Appendix E

Response to groundwater independent peer review

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22 February 2021

Our ref: 754-SYDGE206418-3-AP-Rev1

EMM Consulting Pty Ltd
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Attention: Paul Freeman

Dear Paul

CGO Underground Development EIS - Addendum 1 of the hydrogeological assessment

The NSW Department of Planning, Industry and Environment (DPIE) contracted HydroGeoLogic Pty Ltd (HydroGeoLogic) to carry out a review of the hydrogeological assessment prepared by Coffey Services Australia Pty Ltd (Coffey) for EMM Consulting Pty Ltd (EMM) for the Evolution Cowal Gold Operation (CGO) Underground Development Environmental Impact Statement (EIS).

Following a meeting on Wednesday 25 November with representatives from DPIE, HydroGeoLogic, Evolution, EMM and Coffey, the HydroGeoLogic review (Cowal Gold Underground Development Groundwater Assessment Peer Review, prepared for DPIE by HydroGeoLogic, dated: 10 December 2020 (initial review)) was provided to Coffey by EMM on 14 December 2020.

This letter addresses the items raised in the HydroGeoLogic review in relation to the following hydrogeological assessments for the CGO Underground Development EIS:

- Cowal Underground Development EIS – Mine Site Hydrogeological Assessment (Coffey report ref: 754-SYDGE206418-3-AM, Final, dated 10 September 2020) (the mine site report).
- Cowal Gold Operations Underground EIS - Bland Creek Palaeochannel Borefield and Eastern Saline Borefield Groundwater Assessment (Coffey report ref: 754-SYDGE206418-3-AN-Rev1, dated 27 August 2020) (the BCPB report).

1. Provide documentation on the updated mine site model performance with an improved water balance error term (<1% for all times).

Mine site report reference: Section 8.2.7

The numerical groundwater model was updated to have a reduced maximum time step, in order to reduce the model mass balance error. Figure 1 shows the resulting model mass balance error for the updated model. This can be seen to be below 1% throughout the model calibration (to 2020) and predictive periods. The original model mass balance error is also shown in the figure. Figure 2 shows the model time steps for the original and updated models.

Figure 1: Model mass balance error for the updated and original models

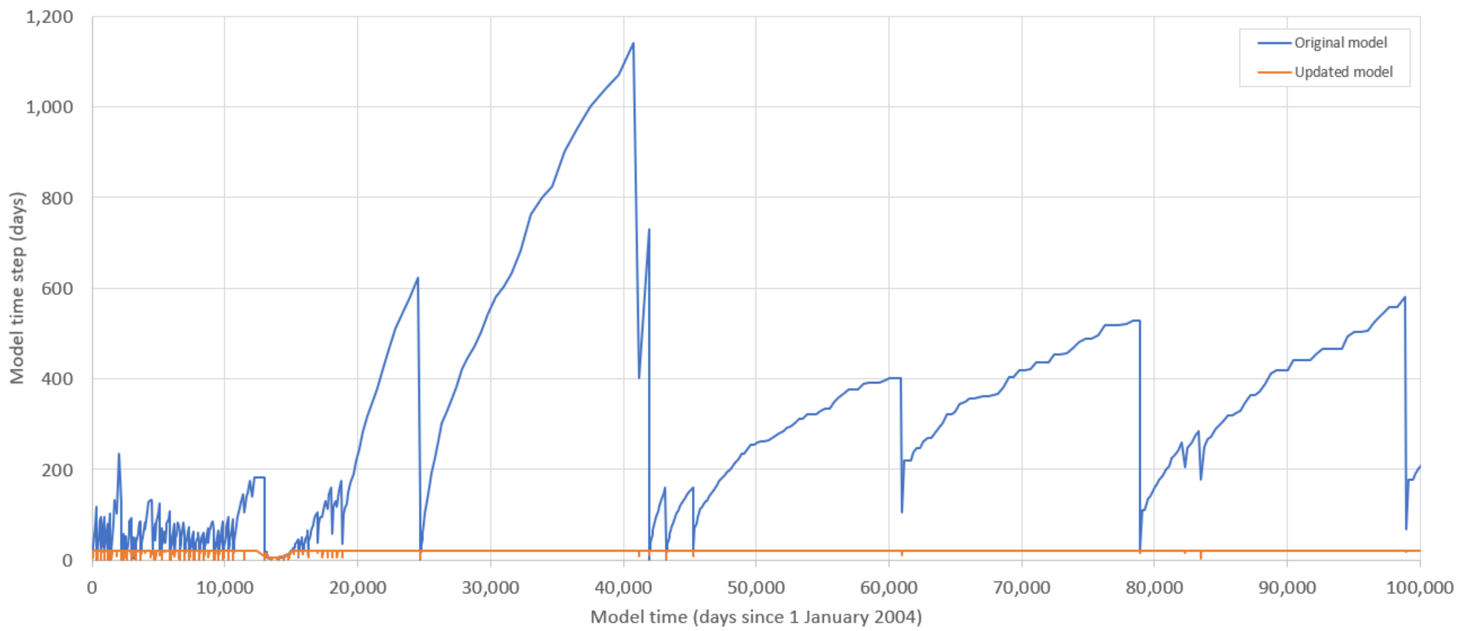

Figure 2: Model time step size for the updated and original models

Figure 3 presents the predicted inflow to the open pit, stopes and tunnels and the post mining infiltration to the paste backfill and tunnels for the updated and original models. The two models can be seen to produce very similar results, although there is a noticeable reduction in oscillations after approximately 2050.

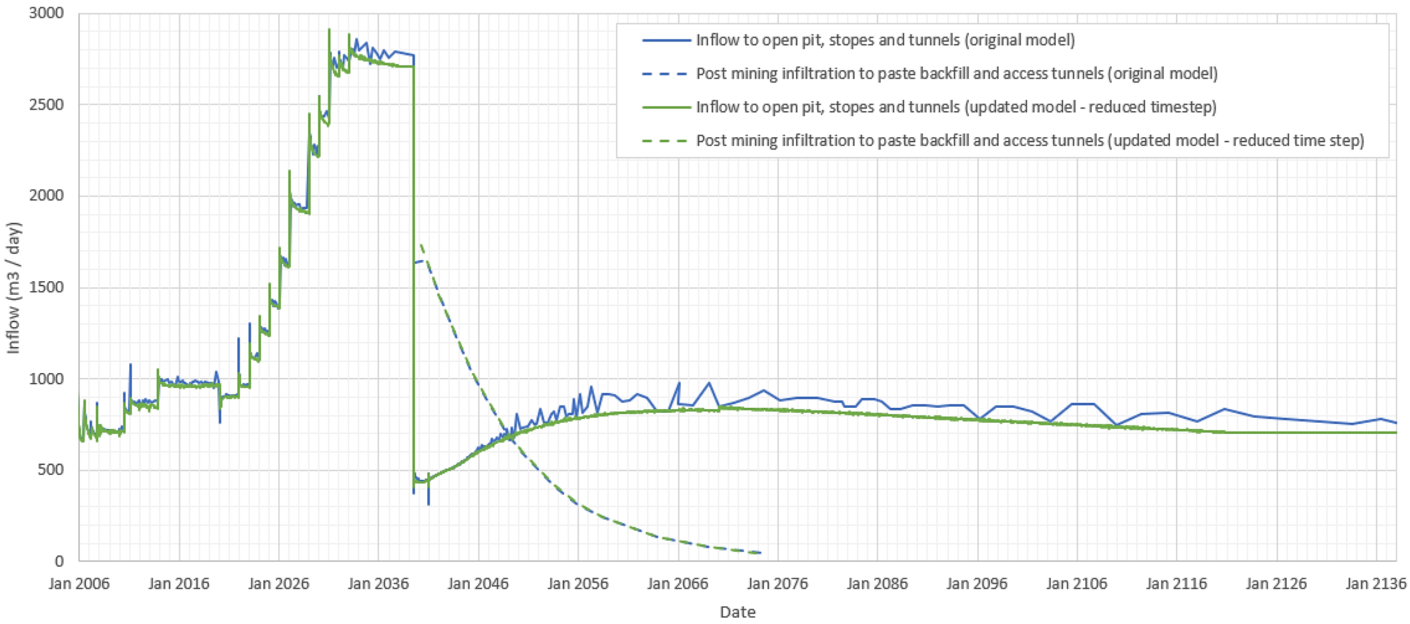

Figure 3: Updated modelled groundwater inflows (adapted from mine site report Figure 10-5)

Figure 4 presents a comparison of groundwater head contours for the original and updated models in 2076, when the mass balance error in the original model was well over 1%. The contours are nearly indistinguishable.

From this point forward, unless where referring to results directly from the mine site report, the updated model with reduced timestep size and mass balance error below 1% will be used.

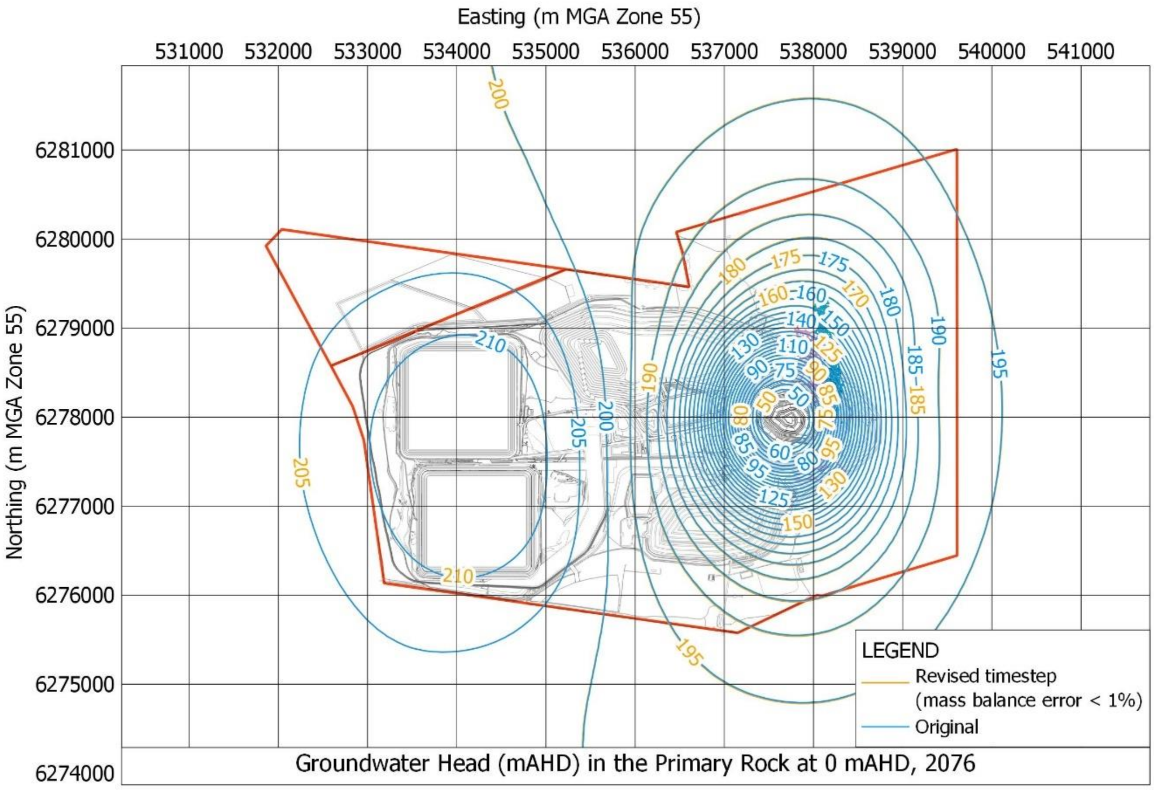

Figure 4: Comparison of groundwater head contours in the Primary Rock at 0 mAHD for the original and updated models (update to achieve mass balance < 1%)

2. Provide modelled and measured groundwater levels for observation bores near the eastern edge of the lease, including: GW704031, GW704252, GW703223, GW703225.

