

APPENDIX 7C

AQ2 2020b - SITE WATER BALANCE



Memo

To	Craig Bovell	Company	Doral Mineral Sands
From	Mark Nicholls	Job No.	136B
Date	13/05/2020	Doc No.	136B 005b
Subject	Yalyalup Mineral Sands Operation – Site Water Balance		

Craig,

We are pleased to provide you with the following report outlining the site water balance work which has been completed for the Yalyalup Mineral Sands Operation.

1. INTRODUCTION

The Yalyalup heavy mineral resource is located ~10-14 km SE of the Busselton CBD. It is midway between Iluka's Tutunup South Mine (closed in 2018) and Cristal's Wonnerup Mine (expanding eastwards). Exploration by third parties, outlined heavy minerals in road reserves and selected properties prior to 2011. Doral took control of exploration leases in 2011 and began exploration drilling in 2012.

The current project areas lie completely within the "Lower Sabina" catchment. Potential north eastern extensions of the Project might overlap the modified channels of the Abba River. Surface water flows from the south of the Project are diverted around the project area via the Woddidup diversion, Sabina diversion and Vasse diversion drains (into Geographe Bay, not the Vasse-Wonnerup wetlands).

The heavy mineral sands resource is located within the Superficial Formation sediments i.e. Bassendean Sand at the top and the Yoganup Formation towards the base. These two units are separated by the Guildford Formation throughout the project area. The thickness of the Superficial Formation is irregular, with a maximum of 9 to 12 m at the site, but generally being 7 to 8 m thick. The Bassendean Sand, Guildford Formation and Yoganup Formation form an unconfined Superficial aquifer at the site. The Bassendean and Yoganup are the more transmissive units, whereas the intervening Guildford has a low permeability, owing to its clayey nature.

AQ2 was engaged by Doral to prepare a conceptual site water balance for the Yalyalup operations, to assist in Doral's environmental submissions (i.e. Environmental Review Document (ERD)) which aim to demonstrate that the operation can meet the Department of Water and Environmental Regulation (DWER, former Environmental Protection Agency (EPA)) objectives: "To maintain the hydrological regimes and the quality of groundwater and surface water, so that environmental values are protected". A site water balance has been created, with the model setup and results documented in the following report.

2. WATER BALANCE OBJECTIVES

The objectives of the water balance are documented in Doral's Environmental Scoping Document (ESD) and include:

- Prepare a conceptual water balance to determine the site water demands over the life of the project. This will include:
 - All fluxes (and their seasonal variations);

- Discussion of capacity to reuse surplus mine dewater;
- Requirements for supplementary process water to be sourced from the Yarragadee aquifer.

In addition to this water balance study, AQ2 has also completed a groundwater assessment (AQ2, 2019a) and a surface water assessment (AQ2, 2019b) for the project, which provide some input and logic to this report.

A water balance was created in GoldSim for the Yalyalup project. GoldSim is a Monte Carlo simulation software, that allows users to create customised models based on built-in functions within the software. The software is well suited for water balance projects and allows users to set input data as a probability distribution, which is randomly sampled in the Monte Carlo analysis.

3. WATER BALANCE MODEL SETUP AND INPUT DATA

3.1 Model Overview

The GoldSim water balance model was set to run on a daily timestep for 100 model iterations for the 3.5-year mine life. Input data/parameters to the model have been set as either a constant value, time-series or probability distribution.

The model operation can be summarised as follows:

- At each time step, open pit areas have been assumed as per the mining schedule provided by Doral.
- Each open pit area has an external surface water catchment area which, reports to the pit during the period over which the pit is open.
- The Process Water Dam (PWD) and Drop-Out Dam (DOD) collect local runoff from the adjacent plant, admin and impervious areas, plus receive pumped water being removed from the open pits (dewatering plus stormwater).
- At each model timestep (daily), rainfall is included within the model, with runoff collected in the base of the operating pit, and within the PWD and DOD.
- Dewatering inflow rates over the mine life, obtained from groundwater modelling studies, have been used as an inflow to the active pit area.
- Water collected within the active pit area is pumped to the PWD/DOD at an assumed transfer rate (nominally 75L/s).
- Process water demand is sourced from the PWD/DOD.
- The model tracks water which exceeds the PWD/DOD capacity (i.e. potentially requires discharge), plus water shortfall from the PWD/DOD (i.e. needs to be supplemented by pumping from the Yarragadee aquifer).

The model has been run for two dewatering scenarios resulting from different rainfall patterns being applied to the groundwater model – a wet rainfall sequence (“Wet Dewatering” scenario) and a dry rainfall sequence (“Dry Dewatering” scenario). Further information is provided below.

Note that Doral will make every effort to maximise water recycling and to minimise water use. Process water will, in the first instance, be sourced from recycled water and dewatering of the pits. Additional process water sourced from the Yarragadee aquifer bore will be used only after other resources have been fully utilised. Water will not be intentionally discharged offsite when it cannot be used for any other purpose. Water will be discharged offsite when the storages at PWD/DOD are at their full capacity (overtop) in the event of sufficiently sustained period of high rainfall events results in site runoff exceeding the mine water demand.

3.2 Rainfall Data

The synthetic rainfall patterns programmed into the GoldSim model are based on historic daily rainfall records from the SILO enhanced climate database service for the Busselton Aero Rainfall Station location (station number 9603). The SILO rainfall data set patches any missing data records for Busselton Aero Rainfall Station, with interpolated values from other nearby weather stations to create a continuous rainfall data set between 1/1/1960 and 31/12/2018 (58 years).

The 58 years of daily rainfall data was used as an input to the eWater program SCL (Stochastic Climate Library). The SCL uses historic rainfall data as an input and produces a synthetic rainfall data set for the required duration, which is a statistical fit to observed rainfall. For this project, 100 sets of 4 years of daily rainfall data was produced by the program.

The synthetic daily rainfall data time series that was produced for the model, is not reproduced within this report for brevity, but summary statistics for the SCL data used are shown in Table 1, along with statistics for the actual SILO rainfall records used. A comparison of the statistics indicates that the synthetic rainfall data used, generally aligns with the annual rainfall characteristics of the observed rainfall patterns. The extremes (minimum and maximum) in the data within the SCL synthetic dataset are greater than in the observed record, due to the larger number of years of data within the SCL dataset.

Table 1: Input Annual Rainfall Data Summary Statistics

Annual Statistic	SILO Rainfall Depth	SCL Output Rainfall Depth
Median	755	765
Mean	774	774
Maximum	1166	1431
Minimum	436	358
90 th Percentile	992	978
75 th Percentile	880	877
25 th Percentile	665	664
10 th Percentile	608	573

Note that across the datasets which were generated (400 years of synthetic daily rainfall data), there are 4 instances where the total rainfall across three consecutive days exceeds the site's 100yr 72hr annual recurrence interval rainfall total, such that the model does contain extreme rainfall events within model iterations. However, a constant "annual average" runoff coefficient has been applied to all runoff events (refer Section 3.4.2), such that the runoff from any 100-yr event is likely to be underestimated in the model.

All 100 synthetic daily rainfall datasets were imported to the GoldSim model, with the GoldSim model using a different dataset for each of the 100 model iterations.

Note that the same 100 synthetic daily rainfall datasets were used for both the "Dry Dewatering" and "Wet Dewatering" model scenarios.

3.3 Evaporation Data

Pan evaporation data was sourced from the SILO enhanced climate database service for the Busselton Aero meteorological station. Average monthly pan evaporation rates were determined from the dataset and a pan factor of 90% was applied to develop an evaporation data set which was applied to open water surfaces within the water balance model (PWP/DOD).

3.4 Pit Data

3.4.1 Pit Void

The volume of water stored within the open pit void was modelled within the water balance. The storage capacity of each pit void was not considered within the model, on the assumption that the volume within the pit would not be exceeded by the incoming surface water and groundwater inflows.

Water collected within the pit (groundwater plus surface water) is pumped to the DOD/PWP at a rate matching the inflow rate, up to an assumed maximum pumping rate of 75L/s (6,480m³/d). If inflows exceed 75L/s, water is assumed to be stored within the base of the pit until the inflow falls and the pump out rate removes the stored volume. Note that the assumed maximum transfer rate from the pit to the DOD/PWP exceeds the mine water demand and may lead to overflow from the DOD/PWP, if the maximum transfer rate is sustained.

