Coppabella Coal Mine – Environmental Authority Amendment

Surface Water Final Void Assessment Report

Peabody Energy

Level 14, 31 Duncan St, Fortitude Valley,
Queensland 4006

Prepared by:

SLR Consulting Australia

Level 16, 175 Eagle Street, Brisbane QLD 4000,
Australia

SLR Project No.: 640.030987.00001

13 February 2024

Revision: 3.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
V0.1	23 January 2024	Samantha Sam	Nadja Kunz	
V0.2	29 January 2024	Samantha Sam	Nadja Kunz; Fiona Stark	
V0.3	31 January 2024	Samantha Sam	Nadja Kunz	
V0.4	5 February 2024	Samantha Sam	Nadja Kunz; Fiona Stark	
V0.5	6 February 2024	Samantha Sam	Nadja Kunz	Fiona Stark
V2.0	12 February 2024	Samantha Sam	Fiona Stark	Fiona Stark
V3.0	13 February 2024	Samantha Sam	Fiona Stark	Fiona Stark

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care, and diligence, taking account of the timescale and resources allocated to it by agreement with Peabody Energy (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

Table of Contents

Tables in Text

Figures in Text

1.0 Introduction

1.1 Scope of Work

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Peabody Energy Australia Pty Ltd (Peabody) to support the preparation of the Coppabella Mine (the 'Project') Environmental Authority Amendment (EA Amendment). Peabody is seeking an amendment to their current EA EPML00579213 to nominate the final void as a non-use management area (NUMA) which includes:

- a change to the final landform and residual void location (**Figure 2-1**). There are currently four pits, and these pits are proposed to be merged to form a single pit void; and
- nominate the final void as a non-use management area (NUMA) prior to submission of the PRC plan.

1.2 Relevant Legislation

This assessment was undertaken in accordance with the following guidelines and documentation:

- *Environmental Protection Act 1994*;
- Environmental Protection Regulation 2019;

1.2.1 EPA Guideline Considerations

As defined by section 111A of the EP Act 1994, land is in a stable condition if:

- the land is safe and structurally stable;
- there is no environmental harm being caused by anything on or in the land; and
- the land can sustain a Post Mining Land Use (PMLU).

If a void is proposed to be situated wholly or partially in a floodplain the void must be rehabilitated to a safe and stable landform that is able to sustain an approved PMLU that does not cause environmental harm (a stable condition).

Therefore, the intent of the surface water assessment is to:

1 Predict the long-term water levels of the final landform. This information can be used to assess the impact on the final landform stability and understand if there are sufficient resources to maintain or support the final land use;

2 Preliminary floodplain assessment to determine the flood risk; and

3 Assess whether the stored water is of appropriate quality to support the identified PMLU.

This is further outlined in Sections 3.6.1 and 3.6.3 of the PRCP Guideline which requires "detailing of the long-term water management requirements and void hydrology addressing the long-term water balance and water level in the voids, stratification, connections to groundwater resources and potential for overflow."

In a manner that is consistent with the requirements of Section 3.6.1 and 3.6.3, a final void water balance model was developed on the proposed final landform which incorporates all projected inflows, outflows, and recharge rates to model the long-term water balance and water quality of the void.

1.3 Site Information

Coppabella Mine is an open cut coal mine located approximately 31 kilometres southwest of Nebo and 10 km east of the town of Coppabella in Queensland. The project is approved under Environmental Authority (EA) EPML00579213 (effective 13 April 2022) and mining leases ML70161, ML70163, ML70164, ML70236, ML70237, and PL1015. The project originally commenced in July 1998 with mining commencing in 2002. Currently, the mine lease at the Coppabella Mine expires in 2040.

The project location is shown below in **Figure 1-1**.

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:236,896 at A4
Project Number:	620.30112
Date:	31-Jan-2024
Drawn by:	SS

Legend

🟥 Project Location

COPPABELLA EA AMENDMENT

Coppabella Project Location

Data Source: DNRME watercourses and ESRI Basemap imagery.

DISCLAIMER: All information within this document may be based on external sources.
SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 1-1

C:\Users\Samantha.Sam\OneDrive - SLR Consulting\Documents\Coppabella\640.030987_Project_Location.mxd

1.4 Document Structure

The structure of this report is set out as follows:

- **Section 1** – Introduction, Relevant Legislation and Site Information
- **Section 2** – Project Data;
- **Section 3** – Water Balance Model Development;
- **Section 4** – Results;
- **Section 5** – Summary of the Study and Conclusions.

Details of each component of the assessment are provided below.

2.0 Project Data

2.1 Available Data

The following data sources for the assessment were provided by Coppabella Coal Mine:

- Final Void Study (Hatch 2016);
- Coppabella Water Balance (Jacobs, 2020); and
- LiDAR data dated Sept 2023.

A final void study was completed in 2016, using a different final landform with three voids. This landform differs from the current final void design which only retains one void at the time of closure. Hydrological water balance parameters were adopted from the previously calibrated final void model (Hatch, 2016) and operations water balance model (Jacobs, 2020).

Figure 4-8 shows stage-storage-surface area curves for the final void, which were derived from the final landform provided by Peabody. These curves were used to estimate the wetted surface area for each daily timestep simulated in the model based on the volume of water predicted to be contained within the void at each given time.

Additional data was obtained from publicly available sources for use in the development of the WBM. The data utilised in the assessment is as follows:

- Historical Rainfall and Evaporation data from Scientific Information for Landowners (SILO) database (Queensland Government, 2023).

2.2 Final Landform

Currently, the Coppabella mine has four open cut pits, an out-of-pit, and in-pit spoil dump, stockpiles, a coal handling process plant (CHPP), and co-disposal with one final void expected to remain as a residual depression capable of storing water i.e., a pit lake. The arrangement of this final void in relation to the proposed rehabilitated area is summarized in **Figure 2-1**, with the details of the proposed final void outlined in **Table 2-1.**

Table 2-1: Final Void Details

Void	Pit Lake Storage Capacity (GL)	Final void Area (ha)	Overflow Level (m AHD)	Catchment Area (ha)	Base Level (m AHD)
Coppabella Void	402.9	460	220	460	6.5

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:29,301 at A4
Project Number:	620.30112
Date:	09-Feb-2024
Drawn by:	SS

Legend

🟥 Final Void

▭ Rehabilitated Area

Topography (mAHD)

COPPABELLA EA AMENDMENT

Coppabella Void Location

Data Source: DNRME watercourses and ESRI Basemap imagery.

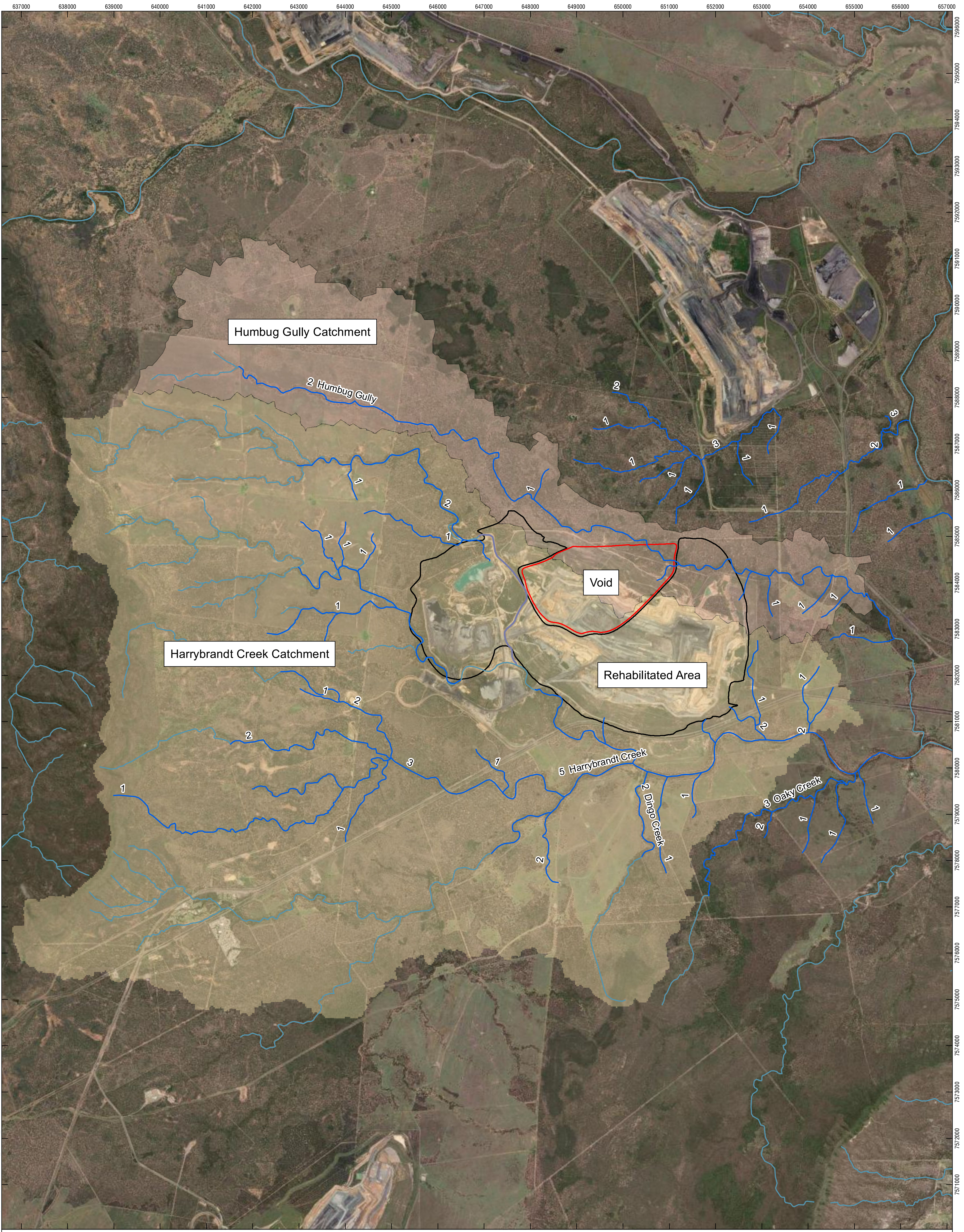
DISCLAIMER: All information within this document may be based on external sources.
SLR Consulting Pty Ltd makes no warranty regarding the data’s accuracy or reliability for any purpose.

