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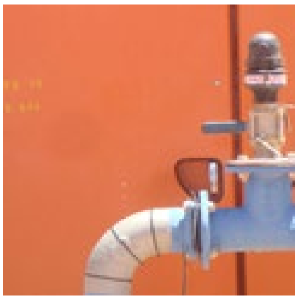

ERIAS Group

Fountain Head Gold Project – Environmental Impact Statement Response and Groundwater Monitoring Plan

10 November 2021

CDM Smith

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Section 1 Introduction

1.1 Background

CDM Smith Australia Pty Ltd (CDM Smith) was engaged by ERIAS Group (ERIAS) to address the comments received for the Fountain Head Gold Project Environmental Impact Statement (FHGP EIS). The FHGP EIS was submitted in July 2021 for review and comment. ERIAS is in the process of preparing a supplementary EIS, for which this report contributes to.

Specifically, the objectives of this report are to address the comments received on the FHGP EIS and in relation to groundwater monitoring.

ERIAS has updated the project layout since the FHGP EIS submission (Figure 1):

- The footprint of the integrated waste landform (IWL) has increased in size and moved further east.
- The potential acid forming (PAF) stockpile, previously located at the southeast end of the pit, has been removed and all PAF waste rock will be stored in the pit during and post mining.

1.2 Scope of Work

The scope of work (SOW) for this report is documented in the ERIAS request for proposal dated 23 September 2021. The SOW formed two main components and this report documents the objectives listed in Section 3 of the Groundwater Monitoring Plan. The Pit Lake Water Quality Study objectives are documented in report number ERIAS-PNX-1001007-RPT-005-0.

1.2.1 Groundwater Monitoring Plan

1.2.1.1 Objectives

- Address comments made from the Department of Environment, Parks and Water Security (DEPWS) regarding monitoring groundwater drawdown and mounding.
- Update the Water Management Plan (WMP) to incorporate groundwater drawdown and mounding triggers.
- Develop a Trigger Action Plan if the groundwater triggers are exceeded.

1.2.1.2 Subtasks

- Review the proposed groundwater monitoring program outlined in the WMP.
- Based on the numerical modelling results develop groundwater drawdown and mounding triggers.
- Review the current groundwater monitoring network and if required propose additional monitoring bore locations to meet monitoring requirements.
- Develop a Trigger Action Plan which outlines the steps to be taken should the groundwater drawdown and mounding triggers be exceeded.

In addition, ERIAS have requested:

- Development of groundwater quality triggers for protection of groundwater environmental values.
- Provide advice on post closure groundwater monitoring for water quality and level.

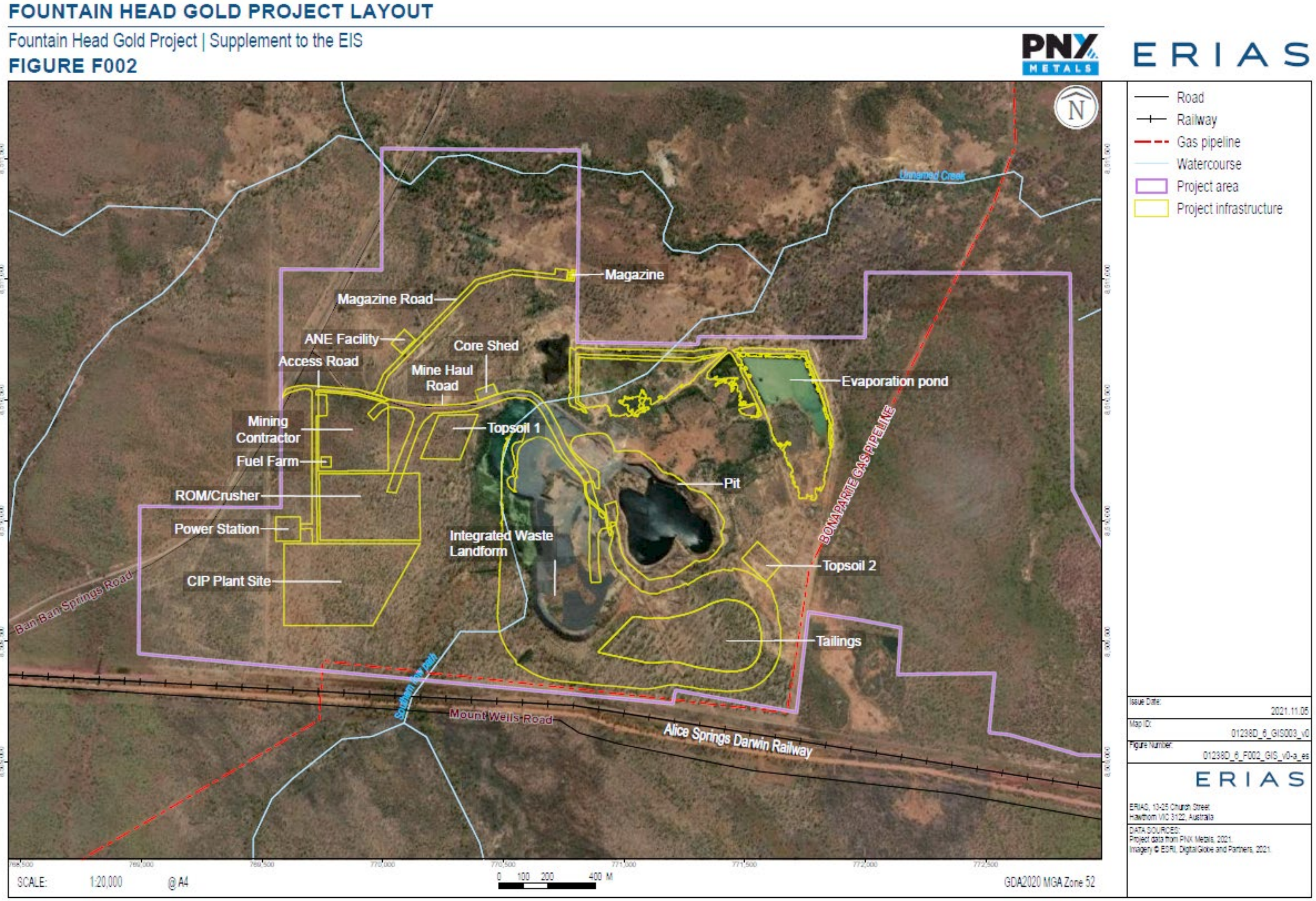

Figure 1-1 Proposed site layout

Section 2 Conceptualisation and Environmental Values

2.1 Conceptualisation

2.1.1 Hydrogeology

The project site is located within the Pine Creek Geosyncline geological province and the surface geology at Fountain Head is dominated by weathering products of the Burrell Creek Formation (Figure 2-1). The site hydrogeology consists of four Proterozoic hydro-stratigraphic units (HSUs) as described below (McGowan, 1989):

- Alluvial sediments consist of variably weathered mudstone with poorly sorted sandstone, gravel and cobbles containing pyritic veining; comprised of remnant fragments of the Mt Bonnie Formation.
- Burrell Creek Formation consists of a fine to course-grained feldspathic meta-greywacke consisting of minor slate/phyllite, mudstone, schist and lenses of volcanilithic pebble conglomerate.
- Mt Bonnie Formation consists of interbedded carbonaceous unit consisting of pyritic and chloritic slate, feldspathic metagreywacke and ferruginous phyllite with chert lenses and nodules. The formation conformably overlies the Gerowie Tuff.
- Gerowie Tuff consists of a combination of cherty/feldspathic crystal tuff, lithic tuff with minor felsic ignimbrite, volcaniclastic shale and siliceous siltstone.

The Pine Creek Geosyncline is bounded by the Hayes Creek Fault to the south, the Pine Creek Shear Zone to the east and the Shoobridge Fault to the west.

2.1.2 Groundwater Levels and Flow Direction

Groundwater monitoring was conducted by CDM Smith in July 2019 on five groundwater bores and the results are summarised in Table 1. Figure 2-2 shows the groundwater levels and inferred groundwater flow direction (CDM Smith, 2021a).

Table 2-1 Groundwater monitoring

Bore	Easting	Northing	Elevation (mTOC)	Depth (m)	SWL (m TOC)	SWL (mAHD)
FHMB01	771005	8510340	102.1	93	8.0	94.1
FHMB02	771361	8510066	104.2	102+	10.0	94.2
FHMB04	771358	8509817	108.0	102+	13.7	94.3
FHMB05	771235	8509841	108.0	102+	13.7	94.3
FHMB06	771236	8509736	104.5	23	9.7	94.8

2.1.3 Water Quality

The fractured rock aquifers of the Pine Creek Geosyncline are characterised by fresh groundwater. Groundwater salinity is typically low, some areas contain elevated concentrations of arsenic and iron, particularly in mineralised zones. This is likely the result of natural groundwater chemistry or in combination with legacy mining operations. Typically, sulfide orebodies in the study area are potentially acid forming (PAF) and prone to generation of acidic and metalliferous drainage (AMD) when exposed to air or oxidised. The aquifer groundwater types range from Magnesium to Sodium Bicarbonate (Mg to Na-HCO_3). Conceptually, shallow groundwater may be sourced from surface water as sheet-flow or creek flow and the elevated Magnesium and Bicarbonate relative to surface water samples indicating interaction with dolomitic rocks.

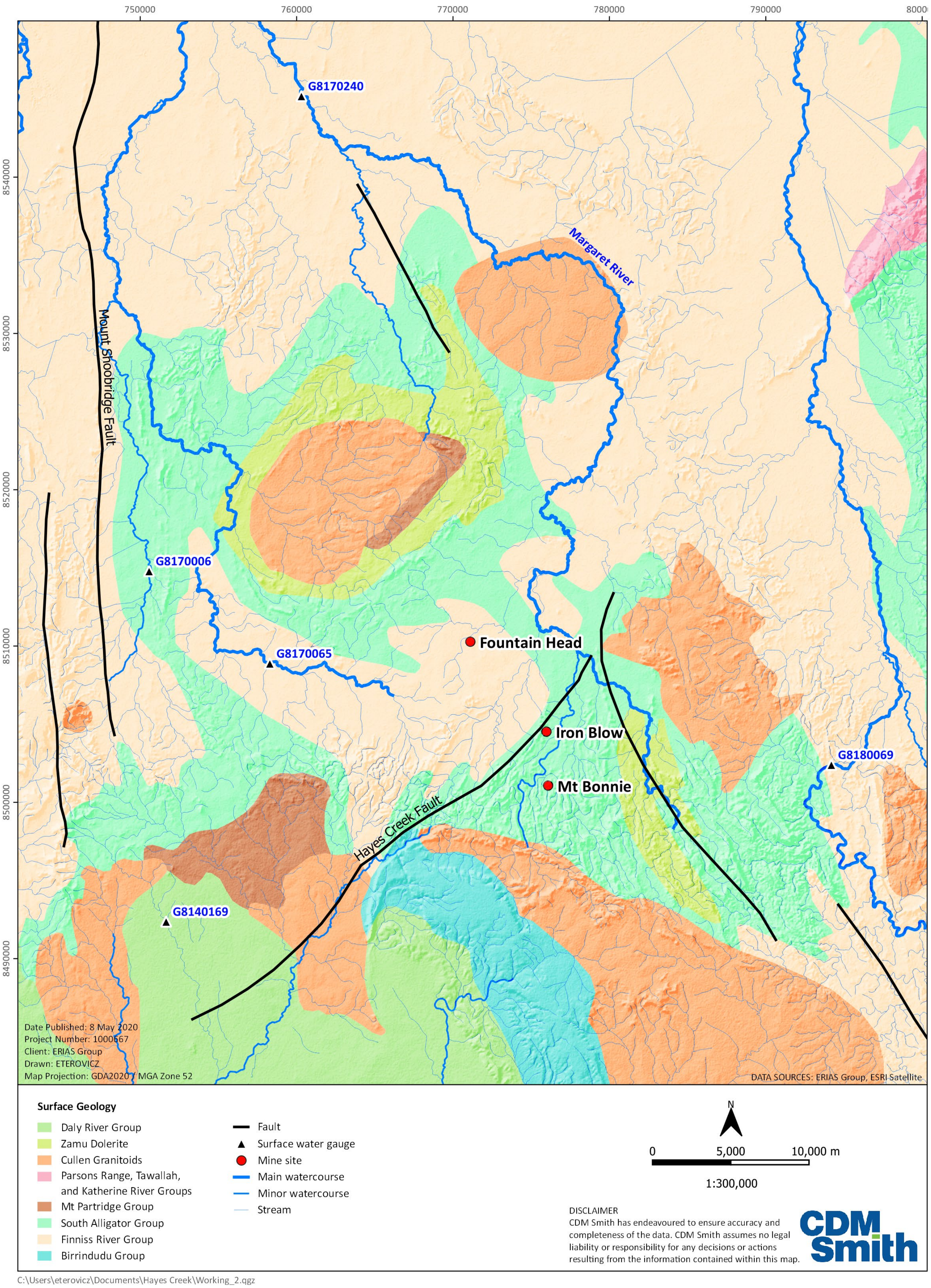

Figure 2-1 Surface geology

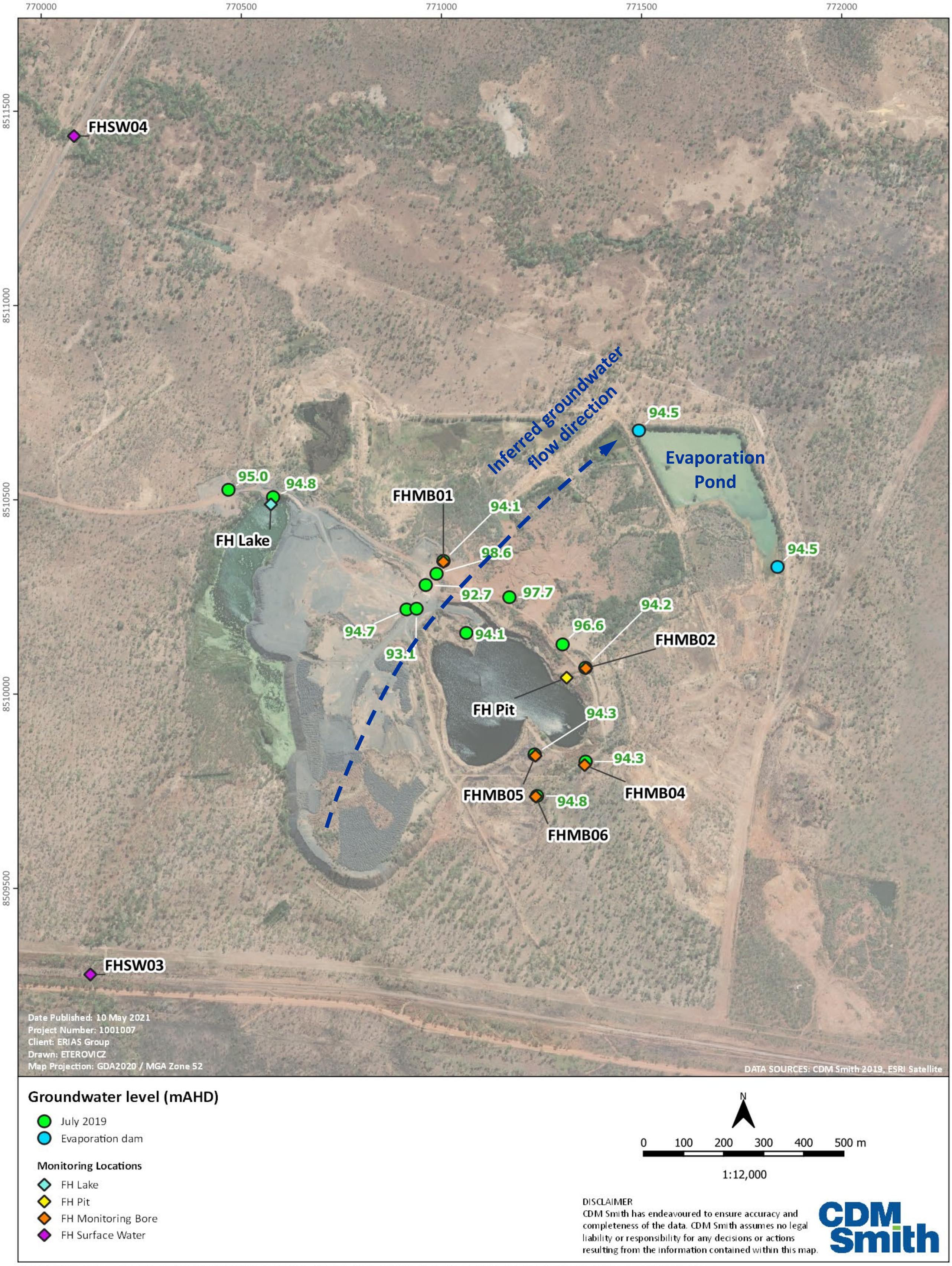

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Figure 2-2 Monitoring sites and groundwater levels

