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SUBJECT: Hemi Pit Lake Model

De Grey Mining Limited (De Grey) is proposing to develop the Hemi Gold Project (Hemi) located in the Pilbara Region of Western Australia, approximately 60 km south of Port Hedland in the Town of Port Hedland (Figure 1). The mine plan includes the development of 6 deposits (Aquila, Brolga, Crow, Diucon, Eagle, and Falcon).

Closure phase modelling has been undertaken for the DFS numeric model to consider the potential long-term effect of pit voids on the surrounding alluvial aquifer and environment. Results are presented below. The closure modelling was done for two scenarios:

1. **Do Nothing Scenario**; the pit void crests are bunded off at the end of operations and pit lakes start to form from groundwater inflows and in-pit rainfall.
2. **Surface Water Harvesting Scenario**; occasional sheet-flow from large rain events near Hemi are directed into the pit voids.

1. Surface Water Harvesting

Surface Water Solutions (SWS, 2024) completed flood modelling of the Hemi region to estimate the potential annual water volumes that may be readily directed into the pit voids during closure, a summary of which is included below:

- The modelling uses the SILO historical rain sequence from Indee Station for pan evaporation and rainfall from 1899 to 2022 (134-year period), in a repeating cycle from year one of closure.
- Minor drains and bunds were used to increase the capture of the sheet flow surface water runoff.
- Four runoff scenarios were modelled: the historical rain pattern with 10, 30, 50 mm event rainfall thresholds plus an increased rainfall climate change scenario informed by the Australian Rainfall and Runoff data hub.
- Figure 2 shows the cumulative inflows for the 4 scenarios.

Groundwater modelling adopted the 10 mm threshold scenario as a 'base case' result, which indicates about 1,250 gegalitres (GL) of water is available to be harvested over a 400-year period. For context, the combined void volume at Hemi for the DFS pit designs totals about 410 Mm³ (or GL).

