DEWATERING AND WATER SUPPLY STUDY

BLUE CAP MINING LIMITED

BRITISH HILL PROJECT

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EXECUTIVE SUMMARY

Blue Cap Mining Limited is assisting IMD with the approvals for their British Hill Gold Project, approximately 73 km south-east of Southern Cross. The proposed project comprises a 70 m deep pit, mined over a 6 month period. The project will require up to 5 L/s for construction and dust suppression purposes. Groundwater Resource Management (GRM) completed a hydrogeological study for the project to estimate dewatering rates and assess potential water supply options.

Data collected during a site visit indicates low permeability conditions in the bedrock in the vicinity of the proposed pit, with an estimated bulk hydraulic conductivity expected to be in the order of 0.01 m/d and groundwater salinity of approximately 29,000 mg/L TDS. The groundwater level is approximately 43 m below ground level. The estimated dewatering rate for the proposed pit is in the order of 2.5 L/s once the pit extends below the water table, indicating that the project will require a reliable water supply, capable of producing 5 L/s for the construction period and the first few months of mining, decreasing by about 50% towards the latter stages once the pit develops below the water table. The dewatering will likely comprise sump pumping methods to maintain dry mining conditions. Sump pumps should be equipped with flow meters, installed in accordance with the DWER guidelines.

There are three bores within the project tenements. Data collected during a recent site visit indicates two of the bores, 20BHMW001 and the FW Drillers Bore are unsuitable as a long term supplies, due to low yields. The nearby Turkeys Nest Bore has not been tested and remains a potential water source.

Potential water supply options for the project include negotiating access to the licenced Dulcie Borefield, utilisation of the Turkeys Nest Bore (which requires airlifting to determine it’s suitability), and identifying new on-tenement fractured bedrock aquifers. Two potential fractured rock targets have been identified. There may also be an option to target pegmatite contacts within the tenement.

A pit lake model was developed to simulate pit lake conditions for 500 years post closure. The results indicate that the pit lake level equilibrates after about 120 years, thereafter the pit lake level varies seasonally from 52 to 54 m below ground level. The results indicate that the pit will act as groundwater sink, and consequently the risk of outflows of pit lake water to the groundwater environment post closure is low for the current climate regime. The model indicates that the salinity in the pit lake will increase to about 106,000 mg/L TDS.

During the operational phase of the project and upon closure, mine dewatering will result in localised groundwater drawdown in proximity to the open pit. The risk of environmental impact as a result of mine dewatering is considered low, given that the expected localised drawdown around the pit is expected to extend about 54 m from the pit perimeter, the short duration of the project (6 months), the nearest registered bore is 5 km away, the nearest current licensee is approximately 6.7 km away, and there are no identified areas of high potential for GDE’s in proximity to the proposed pit.

The project will require a groundwater licence, issued by the DWER, for approximately 160,000 kL per annum (which permits up to 5 L/s on an annualised basis). It is unlikely that an operating strategy will be required for the project. However, DWER may request an operating strategy if they have uncertainty about potential impacts.

GLOSSARY OF TERMS

Aquifer	A saturated geological unit that is permeable enough to yield economic quantities of water.
Aquitard	A geological unit that is permeable enough to transmit water but not sufficient to yield economic quantities.
Aquiclude	A geological unit that is impermeable, *i.e.* cannot transmit water.
Confined Aquifer	An aquifer bounded above and below by an aquiclude, where the water level in the aquifer extends above the aquifer top and is represented by a pressure head, *i.e.* the aquifer is completely saturated.
Drawdown	The change in hydraulic head observed at a well in an aquifer, typically due to pumping.
Leaky Aquifer or Semi-Confined Aquifer	An aquifer with upper and/or lower boundaries as an aquitard, where the water level in the aquifer extends above the aquifer top and is represented by a pressure head. Pumping from the aquifer induces leakage from the neighbouring aquitard units.
Unconfined or Water table Aquifer	An aquifer that is bounded below by an aquiclude, but is not restricted on its upper boundary, which is represented by the water table.
Hydraulic Conductivity (K) [Permeability]	The volume of water that will flow in a unit time under a unit hydraulic gradient through a unit area. Analogous to the permeability with respect to fresh water (units commonly m/d or m/s).
Transmissivity (T)	The product of the hydraulic conductivity and the saturated aquifer thickness (units commonly $m^3/d/m$ or m^2/d)
Specific Storage (S_s)	The volume of water released from a unit volume of aquifer under a unit decline in hydraulic head, assuming confined aquifer conditions. Water is released because of compaction of the aquifer under effective stress and expansion of the water due to decreasing pressure (units commonly m^{-1}).
Storativity (S)	The volume of water released from a unit area of aquifer, i.e. the aquifer column, per unit decline in hydraulic head (dimensionless parameter).
Specific Yield (S_y)	The volume of water released from an unconfined aquifer per unit decline in the water table. The release of water is mostly from aquifer draining. Contributions from aquifer compaction are generally small. Analogous with effective porosity (dimensionless parameter).

Terms referenced from Kruseman GP and deRidder NA (1994) 2nd edition, Analysis and Evaluation of Pumping Test Data. ILRI Publication 47 The Netherlands

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1.0 INTRODUCTION

Blue Cap Mining Limited is assisting IMD Gold Mining (IMD) with the project approvals for their British Hill Gold Project, approximately 73 km south-east of Southern Cross (Figure 1). The project is located across three granted tenements (M77/1256, L77/221 and L77/223) and comprises a small existing pit which was historically mined to a depth of 6 m below ground level.

IMD is proposing to develop the existing pit into the larger pit, to a depth of about 70 m below ground level, over a Life of Mine (LoM) of 6 months. The ore will be processed off-site, transported via a private haul road and then along public roads.

The project will require a small water supply during construction and for dust suppression within the mining area, and along the haul road, which may be in the order of up to 5 L/s. It is anticipated that the demand will be met by an external groundwater source (i.e. water supply bore/s) which will likely be supplemented by mine dewatering once the pit develops below the water table.

Blue Cap Mining Limited, on behalf of IMD, engaged Groundwater Resource Management (GRM) to complete a hydrogeological study for the British Hill project to estimate dewatering rates and assess likely water supply options for the project. The assessment will be used as supporting documentation for the Mining Proposal, groundwater licensing and other project approval documents.

2.0 BACKGROUND

2.1 Project Description

The British Hill project is located approximately 73 km south-east of Southern Cross (Figure 1), across three granted tenements (M77/1256, L77/221 and L77/223) accessed via the Marvel Loch – Forrestania Road (Figure 2).

The project comprises a small existing pit which was mined to a depth of 6 m below ground level during the early 1990's. The shallow ore was treated on site using Vat Heap Leaching.

IMD is proposing to develop the existing pit to around 550 m long and 350 m wide, to a depth of about 70 m below ground level, over a 6 month period. As part of the proposed operation, ore will be trucked off site for processing initially using a private haul road within miscellaneous tenement L77/223 and then along public roads.

The project will require a small water supply during construction, as well as an operational supply for the purposes of dust suppression within the mining area, and along the haul road. The raw water demand is expected to be no more than 5 L/s. It is understood that there is no water quality constraint on the groundwater supply, although low salinity water is preferred to minimise the corrosive impact to machinery and equipment. The proposed water supply will need to be met by an external source (i.e. a water supply bore/s) which will be supplemented by mine dewatering once the pit develops below the water table.

2.2 Climate

The climate in the project area is described as arid with hot dry days in summer, with mild days and cool nights in winter. Mean daytime temperatures range from 16°C in July to 35°C in January, with mean night-time temperatures ranging from 4°C in July to 17°C in January and February.

Rainfall is typically higher during the winter months of June and July, related to frontal activity extending up from the Great Australian Bight. Generally winter rainfall is more reliable but has a lower intensity. Summer rainfall is normally restricted to irregular thunderstorm activity associated with the inter-tropical convergence zone or by remnant tropical cyclones. These systems travel south after crossing the Pilbara coast. Summer rainfall can be heavy and cause substantial flooding.

The nearest Bureau of Meteorology (BoM) station to the project with reliable long term data is Southern Cross (Station Number 012074), which has collected rainfall data since 1895. The closest station with reliable long term evaporation data is Kalgoorlie Boulder Airport (Station Number 012038), which has collected data since 1939. Mean evaporation exceeds rainfall in all months and annually by almost an order of magnitude.

Mean monthly rainfall and evaporation data are presented in Table 1.

Table 1: Long Term Average Rainfall and Evaporation

Month	Mean Monthly Rainfall (mm) Southern Cross (BoM Station 012074)	Mean Monthly Evaporation (mm) Kalgoorlie Boulder Airport (BoM Station 012038)
January	16.3	387.5
February	20.9	304.6
March	24.2	266.6
April	24.5	174.0
May	34.9	111.6
June	40.7	78.0
July	38.6	86.8
August	31.2	117.8
September	19.4	174.0
October	15.6	260.4
November	15.5	309.0
December	12.6	360.0
TOTAL	292.8	2,629.4

2.3 Geology

The project area is located within the Southern Cross greenstone belt on the western side of the Parker granitoid dome, within the Yilgarn Block (Gee, 1982).

The lithology within the project area comprises an exposed, tightly folded Archean metasediment sequence, comprising graphitic and sulphidic schist and phyllite, banded iron formation and quartzite. Intrusive pegmatite and quartz veining is common. Away from the exposed Archean bedrock the near surface geology comprises Cainozoic ferricrete, sands, silcrete and calcrete, and further overlain by younger Quaternary alluvial sands and clays (Figure 3).

The gold mineralisation at British Hill is associated with alteration zones at or close to the contact of magnetic BIF and metasediments, and also within quartz/quartzite zones within the metasediments (Cotton et al, 1989).

2.4 Regional Hydrogeology

The project area is located within the Westonia Groundwater Sub-Area of the Westonia Groundwater Area. Groundwater resources within the subarea comprise alluvium, calcrete, palaeochannel and fractured rock aquifers.

The project area is located on an interfluve between northerly draining palaeo-tributaries of the internally draining Deborah palaeodrainage system (Figure 4). The Deborah palaeodrainage system covers an area of around 250 km by 250 km and drains to a series of central salt lakes. The closest palaeo-tributary is located approximately 3 m west of the project tenements (Figure 5).

Groundwater occurrences within the project tenements are likely to be limited mainly to fractured bedrock aquifers, given the location with respect to the palaeodrainage system and the relatively thin alluvium and calcrete. Small, localised alluvial aquifers may occur but are not expected to be common within the project tenements, given the thin or absent alluvial cover. Fractured bedrock aquifers occur where permeability in the natural rock is enhanced by fracturing, dissolution and chemical weathering. Away from the fractures permeability in the bedrock is typically low.

Larger groundwater supplies are likely to be found away from the project tenements, associated with Tertiary palaeochannel sand aquifers within the Deborah palaeodrainage system. Palaeochannel aquifers are common throughout Australia and used extensively for water supplies, particularly by the mining industry. Palaeochannel aquifers can often provide large quantities of groundwater, but salinity can be higher than in fractured rock aquifers.

Smaller groundwater supplies are also likely, away from the project tenements, within calcrete and alluvial aquifers, associated with the larger drainage systems when the alluvium is sufficiently thick to extend below the water table. This aquifer type can form small, localised, sometimes seasonal, aquifers which typically have a lower salinity compared to the fractured rock and palaeochannel aquifers.

Regionally groundwater is recharged by direct rainfall infiltration or by stream flow during episodic rainfall events. Recharge is expected to be highest following streamflow events, particularly at locations where the alluvium overlies more permeable units (such as calcrete or fractured basement). Groundwater recharge by direct infiltration of rainfall is likely to be small.

Groundwater quality on a regional scale is likely to be variable, with salinity tending to increase downstream along the drainage lines. The lowest salinity groundwater is likely to occur beneath the catchment divides and within the alluvial/calcrete aquifers.

2.5 Other Groundwater Users

A search of bore records within a 50 km radius of British Hill was carried out using the Water Information Reporting (WIR) database, which is managed by the Water Division of the Department of Water and Environment Regulation (DWER).

The WIR data indicates that there is only one registered bore within 10 km of the proposed pit, called “Well” in Figure 5. The bore is reported as being low yielding and high in salinity and is no longer operational. The database identified a second location, approximately 20 km west of the proposed pit, which is called “Actual Lake” and represents a stream sampling location.

The only other registered bores within proximity to the project area are a cluster of bores 35 km north west of the proposed pit, which were installed in the 1970’s as part of a drought relief programme for agriculture.

2.6 Resource Area and Current Allocation

The project area lies within the Westonia Sub-Area of the Westonia Groundwater Area. The groundwater resources available for the three tenements (M77/1256, L77/221 and L77/223), and the corresponding current level of allocation (as sourced from the DWER online Water Register) for each resource are provided in Table 2 below.

