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Attention: Nagindar Singh
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Project Name: Springvale Mine Extension Project - Modification 2
Project Number: IA132100

Subject: Additional Water Quality Uncertainty Analysis (Mine Water Discharge)

Dear Nagindar

1. Introduction

This letter has been prepared in accordance with our proposal (IA097101/047a, dated 14 December 2016) to undertake additional uncertainty analysis simulations of the Regional Water Quality Impact Assessment Model (RWQIAM).

The letter has been prepared in advance of a request from the Department of Planning and Environment (DP&E) for additional water quality uncertainty analysis of the *Water Assessment – SSD 5594 Modification 2* prepared by Jacobs (Jacobs, 2016).

This letter has been prepared in advance due to a similar request made by DP&E with respect to the Surface Water Assessment of Modification 1 (DP&E, 2016) in regard to the impact of potential daily fluctuations in mine water discharge.

The uncertainty analysis was undertaken on results presented in Jacobs (2016) with respect to Approved and Proposed conditions in regard to Modification 2. The uncertainty analysis comprised modelling potential increase in daily mine water discharge, however, conservatively, was assumed to be a constant and maximum increase ranging from +1ML/d to +6ML/d.

The outcome of uncertainty analysis, detail presented below, is that modelled results are not significantly different to that already presented with respect to Modification 2 in Jacobs (2016).

It is highlighted that the current limit to discharge (quantity) at Springvale Licensed Discharge Point 009 (LDP009) is 30ML/d.

2. Analysis and Assessment

2.1 Model Approach

As presented in Jacobs (2016), the RWQIAM was updated to account for several small changes to the calibration model.

For the purpose of consistency with Jacobs (2016), the calibration and prediction periods have been left unchanged in the uncertainty analyses presented in this letter as:

- 1 January 1979 to 30 June 2014 (Calibration Period)
- 1 July 2014 to 31 December 2032 (Prediction Period)

Mine Inflow Distribution

Mine water inflows used in the RWQIAM for the Water Assessment – SSD 5594 Modification 2 (Section 4.4.3 of Jacobs (2016) were based on the recently updated groundwater model predictions by the CSIRO (presented in CSIRO, 2016). Those predictions incorporate the translocation in time of the approved and now modelled other longwalls (LW423 and LW501 to 503). This is an updated simulation from CSIRO (2015).

Figure 1 is the mine inflow distribution used in the RWQIAM (after Figure 4.6 of Jacobs (2016)). Further detail is presented in Section 4.4.3 of Jacobs (2016).

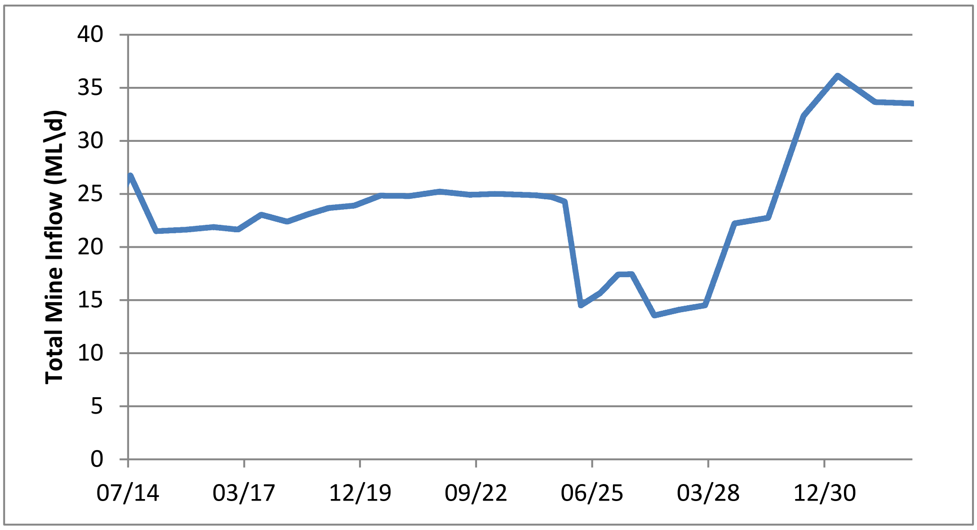

Figure 1 : Assumed Mine Inflow Distribution (ML/d, after Figure 4.6 of Jacobs (2016))

Potential Daily Fluctuation in Mine Inflow

During discussion with DP&E, it was noted that day-to-day variability in mine inflow can be up to +6ML/d. To assess the change in water quality in the Coxs River due to changes in mine water inflow incorporating potential daily fluctuations in mine water discharge, a conservative approach was adopted. The approach adopted was to add a constant and maximum increase to the mine inflow rate presented in **Figure 1**.

