Jacobs

Memorandum

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Subject	**Request for additional information**	**Project Name**	Bayswater Power Station Upgrade
Attention	Matthew Parkinson	**Project No.**	SSD-9697
From	Thomas Muddle and Costante Conte		
Date	27 April 2021		
Copies to	**Shaun Da Costa**		

1. Background

AGL Macquarie Pty Limited (AGLM) owns and operates the Bayswater Power Station (Bayswater), located south-east of Muswellbrook in the Local Government Areas (LGA) of Muswellbrook and Singleton. AGLM are proposing to undertake a range of upgrades to Bayswater aimed at improving the environmental performance of ash, salt and water management infrastructure and associated rehabilitation outcomes referred to as the Bayswater Water and Other Associated Operational Works (WOAOW) Project (the Project).

The Project is State significant development under the *Environmental Planning and Assessment Act 1979* (NSW) and the Environmental Impact Statement (EIS) for the Project was placed on public exhibition between 1 July 2020 and 30 July 2020. The Department of Planning, Industry and Environment (DPIE) received a total of 39 submissions in relation to the Project during the exhibition period (17 from government authorities, nine from special interest groups and organisations and 13 from the general public).

A response to submissions (RtS) report was prepared to address the issues raised in the submissions and submitted to the DPIE and subsequently made publicly available on the DPIE Major Projects Portal. The RtS included a Review of Seepage and Water Assessment, an updated Biodiversity Development Assessment Report, an updated Aboriginal Cultural Heritage Assessment Report and a Coal Ash Characterisation Report.

Following submission of the RtS, the NSW Environment Protection Authority (EPA) issued a request for additional information (EPA RFI) seeking additional information relating to impacts of the Project on surface water and groundwater and proposed management measures.

AGLM has consulted with the EPA and DPIE regarding the issues raised in the EPA RFI and DPIE has undertaken a visit to the site to gain an understanding of existing conditions and the Bayswater Ash Dam (BWAD) seepage management system.

This memorandum addresses information requested in the EPA RFI as clarified during further discussions with the EPA and DPIE in relation to the manner in which seepage rates to Bayswater Creek were calculated and presented in the Seepage and Water assessment of the RtS.

This Memorandum is structured as follows:

- Background

- Additional assessment undertaken
- Clarification of issues with water balance calculation
- Revised assumptions
- Consideration of scale of seepage issue
- Clarification of proposed seepage management improvement works
- Consideration of residual seepage risks to the environment.

2. Additional assessment undertaken

As requested by AGLM, Jacobs has undertaken a review of the water balance calculations presented in the RTS, including the underlying assumptions that resulted in the calculations that approximately:

- 8.7 to 8.75 megalitres (ML) per day of seepage could be occurring under variable climactic conditions under the existing scenario, and
- 8.73 to 9.24 ML per day of seepage that could occur under the proposed scenario prior to the BWAD being closed and capped.

These findings were presented in Table 4.4 of Appendix B to the RtS and were based on water balance calculations which relied largely on the estimated inputs and outputs to the BWAD and ultimately assumed that unaccounted for water must be lost in seepage.

In undertaking this review, the fundamental assumptions previously obtained for the water balance as part of the EIS were reviewed for accuracy through a workshop with relevant AGLM and Jacobs staff. This review identified that the water balance model did not take into account the water removed from the BWAD via the return water pumping system. While actual pumping rates are not recorded by AGLM, the capacity of the system and the pumping duration records indicate that all previously unaccounted water could be accommodated by this return water system. On this basis, the estimates of seepage to Bayswater Creek contained in the Appendix B to the RTS are considered to be significantly overestimated under both the existing and proposed scenarios.

Based on the additional information provided regarding the operation of the BWAD return water pumping system, Jacobs considers that the numerical water balance modelling approach adopted to calculate the potential seepage volumes and seepage changes resulting from the Project is not suitable as it cannot accommodate the level of uncertainty arising from the unrecorded pumping rates of the return water system, the seepage collection dam returns and other processes and catchments reporting to the overall ash management system.

Jacobs considers that a more accurate approach is to estimate the potential magnitude of change in seepage rates based on factors that could contribute to an increase in seepage rates. These factors are considered to be limited to changes in seepage rates due to increases in the:

- Overall ash dam area
- Hydrostatic head pressure from increased decant water level and height of ash emplacement
- Surface area of water and saturated ash against dam walls and natural landforms where seepage may occur.

