Appendix D
Surface Water Assessment Report (ATC Williams 2023)

REPORT

ERNEST HENRY MINING PTY LTD
ABN: 18 008 495 574

Ernest Henry Mine
Environmental Authority Amendment
Water Balance

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JULY 2023

TAILINGS.WATER.WASTE.

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1 INTRODUCTION AND BACKGROUND

Ernest Henry Mining (EHM) operates the Ernest Henry copper-gold mine north-east of Cloncurry in north-west Queensland. Water management is critical to ensure compliance with Environmental Authority (EA) conditions and to control the risk of downstream impacts. The Ernest Henry mine includes an underground mine, process plant, tailings storage and three significant capacity evaporation dams, as well as a number of smaller dams to capture site runoff. The former open cut pit needs to be maintained in a dewatered state in order for underground mining to continue.

ATC Williams Pty Ltd (ATCW), previously Hydro Engineering & Consulting Pty Ltd (HEC), have developed a calibrated operational water balance model for the Ernest Henry mine (HEC, 2020). Key model forecasts include predicted stored water volumes in the main site water storages and the risk of spill occurring from site storages to receiving creeks. The model has been used to predict the site water balance for the planned remaining mine life.

Underground mining is currently approved to a level of 1,200 m (mine datum) which, on current estimates, would be reached by approximately the end of June 2024. EHM is seeking approval via an amendment to their environmental authority (EA) to extend mining down to a level of 1,150 m, which would extend operations until approximately the end of February 2026.

2 SCOPE OF WORK

ATCW have been engaged to undertake simulation of the operational water balance system of the existing, approved Ernest Henry mine (with mining to a level of 1,200 m) and of the proposed amended operation (with mining to a level of 1,150 m).

This report:

- provides a description of the Ernest Henry mine surface water management system (with no significant changes proposed to the system for the proposed amended operation),
- describes the operational water balance model, including key data, and
- presents predictive results for the proposed amended operation, including key forecast changes.

3 WATER MANAGEMENT SYSTEM

The surface layout of the Ernest Henry mine surface facilities, including the main water management storages and their catchments, is shown in **MAP 1** to **MAP 3** for the situation of mining to a level of 1,200 m as at 2024[1], for the situation of mining to a level of 1,150 m as at 2024[1] and for the situation ofmining to a level of 1,150 m as at 2026[1] respectively.

In addition to the water management infrastructure, the main features of the Ernest Henry mine include the former open cut pit (with the underground mine located beneath and to the south-west of this, with surface subsidence gradually enlarging the open cut pit) and two raised waste rock emplacements (raised above the otherwise generally flat surrounding terrain). The surface water management system of the Ernest Henry mine involves a number of interlinked storages, their catchments, the underground mine, the process plant, the two-cell tailings storage facility (TSF) and water pumping systems. A schematic of the operational water management system is provided in **DIAGRAM 1**.

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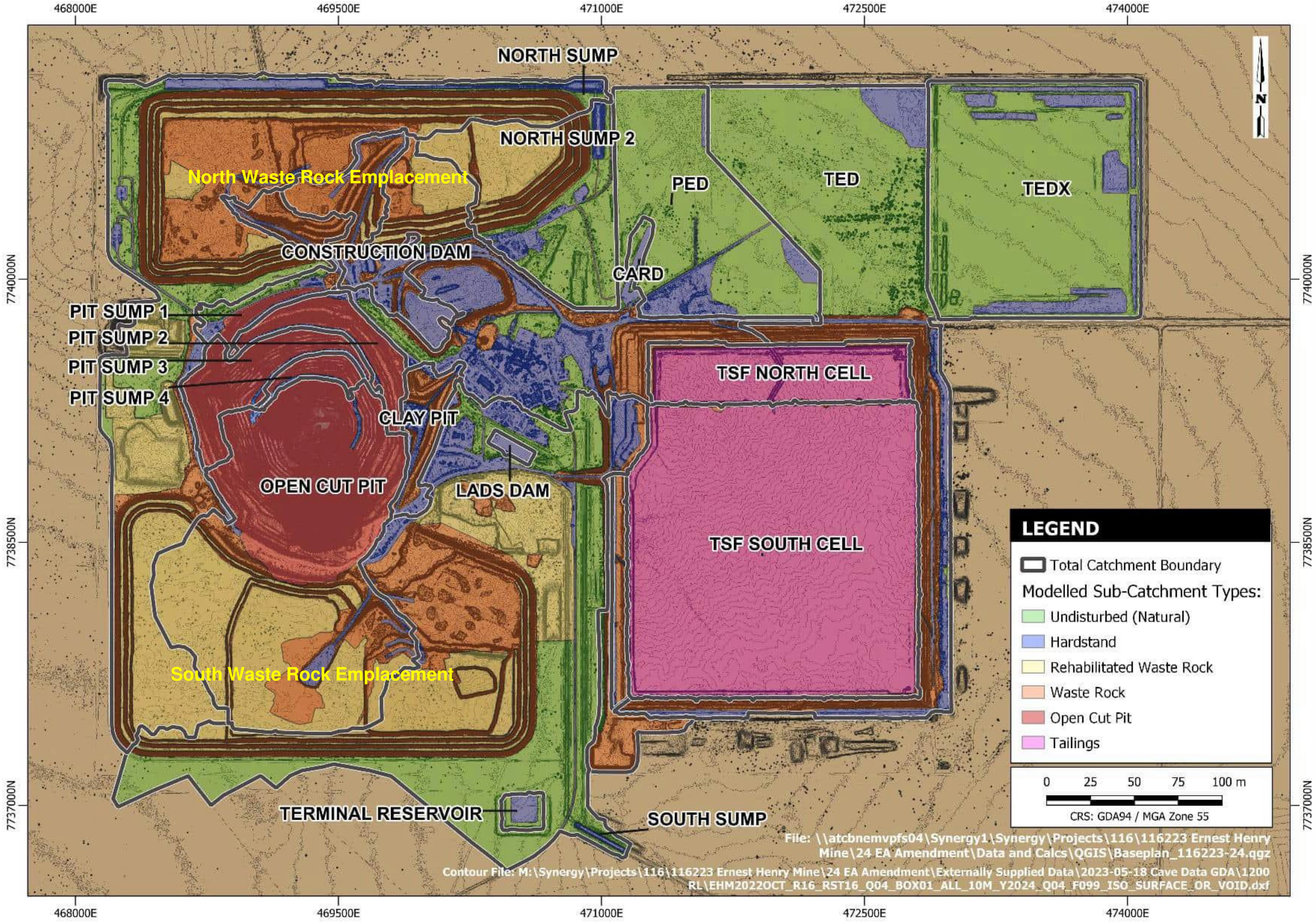
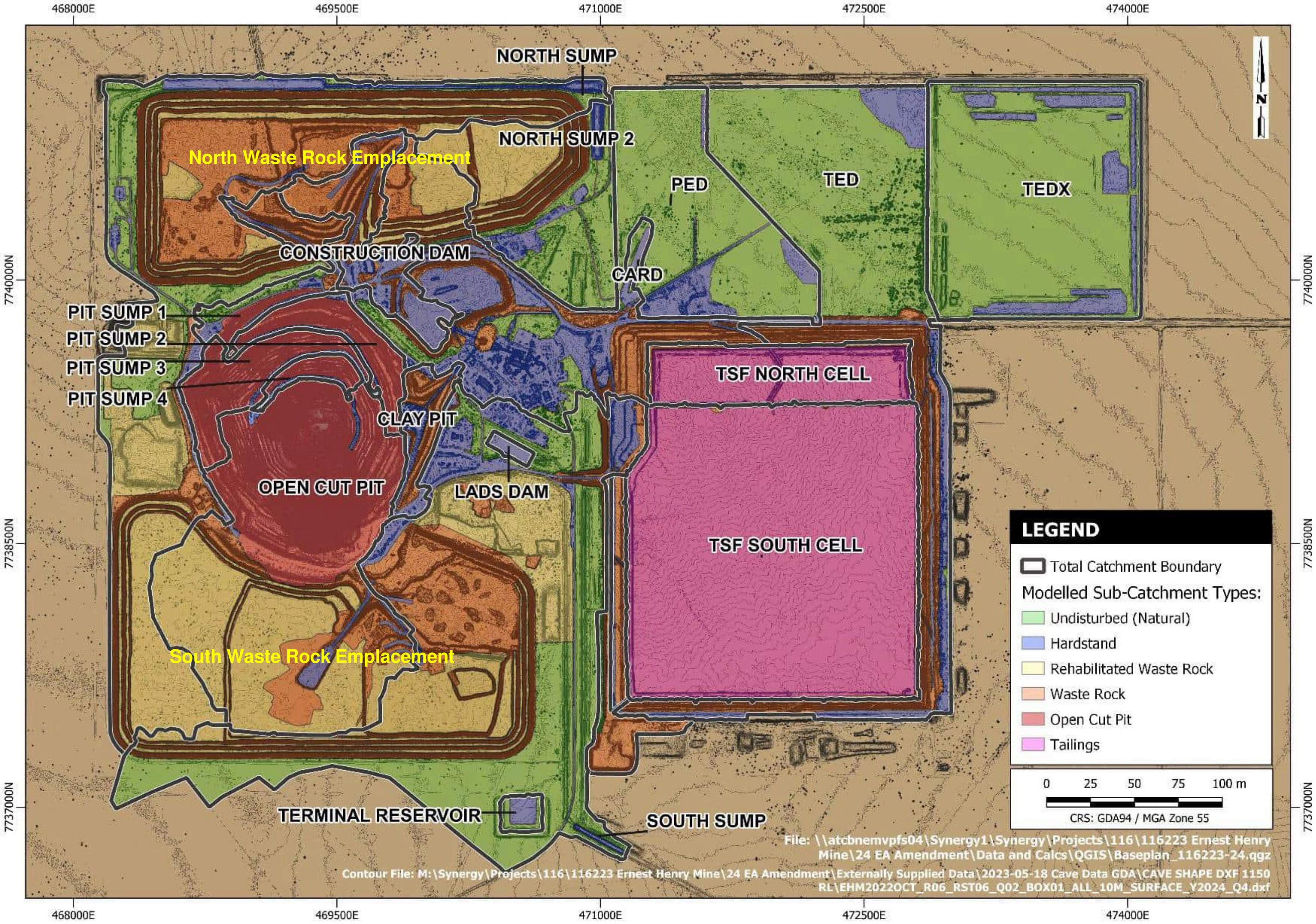
[1] Assumed dates adopted for modelling purposes.