The information provided in Table 2 indicates that there is limited information for all groundwater resources associated with the tenements therefore the department has not set allocation for these resources. In these instances, the DWER will evaluate each application individually and apply an allocation limit on a project by project basis.

This suggests, given the low project water demand, that groundwater licensing for the project is not likely to be a project risk, assuming the hydrogeological investigation is conducted to a suitable level, as discussed further in Section 7.2.

Table 2: Current Resource Allocation

Tenement	Groundwater Area	Sub Area	Groundwater Resource	Current Allocation
77/1256, L77/221, L77/223	Westonia	Westonia	Combined – Fractured Rock West – Alluvium	Limited Information
			Combined – Fractured Rock West – Calcrete	Limited Information
			Combined - Fractured Rock West – Palaeochannel	Limited Information
			Combined Fractured Rock West – Fractured Rock	Limited Information

2.7 Water Register

The DWER online water register was interrogated to identify the presence of existing licensed groundwater users in the vicinity of the project. The existing licensed groundwater users are shown in Figure 5, and the licence details summarised in Table 3 below.

The information shows that:

- The closest groundwater licence holder is Richard Read and Associates Pty Ltd (Richard Reed), for the Dulcie Borefield, located 6.7 km north-west of the project, which draws groundwater from the palaeochannel aquifer and has an annual allocation of 60,000 kL (approximately 1.9 L/s). Tenement L77/221, held by IMD, covers access to this borefield. However, IMD does not have an access agreement in place to obtain groundwater from the borefield.
- The next closest groundwater licence holder to the proposed pit is MH Gold Pty Ltd, which is for the Mt Holland project. The licence has an annual allocation of 5,000 kL from the fractured rock aquifer.

The bore called “Well” from the WIR database search is not covered by a current groundwater licence, which is consistent with the information in the WIR database indicating that the bore was not currently operational.

Table 3: Nearby Groundwater Well Licences

GWL Holder	GWL	Allocation (kL/yr)	Aquifer	Licence Period	Distance from British Hill
Richard Read and Associates Pty Ltd	177402	60,000	Palaeochannel-Palaeochannel	30 Apr 2013 to 30 Apr 2023	6.7 km north
MH Gold Pty Ltd	201377	5,000	Combined Fractured Rock West Fractured Rock	22 Feb 2019 to 29 May 2023	7 km south east

2.8 Groundwater Dependant Ecosystems

A review of the BoM’s Groundwater Dependant Ecosystem (GDE) Atlas for an area of 25 km surrounding the project area indicates that the project area is classified as having:

- No identified subterranean GDE’s.
- Low potential for terrestrial GDE’s.
- Moderate potential for aquatic GDE’s to the south of the project area, based on the National Assessment. However, given there are no surface water bodies in the vicinity of the project, this risk is considered low.

The BoM’s GDE Atlas assessment is provided in Appendix A.

3.0 Dewatering Assessment

3.1 Historical Data Review

Cadre Geology and Mining Pty Ltd (Cadre) coordinate the resource drilling at British Hill on behalf of Blue Cap Mining Limited.

Historical RC drilling data was screened for groundwater information, and anecdotal information was obtained from the Cadre Geology Manager (Mr Ben Pollard). The information indicated that groundwater inflows observed during drilling were negligible, with the exception of one recently drilled hole (20BHRC006) which encountered groundwater inflows of approximately 0.6 L/s at 108 m down hole (at 60° dip). Cadre consequently proposed to drill a temporary water supply bore adjacent to 20BHRC006, for the purpose of a drilling water supply.

3.2 Field Investigations

A site visit was conducted by a GRM Hydrogeologist (Mr Peter Hocking) between 17 and 19 July 2020, to coincide with the drilling of the temporary drilling water supply bore. The exploration drilling contractor was VM Drilling and the site Geologist was Mr Brodie Box.

The field visit comprised the following tasks:

- Collect hydrogeological data, including yield and water quality data, during the drilling of the temporary drilling water supply bore (20BHMW001).
- Collect hydrogeological data from any resource drill-holes drilled during the site visit.
- Collect groundwater level measurements from any existing resource drill-holes.
- Record construction details and water level measurements on two existing drillers water supply bores located along the access road (FW Drillers Bore and Turkeys Nest Bore).
- Collect groundwater samples for laboratory analysis from the new temporary water supply bore (20MHMW001) and the Turkeys Nest Bore.
- Collect anecdotal information from the site geologist and drilling contractor in relation to groundwater inflows in previously drilled holes.

The locations of the tested drill-holes are provided in Figure 6, and data collected during the field visit is summarised in Table 4. The results of the field investigation can be summarised as follows:

- The temporary water supply bore (20BHMW001) was drilled approximately 80 m north-east from the angled (60° dip) drill-hole 20BHRC006. The vertical bore was reamed at 144 mm diameter to a depth of 115 m below surface. A trace of groundwater was encountered at 50 m depth, which increased slightly at 83 m depth, with a final yield of less than 1 L/s recorded at the completion of drilling. The bore was not cased during the site visit. However it is understood that 100 mm Class 9 uPVC casing was on site for this purpose. The groundwater level in the bore was recorded approximately 20 mins after reaming at 46.77 m below surface, and a groundwater sample was collected for laboratory analysis (see Section 3.3).
- Groundwater level data was collected from six previously drilled exploration diamond drill-holes (20BHDD001, 20BHDD002, 20BHDD003, 20BHDD007, 20BHDD009, 20BHDD010). The data is provided in Table 4 and has been corrected for verticality. Groundwater levels within the proposed pit area range from 39.94 to 45.54 m below surface. The data suggests a flow

direction towards the south, which should be confirmed once further groundwater level data becomes available given that the expected flow direction is towards the south-west, based on regional conditions.

- The site geologist and drilling contractor indicated that the majority of the RC exploration drill-holes completed during the recent programme were dry, with the exception of three drill-holes, including 20BHRC00113 which reported 0.6 L/s and was the target of the temporary drilling water supply bore. The two other drill-holes (20BHRC0085 and 20BHRC0092) reported minor yields of less than 0.1 L/s at 102 and 100 m down hole (i.e. at 60° dip).
- The FW Drillers Bore and Turkeys Nest Bore are located approximately 100 m apart, adjacent to a small (25 m long by 25 m wide by 2.5 to 3 m high) Turkeys Nest, along the access road approximately 3 km north-east from the proposed pit. The two vertical bores are constructed with 150 mm, Class 12 uPVC casing to depths of 49.5 and 46.2 m respectively. The groundwater level in the bores was measured at approximately 25.7 m. It is understood from anecdotal information that the bores were constructed during earlier activities at the site and consequently bore logs are not available. The site geologist indicated that the diamond drillers initially attempted to use the FW Drillers Bore. However the yield was insufficient and contractor subsequently switched to using the Turkeys Nest Bore. It is understood only 100 L has been taken from the bore to date. A groundwater sample was collected from The Turkeys Nest Bore and submitted for laboratory analysis (see Section 3.3).

Table 4: Summary of Field Investigations

Hole ID	Easting (MGA94 Z50)	Northing (MGA94 Z50)	RL (mAHD)	Depth (m)	Dip	Azimuth	SWL* (mbgl)	Groundwater inflow (m down hole**)	Airlift Yield (L/s)	Comments
20BHDD001	746,684	6,473,706	439.964	48	-80	69	40.17	n/r	n/r	
20BHDD002	746,651	6,473,694	440.845	76	-80	69	43.40	n/r	n/r	
20BHDD003	746,752	6,473,680	439.568	54	-80	249	45.43	n/r	n/r	Potentially unreliable data, unable to get clear dip depth
20BHDD007	746,894	6,473,599	436.42	42	-75	249	39.94	n/r	n/r	
20BHDD009	746,774	6,473,578	439.633	48	-80	249	43.83	n/r	n/r	
20BHDD010	746,696	6,473,551	443.127	54	-80	69	45.54	n/r	n/r	
20BHRC0085	746,638	6,473,596	446.517	160	-60	69.5	n/r	102	<0.1	
20BHRC0092	746,636	6,473,676	442.506	110	-60	69.5	n/r	100	<0.1	
20BHDD0113	746,629	6,473,914	437.127	144	-60	69.5	n/r	108	0.61	
20BHMW001	746,685	6,473,977	n/r	115	-90	0	46.77	50 and 83	<1	Reamed to 144 mm diameter, but not cased.
Turkeys Nest Bore	749,147	6,476,031	n/r	46.2	-90	0	25.64	n/r	n/r	150 mm Class 12 uPVC. Approx 100 kL taken by diamond drilling contractor
FW Drillers Bore	749,072	6,476,095	n/r	49.5	-90	0	25.80	n/r	n/r	150 mm Class 12 uPVC. Top section of PVC damaged. Initially used as a drilling supply, but couldn't provide sufficient yield

Notes: mbgl = metres below ground level, SWL = standing water level, * = water level corrected for verticality, ** depth not corrected for verticality

3.3 Groundwater Quality

Groundwater samples were collected from the temporary drillers supply bore (20BHMW001) and the Turkeys Nest Bore, to provide an indication of groundwater quality. The samples were analysed by SGS Environmental, under chain of custody documentation.

The results of the laboratory analysis are provided in Table 5 below, and laboratory certificates provided as Appendix B. The results indicate that the groundwater is saline, with cirum-neutral pH and of sodium chloride type.

Table 5: Laboratory Analysis

Analyte	Unit	20BHMW001	Turkeys Nest Bore
pH	pH Unit	6.8	6.6
Electrical Conductivity	µS/cm	40,000	19,000
Total Dissolved Solids	mg/L	29,000	13,000
Total Alkalinity as $CaCO_3$	mg/L	110	25
Carbonate Alkalinity as CO_3	mg/L	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	140	31
Chloride, Cl	mg/L	15,000	6,300
Sulfate, SO_4	mg/L	2,100	1,500
Nitrate, NO_2 as NO_2	mg/L	0.07	<0.05
Calcium, Ca	mg/L	350	290
Magnesium, Mg	mg/L	1,000	500
Sodium, Na	mg/L	7,600	3,300
Potassium, K	mg/L	190	100
Soluble Silicon as Silica, SiO_2	mg/L	69	44
Total Hardness by Calculation	mg/L	5,100	2,800
Aluminium, Al	µg/L	<50	<25
Iron, Fe	µg/L	<50	46,000
Manganese, Mn	µg/L	2,400	8,000

3.4 Aquifer Properties

The hydraulic conductivity of the fractured bedrock has been estimated based on analysis of the airlift data, using the steady state Theim equation. An average inflow rate of 0.2 L/s was used in the equation, to represent the upper range in values, which indicates a hydraulic conductivity value of 0.01 m/d.

3.5 Estimated Dewatering Rates

Average dewatering rates for the pit has been estimated using the Thiem equation for steady state flow in an unconfined aquifer, represented as:

$$Q = \frac{\pi K(H^2 - h_w{}^2)}{ln\frac{R_0}{r_w}}$$

Where:

Q = the discharge in m^3/day
K = hydraulic conductivity in m/day
H = static head measured from the final pit floor, in m
h_w = distance from base of final pit floor to the current pit floor, in m
r_w = radius of pit floor, in m
R_0 = radius of influence

With the radius of influence (R_0) estimated using the Weber equation:

$$R0 = 2.45 \times \sqrt{\frac{(HKt)}{n_e}}$$

Where:

H = static head measured from the bottom of the pit, in m
K = hydraulic conductivity in m/d
t = time, in days
n_e = effective porosity

The hydraulic conductivity value used in the equation was 0.01 m/d, as discussed in Section 3.4.

The pit geometry inputs were based on the preliminary pit outline provided by Cadre, with the pit assumed to progress at a linear rate. For the purpose of the calculation, it is assumed that the pit will progress below the water table in month 3. The static water level was assumed to be 43 m below ground level, based on water level data collected during the site visit.

The results of the dewatering estimates are provided in Table 6 below.

Table 6: Pit Inflow Estimates

Month End	Base of Pit (m below ground level)	Approximate Pit Area (m^2)	Radius of Influence (m)	Dewatering Estimate (L/s)
1	6	45,000	0	0
3	43	30,000	0	0
6	70	30,000	54	2.5

The dewatering estimates indicate that dewatering rates will average around 2.5 L/s once the pit extends below the water table (i.e. between months 3 and 6). This estimate is based on the higher range of hydraulic conductivity encountered during drilling, to maintain a conservative approach with respect to assessing the risk of excess water.

The calculation estimates that the radius of influence (i.e. the area of drawdown surrounding the pit) is likely to extend approximately 54 m from the pit perimeter by the end of mining.

The calculated estimates have several limitations:

- The estimates are based on anecdotal information provided by the client which was not verified by GRM and data collected during the site visit, and if significant water bearing structures (faults, large joint sets etc) are encountered, inflows to the pits may be higher.
- The estimates do not include direct rainfall or rainfall runoff to the pit.

