



Roe Gold Project Bombora Hydrogeological Dewatering Assessment

Prepared for:

Ramelius Resources

September 2025

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DOCUMENT STATUS

Version	Purpose of Document	Author	Reviewed By	Review Date
A	Working Draft Report	BDK	AGH	29/08/2025
B	Revised Version	BDK	AGH	02/09/2025
C	Final Version	BDK	AGH	18/09/2025

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Version:	B		
Date:	18 September 2025		
AQ2 Ref:	F:\514\3_C&R\Reports\514F_033c.docx		

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1. INTRODUCTION

1.1 Project Overview

Ramelius Resources (Ramelius) are currently undertaking a Definitive Feasibility Study (DFS) for the Roe Gold Project (the Project) associated with the Bombora gold deposit (Bombora), located approximately 100 km east of Kalgoorlie and about 45 km southwest of Ramelius' Rebecca Gold Project (Rebecca), in the Eastern Goldfields Region of Western Australia (Figure 1.1).

Ramelius plans to develop Bombora with a mine approximately 2.5 km in length, which will consist of three open-cut pits (numbered 1800, 1100 and 700 pits) together with an underground mine over a total period of 9 years. The Project lies within mining tenement M28/388, which is held by fully owned subsidiaries of Ramelius. Mining of all open pits will be completed prior to the commencement of the underground mining operation. The proposed underground mine will be accessed from three portals located in the 1800 pit and the underground workings will extend some 750 m north of the 1800 pit and also beneath the 1100 and 700 pits. Parts of all 3 pits lie within one of the larger salt lakes of the Lake Roe system, with the southern half of the underground mine beneath it. An overview of the proposed Project layout is presented in Figure 1.2.

To enable optimal resource recovery, the mining at Bombora will occur below the groundwater level and hence, dewatering of the open-cut pits and underground workings is required to provide dry mining conditions. A Prefeasibility Study (PFS) level dewatering investigation was previously conducted on Bombora in 2019 by Groundwater Resource Management (GRM) for its former owner, Breaker Resources (GRM, 2019). This involved the drilling and testing of 17 narrow diameter bores in and around the Bombora deposit. Small scale permeability testing was carried out to determine aquifer properties and a basic groundwater model was constructed to assess likely dewatering requirements. The modelling predicted that the required dewatering pumping rates may be in the 50 to 60 L/s (1.6 to 1.9 GL/a) range, owing to a north to south orientation zone of fracturing, which runs through and close to all 3 proposed pits.

It should be noted that mineral processing is planned to take place at Rebecca, with ore being transported from it to Roe. A 65 km long haul road is planned to be constructed to link the Rebecca and Roe Project sites together. Any dewatering volumes abstracted from the Bombora mine is planned to be used on-site for dust suppression and construction purposes, with any excess water being discharged into planned evaporation ponds located at Bombora. There will be no discharge of surplus dewatering water into the environment (i.e. Lake Roe). The water demand for the Processing Plant at Rebecca (~3 GL/year, or 95 L/s) is planned to be mainly supplied from the regional Rebecca Palaeochannel system and its palaeo-tributary channels (the Rebecca Palaeochannel Borefield), supplemented with any surplus dewatering from the Rebecca Project pits.

AQ2 has been engaged by Ramelius to undertake a DFS level hydrogeological dewatering study at Bombora to further investigate a zone of enhanced permeability, to confirm local aquifer parameters and to more accurately determine dewatering pumping rates likely to be required during mining of the Bombora pits and underground.

Ramelius is currently preparing regulatory approval applications for the development of the Bombora deposit and this report has been prepared in line with required submissions to the Department of Mines, Petroleum and Exploration (DMPE) and the Department of Water and Environmental Regulation (DWER). In order to assess potential impacts that the proposed abstraction of groundwater from the weathered/fractured aquifer at the Bombora Mine (due to dewatering) may have on other existing groundwater users and the environment, an H2 hydrogeological assessment report is required to be prepared, and the results are presented herein. This H2 hydrogeological report will support Ramelius' 5C groundwater licence (GWL) application to DEWR.

This report presents the results of site groundwater investigations completed to date at the Bombora mine and an H2 level of hydrogeological assessment. This report has been prepared in line with *Operational Policy No 5.12 – Hydrogeological reporting associated with a groundwater well licence* (DWER, 2009).