MAP 1 - ERNEST HENRY MINE SURFACE LAYOUT 2024 WITH MINING TO 1,200 m LEVEL



MAP 2 – ERNEST HENRY MINE SURFACE LAYOUT 2024 WITH MINING TO 1,150 m LEVEL



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MAP 3 – ERNEST HENRY MINE SURFACE LAYOUT 2026 WITH MINING TO 1,150 m LEVEL

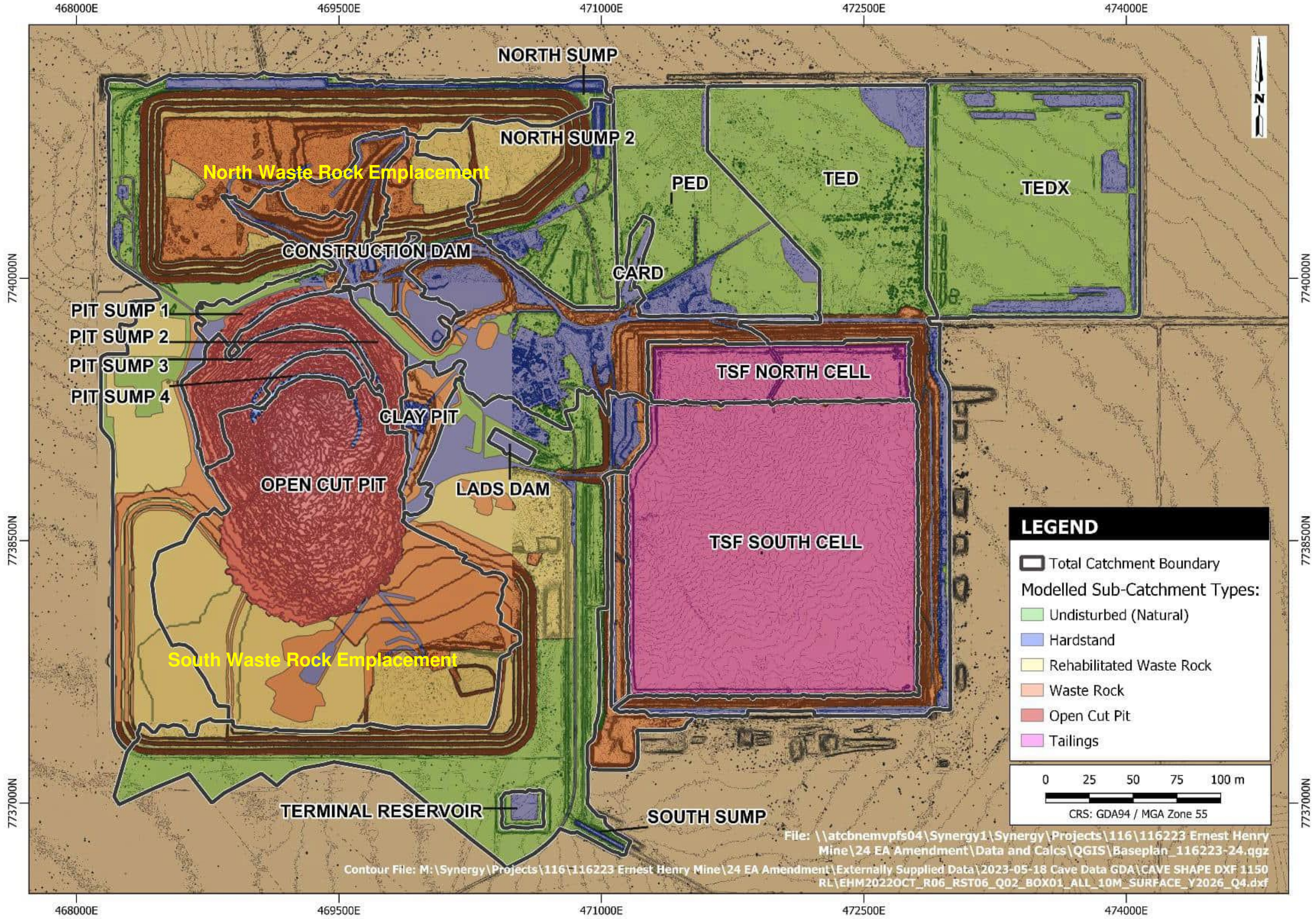

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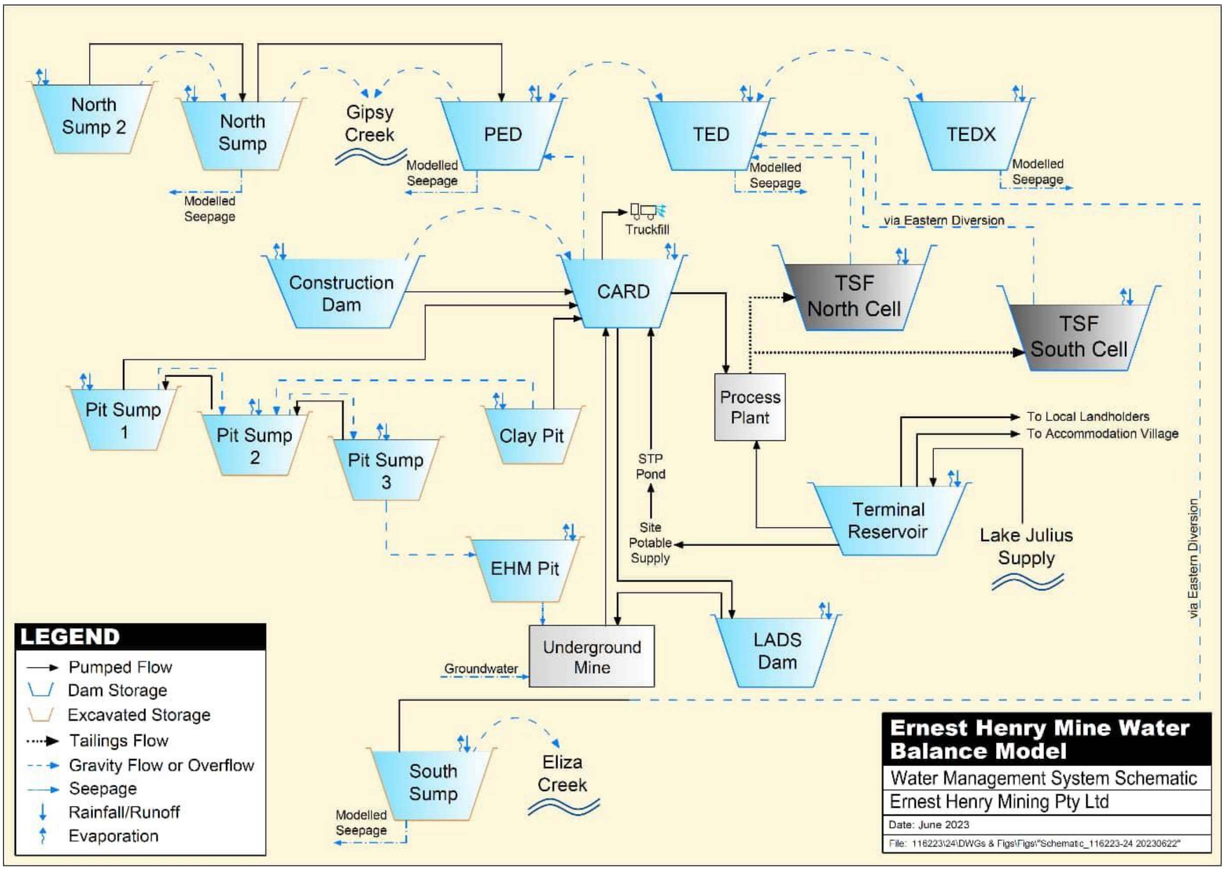
DIAGRAM 1 – ERNEST HENRY MINE OPERATIONAL WATER MANAGEMENT SYSTEM SCHEMATIC