Mine site report reference: Section 6.4

The records for the publicly available bores GW704031, GW704252, GW703223 and GW703225 (as provided on http://www.bom.gov.au/water/groundwater/explorer/map.shtml) were used to assess the stratigraphic profile east of the mine site to provide a calibration to the gravity survey. Groundwater level observations at these bores were not publicly available at the time of writing the mine site report in September 2020. A search of these bores to confirm this was carried out on 21 December 2020. At that time no groundwater level information was available at those bores.

3. Provide more detail on the components of the water balance, notably components of discharge via dewatering bores, and via seepage faces at the pit walls and floor, and via horizontal drains, and leakage from the lake that is captured by the mine, including differences during lake full and empty periods.

Mine site report reference: Section 10

CGO currently holds 3650 units (ML) / annum in the Upper Lachlan Alluvial Zone 7 Management Zone within the Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources 2012.

Table 1 and Table 2 provide a breakdown of the components of seepage into the open pit and underground development at selected times for the model cases of a dry Lake Cowal and a full Lake Cowal respectively. These two cases were modelled by applying fixed head boundary conditions of 201.5 mAHD (dry lake case) or 206.5 mAHD (full lake case) to the surface of the model in the Lake Cowal area. The overall model water balances for the dry Lake Cowal case and the full Lake Cowal case in 2037 are shown in Table 3 and Table 4, respectively. Groundwater inflows during 2037 are representative of the period just prior to the end of underground mining when groundwater inflows are predicted to be at or close to their highest values.

Table 1 and Table 2 also show the predicted total groundwater inflow into the mine (open pit, stopes and access tunnels) originating from the Upper Lachlan Alluvium. This includes all groundwater originating from the Transported unit over an area encompassing the open pit and underground development and extending east to beyond the Lake Protection Bund and west to an area just outside the open pit. The predicted total groundwater inflow into the mine originating from the Upper Lachlan Alluvium is approximately 10% of the total inflow into the mine, reducing slightly towards the end of mining when substantially more inflow to the mine originates from the Primary Rock at elevations below -700 m AHD. The balance of the inflow to the mine comes from the fractured rock of the Lachlan Fold Belt Murray Darlin Basin (MDB) groundwater source.

Table 1: Components of groundwater seepage (m^3/day) at selected times for the dry Lake Cowal case (a negative number indicates seepage into the model)

Seepage component	Date			
	17-11-19	06-11-22	18-11-26	05-10-37
Pit walls	584	624	407	300
Pit floor	262	197	215	141
Dewatering bores	124	0	0	0
Access tunnels	0	115	512	722
Stopes	0	16	476	1555
TSF / IWL foundation	-447	-545	-602	-849
Western model boundary	-9	-10	-13	-100
Eastern model boundary	190	128	96	-198
Lake Cowal	1243	280	53	-104
Storage	-370	793	463	159
Rainfall infiltration	-1577	-1577	-1577	-1577
Total inflow to mine	970	952	1610	2718
Total inflow to mine from Upper Lachlan Alluvium groundwater source	107	101	102	78
Total inflow to mine from Lachlan Fold Belt MDB groundwater source	863	851	1508	2640
Percentage of total inflow to mine from Upper Lachlan Alluvium	11%	11%	6%	3%

Table 2: Components of groundwater seepage (m^3/day) at selected times for the full Lake Cowal case (a negative number indicates seepage into the model)

Seepage component	Date			
	17-11-19	09-09-22	18-11-26	03-12-37
Pit walls	584	625	409	287
Pit floor	262	198	215	141
Dewatering bores	124	0	0	0
Access tunnels	0	115	512	717
Stopes	0	16	476	1556
TSF / IWL foundation	-447	-548	-603	-854
Western model boundary	-9	-10	-13	-100
Eastern model boundary	190	222	219	-73
Lake Cowal	1244	-1482	-284	-408
Storage	-371	2406	686	321
Rainfall infiltration	-1577	-1577	-1577	-1577
Total inflow to mine	970	954	1612	2701
Total inflow to mine from Upper Lachlan Alluvium groundwater source	107	101	102	78
Total inflow to mine from Lachlan Fold Belt MDB groundwater source	863	853	1510	2623
Percentage of total inflow to mine from Upper Lachlan Alluvium	11%	11%	6%	3%

Table 3: Model mass balance, 5 October 2037 – dry Lake Cowal case

Component	Out (m^3/day)	In (m^3/day)
Fixed head and seepage face boundary conditions	2904.4	5401.4
Rainfall recharge	0	1577.4
Storage	5422.9	1290.5
Total	8327.3	8269.3
Absolute error	58.1	
Percentage error	0.70%	

Table 4: Model mass balance, 3 December 2037 – full Lake Cowal case

Component	Out (m^3/day)	In (m^3/day)
Fixed head and seepage face boundary conditions	2992.6	5719.1
Rainfall recharge	0	1577.4
Storage	5542.2	1207.9
Total	8534.8	8504.4
Absolute error	30.4	
Percentage error	0.36%	

Figure 5 and Figure 6 present inflows into the model from the fixed head western and eastern boundaries, and from the Lake Cowal time varying fixed head nodes, excluding rainfall recharge. These figures show the dry Lake Cowal and full Lake Cowal cases respectively. The results divide the eastern boundary into an upper and lower level. This was done to separate localised outflow at the top of the eastern model boundary which occurs due to the interaction of the Lake Cowal fixed head nodes and the eastern boundary fixed head nodes. This flow to the east from the eastern part of Lake Cowal has a negligible impact on inflows to the mine site. This can be seen more clearly in Figure 7, which shows the typical groundwater head contours along a west to east section through the mine in 2024.

Figure 5 shows a small amount of flow into the model from the Lake Cowal nodes for a dry Lake Cowal case. This is a result of a fixed head boundary condition of 201.5 mAHD being applied to these nodes for the dry Lake Cowal case. The rate of inflow to the model from the Lake Cowal nodes is under 5% of the total inflow to the mine and is not considered to affect the predicted inflow to the mine.

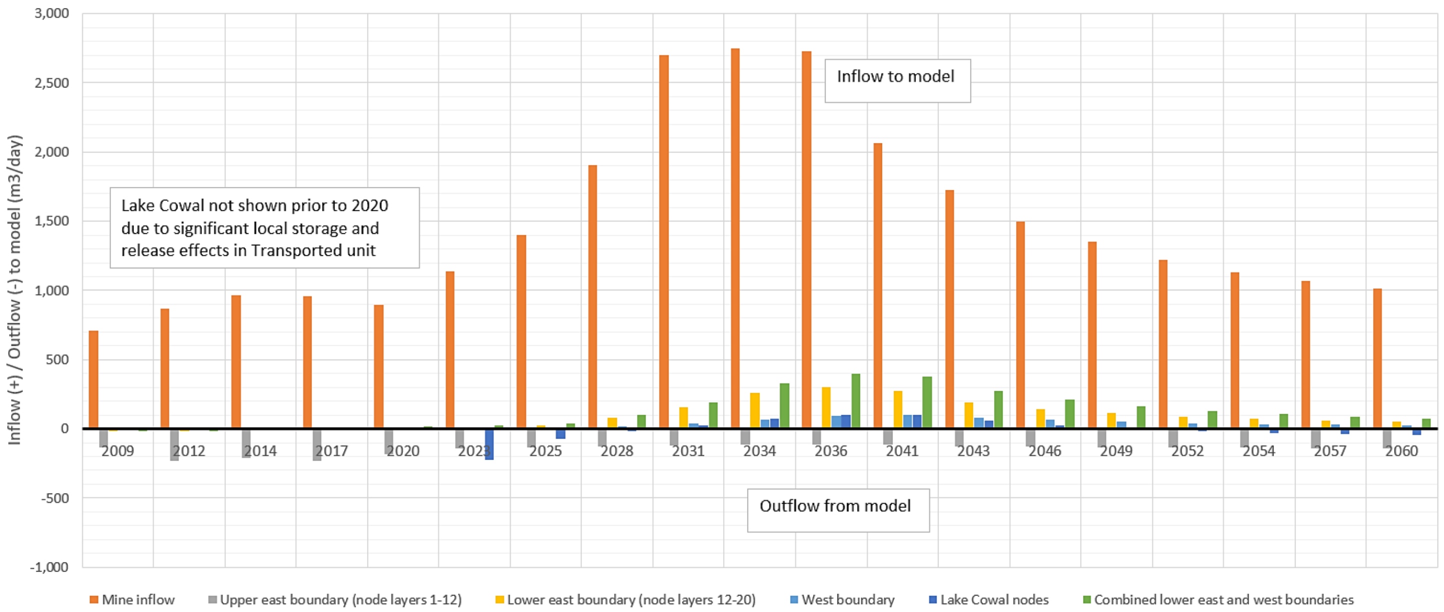

Figure 5: Inflow / outflow at model boundaries and Lake Cowal nodes for the dry Lake Cowal case