No loss of ponded water within the pit was assumed due to evaporation or seepage within the water balance model. Seepage losses will be negligible given groundwater dewatering requirements, and evaporation losses are likely to be insignificant given that the pit pumping system is operated to keep the pit dry.

3.4.2 Pit Catchment Areas

Doral provided a pit progression plan which showed the planned development of the project for each quarter between Q3 2021 and Q4 2024. Catchment areas reporting to the open pit areas in each quarter of the operation were estimated based on the site topographic data and the following assumptions:

- A diversion will be constructed on the upstream side of the mining area (as per the surface water management plan), such that there will be limited external catchments reporting to the pits.
- No water will be captured within pit areas from the previous time periods (i.e. pits will be backfilled as soon as mining is completed).
- Planned internal drainage lines won't be intercepted by the pit developments – these will be diverted around the pit developments.

The estimated catchment areas reporting to open pit areas over the life of the project are summarised in Table 2.

Table 2: Pit Open Areas and External Catchment Areas with Time

Period	Pit Area (km ²)	External Catchment Area (km ²)
Q3 2021	0.08	0.22
Q4 2021	0.17	0.12
Q1 2022	0.18	0.44
Q2 2022	0.21	0.04
Q3 2022	0.25	0.00
Q4 2022	0.13	0.00
Q1 2023	0.20	0.90
Q2 2023	0.17	0.73
Q3 2023	0.13	0.60
Q4 2023	0.18	0.12
Q1 2024	0.29	0.00
Q2 2024	0.13	0.02
Q3 2024	0.18	0.00
Q4 2024	0.17	0.20

A runoff coefficient of 10% was applied to the rainfall over the external catchment areas to estimate the runoff volume to the pit void. This number is considered appropriate for small localised catchments in disturbed areas in the south west of Western Australia. A runoff coefficient of 75% was applied to the rainfall over the pit open area.

3.4.3 Pit Groundwater Inflows

A groundwater dewatering assessment for the project has been completed (AQ2, 2019a). The groundwater assessment produced dewatering estimates for a "Wet" and "Dry" climate sequence using a numerical groundwater model. The dewatering predictions with time for each of these scenarios (Dry and Wet) are summarised in Tables 3 and 4 and were included within the GoldSim water balance model as different model scenarios.

Note that the same synthetic climate sequences have been applied to the GoldSim water balance to generate surface water runoff for both the "Dry" and "Wet" dewatering scenarios. Therefore, the "Dry" dewatering water balance scenario will contain some model iterations with high rainfall sequences (which would in fact result in higher dewatering requirements), and the "Wet" dewatering water balance scenario will contain some model iterations with low rainfall sequences (where dewatering rates would be lower). As the numerical groundwater model was not run for all 100 climate sequences, the approach of running the two dewatering scenarios was taken and is considered valid as the "Dry" dewatering scenario is used to assess potential make-up water supply requirements and the "Wet" dewatering scenario is used to assess potential surplus water discharge volumes.

3.5 Water Demands

Doral provided an estimated water demand of 1.6GL/annum (equivalent of 4,400m³/d or 50L/s) which was constant over the life of the project. The water demand is effectively the make-up water required to supplement water losses within the process water circuit (such as in the tails).

3.6 Process Water Dam

A Process Water Dam (PWD) with a capacity of 40,000m³ has been proposed to support the mine operations, with an adjoining Drop Out Dam (DOD) with a storage capacity of 20,000m³ used to remove sediment from incoming water. Dewatering and stormwater collected within the open pits is pumped to the PWD/DOD, and water stored within the PWD/DOD is used to supply the mine operations. Within the GoldSim model, the PWD and DOD have been modelled as a common storage with a capacity of 60,000m³.

The PWD/DOD also receives runoff from the adjacent plant and impervious areas (car parks, buildings etc.). The adjacent plant and impervious areas reporting to the PWD/DOD are assumed to be 17ha, and a runoff coefficient of 90% has been applied.

The GoldSim model assumes that rainfall runoff reports to the PWD/DOD on the same day that the rainfall event occurs. As discussed above, the pumping rate from the open pit to the PWP/DOD is assumed to match the inflow rate to the open pit up to an assumed maximum discharge rate of 75L/s.

The water supplied to the PWD/DOD from the captured surface water runoff and groundwater dewatering is supplemented from a Yarragadee groundwater supply bore. Within the water balance model, it has been assumed that the supply rate from the groundwater bore is 4,620m³/d (5% higher than the mine water demand). Make up water supply from the Yarragadee groundwater supply bore is utilised within the water balance model, if the water storage within the PWP/DOD falls below 10,000m³ (i.e. allowance for approximately 2 days mine demand emergency storage).

Table 3: Pit Groundwater Inflows with Time (Dry Scenario)

Period	Groundwater Inflow (m3/d)	Period	Groundwater Inflow (m3/d)
1/07/2021	2162	1/02/2023	694
1/08/2021	1448	1/03/2023	629
1/09/2021	1536	1/04/2023	2422
1/10/2021	0	1/05/2023	1730
1/11/2021	0	1/06/2023	2354
1/12/2021	0	1/07/2023	919
1/01/2022	819	1/08/2023	2322
1/02/2022	600	1/09/2023	2055
1/03/2022	507	1/10/2023	1572
1/04/2022	514	1/11/2023	11
1/05/2022	168	1/12/2023	5
1/06/2022	76	1/01/2024	473
1/07/2022	354	1/02/2024	345
1/08/2022	723	1/03/2024	296
1/09/2022	344	1/04/2024	1204
1/10/2022	1008	1/05/2024	1117
1/11/2022	802	1/06/2024	720
1/12/2022	761	1/07/2024	773
1/01/2023	1031	1/08/2024	799
1/02/2023	694	1/09/2024	507
1/03/2023	629	1/10/2024	1208
1/04/2023	2422	1/11/2024	887
1/01/2023	1031	1/12/2024	1021

Table 4: Pit Groundwater Inflows with Time (Wet Scenario)

Period	Groundwater Inflow (m3/d)	Period	Groundwater Inflow (m3/d)
1/07/2021	2123	1/02/2023	724
1/08/2021	2072	1/03/2023	655
1/09/2021	1887	1/04/2023	2773
1/10/2021	256	1/05/2023	2672
1/11/2021	12	1/06/2023	4087
1/12/2021	0	1/07/2023	1837
1/01/2022	901	1/08/2023	1068
1/02/2022	652	1/09/2023	2108
1/03/2022	542	1/10/2023	2834
1/04/2022	191	1/11/2023	1851
1/05/2022	95	1/12/2023	444
1/06/2022	390	1/01/2024	521
1/07/2022	702	1/02/2024	358
1/08/2022	2149	1/03/2024	307
1/09/2022	1067	1/04/2024	1728
1/10/2022	1491	1/05/2024	858
1/11/2022	2038	1/06/2024	1100
1/12/2022	718	1/07/2024	1897
1/01/2023	920	1/08/2024	2597
1/02/2023	2123	1/09/2024	703
1/03/2023	2072	1/10/2024	1233
1/04/2023	1887	1/11/2024	885
1/01/2023	256	1/12/2024	707

4. KEY MODEL ASSUMPTIONS

The key assumptions within the GoldSim water balance model are summarised below:

- The water balance model starts at the commencement of mining operations (01/07/2021) and does not include consideration of antecedent conditions but assumes that the PWD/DOD starts with an initial storage of 10,000m³.
- Nett water demands of 4,400m³/d have been assumed, with all water demands supplied from the PWD/DOD.
- The volume of dewatering required from the pits is dependent on groundwater responses to rainfall. Groundwater models for a "Dry" and "Wet" groundwater recharge sequence were run, and the resulting groundwater dewatering requirements incorporated within the GoldSim water balance model as two different scenarios. Note that the same synthetic climate sequences have been applied to GoldSim water balance to generate surface water runoff within the "Dry" and "Wet" dewatering scenarios, such that in the "Dry" water balance scenario model iterations with runoff from high rainfall events occur and in the "Wet" water balance scenario model iterations with runoff from low rainfall events occur.
- All runoff from a rainfall event is collected on the day of the rainfall event, with no delay in runoff reaching the collection point (pit or PWD/DOD).
- The Solar Evaporation Ponds (SEPs) have not been included within the water balance model, as the return water and losses at these ponds are assumed to have been taken into account when determining the net mine water demand.
- A water year is assumed to commence on 1 July, with licences for groundwater abstraction and discharge assumed to cover a water year.
- Potable water uses have not been included in the model.
- The capacity of the PWD and DOD is 40,000m³ and 20,000m³ respectively, with the model treating these as one combined storage.
- Supplementary water supply from the groundwater supply bore is pumped to the PWD/DOD, if the water storage in the dams falls below nominally 10,000m³. This minimum volume was assumed to allow some emergency storage to maintain water supply in the event of issues pumping the water supply bore, while keeping some buffer storage within the dam to reduce the volume of excess water discharge which would be required during dry periods. The pumping capacity from the groundwater supply bore is assumed to be 5% higher than the mine water demand to provide capacity for the water supply system make-up water supply deficits.
- The maximum pump out rate from the open pit is nominally 75L/s. If inflows exceed this rate, water will be temporarily stored within a sump in the pit base and pumped out in successive time periods.
- Only one mining area will be open at any one time, with no pumping assumed from completed mining areas (either dewatering or stormwater capture).
- Evaporation loss has been applied to the PWD/DOD over an assumed area of pond footprint area of 3.4ha. The evaporation loss has been applied over this area regardless of the pond water volume (i.e. pond vertical sides assumed).
- Catchment areas for each mining cell pit footprint have been assumed based on assumed drainage inside the mine disturbance area. It is assumed that runoff from upstream of the mine disturbance area is diverted around the disturbance area (as per the Surface Water Management Plan) and therefore does not contribute runoff to any of the pit voids.
- Runoff coefficients which have been applied within the model, represent annual average runoff coefficients. In reality, a higher percentage of rainfall will runoff following larger events (and wet antecedent conditions) and a lower percentage of rainfall will runoff following smaller events (and dry antecedent conditions). As such, there is the potential that make-

up water and discharge requirements may be under-estimated by the model. The following runoff coefficients have been assumed:

- RWD/DOD catchment – 90%
- Pit footprint – 75%
- Pit external footprint – 10%

5. RESULTS

5.1 Groundwater Demands

The GoldSim water balance model calculates the volume of water which needs to be supplied from the groundwater supply bore (Yarragadee aquifer) across the 100 model iterations (different synthetic rainfall timeseries). A probability distribution plot of the required groundwater supply volume with time from the model for both the “Dry” and “Wet” dewatering scenarios is shown in Figure 2.

The water balance model indicates that in the driest conditions modelled, the maximum annual abstraction from the Yarragadee aquifer bore is 1.3GL, which is less than the requested groundwater abstraction licence limit of 1.6GL. The highest groundwater bore demand is predicted to occur in the first year of mining, while the second year of mining is predicted to have the lowest annual groundwater bore demand. The groundwater demand is inversely proportional to the average pit footprint and catchment areas over the year, with the higher demand during the year with the smaller average catchment areas. The total volume of make-up water estimated to be required from the Yarragadee aquifer in each mine operating month across the 100 model iterations is also presented in Table 5 (Dry) and Table 6 (Wet). As make-up water requirements are highest during drier periods, the “Dry” dewatering scenario results best represent potential maximum water annual water demands during drought periods.

The requirement to pump from the Yarragadee aquifer is offset by the availability of surface water inflows to the PWD/DOD and groundwater and surface water inflows to the open pit. A time-series of the mean water inflows to the PWD/DOD across all model iterations is shown in Figure 3. The plot shows that demand from the Yarragadee aquifer is highest during the summer months and reduces when more surface water is available in the winter months.

5.2 Pit and PWD/DOD Storage Capacity

The water balance model tracks the stored water volume within the open pit and within the PWD/DOD. As discussed above, the results of the “Dry” dewatering scenario are most valid during dry climate sequences (i.e. when looking at water supply make-up requirements) and the “Wet” dewatering scenario is most valid during wet climate sequences (i.e. when looking at peak water storage volumes or surplus water discharge requirements).

A storage capacity for the open pit wasn't specified, however pump-out rates from the pit to the PWD/DOD were set in the model such that storage volumes within the pit didn't regularly exceed 5ML. A probability plot of the water storage volume within the open pit is show in Figure 4 for both the “Dry” and “Wet” dewatering scenarios. The figure indicates that there is an increased likelihood of relatively large volumes of water being required to be stored within the pit during the winter period and, in particular, during Q2 2023 when the surface water capture area for the pit is greatest. During this period, the mine should include an allowance for a water storage sump in the pit (or in part of the Q1 2023 pit void prior to backfill). Note that the model predicts that there is a 65% chance that no water will collect in the pit during this period, and a 10% chance that more than 9ML would be required to be stored within the pit (or transfer pump rate and discharge allowances increased).

The combined storage in the PWD/DOD is 60,000m³. A probability plot of the water storage volume within the combined PWD/DOD storage is show in Figure 5 for both the “Dry” and “Wet” dewatering scenarios. Similar to the pit storage, the volume of water within the PWD/DOD is generally higher during winter periods than during summer periods. During the Q1 2023 mining period there is a higher chance of incoming water exceeding the capacity of the plant to use the water and the

available storage within the PWD/DOD (which leads to a chance that discharge will be required, refer section below).

Table 5: Monthly Yarragadee Supply Volumes (ML): "Dry" Groundwater Model Run

Period	10 th Percentile	50 th Percentile (Median)	90 th Percentile	Maximum (Driest Model Iteration)
1/07/2021	18	37	51	55
1/08/2021	46	60	74	78
1/09/2021	60	69	78	87
1/10/2021	115	124	129	133
1/11/2021	115	129	133	138
1/12/2021	129	138	143	143
1/01/2022	106	115	120	120
1/02/2022	101	110	110	115
1/03/2022	106	120	124	124
1/04/2022	92	110	115	120
1/05/2022	74	106	120	129
1/06/2022	60	83	106	120
1/07/2022	46	78	97	106
1/08/2022	60	78	92	110
1/09/2022	78	97	110	120
1/10/2022	87	97	106	110
1/11/2022	97	106	110	110
1/12/2022	110	115	120	120
1/01/2023	101	110	110	115
1/02/2023	101	106	110	110
1/03/2023	101	115	120	124
1/04/2023	37	55	64	64
1/01/2023	28	55	69	78
1/02/2023	5	18	37	46
1/03/2023	18	46	74	92
1/04/2023	14	32	51	55
1/05/2023	32	46	60	64
1/06/2023	69	78	83	87
1/07/2023	110	124	129	133
1/08/2023	133	138	143	143
1/09/2023	101	110	110	115
1/10/2023	101	106	110	110
1/11/2023	101	115	120	124
1/12/2023	37	55	64	64
1/01/2024	115	129	129	129
1/02/2024	115	120	124	124
1/03/2024	110	124	129	133
1/04/2024	74	92	97	101
1/05/2024	55	74	87	97
1/06/2024	46	69	87	101
1/07/2024	41	69	83	97
1/08/2024	60	78	92	97
1/09/2024	83	97	106	115
1/10/2024	78	92	101	106
1/11/2024	92	101	106	110
1/12/2024	98	107	112	112

Table 6: Monthly Yarragadee Supply Volumes (ML): "Wet" Groundwater Model Run

Period	10th Percentile	50th Percentile (Median)	90th Percentile	Maximum (Driest Model Iteration)
1/07/2021	18	37	51	60
1/08/2021	32	46	55	64
1/09/2021	46	60	69	78
1/10/2021	106	115	124	129
1/11/2021	115	124	133	138
1/12/2021	129	138	143	143
1/01/2022	101	115	115	120
1/02/2022	101	106	110	110
1/03/2022	106	120	124	124
1/04/2022	101	120	124	129
1/05/2022	83	106	124	129
1/06/2022	46	74	101	115
1/07/2022	41	64	87	97
1/08/2022	18	37	51	69
1/09/2022	55	74	87	92
1/10/2022	74	83	92	97
1/11/2022	60	69	74	74
1/12/2022	106	115	115	120
1/01/2023	101	110	115	115
1/02/2023	97	106	110	110
1/03/2023	101	115	120	124
1/04/2023	28	46	55	55
1/01/2023	5	28	41	51
1/02/2023	0	0	5	9
1/03/2023	0	0	23	37
1/04/2023	23	55	78	83
1/05/2023	32	51	60	69
1/06/2023	32	41	46	51
1/07/2023	60	69	78	78
1/08/2023	115	124	124	124
1/09/2023	101	110	115	115
1/10/2023	97	106	110	110
1/11/2023	101	115	120	124
1/12/2023	28	46	55	55
1/01/2024	115	124	129	129
1/02/2024	115	120	124	124
1/03/2024	106	124	129	133
1/04/2024	60	78	83	87
1/05/2024	60	78	92	106
1/06/2024	32	60	78	87
1/07/2024	14	37	51	60
1/08/2024	9	23	37	41
1/09/2024	69	87	97	106
1/10/2024	78	87	97	101
1/11/2024	92	101	106	110
1/12/2024	107	116	121	121