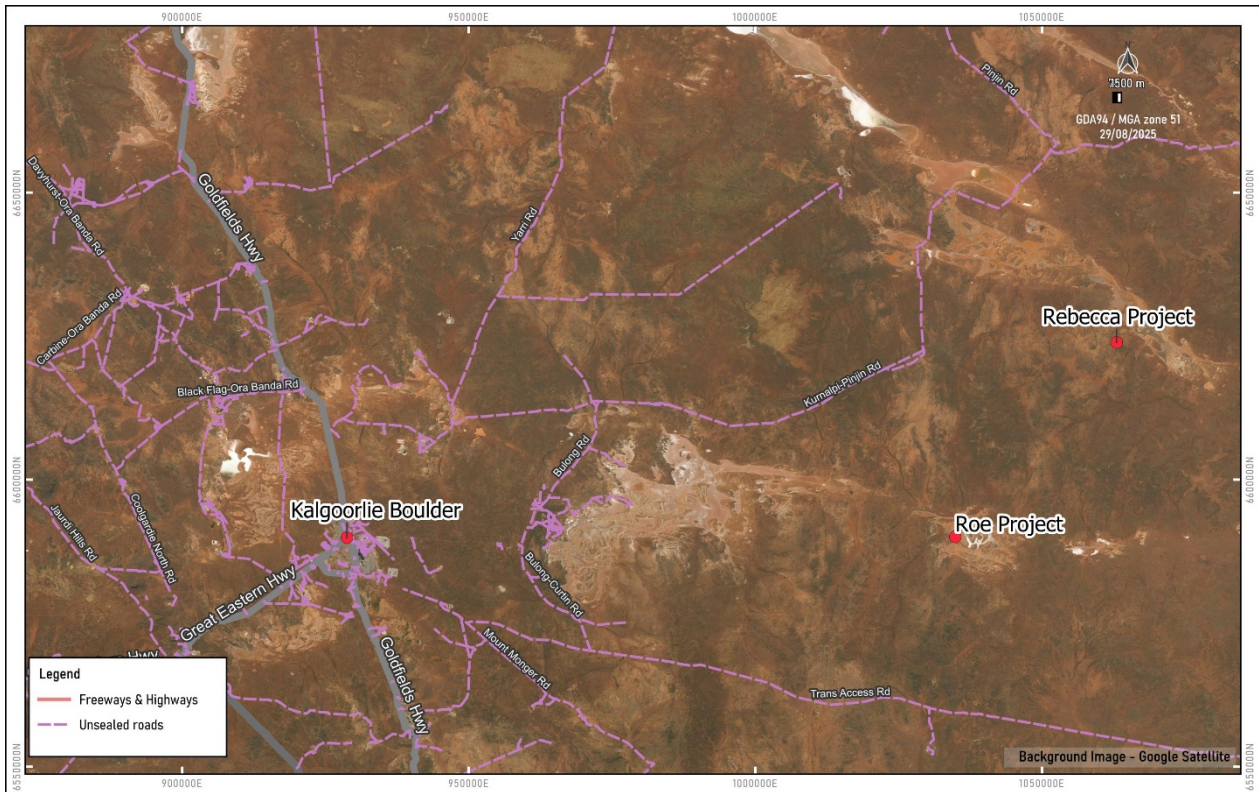


Figure 1.1 Roe Project Location

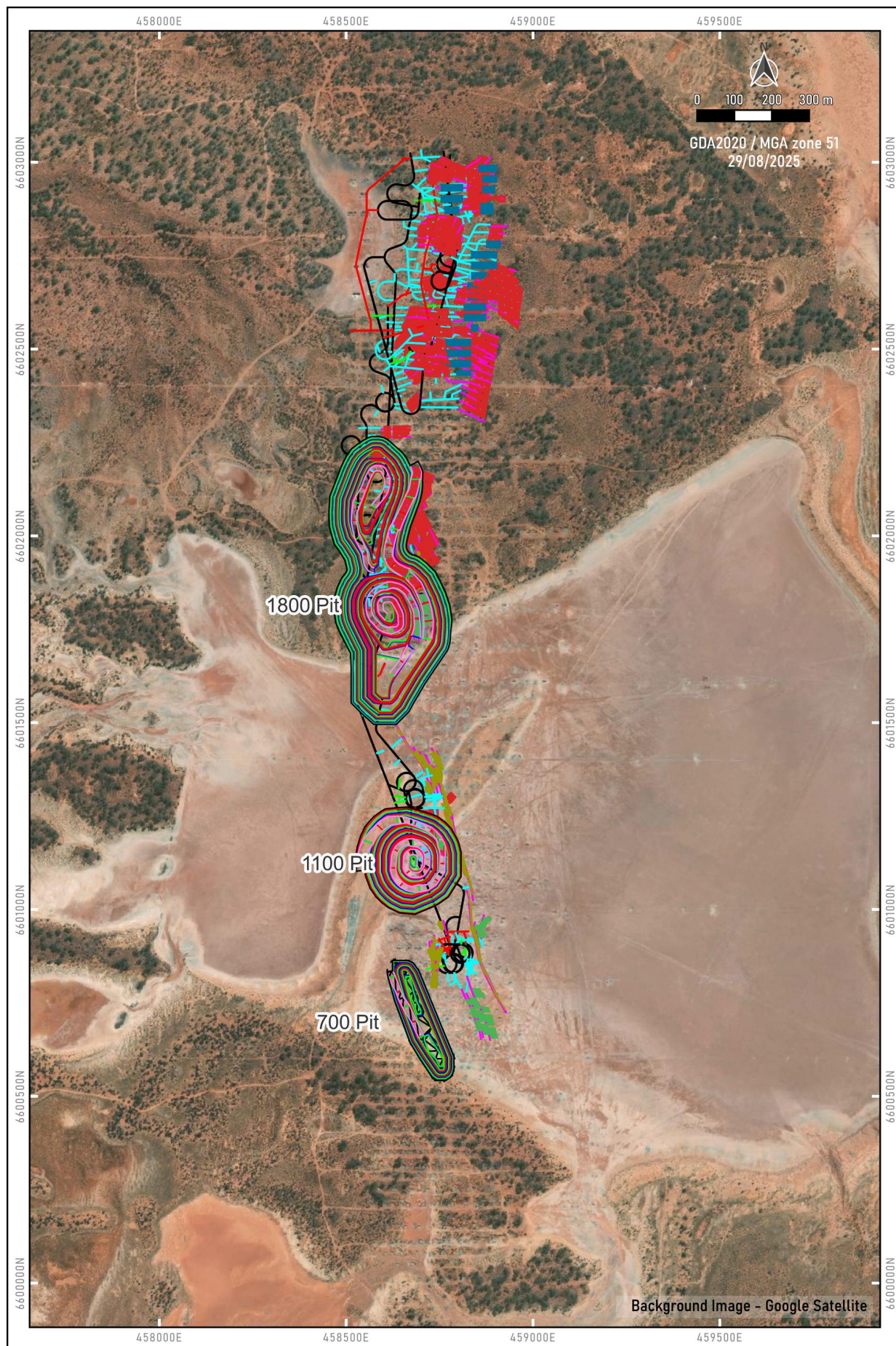


Figure 1.2 Roe Project Deposits Location

2. PHYSICAL SETTING

2.1 Climate and Rainfall

The Project area is located within the northeastern Goldfields region of Western Australia and has a semi-arid climate with dry, hot summers and cool to mild winters. January is the hottest month with mean daily minimum and maximum temperatures of 16.8°C and 33.7°C respectively. In winter, July is the coldest month with an average minimum temperature of 5.1°C and an average maximum temperature of 18.3°C.

There are a number of regional weather stations which collect rainfall data. The location and data availability from each of these weather stations is summarised in Table 2.1.

Table 2.1 Regional Weather Stations

Weather Station	Lake Roe Distance (km)	Direction from Lake Roe	Data Collection Period
Karonie	30	South	1915-1986
Cowarna Downs	40	South-southwest	1968-2020
Kalgoorlie Airport	100	West	1939-2025
Gindalbie	95	Northwest	1918-2025

The nearest Bureau of Meteorology (BoM) rainfall station to the Project is at Cowarna Downs (BoM Station Number 12220), located approximately 40 km away. A summary of the Cowarna Downs station SILO dataset is as follows:

- Long-term average annual rainfall of 260.7 mm.
- Annual average Class A pan evaporation rate of 2,420 mm and an annual average Morton's shallow lake evaporation rate of 1,560 mm (from SILO interpolation at Cowarna Downs).
- Long-term average maximum temperature of 26 °C.

Monthly average rainfall, Class A pan evaporation, Morton's shallow lake evaporation, maximum and minimum temperature (1970–2024) are shown in Figure 2.1.