2.1.4 Hydraulic Properties

Hydrogeological investigations by CDM Smith have been undertaken previously at the nearby Mt Bonnie and Iron Blow sites (CDM Smith, 2018), where estimates of hydraulic conductivity derived for the Mt Bonnie Formation range from 0.5 to 33 m/day (geometric mean of around 4 m/day) and estimates derived for storativity of approximately 7×10^{-5}.

CDM Smith in early 2021 completed additional infiltration testing using Talsma Permeameters within the extent of the proposed evaporation pond area. Four tests were completed and intersected variable soils from silty clays with a median vertical hydraulic conductivity of 1.5×10^{-2} m/day, with three tests indicating values less than 1×10^{-3} m/day (CDM Smith, 2021b).

2.1.5 Conceptualisation Model

The water table surface is likely to follow a subdued form of the topography and be structurally controlled due to the nature of the fractured rock aquifer. Groundwater discharge is expected along ephemeral creek lines as direct groundwater discharge when groundwater heads are higher than bed height of the ephemeral creeks. An unnamed ephemeral creek is located approximately one kilometre north of the Fountain Head Pit and flows approximately five kilometres northeast before joining the Margaret River. This is consistent with the inferred groundwater flow direction. A simplified conceptual cross-section is shown in Figure 2-3.

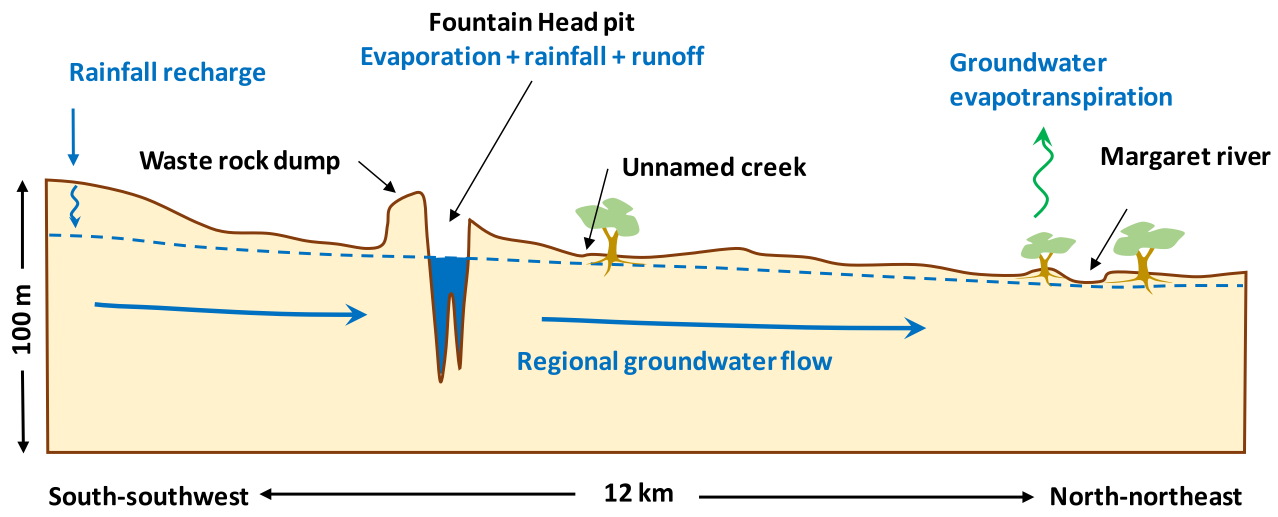

Figure 2-3 Simplified conceptual model

2.2 Environmental Values

2.2.1 Overview

According to the DSD Mineral Regulatory Guidelines (DSD, 2018), an environmental value (EV) is defined as "those qualities of the environment or an environmental element or an environmental receptor that society values to make it suitable to support particular ecosystems and human uses". The below subsections describe the assessed site EVs.

2.2.2 Groundwater Dependant Ecosystems

A search of the Bureau of Meteorology Groundwater Dependent Ecosystems (GDE) Atlas shows two high potential GDE types, a water body to the north and the Margaret River. The GDE Atlas was released in 2012 and was produced by conducting a national-scale assessment using remote sensing and GIS rules-based analysis, which mapped the potential for groundwater/ecosystem interaction. The water body to the north is not a natural feature but remnant infrastructure from past mining activities (ERIAS, 2021b). As detailed in the FHGP EIS, the Margaret River supports a low diversity and richness of aquatic fauna, and the aquatic ecosystem is subject to existing impacts from agricultural activities. No sensitive species, ecosystems or habitat features were recorded in the study area (ERIAS, 2021b). Known GDEs such as monsoon vine forests do not occur near the study area with the closest such ecosystems located approximately 15 km away from the mine lease (ERIAS, 2021b).

2.2.3 Groundwater Use

Groundwater in the area is unsuitable for human consumption due to elevated concentrations of arsenic and iron. The occurrence of these parameters is partly due to naturally high concentrations associated with regional geology (ERIAS, 2021b), although also thought to be the result of contamination from historic events such as mining activities. Groundwater is used locally for livestock drinking water. Stock water is drawn from groundwater near the project and reportedly through one registered bore, RN024290, located adjacent to the mine lease boundary (ERIAS, 2021b).

Groundwater bores not considered relevant to the project include registered bore RN026344, which is located within the mine lease approximately 500 m south of the pit, however, is not currently in use (dry when drilled) and will be covered by the proposed integrated waste landform. The remaining known functional bores within 10 km of Fountain Head are located at Grove Hill, North Point and Princess Louise and are unlikely to be affected by mining activities based on the numerical model results. Figure 2-4 provides a locality plan of the bores described.

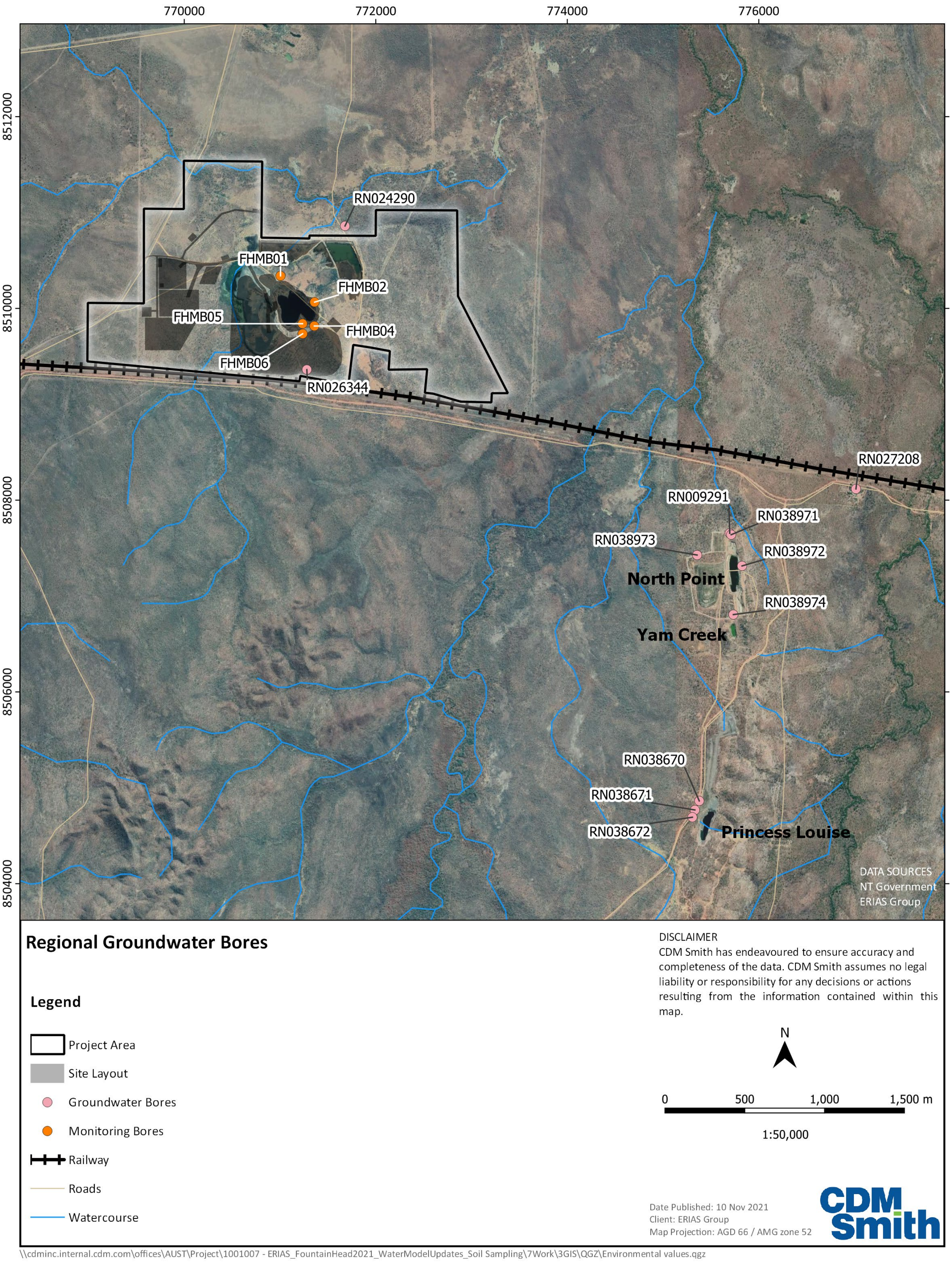

Figure 2-4 **Groundwater bores**

Section 3 Numerical Model

3.1 Drawdown

CDM Smith completed predictive groundwater numerical modelling for the project in May 2021 (CDM Smith, 2021a). Pit water level drawdown is calculated to be rapid, falling from approximately 94 to -28 mAHD and becoming dewatered in September 2022 (Figure 3-1). Drawdown occurs in the immediate vicinity of the pit where the maximum drawdown water level -28 mAHD is maintained until the end of mining occurring in April 2025, followed by recovery. Drawdown contours at the end of mining (maximum dewatering) are shown in Figure 3-2. Drawdown of greater than 100 m is calculated at the end of dewatering but is relatively steep with the cone of depression largely restricted to the near vicinity of the pit. The groundwater drawdown extent of greater than 1 m is calculated to be within approximately 2.5 km from the pit.