The Ernest Henry mine has historically operated in surplus (i.e. water production exceeding site water demands) with significant groundwater inflows to the underground mine and offsite makeup water supply drawn from Lake Julius. Intense rainfall during the tropical wet season has the potential to generate large volumes of runoff. As a result, there has been an emphasis on the capture of site runoff to control the risk of discharge. Recycling of water pumped from the underground mine occurs, while tailings supernatant water and excess wet season runoff is directed to three shallow, large surface area evaporation dams, known as the Production Evaporation Dam (PED), Tailings Evaporation Dam (TED) and Tailings Evaporation Dam Extension (TEDX).

Water in the underground mining operations is managed by a system of underground storages and pump stations, with transfer ultimately to surface storages from which water is recycled for underground use. Up to 160 megalitres (ML) can be accommodated in the existing underground storages. Open cut sumps intercept runoff from much of the open cut catchment and transfer water to surface storages to reduce the volume of infiltration to underground mining operations. Process plant supply is partially sourced from recycling from above ground storages and partially from offsite makeup water supply from Lake Julius.

The following describes the main water storages simulated by the water balance model:

- The <u>CARD</u> (Capture and Reuse Dam) is the central site water storage, formed as an excavated sump within the PED storage area. The CARD receives water pumped from the underground via an open channel as well as water pumped from the uppermost Pit Sump 1 and smaller site storages. The catchment of the CARD includes the process plant, ore stockpiles and a portion of the north waste rock emplacement. The CARD provides supply to the process plant and contains a truckfill station (for road dust suppression). The capacity of the CARD has been estimated as 32 ML.

- The PED is the site evaporation dam within which the CARD is located. With an estimated capacity of 1,036 ML, the PED has an external spillway located in its northern embankment which would allow overflow to the catchment of Gipsy Creek. An internal spillway (estimated to be 0.18 m below the level of the external spillway) links the PED to the adjacent TED. No pumped outflow occurs from the PED. Pumped inflow occurs from the North Sump.
- The TED has an estimated capacity of 2,334 ML to the level of the PED external spillway. The TED receives supernatant water decanted from the two cells of the TSF as well as pumped inflow from the South Sump via the eastern diversion. In addition to an internal spillway to the PED, the TED has an internal spillway to the adjacent TEDX (estimated to be 1.5 m below the level of the PED external spillway). No pumped inflow or outflow occurs to/from the TED.
- The TEDX is the largest site evaporation dam, with an estimated capacity of 4,331 ML to the level of the PED external spillway. The internal spillways linking the TEDX, TED and PED mean that these three storages can form a single large body of water with an estimated volume of 7,701 ML up to the external spill level of the PED. The relative levels of the TEDX, TED and PED spillways are illustrated in **DIAGRAM 2**. The only inflow to the TEDX (other than incident rainfall) occurs from the TED.
- The North Sump is a sediment dam located near the northern perimeter of the north waste rock emplacement, which forms the majority of the sump's catchment area. The North Sump has an estimated capacity of 95 ML and spills to the catchment of Gipsy Creek. Pumped outflow occurs from the North Sump in the wet season to the nearby PED.
- North Sump 2 is a sediment dam located near the North Sump, capturing runoff from a portion of the north waste rock emplacement. A spillway channel directs spill from North Sump 2 to the North Sump. North Sump 2 has an estimated capacity of 47.3 ML.
- The South Sump is a sediment dam located to the southeast of the south waste rock emplacement, which forms the majority of the sump's catchment area. The South Sump has an estimated capacity of 20.4 ML and spills to the catchment of Eliza Creek. Pumped outflow occurs from the South Sump in the wet season to the TED.
- The LADS (Lower Aquifer Dewatering System)[2] Dam is a raised embankment 'turkeys nest' storage (i.e., no external catchment area) located to the south of the process plant area. The LADS Dam is a regulating supply storage for the underground mine, receiving pumped inflow from the CARD. The LADS Dam has an estimated capacity of 98 ML based on an estimated maximum operating depth of 6 m.
- The Terminal Reservoir is a raised embankment 'turkeys nest' storage located near the site entrance and just west of the South Sump. The Terminal Reservoir stores site makeup supply drawn from Lake Julius and provides makeup supply to the process plant, site potable supply, supply to the accommodation village and local landholders. The capacity of the Terminal Reservoir has been estimated at 78 ML. It is kept at a given level by supply from Lake Julius.
- Pit Sump 1, Pit Sump 2 and Pit Sump 3 are small, excavated sumps around the perimeter of the former open cut pit. High-rate pumps are used to dewater these sumps in the wet season to limit inflow to the open cut lower levels which infiltrates to the underground mine. Pit Sump 3 is dewatered to Pit Sump 2, Pit Sump 2 is dewatered to Pit Sump 1 (the highest sump in elevation) and Pit Sump 1 is dewatered to an open channel which flows to the CARD. A formerPit Sump 4 was the lowest sump in elevation and formed part of the system but has been abandoned due to siltation issues. The catchment of Pit Sump 4 is modelled as reporting to theopen cut pit. Each of the other three sumps has an estimated capacity less than 3 ML.

The TSF has been partitioned into two cells which are formed via confining embankments and an internal separating embankment. The two cell embankments are raised alternately and tailingsdischarge cycles between the two. Slotted concrete decant towers (surrounded by rockfill and geotextile filters) are located near the eastern end of each cell and allow supernatant water and rainfall runoff to

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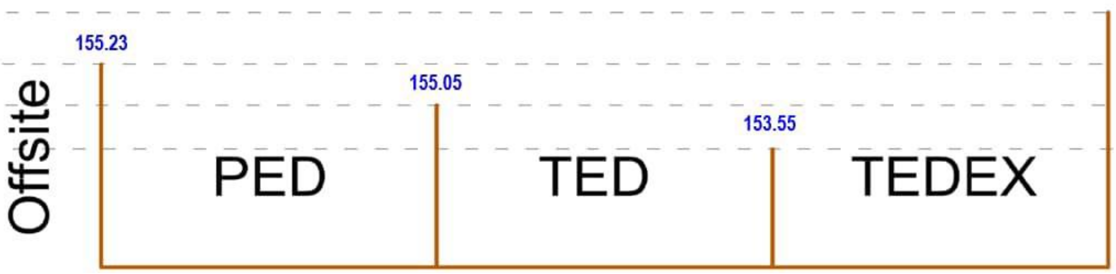
[2] Historically, the operation of dewatering bores around the open cut pit was undertaken to reduce the volume of water reporting to the mine. However, targeted dewatering within the underground mine has eliminated the requirement for these surface dewatering bores to continue.

be decanted to the TED via a perimeter drain, controlling the volume of water stored in each cell. Contingency spillways are formed in each cells' eastern embankment, with spillway discharge also reporting to the TED.

DIAGRAM 2 – ERNEST HENRY MINE EVAPORATION DAMS SPILLWAY LEVELS



4 OPERATIONAL WATER BALANCE MODEL

4.1 Model Description

The Ernest Henry mine water balance model has been developed to simulate the storages and linkages shown in schematic form in **DIAGRAM 1**. The model has been developed using GoldSim simulation software.

The model simulates the volume of water and the mass of salt held in and pumped between all simulated water storages. For each storage, the model simulates:

Change in Storage = Inflow – Outflow

Where:

> *Inflow* includes rainfall runoff, groundwater inflow (to the underground mine), seepage inflow (to the underground from the open cut), tailings bleed[3] (for the TSF cells), water sourced from Lake Julius to the Terminal Reservoir and all transfer inflows from other storages.
>
> *Outflow* includes evaporation, spill, seepage and all transfer outflows to other storages or to a demand sink (for example, the process plant).