5.3 Surplus Water Discharges

As indicated in Figure 5 and discussed above, there are periods within the mine operations where the model predicts that water pumped to the PWD/DOD from the open pit (collected groundwater and stormwater) exceeds the mine water demand for a sufficiently sustained period such that the PWD/DOD will overtop. The required period where surplus water would be generated is generally confined to the Q2 2023 mining period. The annual surplus (discharge) water estimates from the GoldSim model are shown in Figure 6 for both the "Dry" and "Wet" dewatering scenarios.

Note that when considering surplus water discharge events, the "Wet" dewatering scenario is more applicable as any surplus water discharge event will coincide with a high rainfall period which will also result in high groundwater dewatering requirements. As such, for the "Wet" dewatering scenario the figure shows the following:

- The PWD/DOD is predicted to overtop in 55% of the model runs.
- There is a 25% chance that the predicted discharge volume will exceed 23,000m³.
- The maximum total volume of water which is predicted to overtop the PWD/DOD in any of the model iterations is 82,000m³.

5.4 Results Conclusion

Based on the water balance model predictions, the following results have been concluded:

- A 1.6GL annual abstraction licence from the Yarragadee aquifer should be sufficient to provide a reliable water supply system, with the predicted peak annual demand of 1.3GL. The highest demand for groundwater is expected to be in the first year of operation.
- An annual discharge licence in the order of 100,000m³ (100ML) would allow the site to discharge from the PWD/DOD during wet conditions without impacting operations. The largest annual discharge volume was predicted to be 80,000m³ across the 100 model iterations. Some buffer storage capacity within the open pit is assumed within this estimation.
- Although an annual discharge licence in the order of 100,000m³ is suggested, the licence is to cover the risk of a wet period occurring during the 2023 winter (greater than 50% likelihood). Outside this period, the model doesn't predict there to be a requirement to discharge surplus water. Note that a separate assessment has been documented to estimate runoff from a 100-yr event across the site (with different assumptions to this assessment) – refer to AQ2, 2019c.

6. SUMMARY

A GoldSim water balance has been created for the life of the proposed Yalyalup mineral sands operation. The water balance was used to estimate the likely Yarragadee groundwater makeup supply volume which may be required to support the operation, plus the potential discharge volumes of surplus water.

To support a mine water demand of 4,400m³/d, a groundwater abstraction licence from the Yarragadee of 1.6GL/annum should be applied for to cover the full mine water demands. However, the water balance modelling shows that the peak make-up water demand is 1.3GL/annum due to supplementation from priority water supply sources of collected rainfall runoff and pit dewatering.

The water balance assessment indicates that during wet climate sequences there may not be sufficient water demand or on-site storage capacity for water collected within the pit from stormwater runoff and dewatering, plus runoff collected within the PWD/DOD to be managed. Therefore, discharge of surplus water may be required. An annual discharge licence allowance for 100,000m³ would be sufficient to allow the operations to manage surplus water from all climate sequences assessed within the water balance. With the current mine plan, the 2023 winter is the most likely period where surplus water may be generated.

Doral will make every effort to maximise water recycling and to minimise water use. Process water will, in the first instance, be sourced from recycled water and dewatering of the pits. Additional process water sourced from the Yarragadee aquifer bore will be used only after other resources have been fully utilised (i.e. PWD /DOD water storage falls below nominal 10,000 m³, approximately 17% of the total capacity of PWD/DOD). Water will not be intentionally discharged offsite when it cannot be used for any other purpose. Water will be discharged offsite when the storages at PWD/DOD are at their full capacity (overtop) in the event of sufficiently sustained period of high rainfall events results in site runoff exceeding the mine water demand.

We trust that this memo meets your requirements. Please contact us if you require additional information.

Regards

Mark

Consulting Water Resources Engineer

Jeff

Consulting Hydrogeologist

Attached: Figures 1 to 6

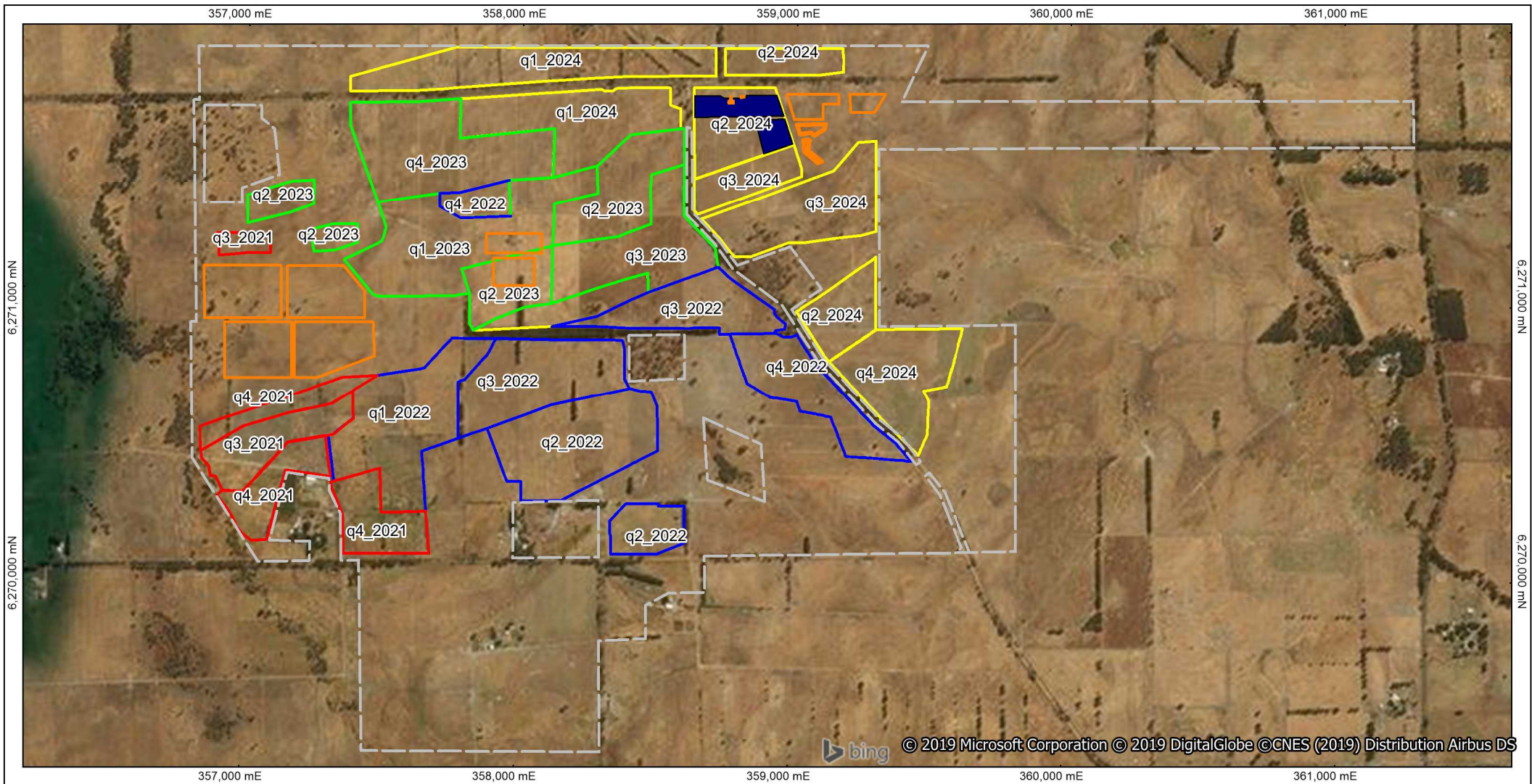
Author: MN (21/10/19)
Checked: BDK (21/10/19)
Reviewed: JLJ (21/10/19)

References

AQ2, 2019a. Hydrogeological Assessment for the proposed Yalyalup Heavy Mineral Sands Project, 136D_007a, October 2019.