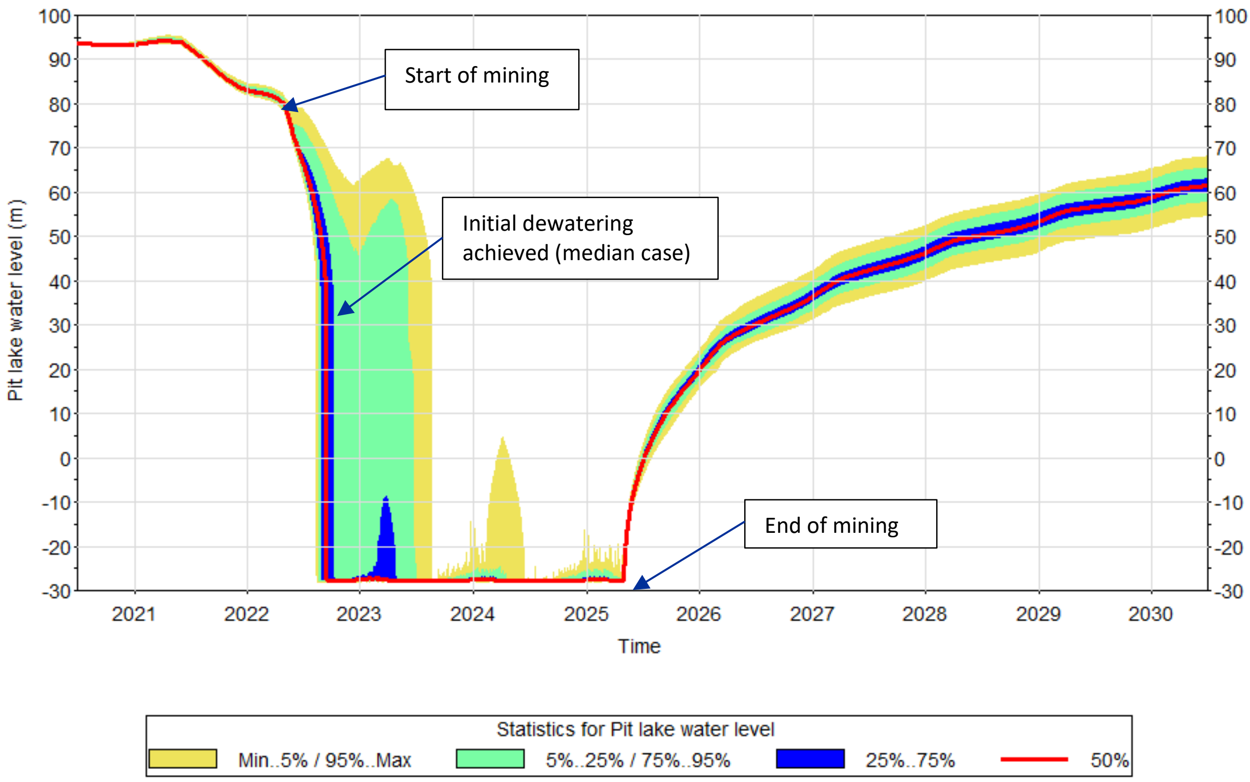

Figure 3-1 Calculated change in level during dewatering and recovery

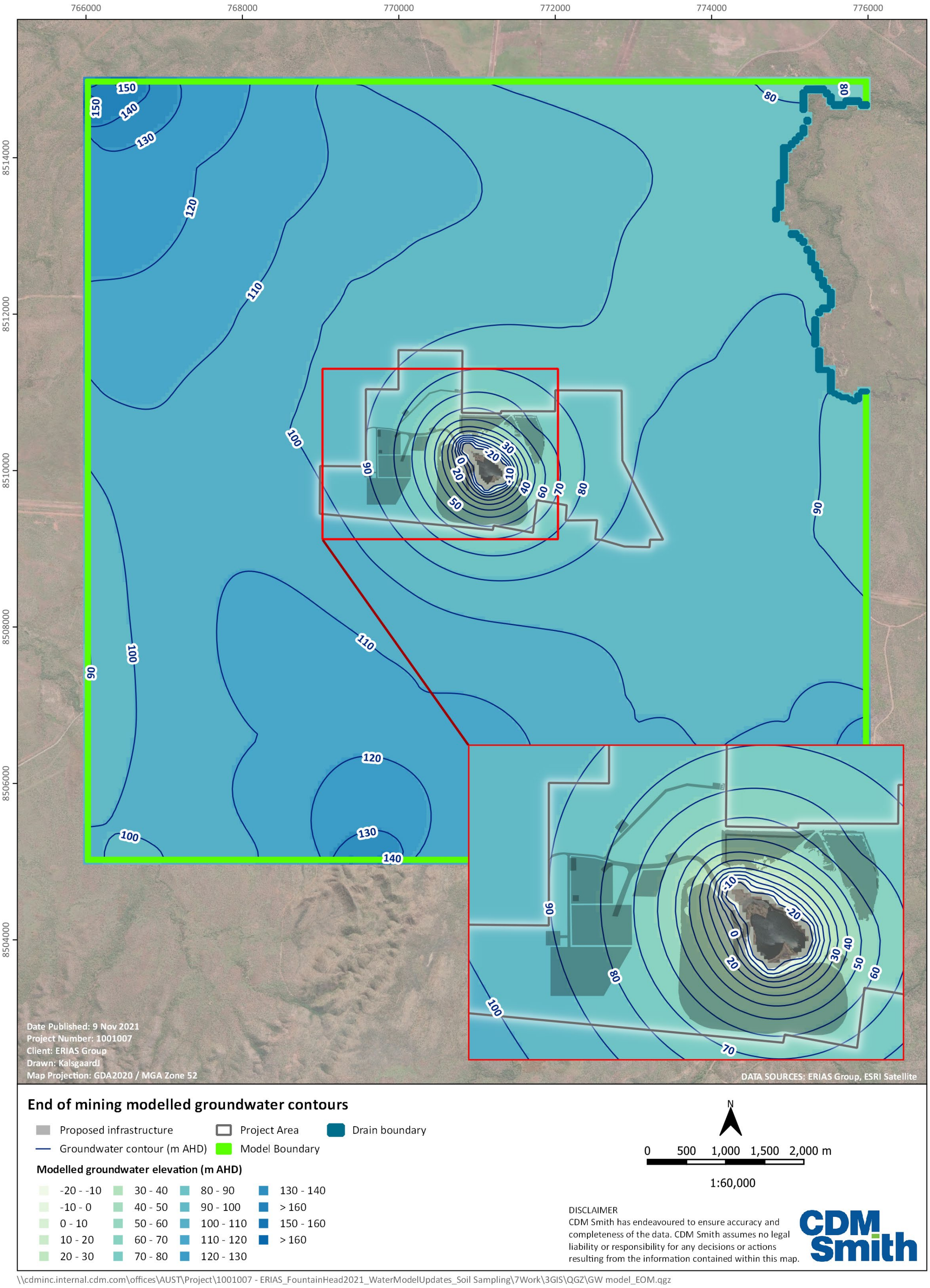

Figure 3-2 Modelled groundwater contours at the end of mining

3.2 Mounding

3.2.1 Approach

A groundwater mounding assessment has been undertaken by CDM Smith to evaluate the mounding related to the evaporation pond. A numerical groundwater model has been constructed to represent the water table aquifer and recharge generated by the evaporation pond. A conservative modelling approach has been adopted and a sensitivity analysis undertaken on the main controlling parameters of the model. A conservative approach does not aim at making exact predictions but aims at overestimating the mounding and related potential impacts. The overestimation of impacts offers a safety buffer that allows a robust and reliable risk assessment, as the response of the real system (mounding of the water table aquifer in this case) to the evaporation pond operations will be contained within the envelope provided by the conservative approach proposed in this study.

The sensitivity analysis aims at adding another layer of risk assessment precaution as the appropriate regionally representative hydraulic parameters are highly uncertain. It evaluates mounding assuming alternative controlling parameters.

3.2.2 Conceptualisation

The evaporation pond is constructed to receive the water produced by the dewatering of the mine pit. Following mining operations, the evaporation pond structure will be maintained, and the retention lake will be used for agriculture (ERIAS, 2021b).

The lowest point of the evaporation pond base is 90 mAHD and the overflow level is 98 mAHD, indicating a maximum depth of the retention lake of 8 m. During operation, the evaporation pond water level varies in accordance with the balance between inflows (transfer from the pit, rainfall, and runoff) and outflows (evaporators, natural surface evaporation and infiltration). The infiltration will generate mounding of the water table aquifer that could potentially impact EVs or evaporation pond structure should it outcrop to the surface, potentially releasing solutes (CoPC) to the water ways.

Post-mining operation, the water level in the evaporation pond will vary seasonally in balance with rainfall, evaporation, infiltration, and water diversion for agriculture need. The water balance modelling conducted in May 2020 by CDM Smith (CDM Smith, 2020b) predicts the evaporation pond retention lake may vary between 93 mAHD and 95.5 mAHD in elevation.

The aquifer is conceptualised as uniform and homogenous with a thickness of 40 m.

3.2.3 Model Plan

Based on the conceptual model, a 3D numerical model was selected to best represent the conceptualisation. The numerical modelling was completed using FEFLOW version 7.2 (FEFLOW, 20). The model domain is 4 km by 4 km with a variable model grid cell size ranging from about 6 m at the mine site and up to 100 m near the edge of the model domain. The model domain is shown in Figure 3-3.

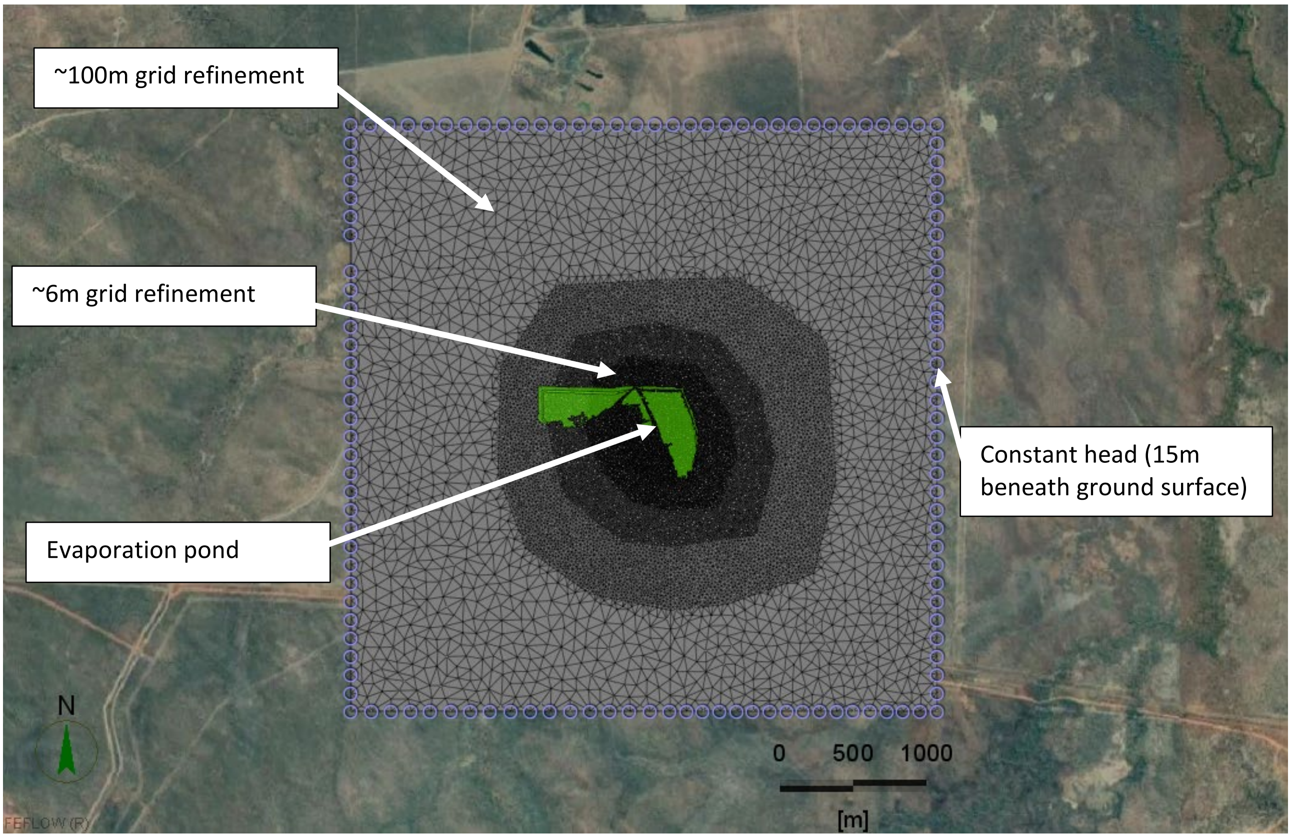

Figure 3-3 Model Grid and external boundary condition.

3.2.4 Boundary conditions and initial conditions

The model domain is bounded on all sides by a constant head boundary condition allowing groundwater to enter and exit the model domain and represents the continuation of the aquifer beyond the limit of the model domain. The constant head boundary is set at 15 m beneath ground surface, this corresponds to the average depth to water level at available observation points.

The initial heads representing the pre-evaporation pond operations was obtained by running the model in steady state and is illustrated in Figure 3-4. The corresponding depth to water table in the vicinity of the evaporation pond is illustrated in Figure 3-5. The model is not calibrated and the initial heads and depth to water table are not assumed to match exactly with observed values.

The evaporation pond is represented by FEFLOW "Fluid-Transfer BC[1]" (or Cauchy BC) illustrated in Figure 3-6. The boundary condition applies a predefined reference head combined with a conductance parameter (transfer rate). The Fluid-Transfer boundary is appropriate for representing a lake with a connection to groundwater limited by the presence of sediment or soil at the base of the lake. The scenario assumes that the evaporation pond is full (at 98.8 mAHD) for three years covering the initial dewatering phase and two years of subsequent mining operations. Post-operations, the residual evaporation pond lake is assumed to decline and stabilise at around 95 mAHD, after which the boundary is then scaled down to the wet surface of the lake at 95 mAHD as illustrated in Figure 3-6.