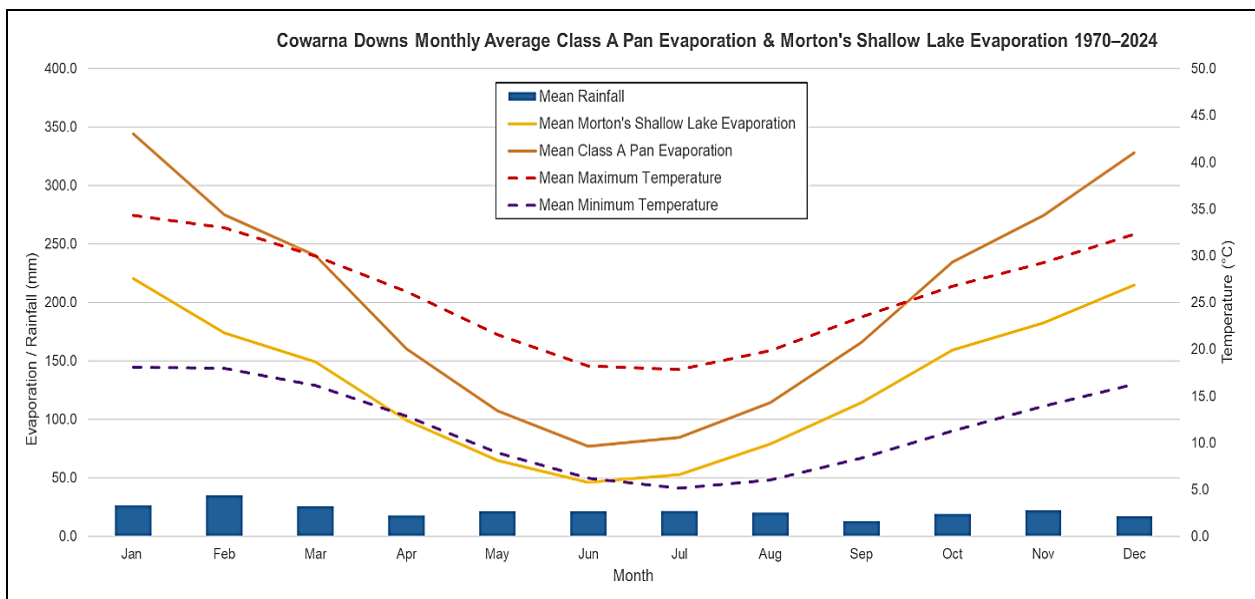


Figure 2.1 Cowarna Downs Monthly Average Climate Characteristics (1970–2024)

The rainfall has also been monitored at an on-site weather station at Bombora since 2018 (Figure 2.2). The average rainfall for the more recent period 2018 to 2023 was 233 mm, but varied between 146 and 482 mm per annum. Rainfall is relatively evenly spread throughout the year, with evaporation greatly exceeding rainfall during every month of the year and being the highest in January (Figure 2.1). The long-term average annual evaporation rate is about 9 to 10 times higher than the long and short-term annual rainfall averages.

