01-P3, 18 June 2015
WRM, 2015b	"Wilpinjong Extension Project, Surface Water Assessment", WRM Water & Environment, Ref. 1052-01-B9, 25 November 2015
WRM, 2016	"Bylong Coal Project - Water Balance Modelling for Revised Groundwater Inflows (Base Case)", WRM Water & Environment, Ref. 0887-03-D2, 17 August 2016