3.6 Dewatering Strategy

Based on the dewatering rates estimated above, the dewatering strategy for the project will likely comprise dewatering of the pit via sump pumping methods to maintain dry mining conditions. Sumps should be located on the lowest point on the pit floor, with drains used as required to direct groundwater inflows to the sump. Pontoon or skid mounted pumps can be used to remove the groundwater from the sumps.

Sump pumps should be equipped with flow meters, installed in accordance with the DWER guidelines (2009).

The discharge will need to be transferred via pipeline to a dedicated pond for use as a water supply for dust suppression. All pipeline infrastructure should include adequate protection to reduce the risk of pipeline failure and saline water spillage, e.g. containment within bunded corridors and installation of sumps are low points.

4.0 WATER SUPPLY

Mine dewatering will need to be supplemented by an alternate water supply to meet the projects construction and dust suppression requirements. It is understood that the project requires a water supply of up to 5 L/s, and whilst there is no constraint on water quality, lower salinity groundwater is preferred to reduce the corrosive impact on machinery and equipment. Given that mine dewatering is not expected to commence until around month 3, a reliable supply of around 5 L/s will be required during construction and for the initial phase of mining.

Three water supply options were assessed as part of the study which are discussed in the following Sections, these include:

- Existing on-tenement water supply bores.
- Negotiating access to existing off-tenement (i.e. third party) water supplies.
- Identifying new on-tenement water supply targets.

4.1 Existing Bores

During the recent site visit, the newly installed temporary drillers supply bore (20BHMW001) was assessed for suitability as a long term water supply for the operation. However, as discussed in Section 3.2 the yield reported from this location was very low (<1 L/s) and it is therefore unlikely to be suitable as a long-term supply option.

In addition to the newly installed bore, two existing drillers supply bores (FW Drillers Bore and Turkeys Nest Bore) to the north west of the proposed pit were visited during the recent site visit. It is understood that the diamond drillers attempted to use the FW Drillers Bore. However the yield was insufficient and the drillers subsequently switched to using the Turkeys Nest Bore, indicating that the FW Driller Bore is also unsuitable as a long term supply bore.

The suitability of the Turkeys Nest Bore is unclear at this stage, given that the drill rig was engaged with drilling 20BHMW001 during the site visit and was therefore unavailable for testing. It would be prudent to airlift test this bore at some stage to assess the bores likely long term potential.

4.2 Negotiating Off-Tenement Access

The DWER online Water Register identified the Dulcie Borefield, which is located 6.7 km north-west of the project (refer to Section 2.7 and Figure 5). The borefield draws groundwater from the palaeochannel aquifer, which is typically a reliable long term groundwater supply. The borefield is currently licensed for only 60,000 kL per annum (1.9 L/s). However, it is not clear whether the borefield has greater capacity than this. IMD may wish to consider negotiating access to the borefield with the licencee (Richard Reed), given that IMD has tenure (L77/221) connecting the groundwater licence tenements to the British Hill project area.

4.3 Identifying New On-Tenement Supplies

The remaining option would be to undertake a groundwater exploration program within the project tenements, targeting fractured bedrock aquifers.

To assist in identifying potential fractured bedrock targets, Newexco Exploration Pty Ltd (Newexco) was engaged to review historic geological and geophysical data to identify potential fractured bedrock targets (i.e. areas of intersecting structural features).

The Newexco findings are provided in Appendix C, which include the recommendation to drill two groundwater exploration drill-holes. The drilling targets are provided in Table 7 below, and shown in Figure 7. It is recommended that the targets are drilled using RC or conventional air rotary methods, to a vertical depth of approximately 100 m, with hydrogeological data collected during drilling. A 26D licence, issued by DWER, will be required to drill the proposed targets.

Table 7: Water Supply Targets

Target	Easting (MGA94 Z50)	Northing (MGA94 Z50)
1	746,750	6,472,680
2	746,460	6,472,897

In the event that the targets identified above are unsuccessful, an alternate option may be to target pegmatite contacts within the tenement. Modest groundwater supplies can occur along pegmatite contacts, particularly where chemical dissolution has enhanced any fracture zones. A desk study would be required to define target locations prior to drilling.

5.0 Pit Lake Modelling

The pit lake model was developed using the generic systems modelling package GoldSim, which is ideally suited to coupled water and solute balance modelling. The model was run over a 500 year period to estimate pit lake conditions after mine closure.

The final mining depth in the proposed pit is below the ambient groundwater level. At mine closure pumping will cease and the groundwater levels will recover forming a pit lake.

In the Wheatbelt and Goldfields region, where evaporation exceeds rainfall by more than an order of magnitude, the main drivers controlling the pit lake level will be groundwater inflow (from the pit walls) and evaporative outflow (from the pit lake).

In the semi-arid zone of Western Australia two pit lake systems typically develop, namely:

- Evaporative sink, where pit lake levels are maintained at a lower elevation than the surrounding groundwater system because of evaporation.
- Throughflow system where there is some degree of pit lake water outflow to the surrounding groundwater environment.

For the evaporative sink pit lake scenario, the depressed lake level will result in the development of a local groundwater sink (i.e. where the lake level lies below the groundwater level), with no discharge of lake water to the surrounding groundwater environment.

For the throughflow system, it is possible that the pit lake level will lie above the ambient groundwater level on the down-gradient side of the pit, thereby allowing pit lake water to flow to the down-gradient groundwater environment.

5.1 Water Balance Set up

The GoldSim pit lake model includes the following components:

- Pit lake storage volume.
- Inflows to the pit comprising:
    - groundwater inflows, which occur when the water level in the pit lake void lies below the ambient groundwater level;
    - direct (incidental) rainfall onto the pit lake; and
    - rainfall runoff from the pit walls into the pit lake.
- Outflows from the pit comprising:
    - evaporation from the pit lake; and
    - groundwater outflows, which occur if the pit lake water level exceeds the ambient groundwater level on the downgradient portion of the pit.

5.1.1 Pit Lake Storage Volume

The volume stored in the pit lake is estimated by the model based upon the total inflows and outflows to the lake over a time step, and the volume of the lake at the previous time step. At time zero (i.e. the start of the model run which corresponds to the end of mining) the lake is assumed to have a nominal volume of 50 m^3. GoldSim requires a volume at the start of the model run for the solute balance calculations.

The water balance equation used to calculate the stored volume is presented below.

$$Storage_i = (Inflow - Outflow) + Storage_{i-1}$$

Where,

$Storage_i$ = the pit lake void volume at the current time step

Inflow = the total inflow to the pit lake

Outflow = the total outflow from the pit lake

$Storage_{i-1}$ = the pit lake void volume at the previous time step

5.1.2 Groundwater Inflows and Outflows

Estimation of seepage outflows and inflows from the pit lake was calculated based upon the Dupuit equation for horizontal groundwater flow in an unconfined aquifer:

$$Q = P\ x\ K\ x\ \frac{(h_{B^2} - h_{A^2})}{2L}$$

Where,

Q = seepage flow rate

P = pit perimeter length

K = hydraulic conductivity of the geological units adjacent to the pit lake

h_B = difference in height between the ambient groundwater level and the base of aquifer (assumed to be equivalent to the pit floor elevation)

h_A =difference in height between the pit lake and the base of pit lake (i.e. the lake depth)

L = flow path length.

All parameters in the equation, apart from h_A, are applied as constants by the water balance. The perimeter length was estimated from mine plans provided in Figures 7.

The height of the ambient groundwater level, which represents the natural water level unaffected by mining or groundwater production, was taken from data collected during the site visit. Hydraulic conductivity and flow path length were based upon analysis of the airlift data.

The parameter values used in the water balance model are provided in Table 8.

Table 8: Groundwater Flow Parameters

Pit	K (m/d)	Ambient GWL (m bgl)	Perimeter Length (m)	Flow Path Length (m)
Proposed Pit	0.01	43	550	54

Note K = hydraulic conductivity.

5.1.3 Rainfall and Runoff

Rainfall and rainfall runoff inflows are estimated by the model using monthly rainfall data from the nearby Southern Cross meteorological station (Table 1).

It was assumed that at closure the pit will be surrounded by a safety bund, which will prevent catchment runoff from entering the pit, and as such surface inflows from only direct rainfall and pit wall runoff have been considered in the model. A conservative runoff coefficient of 1 was applied to the pit.

Table 9: Pit Catchment

Pit	In-Pit Catchment (m^2)	Runoff Coefficient
Proposed Pit	160,000	1

5.1.4 Evaporative Outflows

Evaporation losses are estimated by the model using the monthly evaporation rates for Kalgoorlie Boulder Airport (Table 1). The monthly data is adjusted for pan to lake effects, using a coefficient of 0.7, and a salinity factor based on an empirical relationship developed by Turk (1970). The solute balance used to estimate the pit lake salinities is described in Section 5.1.6.

The adjusted evaporation rate was applied to the area of the pit lake, which was calculated from the relationship between lake volume and surface area at each time step (discussed in the following section).

5.1.5 Pit Geometry

The water balance uses the stage relationship between the pit void volume (the independent variable), which is tracked by the model at each time step, and elevation and pit/void area (dependant variables) to estimate the groundwater-pit lake void interaction, rainfall/runoff inflows and evaporative losses.

The stage relationship, which was estimated based on the final pit shell design, is provided in Table 10.

Table 10: Pit Geometry

Proposed Pit		
Depth (m bgl)	Surface Area (m^2)	Cumulative Volume (m^3)
70	30,000	0
0	140,000	500,000

5.1.6 Solute Balance Set-Up

A solute balance model was developed using the GoldSim software to simulate the increase in salinity of the pit lake after closure. The model assumptions are as follows:

- An initial TDS concentration of 29,000 mg/L, based on water quality measurements from 20BHMW001.
- Zero salt inflows from rainfall.
- Zero salt losses from evaporation.
- Complete mixing within the pit lake (i.e. no allowance was made for stratification).

The model simulated the gradual increase in salinity concentrations to the pit lake from groundwater inflows.

5.2 Water Balance Modelling Results

A run time of 500 years was adopted for the water balance model simulations, using a one day time step. The modelling results are presented as Figure 8.

The model results indicate:

- A gradual pit lake level increase over the initial 50 years post closure, whereby water levels in the pit lake rise to about 60 m below ground level (i.e. a rise of approximately 10 m). The rising water level is the result of high groundwater hydraulic gradient and the comparatively small lake area available for evaporation.
- The pit lake level increases at a slower rate between 50 and 120 years post closure, with the pit lake level rising to 54 m below ground level by year 120 (i.e. an additional rise of approximately 6 m). The reduction in the rate of rise is due to increased evaporation rates, because of the expanded pit lake area as the pit fills, and the reduced groundwater inflow rate in response to the lower groundwater gradients away from the pit.
- The pit lake water levels stabilise after about 120 years as the groundwater and rainfall inflows are in equilibrium with the evaporative losses. The pit lake level during the remainder of the 500 year modelled period varies seasonally between about 52 to 54 m below ground level, which is 9 to 11 m below the ambient pre-mining groundwater level.
- The salinity of the pit lake increases with time to about 106,000 mg/L TDS after 500 years post closure, due to evaporative concentration of salts.

The results indicate that the pit acts as groundwater sink, and consequently the risk of outflows of pit lake water to the groundwater environment post closure is low for the current climate regime.

Note that the model results assume that a catchment bund is in place to prevent catchment runoff to the pit, which will need to be confirmed for closure planning.

6.0 ENVIRONMENTAL IMPACTS

Mine dewatering will result in localised groundwater drawdown in proximity to the open pit. Drawdown is not expected to extend far from the perimeter of the pit, given the low hydraulic conductivity of the intact rock mass. Analytical modelling undertaken as part of this assessment indicates a radius of influence of 54 m from the proposed pit.

The risk of environmental impact to other groundwater users, the groundwater environment and GDE's as a result of groundwater abstraction for open pit dewatering purposes is considered low, given;

- the expected localised drawdown around the pit is limited to about 54 m,
- the short duration of the project (6 months),
- the nearest registered bore is 5 km from the proposed pit, and is not currently licensed for use,
- the nearest current licensee is approximately 6.7 km north of the proposed pit, and
- there are no identified areas of high potential for GDE's in proximity to the proposed pit.

7.0 GROUNDWATER LICENSING

Groundwater abstraction for the project will require the application of a groundwater licence (GWL) to abstract water, issued by the DWER, under the *Rights in Water and Irrigation Act 1914* (WA).

The DWER issues GWLs using a risk based assessment tool termed the *Level of Water Allocation*. Under this system a water allocation limit is placed on each aquifer resource within a groundwater area or, where defined, groundwater sub-area. The scale of assessment required for licensing is then set depending upon the proportion of the maximum allocation that has already been assigned, with the aim to minimise the risk of unacceptable impacts upon existing users and future public water supplies, and to support future development in the area/sub-area.

Once the maximum allocation is reached, the DWER will review any new applications to identify any unacceptable impacts. If unacceptable risks are identified by the department, then the licence application will be rejected. Securing of additional water supplies will then be limited to water trading with existing licence holders or seeking supplies from other aquifer resources. Inherent in this scheme is the allocation of new licences on a first-come first-served basis.