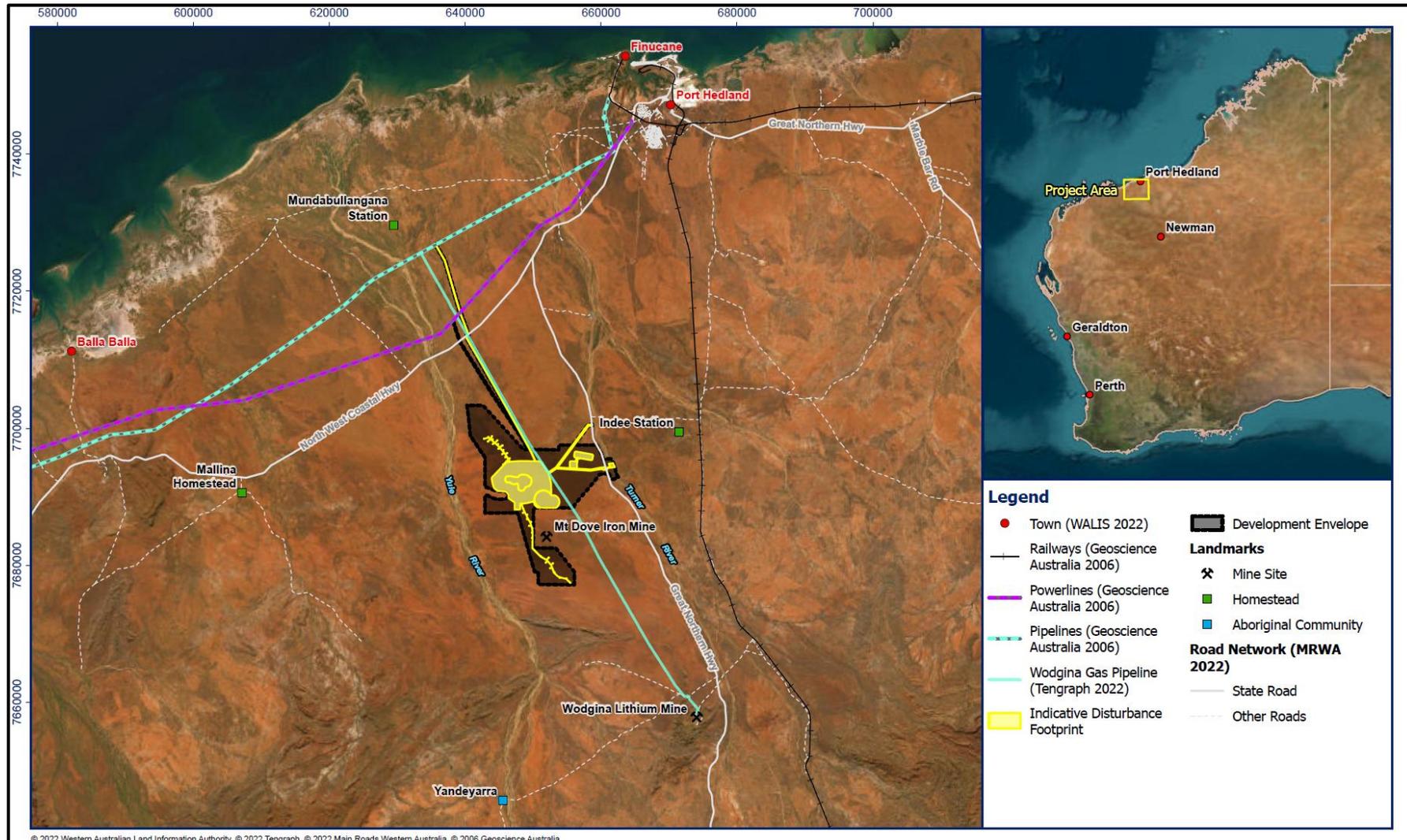


Figure 1: Location Plan

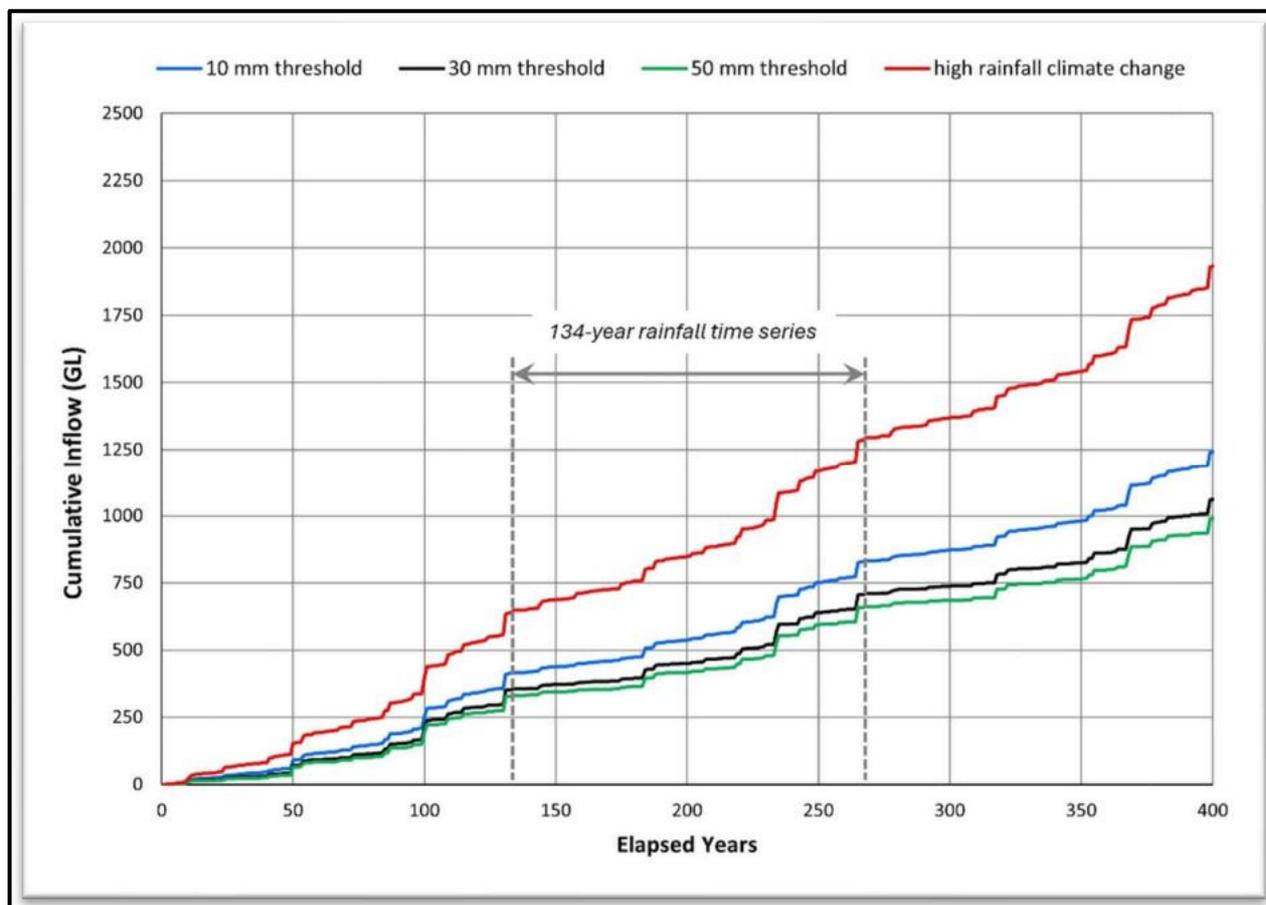


Figure 2: Cumulative Surface Water Harvesting Volumes

2. Modeling Approach

Two modelling platforms were adopted for the closure predictions;

1. The DFS numeric *Modflow* groundwater model was used to predict changes at a regional and local scale in terms of groundwater levels and flows.
2. An *Excel* mass balance for each of the two main voids (Diucon-Eagle and Broлга-Crow-Aquila-Falcon) was developed that used the results of the *Modflow* models to estimate void water levels and salinities over time and to also consider uncertainty aspects of the pit lake balance by applying variations to key input parameters.

Investigations and modelling to date by Geowater indicate the following parameters and processes are likely to be the most important (sensitive) to predicting groundwater-related closure outcomes:

- Regional rainfall recharge. Due to its known and interpolated moderate to high permeabilities, drawdowns from dewatering within the alluvial aquifer will be significant over large distances from the open pits. The natural process of rainfall recharge to the water table in the alluvial aquifer surrounding Hemi is variable but on average, quite limited over time. Investigations and assessments since the DFS groundwater model was applied (in early 2023) suggest rainfall recharge in the Operations model may be conservatively low in some areas. Two model runs were completed with a 'low' and 'high' set of rainfall recharge rates applied in the *Modflow* model to consider uncertainty. Over the circular area within a 10 km radius of Hemi, the low recharge case has an average rainfall recharge rate of 2.5 mm/year and 6.5 mm/year for the high recharge case.