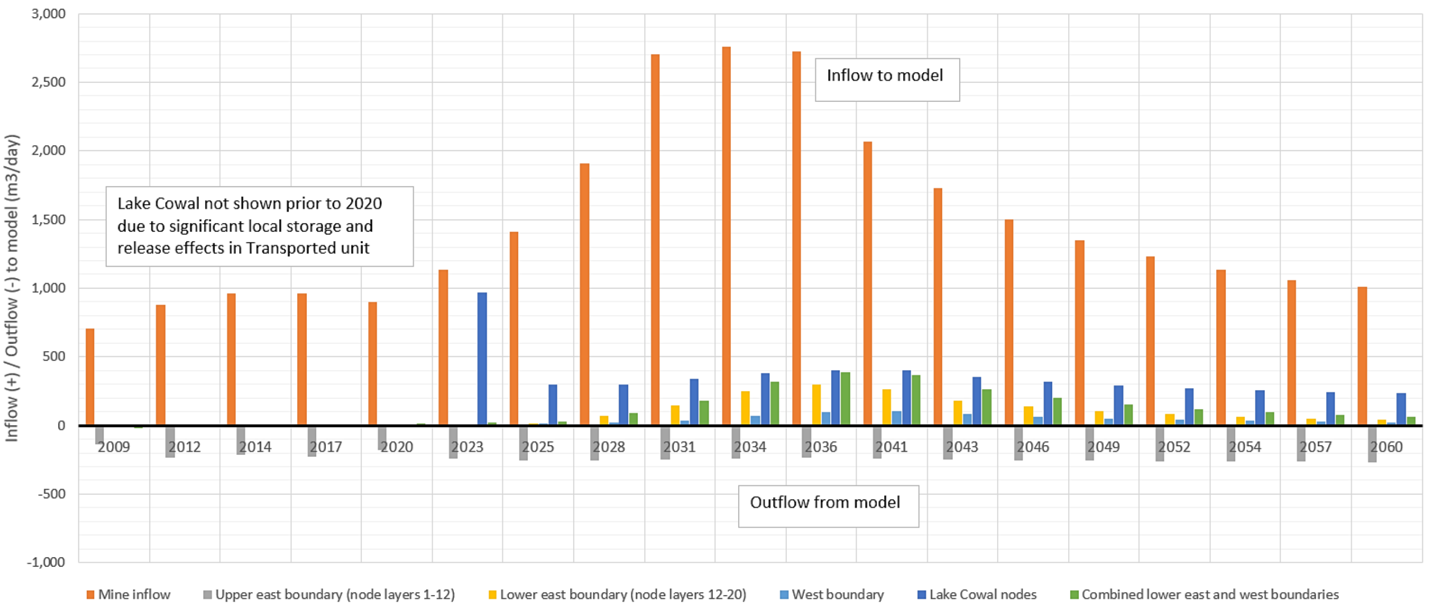

Figure 6: Inflow / outflow at model boundaries and Lake Cowal nodes for the full Lake Cowal case

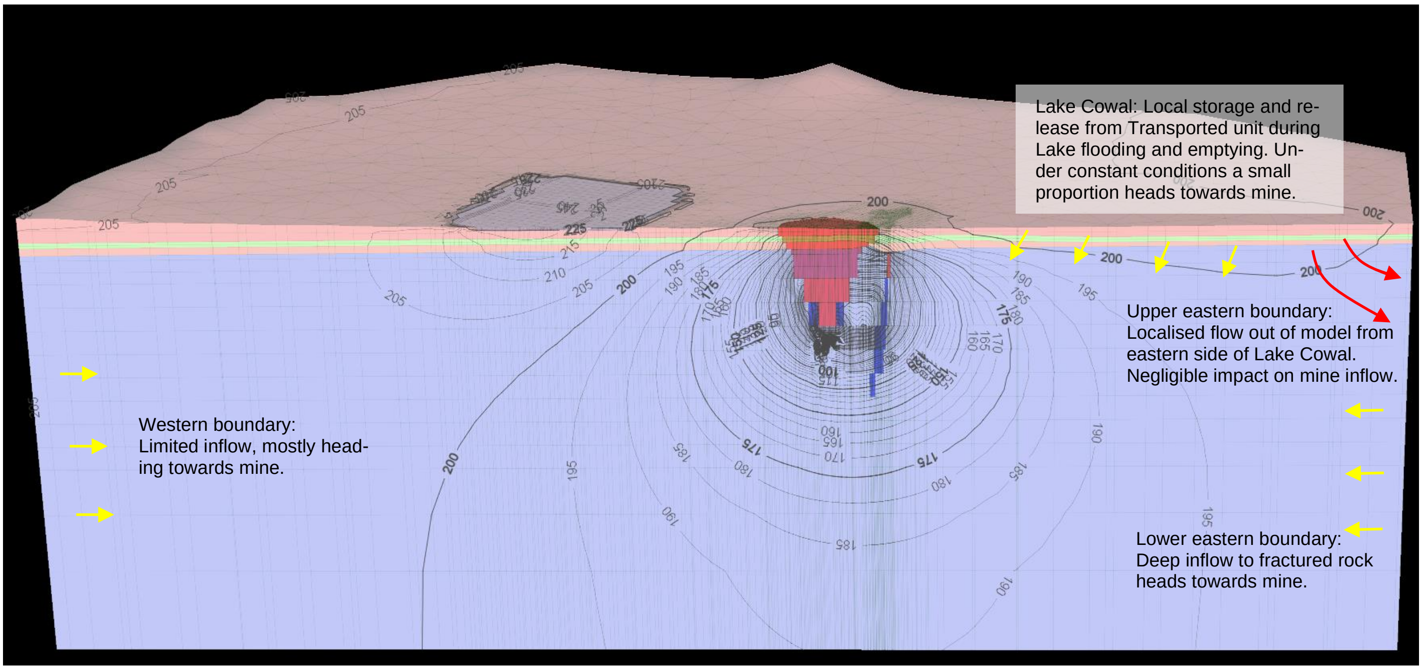

Figure 7: West to east section showing 5 m head contours, July 2024

It is important to note that the combined inflow from the western and lower eastern boundaries of approximately 18% of the total inflow to the mine just after the end of mining in 2041 does not imply that the model over-estimates the inflow to the mine by 18% at this time. If the model eastern and western boundaries were located further away from the mine, groundwater head drawdown would still influence flow towards the mine.

The northern and southern no flow boundaries lead, in a similar way, to a slight under-estimation of flows. These boundaries are located similar distances from the underground development to the western and eastern boundaries, and their effect will tend to be to cancel out the over-estimation due to the western and eastern boundaries. The combined effect on the predicted inflow to the underground mine from all of the model lateral boundaries is assessed to be insignificant.

It is noted that there are very similar predicted total inflows to the mine for the dry Lake Cowal and the full Lake Cowal cases, however the inflow to the model from the Lake Cowal nodes for the flood case is notably higher than for the dry case, as shown in Figure 5 and Figure 6. This additional inflow is either captured by storage or exits the model as outflow from the eastern boundary.

A key parameter for modelling the speed of groundwater particles in the rock is the effective porosity of the soil/rock medium. Based on our experience with materials of similar nature, an effective porosity of 0.01% is considered to be reasonable for the modelling of the velocity at which water travels through the rock/soil medium.

Figure 8, presents four figures for illustrative qualitative purposes only. These show the predicted distance groundwater particles would travel in a 5 year period starting from in the Transported unit beneath Lake Cowal. It is assumed for simplicity that the heads for those 5 years remain as they were at the start of the movement. The results are assuming the full Lake Cowal case with a constant fixed head of 206.5 mAHD at Lake Cowal. The figures illustrate that only a small proportion of the water originating beneath Lake Cowal on the western lake boundary reaches the underground mine, and that it may take several years to do so due to low permeability formations.

Over the last 40 years Lake Cowal has generally not remained full for continuous periods of over five years duration, as shown in Figure 9. It is therefore considered that only a small amount of groundwater originating from directly beneath Lake Cowal has reached the existing CGO open pit mine between 2005 and 2020.

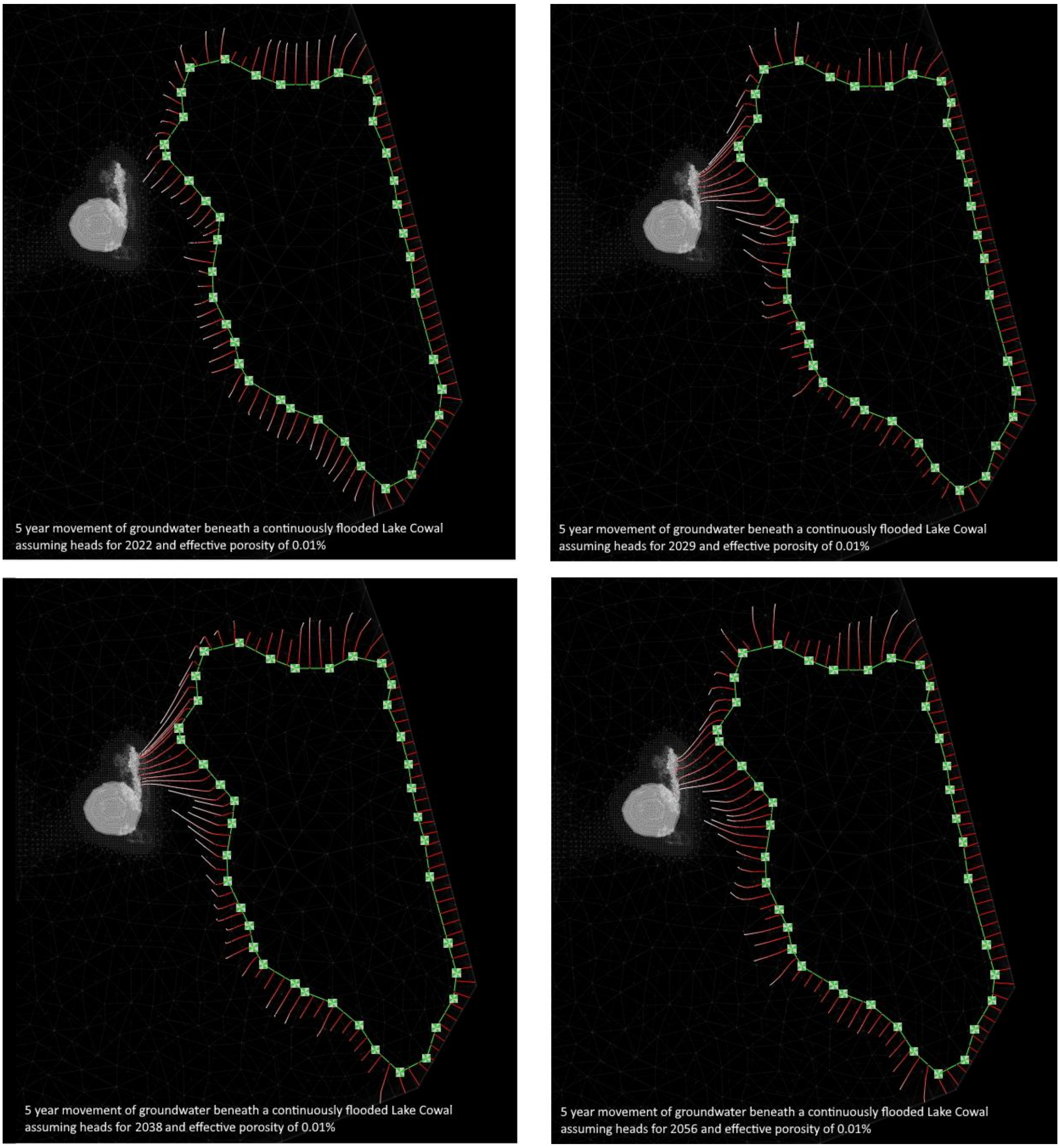

Figure 8: Illustration of the distance travelled by groundwater particles in a 5 year period beneath Lake Cowal, with the simplifying assumption that heads remain as they were at the start of the travel time