Several simulations were prepared:

- +1ML/d, +2ML/d, +3ML/d, +4ML/d and +6ML/d.

As noted in Jacobs (2016), inflow to underground operations do dominate the local site water balance at both Angus Place and Springvale mines. An assumption adopted in the RWQIAM has been that these inflows are representative of mine water discharge.

From **Figure 1**, peak mine inflow rate is 36ML/d in 2031. The current discharge limit at Springvale LDP009, as prescribed in EPL 3607 is 30ML/d. With respect to the simulations presented in this letter, mine inflow rates represent a peak inflow of 42ML/d in 2031, being 36ML/d + 6ML/d = 42ML/d.

Jacobs (2016) presents simulations of Water Strategy WS2b-S. The water strategy definitions refer back to the time of the EIS. WS2b-S assumes mine water discharge at Angus Place LDP001 to Kangaroo Creek is constant at 2ML/d, with the remainder discharged through Springvale LDP009 to Sawyers Swamp Creek. The "-S" nomenclature refers to sequential implementation. The sequential implementation simulations were prepared at the time due to Angus Place being placed into Care and Maintenance in March 2015.

Figure 2 presents the mine inflow distribution incorporating the constant and maximum increase in flow rate used in the uncertainty analyses presented in this report.

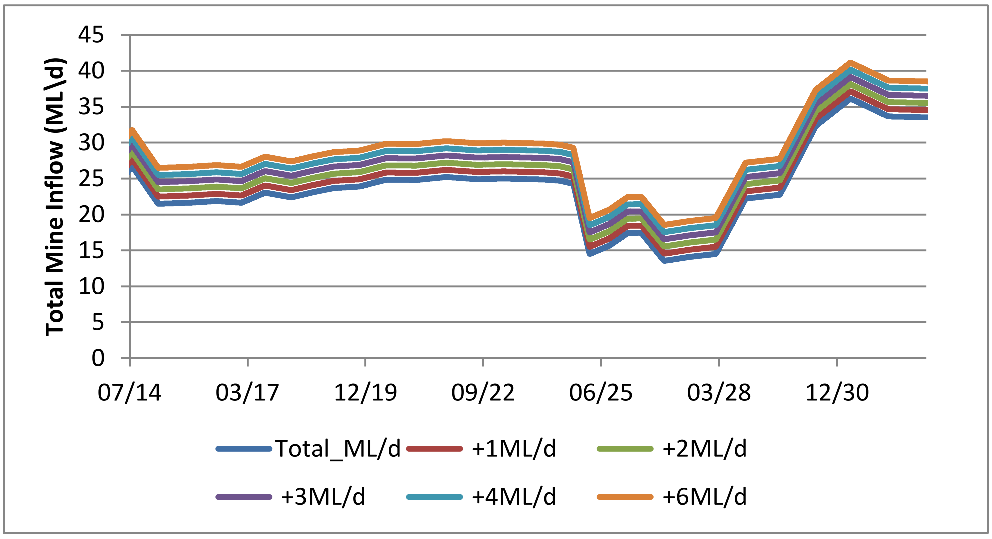

Figure 2 : Mine Inflow Distribution (ML/d) – Uncertainty Analysis Simulations

From **Figure 2**, peak mine inflow rate, and therefore mine water discharge rate, is 42ML/d in the +6ML/d simulation.

Water Quality Characteristics

Jacobs (2016) presents, in detail, the approach adopted in representing water quality characteristics of mine water discharge to Kangaroo Creek (Angus Place LDP001) and Sawyers Swamp Creek (Springvale LDP009).