FIGURE 2-1

3.0 Flood Risk Assessment

The project area is comprised of two catchments, Humbug Gully and Harrybrandt Creek Catchments as seen in **Figure 3-1.**

Section 3.4 of the PRCP guidelines requires that NUMA voids be located outside the pre-mining condition 0.1% AEP flood extent for relevant watercourses (i.e. watercourses with Strahler Stream Order 4 or greater). Preliminary review of available watercourse data indicates that the only stream order higher than 4 is the Harrybrandt Creek with stream order 5, **Figure 3-1**.



C:\Users\Samantha.Sam\OneDrive - SLR Consulting\Documents\Coppabella\640.030987_Stream_Order.mxd

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:73,092 at A4
Project Number:	620.30112
Date:	09-Feb-2024
Drawn by:	SS

Legend

—	Stream Order
—	Final Void
—	Rehabilitated Area
▭	Humbug Gully Catchment
▭	Harrybrandt Creek Catchment

COPPABELLA EA AMENDMENT

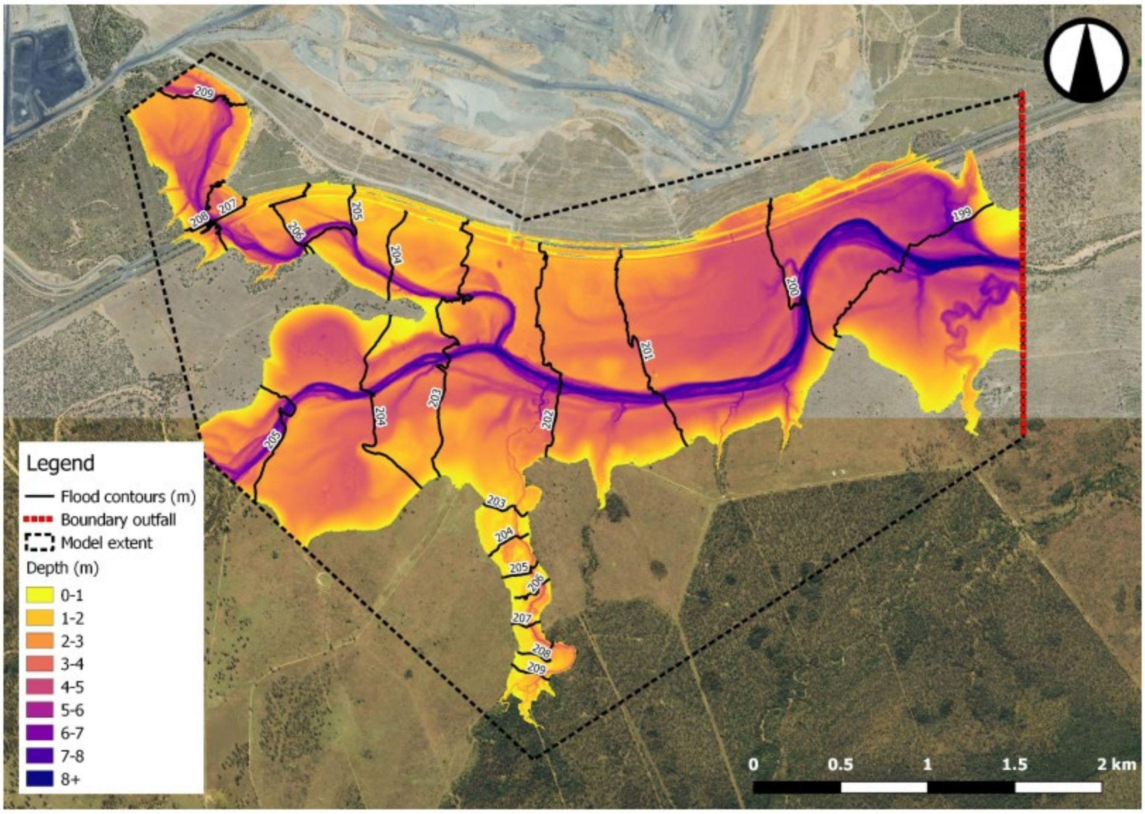
Coppabella Stream Order

Data Source: DNRME watercourses and ESRI Basemap imagery.

DISCLAIMER: All information within this document may be based on external sources.
SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 3-1

Figure 3-2: PMF Harrybrandt Creek (Neilly, 2019)



The Probable Maximum Flood (PMF) Model, previously developed for the Coppabella Mine current pit by the Neilly Group in 2019, includes a hydrologic model and a hydraulic model. This model did not analyse the final landform design. According to that model, both the Humbug Gully and the Harrybrandt Creeks are unlikely to experience flood ingress during a PMF event. However, the North and South Arms of the Thirty Mile Creek are susceptible to significant inundation events. The modelled PMF flow in the Harrybrandt Creek is seen in **Figure 3-2** which will reach a maximum elevation of 209 m AHD which is lower than the crest of the void (220 mAHD). Consequently, flooding at this creek will have no discernible impact on the void. Further modelling should be completed in the PRCP for more detailed assessments.

Modelling of the pre-mining landform is not required for the purposes of this EA amendment, and a desktop review detailing the above is sufficient to support the consideration of the revised final landform void.

4.0 Water Balance Modelling

A Water Balance Model (WBM) was developed using the GoldSim software package (version 14.0) to determine the long-term water level and water quality of the residual void following the closure of Coppabella Mine. GoldSim is a software program developed by the GoldSim Technology Group which can analyse complex time-dependent systems and is capable of analysing stochastic systems resulting in probabilistic outcome ranges.

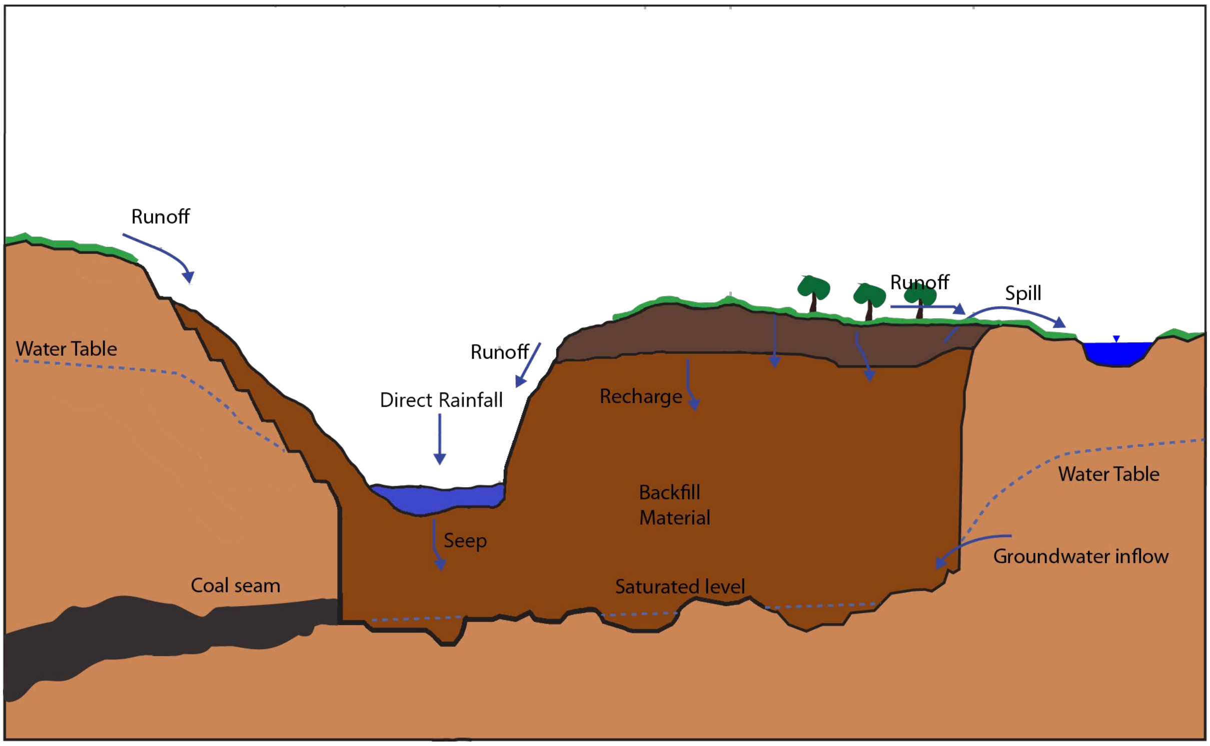
The model simulates daily changes in the volumes of stored water in response to inflows (rainfall, groundwater) and outflows (evaporation and controlled releases/overflows). The WBM was run at a daily time step over a 100-year simulation period and assessed under 500 varying climate sequences, allowing the model to predict long-term water levels, water quality, and the risk of overflow from the void. The model only considers salinity; however, it is representative of potential trends that might be expected for other water quality constituents (e.g. if salinity is accumulating, this is probably the case for other water quality components as well).

4.1 Methodology

4.1.1 Conceptual Model

A conceptual model of a typical residual void directly after reshaping and rehabilitation of the backfill material is provided in **Figure 4-1.**

Figure 4-1: Conceptual Model of Typical Residual Void (SLR)



As the groundwater levels recover, the saturated level in the backfill material will rise until a quasi-equilibrium is reached between the water level in the void and local groundwater levels. This equilibrium will shift seasonally and during wet and dry periods affecting the rate at which groundwater seeps into the void (void acts as a sink) or void runoff water seeps out into the backfill material (void acts as a source).

The diagram shows the varying sources of water which may contribute to the void water body. These include:

- Direct rainfall on the waterbody (once established);
- Runoff from pit walls;
- Runoff from the rehabilitated catchment draining towards the void;
- Runoff from any natural catchment draining towards the void; and
- Groundwater inflow while the water levels in the void and spoils are lower than the surrounding water table.

Potential water losses from the void include:

- Evaporation, if an open water surface has established;
- If the water level in the void exceeds that of the surrounding water table, water can seep out from the void to the surrounding aquifer systems;
- Overtopping or spilling if the accumulated volume exceeds the storage capacity.
- The assumed groundwater flows into the pit were based on the analytical groundwater model produced by SLR, as described in the SLR Groundwater Report (SLR, 2024) Assumed interactions between surface-groundwater are further described in that report.