7.1 Licence Application

The project will require a groundwater licence to permit groundwater abstraction from the Combined - Fractured Rock West – Fractured Rock groundwater resource, within the Westonia Sub-Area of the Westonia Groundwater Area.

As mentioned in Section 2.7, the current allocation from this aquifer resource is listed as having limited information, indicating that an allocation has not been set for that resource. The DWER would evaluate each application individually and apply an allocation limit when sufficient data is available to assign a suitable allocation limit. This suggests that a licence for the project is not likely to be a project risk, assuming the hydrogeological investigation is conducted to a suitable level, as discussed further in Section 7.2.

7.2 Regulatory Reporting Requirements

The DWER set the level of investigation required for any future groundwater abstraction based upon a decision matrix (defined under Operational Policy No. 5.12, Hydrogeological Reporting Associated with a Groundwater Well Licence). The matrix uses five criteria; the volume requested, the level of allocation, the risk of impacts upon other users and GDEs, and the existing groundwater salinity.

A copy of the decision matrix is provided in Table 11, with the highlighted cells providing the assessment for the proposed groundwater usage based upon an allocation of up to 160,000 kL (5 L/s), a salinity of about 29,000 mg/L TDS, and a level of allocation of 30% to 70%. It is assumed that impacts to other users and GDE's are unlikely.

The results for Table 11 indicate a total score of 6 points, which indicates that an assessment is generally not required, unless other knowledge of risks indicate a higher level of assessment is warranted. The next level of assessment is a H1 assessment, which requires a desktop hydrogeological assessment.

Note that the level of allocation and potential for unacceptable impacts has been estimated, based on available information, and the DWER reserve the right to request a higher level of assessment if they are uncertaint about the potential impact to the water resource, other groundwater users or the environment. However, the level of studies completed to date is consistent with a H1 or H2 level study and should be sufficient to meet DWER licensing requirements.

Table 11: DWER Decision Matrix for Hydrogeological Assessments

Volume Requested (kL/year)	**Level of Allocation**	**Potential for Unacceptable Impacts**		**Existing Salinity (mg/L TDS)**
		Other Users	**GDE's**	
<10,000 (0 points)	**30-70% (1 point)**	**Impacts unlikely (0 points)**	**Impacts unlikely (0 points)**	Fresh <500 (4 points)
10,001–50,000 (2 points)	70-<100% (3 points)	Impacts possible (2 points)	Impacts possible (2 points)	Marginal 501-1,500 (3 points)
50,000-250,000 (4 points)	100% + (5 points)	Impacts likely (5 points)	Impacts likely (5 points)	Brackish 1,501-5,000 (2 points)
250,001-500,000 (6 points)				**Saline 5,001-50,000 (1 point)**
500,001-1,000,000 (8 points)				Hypersaline >50,000 (0 points)
1,000,000-2,500,000 (15 points)				
>2,500,000 (20 points)				

0 to 7 Points – Generally no assessment required, unless other knowledge of risks indicates that H1 level assessment is warranted.

8 to 12 points – H1 level of assessment (desktop hydrogeological assessment). However, low volume applications with low risk of impacts may not warrant an assessment.

12 to 18 points – H2 level of assessment (basic hydrogeological assessment, including installation and testing of investigation bores).

>19 points – H3 level of assessment (detailed hydrogeological assessment including installation and testing of investigation bores and a groundwater model)

7.3 Requirement for Operating Strategies

The DWER may require an operating strategy as part of the GWL conditions. This requirement is assessed using a second decision matrix presented in Operational Policy 5.08 (Use of Operating Strategies in the Water Licensing Process), which is similar to the matrix used to assess reporting requirements (Section 7.2).

A copy of the operating strategy matrix is presented as Table 12, with the highlighted cells providing the assessment for the proposed groundwater usage. The tabulated results indicate a total score of 2 points, which indicates an operating strategy is unlikely to be required. Again, the DWER reserves the right to request a basic operating strategy if they are uncertaint about the potential impact to the water resource, other groundwater users or the environment.

Table 12: DWER Decision Matrix for Operating Strategies

Volume Requested (kL/year)	Level of Allocation	Potential for Unacceptable Impacts		Existing Salinity (mg/L TDS)
		Other Users	GDE's	
0-499,999 (0 points)	0-30% (0 point)	**Impacts unlikely (0 points)**	**Impacts unlikely (0 points)**	Fresh <1500 (4 points)
500,000-2,000,000 (2 points)	**30-70% (1 point)**	Impacts possible (2 points)	Impacts possible (2 points)	Brackish 1,501-5,000 (2 points)
2,000,001-5,000,000 (5 points)	70-<100% (3 points)	Impacts likely (5 points)	Impacts likely (5 points)	**Saline 5,001-50,000 (1 point)**
>5,000,001 (8 points)	100% + (5 points)			Hypersaline >50,000 (0 point)

0 to 7 Points – Development of an operating strategy unlikely to be required.

8 to 12 points – A basic operating strategy is likely to be required.

12 to 18 points – Development of a detailed operating strategy is required.

8.0 Summary and Conclusions

Blue Cap Mining Limited is assisting IMD with the project approvals for their British Hill Gold Project, approximately 73 km south-east of Southern Cross. The proposed project will comprise an open pit developed to a depth of about 70 m below ground level, over a LoM of 6 months. It is proposed that ore will be trucked off site for processing.

The project will require a small water supply during construction and for dust suppression during mining, which may be in the order of up to 5 L/s. It is anticipated that the demand will be met by an external source (i.e. water supply bore/s) which will be supplemented by mine dewatering once the pit develops below the water table.

Groundwater Resource Management (GRM) completed a hydrogeological study for the British Hill project to estimate dewatering rates and assess likely water supply options. The results of the assessment can be summarised as follows:

- The project is located within the Westonia Groundwater Sub Area of the Westonia Groundwater area, on an interfluve between northerly draining palaeo-tributaries of the internally draining Deborah palaeodrainage system. Groundwater occurrences within the project tenements are likely to be limited to fractured bedrock aquifers.
- The closest registered bore, as reported in the DWER WIR database, is located 5 km from the proposed pit and is not currently licensed for use. The nearest current groundwater licensee is Richard Reed, for the Dulcie Borefield, located 6.7 km north-west of the proposed pit.
- A site visit was undertaken by GRM in July 2020 which included collection of hydrogeological data during the drilling of a temporary water supply bore, the collection of groundwater samples for laboratory analysis, groundwater level measurements and general observations.
- The data collected during the site visit indicates low permeability conditions in the bedrock in the vicinity of the proposed pit, with an estimated bulk hydraulic conductivity expected to be in the order of 0.01 m/d. This value is consistent with the regional interpretation which indicates that modest permeability is associated with discrete fractures within the otherwise low permeability, intact bedrock. The groundwater quality is approximately 29,000 mg/L TDS and the groundwater level is approximately 43 m below ground level.
- Estimated dewatering rates for the proposed pit, based on the calculated bulk hydraulic conductivity value is in the order of 2.5 L/s once the pit extends below the water table. This indicates that the project will require a reliable water supply, capable of producing 5 L/s for the construction period and the first few months of mining, decreasing by about 50% towards the latter stages once the pit extends below the water table.
- Based on the dewatering rates estimated above, the strategy for the project will likely comprise dewatering of the pit via sump pumping methods to maintain dry mining conditions. Sumps should be located on the lowest point on the pit floor, with drains used as required to direct groundwater inflows to the sump. Sump pumps should be equipped with flow meters, installed in accordance with the DWER guidelines (2009).
- Airlift yield measurements were collected from a newly constructed drillers water supply bore (20BHMW001) during the site visit. Airlift yields were low, less than 1 L/s, indicating the bore is not considered a viable long term water supply for the project. Similarly the FW Drillers Bore, located 3 km north east from the proposed pit is also low yielding, and unsuitable as a long term groundwater source. The nearby Turkeys Nest Bore has not been tested at this stage and could still be considered a potential water source.

SUMMARY AND CONCLUSIONS

- Potential water supply options for the project include:
  - Negotiating access to the licenced Dulcie Borefield, with licensee Richard Reed. The borefield draws groundwater from the palaeochannel aquifer which is considered a reliable long term supply and given that IMD has tenure (L77/221) connecting the groundwater licence tenements to the British Hill project area, this option may be a consideration. The borefield is currently only licenced for 60,000 kL per annum (1.9 L/s), although it is unclear whether the borefield is capable of higher yields.
  - Airlift test the Turkeys Nest Bore to determine it's suitability as a long term supply.
  - Identify new on-tenement fractured bedrock water sources. Newexco has identified two potential groundwater targets, based on assessment of existing geophysical data. The target locations are provided in Table 7 and shown in Figure 7. In the event that the targets are unsuccessful, an alternate option may be to target pegmatite contacts within the tenement. Modest groundwater supplies can occur along pegmatite contacts, particularly where fracture zones have been enhanced by chemical dissolution.
- A pit lake model was developed using the generic systems modelling package GoldSim, to simulate pit lake conditions after mine closure. The results indicate that the pit lake level equilibrates after about 120 years as the groundwater and rainfall inflows reach equilibrium with the evaporative losses. The pit lake level during the remainder of the 500 year modelled period varies seasonally between about 52 to 54 m below ground level. The results indicate that the pit acts as groundwater sink, and consequently the risk of outflows of pit lake water to the groundwater environment post closure is low for the current climate regime. Note that the model results assumed that a catchment bund is in place to prevent catchment runoff to the pit, which should be confirmed for closure planning. The model indicates that the salinity in the pit lake will increase to about 106,000 mg/L TDS after 500 years post closure.
- During the operational phase of the project and upon closure, mine dewatering will result in localised groundwater drawdown in proximity to the open pit. The risk of environmental impact to other groundwater users, the groundwater environment and GDE's as a result of mine dewatering is considered low, given that:
  - the expected localised drawdown around the pit is limited to about 54 m,
  - the short duration of the project (6 months),
  - the nearest registered bore is 5 km from the proposed pit, and is not currently licensed for use,
  - the nearest current licensee is approximately 6.7 km north of the proposed pit, and
  - there are no identified areas of high potential for GDE's in proximity to the proposed pit.
- The project will require a groundwater licence, issued by the DWER, for approximately 160,000 kL per annum (which permits up to 5 L/s on an annualised basis). This report should be used as supporting documentation for the application to DWER. It is considered unlikely that an operating strategy will be required for the project. However, DWER may request an operating strategy if they have uncertainty about potential impacts.

Signatures

Groundwater Resource Management Pty Ltd

KMcDougall

R. Garnham

Kathy McDougall

PRINCIPAL HYDROGEOLOGIST

Rob Garnham

PRINCIPAL HYDROGEOLOGIST

Doc Ref: J1948R01_final

REFERENCES

Cotton, Dunphy, Bubner 1989 “Annual Report to 25 April 1989 on P77/706-729, P77/791-792 (M77/289), P77/976-977, 988 (M77/365), E77/48 (M77/342-344), Parker Range, SH-60-16, Southern Cross, Western Australia” Internal report prepared by CRA Exploration

Department of Water and Environment Regulation 2011 “Operational policy 5.08 – Use of Operating Strategies”

Department of Water and Environment Regulation 2011 “Operational Policy 5.12 – Hydrogeological Reporting Associated with Groundwater Well Licenses”

Department of Water and Environment Regulation 2009 “Guidelines for Water Meter Installation”

Gee 1982 1:250,000 Geological Series Explanatory Notes Southern Cross, Geological Survey of Western Australia

Theis, C.V., 1935 “The Relationship Between The Lowering of the Piezometric Surface and the Rate and Duration of Discharge of a Well Using Groundwater Storage”, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

Thiem, G., 1906 “Hydrologische Methoden”, Gebhardt, Leipzig.

Turk. L.J., 1970 “Evaporation of Brine: A Field Study of the Bonneville Salt Flats, Utah”, Water Resource Research, vol 6, no. 4, pp 1209-1215.