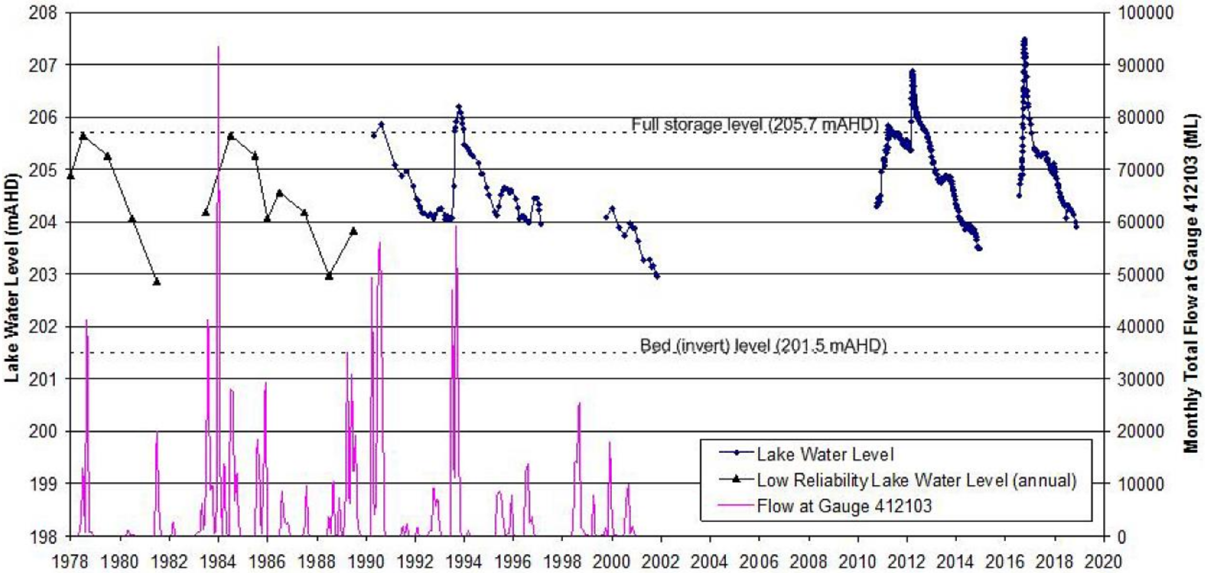

Figure 9: Observed water levels in Lake Cowal and flow at gauge 412103 (Bland Creek at Morangarell, flow data available from 1978 - 2003 only)

During periods of alternate flooding and drying of Lake Cowal, the groundwater model indicates that a localised regime of storage and release of groundwater in the sediments and weathered rock beneath Lake Cowal occurs. Figure 10 presents modelled inflow to the Lake Cowal nodes (including rainfall recharge which is indicated by the dashed black line) and resulting net inflow to the model accounting for storage in layers 2 to 5, representing the Transported and Saprolite units, beneath Lake Cowal. Storage in the Lake Cowal nodes themselves is omitted from the calculations.

Note that Figure 10 shows a small amount of flow into the model from the Lake Cowal nodes for a dry Lake Cowal case above the rate of rainfall infiltration (rainfall infiltration is indicated by a dashed black line). This is a result of a fixed head boundary condition of 201.5 mAHD being applied to these nodes for the dry Lake Cowal case. The rate of inflow to the model from the Lake Cowal nodes is under 5% of the total inflow to the mine and is not considered to affect predicted inflow to the mine.

Whilst it is not the purpose of the hydrogeological assessment to provide a detailed discussion on the dynamic local effects related to Lake Cowal drying and flooding, the results are included here to provide an illustration of the surface-groundwater interchange associated with the filling and emptying events within Lake Cowal which is independent of mine related seepage.

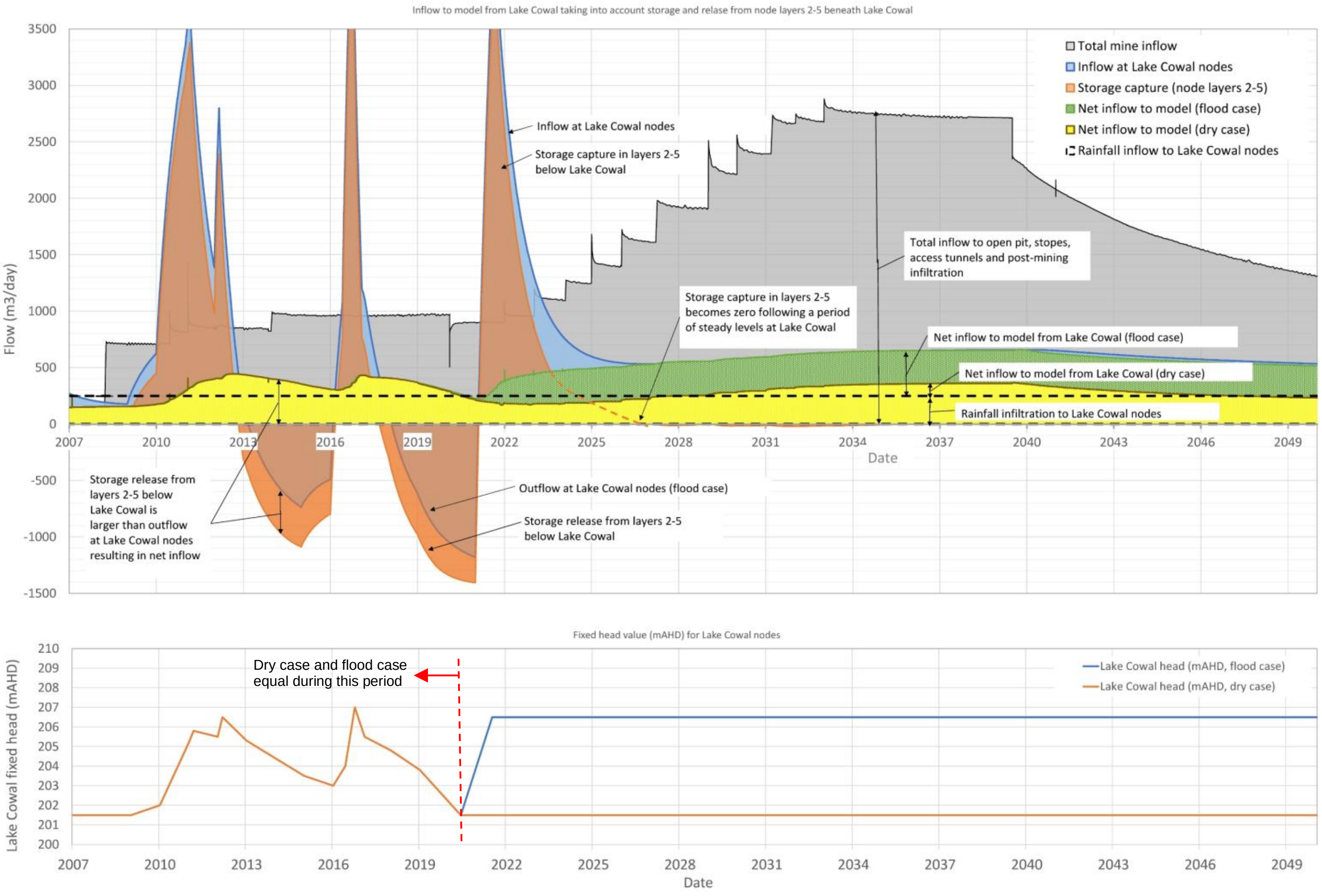

Figure 10: Inflow to the model from Lake Cowal accounting for storage capture and release from model layers 2-5 (Transported and Saprolite units) beneath Lake Cowal

4. If still relevant given the above, provide improved justification of the very steady mine inflow rate predictions compared to the high variability in reported inflows, and why it is acceptable for the model to be benchmarked to 'groundwater inflows' only during dry periods.

Mine site report reference: Section 8.2.9

Modelled groundwater inflow rates are much less variable than recorded pit dewatering volumes, as shown in Figure 11 below. The spikes in recorded pit dewatering volumes are likely related to surface water runoff into the open pit and not groundwater inflow. This is due to groundwater flow being proportional to gradients in groundwater head. These do not suddenly change by factors of 5 over the space of a month, which recorded pit dewatering volumes sometimes do. Surface water runoff is removed from the pit relatively quickly, and it is not considered to significantly affect groundwater levels in the area around the open pit, and so has been excluded from the groundwater model.

It is considered that during drier periods, such as 2018, recorded pit dewatering rates are more representative of actual groundwater inflows rather than surface water inflows. For this reason, it is considered acceptable to use such periods as a basis for comparison, or benchmarking, of modelled versus observed groundwater inflow to the open pit.

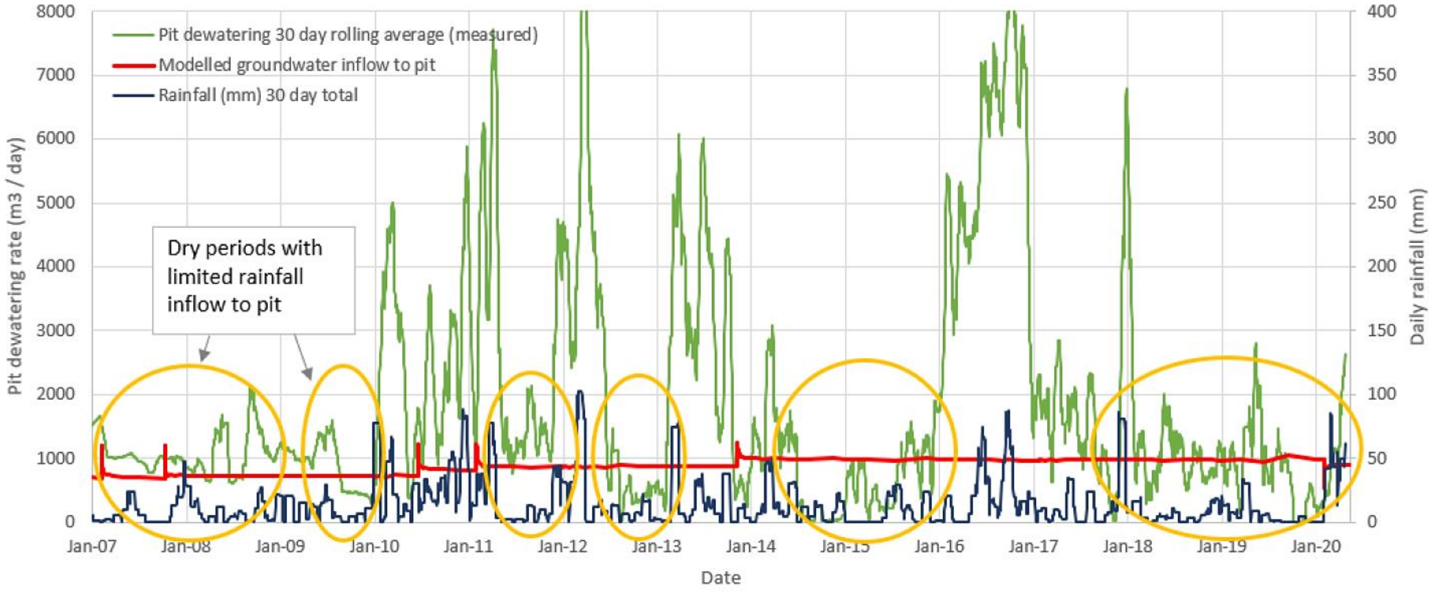

Figure 11: Pit dewatering records, rainfall and modelled groundwater inflow to the open pit (mine site report Figure 8-18)

5. Correct the arithmetical error in the statement on the maximum rate of inflow to the mine being 100,000 times less than the estimated evaporation from Lake Cowal.