4.1.2 Key Statistics

A key component of the WBM is the variability of climatic conditions. The WBM is simulated with a range of rainfall conditions, statistically equivalent to the historic records, to allow for the calculation of percentiles of key model outputs. These percentiles represent the results range due to the variability in the climate. These percentiles can be interpreted as the chance of the statistic being exceeded. The results of the WBM focus on the 5th (very dry), 50th (median), and 95th percentile (very wet) conditions.

4.1.3 Simulation Period

The final void WBM was simulated for two different time periods. Water levels within the voids and the water quality component of the model were predicted over a 100-year period (2040 – 2140) under 500 varying climatic sequences. This allowed assessment of long-term water levels, quality, and probable risk of overflow for each void.

4.2 Climate

4.2.1 Rainfall

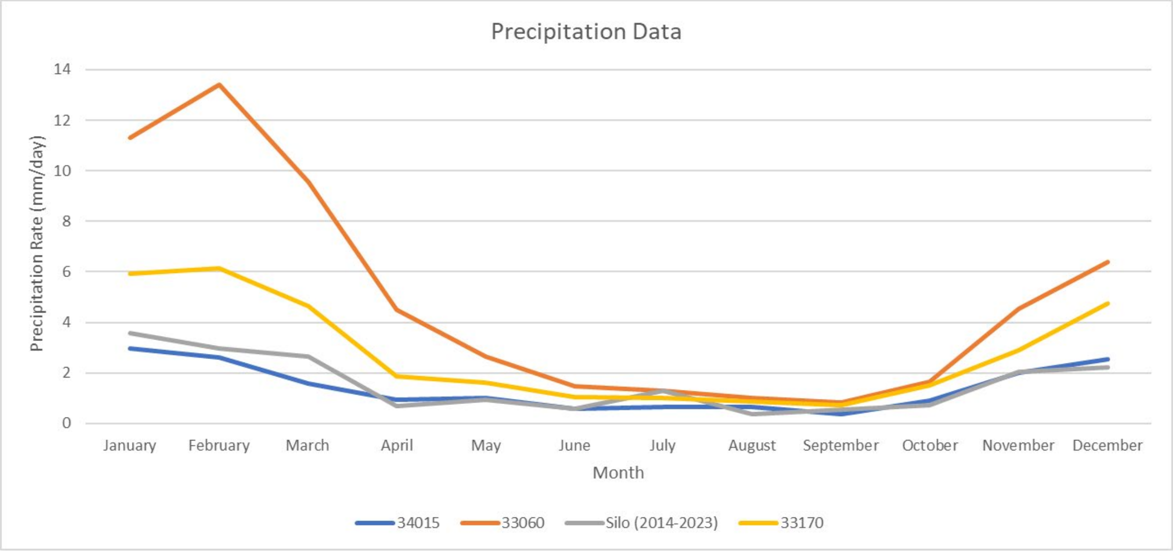
Historical rainfall data was sourced for the site from the Scientific Information for Land Owners (SILO) database. The SILO database is hosted by the Queensland Department of Environment and Science (DES) developed in collaboration with the Bureau of Meteorology (BoM). SILO provides a continuous daily time series of data at either recording stations or grid points across Australia. The data consists of observational records with missing data interpolated from surrounding gauges. The grid consists entirely of interpolated estimates based on a 0.05° × 0.05° grid. The gridded data point for SILO data was selected from 1889 to present due to its correlations with nearby gauges and the length and quality of the gauged record. The centroid of the SILO grid selected was -21.85, 148.45 (Latitude/Longitude) based on the site location placed in Google Earth.

The Bureau of Meteorology (BoM) operates rainfall and evaporation gauges for several locations in the vicinity of the Project Site. A comparison was undertaken between the SILO gridded data and BoM historical rainfall records in the surrounding area, as listed in **Table 4-1** to determine the climate at the Site. The average daily rainfall rates for these stations are indicated in **Figure 4-2**. Annual precipitation ranges from 230mm to 1,316mm with a median rate of 577mm/year and a standard deviation of 212mm (Hatch, 2016).

Table 4-1: Rainfall Gauge Data

Gauge Number	BoM Name	Period	Elevation (mAHD)	Location (Latitude/ Longitude)	Distance & Direction from Site
33170	Mystery Park	1972-Open	40	-21.36, 149.37	114 km southwest
33060	Pleystowe Sugar Mill	1913-Open	27	-21.14, 149.04	126 km southwest
34015	Wentworth	1963-Open	225	-22.07, 147.72	70 km northeast

Figure 4-2: Comparison of Rainfall Records – Daily Average



Examining the water stream gauged data in **Figure 4-2,** it is evident that the SILO data closely relates to the Wentworth station (34015), deviating from where the other stations experience more rain. The proximity of the Wentworth station to the site and its similarity in elevation logically explains the close relationship between its values and those of SILO. The higher rates of precipitation in the Mystery Park station can be due to its location between the Glencoe State Forest and the Ocean which can geographically provide orographic condensation creating a rain shadow over that gauge area, this makes it less appropriate to use as a stream representation for the site. Since the SILO values are closely related to the closest and more representative stream gauge, it is concluded that the SILO data seems appropriate to be used to generate the probabilistic rainfall dataset.

4.2.2 Probabilistic Rainfall Generation

Probabilistic climate data for the WBM was used to predict the rainfall at the site using the retrieved SILO rainfall data and the Stochastic Climate Library program (eWater CRC).

The purpose of probabilistic rainfall generation is to develop a wide range of climate sequences based on the recorded rainfall data of the area. These sequences have the same statistical characteristics of the historical data set for a range of parameters, including mean, variance, skew, and number of wet days or dry days. Each sequence has an order in which the rainfall has occurred. For example, one sequence may have wetter years at the start of the sequence, whereas another sequence may have wetter years towards the end of the sequence. Some sequences may be wetter or drier than others in order to account for the variability of the climate which may occur after the Mine is rehabilitated. The probabilistic rainfall data replicates the seasonality of the rainfall data. This climate data does not reflect changes in the climate over the years, but rather variable future climates based on historical data.

From the SILO data (1923 to present), probabilistic rainfall data was produced for 500 replicates of 100-year rainfall data (50,000 years of probabilistic data). This allows a wide range of climatic conditions to be simulated, and the mean and median of the assessment are then summarized. The assessment also yields percentiles which are interpreted as a percentage exceedance probability (i.e., the risk of an event occurring).

The comparison shows a good correlation for typical rainfall conditions through most of the records, i.e. 99th percentile **Figure 4-3**. The probabilistic data representing extreme events (<5%) includes the representation of outlier years similar to those in the historical record but at a lower frequency. Since the purpose of this assessment is to develop an understanding of the long-term residual void water levels and qualities, which are primarily driven by averages and partially by seasonal or multi-year variances rather than outlier years, the probabilistic representative dataset can be considered appropriate for the analysis. Annual rainfall depths equivalent to and exceeding the wettest year on record (996.2 mm in 2010) are represented in the probabilistic dataset (the wettest simulated rainfall is 1114.3 mm) and thus any spills predicted results from a single outlier wet year (such as that historically recorded or even greater) will be observed in the modelling results. Similarly, dry years are adequately represented, the driest on record being 146 mm in 1982 (the driest simulated is 97.07 mm). These values are considered the ultimate extremes, however, the probability of exceedance comparison indicated in **Figure 4-4** confirms the adequacy of exceeding annual depths.

Figure 4-3: Stochastic and Historical Data Comparison - Annual Rainfall

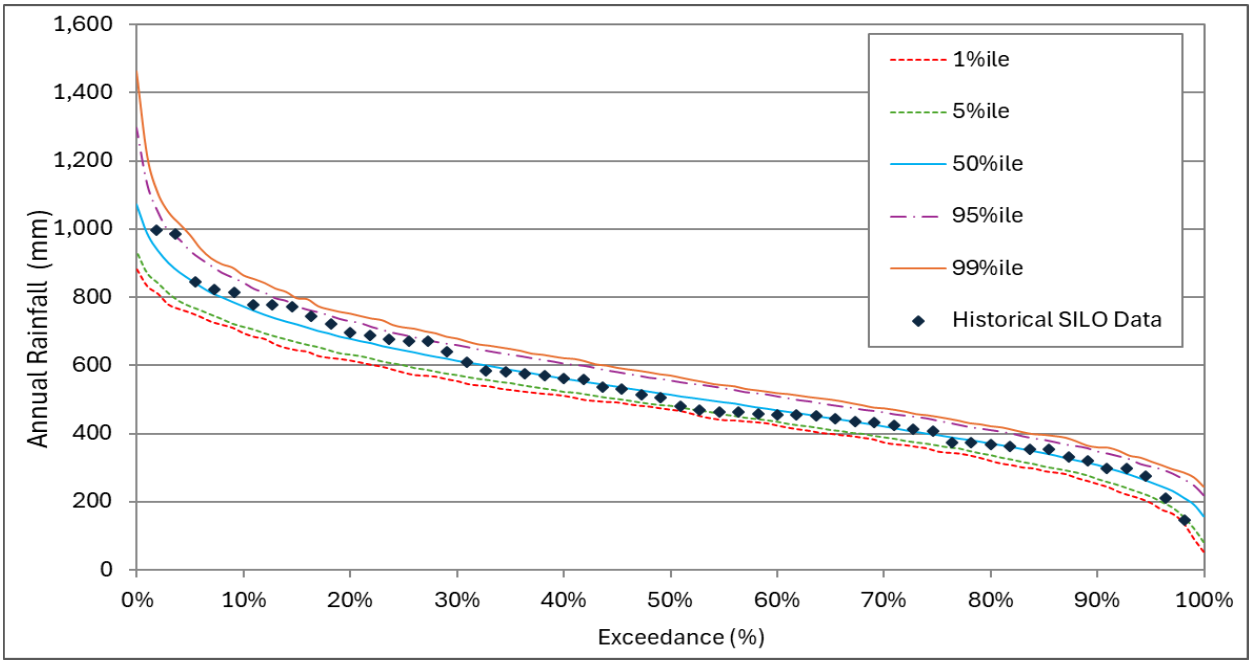
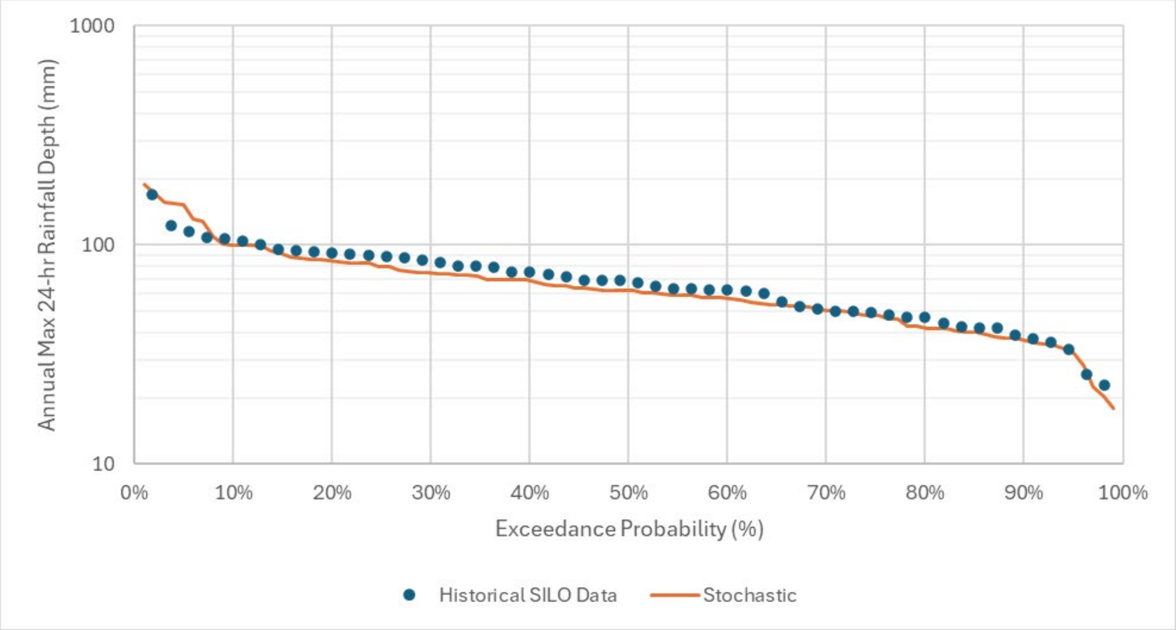