AQ2, 2019b. Surface Water Assessment for the proposed Yalyalup Heavy Mineral Sands Project, 136D_005b, September 2019.

AQ2, 2019c. Doral Yalyalup Operations - Surface Water Discharge Assessment, 136D_006a, October 2019.



LOCATION MAP



Location: F:\13614.GIS\Workspaces

LEGEND

Pit Footprint Schedule

- Year 2021
- Year 2022
- Year 2023
- Year 2024

- Potential Disturbance Envelope
- Infrastructure (workshop, admin, slime tailings)
- Process Water Dam / Dropout Dam



AUTHOR: MN
 DRAWN: LDS
 DATE: 21/10/2019

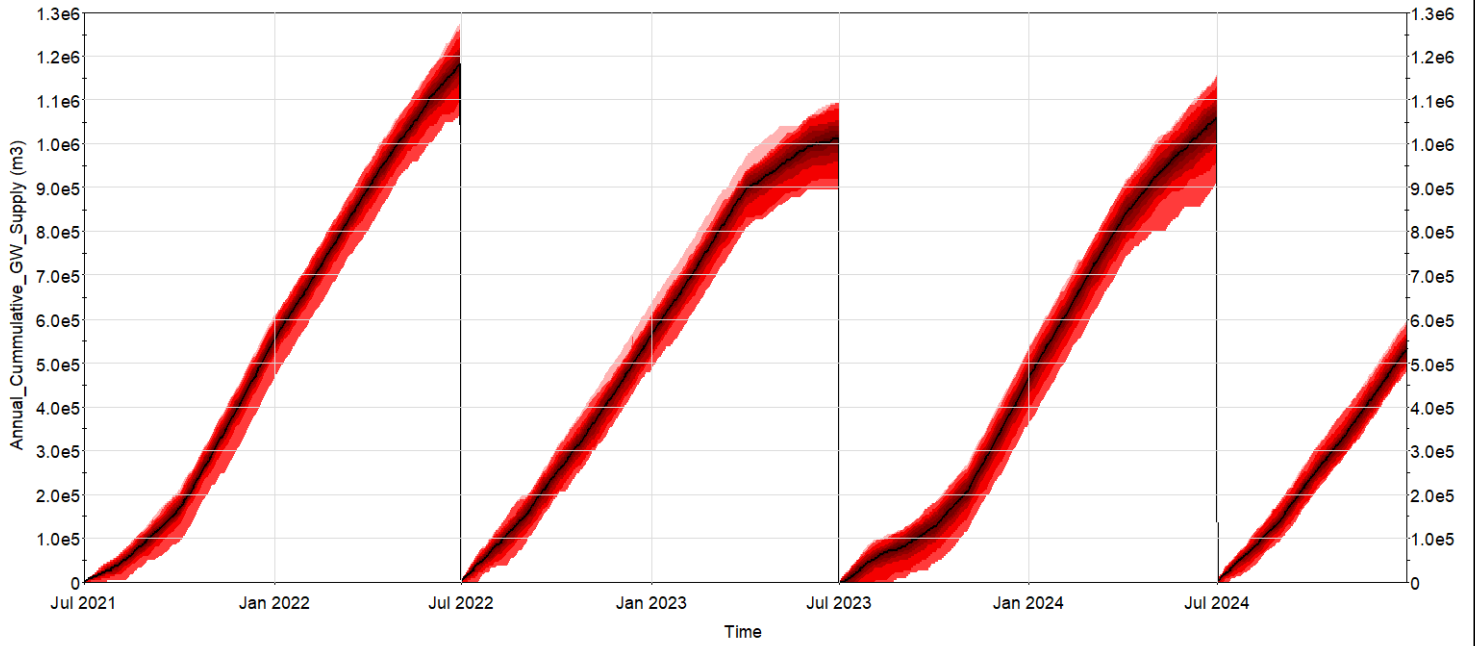
REPORT NO: 005a
 REVISION: A
 JOB NO: 136

NOTES & DATA SOURCES:
 Data provided by Doral.



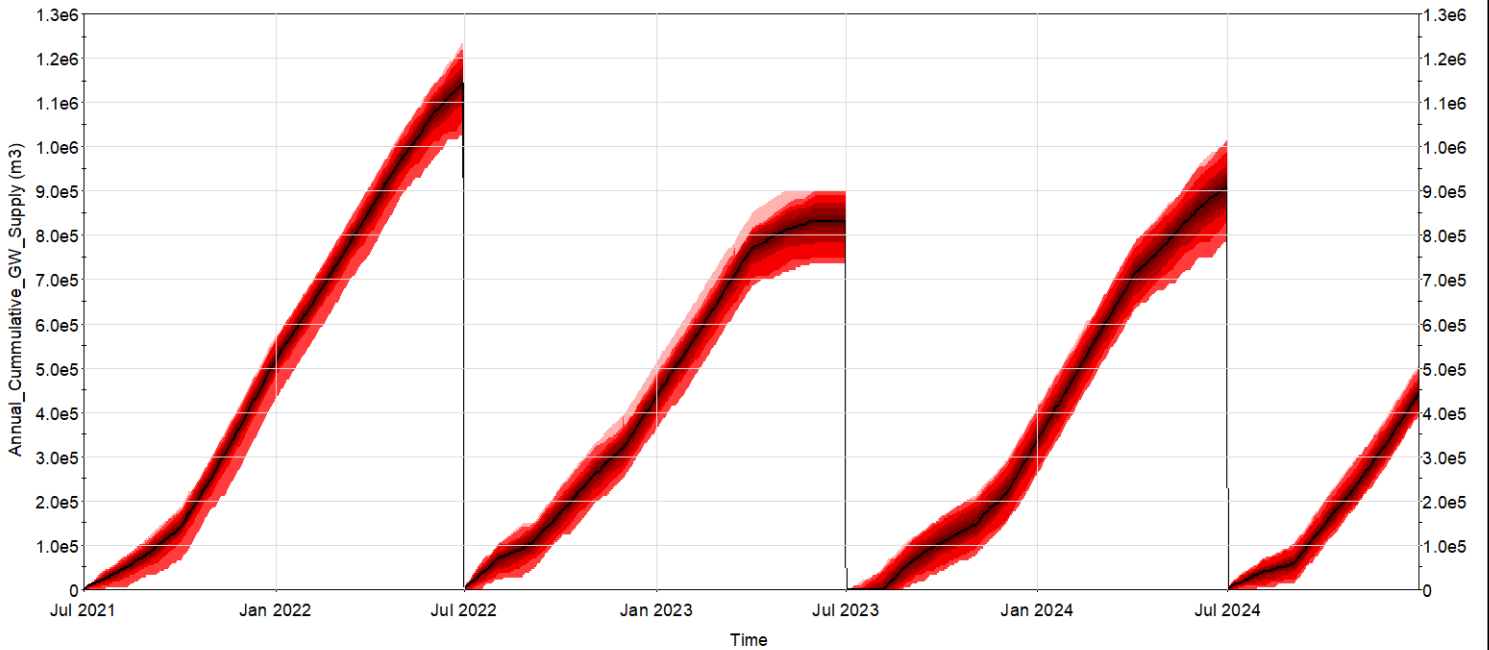
FIGURE 1
 MINE LAYOUT

DRY DEWATERING SCENARIO



Statistics for Annual_Cummulative_GW_Supply			
Min..1% / 99%..Max	1%..5% / 95%..99%	5%..15% / 85%..95%	15%..25% / 75%..85%
25%..35% / 65%..75%	35%..45% / 55%..65%	45%..55%	50%