A detailed seepage model has not been produced for the purposes of calculating seepage rates.

3. Clarification of issues with water balance calculations in the RTS

Appendix B to the RTS reported on the results of a GoldSim water balance model which was developed and used to calculate the volume of water in storages at the end of each day by accounting for inflows and outflows. The GoldSim water balance model was developed based on the schematic presented in Appendix A of Appendix E of the EIS.

The main contributing factors to the water balance included in the model were:

- Average daily water volumes in ash slurry delivered to the BWAD (8.2 ML / day)
- Direct rainfall to decant basin
- Runoff
- Evaporation
- Seepage collection pond return water
- Demineralisation effluent (0.78 ML/d).

A high-level model calibration was carried out as part of the model to estimate the BWAD seepage loss rate based on the observed BWAD water pond level data. AGLM provided Jacobs with the BWAD bathymetric data from a survey undertaken at the end of August 2019 and Jacobs used the data to develop relationships between BWAD pond water elevation, pond storage volume and pond area.

During the model calibration process, the BWAD estimated seepage rate was adjusted in order to obtain a reasonably good match between simulated and observed pond water storage volumes for the period at the end of August 2019. The best match between simulated and observed pond water storage volumes was obtained when the BWAD seepage rate applied to the model was between 105 L/s and 110 L/s.

The model did not take account of the BWAD return water volumes which are transported via the return water pumping system. Since the model was developed and reported on in the RTS, AGLM has confirmed that return water pumping occurs and provides operational water to the Return Water Tanks which supply the Bayswater ash transfer system to both the BWAD and Ravensworth voids.

While the volume of return water pumping is unknown, AGLM has now confirmed that the return water system operated for a combined 22,298 hours during the calibration period with a pumping name plate capacity of 650l/s. Accordingly, if the pumps were running at full speed during this period, the volume of water removed from the BWAD via the return water system would far exceed volumes which the model (incorrectly) assigned to seepage meaning the match between the simulated and observed pond water storage volumes could be achieved with no unaccounted seepage.

In addition, the review of the model has identified that the rainfall included was limited to rain falling directly onto the decant pond surface area (which will decrease over time because of the ash beaching strategy), without including a corresponding increase in run-off from an increased ash beach surface or infiltration within the BWAD. If recalculated, this would be expected to result in increase in unaccounted for water under the proposed scenario.

4. Revised assumptions

In light of the further information now available which highlights the level of uncertainty in the BWAD water balance model assumptions, Jacobs considers the use of a water balance model to calculate likely seepage rates is fundamentally flawed.

Further, since the BWAD water balance model was prepared, AGLM has continued to progress the detailed design plans for the BWAD augmentation and in doing so revised assumptions on ash generation and management rates to 2035. These revised assumptions are provided by AGLM as follows:

- Average coal consumption up to 2035 of approximately 6.3 million tonnes per annum
- 27% Coal/Ash Ratio up to 2035
- Fly Ash to Bottom Ash Ratio of 86:14
- Approximately 80% of fly ash to Ravensworth voids and 20% to BWAD
- All bottom ash to BWAD
- Average water content in bottom ash slurry of 70%
- Average water content in fly ash slurry of 40%.

The BWAD has the following main water inputs:

- Water contained in Bottom Ash slurry
- Water contained in the Fly Ash slurry directed to BWAD
- Direct rainfall to the natural BWAD catchment
- Rainfall and process water reporting to the ash sluiceways or effluent processing and collection system
- Washdown water and potential fire water deluge.

The further information provided by AGLM has confirmed that the water used to make the ash slurries which are directed to the BWAD and Ravensworth voids is pumped from the BWAD. The only circumstances in which deliberate make-up water is typically added to the system from the AGLM Water Access Licence allocations is during return water system maintenance (approximately 120-170 ML per year between 2018 and 2020). Process water and effluent volumes were previously identified in the model as not exceeding 1 ML/day.