The model operates on a maximum eight hourly time-step with balance checks performed on the system as a whole and on individual sub-systems to ensure a balance is maintained at all times.

The forecast model can simulate any future life of mine period. The model simulates 134 "realizations" derived using daily rainfall and evaporation data[4] from 1889 to 2022 inclusive. The first realization uses climatic data starting in 1889, the second starting in 1890, the third in 1891 and so on. The results from all realizations are used to generate water storage volume estimates and other relevant water balance statistics. This method effectively includes all recorded historical climatic events in the water balance model, including high, low and median rainfall periods.

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[3] Tailings 'bleed' refers to water liberated from tailings as settling occurs.

[4] Data was sourced from SILO point data generated climatic data for the Ernest Henry mine location. SILO point data provides synthetic data sets for a specified point by interpolation between surrounding point records held by the Bureau of Meteorology (refer: https://www.longpaddock.qld.gov.au/silo/point-data/). Both rainfall and pan evaporation data were obtained from this source. For the period from December 2016 to the end of 2022, where recorded daily rainfall data was available from EHM, that data was substituted for SILO rainfall data.

4.2 Model Data and Assumptions

4.2.1 Rainfall Runoff Modelling

Rainfall runoff in the model is simulated using the Australian Water Balance Model (AWBM) (Boughton, 2004). The AWBM is a nationally recognised catchment-scale water balance model that estimates catchment yield (flow) from rainfall and evaporation.

AWBM simulation of flow occurs from seven different modelled sub-catchment types, namely: undisturbed (natural) areas, hardstand (for example, roads and infrastructure areas), open cut pit, waste rock, rehabilitated waste rock, and tailings. Each storage catchment area was divided into these sub-catchment areas which were estimated from aerial photography and contour plans supplied by EHM (refer **MAP 1** to **MAP 3**).

Model parameters (which affect the simulated rate of rainfall runoff) differed between the seven different sub-catchment types. Model parameters were either taken from literature-based guideline values, experience with similar projects or on the basis of model calibration (refer HEC, 2020). Note that assigning a sub-catchment type to a particular part of the EHM site does not necessarily reflect the actual land use of that part of the site but rather that the AWBM parameters for that sub-catchment most closely reflect that part of the site. For example, the sub-catchment type 'waste rock' extends beyond the actual formed waste rock emplacements in **MAP 1** to **MAP 3**. This does not mean that waste rock material has been placed in those areas but rather that the surface in those areas appears to resemble waste rock on the basis of aerial photograph interpretation.

4.2.2 Catchment Areas

The only changes to catchment areas expected to occur as part of this EA amendment relate to a slight increase in the catchment area of the open cut pit, with corresponding decreased waste rock area reporting to nearby storages (e.g. the South Sump).

Time varying surface and sub-surface catchment areas are used in the model to calculate the surface runoff reporting to each storage. The updated catchment and sub-catchment areas modelled are shown in **MAP 1** to **MAP 3**. The total site sub-catchment areas are summarised in **TABLE 1**.

TABLE 1 – CALCULATED TOTAL SITE SUB-CATCHMENT AREAS

Modelled Sub-Catchment Type	Area (ha)		
	2024[5] Mining to 1,200 m Level	2024[5] Mining to 1,150 m Level	2026[5] Mining to 1,150 m Level
Undisturbed (Natural)	571	571	571
Hardstand	245	245	242
Rehabilitated Waste Rock	305	305	293
Waste Rock	420	419	407
Open Cut Pit	152	152	172
Tailings	311	311	311

The storage total catchment areas shown in **MAP 1** to **MAP 3** are based on digital elevation data supplied by EHM, which comprises 2021 LiDAR data combined with subsidence predictions for 2024 and 2026, as well as 2021 aerial photography.

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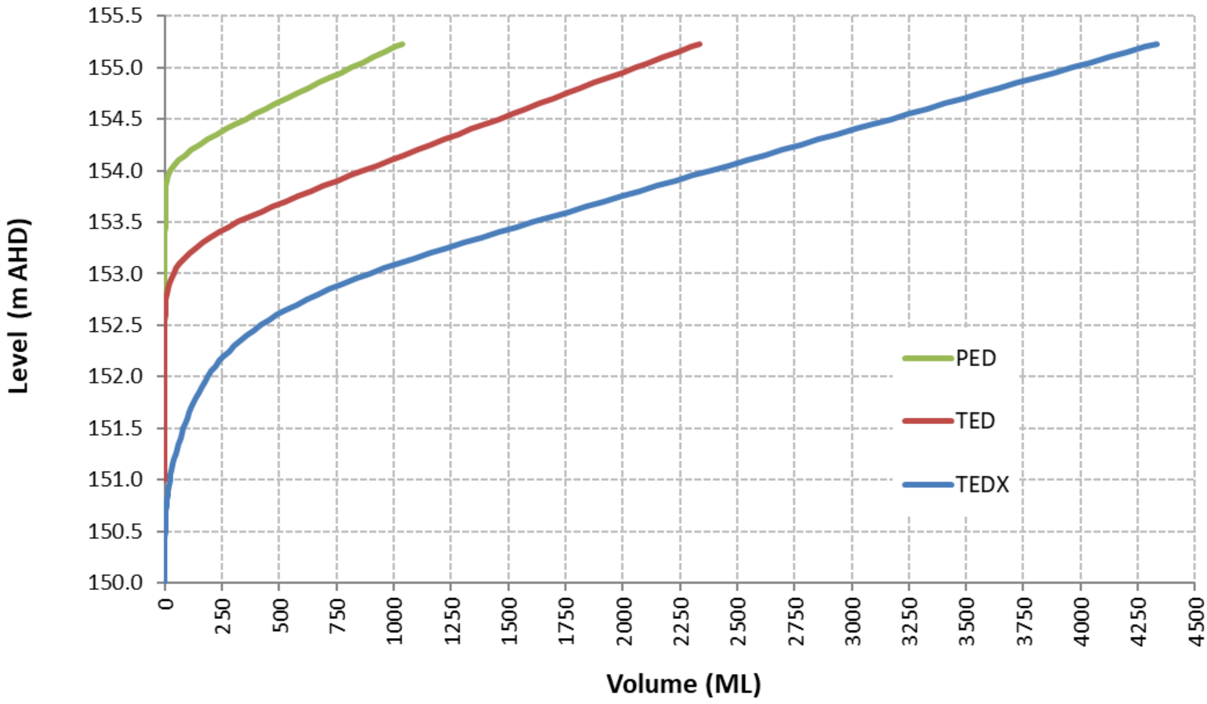
[5] Assumed dates adopted for modelling purposes.

4.2.3 Evaporation from Storage Surfaces

Storage volumes calculated by the model are used to calculate storage surface area (i.e. water area) based on storage level-volume-area relationships for each water storage. The level-volume-area relationships for the evaporation dams were developed from 2021 LiDAR data and are plotted in **GRAPH 1**. Similar relationships for other storages, including the subsided open cut pit, were either developed from LiDAR data or provided by EHM.

GRAPH 1 – EVAPORATION DAM STORAGE LEVEL-VOLUME



Pan evaporation was multiplied by a pan factor in the calculation of storage evaporation losses for modelled water storages. Monthly pan factors were taken from McMahon et al. (2013) data for Mt Isa (located 130 km west of the Ernest Henry Mine) and are listed in **TABLE 2**.