Figure 4-4: Probabilistic and Historical Data Comparison – Daily Maximum Rainfall



4.2.3 Evaporation Rates

Morton Lake evaporation data sets taken from SILO were used to determine evaporation rates on-site (Morton, 1983). The Morton wet surface dataset will be used to determine void evaporation rates. These rates were also compared to the available Morton's shallow lake evaporation rates, which are approximately 10% more than the Potential Evaporation with a 0.8 pan factor. The adopted lower evaporation rates are conservative with regard to the estimated excess water volumes requiring management in the long term. According to the SILO Data, evaporation data from 1889 to the present year indicates a median evaporation rate of 1,822 mm per year.

Probabilistic evaporation data was not adopted for the modelling due to poor correlation to historical statistics when evaporation data was included in the probabilistic data generation. This is likely due to the limited daily evaporation record and infilling of the evaporation data set with monthly records which skews the generated data set. As a result, the monthly average data was adopted based on long-term values. **Table 4-2** shows the adopted evaporation rates.

Table 4-2: Adopted Evaporation Rates

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Potential Evaporation (mm/day)	5.8	5.2	4.9	4.0	3.0	2.5	2.7	3.4	4.6	5.6	6.1	6.2

4.3 Catchment Areas

Water accumulating in the voids will come from the following sources:

1. Direct rainfall on the surface of the void;
2. Runoff from the void walls and the surrounding catchment (rehabilitated and natural surfaces);
3. Rainfall infiltrating the backfilled material, saturating the spoils, and seeping into the void; and

4. Groundwater ingress from the surrounding aquifers.

For sources 1 through 3 listed above, the relevant catchment areas were determined as detailed below:

Direct rainfall: A stage-area relationship for each void was determined based on the proposed final landform digital elevation model (DEM). From this relationship, a wetted surface area was calculated for each timestep simulated in the model based on the volume of water in storage. These stage-area relationships are provided in **Figure 4-8**.

Runoff: The natural catchment configurations for the residual voids at the Mine were determined based on the final landform contours provided by Peabody. The final landform covers two catchment areas, Humbug Gully, north of the void, and Harrybrant Creek catchment, south of the void (as outlined in Section 3.0). Peabody instructed SLR to assume that runoff from the Humbug Gully Catchment will not report into the final void.

The residual void catchment consists primarily of rehabilitated spoil dumps, with an elevated stable landform assumed to be constructed around the perimeter to prevent external catchment and flood ingress into the voids. The void catchment, as visualized in **Figure 4-5,** was used to determine surface inflows to the void. It is assumed that the void is fully bunded and all fully rehabilitated surface areas above the crest of the void are diverted away from the void.

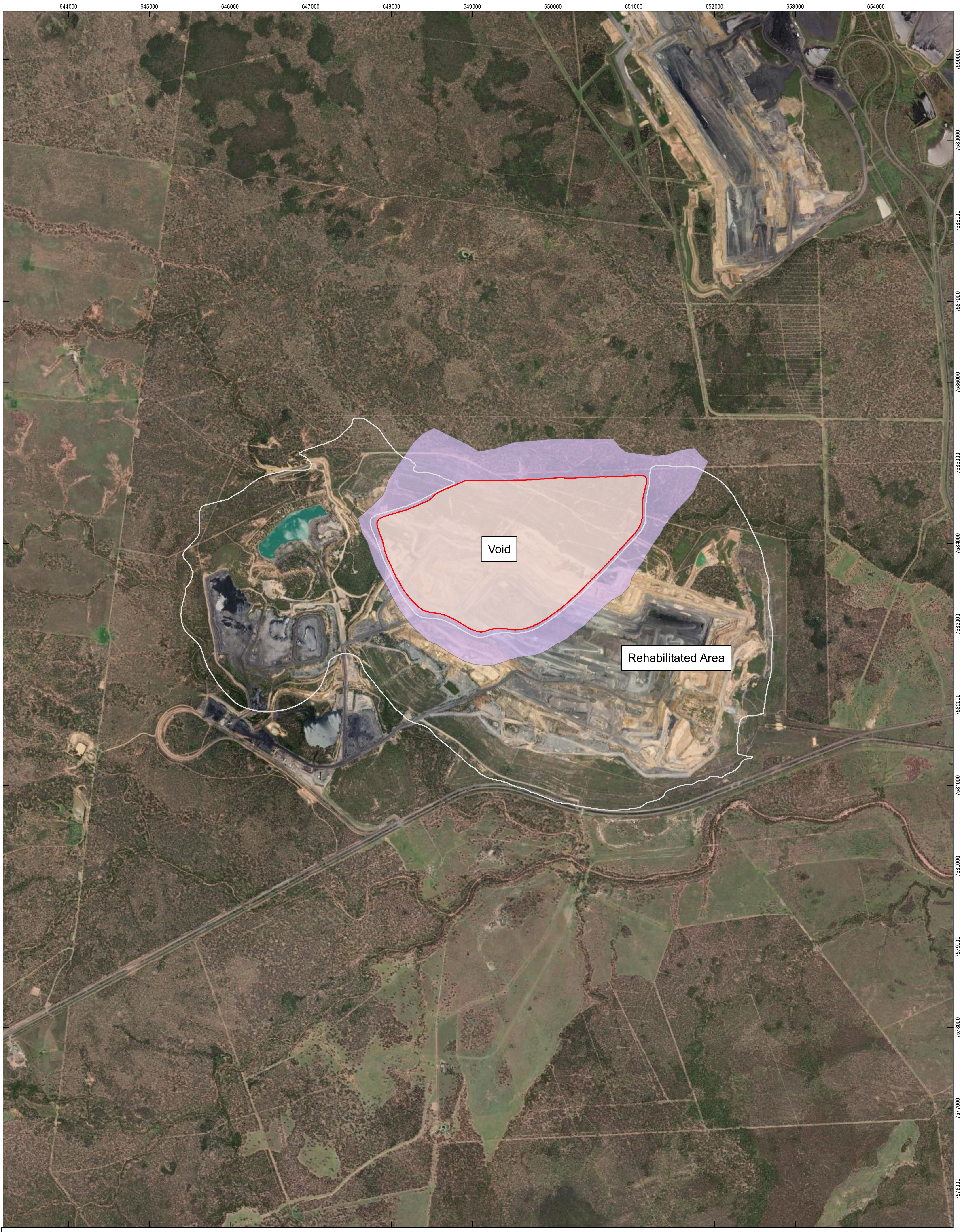
Infiltration/Seepage: A portion of the rainfall landing on the rehabilitated areas overlaying the backfilled material in the pits will seep through the covered soils and into the spoils. As the spoil material becomes saturated, it is expected that the excess water will seep along the original pit floor and fill the lowest-lying spoils progressively until the invert level of the remaining void is reached, at which time the excess water will seep into the void. The approximate catchment areas associated with this infiltration water source would equal the original excavated pit footprint minus the wetted surface in the void (if a water body has already been established). The catchment area for seepage and infiltration differs from that of the surface runoff as the baseflow component of the catchment can’t be diverted through surface bunding.

The landuse and catchment areas have been based on the currently available pit outlines, LIDAR imagery, surface contours, and the proposed final landform of the site. The adopted catchment areas for each land use are summarised in **Table 4-3**.

Two scenarios were considered to model the final water levels, volume, and surface area. The first scenario assumes the entire catchment inside the void (up to the crest) has a land use of mine pit. The second scenario assumes a rehabilitation land use for the area unlikely to be wetted by the final void lake.

Table 4-3: Summary of Landuse within the Void and its surrounding catchment

Landuse	Scenario 1 Catchment Area (ha)	Scenario 2 Catchment Area (ha)
Final Void	460	100
Rehabilitation area	0	360
Infiltration/seepage area	370	370



C:\Users\Samantha.Sam\OneDrive - SLR Consulting\Documents\Coppabella\640.030987_Coppabella_catchments_26012024.mxd

Coordinate System:	GDA 1994 MGA Zone 55
Scale:	1:41,881 at A4
Project Number:	620.30112
Date:	09-Feb-2024
Drawn by:	SS

LEGEND

—	Rehabilitated Area
—	Final Void
▭	Void Catchment
▨	Inflitration catchment to the void

COPPABELLA EA AMENDMENT

Catchment Reporting to the Void

Data Source: DNRME watercourses and ESRI Basemap imagery.