The BWAD has the following water outputs:

- Return water pumped from BWAD decant pond to the return water tanks which supply the ash plant used to transfer ash to BWAD or Ravensworth
- Based on typical 60 /40 ash/water ratio for fly ash transfers approximately 1.3 ML/day of water may be lost from the system via Ravensworth with the remainder recirculated
- Evaporation
- Infrequent discharges under significant rainfall events via the emergency spillway to Lake Liddell which is licenced under the Environmental Protection Licence 779 (note that no discharges from the spillway have occurred since 2014)
- Seepage.

The following represents Jacobs understanding of current seepage from the BWAD as informed by information provided by AGLM:

- Seepage through the main embankment of the BWAD is captured in Seepage Collection Ponds 1 and 2, measured via various V-notches (approximately 0.78ML/day on average) and reported in accordance with dam safety requirements and returned to the BWAD
- Seepage through northern saddle dam is measured by V notch (approximately 0.1ML/day on average) and reported in accordance with dam safety requirements but is neither captured nor returned
- Seepage to the south of the BWAD is the subject of investigation recently provided to the EPA and has been conservatively estimated to be in the order of 0.4 ML/day for the 900 m length of the southern boundary
- Seepage rates below the dam and from the base of BWAD are unknown but have been identified as predominately generated from the right (southern) abutment and reporting to the Seepage Collection system
- Seepage which bypasses Seepage Collection Pond 1 (or overflows) reports to Seepage Collection Pond 2
- Seepage Collection Ponds 1 and 2 are fitted with return water pumps that operate on an as needs basis (typically three hours per day and estimated as currently returning approximately 0.13 ML per day)
- Seepage Collection Pond 1 and 2 currently have large catchments such that clean water run-off is also captured and added to system and overflows occur in significant rainfall events.

AGLM has confirmed that water levels have been maintained in the BWAD to provide environmental freeboard, avoid overflows and ensure sufficient volume of return water is available for ash transfers since 2014. While water inputs or outputs are not currently measured, the system has operated without significant volumes of make-up water being required. In the absence of significant make-up water being added, and based on the revised assumptions outlined above, the review confirmed that a loss of 8-9 ML per day in seepage as estimated in the model presented in the RTS cannot be occurring from the BWAD.

5. Revised consideration of the seepage impacts of the Project

The BWAD is currently approved and operational. The Project proposes to augment the BWAD and make a number of improvements to water management structures and systems to ensure continued collection and reuse of process water and return waters from the BWAD. Accordingly, only the magnitude of change to the seepage levels from the BWAD resulting from the Project and the measures proposed to manage any such changes are required to be assessed in determining the development application for the Project under the *Environmental Planning and Assessment Act 1979 (NSW)*.

The additional information provided as part of the review of the water modelling contained in the RTS has confirmed that reliance on a water balance to calculate the current BWAD seepage loss is flawed given the level of uncertainty in most input and output volumes.

Jacobs considers that the potential impacts of the Project on seepage from the BWAD is as follows:

- The footprint of ash emplacement within the natural catchment of the BWAD will increase by up to16.7 hectares from existing, with new inundation limited to the south of the existing footprint
- The standing water level in the decant pond will be maintained at marginally higher level, up to 1 m higher at the end of the proposed Stage 3 Augmentation
- The ash depth will increase by an average of 6.5 m as a result of the Project but the saturation zone will continue to be limited by decant water level
- The Project will result in a potential increase in overall head pressure at the Main Embankment of 0.03%
- Any increase in seepage through the main embankment as a result of the Project, if any, would be captured for the most part and returned via the existing seepage collection systems. Therefore, no increase in impact is considered likely
- Seepage at the main embankment is driven primarily by water in the BWAD being in contact with the embankment wall. In a scenario where the decant pond level were increased by 1 m, the seepage rate has been estimated to increase from 0.78 ML/d to 0.86 ML/d
- Emplaced ash in the BWAD has a low hydraulic permeability in the order of $8x10^{-6}$ to $9x10^{-6}$ m/sec (Aurecon 2015) for recently deposited ash and $1x10^{-6}$ m/sec to $1x10^{-6}$ m/sec (U.S. DOT 2016) for older and compacted ash. Accordingly, the permeability of the ash decreases over time as the ash compacts under its own weight. Additionally, due to the depositional methodology, the ash is likely to be stratified, causing a greater horizontal permeability (Kh) compared to the vertical permeability (Kv). The difference between the Kv and Kh is likely to be approximately one order of magnitude. Therefore, the downward migration of BWAD water to the underlying hydrostratigraphic units is expected to be low
- The current seepage rates through northern Saddle Dam wall are in the order of 0.1 ML/d. This rate may increase as a result of the Project increasing the hydrostatic head within any additional ash emplaced in the northern section of the BWAD. That said, ash placement in this area against existing dam wall is largely complete and the wall raise to accommodate higher ash levels proposed as part of the Project would be designed with seepage prevention measures so increased seepage rates to the environment are expected to be minimal
- Seepage rates to the south of the BWAD have been conservatively estimated to be 0.42 ML/d and the Stage 1 works proposed as part of the Project may cause this seepage rate to increase slightly to 0.62 ML/d (an increase of 0.2 ML/day), due to the increased hydrostatic head of the ash placement. This potential increase in seepage rate is not expected to cause a significant change to the current seepage conditions
- Seepage that may bypass the Main Embankment seepage collection system may increase as a result of the Project however would predominantly report to the catchment of Seepage Pond 2 proposed for upgrade as part of the Project.