WET DEWATERING SCENARIO

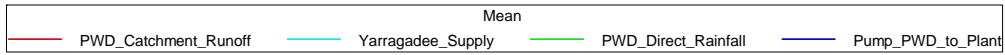
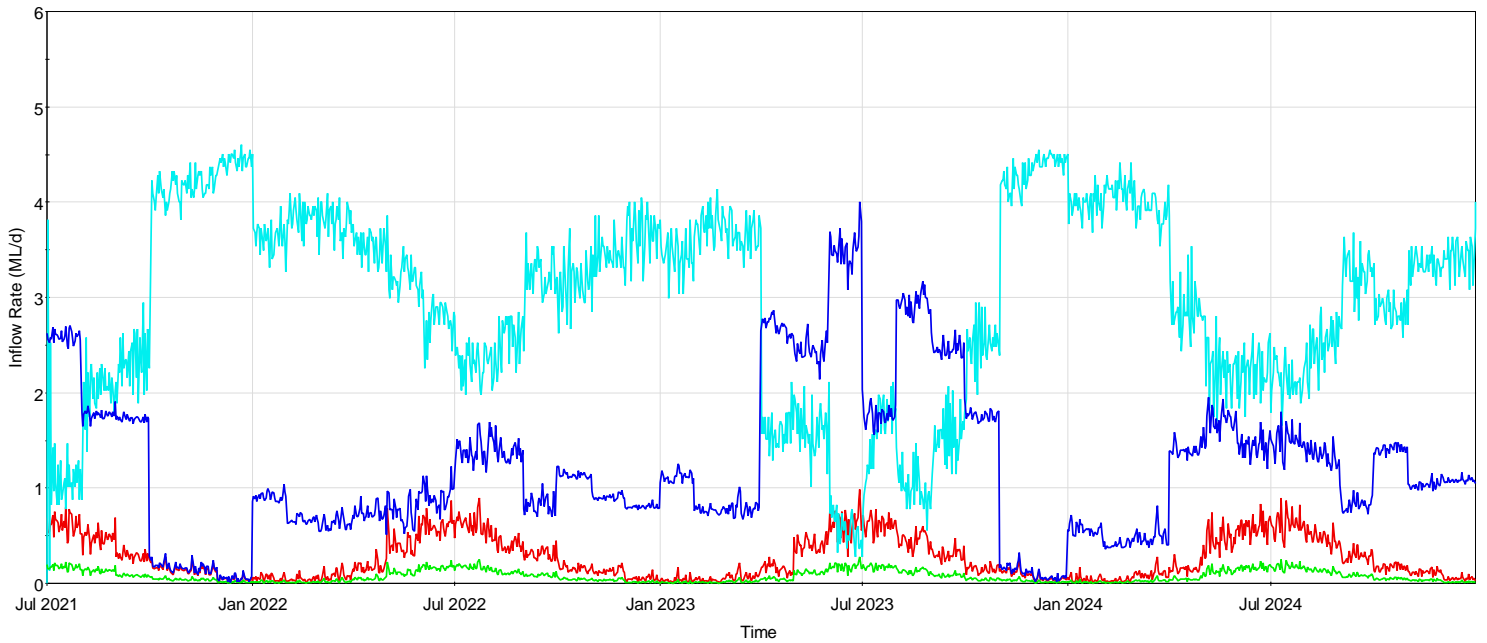


Statistics for Annual_Cummulative_GW_Supply			
Min..1% / 99%..Max	1%..5% / 95%..99%	5%..15% / 85%..95%	15%..25% / 75%..85%
25%..35% / 65%..75%	35%..45% / 55%..65%	45%..55%	50%

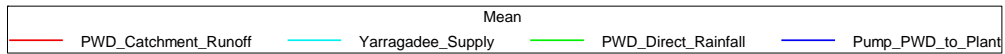
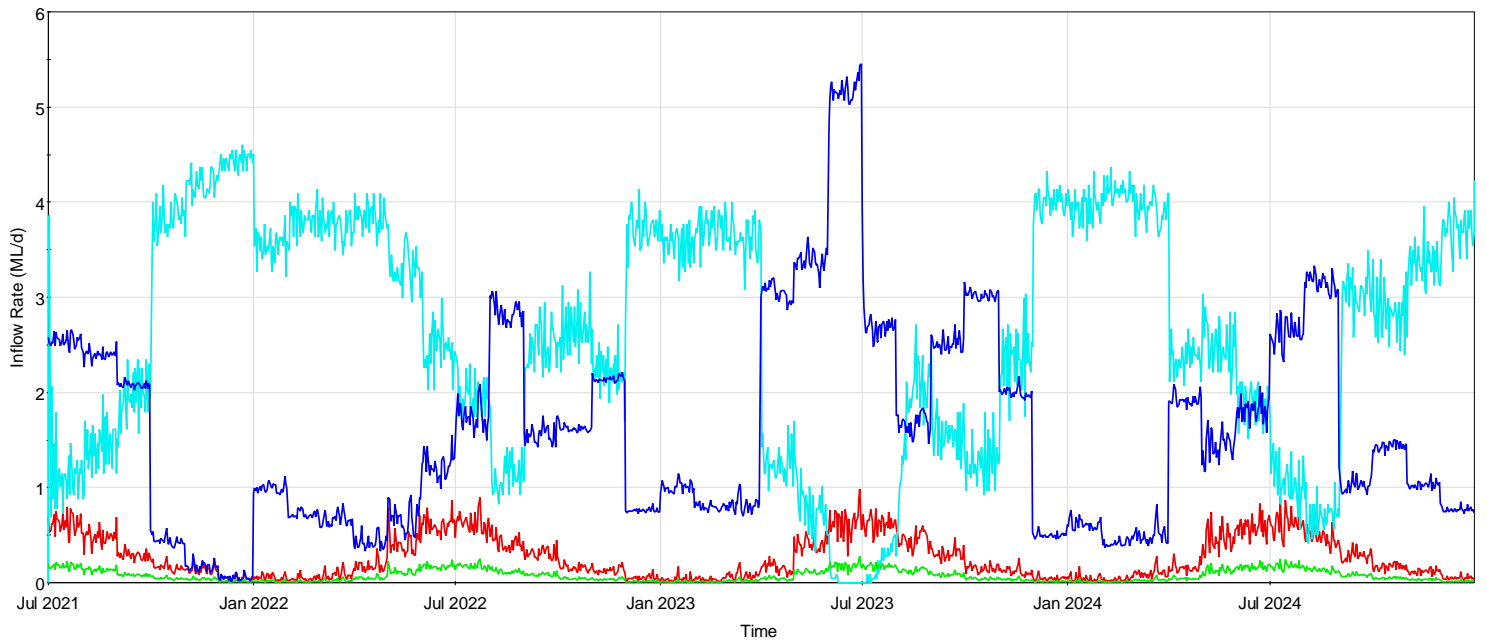