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[1] Boundary Condition

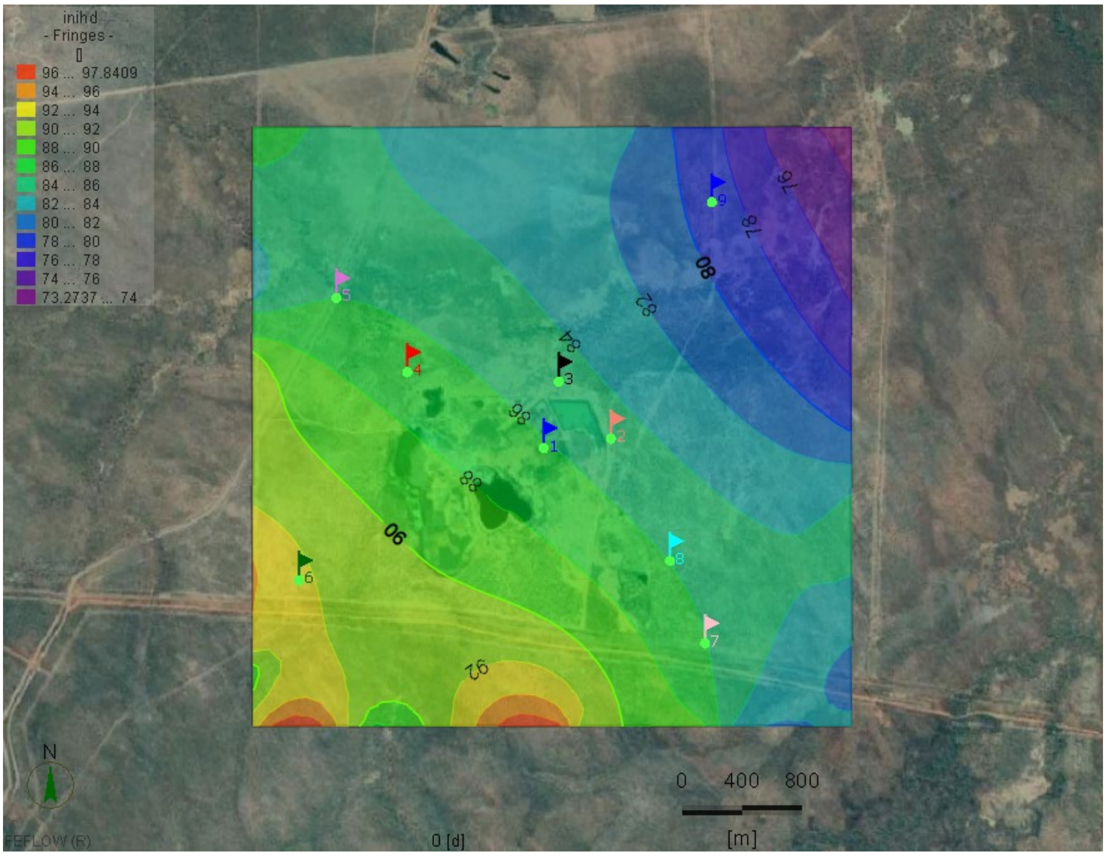

Figure 3-4 Initial head

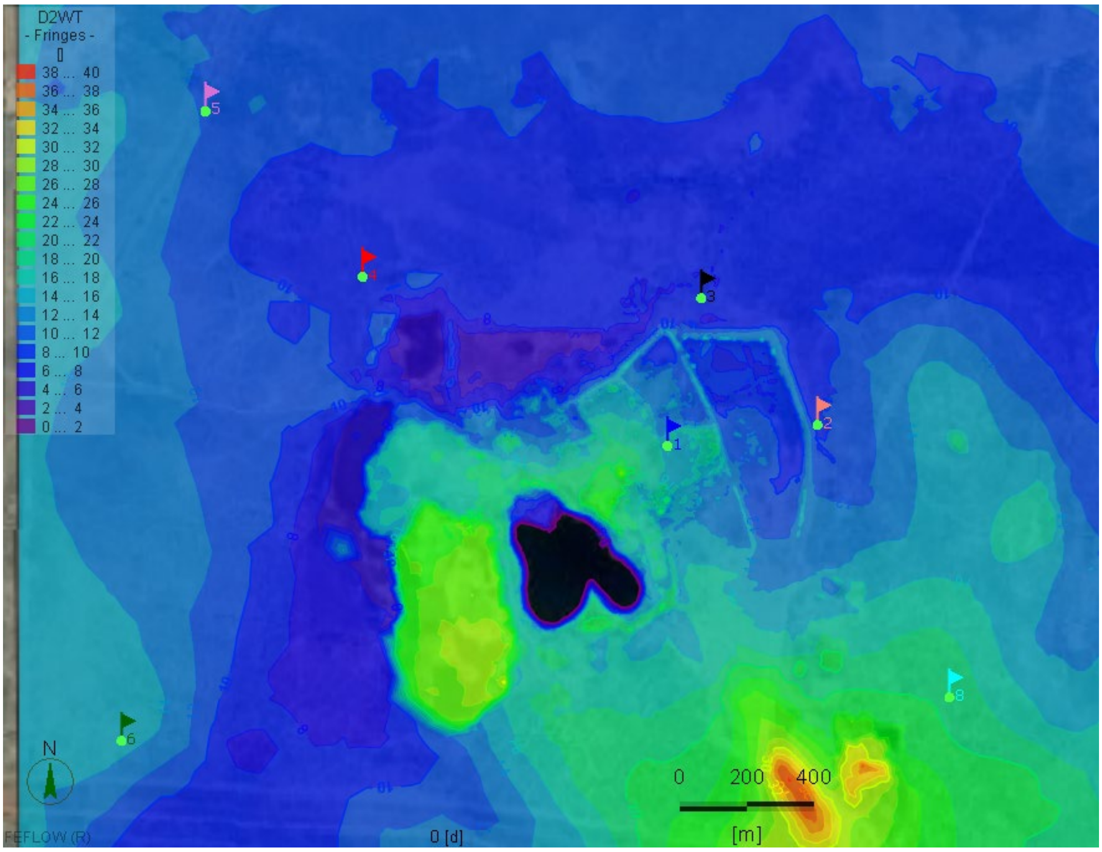

Figure 3-5 Pre-operation depth to water table

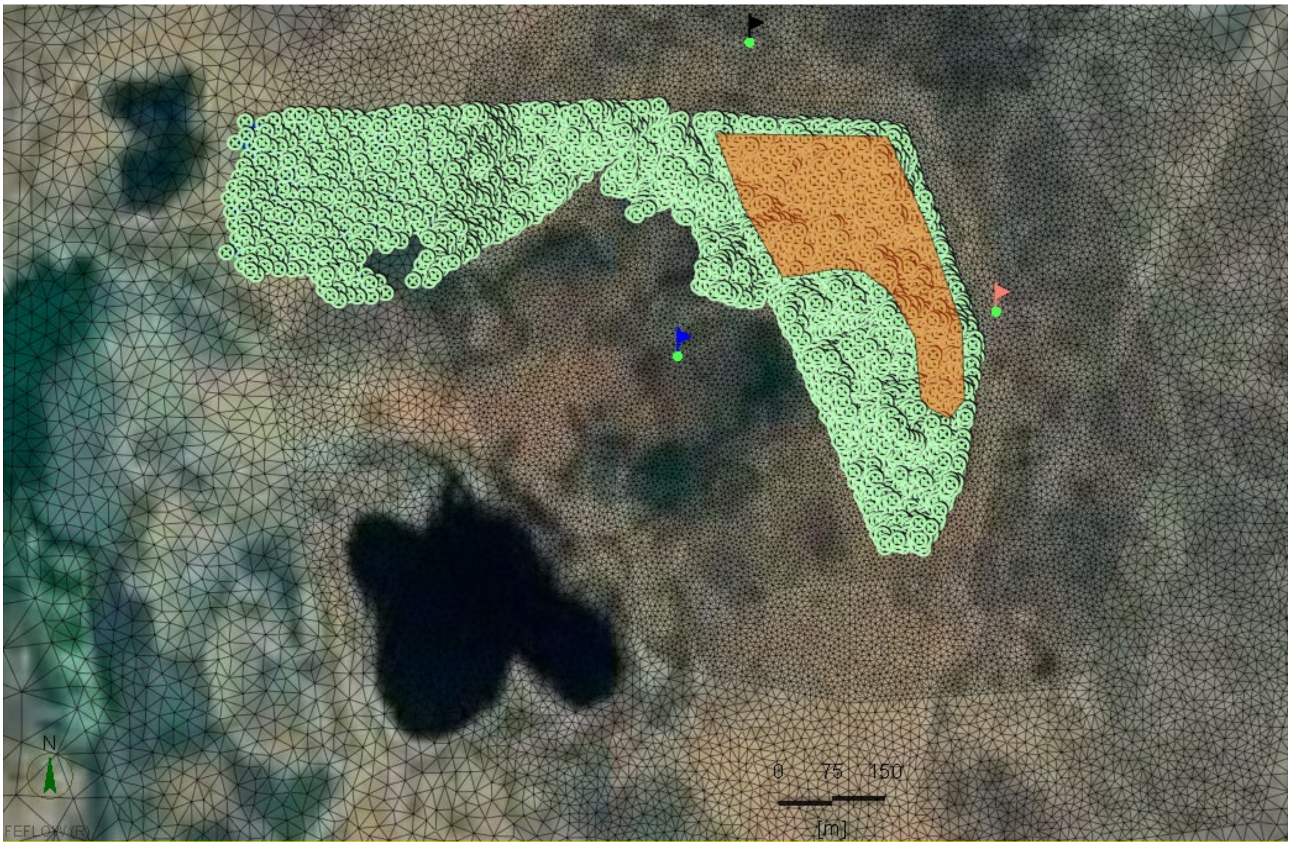

Figure 3-6 Pit Lake representation with a Fluid-transfer BC. The figure shows in purple/green the boundary set for a full pit lake (at 98 mAHD) and in light blue, the extent of the lake at 95 mAHD

3.2.5 Model assumptions

The groundwater flow model simulates a simplified version of the geological and hydrogeological system. This simplification is required to allow the model to be run within a reasonable timeframe. Further, the model assumptions are deemed appropriate and acceptable given the purpose of the model and the conservative approach adopted for this assessment. The conservative assumptions have been made to overestimate the potential water table mounding and related potential impacts and include the following:

- The evaporation pond is considered to operate at a full level of 98 mAHD for three years covering the initial dewatering phase and two years of mining operations. This is conservative as during operations, the evaporation pond will not likely remain at full capacity.
- Post-operation, the residual evaporation pond lake is assumed to stabilise at 95 mAHD. This assumption is conservative as this level is higher than the current observed water level within the evaporation pond and around 20% higher than the level simulated using the Goldsim model (CDM Smith, 2021b).
- Evaporation is not represented in the model. This assumption is also conservative as evaporation would delay an eventual outcropping of the water table.
- The transit through the unsaturated zone is not represented. The evaporation pond seepage reports directly to the water table and flow through delays from unsaturated zone (which should be about 5 m thick at the beginning of operations) are ignored.
- The mounding assessment does not account for the drawdown generated by the Fountain Head pit dewatering. This assumption is also conservative as the actual water table elevation will result from the superposition of mounding generated by the evaporation pond and drawdown generated by the pit dewatering.

3.2.6 Model parameter

The adopted parameters for this assessment are sourced from the groundwater dynamic assessment reported by CDM Smith (2021b) and summarised in Table 3-1.

In FEFLOW, the "in-transfer rate" parameter is a conductance term describing the properties of a clogging layer, which in this case represents the topsoil constituting the base of the evaporation pond overlying the top of the aquifer. Assuming a soil hydraulic conductivity of 0.00034 m/d (CDM Smith, 2021b) and a soil thickness of 3 m, the resulting conductance term is approximately 0.001 d^{-1}.

Table 3-1 Adopted model parameters

Parameter	Unit	Value	Source
Hydraulic conductivity	[m/d]	0.01	Groundwater numerical model reported in CDM Smith (2021b)
Specific Yield	-	0.05	Groundwater numerical model reported in CDM Smith (2021b)
In-transfer rate	[1/m]	0.001	Based on adopted soil conductance values used in the Goldsim water Balance approach reported in CDM Smith (2021b).

3.2.7 Model results

Figure 3-7 shows the mounding at the proposed observation bores for the first 50 years following the beginning of operations at the evaporation pond. Mounding is predicted to be rapid, occurring between around 2.5 and 6.5 m within the first four (4) years of dewatering at the three (3) observation bores (MB-1, MB-2, and MB-3) located in the direct vicinity of the evaporation pond. After 10 years, mounding at MB-2 declines slightly as the evaporation pond lake surface area retracts to its residual level following mining operations. At 500 years post mining (Figure 3-8), provided the evaporation pond remains, the mounding stabilises and increases slightly to around 8 m at MB-2, 6.3m at MB-1 and 6.7 m at MB-3. MB-4 and MB-8 starts experiencing mounding about 5 years and 50 years respectively following the presence of the evaporation pond lake where the mounding of around 2 m is reached at both bores after 500 years. Other observation bores (MB-5, MB-6, MB-7, MB-9) eventually experience mounding but remains less than 1 m.

The extent of mounding at the end of evaporation pond operations in year 3, 10, and 50 years post-operation is illustrated respectively in Figure 3-9 to Figure 3-11[2]. At the end of operations, the 0.2 m mounding contour extends no further than 260 m from the evaporation pond. At 10 years post mining, the 0.2 m contour has migrated to about 500 m from the pond. At 50 years post-mining the 0.2 m mounding contour[3] extends about 1 km from the evaporation pond.

None of the predicted mounding outcrops at the surface at any point within the model domain (except within the evaporation pond where the water table eventually reaches the base of the structure).

[2] Flag colours are arbitrary and denote proposed monitoring bores rather than existing monitoring infrastructure.
[3] 0.2 m of mounding is an arbitrary limit that is close to the smallest meaningful noticeable effect on the water table elevation and is within the numerical accuracy of the model.

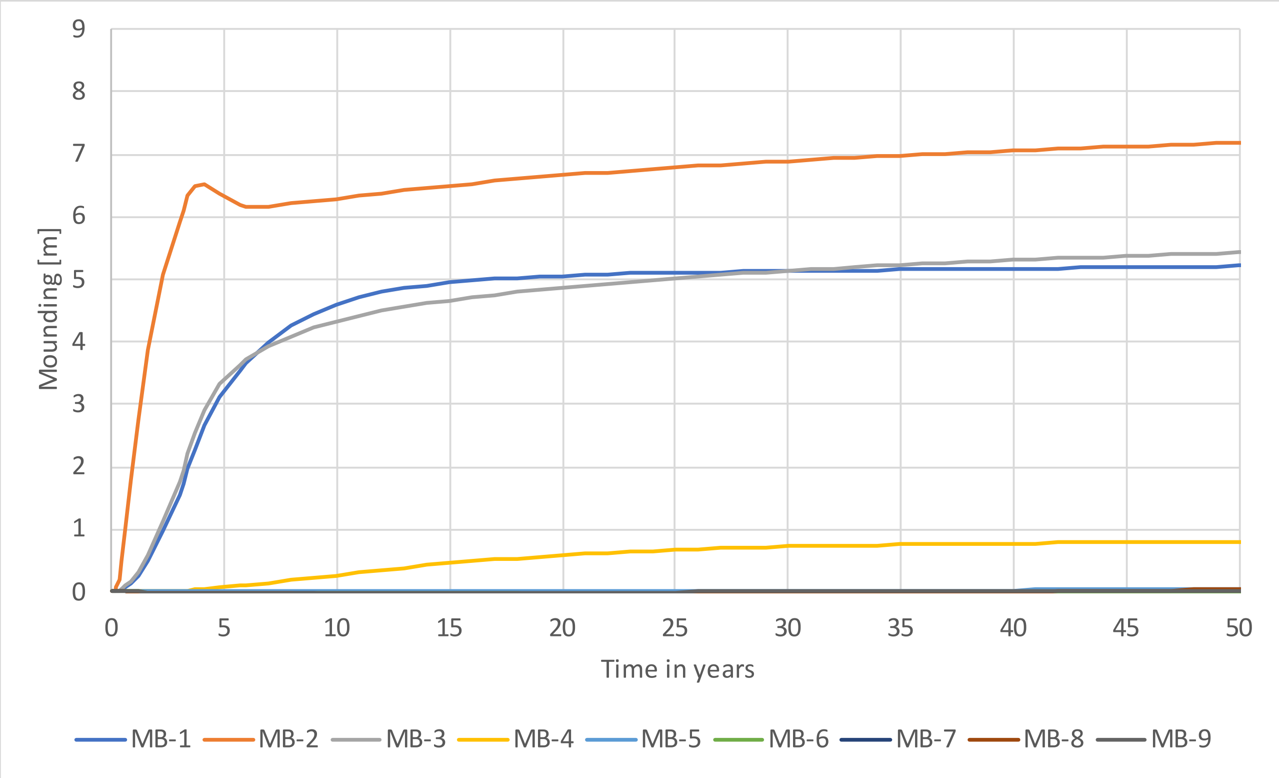

Figure 3-7 Mounding at proposed monitoring bores for the first 50 years following beginning of operations

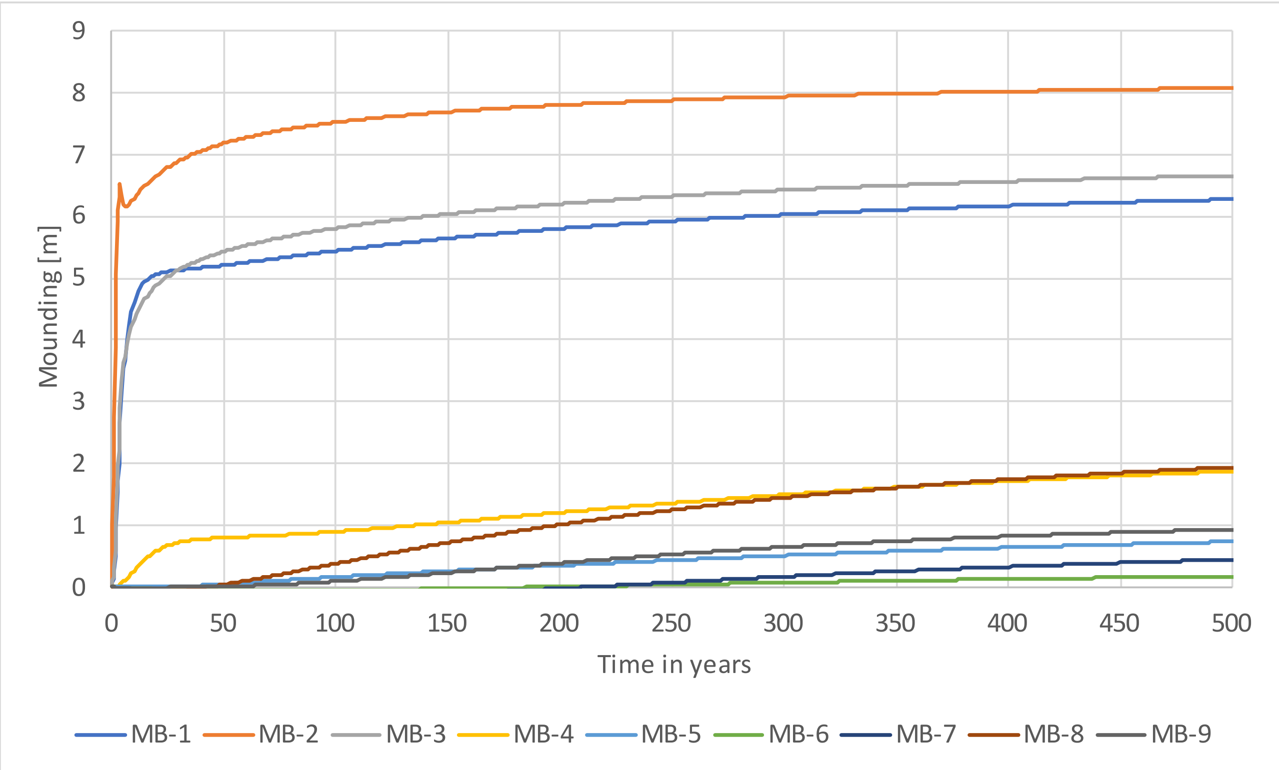

Figure 3-8 Mounding at proposed monitoring bores for 500 years following beginning of operations