TABLE 2 – ADOPTED MONTHLY PAN EVAPORATION FACTORS

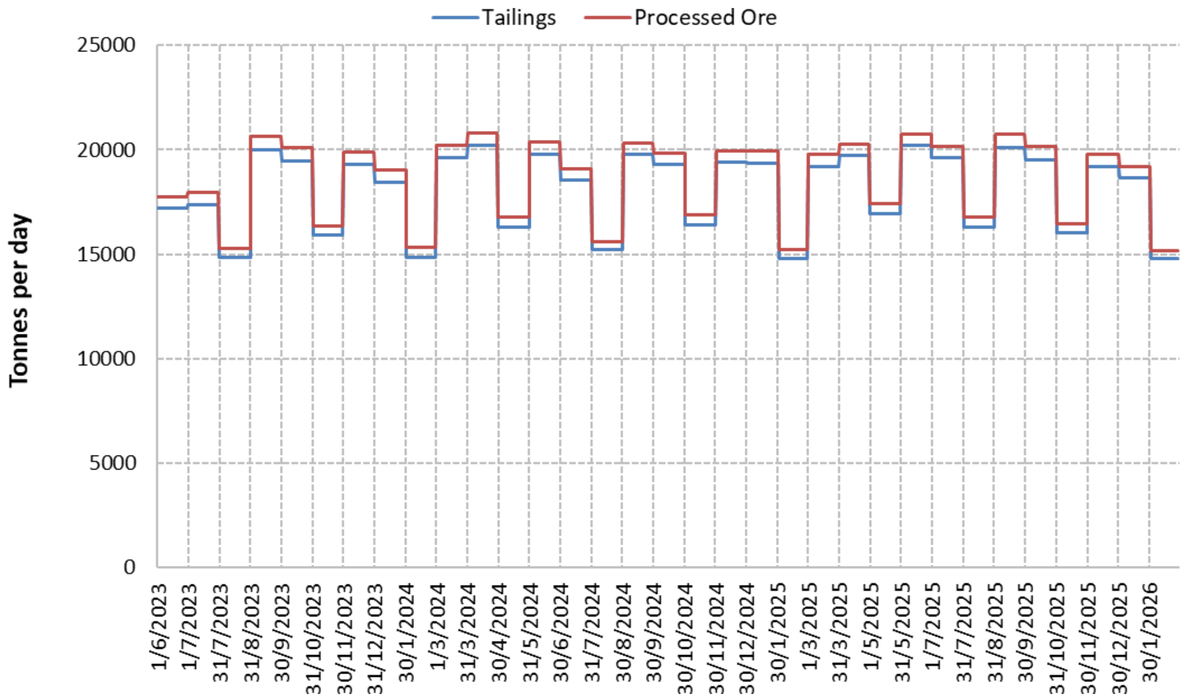
Month:	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pan Factor:	0.75	0.75	0.73	0.71	0.73	0.74	0.75	0.75	0.72	0.71	0.72	0.73

A pan factor of 1 was used in the simulation of evaporation from wet tailings surfaces (assumed to be 20% of the surface of the active tailings storage cell – refer **Section 4.2.5**). A pan factor of 0.6 was assumed for evaporation from the open cut pit (due to the effects of shading).

4.2.4 Processing Rate and Process Plant Demand

Annual planned dry tonnes of processed ore and tailings for the planned duration of the Ernest Henry mine, as advised by EHM are summarised in **GRAPH 2**. For mining to the approved level of 1,200 m, processing would cease at the end of June 2024, whereas for mining down to a level of 1,150 m, processing would occur until the end of February 2026. For the period until the end of June 2024 there is no difference in the processing and tailings rates. The average concentrate yield for the period until the end of June 2024 is 3.0%.

GRAPH 2 – PLANNED PROCESSED AND TAILINGS TONNAGES



Relevant ore, concentrate and tailings properties which affect the calculation of process plant demand are as follows (as advised by EHM or calculated from data records supplied):

- Run of mine ore moisture content: dry (as advised by EHM)
- Concentrate moisture content: 8.06% (calculated from EHM data records)
- Thickened tailings (pumped) solids content: 68% (as advised by EHM)

In addition, a constant demand of 0.9 ML/d was simulated (as advised by EHM) for washdown, conveyor dust suppression and other miscellaneous use.

The planned tonnages given in **GRAPH 2** as well as the above properties were used to calculate process plant water demand for the EA amendment in the model – this is illustrated in **GRAPH 3**.

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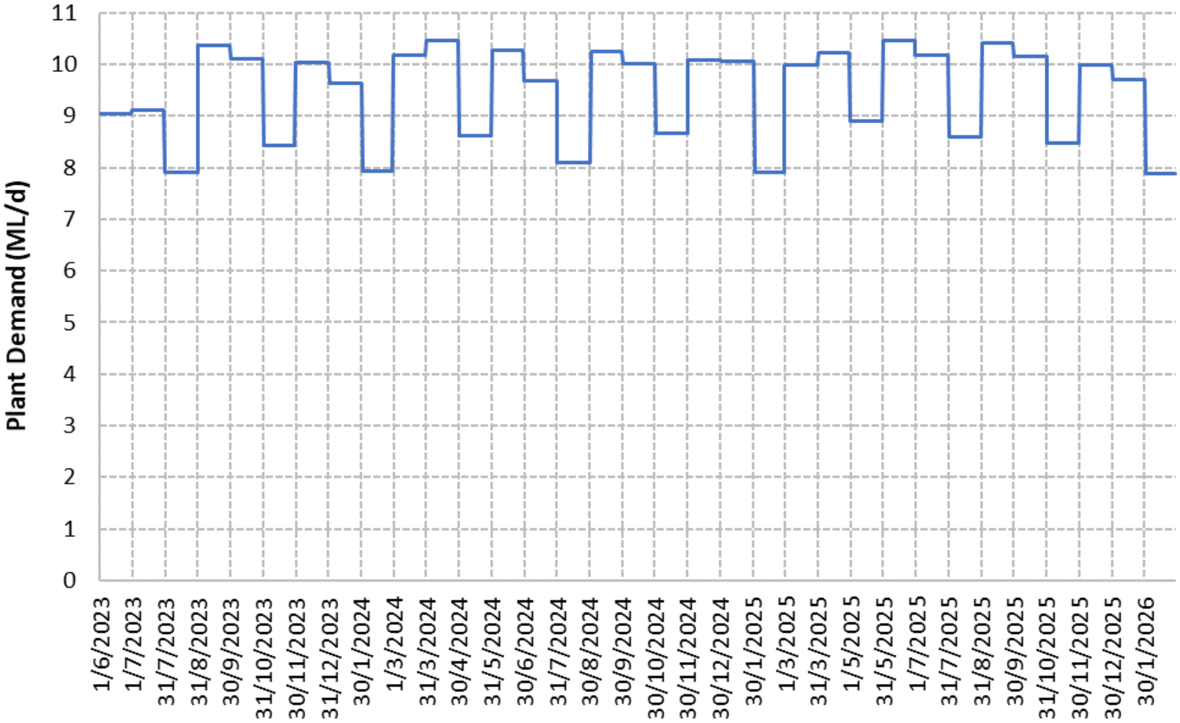
GRAPH 3 – CALCULATED PROCESS PLANT WATER DEMAND



In the model, demand is supplied first from the CARD at a rate of up to 125 L/s or 10.8 ML/d (rate as advised by EHM), with additional supply from the Terminal Reservoir if required.

4.2.5 Tailings Disposal

It was assumed that tailings would continue to be pumped as a slurry to the TSF cells. Based on information provided by EHM, it appears that the tailings schedule follows a 7 month: 30 month cycle (north cell: south cell) and this pattern was assumed to continue for the expanded duration of the Ernest Henry mine. Water discharged with the tailings was calculated based on a tailings solids concentration of 68**%** (w/w).

Modelling of supernatant tailings water (bleed) and rainfall runoff from the tailings storages was included in the water balance model, with an assumed initial settled dry density of 1.6 t/m^3 (ATCW, 2017) and a particle density of 3 t/m^3 (as advised by EHM). This data was used to calculate the water bleed rate, which amounts to approximately 38% of the water pumped out with the tailings. Bleed water and TSF rainfall runoff were modelled as being reclaimed by discharge to the TED.

4.2.6 Road Water (Truckfill) and Construction Demand

Data provided by EHM indicates that recorded road dust suppression water amounts to 19.9 ML/month (HEC, 2020) and this value was used as a constant demand in model forecasts as advised by EHM. In addition, construction water is required during tailings cell embankment raising works and this was modelled as comprising an additional 8.7 ML/month (per advice from EHM), modelled as occurring in May and June 2025.

4.2.7 Underground Demand

An underground demand of 0.79 ML/d was adopted based on monitoring data provided by EHM. No underground losses were assumed. It was assumed that all water pumped to underground operations was subsequently recovered together with groundwater inflow and seepage from the former open cut pit.

4.2.8 Groundwater Inflow and Seepage

A constant groundwater inflow rate to underground operations of 11.1 ML/d was adopted per estimates by AGEC[6].

A seepage rate from the former open cut to underground operations of 1 m/d (i.e. a flux rate multiplied by the calculated area of the water ponded in the open cut) was adopted in the model (derived as part of model calibration – refer HEC [2020]).

Seepage is also simulated from the evaporation dams, the North Sump and the South Sump as part of modelling. Seepage flux rates were derived as part of model calibration (HEC, 2020). Seepage from these storages is simulated as a system loss.