ANNUAL CUMULATIVE YARRAGADEFEE GROUNDWATER SUPPLY VOLUME FIGURE 2

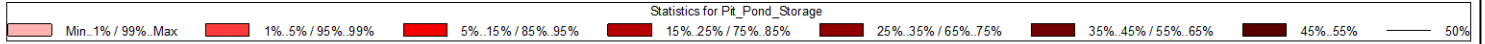
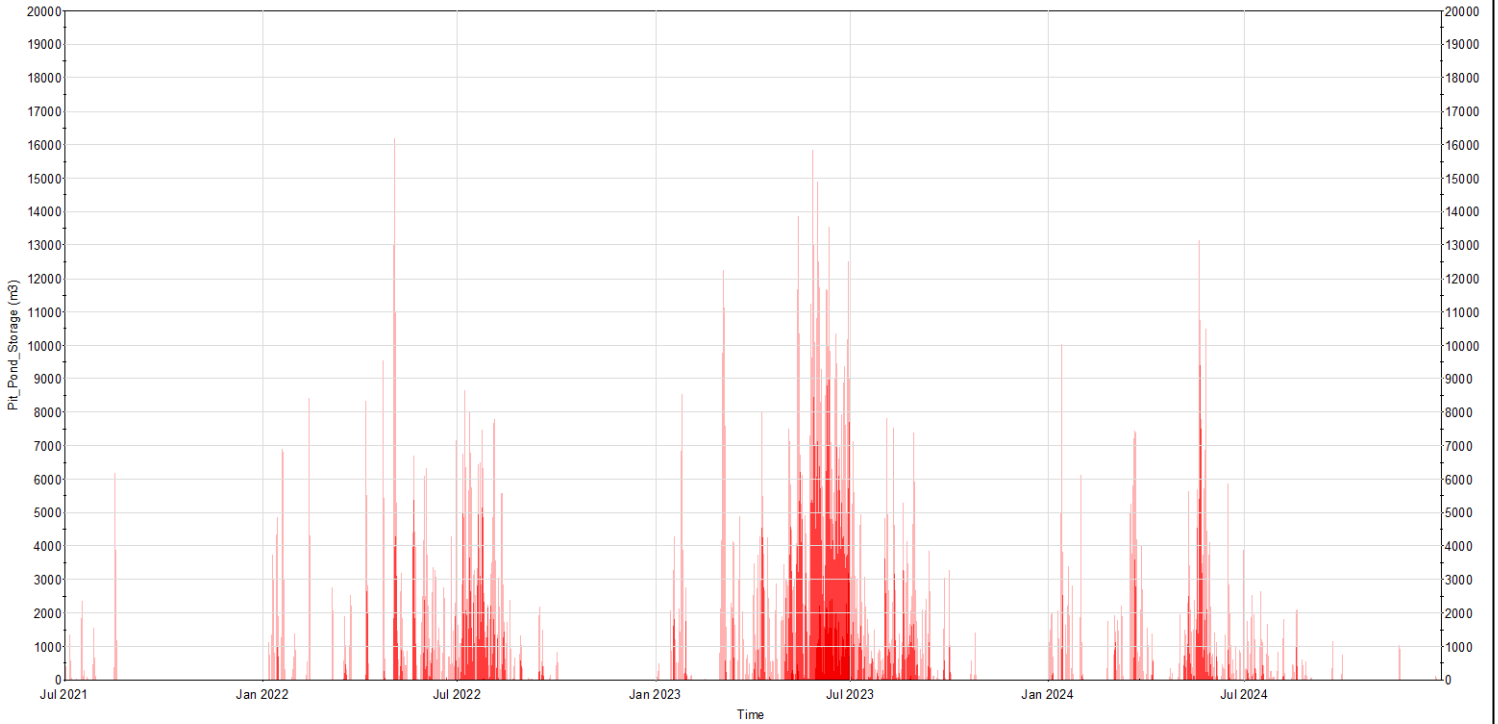
DRY DEWATERING SCENARIO



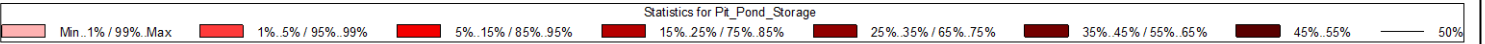
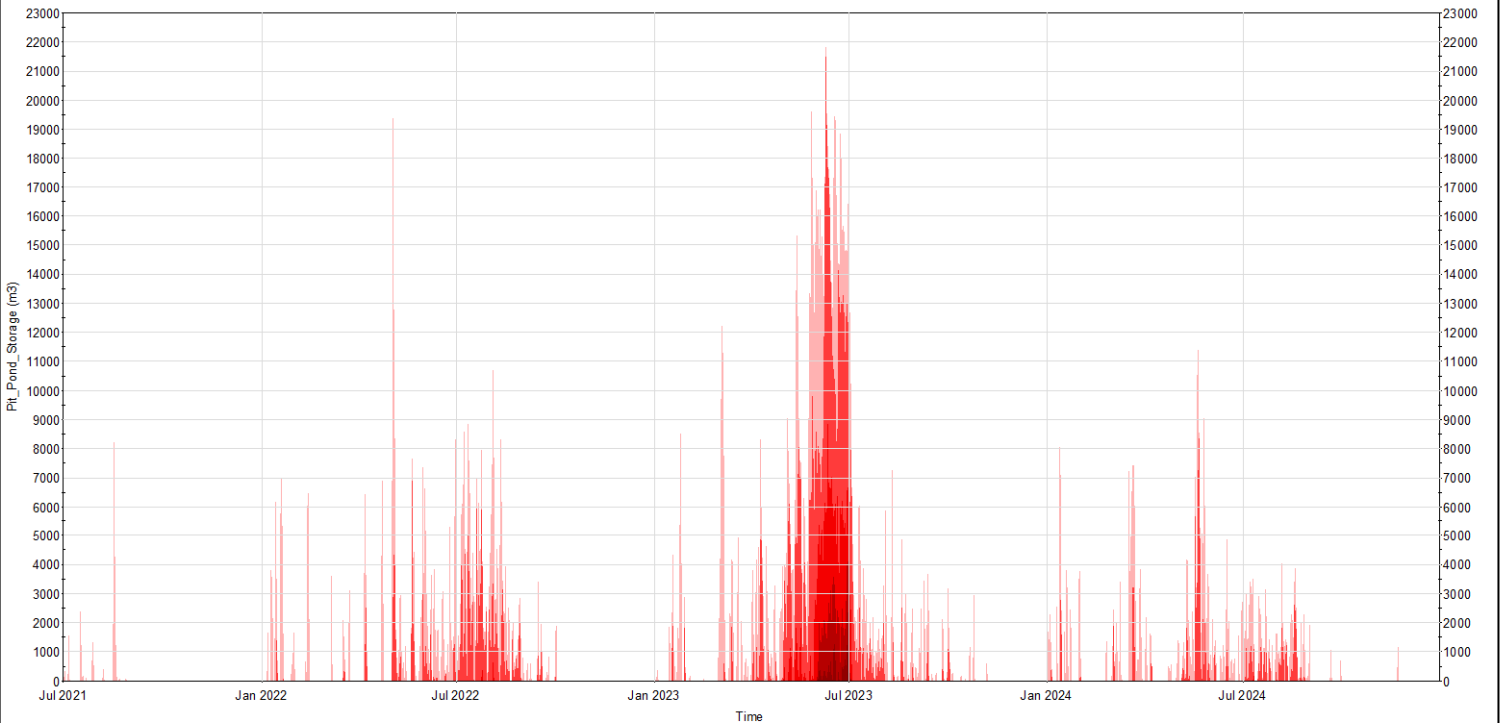
WET DEWATERING SCENARIO