Mine site report reference: Section 10.5

The last paragraph of Section 10.5 of the mine site report contains an arithmetical error. The corrected paragraph should read:

> When Lake Cowal is full it occupies an area of 13,000 hectares and would thus lose on average 534,000 m^3/day to evaporation (assuming 1.5 m net annual pan evaporation, refer to Table 4-1). This means that the average rate of evaporation from the surface of Lake Cowal is approximately 300 times the predicted maximum rate of groundwater inflow due to the CGO Underground Development alone (1,800 m^3/day, as discussed in Section 10.3). As such, the impact of mine groundwater inflow on the water levels of Lake Cowal is considered to be negligible.

6. Provide updated post-mining simulations with corrected paste backfill Ss parameters, along with related final void water balance modelling, including confirmation that the recovery simulation started from the base of the underground dewatered stopes at around -700 mAHD.

Mine site report reference: Section 9.1.8

An error in the assessment of total stopes volume based on the provided total mass of extracted ore resulted in an incorrect total stopes volume of 64,739,000 m^3. The correct total stopes volume is 9,242,038 m^3 (reference: GRE-46_UG_SSD Design - Final - Capped at 1.8.xlsx).

With the volume of the access tunnel voids being 1,326,000 m^3, and assuming a paste fillable porosity of 0.1, the total volume to be filled with groundwater during the post-mining recovery is:

- 2,250,204 m^3 (0.1 x paste backfill volume plus 1 x tunnels volume)

The original (incorrect) model resulted in a modelled inflow of 6,186,000 m^3 to the paste fill and tunnel voids. This corresponds to a paste fillable porosity of approximately 0.5 for the corrected total stopes volume.

To correct this discrepancy, the specific storage parameter for the paste backfill in the model was revised to a value of 1.07 x 10^{-4} /m. With the updated paste backfill specific storage parameter, the modelled inflow to the paste fill and tunnel voids was 2,038,750 m^3. This corresponds to a paste fillable porosity of approximately 0.08 for the correct total stopes volume.

Figure 12 presents the predicted total inflow into the open pit, stopes, access tunnels and paste backfill for the two cases of paste fillable porosity of 0.08 and 0.5. It can be seen from the figure that the recovery time for a paste fillable porosity of 0.08 is approximately 10 years earlier compared to that for a paste fillable porosity of 0.5.

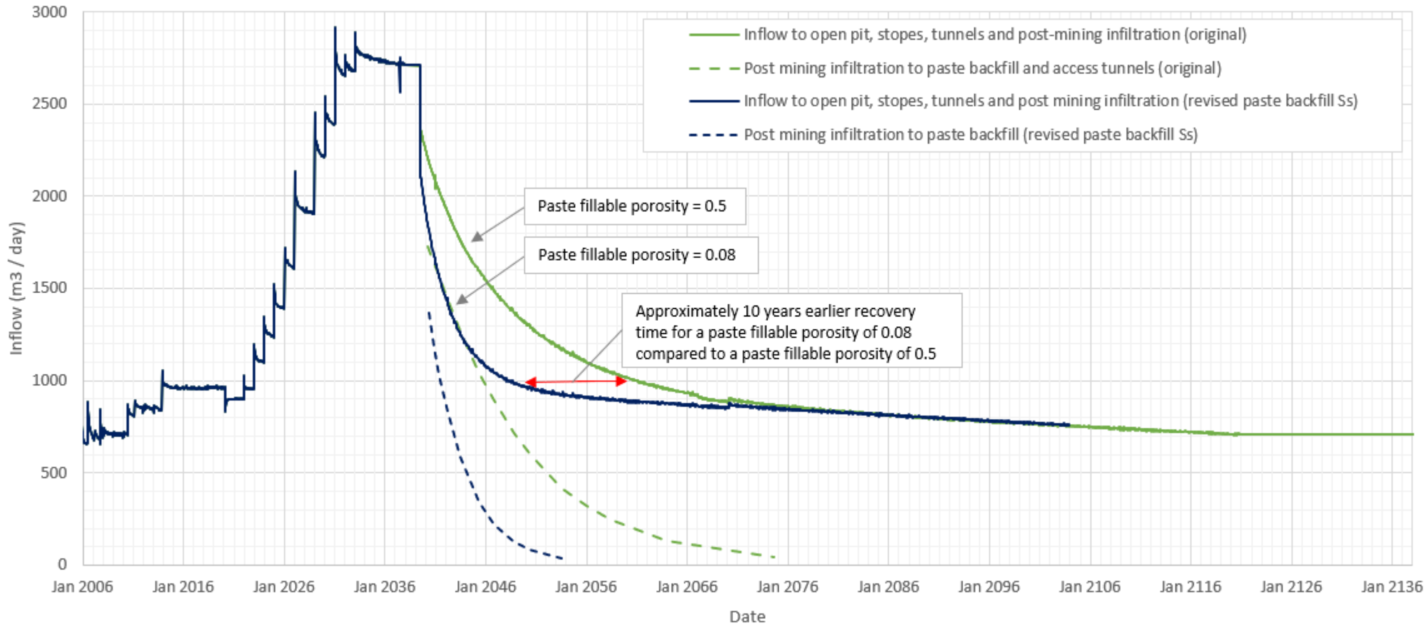

Figure 12: Sensitivity to paste backfill porosity of predicted inflow to open pit, stopes, access tunnels and post-mining infiltration

Figure 13 shows the predicted difference in groundwater head contours at the base of the Transported unit for the two cases in 2046. The effect of the different paste fillable porosities can be seen to have a minor effect on groundwater head contours in the Transported unit during the post-mining recovery. Notice that the groundwater levels are slightly higher in 2046 for a paste fillable porosity of 0.08 compared to a paste fillable porosity of 0.5.

The case presented in the mine site report (which is for a paste fillable porosity of 0.5) is conservative in terms of recovery time and groundwater head drawdown. It is considered that due to them being on the more conservative side, the results presented in the mine site report Figure 10-5 remain valid, with reference to the results shown in Figure 12 which illustrate the sensitivity of the results to paste backfill porosity.

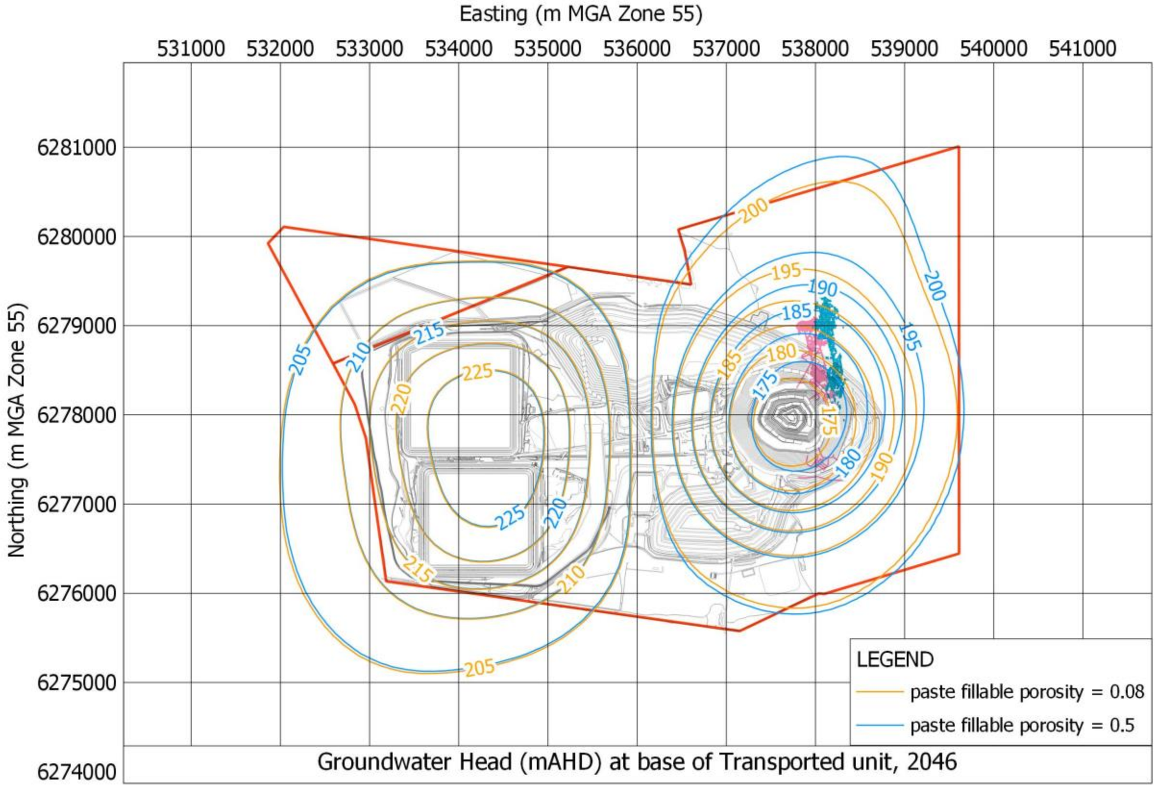

Figure 13: Groundwater head at base of Transported unit in 2046 for paste fillable porosities of 0.08 and 0.5

Figure 14 presents modelled inflow rates for each stopes level for the case of a paste backfill porosity of 0.08. Note that during the first 6 months while the model (which assumes confined / fully saturated conditions in the Primary Rock) re-equilibrates following the reactivation of the stopes elements, there is some internal transfer of water. This is an artifact of the modelling process and is not predicted to occur in reality. The key points to note are:

- The modelled total inflow or volume captured by storage is 2,038,750 m^3. This represents a paste backfill porosity of 0.08.
- Model results show groundwater flowing into each layer of stopes throughout the recovery period, from the base of stopes at approximately -700 mAHD to the top of layer 8 at 50 mAHD.
- The modelled post-mining infiltration shows the rate of inflow into each of the stopes layers declining with time at an approximately equal rate. Whilst this is not an exact replication of reality where first the lowest stopes would fill and then the ones above and so on, Figure 15 shows that the impact of this on modelled groundwater head contours above the stopes is almost negligible. There can be seen to be little observed difference in the 180 mAHD head contour from the time immediately prior to backfilling, when the stopes are all modelled as voids, compared to 10 months after backfilling when groundwater pressures inside the stopes have approximately equalised.
- It is noted that since the modelled total volume of groundwater infiltration to the stopes is consistent with the physical fillable void space volume in the backfill (assuming a paste fillable porosity of 0.08) and the total void space in the access tunnels, the model provides a reasonable representation of groundwater recovery times, including a consistent representation of the volume of groundwater that will be taken from the environment during the recovery period.