The water quality criterion comprises (from the Conditions of Consent for SSD 5594):

- "*Discharge all groundwater inflow mine water (except from the Renoun workings) through the Springvale Delta Water Transfer Scheme*
- *Meet limits for salinity of 700 (50th percentile), 900 (90th percentile) and 1,000 (100th percentile) µS/cm EC by 30 June 2017*
- *Meet a limit for salinity of 500 (90^{th} percentile) µS/cm EC by 30 June 2019*

- *Eliminate acute and chronic toxicity from LDP009 discharges to aquatic species by 30 June 2017, with acute toxicity defined as >10% effect relative to the control group and chronic toxicity defined as >20% effect relative to the control group*".

Two interpretations of the water quality criterion were presented in Jacobs (2016):

- Linear Fit
- Stepped Fit

The 'Linear Fit' approach assumed a linear difference between the 0th percentile (set at 500µS/cm) and the 50th percentile (700µS/cm), a linear difference between the 50th and the 90th percentile (900µS/cm) and a linear difference between the 90th percentile (900µS/cm) and the 100th percentile (1000µS/cm).

The 'Stepped Fit' approach assumed a constant value for salinity between the 0th percentile (set at 700µS/cm) and the 50th percentile (700µS/cm), and a constant value for salinity between 51st percentile (900µS/cm) and the 90th percentile (900µS/cm) and a constant value between 91st percentile (1000µS/cm) and the 100th percentile (1000µS/cm).

Uncertainty analyses presented in this letter considered both of these interpretations.

It is noted that the assumed water quality characteristics presented in Jacobs (2016) were not changed; merely the magnitude of mine water discharge at Springvale LDP009 was increased by +1ML/d, +2ML/d, +3ML/d, +4ML/d and +6ML/d. **Figure 2** presents graphically, the increase in magnitude. As noted above, the assumption of 2ML/d discharge from Angus Place LDP001 was not changed in the simulations presented in this letter.

2.2 Model Results

The change in water flow and salinity is quantified at multiple locations in the RWQIAM. Appendix A provides model output locations, including a list of modelled reservoirs.

As noted, the change to flow and salinity is modelled at multiple locations (~280 nodes), however, output from the RWQIAM, for the uncertainty analysis is only presented at two locations, as these are pertinent:

- Lake Wallace (Model Node #074)
- Lake Burragorang (Model Node #280)

Lake Wallace was selected as it is the first water store in the Upper Coxs River catchment and has been adopted as the reporting location with respect to Condition 13, Schedule 4 of SSD 5994. Lake Burragorang was selected because it is relevant with respect to the Neutral or Beneficial Effect test (WaterNSW, 2015).

2.2.1 Linear Fit to Water Quality Criteria

The model control files pertaining to the 'Linear Fit' uncertainty analysis simulations are as follows:

- 0020_Rev0_UNC-WS2b-S_1ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_1ML_01a_NUL.gsp
- 0020_Rev0_UNC-WS2b-S_2ML_01a.gsp

- 0020_Rev0_UNC-WS2b-S_2ML_01a_NUL.gsp
- 0020_Rev0_UNC-WS2b-S_3ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_3ML_01a_NUL.gsp
- 0020_Rev0_UNC-WS2b-S_4ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_4ML_01a_NUL.gsp
- 0020_Rev0_UNC-WS2b-S_6ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_6ML_01a_NUL.gsp

Lake Wallace (Model Node #074)

Table 2.1 presents the outcome of the uncertainty analysis simulations at Lake Wallace (#074).

The results from Jacobs (2016) are also presented in **Table 2.1** for the purpose of reference. It is highlighted that the percentage differences are calculated with respect to the original results from Jacobs (2016) in regard to Approved simulations. For the Proposed simulations, the percentage differences are calculated with respect to the equivalent Approved simulation. Further detail is provided in the footnote to **Table 2.1**.

As discussed in Jacobs (2016) the Approved and Proposed simulations take into account the water quality characteristics (linear fit and stepped fits discussed above) and therefore are a more sophisticated approach to that presented in the original environmental impact assessment was required.

From **Table 2.1**, the modelled median salinity in Lake Wallace in the Approved simulation is 305mg/L, is 305mg/L (0% increase) in the Approved +1ML/d simulation and is 306mg/L (0% increase) in the Approved +6ML/d simulation.