4.2.9 Miscellaneous Demands and Terminal Reservoir Supply

Supply to the EHM accommodation village and local landholders is drawn from the Terminal Reservoir. Rates of 0.17 ML/d and 0.13 ML/d respectively were adopted for these two demands based on records provided by EHM (HEC, 2020).

Also based on previously recorded data, a maximum supply rate of 26.4 ML/d has been adopted for simulating make-up supply to the Terminal Reservoir from Lake Julius. The make-up requirement is calculated in the model in order to keep the Terminal Reservoir ‘topped up’ to an assumed volume of 59 ML (compared with an estimated capacity of 78 ML).

4.2.10 Pumping and Transfer Rates

Modelled pump rates from storages are summarised in **TABLE 3**. These were either as advised directly by EHM, derived from information supplied or, in two instances (as indicated in **TABLE 3**), assumed.

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[6] Australasian Groundwater & Environmental Consultants Pty Ltd – per email from A. Bush 18 May 2023.

TABLE 3 – MODELLED PUMP TRANSFER RATES

Storage	Pump Rate (L/s)
North Sump	400
North Sump 2	100
South Sump	431
Pit Sump 1	2,000
Pit Sump 2	1,500
Pit Sump 3	1,000
Underground (Total)	440
CARD to Process Plant	125
CARD to LADS	125*
Clay Pit Pump 1	99
Clay Pit Pump 2	79
Clay Pit Pump 3	53
Construction Dam	100*
CARD to Process Plant	125

* Assumed rate

In order to simulate a varying (head-dependent) decant rate from each tailings cell a rate of 0.6 m/d was assumed (i.e. a flux rate multiplied by the calculated area of the water ponded in each cell). This was found to give quite high decant rates (of up to approximately 90 ML/d in the south cell) which appear to be realistic based on anecdotal evidence.

4.2.11 Spillway Flow Rates

Spillway flow rates in the model are simulated using the broad crested weir equation (Henderson, 1966) and spillway widths estimated from EHM supplied 2018 LiDAR or as-built survey data. Free outflow (no backwater) conditions were assumed for all spillways, except for internal spills between the evaporation dams. When the evaporation dam water levels rose above the internal spillway levels on both sides ofa given internal spillway, the spill rate was arbitrarily set to 83 ML per 8 hour time step (i.e. 250 ML/d) and the spill direction determined by the relative evaporation dam water levels.

4.2.12 Storage Operating Volumes

A number of operating ‘trigger’ volumes were assumed in the model which affect when pumping is triggered either on or off. These are summarised in Table 4.

TABLE 4 – ASSUMED OPERATING VOLUMES AND STORAGE CAPACITIES

Storage	Operating Details	Modelled Operating Conditions
LADS	Normal Operating Volume = 45 ML	Pumping from CARD initiated when volume falls 10 ML below this until volume rises to 10 ML above this.
	Capacity = 98 ML	
Terminal Reservoir	Normal Operating Volume = 59 ML	Supply from Lake Julius initiated when volume falls 4 ML below this until volume rises to 4 ML above this.
	Capacity = 78 ML	
Clay Pit	Pump #1 Start Volume = 0.23 ML	Pump #1 initiated when volume rises above this until volume falls below 0.1 ML (assumed dead storage).
	Pump #2 Start Volume = 0.45 ML	Pump #2 initiated when volume rises above this until volume falls below 0.1 ML (assumed dead storage).
	Pump #3 Start Volume = 0.45 ML	Pump #3 initiated when volume rises above this until volume falls below 0.1 ML (assumed dead storage).
	Capacity = 1.13 ML	
North Sump	Pump Start Volume = 6 ML	Pump initiated when volume rises above this until volume falls below 4 ML (assumed dead storage).
	Capacity = 95 ML	
South Sump	Pump Start Volume = 4 ML	Pump initiated when volume rises above this until volume falls below 0.5 ML (assumed dead storage).
	Capacity = 20.4 ML	
CARD	Normal Operating Volume = 21 ML	Can supply water to process plant when above this volume until volume drops to 3 ML below this.
	Capacity = 31.7 ML	
North Sump 2	Pump Start Volume = 8.3 ML	Pump initiated when volume rises above this (provided that North Sump is below 20 ML) until volume falls below 3.1 ML (assumed dead storage).
	Capacity = 47.3 ML	

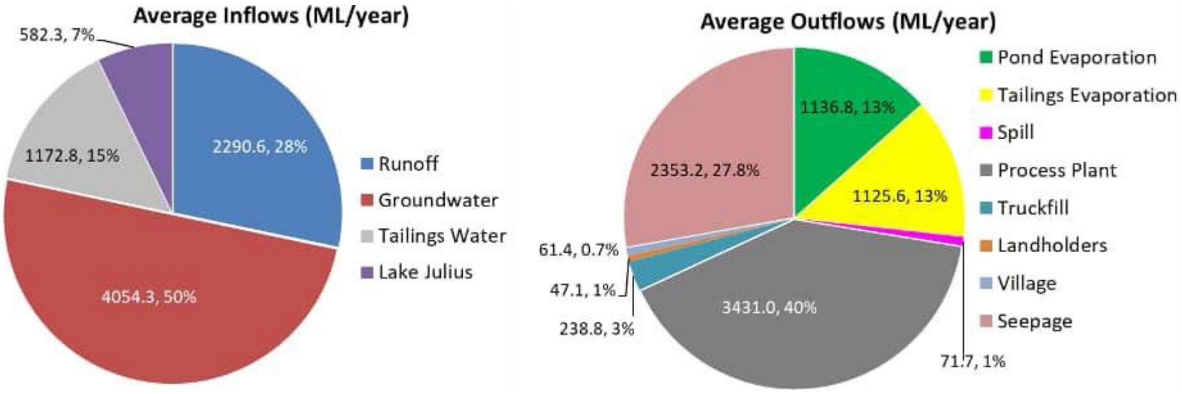
4.3 Model Forecast Results

4.3.1 Supply Reliability and Overall Water Balance

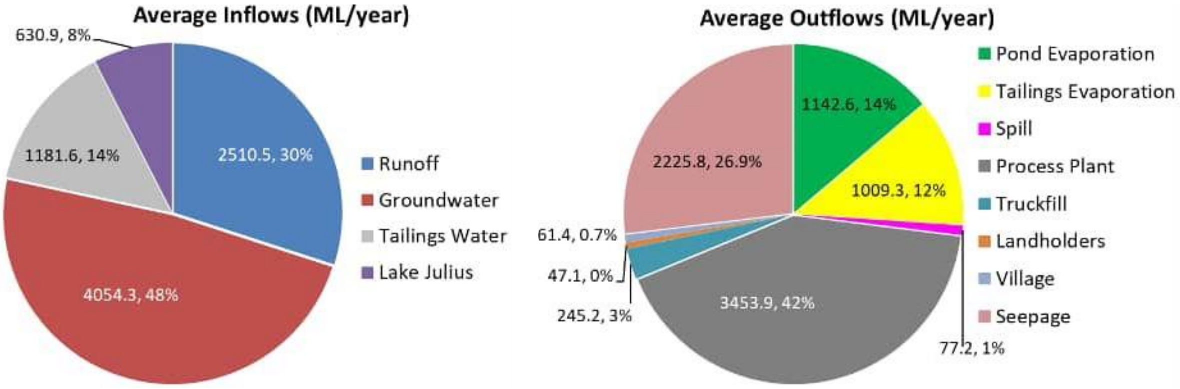
No process plant, underground supply or haul road shortfalls are forecast in any of the 134 modelled realizations.

A summary average (mean) water balance is shown in **GRAPH 4** derived from all 134 realizations and the full period simulated for the situation of mining to a level of 1,200 m and in **GRAPH** 5 for the situation of mining to a level of 1,150 m. These are given as average rates (in ML/year) over the respective forecast periods and as percentages of the total inflow or outflow. For each water balance component, the average is calculated individually from all 134 realizations – each component does not represent the results for a given realization that corresponds to average climatic conditions.

GRAPH 4 – MODELLED AVERAGE SYSTEM INFLOWS AND OUTFLOWS WITH MINING TO 1,200 m LEVEL



GRAPH 5 – MODELLED AVERAGE SYSTEM INFLOWS AND OUTFLOWS WITH MINING TO 1,150 m LEVEL



GRAPH 4 and **GRAPH 5** indicate that the majority of average system inflows comprise underground groundwater inflow, while process plant supply comprises the greatest system outflow. Although rainfall runoff inflow averages 2,391 ML/year and 2,510 ML/year respectively for the two cases modelled, this number varies widely between modelled realizations. Forecast rainfall runoff varies between 43 ML/year and 16,203 ML/year for the situation of mining to a level of 1,200 m, which simulates only a 13 month forecast period (i.e. effectively a single wet season), illustrating the high variability of wet season rainfallfrom year to year[7]. Forecast average rainfall runoff for the situation of mining to a level of 1,150 m variesfrom 592 ML/year to 7,835 ML/year, with less variability due to those simulations being for a longer duration of 2¾ years (i.e. nearly 3 wet seasons). This lower variability results from 'smoothing' due to averaging over a longer period, combined with the fact that extremely high rainfall totals have not occurred in consecutive wet seasons historically.