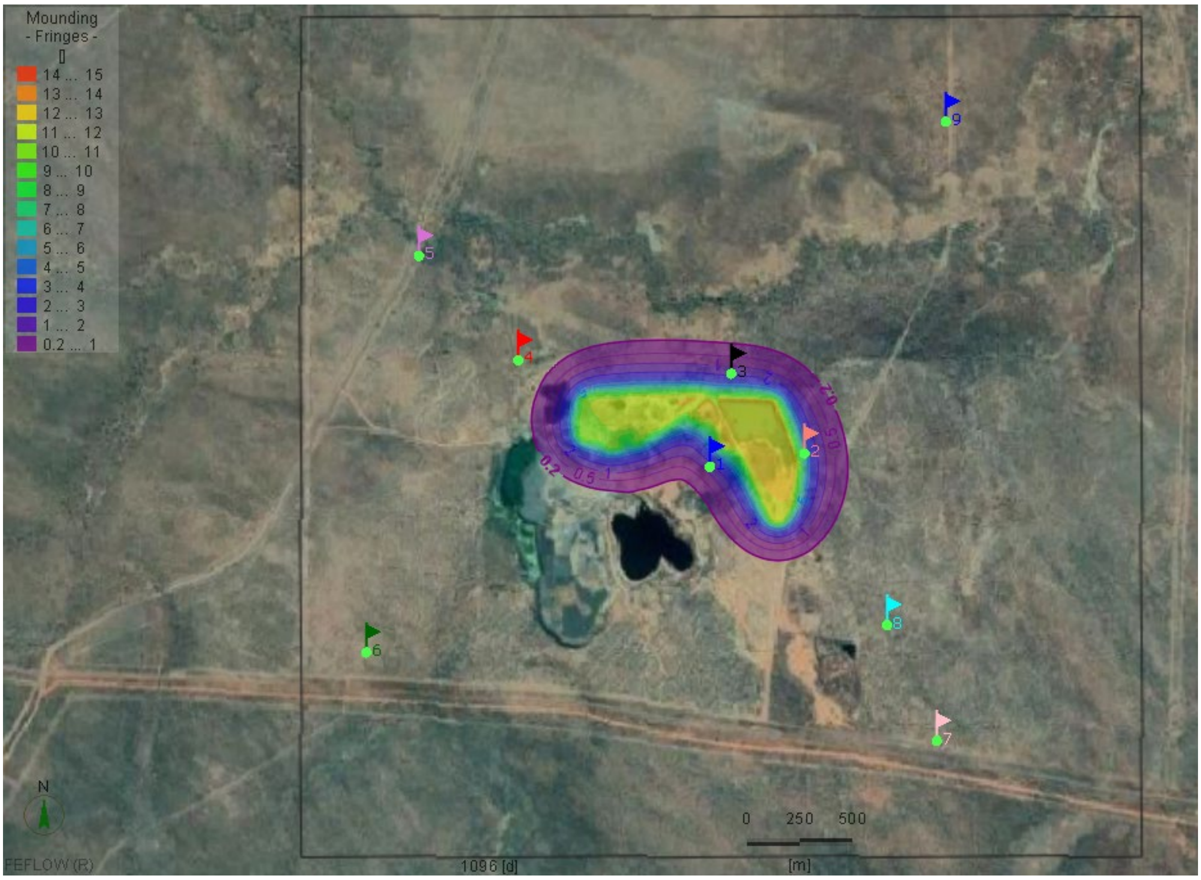

Figure 3-9 Mounding after 3 years of operations (flags indicate the location of proposed monitoring bores)

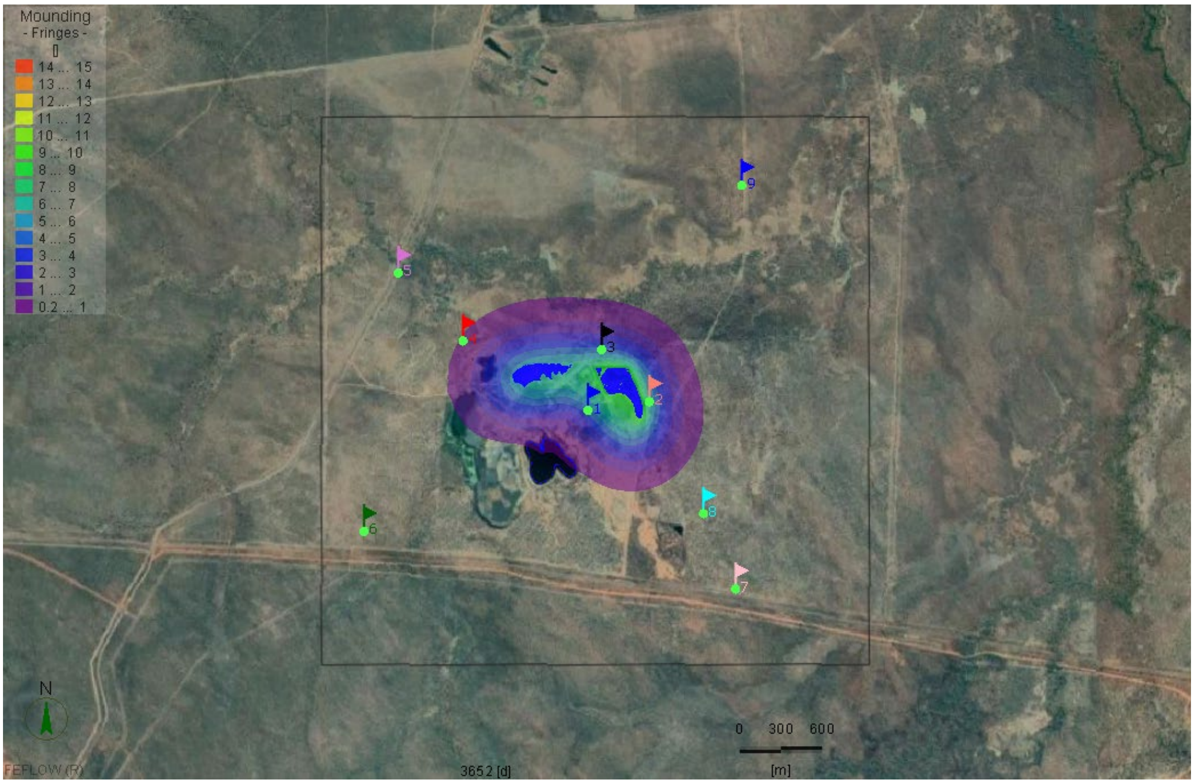

Figure 3-10 Mounding 10 years after the beginning of operation (blue zone indicates the presence of the residual retention lake post-mining)

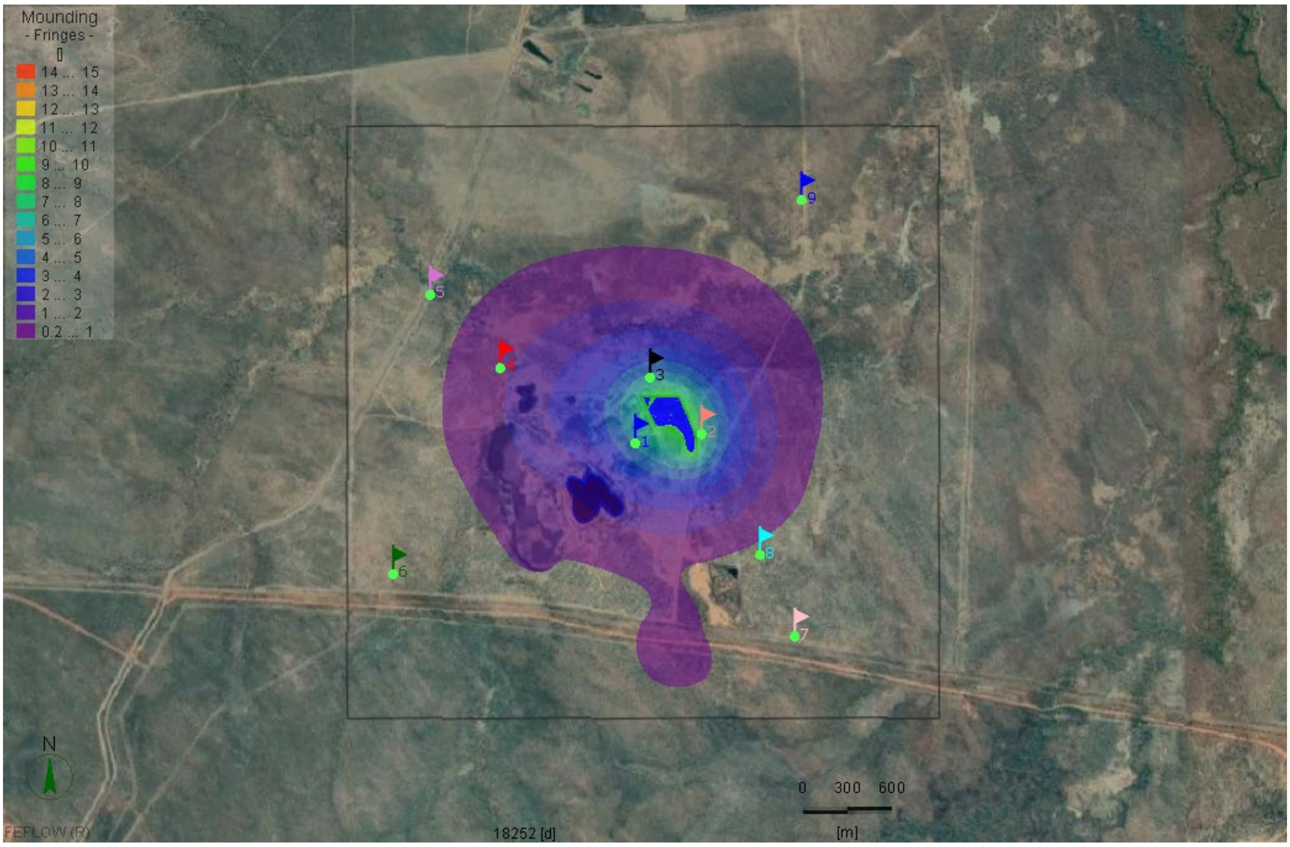

Figure 3-11 Mounding 50 years after the beginning of operation (blue zone indicates the presence of the residual retention lake post-mining)

3.2.8 Sensitivity

The aquifer is heterogeneous, and the appropriate regionally representative hydraulic parameters are uncertain. To evaluate the magnitude of the mounding uncertainty related to the aquifer hydraulic parameters, six (6) sensitivity scenarios were developed. Sensitivity simulations were completed by varying the adopted hydraulic conductivity, specific yield and the conductance (In-transfer rate) term. Table 3-2 shows the adopted parameter values for the sensitivity scenarios.

Table 3-2 Sensitivity scenario

Scenario	Kh [m/d]	Sy	In-transfer rate [1/d]
Sen_Kh1	**0.001**	0.05	0.001
Sen Kh2	**0.1**	0.05	0.001
Sen_Sy1	0.01	**0.005**	0.001
Sen_Sy2	0.01	**0.1**	0.001
Sen_Cond1	0.01	0.005	**0.005**
Sen_Cond2	0.01	0.0005	**0.002**

The mounding at MB-1, MB-3 and MB-4 is illustrated respectively in Figure 3-12 to Figure 3-14. The sensitivity scenarios show that with a higher hydraulic conductivity (scenario Sen_Kh2) or with a lower specific yield (scenario Sen_Sy1), the mounding spikes sooner and a few meters higher, generating a risk of the water table outcropping at the foot of the evaporation pond dam. However, long term mounding is not significantly dissimilar than the reference scenario and shows no risk of water table outcropping within the model domain.