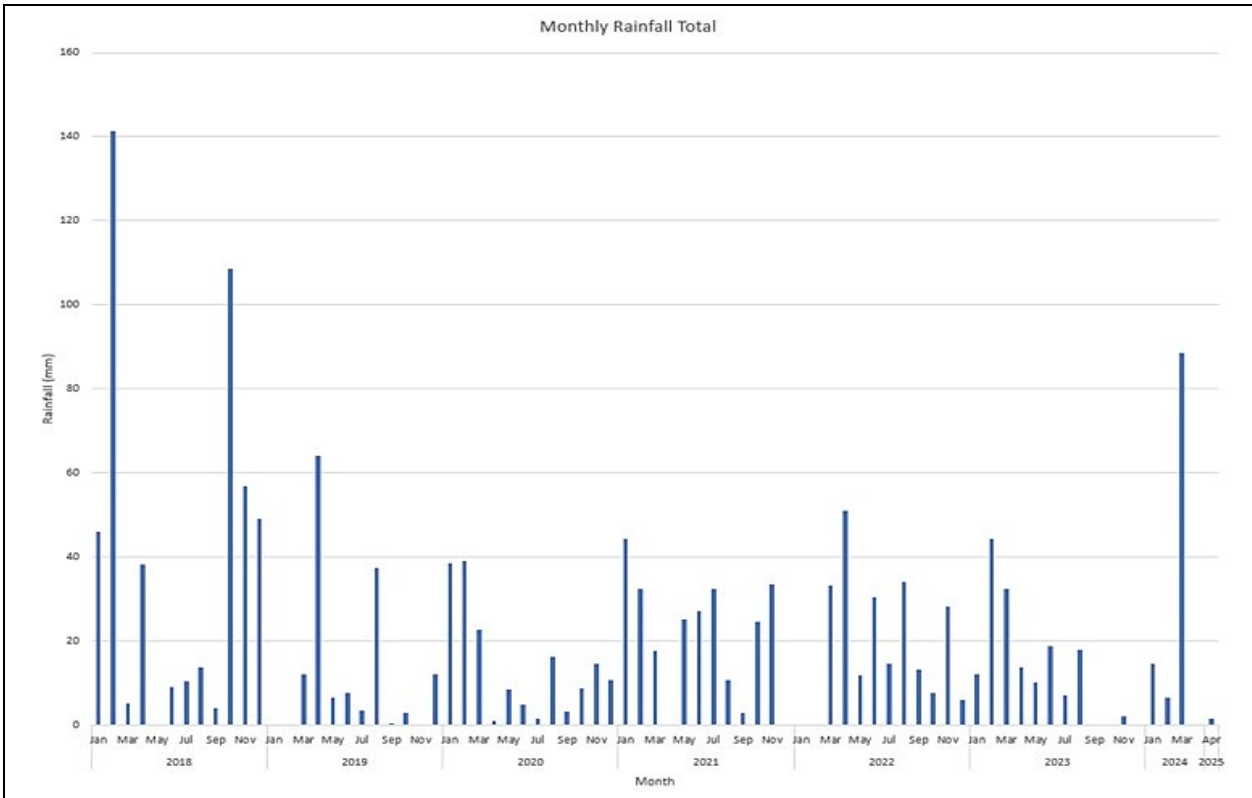


Figure 2.2 Bombora On-Site Rainfall Station Data

2.2 Landforms and Drainage

The Project site is located within the catchment area of Lake Roe. The area colloquially referred to as Lake Roe is a complex of interconnected smaller lake sub-areas which span approximately 90 km in length (west to east), situated within a broader paleo-drainage system that historically flowed from northwest to southeast. As the elevation gradient of the paleo-drainage system has reduced with time and the climate dried, the system has become a number of salt lakes which become terminal drainage points under most runoff events.

The region lies within an arid zone characterised by large dryland creek systems and highly variable hydrological conditions, which range from prolonged droughts to episodic flood events. These extremes influence the region’s physical, chemical, and biological characteristics. There are no natural permanent watercourses or wetlands within the project area. All drainage lines in the project area are small and intermittent, flowing only after major rainfall events. Drainage is internal, terminating in salt lakes and clay pans and surface drainage is only significant immediately following rainfall events. Local flooding may occur, especially following cyclonic thunderstorms.

Most of the Project area is gently undulating and of subdued relief, with elevations between 310 to 350 mAHD (metres above Australian Height Datum).