DISCLAIMER: All information within this document may be based on external sources.
SLR Consulting Pty Ltd makes no warranty regarding the data's accuracy or reliability for any purpose.

FIGURE 4-5

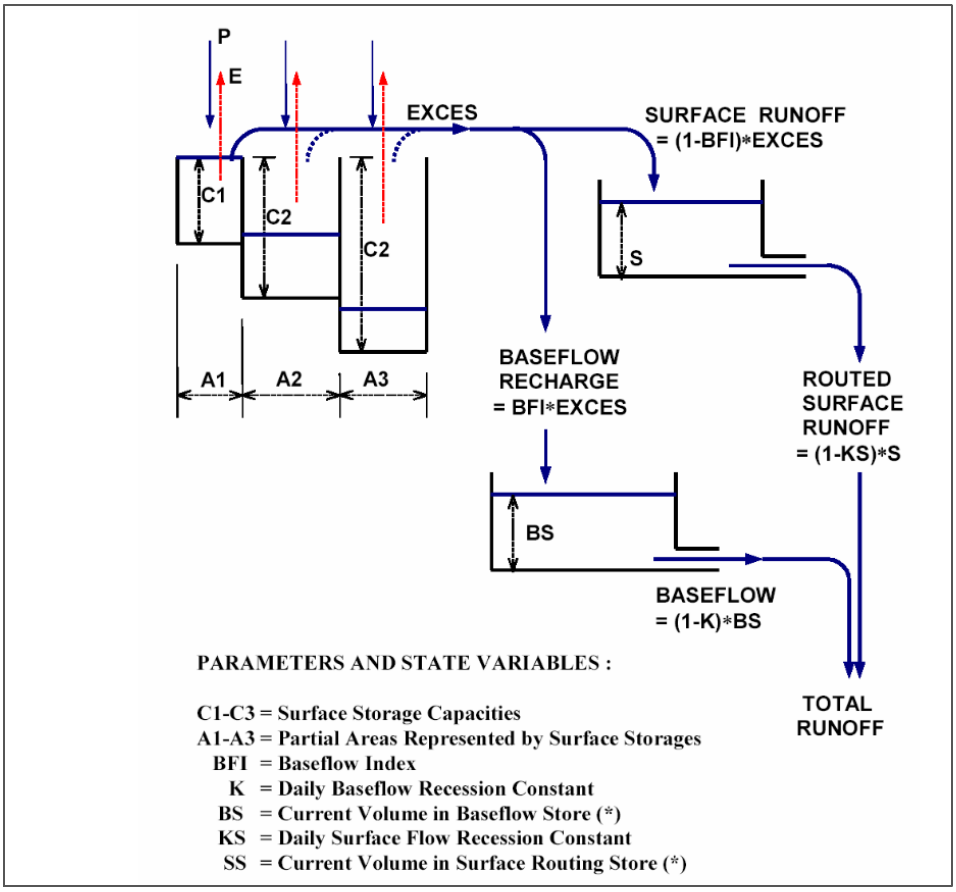
4.4 Runoff Modelling

The WBM utilises the Australian Water Balance Model (AWBM) rainfall runoff module to calculate the rainfall and runoff inflows from the catchment.

The rainfall is converted to runoff using the Australian Water Balance Model (AWBM), illustrated in **Figure 4-6.** This runoff can be split into two forms:

1. Surface runoff which travels overland to the destination; or
2. Sub-surface which travels through the ground to reach the destination.

Figure 4-6: Australian Water Balance Model Schematic



The AWBM parameters were adopted from the previously calibrated GoldSim model (Jacobs, 2020 and WRM, 2022), and are consistent with the 2016 Final Void model produced by Hatch, no further validation of these by SLR was undertaken. All models were reviewed for this assessment. A summary of the AWBM parameters used for each catchment type is presented in **Table 4-4**.

Table 4-4: Adopted AWBM Parameters

Parameter	Abbreviation	Void	Rehabilitated
Small storage capacity (mm)	C1	0.5	25
Medium storage capacity (mm)	C2	20	140
Large storage capacity (mm)	C3	NA	200

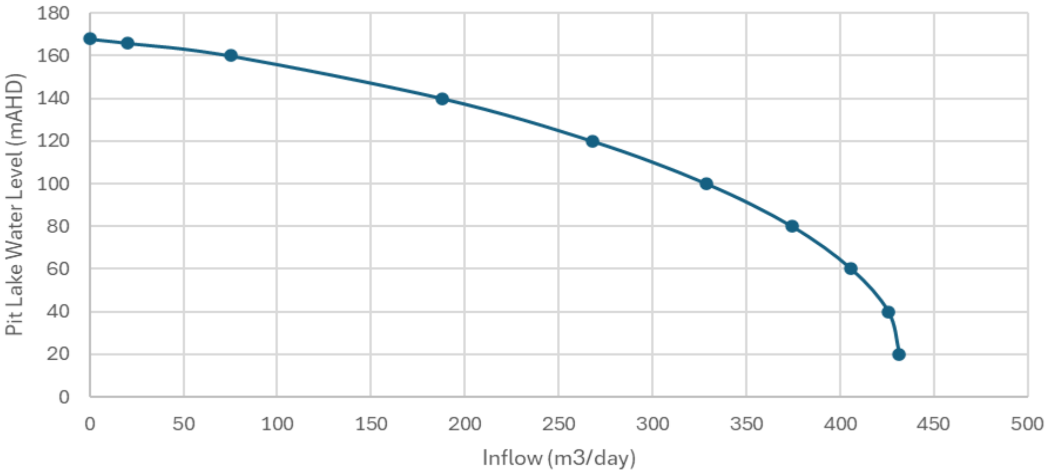
Parameter	Abbreviation	Void	Rehabilitated
Small partial area portion	A1	0.1	0.1
Medium partial area portion	A2	0.9	0.45
Large partial area portion	A3	0	0.54
Baseflow Index	BFI	0.25	0.25
Baseflow recession	K_b	0	0.3
Daily streamflow recession	K_s	0	0

4.5 Groundwater Interaction

Groundwater inflows and outflows to/from the voids were adopted from the analytical groundwater model developed alongside this study (SLR, 2024). The 2016 Final Void Study by Hatch noted no net groundwater inflow verified from site validations. The existing groundwater level is 180m AHD with the pit lake likely expected to act as a groundwater sink (Hatch, 2016; Jacobs, 2020).

The flux rate applied in the WBM was dependent on the water level within the void. This relationship is illustrated in **Figure 4-7**. Baseflow to the pit was included in the AWBM surface water model.

Figure 4-7: Inflow vs Pit Lake (i.e. Final Void) Water Levels



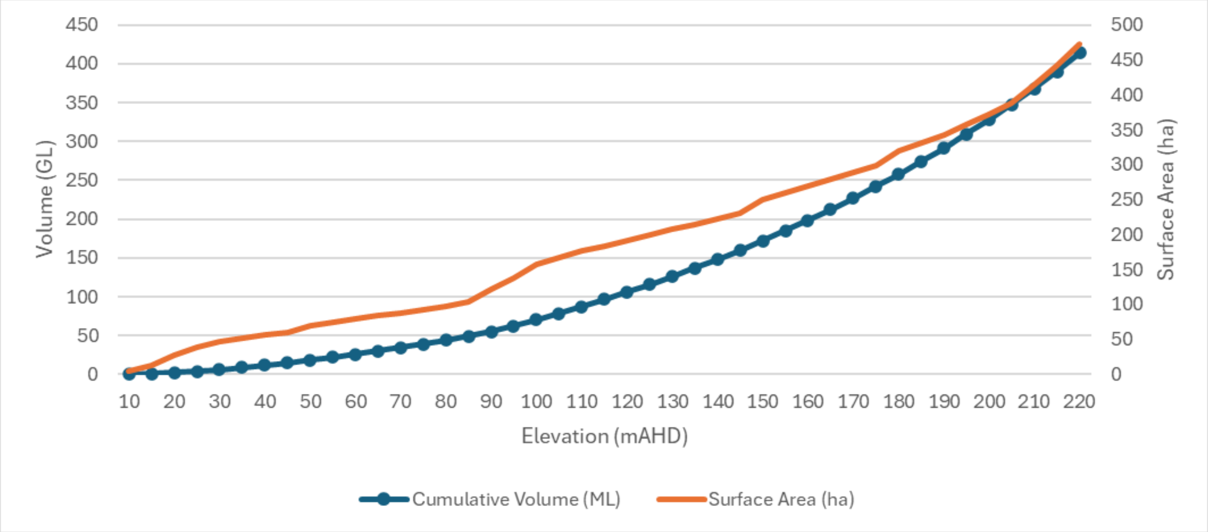
Generally, the rate at which water is expected to seep from the voids reduces over time as the groundwater levels recover.

4.6 Storage

4.6.1 Void

The stage-storage and surface area relationship curves were derived from the final landform contours provided by Peabody. Residual void maximum depth is 214 m with the lowest depth at 6 m AHD and a crest at 220 m AHD. Residual void staged storage area relationships for the void is shown in **Figure 4-8**.

Figure 4-8: Stage Storage Curve for the Final Void



4.7 Water Quality

The WBM was developed to include a high-level salt balance to track both the quantity and quality of water on site. The salt balance tracks the water quality or salinity (total dissolved solids (TDS) in mg/L) for the inflows into the voids and subsequent effects from evaporation and releases on the storage water quality. This also includes salinity modelling to represent the general salt estimated within the final voids.

Each land use type was allocated a specific Electrical Conductivity (EC) (in µs/cm) value which is then applied to the runoff for each land use type that reports to the void. In addition to runoff, the groundwater inflow to the voids also contributes to TDS levels. This net groundwater inflow was taken from the SLR Groundwater Study (SLR, 2024) analytical model; the rates are conservative. The salt loading parameters for this project were adopted from the existing operational WBM for Peabody (Jacobs, 2020; WRM, 2022) and the groundwater concentration was taken from the Hatch 2016 Final Void Report.

Adopted water quality (salinity) parameters were taken from the Peabody WBM (Jacobs, 2020) and the Hatch Final Void Study (Hatch, 2016) and reference to the salinity findings of the SLR Groundwater Report (SLR, 2024), as summarized below.