On this basis, the Project may result in an additional 0.3 ML/d of seepage from the BWAD (0.2 ML/d south of the BWAD and 0.1ML/day at the Main Embankment).

As noted in the EIS and RtS, the Project includes the capping and rehabilitation of the BWAD at its planned end of life. Once Bayswater power station ceases to operate and operational water inputs cease to be provided to the BWAD and the BWAD is capped, seepage rates will ultimately decline.

6. Clarification of proposed seepage management improvement works

The RTS provides details of AGLM's commitment to upgrade the BWAD seepage collection system to maximise the volume of BWAD seepage loss flows that are captured by the seepage pond collection and pumped back to BWAD to reduce impacts on Lake Liddell and Bayswater Creek. As outlined in the RTS, the upgrades to the seepage collection and return water system proposed as part of the Project include:

- Installation of capture and return of seepage through the northern Saddle Dam
- Improvements to Seepage Collection Pond 1 and 2 include lowering the pumps and increasing the pumping duration to return more seepage
- Clean water diversions to minimise non-seepage water reporting to seepage collection infrastructure, providing greater capacity to handle wet weather events without loss to Bayswater Creek.

As outlined in the RTS, and with reference to the recommendations in AECOM (2016), these measures have the potential to reduce seepage loss by approximately 0.78 ML/day (284 ML/yr), which is more than double the predicted increased seepage potential outlined in the previous section.

Further, AGLM has committed to preparing and implementing an updated water management plan for the Project, including for the Bayswater Ash Dam (BWAD). The water management plan will include:

- Further monitoring data of existing groundwater wells and surface water conditions at the locations suggested by the EPA in its letter of 11 February 2021
- Updated hydrogeological assessment of seepage as part of detailed design
- Further details of the seepage improvement works which will be sized and designed to maximise seepage collection and return to ensure a net reduction in seepage loss
- The development of site specific environmental goals - informed by existing site conditions - to ensure no material impacts result from the works forming part of the Project (noting that impacts related to existing approved operations do not form part of the Project)
- Ongoing monitoring against the site specific environmental goals
- A strategy for verifying impacts and implementing management actions if the site specific environmental goals are exceeded.

The water management plan would be prepared in consultation with the EPA and ultimately approved by the DPIE before being implemented by AGLM. As agreed in consultation between DPIE and EPA, AGLM will commence additional water sampling ahead of preparing the water management plan for the Project to build on the currently available dataset.

7. Conclusion

The RtS stated that while not resolving all current ash dam seepage issues, the Project remains an improvement in comparison to a 'do-nothing' scenario and water quality is expected to remain suitable based on the absence of water users or sensitive environments within the zone of influence of seepage. With the clarifications raised in this memorandum (including a significant reduction in estimated seepage rates under the existing and proposed scenarios, and having regard to the measures included as part of the Project to capture and return more seepage) the Project is expected to result in improved water quality outcomes in relation to seepage from the BWAD when compared to a do nothing scenario.

References

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U.S. DOT (2016). *User Guidelines for Waste and Byproduct Materials in Pavement Construction*. U.S. Department of Transportation/Federal Highway Administration. Last updated on 03/08/2016. Accessed at: https://www.fhwa.dot.gov/publications/research/infrastructure/structures/97148/cfa54.cfm