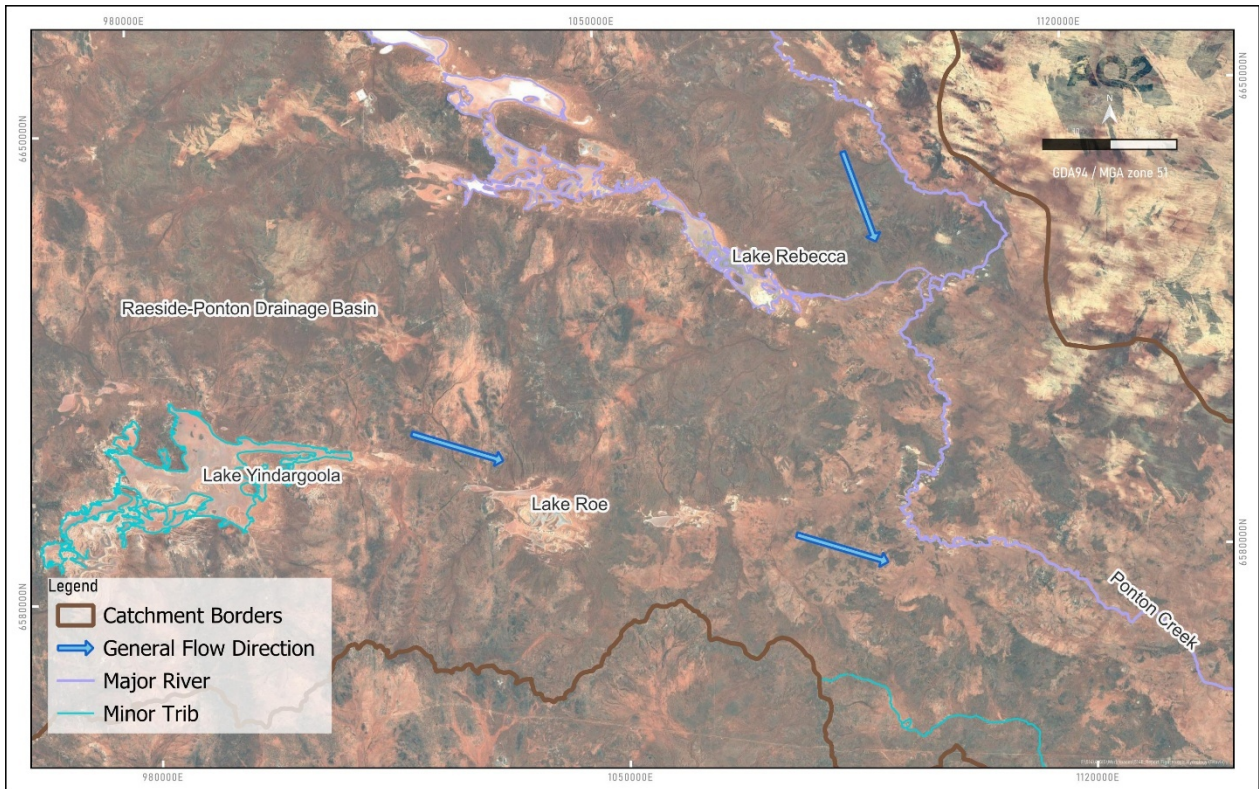


Figure 2.3 Regional Hydrology

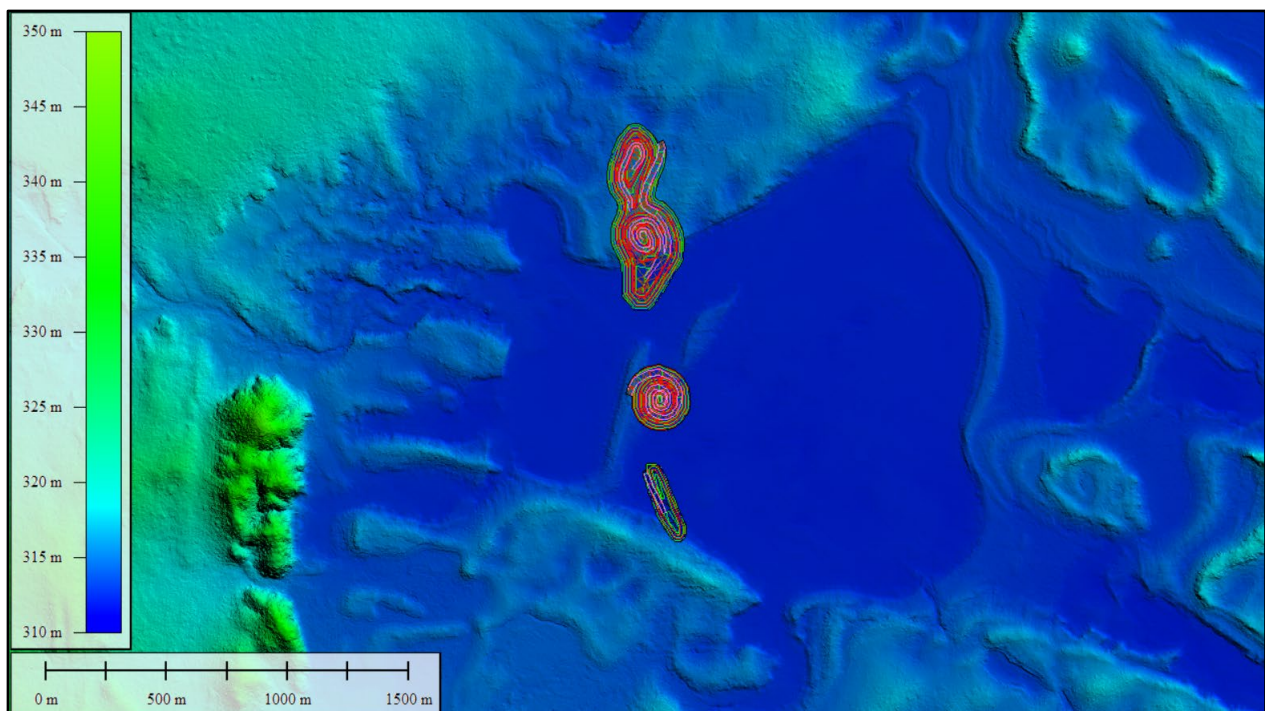


Figure 2.4 Regional Topography

3. HYDROGEOLOGY

3.1 Geology

3.1.1 Regional Geology

The Roe project area is underlain by greenstone and granitoid rocks belonging to the Kurnalpi Terrane of the Archean Yilgarn Craton (GSWA terminology of Smithies, 1994). Two craton-scale structural corridors transect the project area; the Roe Shear Zone and the Claypan Shear Zone (Figure 3.1).

The greenstone geology of the Roe project area can be divided into the Yindi (Western) domain and the Edjudina (Eastern) domain. The Yindi Domain is centred around the ~60-70° E-dipping Roe Shear Zone corridor. Lithology is dominated by mafic amphibolite, fine-to coarse-grained felsic-intermediate schists, and turbiditic siltstone-shale. The Edjudina domain is distinguished from the Yindi domain by major lithological, metamorphic and structural changes that occur across the interpreted western branch of the Claypan Shear Zone. A major lithological distinction is the presence of large volumes of high-Fe tholeiitic mafic rocks, mostly in the form of fractionated dolerite sills. The Bombora Sill is the largest of these bodies and hosts most of the gold mineralisation at Bombora. The main body of the Bombora Sill is 150-300 m in true thickness at the centre of the project area, but magmatic and/or structural duplication creates a sill complex up to ~500 m true thickness towards the southern end of the Project area.

The Bombora deposit is located on the eastern limb of the Bombora Antiform, a moderately southeasterly plunging, partly preserved isoclinal fold, which occupies a low-strain domain between the Claypan Shear Zone west and east branches. The plan geometry of the fold is illustrated by the folded trace of a BIF marker horizon, and the rotation of the Bombora Sill into the southern hinge, where it is truncated by the Claypan Shear Zone west branch. The westward younging of the eastern limb (that is, towards the hinge) makes the fold an antiformal syncline.