From **Table 2.1**, the modelled 90th percentile salinity in Lake Wallace in the Approved simulation is 426mg/L, is 428mg/L (1% increase) in the Approved +1ML/d simulation and is 441mg/L (4% increase) in the Approved +6ML/d simulation.

From **Table 2.1**, the modelled median salinity in Lake Wallace in the Proposed simulation is 306mg/L and is 307mg/L (0% increase) in the +6ML/d simulation.

From **Table 2.1**, the 90th percentile modelled salinity is 480mg/L in the Proposed simulation and is 502mg/L (5% increase) in the +6ML/d simulation.

The modelled increase in salinity between Approved and Approved +6ML/d simulation and the Proposed and Proposed +6ML/d simulation is 0% with respect to modelled median salinity and is 5% at modelled maximum salinity. Uncertainty analysis indicates that the modelled increase in mine water discharge does not lead to a significantly different water quality to that already presented in the Modification 2 Water Assessment (Jacobs, 2016).

As noted in Jacobs (2016), the increase in salinity in Lake Wallace between the Approved and Proposed simulation is considered to be minor.

Lake Burragorang (Model Node #280)

Table 2.2 presents the outcome of the uncertainty analysis simulations at Lake Burragorang (#280).

Table 2.1: Prediction Daily Statistics at #074 (Lake Wallace) (adapted from Table 4.12 of Jacobs (2016)) – Linear Fit to Water Quality Criteria

	APPROVED Jacobs (2016)	APPROVED +1ML/d	% Change[1]	APPROVED +2ML/d	% Change[1]	APPROVED +3ML/d	% Change[1]	APPROVED +4ML/d	% Change[1]	APPROVED +6ML/d	% Change[1]	PROPOSED Jacobs (2016)	PROPOSED +1ML/d	% Change[2]	PROPOSED +2ML/d	% Change[2]	PROPOSED +3ML/d	% Change[2]	PROPOSED +4ML/d	% Change[2]	PROPOSED +6ML/d	% Change[2]
Minimum	157	157	0%	157	0%	157	0%	157	0%	157	0%	157	156	-1%	156	-1%	156	-1%	156	-1%	156	-1%
5%	233	234	0%	235	1%	235	1%	236	1%	237	2%	234	235	0%	236	1%	237	1%	238	2%	240	3%
10%	255	256	0%	257	1%	258	1%	258	1%	260	2%	256	256	0%	257	0%	258	1%	259	1%	261	2%
20%	275	275	0%	276	0%	276	0%	277	1%	278	1%	275	276	0%	276	0%	277	1%	277	1%	278	1%
50%	305	305	0%	305	0%	306	0%	306	0%	306	0%	306	306	0%	306	0%	307	0%	307	0%	307	0%
80%	369	371	1%	373	1%	373	1%	374	1%	377	2%	392	396	1%	399	2%	403	3%	407	4%	415	6%
90%	426	428	0%	430	1%	433	2%	435	2%	441	4%	480	484	1%	487	1%	491	2%	495	3%	502	5%
95%	462	466	1%	469	2%	472	2%	475	3%	479	4%	518	523	1%	527	2%	531	3%	535	3%	543	5%
Maximum	561	566	1%	571	2%	576	3%	580	3%	589	5%	600	605	1%	609	2%	614	2%	618	3%	627	5%

Note 1: % Change is Percentage Change compared to Approved Simulation. i.e. APPROVED +1ML/d is compared to APPROVED.

Note 2: % Change is Percentage Change compared to Proposed Simulation. i.e. PROPOSED +1ML/d is compared to PROPOSED.