In cases where there were differences between the water quality parameters from the Jacobs (2020) SLR (2024) or Hatch (2016) studies, the higher salinity values were adopted as a more conservative estimate.

Runoff:

- Pit: 1,500 µS/cm (Jacobs, 2020)
- Infiltration/Seepage via spoils: 700 µS/cm (Jacobs, 2020)
- Groundwater: 14,000 µS/cm (Hatch, 2016, SLR 2024).

The reported TDS concentrations in the voids were limited to 357,000 mg/L (532,800 µS/cm), as this is the solubility limit of salt in water. Importantly it is noted that while reported concentrations were limited, the mass of salt in the model is preserved.

The ANZECC & ARMCANZ (2000) Water Quality Guidelines for livestock drinking water quality recommends up to 5,000 mg/L TDS for beef cattle. The Guideline suggests that animals may experience an initial reluctance to drink or there may be some scouring, with such salinity levels but should adapt without loss of production. The current EA (EPML00579213) stipulates a stock water storage containment limit of 5,970 µS/cm.

To evaluate the salinity modelling outcomes, three risk categories have been defined:

- Low = EC < 5,970 µS/cm (complies with current EA stock water release limits)
- Medium = EC > 5,000 and < 18,000 µS/cm (complies with fauna habitat requirements)
- High = EC > 18,000 µS/cm (Not expected to support fauna habitat or cattle drinking)

For the purposes of this assessment, EC has been used as an indicator element to show the projected rate of concentration of an element over the modelled period. Although all critical analytes have not been assessed within this report, the approach provides an indication of the rate of concentration which could apply to other contaminants of concern based on the range of modelled scenarios.

5.0 Results

5.1 Residual Water Bodies

The system response was simulated daily over a period of 100 years and with 500 different sequences of rainfall, to estimate the probable range of results when considering water volumes within the residual voids.

Table 5-1: Simulated water levels and water volumes in residual voids (Percentile Results)

Residual Void	Water level (mAHD)			Volume (GL)			Total void storage capacity below spill level (GL)
	5%	50%	95%	5%	50%	95%	
Final Void (Scenario 1)	88.9	94.9	101.2	51.1	58.9	68.3	402.9
Final Void (Scenario 2)	41.1	48.7	55.5	11.2	15.9	20.8	402.9

Table 5-2: Simulated Size and Permanence of the Final Void (median results)

Landform	Volume (GL)	Water Level (mAHD)	Elevation at the Lowest Point (mAHD)	Water Surface Area (ha)
Void Scenario 1	43.9	81	6.5	98
Void Scenario 2	15.9	48.7	6.5	65

5.1.1 Scenario 1

The simulated 5th percentile, median, and 95th percentile water levels and water volumes in each of the water-storing residual voids after 100 years are provided in **Table 5-1** with the daily median volumes and surface water level over this period graphed in **Figure 5-1 and Figure 5-2,** respectively.

The void is expected to store 43.9 GL or more of water under median conditions. It is predicted to reach its steady state water levels after around 100 years following the final landform shaping and rehabilitation. The simulated median depth, volume and permanency of the void is provided in **Table 5-2**.

Figure 5-1: Scenario 1 - Residual Voids Simulated Volumes (Percentile Results)

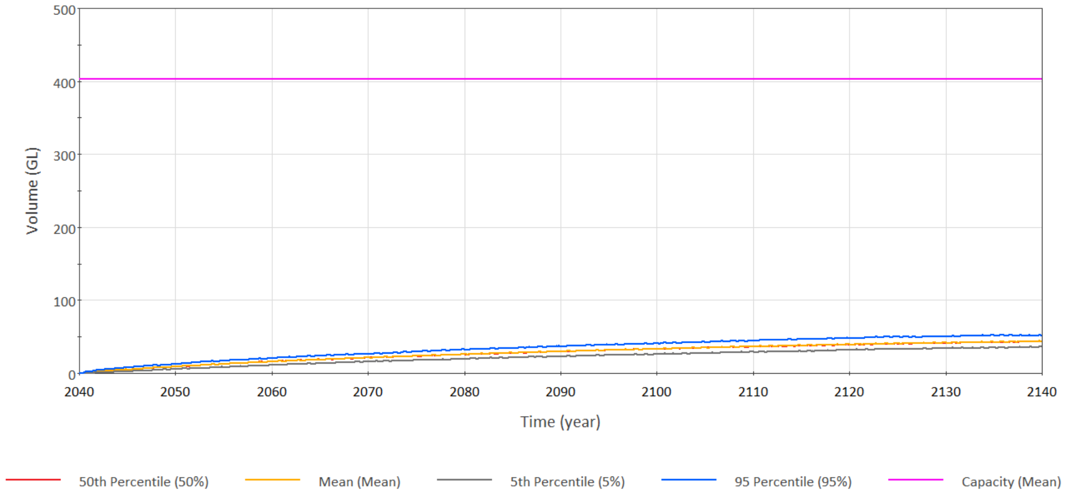
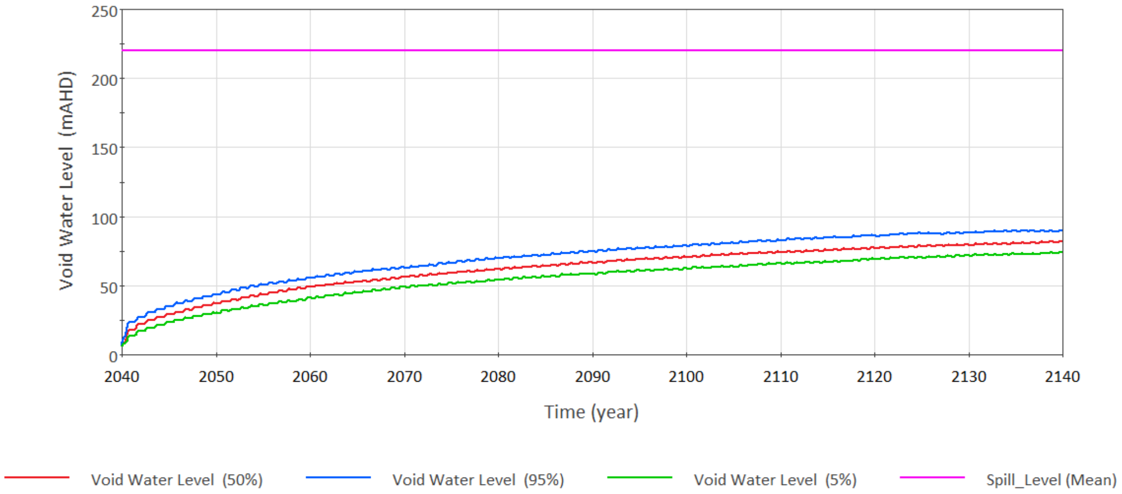


Figure 5-2: Scenario 1 - Simulated Water Levels of the Final Void (Percentile Results)



5.1.2 Scenario 2

The simulated 5th percentile, median, and 95th percentile water levels and water volumes in each of the water-storing residual voids after 100 years are provided in **Table 5-1** with the daily median volumes and surface water level over this period graphed in **Figure 5-3 and Figure 5-4,** respectively.

The void is expected to store 15.9 GL or more of water under median conditions. It is predicted to reach its steady state water levels after around 100 years following the final landform shaping and rehabilitation. The simulated median depth, volume and permanency of the void is provided in **Table 5-2**.

Figure 5-3: Scenario 2 - Residual Voids Simulated Volumes (Percentile Results)

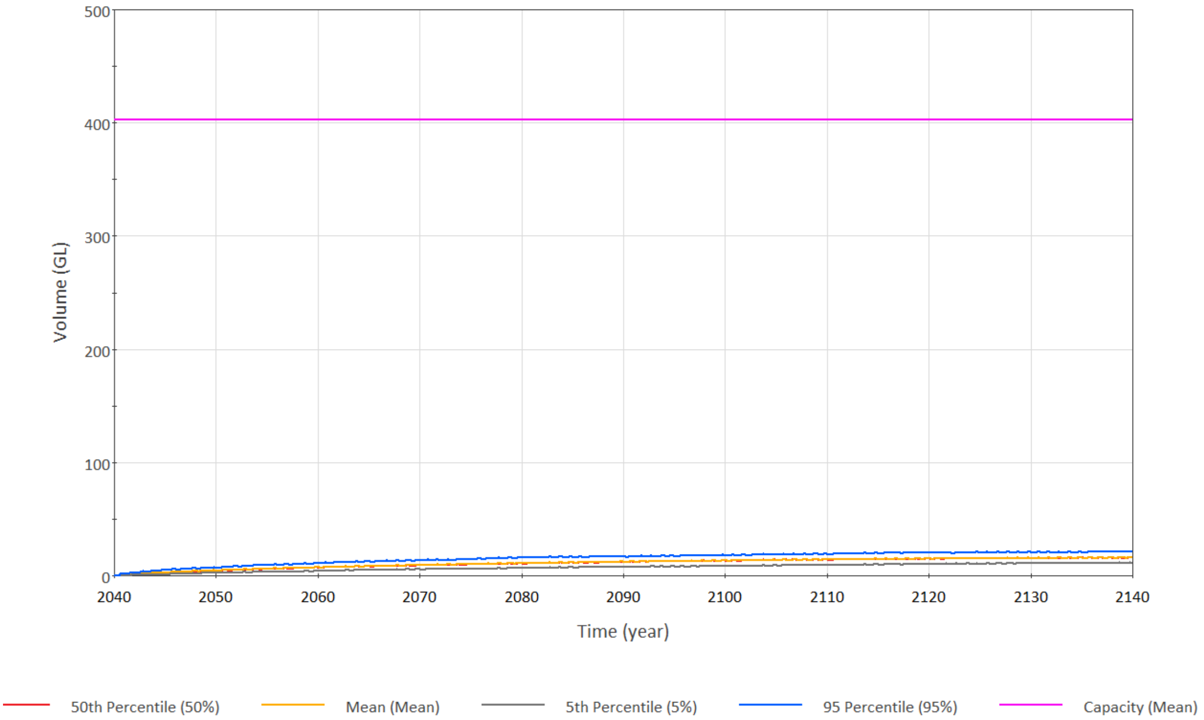
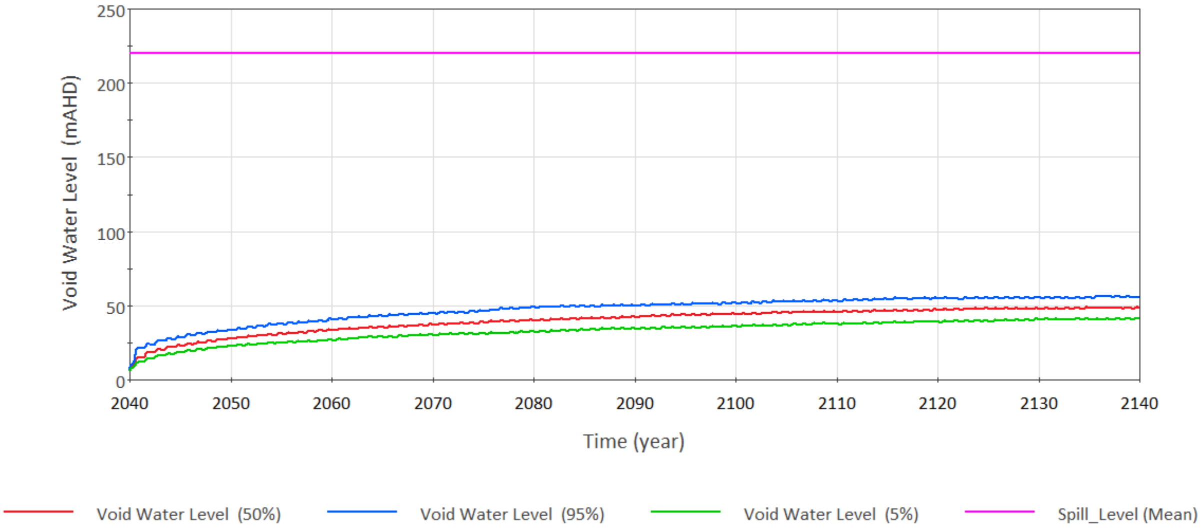