A cover of Cenozoic sediments is widespread in the Eastern Goldfields region. The thickest sections of cover occur in the form of a network of narrow palaeovalleys (palaeochannels) that were incised into the weathered bedrock surface of the Yilgarn Craton during the Early Eocene, and then filled with continental to shallow marine sediments as a result of changes in climate and sea level rise during the Middle Eocene to Miocene (de Broekert, 2002).

Overlying the palaeochannels and basement rock are a variety of Cainozoic superficial deposits (alluvials/colluvials, laterites, eolian and lake deposits). The colluvial and alluvial deposits occur in outwash fans and stream channels respectively and can reach thicknesses of up to 10 m.

3.1.2 Local Geology

The dominant host lithology at Bombora is the Bombora Sill, a fractionated quartz dolerite. In the deposit area, the sill is consistently ~ 300 m in thickness, dips ~ 45 to 60° east (flatter dips towards the southern fold hinge) and is overturned (younging westward/down). The sill was emplaced into a 5 to 15 m wide fine-grained interflow sedimentary unit (sulphidic shale, siltstone) deposited between a volcanic sequence (hanging wall; stratigraphically below the sill) and a low-iron basalt-dolerite sequence (footwall; stratigraphically above the sill). Three major faults, the Argus Thrust, the Inlet Fault, and the Peninsula Fault, significantly modify the architecture of the Bombora Sill at the deposit scale.

Gold mineralisation at Bombora is largely strata bound, occurring preferentially in an iron-rich granophyric quartz dolerite zone of the Bombora Sill (western zone) over a 3 km strike length. Mineralisation is hosted in three main lode orientations: north northwest striking, subvertical steep lodes; gently north to northeast dipping flat lodes and moderately west dipping west lodes. Lamprophyre dykes run the full length of Bombora, mainly in a 30 to 40 m wide moderately west dipping swarm, subparallel

to mineralised west lodes. Individual dykes are typically 1 to 10 m in thickness. The lamprophyres are interpreted to post-date most or all gold mineralisation.

The Bombora deposit is completely concealed under a thin (5 to 15 m) layer of transported cover developed within and peripheral to the Lake Roe Salt Lake system. The transported cover is dominated by lacustrine clays, overlain by aeolian sands and transported ferricrete adjacent to the lake footprint. The in-situ regolith profile is strongly stripped, with the upper saprolite rarely preserved in the deposit area. The bedrock is generally fresh from depths of about 20–60 m (average of 30 mbgl), with the bedrock varying from being deeply weathered (saprolite) to partially weathered (saprock). Depth of weathering across the deposit does not appear to be affected by rock type. The outcrop and bedrock geology in the Bombora deposit area are shown in Figures 3.2 and 3.3.

3.2 Hydrogeological Setting

3.2.1 Regional Hydrogeology

The regional hydrogeology has been well documented in numerous previous reports (Kern, 1995; Johnson, et. al., 1999 and RPS, 2013). The occurrence of groundwater across the Goldfields region (the Project area) is mainly associated with the following main aquifer systems:

- Weathered/ fractured bedrock – low yielding, saline to hypersaline aquifer associated with partially weathered bedrock (i.e. saprock zone) at the base of weathering profiles (especially over coarse-grained felsic rocks), vuggy secondary minerals such as a calcrete and silcrete developed within weathered bedrock, and fresh fractured bedrock related to local and regional structures (i.e. fractures, faults, shear zones). This aquifer varies in extent and hydraulic properties, depending upon structural integrity, degree of weathering, bedrock depth and lithology. The weathered bedrock is generally in hydraulic connection with the underlying fractured bedrock.
- Tertiary-age sediments – high yielding, hypersaline aquifer associated with alluvial sands and gravels deposited within the base of the paleovalleys (palaeochannel aquifers). This aquifer can provide stable, long-term sustainable yields, due to ‘high’ permeability, large groundwater storage and significant leakage from the overlying clays and surrounding basement rocks.
- Quaternary-age sediments deposited along modern drainage lines – low yielding, shallow and intermittent brackish to saline aquifer associated with the alluvial and lacustrine deposits, which are sporadically saturated after heavy rainfall events, with the water table close to the surface in playa lake environments.

The regional water table ranges from less than 1 mbgl in playa-lake environments to more than 40 mbgl in elevated areas. The regional water table may be absent in high areas where the weathered and fractured zone is unsaturated or where fractures are poorly developed. Regional groundwater flow is generally to the east towards the major palaeodrainage systems, the ephemeral lakes and salt pans. Directions of groundwater flow and variation in salinity are closely related to topography. Recharge to the aquifers is via rainfall infiltration and is thought to be minimal due to high evaporation rates and low vertical infiltration rates. Groundwater discharge occurs mainly by evaporation from salt lakes, with a small amount by throughflow within the palaeochannel aquifers.