DRY DEWATERING SCENARIO



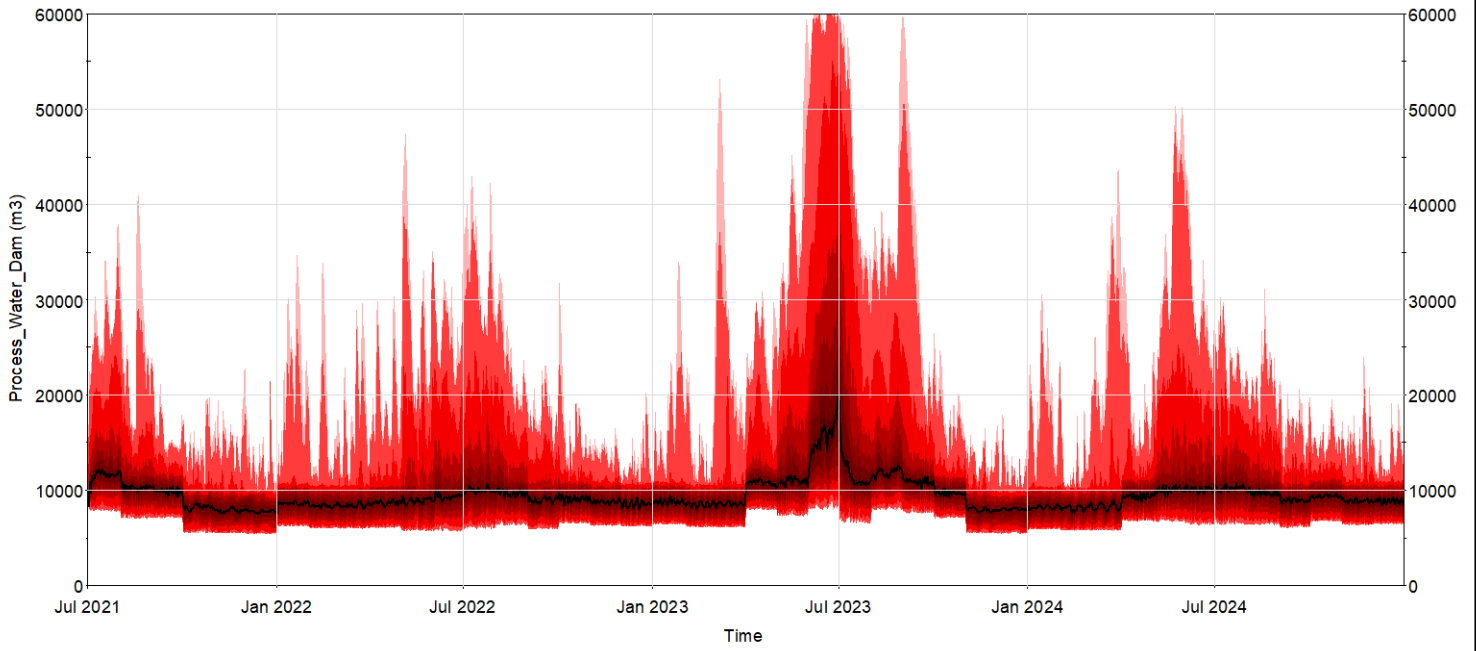
WET DEWATERING SCENARIO



OPEN PIT STORED WATER VOLUME TIMESERIES

FIGURE 4

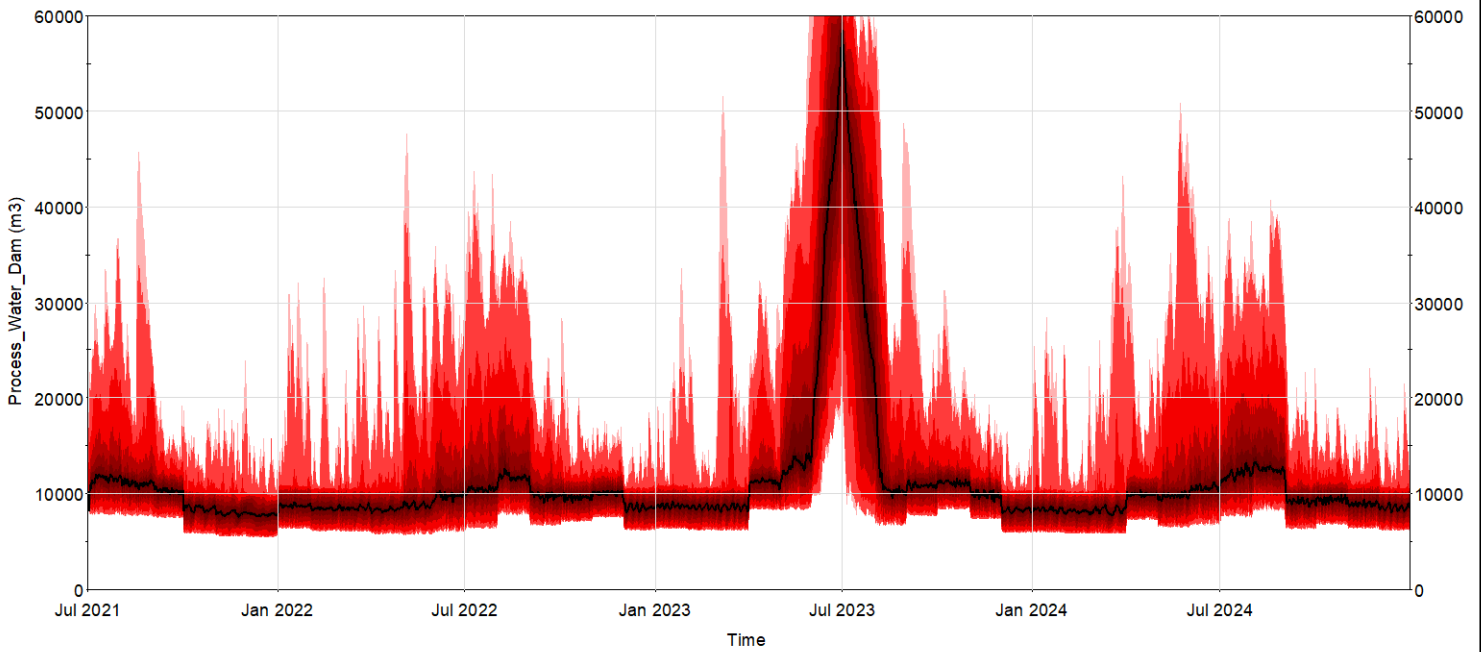
DRY DEWATERING SCENARIO



Statistics for Process_Water_Dam

Min..1% / 99%..Max	1%..5% / 95%..99%	5%..15% / 85%..95%	15%..25% / 75%..85%
25%..35% / 65%..75%	35%..45% / 55%..65%	45%..55%	50%

WET DEWATERING SCENARIO



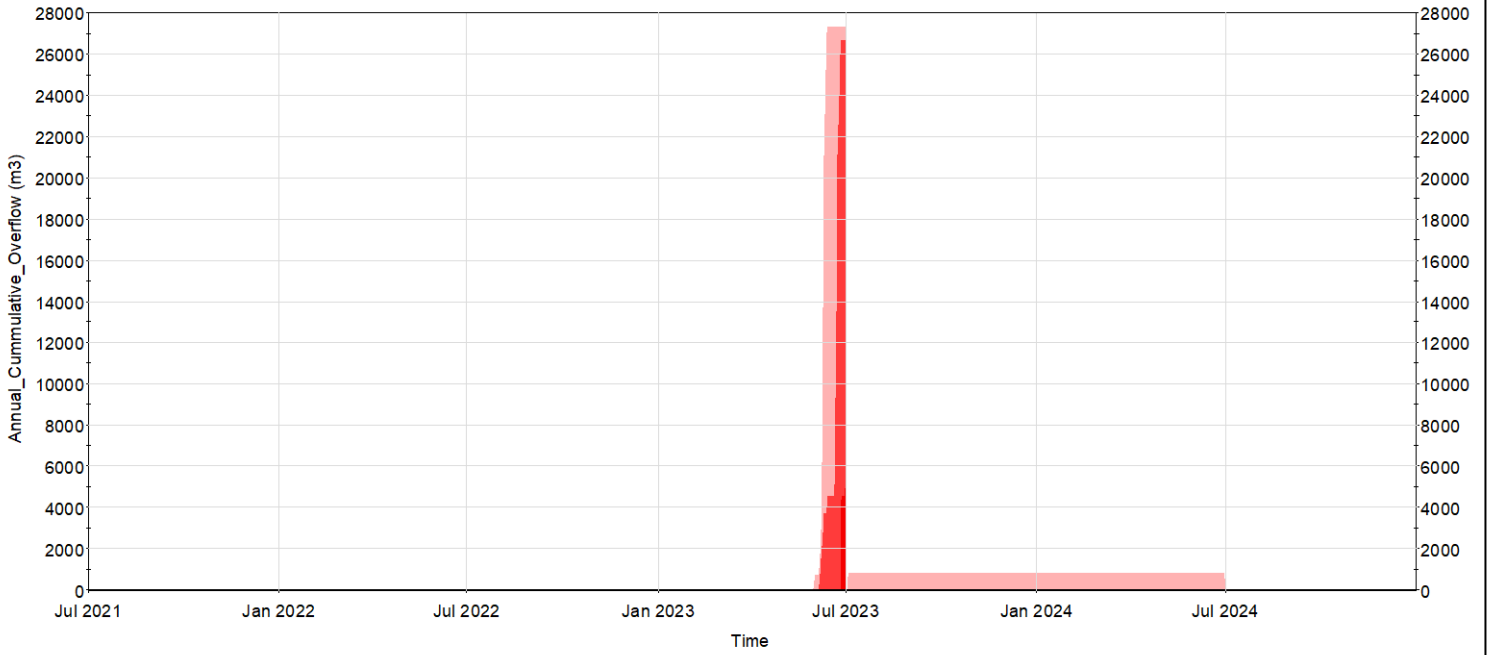
Statistics for Process_Water_Dam

Min..1% / 99%..Max	1%..5% / 95%..99%	5%..15% / 85%..95%	15%..25% / 75%..85%
25%..35% / 65%..75%	35%..45% / 55%..65%	45%..55%	50%



PWD/DOD - STORED WATER VOLUME TIME SERIES FIGURE 5

DRY DEWATERING SCENARIO



WET DEWATERING SCENARIO