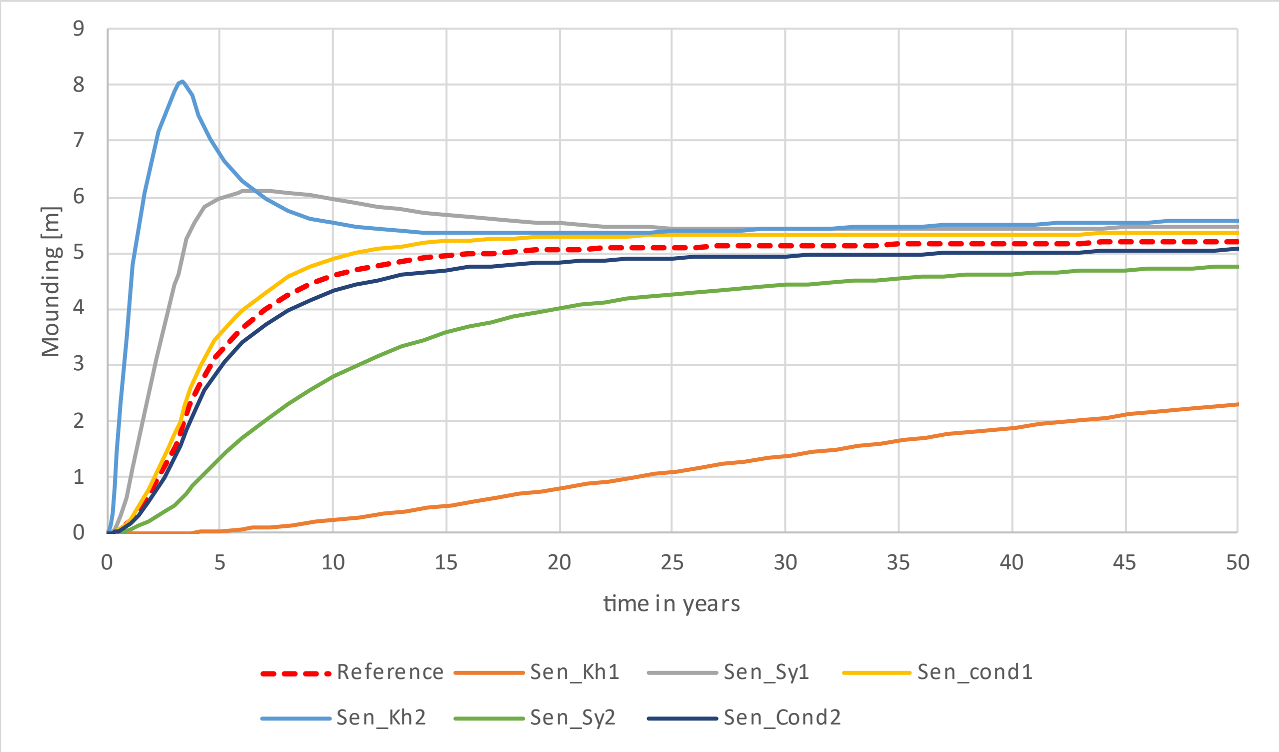

Figure 3-12 Mounding at MB-1 for the sensitivity scenarios for the first 50 years

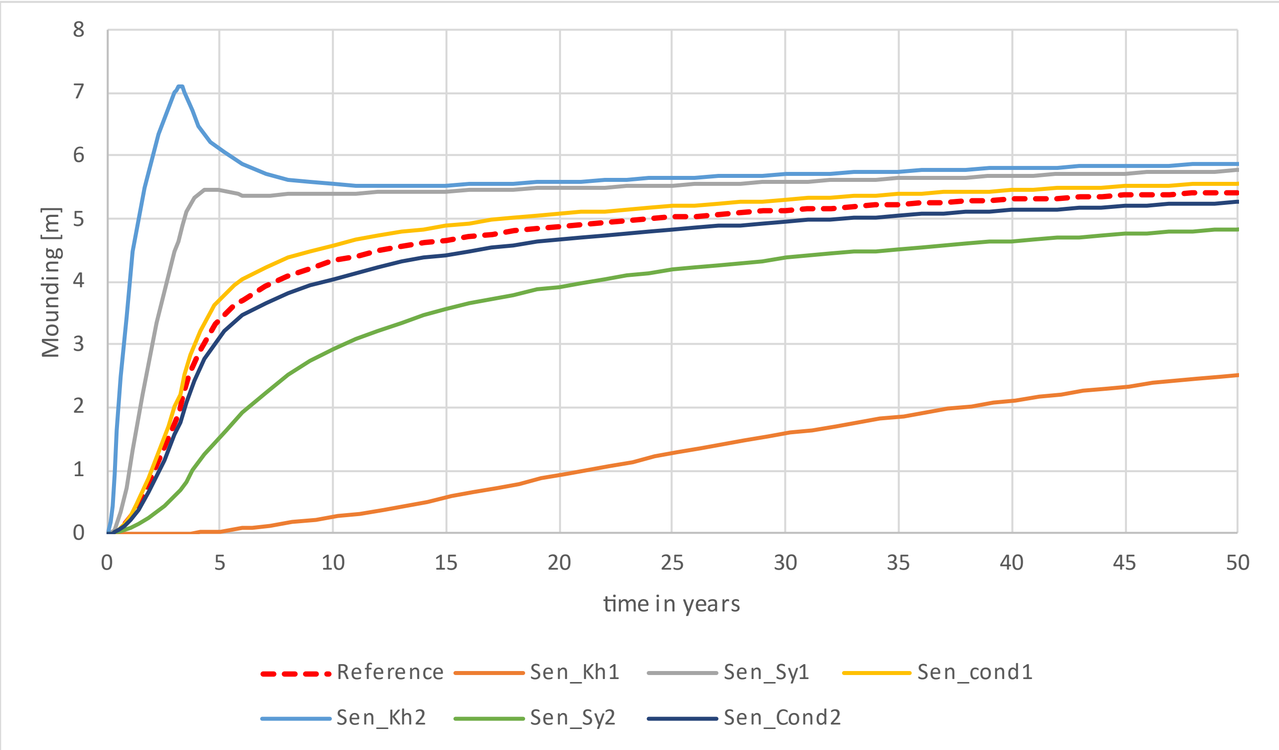

Figure 3-13 Mounding at MB-3 for the sensitivity scenarios for the first 50 years

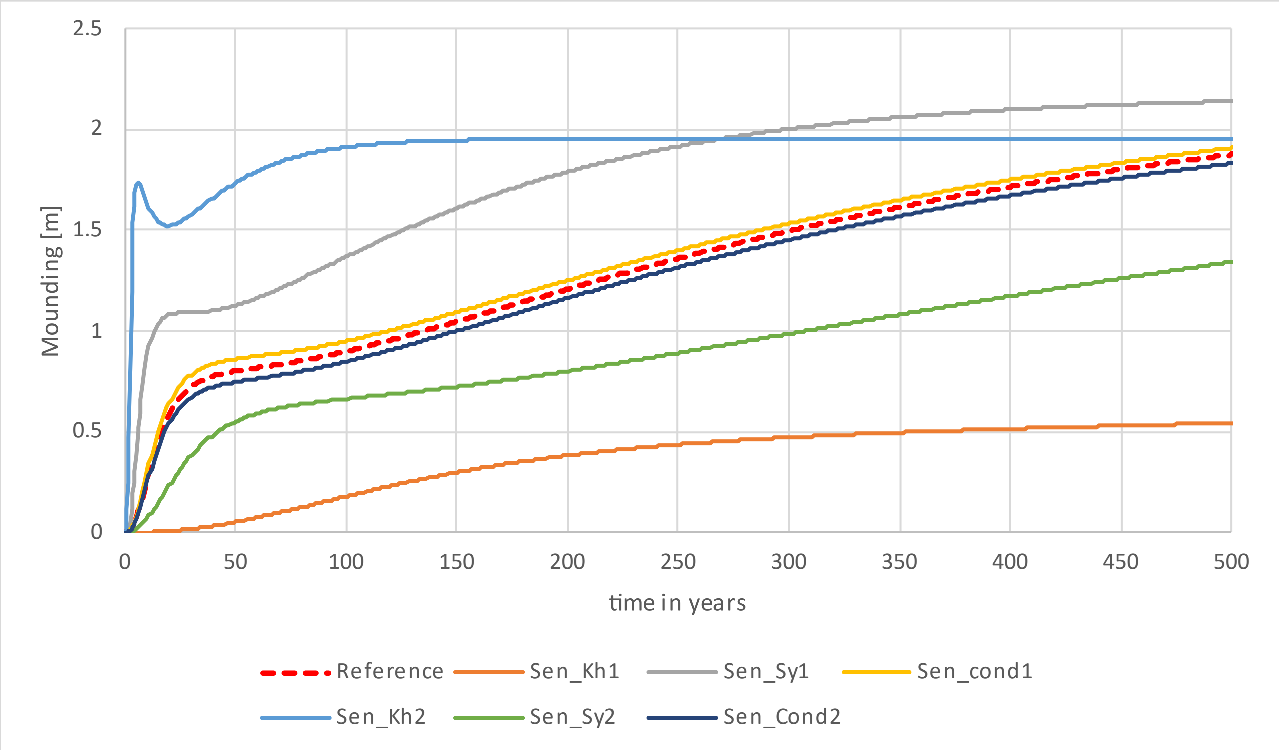

Figure 3-14 Mounding at MB-4 for the sensitivity scenarios for 500 years

Section 4 Monitoring Bore Network Review

4.1 Existing Monitoring Bore Network

A review of the existing monitoring bore network has been completed to determine (i) whether the monitoring bores are constructed deep enough to measure the maximum drawdown or mounding, and (ii) whether the positioning of the monitoring bores is suitable to measure the expected water level change with distance from the Project area. The drawdown at the end of mining for each of the existing monitoring bore locations is listed in Table 4-1 and shown in Figure 4-1.

Table 4-1 Existing groundwater bore details and estimated end of mining water level

Bore	Easting	Northing	Elevation (mTOC) [1]	Bore Depth (mTOC)	Bore Depth (mAHD) [2]	Estimated End of Mining Water Level (mAHD)
FHMB01	771005	8510340	102.1	93	9.1	-5.2
FHMB02	771361	8510066	104.2	102+	2.2	-27.6
FHMB04	771358	8509817	108.0	102+	6.0	-7.7
FHMB05	771235	8509841	108.0	102+	6.0	-27.6
FHMB06	771236	8509736	104.5	23	81.5	-3.4

Notes: 1. Metres top of casing
2. Metres above height datum

Based on the supplied bore details, the existing monitoring bores are too shallow to monitor the maximum calculated drawdowns. Additionally, the bores are positioned within the immediate surrounds of the Fountain Head pit which do not allow for measurement of drawdown or mounding propagating outwards (at distance) from the pit and evaporation pond. Furthermore, the existing monitoring bores are located within the proposed expanded Fountain Head pit footprint (Figure 4-1). The FHGP WMP recognises the loss of some bores will occur during operation and proposes to utilise the bores where available, or until a new network of monitoring bores are constructed (ERIAS, 2021a).

4.2 Proposed Monitoring Bore Network

In May 2020, CDM Smith provided ERIAS with a preliminary design and cost estimate for installation of a monitoring bore network for the FHGP (CDM Smith, 2020b). The monitoring network was designed to assist in assessing baseline groundwater flow direction and water quality prior to mining and processing operations. A total of 12 sites were selected and ranked in order of priority for installation. The proposed design of the monitoring bores at approximately 20 m deep does not allow sufficient depth for monitoring of the maximum predicted drawdowns.

A revision of the monitoring bore network has been conducted and the proposed new monitoring bores have been located to measure the calculated impacts of mining on the groundwater. The proposed position of the bores will allow measurement of the drawdown propagation from the pit and assessment of groundwater triggers. The calculated groundwater levels at the end of mining at the individual bore locations are shown in Table 4-2, while Figure 4-1 provides a locality plan of the bores alongside the existing monitoring network.

Table 4-2 Proposed groundwater bore depths and estimated end of mining water level

Bore	Easting	Northing	Elevation (mAHD)	Monitoring Purpose	Nominal Bore Depth (m)	Estimated Bore Depth (mAHD)	Estimated End of Mining Water Level (mAHD) [1]
MB-1	772521	8509054	102.0	Mounding	70	32	40.1
MB-2	771443	8510358	95.0	Mounding	40	55	69.7
MB-3	771892	8510421	93.5	Mounding	30	63.5	70.1
MB-4	771544	8510801	96.0	Drawdown	40	56	69.7
MB-5	772565	8512000	97.4	Drawdown	20	77.4	89.8
MB-6	770529	8510864	107.0	Drawdown	25	82	90.0
MB-7	770058	8511361	105.6	Drawdown	25	80.6	89.8
MB-8	772286	8509604	105.5	Drawdown	35	70.5	79.9
MB-9	769807	8509474	95.0	Drawdown	20	75	90.0

Notes: 1. Assuming no mounding

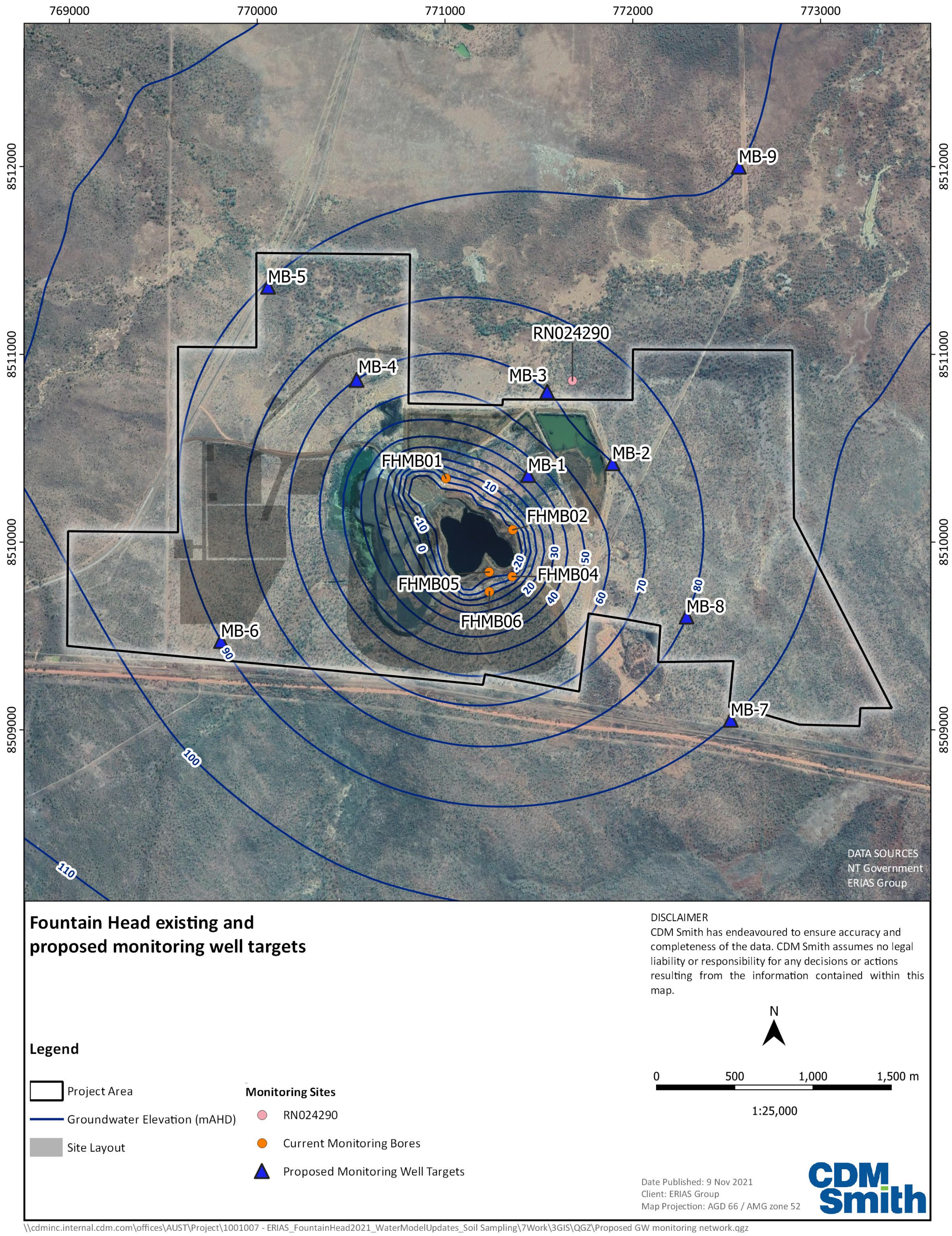

Figure 4-1 Existing and proposed groundwater monitoring bore locality plan

Section 5 Review of Current Targets and Monitoring

5.1 Groundwater Level Targets

Table 5-1 lists the groundwater level targets according to the FHGP WMP. In response to the qualitative metrics, DEPWS have commented that the WMP should incorporate drawdown and mounding triggers instead of relying on impacts being reported or observed, set drawdown and mounding triggers based on the groundwater modelling results for monitoring bores located at varying distance and propose a plan if those triggers are breached. The use of monitoring bores allows for level triggers to be set in addition to the targets currently proposed in the WMP.