FIGURES

GROUNDWATER RESOURCE MANAGEMENT

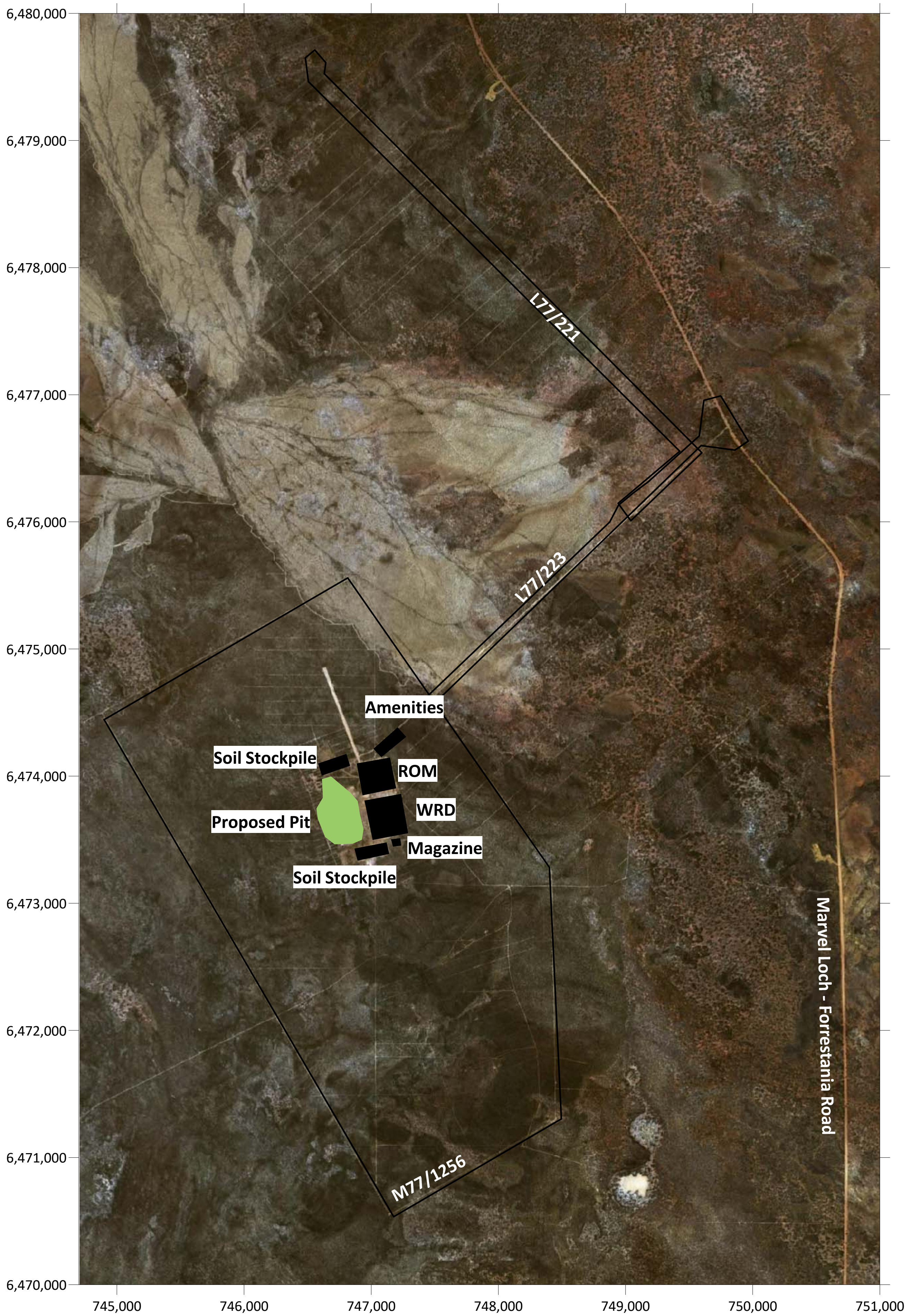
FIGURE 1
LOCATION PLAN

Date Jul 20
Client Blue Cap Mining Ltd
Project British Hill Project
Document J1948R01

Coordinate System
nil
Notes

Data Sources

FILE://Jobs2019/J1948 Blue Cap British Hill/figures/surfer/J1948R01/J1948R01 fig1 site location plan.srf



GROUNDWATER RESOURCE MANAGEMENT

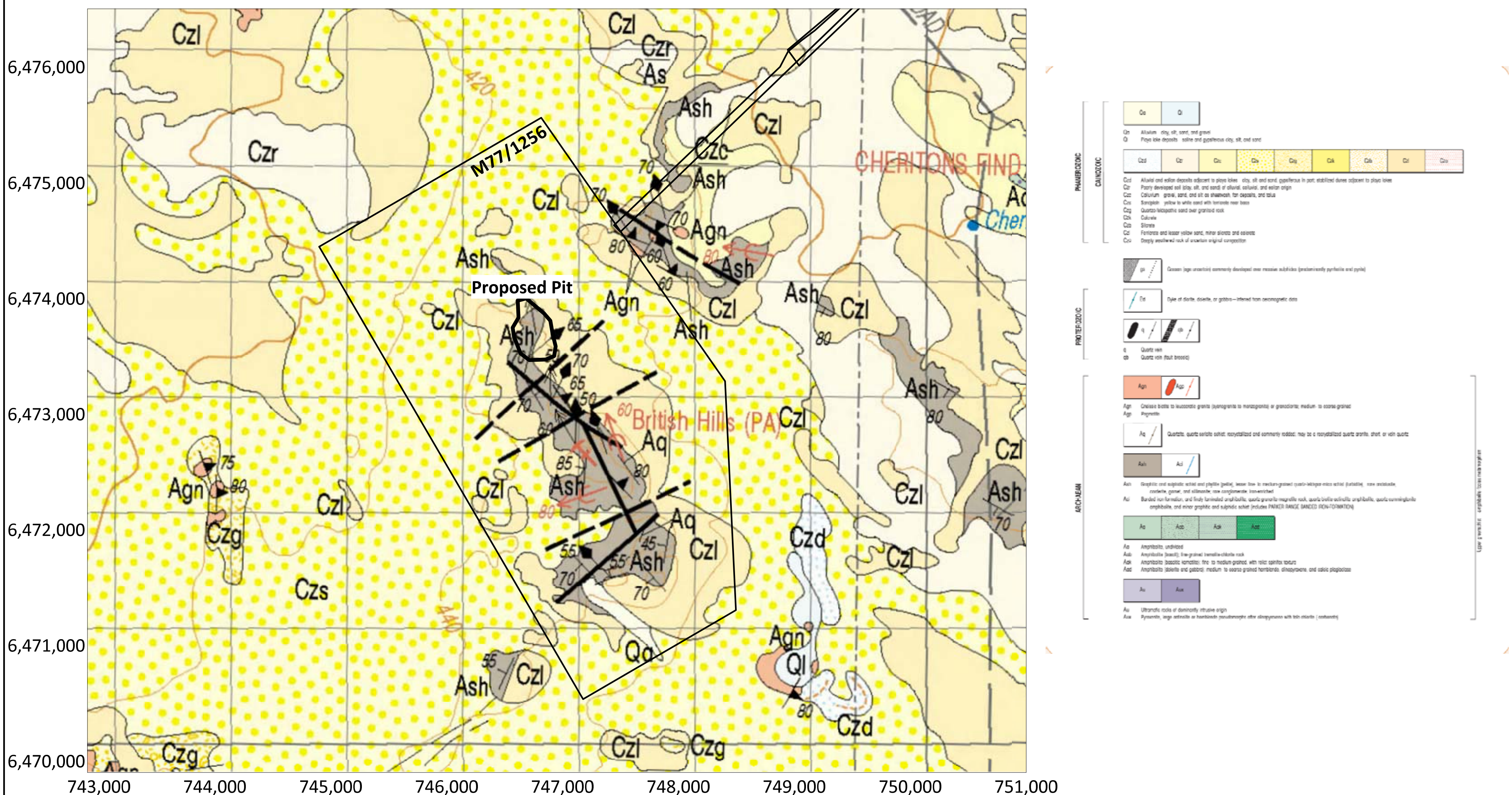
FIGURE 2
SITE PLAN

Date Jul 20
Client Blue Cap Mining Ltd
Project British Hill Project
Document J1948R01

Coordinate System
MGA Zone 50
Notes

Data Sources

FILE://Jobs2019/J1948 Blue Cap British Hill/figures/surfer/J1948R01/J1948R01 fig2 site plan.srf



GROUNDWATER RESOURCE MANAGEMENT

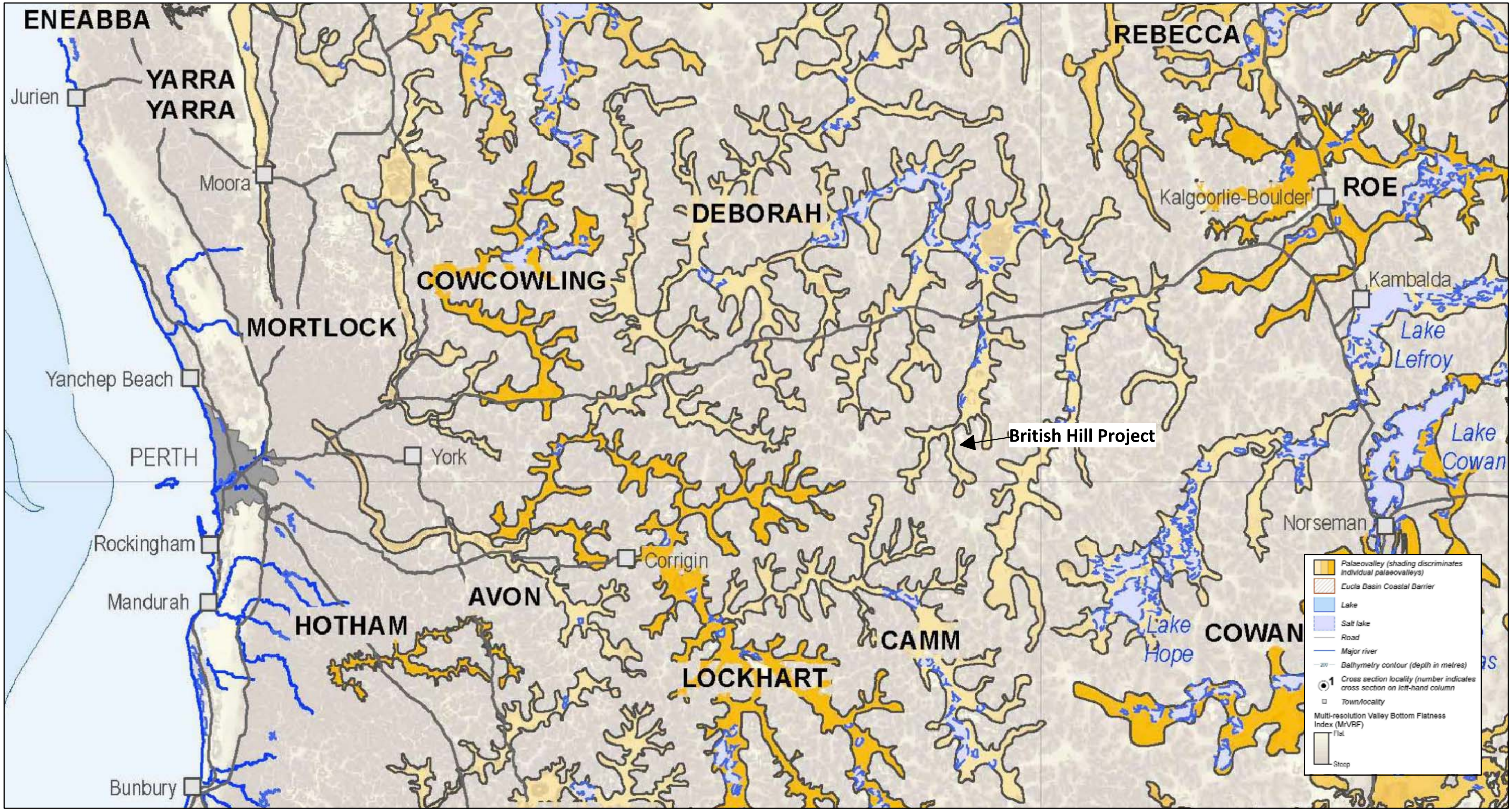
FIGURE 3
GEOLOGY

Date July 2020
Client Blue Cap Mining Ltd
Project British Hill Project
Document J1948R01

Coordinate System
GDA94 Zone 50
Notes

Data Sources
1:100 000 Cheritons Find Geological Sheet

FILE://J1948 Blue Cap Mining British Hills/figures/surfer/J1948R01/J948R01 figure 3 geology.srf