Table 2.2: Prediction Daily Statistics at #280 (Lake Burragorang) (adapted from Table 4.22 of Jacobs (2016)) – Linear Fit to Water Quality Criteria

	APPROVED Jacobs (2016)	APPROVED +1ML/d	% Change[1]	APPROVED +2ML/d	% Change[1]	APPROVED +3ML/d	% Change[1]	APPROVED +4ML/d	% Change[1]	APPROVED +6ML/d	% Change[1]	PROPOSED Jacobs (2016)	PROPOSED +1ML/d	% Change[2]	PROPOSED +2ML/d	% Change[2]	PROPOSED +3ML/d	% Change[2]	PROPOSED +4ML/d	% Change[2]	PROPOSED +6ML/d	% Change[2]
Minimum	88	88	0%	88	0%	89	1%	89	1%	89	1%	88	88	0%	88	0%	89	1%	89	1%	89	1%
5%	91	91	0%	91	0%	91	0%	91	0%	91	0%	91	91	0%	91	0%	91	0%	91	0%	91	0%
10%	92	92	0%	92	0%	92	0%	92	0%	93	1%	92	92	0%	92	0%	92	0%	92	0%	93	1%
20%	96	96	0%	96	0%	96	0%	96	0%	96	0%	96	96	0%	96	0%	96	0%	96	0%	96	0%
50%	100	100	0%	100	0%	100	0%	100	0%	100	0%	100	100	0%	100	0%	101	1%	101	1%	101	1%
80%	102	102	0%	102	0%	102	0%	102	0%	102	0%	102	102	0%	102	0%	102	0%	102	0%	103	1%
90%	102	102	0%	103	1%	103	1%	103	1%	103	1%	103	103	0%	103	0%	103	0%	103	0%	103	0%
95%	103	104	1%	104	1%	104	1%	104	1%	104	1%	104	104	0%	104	0%	104	0%	104	0%	104	0%
Maximum	104	104	0%	104	0%	104	0%	105	1%	105	1%	104	104	0%	105	1%	105	1%	105	1%	105	1%

Note 1: % Change is Percentage Change compared to Approved Simulation. i.e. APPROVED +1ML/d is compared to APPROVED.

Note 2: % Change is Percentage Change compared to Proposed Simulation. i.e. PROPOSED +1ML/d is compared to PROPOSED.

From **Table 2.2**, the modelled median salinity in Lake Burragorang in the Approved simulation is 100mg/L, is 100mg/L (0% increase) in the Approved +1ML/d simulation and is 100mg/L (1% increase) in the Approved +6ML/d simulation.

From **Table 2.2**, the modelled 90th percentile salinity in Lake Burragorang in the Approved simulation is 102mg/L, is 102mg/L (0% increase) in the Approved +1ML/d simulation and is 103mg/L (1% increase) in the Approved +6ML/d simulation.

From **Table 2.2**, the modelled median salinity is 100mg/L in the Proposed simulation and is 101% (1% increase) in the Proposed +6ML/d simulation.

From **Table 2.2**, the modelled 90th percentile salinity in Lake Burragorang is 104mg/L in the Proposed simulation and is 105mg/L (1% increase) in the Proposed +6ML/d simulation.

The modelled increase in salinity between Approved and Approved +6ML/d simulation and the Proposed and Proposed +6ML/d simulation is 1% with respect to modelled median salinity and is 1% at modelled maximum salinity. Uncertainty analysis indicates that the increase in mine water discharge does not lead to a significant change in modelled water quality in Lake Burragorang in the Approved +6ML/d and Proposed +6ML/d simulation compared to Approved and Proposed simulations already presented in the Modification 2 Water Assessment (Jacobs, 2016).

As noted in Jacobs (2016), the increase in salinity in Lake Burragorang between the Approved and Proposed simulation is considered to be negligible.

2.2.2 Stepped Fit to Water Quality Criteria

The model control files pertaining to the 'Stepped Fit' uncertainty analysis simulations are as follows:

- 0020_Rev0_UNC-WS2b-S_Step_1ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_Step_1ML_01a_NUL.gsp
- 0020_Rev0_UNC-WS2b-S_Step_2ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_Step_2ML_01a_NUL.gsp
- 0020_Rev0_UNC-WS2b-S_Step_3ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_Step_3ML_01a_NUL.gsp
- 0020_Rev0_UNC-WS2b-S_Step_4ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_Step_4ML_01a_NUL.gsp
- 0020_Rev0_UNC-WS2b-S_Step_6ML_01a.gsp
- 0020_Rev0_UNC-WS2b-S_Step_6ML_01a_NUL.gsp

Lake Wallace (Model Node #074)

Table 2.3 presents the outcome of the uncertainty analysis simulations at Lake Wallace (#074).