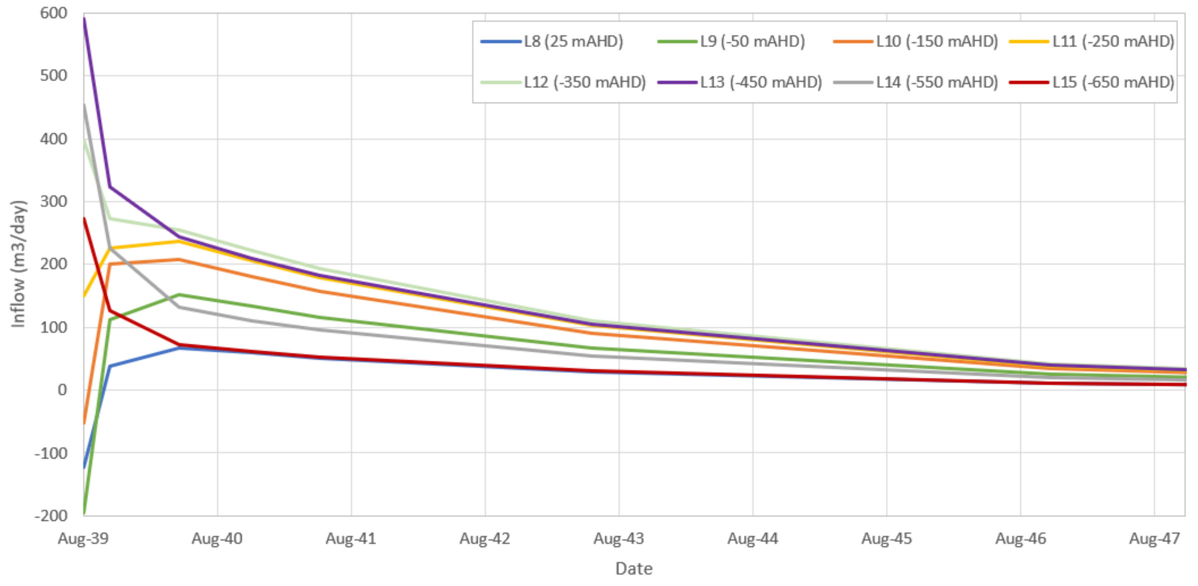

Figure 14: Post-mining infiltration into each layer of stopes (showing midpoint of layer in mAHD)

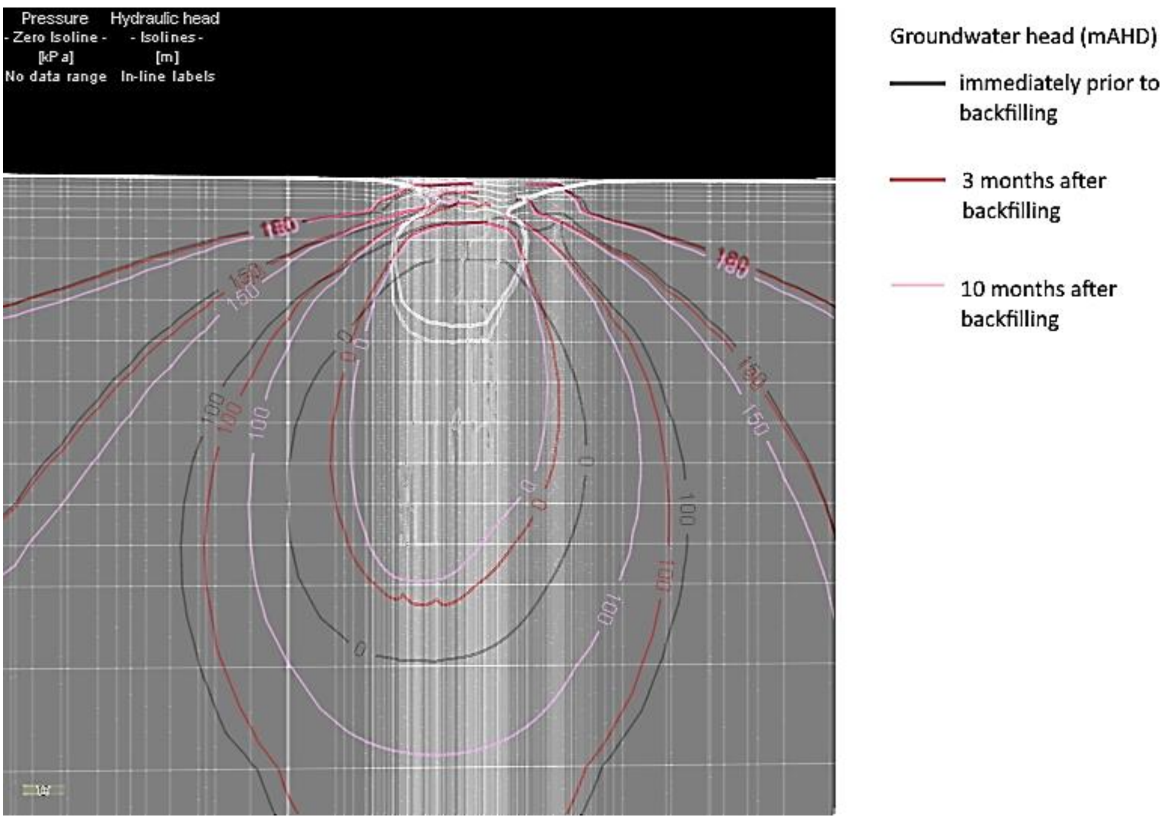

Figure 15: Modelled groundwater head during the initial period after backfilling of the stopes

7. Provide a rationalisation of the inconsistencies between the mine site and the borefields models in relation to the Upper Cowra unit having a more limited westwards extent over the CGO site area in the borefields model, and it having quite different values for its key properties (K_h and S_y).

Mine site report reference: Section 8.2.6

BCPB report reference: 6.1

The Transported Unit in the mine site model is modelled as extending over the whole model domain compared to in the BCPB model where the upper Cowra Unit extends to approximately 1 km west of the open pit. The effect on the BCPB model of the upper Cowra Unit within the zone of influence of the CGO mine site is assessed to be negligible because this is a low yielding aquifer at distance from the offsite borefield. The purpose of the BCPB model is for modelling the effects of drawdown in the Lachlan Formation due to pumping from borefields located in the Bland Creek Palaeochannel over 13 km to the north west of the CGO site.

For the mine site model, the effects of the Transported unit extending west of the mining lease to the western model boundary are considered to be minimal. The calibrated parameters for the Transported, Saprolite and Saprock units are similar, as shown in mine site report Table 8-1. Groundwater head contours to the west of the TSF/IWL in 2038 can be seen to not be significantly influenced by the boundaries between the Transported, Saprolite and Saprock units, as shown in Figure 16.

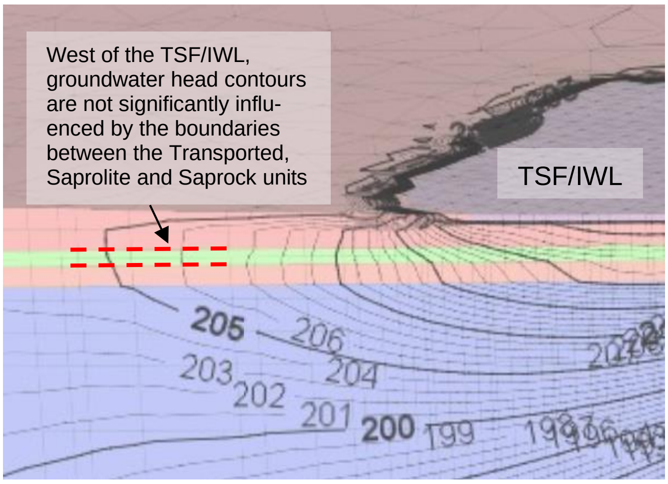

Figure 16: Groundwater head contours (mAHD) west of the TSF/IWL in 2038

The hydrogeological parameters adopted for the mine site model and the BCPB model are shown in Table 5. The differences in the adopted parameters between the two models are a result of the mine site model calibration taking account of mining activities and monitoring around the existing CGO open pit, compared to the BCPB model which was calibrated over a much larger area and with limited groundwater stresses modelled on the Upper Cowra unit.

Relative calibration sensitivities for hydraulic conductivity parameters for the BCPB model are shown in Figure 17 below. The figure shows that the BCPB model calibration is almost insensitive to the horizontal hydraulic conductivity (K_{xy}) parameters in the Upper Cowra and Lower Cowra units. On the other hand, the mine site model calibration shows comparable calibration sensitivities among the hydraulic conductivity and specific storage parameters.

It is considered that, due to its low calibration sensitivity in the BCPB model, the calibrated horizontal hydraulic conductivity of the Upper Cowra unit in the BCPB model is not applicable to the mine site area. The BCPB model, developed to assess groundwater impacts from drawdowns in the Bland Creek Palaeochannel, did not account for mining activities and monitoring at the mine site and this has led to the difference in the assessment of parameters between the two models. The BCPB model was calibrated to provide assessment of conditions within the high yielding aquifers of the Bland Creek Palaeochannel while the Mine Site Model was calibrated against the observations in the low yielding ground around the mine site.