GROUNDWATER RESOURCE MANAGEMENT

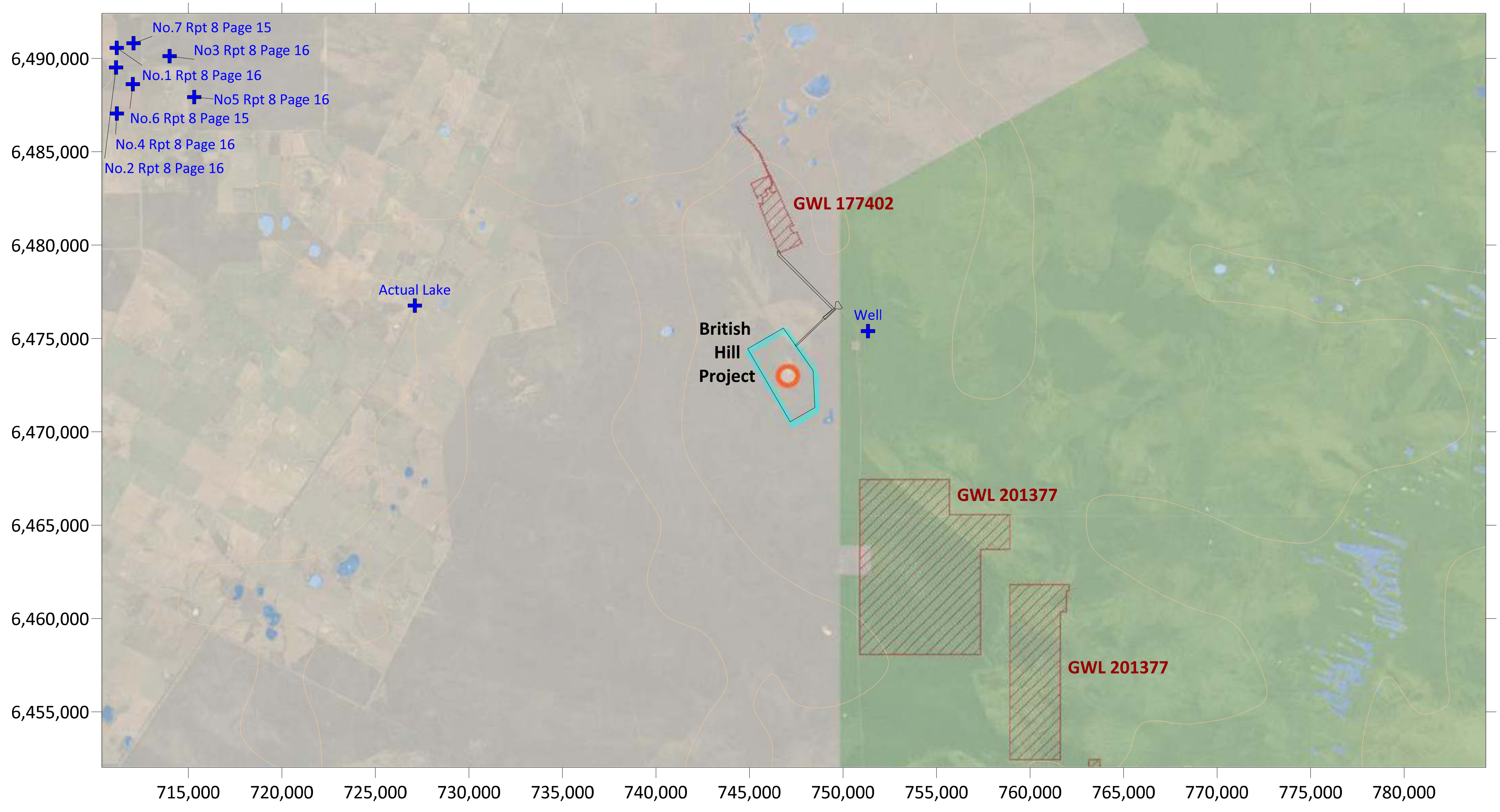
FIGURE 4
REGIONAL HYDROGEOLOGY

Date July 2020
Client Blue Cap Mining Ltd
Project British Hill Project
Document J1948R01

Coordinate System
nil
Notes

Data Sources
WASANT Palaeovalley Map

FILE://J1948 Blue Cap Mining British Hills/figures/surfer/J1948R01/J948R01 figure 4 regional hydrogeology.srf



Project Tenements
WIR Database
Nearby Groundwater Licences
WASANT Palaeovalleys

GROUNDWATER RESOURCE MANAGEMENT

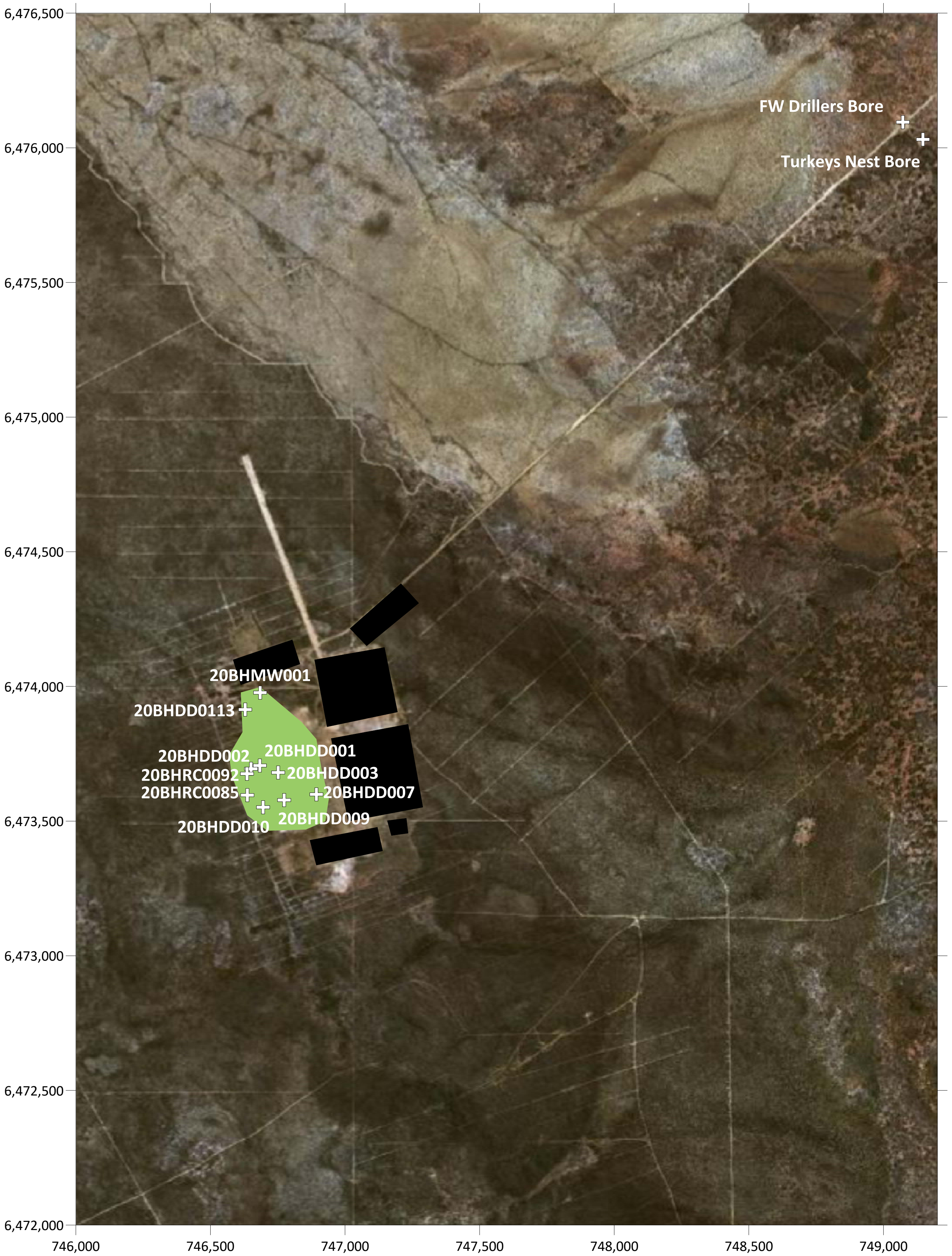
FIGURE 5
OTHER GROUNDWATER USERS

Date July 2020
Client Blue Cap Mining Ltd
Project British Hill Project
Document J1948R01

Coordinate System
GDA94 Zone 50
Notes

Data Sources
WIR Database
WASANT Palaeovalley
DWER Water Register

FILE://J1948 Blue Cap Mining British Hills/figures/surfer/J1948R01/J1948R01 Fig5 Other users.srf



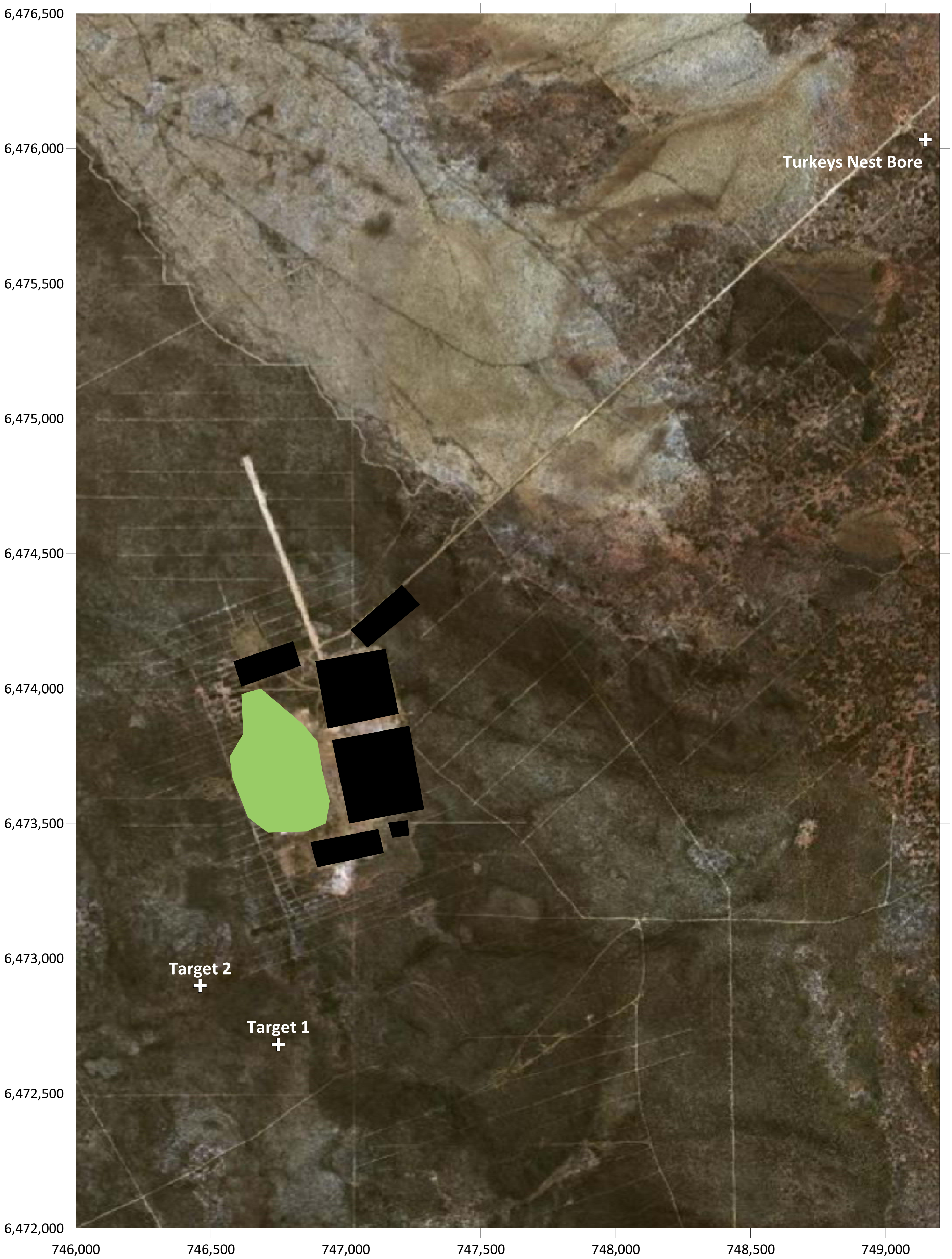
GROUNDWATER RESOURCE MANAGEMENT

FIGURE 6
FIELD INVESTIGATIONS

Date Jul 20
Client Blue Cap Mining Ltd
Project British Hill Project
Document J1948R01

Coordinate System
MGA Zone 50
Notes

Data Sources



GROUNDWATER RESOURCE MANAGEMENT

FIGURE 7
WATER SUPPLY TARGETS

Date Jul 20
Client Blue Cap Mining Ltd
Project British Hill Project
Document J1948R01

Coordinate System
MGA Zone 50
Notes

Data Sources

FILE://Jobs2019/J1948 Blue Cap British Hill/figures/surfer/J1948R01/J1948R01 fig7 water supply options.srf