- Longer term climate changes. The assessment of future Pilbara climate conditions by CSIRO (2015) only predicted rainfall and evaporation changes to 2050. Projections indicate that the

Pilbara may become slightly drier by 2030 and 2050, although wetter projections cannot be discounted. There is not sufficient confidence in the projections to allow quantification of the probabilities of wet or dry scenarios occurring in the future. Areal potential evaporation over the Pilbara would increase slightly by 3 to 4 % for 2030 and by 4 to 7 % for 2050. Increased and decreased rates of lake evaporation and harvested surface water volumes were applied to the *Excel* void models to consider potential climate change-related factors.

3. Modelling Methodology

3.1. Modflow Model

The closure modelling was conducted by letting groundwater recover from the depressed water table and depressurised aquifers generated from dewatering of the open pits. Simulated hydraulic heads at the end of the DFS dewatering model base case were used as starting heads for the recovery models.

The Do Nothing scenario was modelled by ‘assigning’ material of high hydraulic conductivity and high specific yield (0.99) to the pit void cell spaces in the model. Alternate model runs were done for the Do Nothing scenario by simulating one model run with no in-pit rainfall or evaporation and one with both in-pit rainfall and evaporation applied to the pit voids. The model run with no in-pit rainfall and evaporation was utilised as part of the *Excel* pit lake balance modelling, which applied these loss and gain components ‘outside’ of the groundwater model.