Figure 5-4: Scenario 2 - Simulated Water Levels of the Final Void (Percentile Results)



The analysis indicates that the water surface area of the final void lake would be between 98 and 65 ha, depending on the establishment of vegetation within the final void. It is therefore considered that the proposed final landform design will be able to meet the current EA conditions, Table C1, with the residual void having a surface area ~80ha.

5.2 Water Quality

The results of the residual void salinity modelling for the permanent void are provided in **Figure 5-5**, **Figure 5-6**, and **Table 5-3**. After 100 years post-mine closure, the pit exhibits moderate salinity. The graphed data indicates an ongoing upward trend that has not yet stabilised over 100 years.

Since evaporation is the predominant outflow mechanism, salt will stay within the void. The salinity levels within the void are expected to persist in an upward trajectory, eventually reaching a hyper saline state with the void in the future.

The sensitivity analysis in **Section 4.8.2** reveals changes in evaporation rates will significantly impact the EC of the void. Therefore, conservative rates were used for the evaporation.

Figure 5-5: Scenario 1 - Simulated EC of the Final Void (median results)

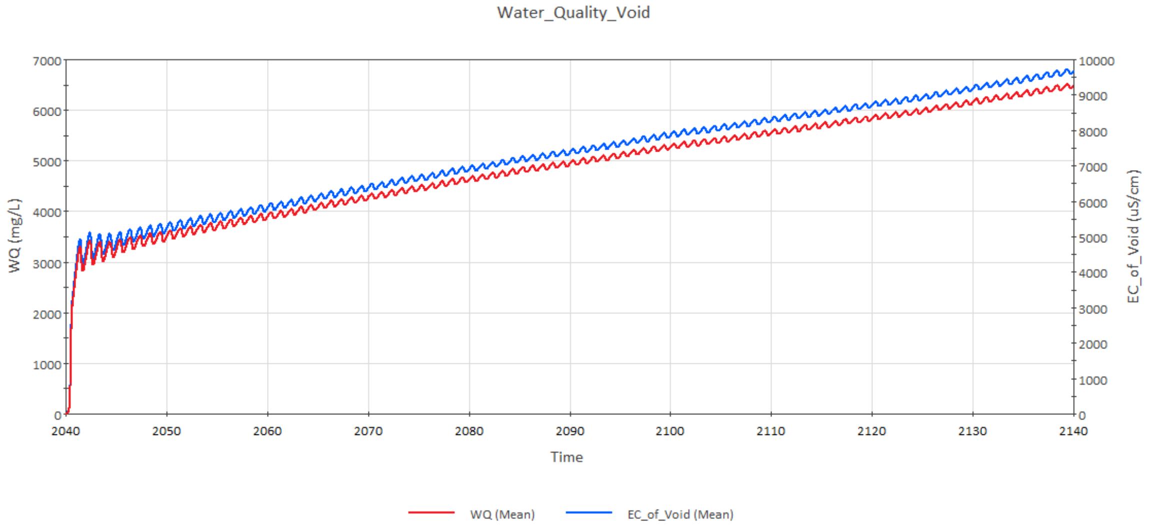


Figure 5-6: Scenario 2 – Simulated EC of the Final Void (median results)

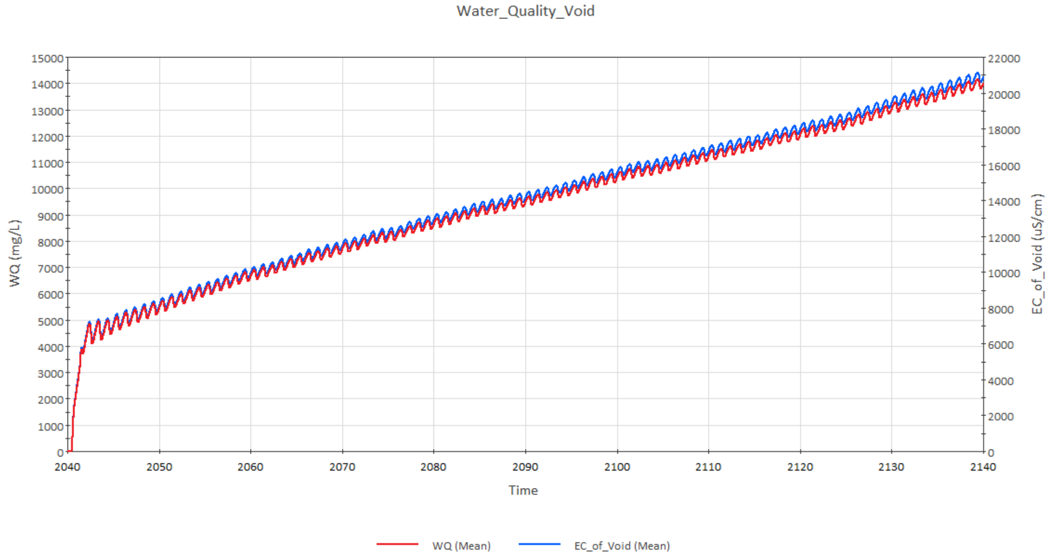


Table 5-3: Simulated Long-Term Median Salinity of the Final Void

Residual Void	100 years post mining	
	TDS (mg/l)	EC (µS/cm)
Void (Scenario 1)	6,476	9,666
Void (Scenario 2)	14,000	20,895

5.3 Sensitivity Analysis

5.3.1 AWBM

Climate data was reviewed in the sensitivity analysis to determine the effects of the calibrated parameters in the WBM. A 20% increase and decrease were applied to the AWBM to analyse the sensitivity of the climate model to the water level of the void.

In running this sensitivity analysis, the final water level in the void differs to the model scenario by <5 m over the period of 100 years. In both scenarios, water level continues to be a groundwater sink and stays relatively consistent within the 5 m difference therefore showing the suitability of the parameters in the hydrological model.

Since the groundwater inflows are based on an analytical model, a sensitivity analysis was performed on the water quality. The analysis indicates large effects of the evaporation rates on the water quality of the void since groundwater outflow and overflow are minimal to none. Increases and decreases in the evaporation rates show large changes in the long-term EC of the final void. Therefore, conservative estimates of the EC will be used for the evaporation component of the water quality section within the WBM.

5.3.2 Groundwater

A sensitivity assessment was undertaken of the assumed groundwater-surface water inflow relationship and was found to change the final void water surface levels and volumes by 3% and 7% respectively. Importantly it did not change the key findings of the assessment that the void would reach equilibrium and remain a sink with significant freeboard maintained within the void. The salinity of the void would continue to increase with time due to the effects of evaporation, eventually reaching hypersaline conditions.

The assumed groundwater quality was consistent with findings from the Groundwater Report (SLR, 2024) which indicated ranges of (13,000 – 15,000 µS/cm) and is therefore considered appropriately conservative.

5.3.3 Climate

According to the Climate Futures Exploration Tool, the climate at the project site in 2090 under the climate scenario RCP 8.5, predicts the area to have approximately 10% increase in annual evaporation and an annual rainfall decrease of 5% (Climate Change in Australia, 2021). These climate change estimates were included in the WBM and confirm the void is still well within the capacity of the void under 100 m AHD and continues a groundwater sink.

The increase in evaporation rates also affects the final void water quality. The effects of the climate change scenario result in higher final salinity levels.

5.4 WBM Risk Assessment

A summary of the residual void risk assessment is provided in **Table 5-4**. The expected size, permanency, overtopping probability, and long-term water quality of the void have been considered when allocating an overall risk rating for the two scenarios.

Table 5-4: Residual Void Risk Assessment Summary

Residual Void	Size and Permanence of Waterbody (100 Years)	Overtopping Risk	Water Quality	Surface Water Risk
Scenario 1	Average volume: 43.9 GL Final water level Surface area: 98 ha	None	Slow rising trend, expected to reach 9,666 µS/cm after 100 years, and is trending up. Will eventually reach hypersaline	Medium: Large-sized waterbody, moderately saline in the long-term
Scenario 2	Average volume: 15.9 GL Final water level Surface area: 65 ha	None	Slow rising trend, expected to reach 20,895 µS/cm after 100 years, and is trending up. Will reach hyper-salinity	Medium: Medium sized waterbody, high salinity in the long-term.

5.5 Limitations of the Assessment

The accuracy of the assessment is reliant on the accuracy of the utilised data, as detailed in Section 2. SLR has assumed all source data to be fit for purpose and sufficiently accurate for the purpose of this assessment. Except where noted, no verification of the accuracy of the information has been carried out. In the event that some of the information which was relied upon for this assessment is found to be inaccurate, then some or all of the findings may change.