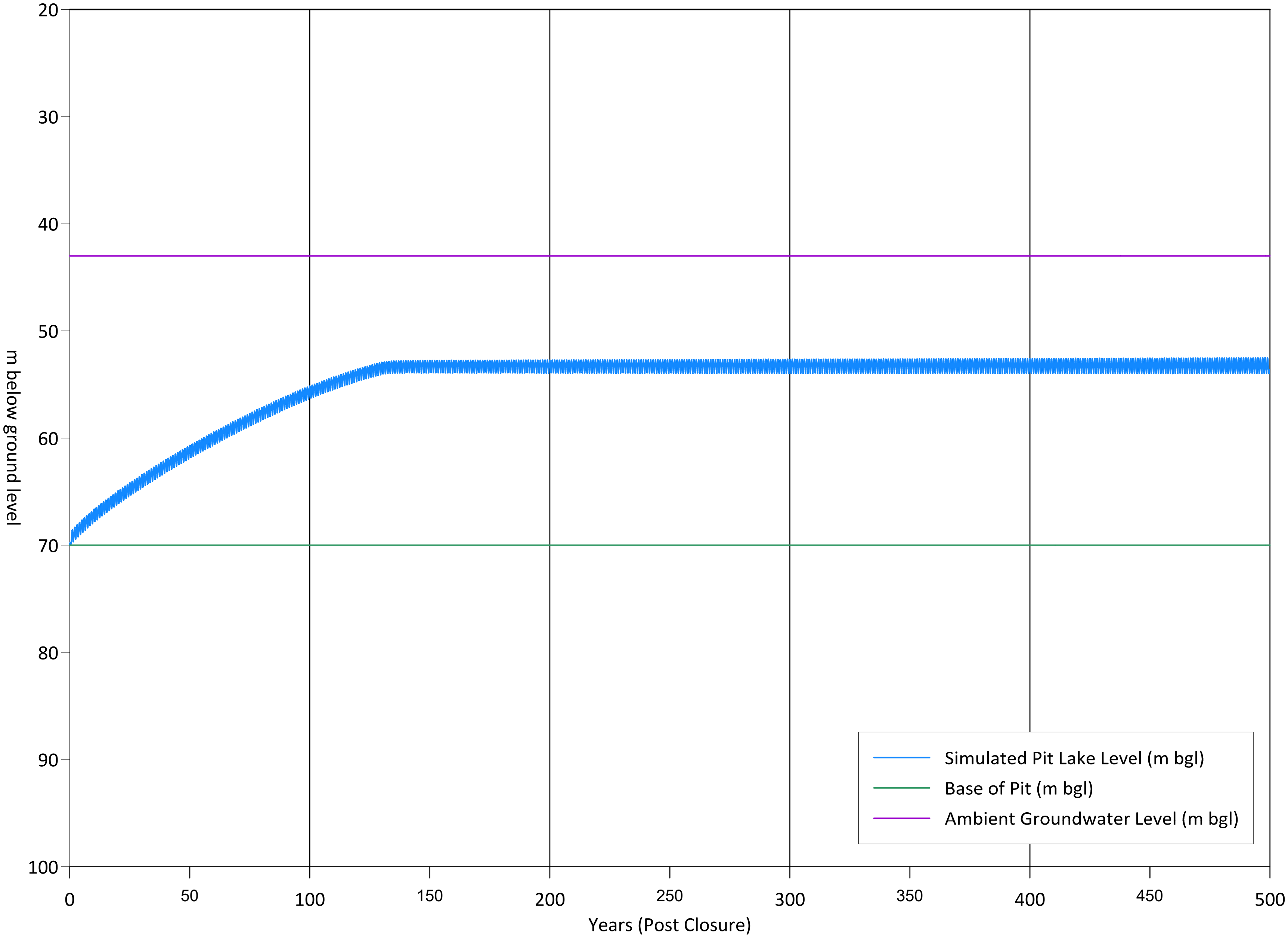
E:\Dropbox (GRM)\GRM Team Folder\Jobs 2019\J1948 Blue Cap Mining British Hills\figures\grapher\J1948R01 Fig 8 Pit lake modelling results.grf

GROUNDWATER
RESOURCE MANAGEMENT

FIGURE 8
PIT LAKE MODELLING RESULTS

Date July 2020
Client Blue Cap Mining Ltd
Project British Hill Project
Document J1948R01

Notes:

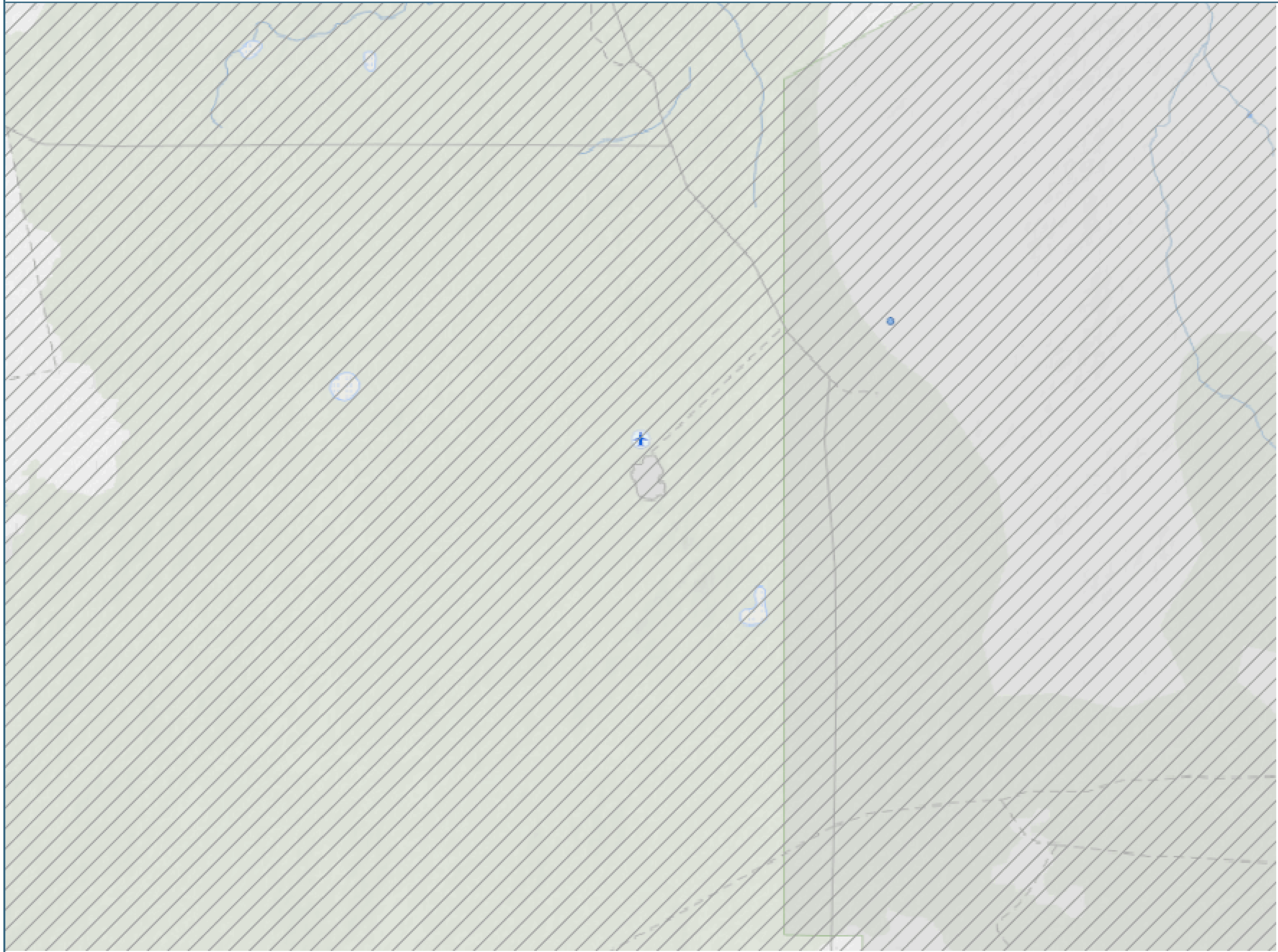


Appendix A: GDE Map

Australian Government
Bureau of Meteorology

Groundwater Dependent Ecosystems Atlas

Subterranean GDE 25 km from 746,770mE 6,473,700mN



GDE Update Subterranean

Replace

Hybrid

New Attributes

No Change

Subterranean GDE

Known GDE (regional study)

High potential GDE (regional study)

Moderate potential GDE (regional study)

Low potential GDE (regional study)

Unclassified potential GI (regional study)

Subterranean GDE (no data)

N

1:132,553

Kilometres 2 4

Data Source: Bureau of Meteorology, Geoscience Australia and State/Territory lead water agencies. Refer to metadata for further information: Click here

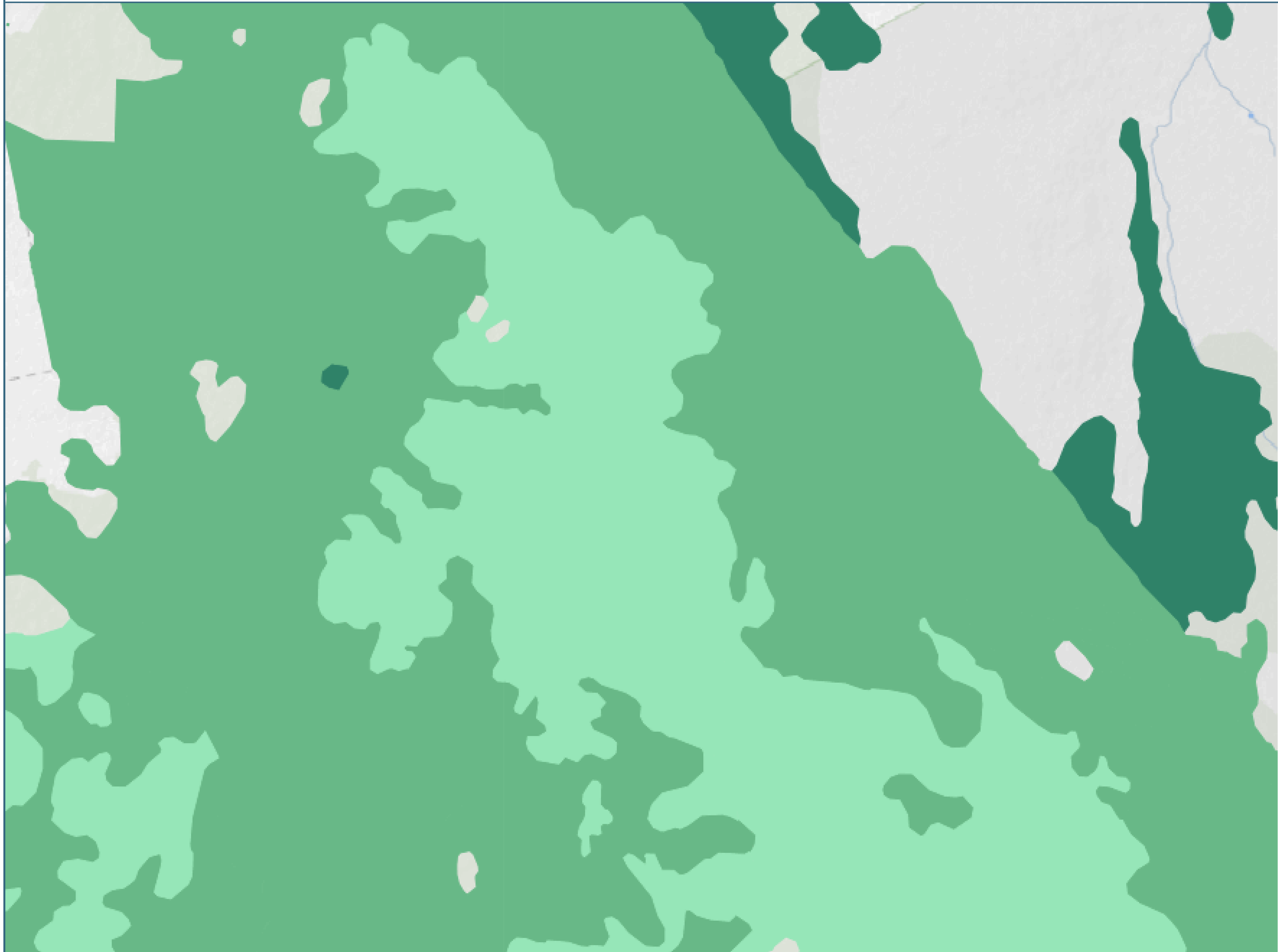
Australian Albers GDA94

Date: 20 July, 2020

Australian Government
Bureau of Meteorology

Groundwater Dependent Ecosystems Atlas

Terrestrial GDE 25 km from 746,770mE 6,473,700mN



Terrestrial GDE (no data)

No ecosystems analysed

Terrestrial GDE

Known GDE (regional study)

High potential GDE (regional study)

Moderate potential GDE (regional study)

Low potential GDE (regional study)

Unclassified potential GI (regional study)

High potential GDE (national assessment)

Moderate potential GDE (national assessment)

Low potential GDE (national assessment)

Unclassified potential GI (national assessment)

N

1:132,553

Kilometres 2 4

Data Source: Bureau of Meteorology, Geoscience Australia and State/Territory lead water agencies. Refer to metadata for further information: Click here