The 'smoothing' of water balance totals over the longer period simulated for the situation of mining to a level of 1,150 m is the main reason for the differences in volumes plotted in **GRAPH 4** compared with **GRAPH** 5. There are very small physical differences between the two modelled cases in terms of catchment areas and open cut pit storage characteristics (refer **Section 4.2**) that could significantly affect water balance model forecasts.

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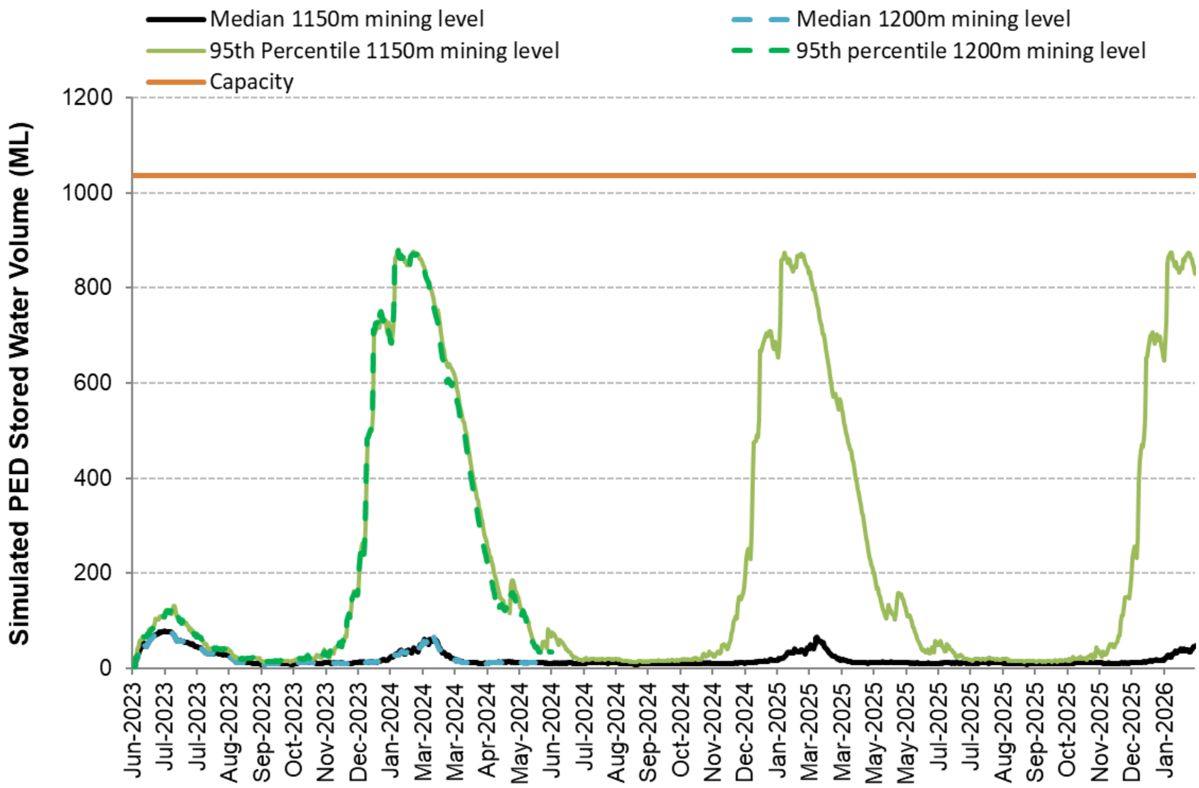
[7] The highest modelled runoff totals were simulated for rainfall recorded during the 1973/74 wet season. Analysis indicates that the 1973/74 wet season 2-month maximum rainfall had an annual exceedance probability of 0.3% to 0.4% (1:300 to 1:250).

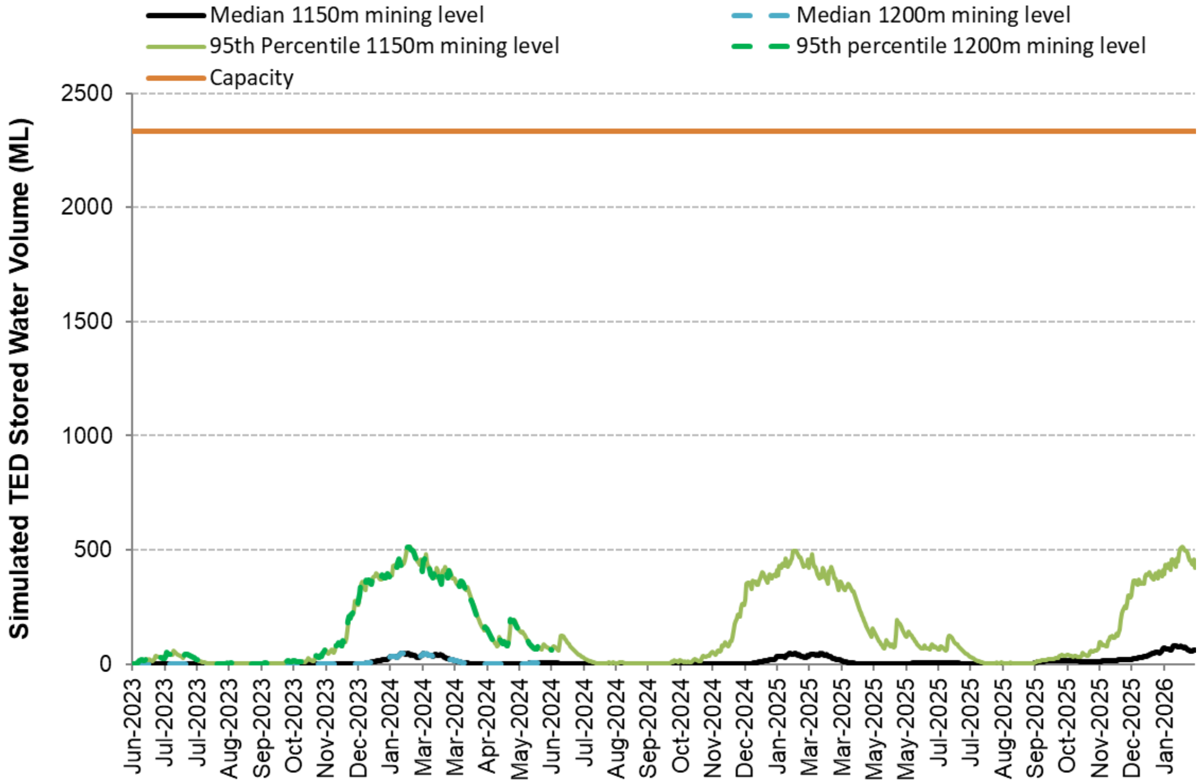
4.3.2 Simulated Stored Water Volumes

The predicted stored water volume in the PED, TED and TEDX is shown in **GRAPH 6**, **GRAPH 7** and **GRAPH 8** respectively as probability plots over the simulation period. These probability plots show a range of likely total stored water volumes, with median and 95th percentile volumes plotted. It is important to note that the plots do not represent a single climatic scenario – these probability plots are compiled from all 134 realizations - e.g., the median volume plot does not represent model forecast volume for median climatic conditions. Note that the plots for the situation of mining to a level of 1,200 mextend only to the end of June 2024.