The Surface Water Harvesting scenario was simulated in the groundwater model by using the *Modflow-LAK* lake package, which was developed by the USGS to allow interactions between lakes, groundwater and streams to be modelled. The package is suitable to simulate the sudden influx of large surface water volumes, causing the pit lake to become a source of groundwater, whilst at other times, the pit lake would revert to behaving as a receiver of groundwater. The lake package was implemented in the model by assigning the pit void cells as inactive cells, extending downward from the first layer of the model. The active model cells surrounding the inactive pit lake cells exchange groundwater with the pit lake at a rate determined by the lake level, lakebed conductance and head difference between the lake level and the aquifer. A lakebed conductance of $1\text{m}^2/\text{day}$ was assumed for the simulations. Sensitivity analysis shows the lakebed conductance has no significant impact on the formation or levels of the pit lakes.

The water budget for each lake is calculated independently to determine the lake level within the lake package. This allows for pit wall runoff, pit lake evaporation, and withdrawal and/or augmentation of water to each lake. Based on their overall geometries, five void lakes were modelled; Eagle, Diucon, Falcon, Brolga and Aquila-Crow. The surface water harvesting volume time series from SWS for the 10 mm threshold case (see Section 1) was modelled as water augmentation in the lake package. For simplicity and model stability, 20% of the SWS water volumes were assigned equally to each of the five voids. At certain elevations, some of the pit voids coalesce together, which was accommodated in the lake package modelling by assigning the join or spillover connection between Eagle and Diucon at 5 mAHD; between Falcon and Aquila-Crow at -30 mAHD, and between Brolga and Aquila-Crow at -64 mAHD.

Common input terms and steps for both closure scenarios include:

- Regional rainfall recharge was simulated by applying the same rainfall ratios from the DFS model to the SWS rainfall sequence.
- Evaporation was applied at 60% of the pan evaporation time series from SWS (3,000 – 3,300 mm/year). The 60% value was derived as an averaged approximation between potential values of between 50 – 70% with lower ratios most likely to be applicable at lower lake water levels where pit wall shading effects are significant.
- Water salinity can reduce evaporation rates significantly when the water becomes saline and hypersaline, but this factor was not applied due to the relatively low salinities predicted at Hemi.

- A rainfall runoff factor of 30% was applied to estimate the volumes of rainfall runoff generated from pit walls above the lake surface.
- A model duration of 366 years, with stress periods increasing over time, initially monthly, then quarterly, half yearly, yearly, two yearly, four yearly, eight yearly and ten yearly. This was to capture the large change in groundwater gradients at the beginning of the recovery with a smaller stress period and then longer stress periods to reduce model runtime at the later part of the simulation. A second model was then run for each scenario and sensitivity run over a 500-year period with uniform (5 year) stress periods that represented year 367 – 866 of mine closure.

3.2. Excel Void Balance

Two separate void balances were created; one for Diucon-Eagle (DE) and one for Brolga-Crow-Aquila-Falcon (BCAF). The relationship between void RL, areas and volumes were established in *Global Mapper* software using the DFS (May 2023) pit designs provided by De Grey. The BCAF void is approximately twice the size of the DE void, with the total combined void volumes being almost 410 Mm³ (or GL) and a combined surface area at ground level of about 3.3 km².

Base case inputs were the same as applied to the *Modflow* closure models:

- Incident rainfall volumes onto lake surface based on the 134-year repeating rainfall sequence from SWS.
- 30% rainfall-runoff factor for pit wall runoff.
- 60% pan evaporation factor.
- 40% of surface water harvesting volumes applied to DE void and 60% to BCAF void.

The following salinities were adopted in the *Excel* balance:

- Initial groundwater inflows to DE = 850 mg/L and 900 mg/L to BCAF.
- Harvested surface water and in-pit rainfall runoff = 150 mg/L.
- Rainfall = 10 mg/L.
- Salinity of evaporated water = 0 mg/L.

For the Do Nothing scenario, in which the pit voids become a permanent groundwater sink, the groundwater inflows were derived by reconciling the time-flow and time-pit lake RL results of the *Modflow* model. For the Surface Water Harvesting scenario, the groundwater inflow and groundwater outflow results from the *Modflow* lake zone budgets were interpolated at annual intervals. A spill level from the pit voids set at 64.0 mAHD was used to record any overflow events from the lake balance. The spill level provides a 'freeboard' of about 2 – 2.5 m in the pit voids. The estimated salinity of groundwater inflows and outflows for the surface water scenarios are based on the simplistic assumption that water in the void always remains mixed and non-stratified.