From **Table 2.3**, the modelled median salinity in Lake Wallace in the Approved simulation is 340mg/L, is 342mg/L (0% increase) in the Approved +1ML/d simulation and is 347mg/L (2% increase) in the Approved +6ML/d simulation.

Table 2.3: Prediction Daily Statistics at #074 (Lake Wallace) (adapted from Table 4.12 of Jacobs (2016)) – Stepped Fit to Water Quality Criteria

	APPROVED Jacobs (2016)	APPROVED +1ML/d	% Change[1]	APPROVED +2ML/d	% Change[1]	APPROVED +3ML/d	% Change[1]	APPROVED +4ML/d	% Change[1]	APPROVED +6ML/d	% Change[1]	PROPOSED Jacobs (2016)	PROPOSED +1ML/d	% Change[2]	PROPOSED +2ML/d	% Change[2]	PROPOSED +3ML/d	% Change[2]	PROPOSED +4ML/d	% Change[2]	PROPOSED +6ML/d	% Change[2]
Minimum	157	157	0%	157	0%	157	0%	157	0%	156	-1%	157	156	0%	156	0%	156	0%	156	0%	156	-1%
5%	242	244	1%	245	1%	247	2%	248	2%	251	4%	244	245	1%	247	1%	249	2%	250	2%	254	4%
10%	270	272	1%	274	1%	275	2%	277	3%	280	4%	272	273	1%	275	1%	277	2%	279	3%	282	4%
20%	301	303	1%	304	1%	305	1%	307	2%	309	3%	302	303	1%	305	1%	306	1%	307	2%	309	3%
50%	340	342	1%	343	1%	344	1%	345	1%	347	2%	342	343	1%	344	1%	345	1%	346	1%	348	2%
80%	404	406	0%	409	1%	410	1%	411	2%	414	2%	413	414	0%	416	1%	417	1%	420	2%	421	2%
90%	443	445	0%	447	1%	450	2%	453	2%	458	3%	482	486	0%	490	1%	494	2%	498	2%	505	3%
95%	470	473	1%	477	1%	480	2%	483	3%	489	4%	520	524	1%	528	1%	532	2%	537	3%	544	4%
Maximum	561	566	1%	571	2%	576	3%	580	3%	589	5%	600	605	1%	609	2%	614	3%	618	3%	627	5%

Note 1: % Change is Percentage Change compared to Approved Simulation. i.e. APPROVED +1ML/d is compared to APPROVED.

Note 2: % Change is Percentage Change compared to Proposed Simulation. i.e. PROPOSED +1ML/d is compared to PROPOSED.

From **Table 2.3**, the modelled 90th percentile salinity in Lake Wallace in the Approved simulation is 443mg/L, is 445mg/L (0% increase) in the Approved +1ML/d simulation and is 458mg/L (4% increase) in the Approved +6ML/d simulation.

From **Table 2.3**, the modelled median salinity in the Proposed simulation is 342mg/L and is 348mg/L (2% increase) in the Proposed +6ML/d simulation.

From **Table 2.3**, the modelled 90th percentile salinity in the Proposed simulation is 482mg/L and is 505mg/L (3% increase) in the Proposed +6ML/d simulation.

The modelled increase in salinity between Approved and Approved +6ML/d simulation and the Proposed and Proposed +6ML/d simulation is 0% with respect to modelled median salinity and is 5% at modelled maximum salinity. Uncertainty analysis indicates that the modelled increase in mine water discharge does not lead to a significantly different water quality to that already presented in the Modification 2 Water Assessment (Jacobs, 2016).

As noted in Jacobs (2016), the increase in salinity in Lake Wallace between the Approved and Proposed simulation is considered to be minor.

Lake Burragorang (Model Node #280)

Table 2.4 presents the outcome of the uncertainty analysis simulations at Lake Burragorang (#280) with respect to the stepped fit to water quality characteristics.

From **Table 2.4**, the modelled median salinity in Lake Burragorang in the Approved simulation is 100mg/L, is 100mg/L (0% increase) in the Approved +1ML/d simulation and is 101mg/L (1% increase) in the Approved +6ML/d simulation.