Several assumptions have been made to inform the development of the WBM. The modelling and sensitivity assessment provides guidance regarding the likely importance of these assumptions and parameters on the model results. However, the passage of time and additional further studies may refine these assumptions leading to improvements in model accuracy and changes to the conclusions drawn in this report.

Although the analyses undertaken, as detailed in this report, were done so with the appropriate care and professionalism, this report shall only be used for the purposes intended. The analyses detailed in this report were undertaken solely for the purpose of addressing the requirements for the final void WBM for Coppabella Mine in accordance with the relevant documentation as detailed in **Section 1.2**.

This report should be read in full, and no excerpts are to be taken as representative of the findings. This report has been prepared on behalf of Peabody and SLR accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

This assessment was completed alongside a groundwater assessment (SLR, 2024) and utilises data from the groundwater assessment. This report is therefore also subject to the limitations of this groundwater assessment (SLR, 2024). While the model represents key processes that influence the expected water level and water quality within each void, there remains both uncertainty and unknowns in the model and its parameterisation. In particular, the following is noted:

- The model is based on a single assumed inflow water level relationship which was derived utilising an analytical method. No iteration between the groundwater analysis and results of this assessment have been undertaken.
- While the AWBM rainfall runoff assumptions are based on calibration undertaken by others (Hatch, 2016, Jacobs, 2020), these have not been validated for a closure scenario. Assumptions around the porosity/void space associated with the backfill material may impact the time to saturation of this material which could reduce or lengthen the time it takes for the surface residual void to start sustaining a permanent waterbody.
- There is very little research done on estimating evaporation from void waterbodies. Studies have been conducted attempting to increase the confidence in the estimations and have generated mixed results, particularly for voids with smaller depths, volumes, and surface areas when the localised effects of the final landform topography are unknown. Lower evaporation rates have been adopted to be more conservative with regards to the estimated excess water volumes requiring management in the long term. Higher evaporation rates have been reviewed for climate scenarios to analyse void water quality and void salinity.
- Due to the chemical processes transpiring within the waterbody, a portion of the dissolved salts will likely precipitate and accumulate on the void floor. Some of these salts may readily re-dissolve in the water during wetter periods, however a portion is expected to remain insoluble. Thus, any predicted future water quality is deemed conservative.
- Based on the above it is considered likely that the water storage volume identified in this report will be conservative and the actual volumes of water accumulating within each void are expected to be less.

The model limitations discussed above, in combination with the groundwater model limitations, as detailed in the Groundwater Modelling Report (SLR, 2024), could result in changes to the conclusions drawn in this report.

6.0 Conclusion

Once the final landform is completed, one residual void will remain capable of capturing and storing runoff water as well as infiltrating groundwater. The void is deemed a groundwater sink. Surface water will also be contained in the void and not flow through and out via surface pathways. The void has been modelled, considering long-term climate, catchments, runoff generation, and groundwater interaction.

Two scenarios have been modelled to predict the long-term water levels, volumes and surface area. The scenarios differ in the assumption around the establishment of vegetation within the final void. The analysis indicates that the proposed single residual void is able to be constructed to have a final lake water surface level with a surface area ~80 ha, which is within the current EA condition, Table C1. In all scenarios there is no risk of overtopping of the residual void.

The void has been allocated a medium-risk rating with regard to the surface water impacts. It is considered a large permanent water body with medium salinity levels and the capacity to become hypersaline in the long-term future due to evaporation as the only water loss. Limited stratification is expected to occur, given the dry climate. Long term predictions in water quality indicate the final void salinity is trending upward and the void is expected to eventually become hypersaline but remain a groundwater sink.

A NUMA is proposed for this void due to its medium risk profile where rehabilitating the land would pose a greater environmental risk than not rehabilitating the land.

Section 3.4 of the PRCP guidelines require that NUMA voids be located outside the pre-mining condition 0.1% AEP flood extent for relevant watercourses (i.e. watercourses with Strahler Stream Order 4 or greater).

A preliminary review of available watercourse data indicates that the only stream order higher than 4 within the project area is the Harrybrandt Creek, which lies outside of the void catchment. Therefore, it is anticipated that modelling of the pre-mining landform was not deemed to be required for the purposes of this EA amendment, and a desktop review detailing the above is sufficient to support the proposed PMLU for the final landform void.

Several assumptions regarding the hydrology and groundwater interactions of the site have been made while developing the current understanding and the model. It is recommended that ongoing monitoring of the water levels and water quality be maintained, and the assessment revisited at least every 5 years to improve confidence in the long-term forecasting.

Sincerely,

SLR Consulting Australia

Nadja Kunz, Ph.D., BE (Chem)/BBusMan
Principal Consultant, Hydrology & Hydrogeology

Samantha Sam, B.Sc
Senior Water Modeller, Hydrology & Hydrogeology

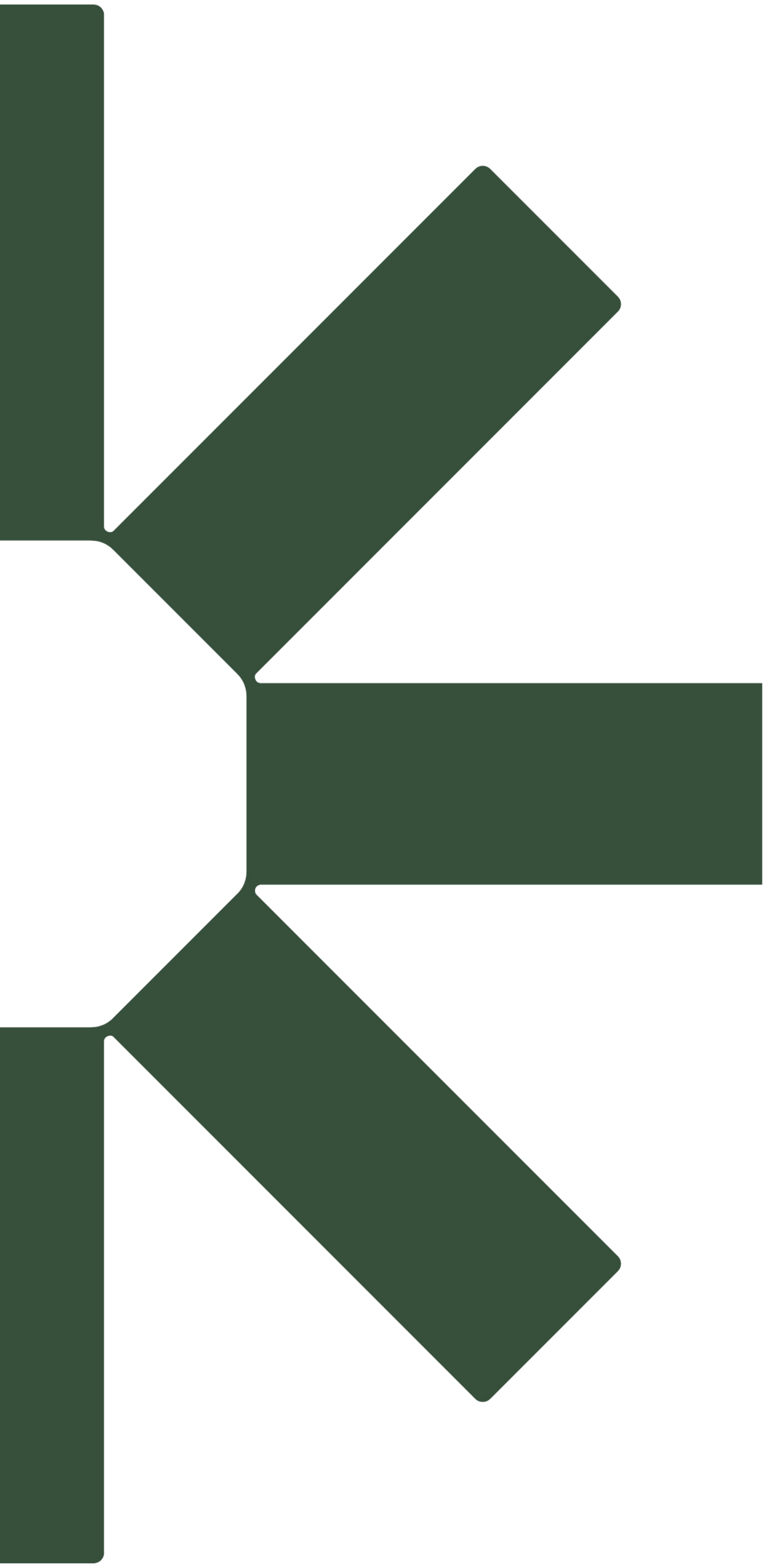
7.0 References

Bureau of Meteorology, 2023	Design Rainfall Data System (2016), extracted from http://www.bom.gov.au/water/designRainfalls/revised-ifd/ on 24 November 2023 at (-21.85, 148.43)
Climate Change in Australia, 2021	Climate Futures Exploration Tool (2021), extracted from Climate Futures Tool (climatechangeinaustralia.gov.au) in Feb 2024
DES, 2023	SILO Australian Climate Database. Queensland Government 2023. Climate data was obtained at Latitude: -21.85, and Longitude: 148.45 on 22 November 2023.
Hatch, 2017	*Peabody Energy Australia Coppabella Mine – Water Balance Update 2017.* Project memo. April 2017.
Jacobs, 2020	*Coppabella Water Balance*, Revision 0. GoldSim Version 12.
Peabody, 2023	*Coppabella Coal Mine Water Management Plan*. Version 6. May 2023.
Neilly, 2019	Coppabella Mine PMF Flood Modelling. March 2019
SLR, 2024	Environmental Authority Amendment - Groundwater Assessment Final Void Assessment Report. Feb 2024
WRM, 2022	*Coppabella Coal Mine, Water Balance Model Report.* June 2022.

8.0 Feedback

At SLR, we are committed to delivering professional quality service to our clients. We are constantly looking for ways to improve the quality of our deliverables and our service to our clients. Client feedback is a valuable tool in helping us prioritise services and resources according to our clients needs.

To achieve this, your feedback on the team’s performance, deliverables and service is valuable and SLR welcomes all feedback via https://www.slrconsulting.com/en/feedback. We recognise the value of your time and we will make a $10 donation to our 2023 Charity Partner - Lifeline, for every completed form.



Making Sustainability Happen