Table 5-1 Groundwater level targets (ERIAS, 2021a)

Environmental Impact	Environmental Performance Objective	Environmental Performance Target	Monitoring	Contingency	Reporting and Record Keeping
Groundwater drawdown	Minimise impacts on other groundwater users.	No complaints from groundwater users.	Complaints received.	Investigate cause of reduced groundwater availability and provide alternative water source if mine-related.	Complaints register.
Groundwater mounding	Avoid waterlogging of soil and surface expression of evaporation pond seepage.	No surface expression of groundwater or waterlogging of soils.	Regular groundwater level monitoring and visual inspections of seepage from evaporation pond.	Action measures to prevent seepage to the downstream catchment (e.g., interception trenches/ bores).	Maintain records of visual inspections.

5.2 Groundwater Quality Targets

Table 5-2 lists the groundwater quality targets listed in the FHGP WMP (ERIAS, 2021a). There was no comment made by DEPWS regarding the targets listed and there are no proposed changes. The FHGP WMP considers a number of environmental impacts relating to potential changes in groundwater quality from the planned activities. Except for groundwater contamination from septic and hydrocarbon sources, the environmental performance targets for each of the environmental impacts refer to the Australian water quality guideline trigger values in groundwater monitoring bores (ANZG, 2018) or the detectable change from background concentrations. The WMP does clarify that while these guideline values provide a reference point for comparison of the data, as described in the ANZG (2018), exceedance of the guideline values is intended as an 'early warning' mechanism rather than an instrument for assessing compliance.

Table 5-2 Groundwater quality targets (ERIAS, 2021a)

Environmental Impact	Environmental Performance Objective	Environmental Performance Target	Monitoring	Contingency	Reporting and Record Keeping
Groundwater contamination from seepage from the evaporation pond.	Minimise impacts to groundwater quality from evaporation pond seepage.	No exceedances of the applicable ANZG (2018) Australian Water Quality Guideline Trigger Values in groundwater monitoring bores, or detectable change of significance from background concentrations (e.g., for arsenic, aluminium and other already elevated metals and metalloids).	Groundwater monitoring.	Investigate extent of potential contamination.	Annual reporting as required by the mine management plan.
Groundwater contamination from waste rock, ore and tailings.	Prevent impacts to groundwater quality from NAF waste rock and ore at the ROM pad.		Groundwater monitoring.	Where testing shows operational blending is unable to buffer the acid forming potential of PAFLC, implement appropriate management measures to reduce potential acidic drainage from PAF-LC (e.g., temporary segregation and subsequent submersion).	
	Minimise impacts to groundwater quality from PAF waste rock.		Groundwater monitoring. Verify further testing conducted to quantify PAF material. Visual inspection of segregated material and verify that runoff is contained in ponds.	If testing estimates larger quantity of PAF material than expected (i.e., >5%), review PAF material management strategy to ensure adequacy. Investigate sources of contamination and implement remedial action.	
	Minimise impacts to groundwater quality from spent ore.		Groundwater monitoring.	Investigate sources of contamination and implement remedial action. Develop appropriate long-term management strategy (if required).	
Groundwater contamination from septic system.	Prevent contamination of groundwater from septic system.	No exceedances of the applicable ANZG (2018) Trigger Values for nutrients and dissolved oxygen.	Groundwater monitoring. Visual/odour monitoring for signs of septic leaks.	Investigate potential source of septic leak.	Annual reporting as required by the mine management plan. Maintain records of septic pumping and repairs (if required).
Groundwater contamination from final pit water quality.	Minimise impacts to groundwater quality from final pit water.	No exceedances of the applicable ANZG (2018) Australian Water Quality Guideline Trigger Values in groundwater monitoring bores, or detectable change of significance from background concentrations (e.g., for arsenic, aluminium and other already elevated metals and metalloids).	Groundwater monitoring.	Investigate extent of potential contamination.	Annual reporting as required by the mine management plan.
Groundwater contamination from accidental release of hydrocarbons and chemicals.	Prevent or minimise contamination of groundwater from the accidental release of hydrocarbons and chemicals.	As above No undetected or uncontained release of hydrocarbons or chemicals.	Groundwater monitoring. Visual monitoring for signs of leaks or spills from vehicles, plant and machinery. Inspect bunds, sumps and storage pits designed to contain hydrocarbons or chemicals and remove water and dispose offsite using a licensed contractor where operational limits are reached. Verify spill containment kits are located on site at required locations (e.g., at refuelling areas) within vehicles (as necessary) and within tankers transporting fuel or hazardous materials. Inspect vessels, tanks and secondary containment for leaks and activate appropriate actions as per the Spill Response Plan (or similar). Verify service and maintenance schedule developed and adhered to.	Investigate potential source of hydrocarbon or chemical releases (if unknown). Investigate potential environmental impacts of a known release (if considered a reportable incident). Review management measures and procedures and implement corrective actions to reduce likelihood of incident recurrence. Remove from use vehicles, plant or machinery which have not been serviced in accordance with the service and maintenance schedule and only return to service once servicing has been completed. Provide training to untrained personnel in handling, storage and transport of hydrocarbons and chemicals and spill response and containment measures.	Incident reporting and investigation of release of hydrocarbons or chemicals as required by the NT EPA and PNX procedures. Maintain service and repair records of vehicles, plant and machinery. Maintain personnel training records. Annual reporting as required by the mine management plan.

5.3 Groundwater Monitoring Parameters and Frequency

The FHGP WMP (ERIAS, 2021a) details the monitoring to be undertaken biannually, during the early and late wet season for the following parameters:

- Standing water level measurement.
- pH and electrical conductivity, water hardness and alkalinity.
- Major cations (Ca, K, Na, Mg) and anions (Cl, SO_4), filtered metals (Al, As, Cd, Cr, Co, Cu, Hg, Pb, Mn, Ni, Zn).
- Cyanide, TRH and BTEXN.

The FHGP WMP uses stock drinking water guidelines (ANZECC/ARMCANZ,2000) as a trigger for groundwater protection. As stock watering has been identified as a potential beneficial use of groundwater, this is considered an appropriate approach. The table shown in the FHGP WMP, however, does not correctly list the ANZECC stock drinking water guidelines. Table 5-3 lists the amended livestock water guidelines for implementation as trigger values for the FHGP WMP.

Table 5-3 Livestock drinking water guideline values

Parameter	ANZECC, 2000 Guideline – Stock Drinking Water
TDS (mg/L)	4,000 – 5,000 (Beef Cattle)
Calcium (mg/L)	1,000
Fluoride (mg/L)	2
Sulfate (mg/L)	1,000
Nitrate (mg/L)	1,500
Nitrite (mg/L)	30
Aluminium (mg/L)	5
Arsenic (mg/L)	0.5
Boron (mg/L)	5
Cadmium (mg/L)	0.01
Chromium (mg/L)	1
Cobalt (mg/L)	1
Copper (mg/L)	1 (Beef Cattle)
Lead (mg/L)	0.1
Mercury (mg/L)	0.002
Molybdenum (mg/L)	0.15
Nickel (mg/L)	1
Selenium (mg/L)	0.02
Uranium (mg/L)	0.2
Zinc (mg/L)	20

Notes: - Where guidelines stipulate, the value for beef cattle has been adopted.
- The stock water guidelines (ANZECC, 2000) stipulate for metals and metalloids that trigger values relate to total or unfiltered concentrations of the constituent.

Section 6 Proposed Triggers and Monitoring

6.1 Groundwater Levels

Table 6-1 lists the nominated level trigger value for each monitoring location and monitoring frequency based on the numerical modelling drawdown and mounding results. As per the FHGP WMP monitoring approach, the existing monitoring bores will continue to be utilised where available or until removed and a new network of monitoring bores installed.

The groundwater level triggers have been established to be equal to the predicted end of mine groundwater elevation (mAHD), a function of drawdown and mounding effects. Given the conservative modelling approach[4] for both the drawdown and mounding numerical models, the triggers are also considered conservative in that exceedance of these levels is considered unlikely. The triggers have been developed to measure exceedances from two (2) types of monitoring bores: (i) drawdown monitoring bores, and (ii) mounding monitoring bores. For each of these bores, a trigger exceedance is determined by:

- Water levels lower than the trigger listed for 'drawdown' type monitoring bores.
- Water levels higher than the trigger listed for 'mounding' type monitoring bores.

Section 7.1 provides a framework for managing exceedance events of the proposed groundwater level trigger values.

Table 6-1 Proposed groundwater level triggers

Monitoring Location	Easting	Northing	Type	Environmental Performance Target	Proposed Environmental Performance Target (trigger value) (mAHD)	Monitoring Frequency
FHMB01	771005	8510340	Drawdown	Minimise impacts on other groundwater users.	< -5.2	Biannual (early and late dry season)
FHMB02	771361	8510066	Drawdown		< -27.6	
FHMB04	771358	8509817	Drawdown		< -7.7	
FHMB05	771235	8509841	Drawdown		< -27.6	
FHMB06	771236	8509736	Drawdown		< -3.4	
MB-1	772521	8509054	Mounding	Avoid waterlogging of soil and surface expression of evaporation pond seepage.	> 87.5	
MB-2	771443	8510358	Mounding		> 90.9	
MB-3	771892	8510421	Mounding		> 86.8	
MB-4	771544	8510801	Drawdown	Minimise impacts on other groundwater users.	< 69.7	
MB-5	772565	8512000	Drawdown		< 89.8	
MB-6	770529	8510864	Drawdown		< 90.0	
MB-7	770058	8511361	Drawdown		< 89.8	
MB-8	772286	8509604	Drawdown		< 79.9	
MB-9	769807	8509474	Drawdown		< 90.0	

[4] An approach which does not aim at making exact and reliable predictions but aims at overestimating the related and potential impacts

6.2 Groundwater Quality

Table 6-2 lists the nominated trigger values and monitoring frequency for each monitoring bore. The existing monitoring bores will continue to be utilised where available or until removed and a new network of monitoring bores installed.

By having protection of baseline groundwater conditions as our primary approach we are mitigating any potential project impacts to aquatic environments. As mounding is not expected to outcrop within the Project area, surface water criteria have not been considered as triggers. The only known beneficial use of groundwater is as stock water (ERIAS, 2021a; ERIAS, 2021b), and therefore, maintaining the livestock water guidelines as trigger values is deemed appropriate.

Section 7.2 provides a framework for managing exceedance events of the proposed groundwater quality trigger values as well as further advice for determining 'detectible' change in groundwater parameter concentrations.

Table 6-2 Proposed groundwater quality triggers

Monitoring Location	Environmental Impact	Environmental Performance Objective	Proposed Environmental Performance Target (trigger value)	Monitoring Frequency
MB-1, MB-2, MB-3	Groundwater contamination from seepage from the evaporation pond.	Minimise impacts to groundwater quality from evaporation pond seepage.	No change, ensure update of full suite of livestock water guideline values as shown in Table 5-3.	Biannual (early and late dry season)
FHMB1, FHMB2, FHMB4, FHMB5, FHMB6, MB-1 to MB-9	Groundwater contamination from waste rock, ore and tailings.	Prevent impacts to groundwater quality from NAF waste rock and ore at the ROM pad.		
		Minimise impacts to groundwater quality from PAF waste rock.		
FHMB1, FHMB2, FHMB4, FHMB5, FHMB6, MB-1 to MB-9	Groundwater contamination from septic system.	Prevent contamination of groundwater from septic system.	Ensure update of full suite of livestock water guideline values as shown in Table 5-3. Remove dissolved oxygen as an environmental performance target.	
FHMB1, FHMB2, FHMB4, FHMB5, FHMB6, MB-1 to MB-9	Groundwater contamination from final pit water quality.	Minimise impacts to groundwater quality from final pit water.	No change, ensure update of full suite of livestock water guideline values as shown in Table 5-3.	
FHMB1, FHMB2, FHMB4, FHMB5, FHMB6, MB-1 to MB-9	Groundwater contamination from accidental release of hydrocarbons and chemicals.	Prevent or minimise contamination of groundwater from the accidental release of hydrocarbons and chemicals.		

No changes to the current trigger values or frequency have been made regarding groundwater quality. The monitoring for stock drinking water should be updated to include parameters shown in Table 5-3 and the parameters listed below to assess the broader water quality characteristics and impacts to groundwater:

- pH, electrical conductivity, total dissolved solids, hardness and alkalinity.
- Major cations (Ca, K, Na, Mg) and anions (Cl, SO_4).
- Fluoride, nitrate and nitrite.
- Filtered and unfiltered metals (Al, As, Bo, Be, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, U, Zn).
- Cyanide.

- TRH and BTEXN.

6.3 Post Closure Groundwater Monitoring

Section 9 of the FHGP mine closure plan (ERIAS, 2021c) describes the monitoring that will be undertaken to assess progress towards meeting the closure objectives and completion criteria. Table 6-3 shows the proposed locations, description and duration of the post closure groundwater monitoring program.

Table 6-3 Post closure groundwater monitoring program

Aspect	Location	Description	Frequency	Duration	Responsibility
Groundwater	• Bores north and northwest of pit • Bores on southern edge of pit	• Standing water level • Field parameters • TSS • Metals • Major cations	Biannual (early and late dry season)	Until completion criteria met, and site relinquished by DITT	Environmental Manager

The description of the parameters to be monitored should be expanded and maintained as per below:

- Standing water levels.
- pH, electrical conductivity, total dissolved solids, hardness and alkalinity.
- Major cations (Ca, K, Na, Mg) and anions (Cl, SO_4).
- Fluoride, nitrate and nitrite.
- Filtered and unfiltered metals (Al, As, Bo, Be, Cd, Cr, Co, Cu, Fe, Hg, Pb, Mn, Mo, Ni, Se, U, Zn).
- Cyanide.
- TRH and BTEXN.

Furthermore, the proposed groundwater monitoring locations are recommended to be expanded and include the proposed monitoring network, as shown in Table 6-4.

Table 6-4 Recommended post mining groundwater monitoring locations

Monitoring Location	Easting	Northing	Frequency	Duration
FHMB01	771005	8510340	Biannual (early and late dry season)	Until completion criteria are met, and site relinquished by DITT
FHMB04	771358	8509817		
FHMB06	771236	8509736		
MB-1	772521	8509054		
MB-2	771443	8510358		
MB-3	771892	8510421		
MB-4	771544	8510801		
MB-5	772565	8512000		
MB-6	770529	8510864		
MB-7	770058	8511361		
MB-8	772286	8509604		
MB-9	769807	8509474		

Notes: As FHMB02 and FHMB05 will be removed during pit expansion, monitoring from these bores post mining will not be possible.

Section 7 Trigger Action Plan

7.1 Groundwater Levels

The Trigger Action Plan for groundwater levels is shown in Figure 7-1. The groundwater level triggers are intended to initiate an appropriate response, based on observed variances to the predicted outcomes. The TAP identifies proposed actions and responses if the calculated groundwater trigger levels are exceeded.