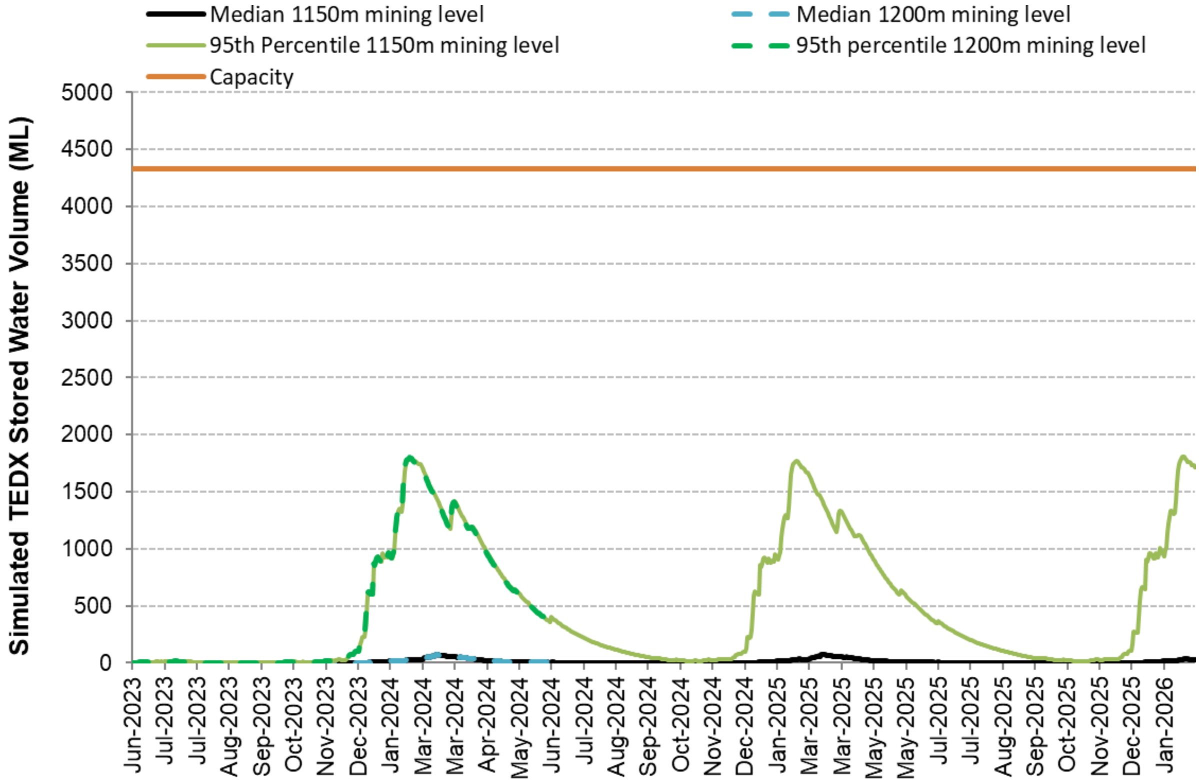
GRAPH 6 – MODELLED PED STORED WATER VOLUME



GRAPH 7 – MODELLED TED STORED WATER VOLUME



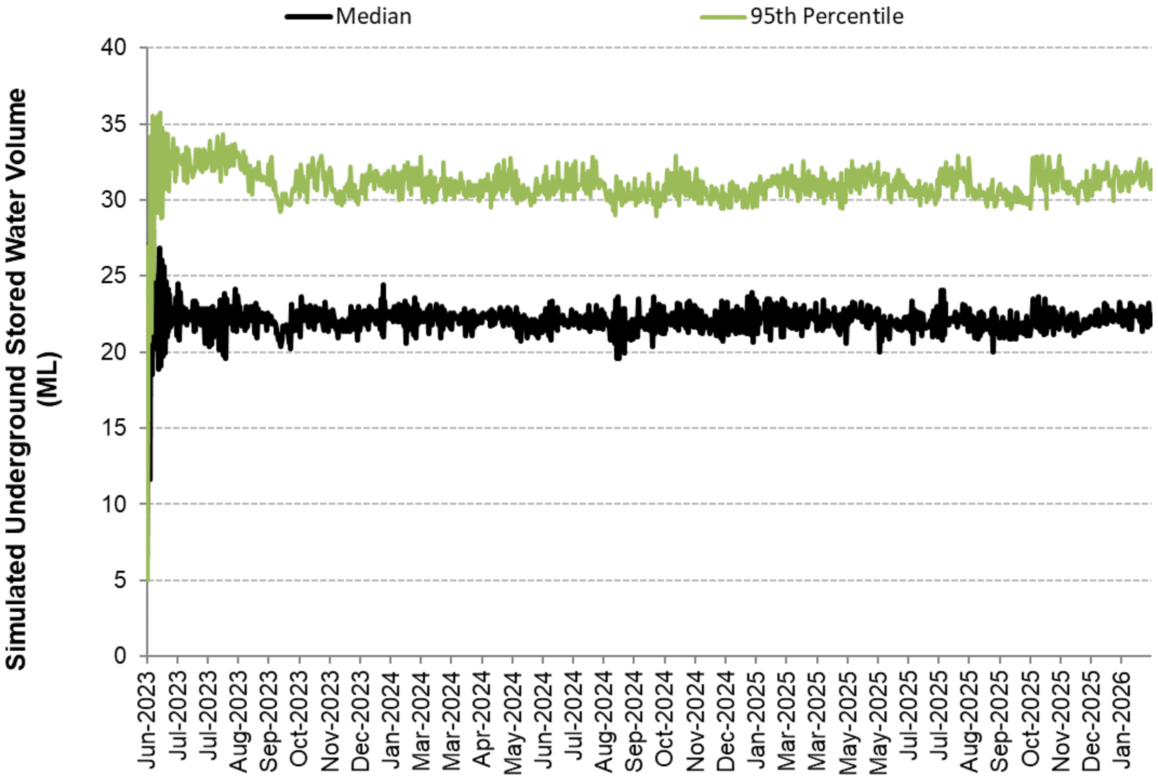
GRAPH 8 – MODELLED TEDX STORED WATER VOLUME



These graphs show a repeating pattern of increased volume during and following the wet season which does not vary significantly from year to year and between the two mining cases modelled. The predicted peak volume in the PED for the 95th percentile result decreases for the situation of mining to a level of 1,150 m compared with mining to a level of 1,200 m by less than 1 ML.

A probability plot of water temporarily stored in the underground is shown in **GRAPH 9** for the situation of mining to a level of 1,150 m. This indicates a high probability of minor volumes of water in the underground most of the time. There is negligible difference in forecast volumes between the two mining cases modelled for the concurrent period simulated (results for mining to a level of 1,200 m not plotted).

GRAPH 9 – MODELLED UNDERGROUND STORED WATER VOLUME WITH MINING TO 1,150 m LEVEL



4.3.3 Simulated External Spill Risk

Modelled external spills can occur from the PED, the North Sump and the South Sump. Spills were simulated from each of these storages. An analysis of the spill frequency of, in particular, small storages such as the North Sump and South Sump using a water balance model which uses daily climatic data, may not accurately reflect the spill risk for such storages which are likely to have a short time of concentration[8] (shorter than one day). Nevertheless, estimated annual spill risks have been derived from the water balance model results for the three storages based on an analysis of annual spill occurrence over all 134 modelled realizations from the start of the 2023/24 water (financial) year, in order to assess the potential change in spill risk that could result from the EA amendment. Estimated annual spill risks are given in **TABLE 5**. Note that this assumes pumps are operational at all times (refer**TABLE 3**).

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[8] The rainfall duration that results in a peak flow for a given catchment area.

TABLE 5 – SIMULATED STORAGE SPILL RISKS

Storage	Annual Spill Risk	
	Mining to 1,200m Level	Mining to 1,150m Level
North Sump	4.5%	4.5%
South Sump	31.3%	28.9%
PED	0.7%	0.7%

The above forecast results indicate that the forecast spill risk from the South Sump is significantly higher than that from the North Sump. This is regardless of the estimated catchment area of the North Sump (438 ha, including North Sump 2) exceeding that of the South Sump (370 ha). The increased forecast spills from the South Sump are due to the higher capacity of the North Sump (approximately 95 ML compared with approximately 20 ML), as well as the higher proportion of undisturbed (natural) area within the South Sump catchment compared with the North Sump (approximately twice as much). The undisturbed areas have higher runoff generating potential compared with waste rock and rehabilitated areas. There is no forecast change in spill risk for the North Sump for mining down to a level of 1,150 m and a slight decrease in spill risk for the South Sump.

There is no forecast change in spill risk for the PED for mining down to a level of 1,150 m. PED forecast external spills are simulated to only occur as a result of the highest rainfall wet season in recorded history (1973/74) which has an estimated annual exceedance probability, based on 2-month maximum rainfall, of 0.3% to 0.4%. Rainfall in 1973/74 included 1,149 mm in the 69 days from 2nd January 1974, with a total of 798 mm in January. The single wet season spill volume simulated for the case of mining to a level of 1,200 m was 1,207 ML, while for the case of mining to a level of 1,150 m the average spill volume (averaged over the three realizations and for those years in which spill occurred) was 1,149 ML (i.e. a slight decrease).

The risk of spill from the PED is affected by the rate of runoff inflow/seepage from the open cut pit to the underground mine because the underground is dewatered to the CARD and the PED (refer **DIAGRAM 1**).

5 REFERENCES

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