4. Modeling Results

Model results are presented below for:

- **Case A** - Do Nothing Scenario model with low recharge.
- **Case B** - Surface Water Harvesting Scenario model with low recharge.

The *Excel* void balance results are shown in Figure 3 for void water levels and in Figure 4 for void water salinities. The annual water balances indicate that for Case A, lake levels take about 100 years to reach a steady state level, when rainwater and groundwater inflows match evaporation losses. The steady state lake levels remain well below ground level; about 140 m in DE and about 110 m in BCAF. The different water levels between the two main voids partly reflect limited hydraulic connection

(permeability) between the bedrock zones that remain saturated between the two voids. Actual lake levels in Case A conditions are likely to also vary in between individual pits (e.g., Falcon and Brolga).

Water salinity for Case A slowly climbs in both voids due to evapo-concentration effects and does not attain a steady state, reaching up to 12,000 – 15,000 mg/L after 866 years. This saline water is permanently trapped within the pit voids due to the strong groundwater sink condition created by the depressed lake water levels.

The Surface Water Harvesting scenario also reaches steady state levels after about 100 years, but with lake water levels much higher than Case A due to the significant amounts of surface water harvested in the simulation. Lake levels between DE and BCAF are similar due to the permeable connection via the alluvial aquifer that would be activated when pit lake levels rise above 25 – 30 mAHD. Void water salinity is simulated to rise only for Case B with DE reaching about 2,000 mg/L TDS after 866 years and BCAF about 6,000 mg/L. The differences in salinity reflect a higher evaporation-to-inflow rate in BCAF than DE. The salinities would likely be less different, and potentially equal if a void ‘interflow’ drain was cut between DE and BCAF as part of closure water management.

A spill level of 64.0 mAHD was set in the void balances, however, the highest water level attained in the Case B simulation was 57.0 mAHD.