From **Table 2.4**, the modelled 90th percentile salinity in Lake Burragorang in the Approved simulation is 103mg/L, is 103mg/L (0% increase) in the Approved +1ML/d simulation and is 104mg/L (1% increase) in the Approved +6ML/d simulation.

From **Table 2.4**, modelled median salinity in the Proposed simulation is 100mg/L and is 101mg/L (1% increase) in the Proposed +6ML/d simulation.

From **Table 2.4**, the modelled 90th percentile salinity in the Proposed simulation is 103mg/L and is 104mg/L (1% increase) in the Proposed +6ML/d simulation.

The modelled increase in salinity between Approved and Approved +6ML/d and Proposed and Proposed +6ML/d is 1% with respect to modelled median salinity and is 1% at modelled maximum salinity. Uncertainty analysis indicates that the increase in mine water discharge does not lead to a significant change in modelled water quality in Lake Burragorang in the Approved +6ML/d and Proposed +6ML/d simulation compared to Approved and Proposed simulations already presented in the Modification 2 Water Assessment (Jacobs, 2016).

As noted in Jacobs (2016), the increase in salinity in Lake Burragorang between the Approved and Proposed simulation is considered to be negligible.

Table 2.4: Prediction Daily Statistics at #280 (Lake Burragorang) (adapted from Table 4.22 of Jacobs (2016)) – Stepped Fit to Water Quality Criteria

	APPROVED Jacobs (2016)	APPROVED +1ML/d	% Change[1]	APPROVED +2ML/d	% Change[1]	APPROVED +3ML/d	% Change[1]	APPROVED +4ML/d	% Change[1]	APPROVED +6ML/d	% Change[1]	PROPOSED Jacobs (2016)	PROPOSED +1ML/d	% Change[2]	PROPOSED +2ML/d	% Change[2]	PROPOSED +3ML/d	% Change[2]	PROPOSED +4ML/d	% Change[2]	PROPOSED +6ML/d	% Change[2]
Minimum	88	88	0%	88	0%	89	1%	89	1%	89	1%	88	88	0%	88	0%	89	1%	89	1%	89	1%
5%	91	91	0%	91	0%	91	0%	91	0%	91	0%	91	91	0%	91	0%	91	0%	91	0%	91	0%
10%	92	92	0%	92	0%	92	0%	92	0%	93	1%	92	92	0%	92	0%	92	0%	92	0%	93	1%
20%	96	96	0%	96	0%	96	0%	96	0%	96	0%	96	96	0%	96	0%	96	0%	96	0%	96	0%
50%	100	100	0%	101	1%	101	1%	101	1%	101	1%	100	101	1%	101	1%	101	1%	101	1%	101	1%
80%	102	102	0%	102	0%	103	1%	103	1%	103	1%	102	103	1%	103	1%	103	1%	103	1%	103	1%
90%	103	103	0%	103	0%	103	0%	104	1%	104	1%	103	103	0%	103	0%	104	1%	104	1%	104	1%
95%	104	104	0%	104	0%	104	0%	105	1%	105	1%	104	104	0%	104	0%	105	1%	105	1%	105	1%
Maximum	105	105	0%	105	0%	105	0%	106	1%	106	1%	105	105	0%	105	0%	105	0%	106	1%	106	1%

Note 1: % Change is Percentage Change compared to Approved Simulation. i.e. APPROVED +1ML/d is compared to APPROVED.

Note 2: % Change is Percentage Change compared to Proposed Simulation. i.e. PROPOSED +1ML/d is compared to PROPOSED.

2.3 Assessment and Conclusion

Uncertainty analysis has been undertaken on potential daily fluctuations in mine water discharge on predicted change to salinity in the Coxs River using the RWQIAM.

For the purpose of conservativeness, the uncertainty analysis simulations in the RWQIAM were conducted assuming a constant and maximum increase in mine water discharge rate, ranging from +1ML/d to 6ML/d.

Two sets of analysis were undertaken, one with respect to a Linear interpretation of the water quality criteria and the other with respect to a Stepped interpretation of the water quality criteria.