Table 5: Hydrogeological parameters for the Transported / Upper Cowra unit for the mine site and BCPB models

Model	Hydrogeological unit	Horizontal hydraulic conductivity (m/day)	Vertical hydraulic conductivity (m/day)	Specific storage (m^{-1})	Specific yield
Mine site	Transported / Upper Cowra	2.2×10^{-2}	3.4×10^{-4}	4.8×10^{-4}	0.2
BCPB	Transported / Upper Cowra	1	6×10^{-5}	n/a	0.04

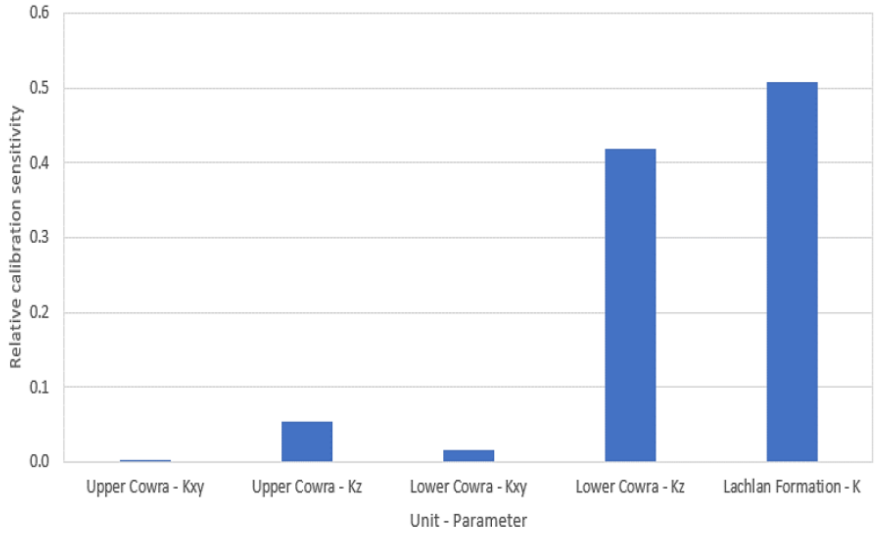

Figure 17: BCPB model calibration sensitivity to hydraulic conductivity parameters (after BCPB report, Figure 6-6)

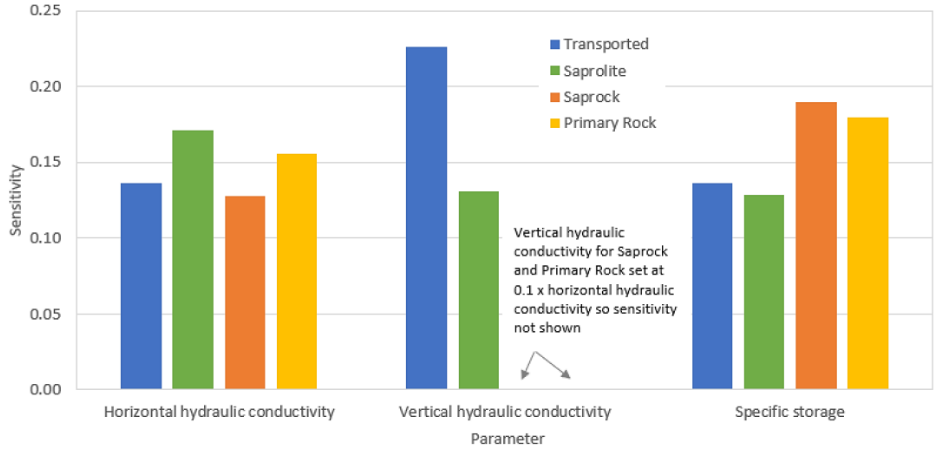

Figure 18: Mine site model calibration sensitivity to hydraulic conductivity parameters (after mine site report, Figure 8-17)

Specific yield was not calibrated in the mine site model. A value of 0.2 was adopted for the Transported unit in the mine site model (consistent with the approved Mod-14 assessment which adopted a value of 0.15) and a value of 0.04 was adopted for the BCPB model.

Figure 19 shows a comparison of modelled groundwater inflow to the open pit, stopes and access tunnels for specific yield values of 0.04 and 0.2 in the Transported unit. It can be seen from Figure 19 that the impact is relatively minor on predicted inflows.

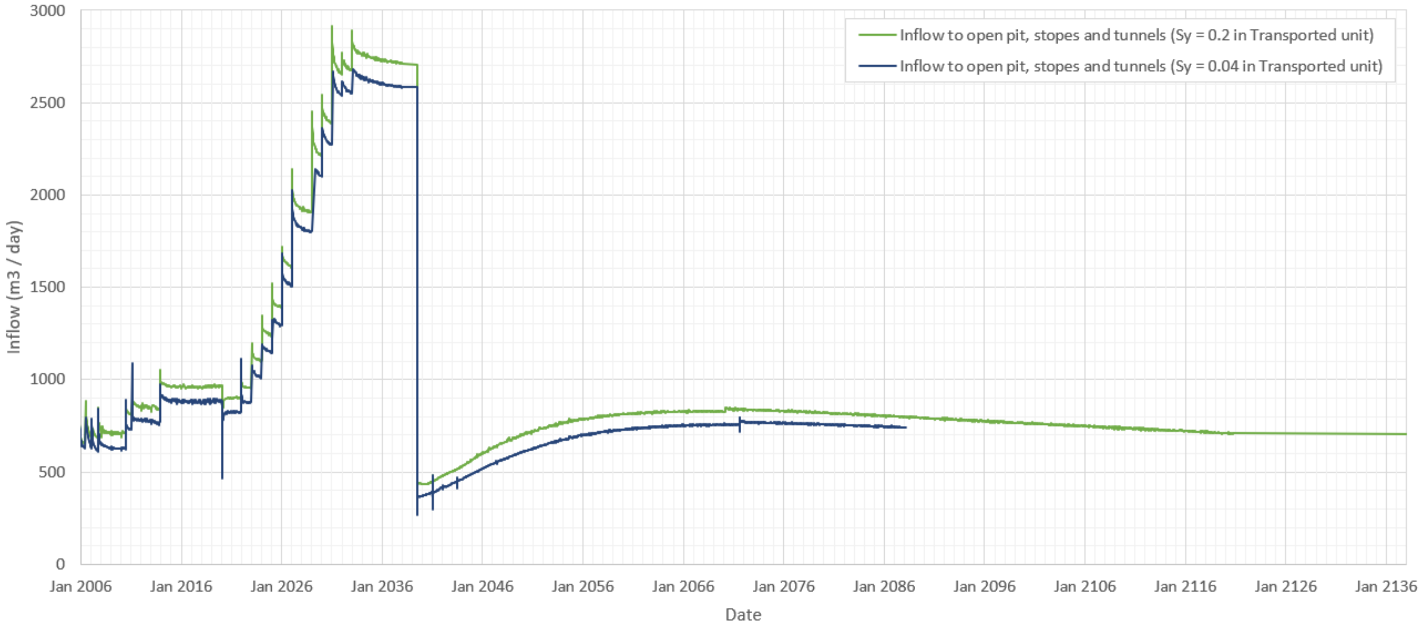

Figure 19: Effect of the specific yield parameter of the Transported unit on modelled groundwater inflows

Figure 20 shows the difference in groundwater head contours at the base of the Transported unit and in the Primary Rock at 0 mAHD in January 2038, just prior to the end of underground mining, for specific yield values of 0.04 and 0.2 in the Transported unit.

At the base of the Transported unit, the 200 mAHD head contour for the Sy = 0.04 case can be seen to extend out approximately 300 m to the east and approximately 500 m to the north and south compared to the Sy = 0.2 case. The 205 mAHD contour around the TSF/IWL can be seen to extend up to approximately 300 m further out for the Sy = 0.04 case compared to the Sy = 0.2 case. The overall shape of the contours is similar for the two cases.

In the Primary Rock at 0 mAHD the difference between the two cases is much smaller, although still noticeable.

The differences in groundwater head contours between the cases of specific yield values of 0.04 and 0.2 in the Transported unit do not change by an amount significant enough to affect nearby groundwater users, the closest one to the mining lease being located over 2 km east of the mining lease.

As the shape of the contours are very similar for the two cases, and the groundwater head gradients are slightly smaller for the case of Sy = 0.04 around the TSF/IWL, contaminant transport predictions are considered to be slightly more conservative for the case of Sy = 0.2 adopted in the mine site report. The differences are considered to be minimal.

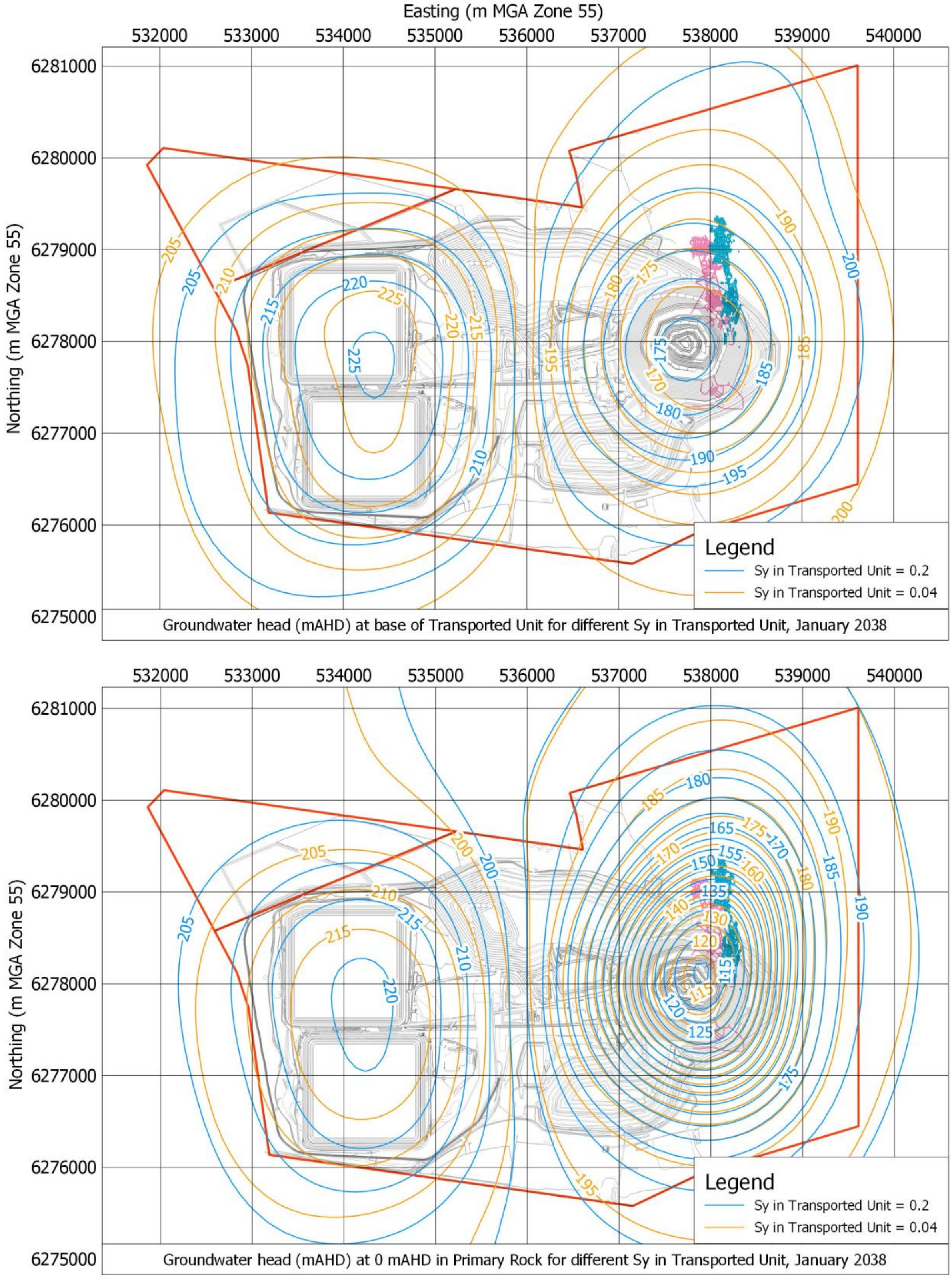

Figure 20: Effect of the specific yield parameter of the Transported unit on groundwater heads in 2038

In summary, the BCPB and the mine site models were calibrated separately. The parameters adopted for each were based on information relevant to each of the model domains, bearing in mind the purpose of each of the models. The BCPB model was calibrated to provide overall representation of regional conditions as a result of pumping from the Bland Creek Paleochannel, while the mine site model was calibrated against local conditions affected by the CGO mine operations. This resulted in a difference in the adopted parameters for the Upper Cowra Formation / Transported unit between the models. An assessment was provided on the effect on the results of the mine site model if the specific yield parameters adopted for the BCPB model were used, and this was shown to not affect the model results significantly.