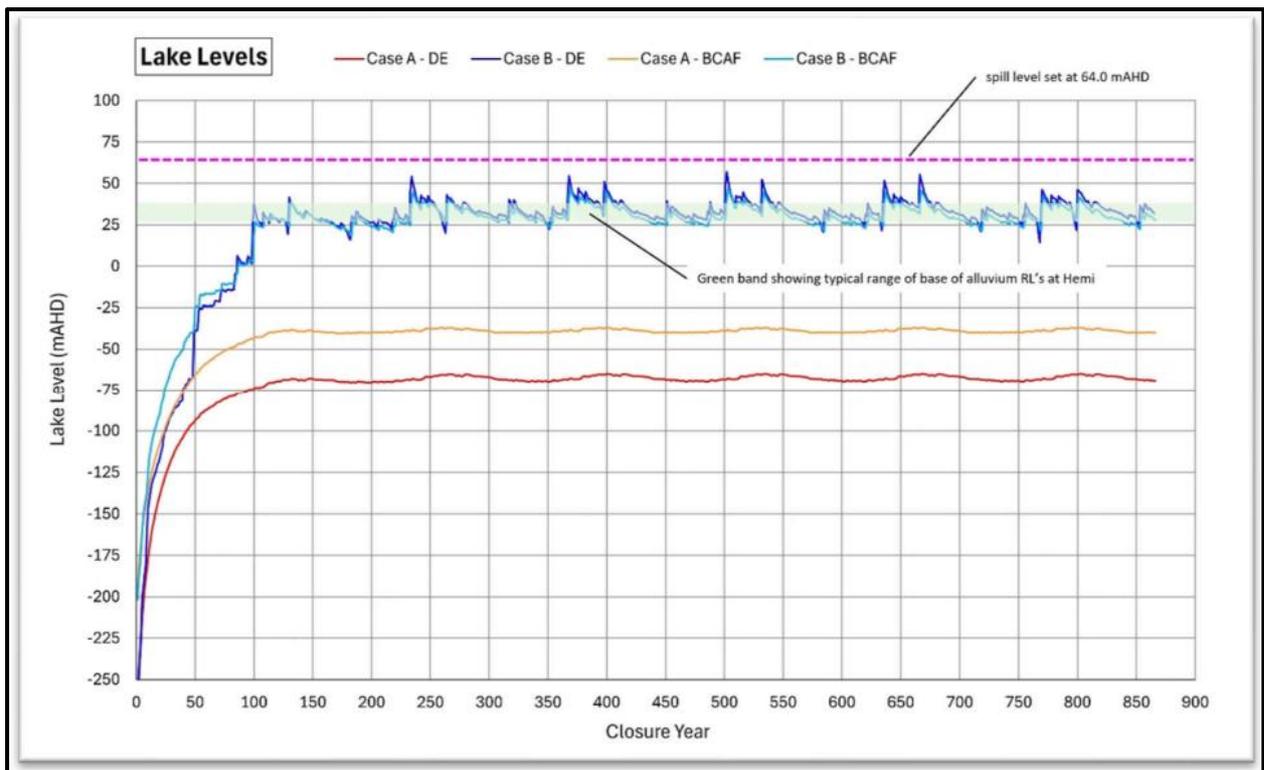


Figure 3: Predicted Void Lake Levels.

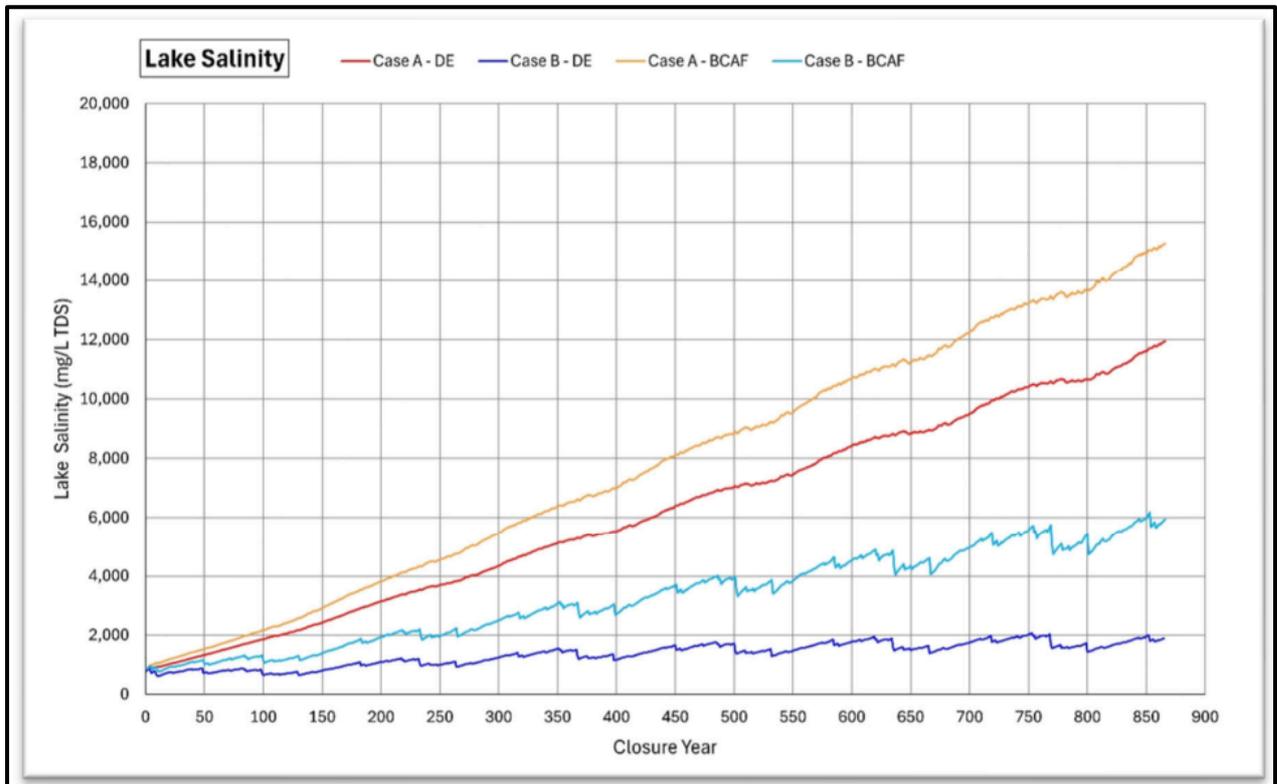


Figure 4: Predicted Void Lake Salinities.