Results indicate an increase of 5% in maximum salinity between Approved and Approved +6ML/d simulation and between Proposed and Proposed +6ML/d simulation with respect to Lake Wallace. Results indicate an increase in maximum salinity between Approved and Approved +6ML/d and Proposed and Proposed +6ML/d of 1% with respect to Lake Burragorang. The outcome of uncertainty analysis indicates that the increase in mine water discharge does not lead to significantly different modelled water quality compared to that already presented in the Modification 2 Water Assessment (Jacobs, 2016).

The environmental consequences of a further 5% increase in modelled 90th percentile salinity is considered to be minor with respect to water quality, since modelled and actual water quality remains within the range of historical observation.

The current limit to mine water discharge to the Coxs River via Sawyers Swamp Creek is 30ML/d, as presented in EPL 3607. If the discharge was 42ML/d, compared to the currently expected peak discharge of 36ML/d, the impact to flooding and geomorphology is considered to be negligible, since the discharge rate is significantly lower than that experienced in a typical 1 year ARI (Average Recurrence Interval) rainfall event.

Given the uncertainty analysis was undertaken with respect to mine water discharge, with no change to assumed water quality, there is no change to the assessment presented in Jacobs (2016) that the proposed modification to consent (MOD 2) will have a neutral impact with respect to the Neutral or Beneficial Effect water quality effect test.

3. References

CSIRO, 2015. *Appendix G – Alternative Mine Schedule: Angus Place and Springvale Colliery Operations - Groundwater Assessment.* Consultant report prepared by the CSIRO (Adhikary, D.P. and A. Wilkins) for Centennial Angus Place Pty Ltd and Springvale Coal Pty Ltd. Reference No. EP15346, dated January 2015.

CSIRO, 2016. SPR then APE including LW423, LW501 to LW503 Model Results. Consultant letter prepared by the CSIRO for Springvale Coal Pty Ltd. Reference No. N/A, dated 20 September 2016.

DP&E, 2016. *Springvale Coal Mod 1 – Information Request*. Correspondence to Springvale Coal Pty Ltd from the Department of Planning and Environment. Reference No. N/A, dated 13 December 2016.

Jacobs, 2016. *Water Assessment – SSD 5594 Modification 2*. Consultant report prepared by Jacobs Group (Australia) Pty Ltd for Springvale Coal Pty Ltd. Reference No. IA132100-0006-NW-RPT-00006_Rev2, dated 16 December 2016.

WaterNSW, 2015. *Neutral or Beneficial Effect on Water Quality Assessment Guideline*. Reference No. ISBN 987-0-9874680-3-1, dated February 2015.

4. Closing

Should you require additional information then please do not hesitate to contact our office.

Yours sincerely

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Attachments: Water Balance Modelling Locations (Figure and List)

H:\Projects-SLR\630-SrvNTL\630-NTL\630.11495 Centennial Drafting Support\06 SLR Data\01 Drafting\SV MOD 2 SEE\CAD\CURRENT\SLR_630.11495_FIGA_SV-COXSCATCH_SVMOD2_V2.dwg

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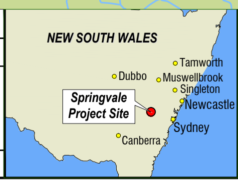

Figure A
Water Balance Modelling Locations in Coxs River Catchment

0.0 6.25 12.5 KM

Centennial Coal
Western Coal Services

Prepared by: SLR

A4

List of Model Output Locations

Five reservoirs, shown in **Figure A**, have been included in the RWQIAM:

- Lake Wallace (Node #074)
- Lake Lyell (Node #174)
- Thompsons Creek Reservoir (Node #272)
- Sawyers Swamp Creek Ash Dam (Node #297)
- Lake Burragorang/Warragamba Dam (Node #280).

Model predictions are presented for the following modelled locations in the Coxs River catchment and Lake Burragorang (**Figure A**).

Lake Wallace:

- Node #074[1] (Lake Wallace)

Lake Burragorang and above Lake Burragorang

- Node #280[1] (Lake Burragorang).

Note 1. All RWQIAM nodes are included in the simulations undertaken; however, output from only Node #074 and Node #280 is presented in this letter.