8. Provide an objective assessment of the magnitude and extent of cumulative drawdown impacts (mining and borefields, possibly using the principle of superposition), noting that the DPIE reviewer does not believe that the effort required for an integrated modelling of cumulative impacts is commensurate with the groundwater-related risks and uncertainties predicted for the proposed underground development, despite low confidence in the mine site model results.

Mine site report ref: Section 10.1 and Section 10.2

BCPB report ref: Section 7.3.2

The maximum drawdown modelled in the BCPB model in the Upper Cowra Formation (approximately representative of groundwater table drawdown in that model) is 2.7 m, occurring in the central part of the Eastern Saline Borefield (ESB) in 2040. At the mine site, Figure 10-3 of the mine site report shows groundwater table drawdowns are predicted to be contained approximately within the CGO mining lease in 2040.

Figure 21 presents the combined groundwater table drawdowns from the mine site model and the BCPB model using the principal of superposition. It can be seen that there are no significant cumulative effects on the groundwater table.

Note that the BCPB report does not provide a figure showing the relatively minor drawdown in the Upper Cowra Formation, however, Figure 4-6 of the BCPB report provides an example illustrating the very minimal drawdown of the water table that has been observed at bore GW036594 in the BCPB area.

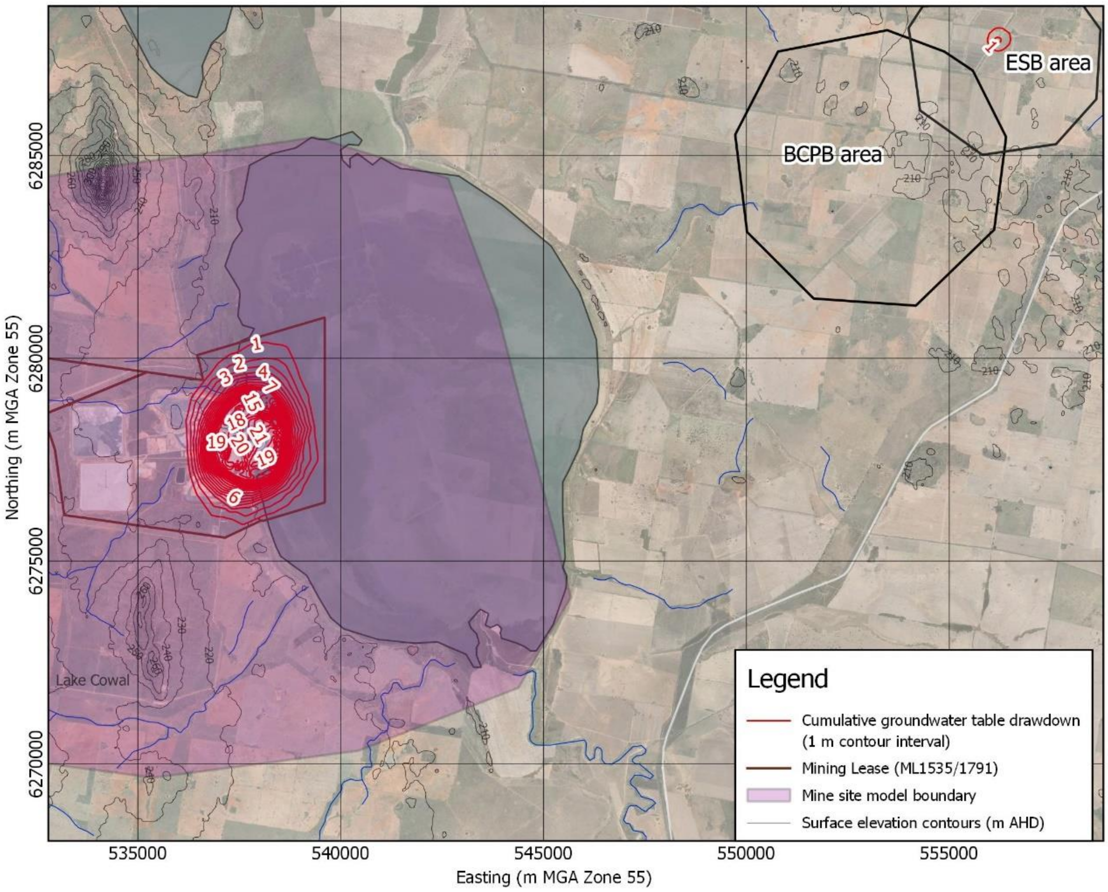

Figure 21: Cumulative groundwater table drawdown in 2040 from the mine site and BCPB models

9. If the previous assessment information on the final void lake water quality (Gilbert and Sutherland, 1997) is considered not adequate in relation to the current proposal, then detailed information is required on the long term prediction of final void lake hydro-geochemistry, including the influence of the backfilled underground voids, with comprehensive justification on the sustainability of the rehabilitation plan;

Mine site report ref: 11.2.1

A previous hydrogeological assessment (Cowal Gold Mine E42 Modification - Hydrological Assessment, Gilbert & Associates Pty. Ltd ref: J0616-1.rg1b.doc, dated: July 2008) (the Gilbert & Associates report) provides discussion on the final void lake water quality. This is considered adequate in relation to the current proposal, which does not propose changes to the final open pit void shape from the previous approval (Mod 14). The presence of stopes paste backfill from the proposed underground development is not expected to significantly affect the chemistry of the groundwater flowing into the open pit post mining.

The following extract from the Gilbert & Associates report discusses final void lake water quality, in particular salinity:

The void water quality would reflect the influence of the high salinity in the groundwater. Predictions of average void salinity based on a solute balance between inflows and outflows confirm that salt concentrations in void waters would slowly increase. However, the lower groundwater inflow rates mean that salinity would increase more slowly than was originally predicted for the approved CGM – reaching about 67,000 mg/L after about 200 years – refer Figure B-6. Salinity is predicted to continue to increase trending to hyper-salinity.

Figure B-6 from the Gilbert & Associates report is shown as Figure 22 below.

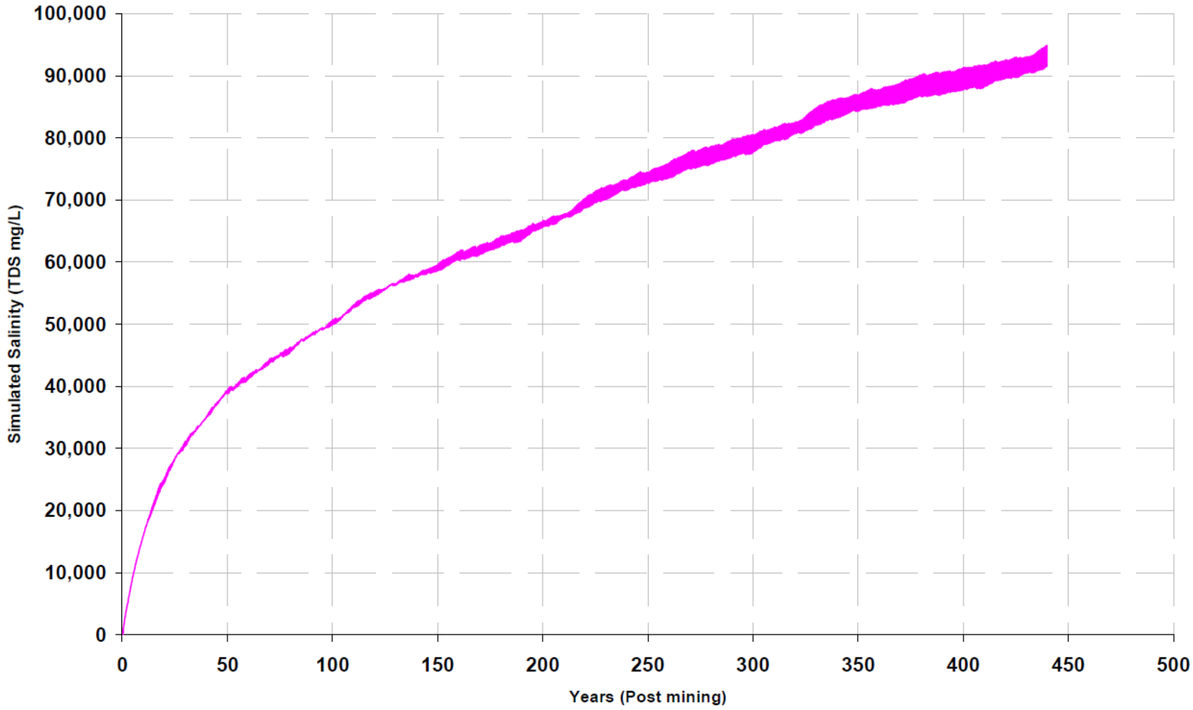

Figure 22: Predicted Final Void Water Quality (Salinity TDS mg/L) (after Gilbert & Associates, 2008)

10. Provide updated contaminant migration assessments, based on the updated flow model.

As a result of the items identified for clarification and correction by the HydroGeoLogic report, the mine site groundwater flow model was updated with a reduced timestep to bring the model mass balance error below 1%, as discussed in Section 1. This was shown to have a minimal effect on groundwater head contours during the period where the original model mass balance error was well above 1%. In addition, corrections to the assessment of the paste backfill volume and a sensitivity assessment on the specific yield parameter in the transported unit were shown to have a very limited and short term effect on groundwater head contours in the case of the paste backfill volume correction, and to result in slightly lower groundwater head gradients around the TSF/IWL in the case of the specific yield sensitivity assessment.

The results of the model corrections and sensitivity studies described in this addendum have shown that the effects on the modelled groundwater head contours compared to the original model are either very limited to negligible, or would result in slightly lower head gradients around the TSF/IWL leading to a less conservative assessment of contaminant transport times from the TSF/IWL. As such, it is considered that the contaminant migration assessment provided in the mine site report Section 10.7 remains valid and will not be further updated here.

For and on behalf of Coffey,

Antony Orton
Senior Groundwater Engineer