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Date: 20 July, 2020

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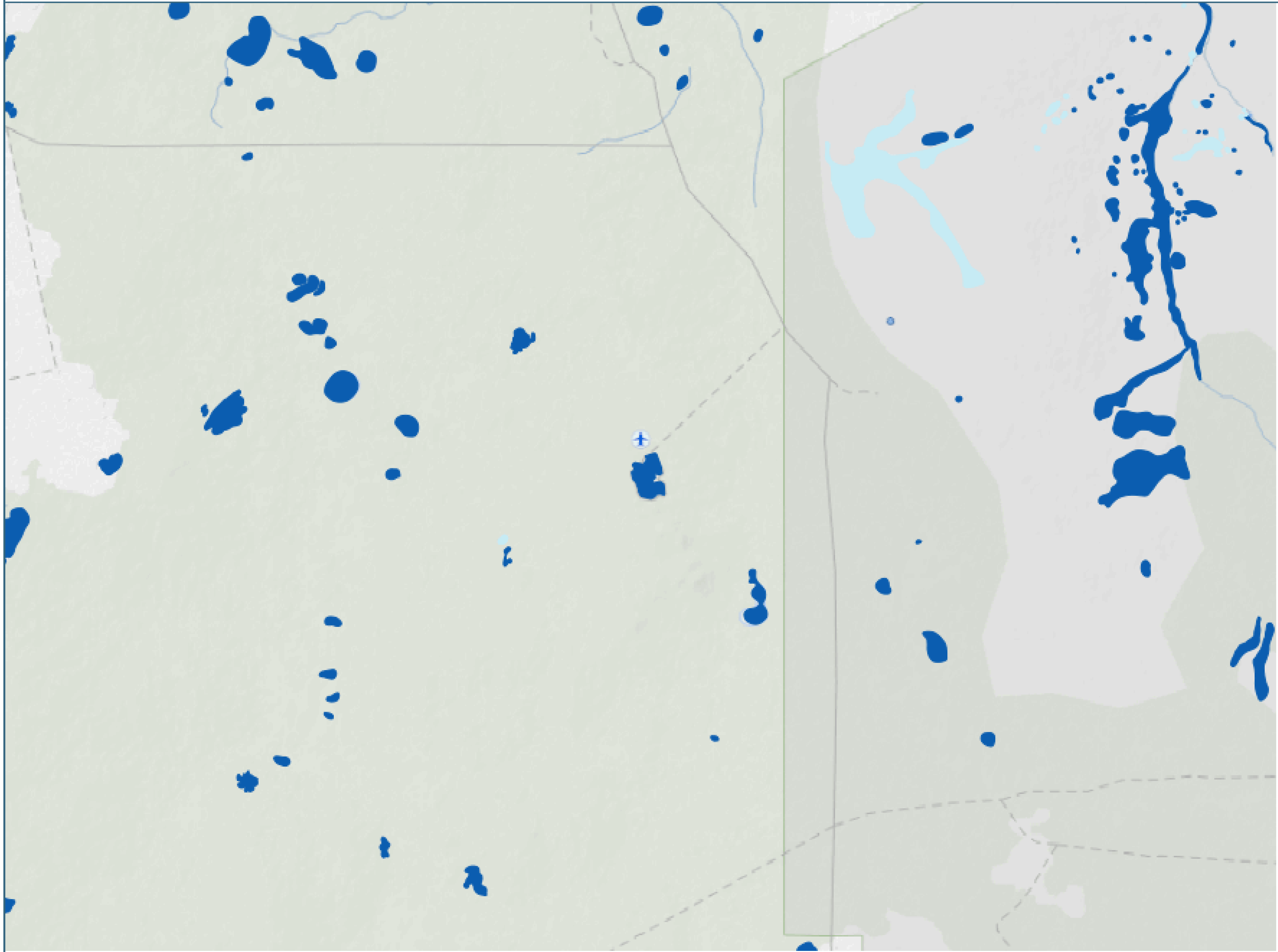
Groundwater Dependent Ecosystems Atlas

Aquatic GDE 25 km from 746,770mE 6,473,700mN



Aquatic GDE

- Known GDE (regional study)
- High potential GDE (regional study)
- Moderate potential GDE (regional study)
- Low potential GDE (regional study)
- Unclassified potential GI (regional study)
- High potential GDE (national assessment)
- Moderate potential GDE (national assessment)
- Low potential GDE (national assessment)
- Unclassified potential GI (national assessment)

GDE Update Aquatic - spring

- Replace

N

1:132,553

Kilometres 2 4

Data Source: Bureau of Meteorology, Geoscience Australia and State/Territory lead water agencies. Refer to metadata for further information: Click here

Australian Albers GDA94

Date: 20 July, 2020

Appendix B: Laboratory Certificates

SGS

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Kathy McDougall
Client	Groundwater Resource Management
Address	PO Box 8110 Fremantle High Street, Fremantle, WA, 6160 23 Parry Street Fremantle 6160 KARDINYA WA
Telephone	9433 2222
Facsimile	9433 2322
Email	kathy@g-r-m.com.au
Project	**British Hill**
Order Number	**J1948**
Samples	2

LABORATORY DETAILS

Manager	Marjana Siljanoska
Laboratory	SGS Perth Environmental
Address	28 Reid Rd Perth Airport WA 6105
Telephone	(08) 9373 3500
Facsimile	(08) 9373 3556
Email	au.environmental.perth@sgs.com
SGS Reference	**PE143978 R0**
Date Received	22 Jun 2020
Date Reported	29 Jun 2020

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(898/20210).

Metals: LORs raised due to high conductivity.
Metals: The over range results on ICPMS Method AN318 were reported using ICPOES method AN320.

SIGNATORIES

Louise HOPE
Laboratory Technician

Murray O'NEILL
Lab Technician-Nutrients Signatory

Ohmar DAVID
Metals Chemist

Parameter	Units	LOR	PE143978.001	PE143978.002
Sample Number			PE143978.001	PE143978.002
Sample Matrix			Water	Water
Sample Date			18/6/20 13:30	18/6/20 15:55
Sample Name			Turkey Nest Bore	New Water Hole

pH in water Method: AN101 Tested: 22/6/2020

pH**	pH Units	0.1	6.8	6.6

Conductivity and TDS by Calculation - Water Method: AN106 Tested: 22/6/2020

Conductivity @ 25 C	µS/cm	2	40000	19000

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 24/6/2020

Total Dissolved Solids Dried at 175-185°C	mg/L	10	29000	13000

Alkalinity Method: AN135 Tested: 22/6/2020

Total Alkalinity as CaCO3	mg/L	5	110	25
Carbonate Alkalinity as CO3	mg/L	1	<1	<1
Bicarbonate Alkalinity as HCO3	mg/L	5	140	31

Chloride by Discrete Analyser in Water Method: AN274 Tested: 23/6/2020

Chloride, Cl	mg/L	1	15000	6300

Sulfate in water Method: AN275 Tested: 23/6/2020

Sulfate, SO4	mg/L	1	2100	1500

Parameter	Units	LOR	Sample Number: PE143978.001 Sample Matrix: Water Sample Date: 18/6/20 13:30 Sample Name: Turkey Nest Bore	Sample Number: PE143978.002 Sample Matrix: Water Sample Date: 18/6/20 15:55 Sample Name: New Water Hole

Low Level Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA   Method: AN258   Tested: 25/6/2020

Parameter	Units	LOR	PE143978.001	PE143978.002
Nitrate, NO_3 as NO_3	mg/L	0.05	0.07	<0.05

Metals in Water (Dissolved) by ICPOES   Method: AN320   Tested: 24/6/2020

Parameter	Units	LOR	PE143978.001	PE143978.002
Calcium, Ca	mg/L	0.2	350	290
Magnesium, Mg	mg/L	0.1	1000	500
Potassium, K	mg/L	0.1	190	100
Soluble Silicon as Silica, SiO2	mg/L	0.05	69	44
Sodium, Na	mg/L	0.5	7600	3300
Total Hardness by Calculation	mg CaCO3/L	1	5100	2800

Trace Metals (Dissolved) in Water by ICPMS   Method: AN318   Tested: 25/6/2020

Parameter	Units	LOR	PE143978.001	PE143978.002
Aluminium, Al	μg/L	5	<50↑	<25↑
Iron, Fe	μg/L	5	<50↑	46000
Manganese, Mn	μg/L	1	2400	8000

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Total Alkalinity as CaCO3	LB173003	mg/L	5	<5	105%
Carbonate Alkalinity as CO3	LB173003	mg/L	1	<1	
Bicarbonate Alkalinity as HCO3	LB173003	mg/L	5	<5	

Chloride by Discrete Analyser in Water Method: ME-(AU)-[ENV]AN274

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Chloride, Cl	LB172998	mg/L	1	<1	0%	105%	76 - 83%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB173004	µS/cm	2	<2	0%	99%

Low Level Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA Method: ME-(AU)-[ENV]AN258

Parameter	QC Reference	Units	LOR	MB
Nitrate, NO_3 as NO_3	LB173103	mg/L	0.05	<0.05

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Calcium, Ca	LB173012	mg/L	0.2	<0.2	4%	101%	
Magnesium, Mg	LB173012	mg/L	0.1	<0.1	3%	102%	
Potassium, K	LB173012	mg/L	0.1	<0.1	3%	96%	
Soluble Silicon as Silica, SiO2	LB173012	mg/L	0.05	<0.05			
Sodium, Na	LB173012	mg/L	0.5	<0.5	4%	100%	93%
Total Hardness by Calculation	LB173012	mg CaCO3/L	1	<1			

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage.* Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

pH in water   Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB173004	pH Units	0.1	5.7	0%	99%

Sulfate in water   Method: ME-(AU)-[ENV]AN275

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Sulfate, SO4	LB172998	mg/L	1	<1	0 - 3%	107 - 111%	89 - 102%

Total Dissolved Solids (TDS) in water   Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery	MSD %RPD
Total Dissolved Solids Dried at 175-185°C	LB173029	mg/L	10	<10	1%	102%	98%	9%

Trace Metals (Dissolved) in Water by ICPMS   Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Aluminium, Al	LB173074	µg/L	5	<5	8%	91%
Iron, Fe	LB173074	µg/L	5	<5	0%	120%
Manganese, Mn	LB173074	µg/L	1	<1	1 - 7%	96%

METHOD	METHODOLOGY SUMMARY
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN106	Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN113	The Total Dissolved Solids residue may also be ignited at 550 C and volatile TDS (Organic TDS) and non-volatile TDS (Inorganic) can be determined.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN258	Nitrate and Nitrite by FIA: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Without the cadmium reduction only the original nitrite is determined. Reference APHA 4500-NO3- F.
AN274	Chloride by Discrete Analyse: Chloride reacts with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference APHA 4500Cl-
AN275	sulfate by Discrete Analyse: sulfate is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulfate concentration in the sample. Reference APHA 4500-SO42-. Internal reference AN275.
AN318	Determination of elements at trace level in waters by ICP-MS technique,, referenced to USEPA 6020B and USEPA 200.8 (5.4).
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components .
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
Calculation	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
		NVL	Not Validated

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

Appendix C: Geophysics

NEWEXCO
GEOLOGY GEOPHYSICS DISCOVERY

Newexco Exploration Pty Ltd
A 15 Joel Terrace East Perth WA 6004
P +61 8 9227 1266
E hrh@newexco.com.au
W www.newexco.com.au

Technical Note

TO:	Kathy McDougall	**CLIENT:**	GRM
FROM:	Bill Amann	**PROJ / PROS:**	British Hill
Cc:		**DAT / PROJ:**	GDA94
DATE:	12 February 2020	**MEMO #:**	NX23364
SUBJECT:	Fracture Rock Aquifer		

At your request I have examined the historic annual reports, as supplied, for geophysical and geological information to access the area for evidence (interpretational) of faulting for fractured rock aquifer potential in sheared rock, specifically at Grid 1 British Hill, proximal to the pit and laydown areas.

Previous work included Geopeko Moving Loop Electromagnetic (MLEM), two lines Ground Magnetics (GM) carried out by CRAE and Induced Polarization (IP) and geological mapping.

The MLEM at British Hill is only two profiles 6250N and 9150N. A strong bedrock conductor is evident on 6250 N and weak surficial conductors on 9150N; not all that helpful.

The IP is not helpful for this work.

A structural interpretation by CRAE geologists suggests faulting displaced the magnetic anomalies as shown. There was possibly surface evidence mapped that corroborated this interpretation.

Stacked profiles of the Ground Magnetics are shown; located in what I have assumed were AMG 66. My interpretation of these data suggests that a high frequency surficial noise source is related to faulting with a buildup of mag hematite and ferro-crete material along fault zones as shown. Also, the displacement of the main magnetic anomalies is interpreted to be fault related which has been extrapolated to the west. Location of a CRAE geological plan shows interpreted structure as well.

I have selected two positions for possible drilling to intersect the interpreted structures (shown as red stars on Figure 1).

x	y	Datum
746750	6472680	GDA94
746460	6472897	GDA94

Figure 1: GDA94 MGA Z50 translated from AGD using QGIS. Red stars show position of interpreted shear for drilling.