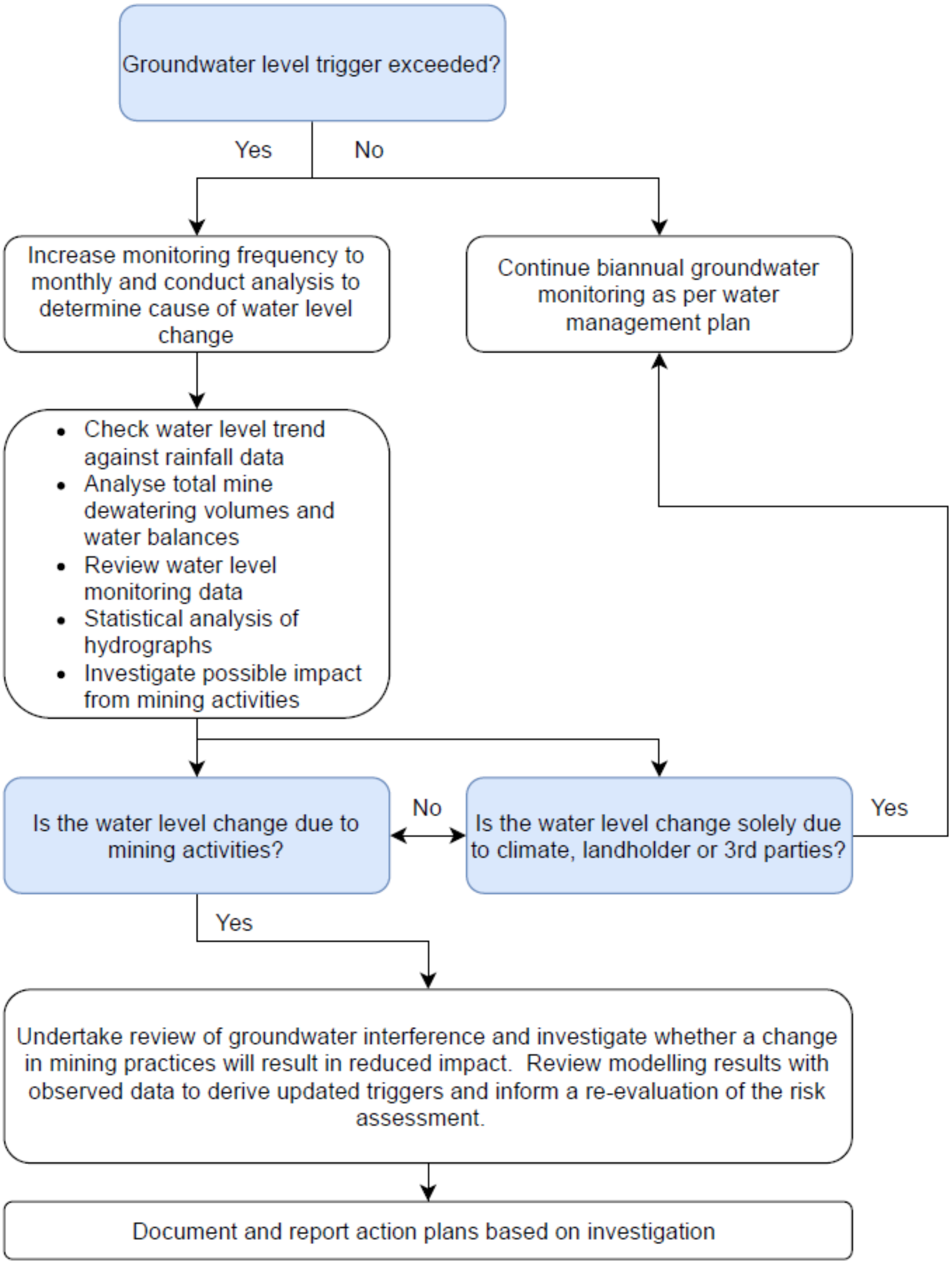

Figure 7-1 Groundwater level trigger action plan

7.2 Groundwater Quality

The Trigger Action Plan for groundwater quality is shown in Figure 7-2. The TAP is intended to initiate a phased approach which considers the statistical significance of exceedances to inform an appropriate response. The TAP identifies proposed actions and responses if the groundwater quality trigger values are exceeded based on 80th percentiles of the baseline dataset for individual monitoring bores. Note, as mentioned in the FHGP WMP, exceedance of the guideline values is intended as an 'early warning' mechanism rather than an instrument for assessing compliance. The TAP provides a framework for assessing change in baseline concentrations and is not intended to decrease concentrations of parameters below that of the livestock water guidelines where such exceedances occur in baseline conditions.

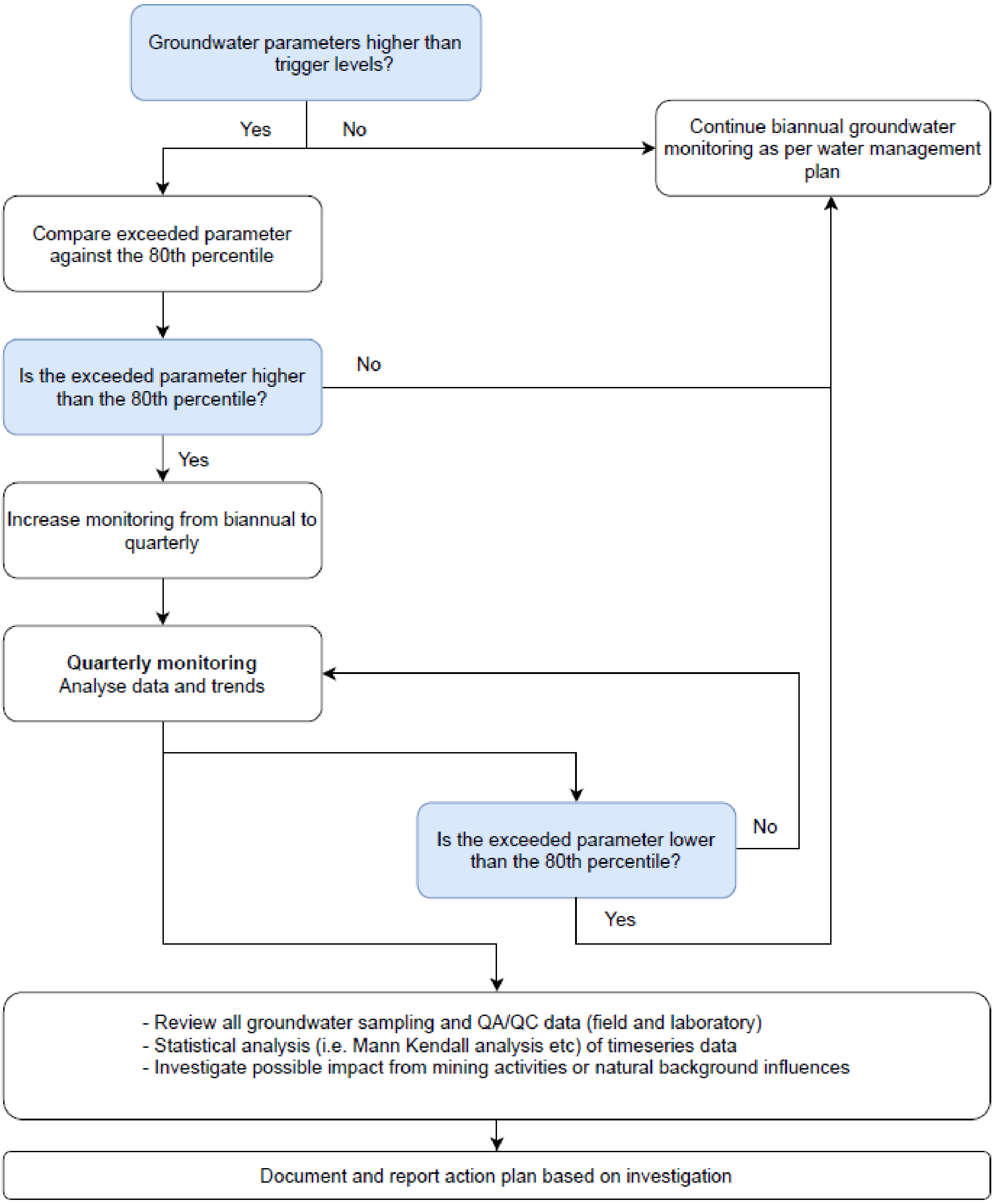

Figure 7-2 Groundwater quality trigger action plan

Section 8 EIS Comment and Response

Comment on the FHGP EIS (ERIAS, 2021b) was received from DEPWS specific to groundwater. The DEPWS comment and CDM Smith response is shown in Table 8-1.

Table 8-1 DEPWS comment and CDM Smith response

Regulator	Comment	Recommendation	Response
Department of Environment, Parks and Water Security – Water Resources Division	The proponent has advised that their intended monitoring procedure for groundwater drawdown and mounding will be based on complaints from existing users and no surface expression of groundwater or waterlogging of soils respectively. These indicators, if they were to occur, suggest that the proponents modelling has failed significantly and that they have failed to mitigate potential impacts. Rather than relying on impacts being reported or observed at the surface, the proponent should actively align their monitoring program to assess whether their modelled scenarios are occurring as predicted. If significant deviation from modelled scenarios occurs, re-evaluation of the model (i.e., re-calibrated with observational data and hydraulic parameters changed accordingly) should be promoted.	The proponent should propose a monitoring plan for groundwater quantity that does not rely on complaints from existing users or visual signs of impact. Instead, they should base the monitoring plan on ensuring that the minimal impact suggested by their modelling progresses as predicted. An example would be to set drawdown and mounding triggers (based on the modelling results) for monitoring bores located at varying distance (e.g., 500 m and 1 km, or as appropriate) down gradient of the likely propagation of drawdown and mounding impacts and propose a plan for if those triggers are breached (i.e., review of modelling, re-evaluation of risk assessment). The Water Management Plan indicates that a series of bores around the project area are planned to be monitored biannually for standing water level, so the suggestion above should not be too onerous to include in their monitoring plan.	A revision of the monitoring bore network was conducted and the proposed new monitoring bores are designed to measure the impacts of mining on the groundwater. The proposed position of the bores will allow PNX to measure the propagation of drawdown from the pit and mounding from the evaporation pond to assess groundwater level triggers. A Trigger Action Plan (TAP) has been developed for groundwater level and quality. The groundwater triggers are intended to initiate an appropriate response, based on observed variances. The TAP identifies proposed actions and responses if the calculated groundwater triggers are exceeded.

Section 9 Conclusions and Recommendations

9.1 Conclusions

The following presents the key findings of this report:

- A numerical model has been built to predict the level of mounding from the evaporation pond. The model results suggest:
  - The model is conservative; assuming no evaporation, water levels are maintained at capacity and no interference effects from dewatering (drawdown).
  - The greatest mounding effect will occur at monitoring bores MB-1, MB-2 and MB-3 with up to around 7.2 m of mounding expected during the first 50 years of operation with 0.2 m of mounding extending about 1 km from the evaporation pond over this same period.
  - None of the predicted mounding outcrops at the surface at any point within the model domain (except within the evaporation pond where the water table eventually reaches the base of the retention lake).
- The existing monitoring bore network is too shallow to monitor predicted groundwater drawdown at end of mining and incorrectly positioned to allow for measurement of drawdown propagating from the Fountain Head pit or mounding propagating from the evaporation pond. Nine additional monitoring bores have been proposed which together with the existing monitoring bores, will enable groundwater level monitoring of drawdown and mounding as well as groundwater quality monitoring over the life of mine and post mining.
- No changes to the existing groundwater quality triggers have been made, however, corrections have been made for the parameters for which will be monitored. This includes the addition of unfiltered metals suites and alignment of the measured parameters with the full livestock water guidelines.
  - Should these triggers be exceeded, comparison against the 80th percentile of the individual bores will be made at which time increased monitoring and evaluation of the exceedances respectively will be made.
- Groundwater level triggers have been devised and are based on the predicted end of mine elevations (mAHD).
  - Should these triggers be exceeded, an investigation into the water affecting activities will ensue to determine the cause (s) of exceedance and re-evaluation of the groundwater model, triggers and risk assessment made.

9.2 Recommendations

The following recommendations are made regarding the adoption and implementation of groundwater level and quality triggers:

- It is recommended that new monitoring bores are installed to measure the drawdown from the pit, mounding from the evaporation pond and to assess groundwater level triggers for each monitoring location. Any new monitoring bore(s) installed should be designed with regard to the predicted drawdown of the groundwater model to enable monitoring of water levels over the life of mine.
- The pit drawdown will capture much of the water that infiltrates through the IWL and beneath the evaporation pond as seepage to the water table, however, it is recommended to monitor the groundwater levels and assess groundwater mounding from the evaporation pond.
- The groundwater drawdown from the pit dewatering is calculated to extend to registered bore RN024290. The FMGP WMP recognises stock drinking water is a potential beneficial use of groundwater, therefore, the recommended trigger values should be expanded to include the full suite of livestock drinking water quality guidelines listed in ANZECC, 2000.

- Low flow method of sampling should be adopted (if not already conducted) as part of the groundwater sampling methodology. Low flow methods minimise the impact of the sampling method on the aquifer and are more likely to obtain a representative sample, while some high flow pumps can sometimes induce water chemistry changes.

Section 10 Limitations

10.1 Drawdown Model

Limitations of the numerical model and groundwater triggers include:

- The influence of faults or fault zones have not been considered in the numerical model and may have considerable control on local groundwater flow dynamics as they may act as recharge or discharge boundaries.
- The drawdown numerical model has not directly considered the influence of the unsaturated zone on recharge timing or other spatial variability.
- The drawdown numerical model sensitivity analysis suggests groundwater inflow to the pit is highly sensitive to the value of specific yield and there is no field-based data from the site to provide constraints.

10.2 Groundwater Triggers

Limitations of the groundwater triggers include:

- The water level triggers are based on the numerical groundwater model which calibration is based on the outputs of the GoldSim water balance model and a relatively limited number and spatial distribution of groundwater level data.
- Background groundwater quality at the site may have elevated concentrations of analytes that exceed livestock water guidelines listed for the groundwater quality triggers.

10.3 Mounding Model Limitations

Limitations of the mounding model include:

- All the physical processes are not represented or “captured” in the model (e.g. unsaturated flow is not represented).
- Approximations have been made in the formulation and application of model boundaries and initial conditions.
- The model excludes any design or features that reduce groundwater mounding, such as the pit dewatering.
- The model excludes groundwater mounding associated with the temporary tailings storage facility for process plant tailings management outside of the evaporation pond. The model excludes groundwater mounding associated with stockpiles or process storage facilities.
- The model excludes the possibilities of perching conditions to form within the unsaturated zone.

Section 11 References

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Appendix A Disclaimer and Limitations

Appendix A Disclaimer and Limitations

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If further information becomes available, or additional assumptions need to be made, CDM Smith reserves its right to amend this report.