Most groundwater in the region is of saline or hypersaline quality. Lower salinity concentrations typically occur in low elevated areas of enhanced recharge and are typically located within unweathered fractured bedrocks (Kern, 1995) or in the uppermost reaches of palaeochannel systems. The higher salinity concentrations are typically found in the groundwater of palaeochannels and in bedrock aquifers which are adjacent and below alluvial flats and playa lakes, where salinity values of up to 300,000 mg/L total dissolved solids (TDS) have been recorded.

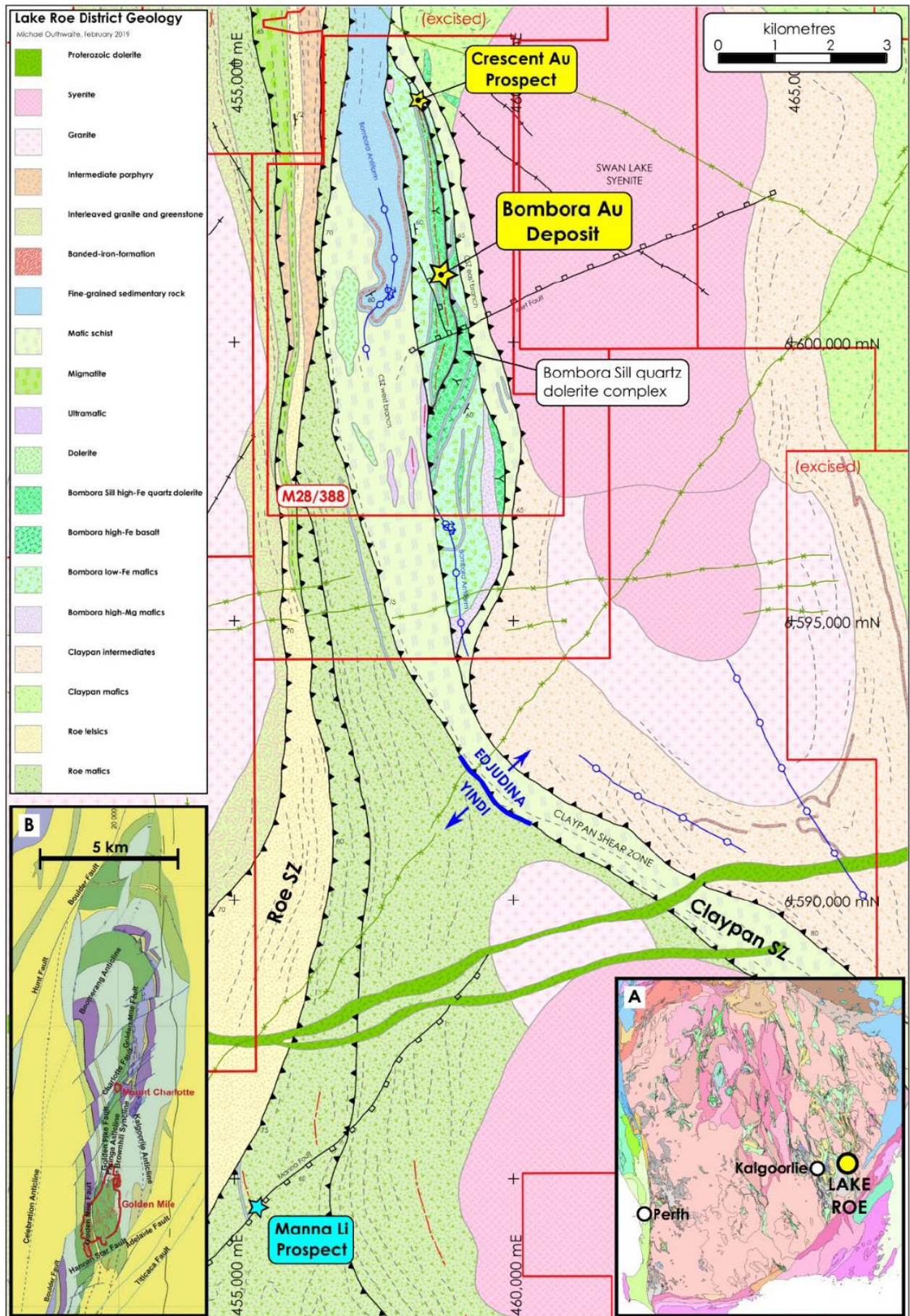


Figure 3.1 Roe Project, Regional Simplified Bedrock Geology

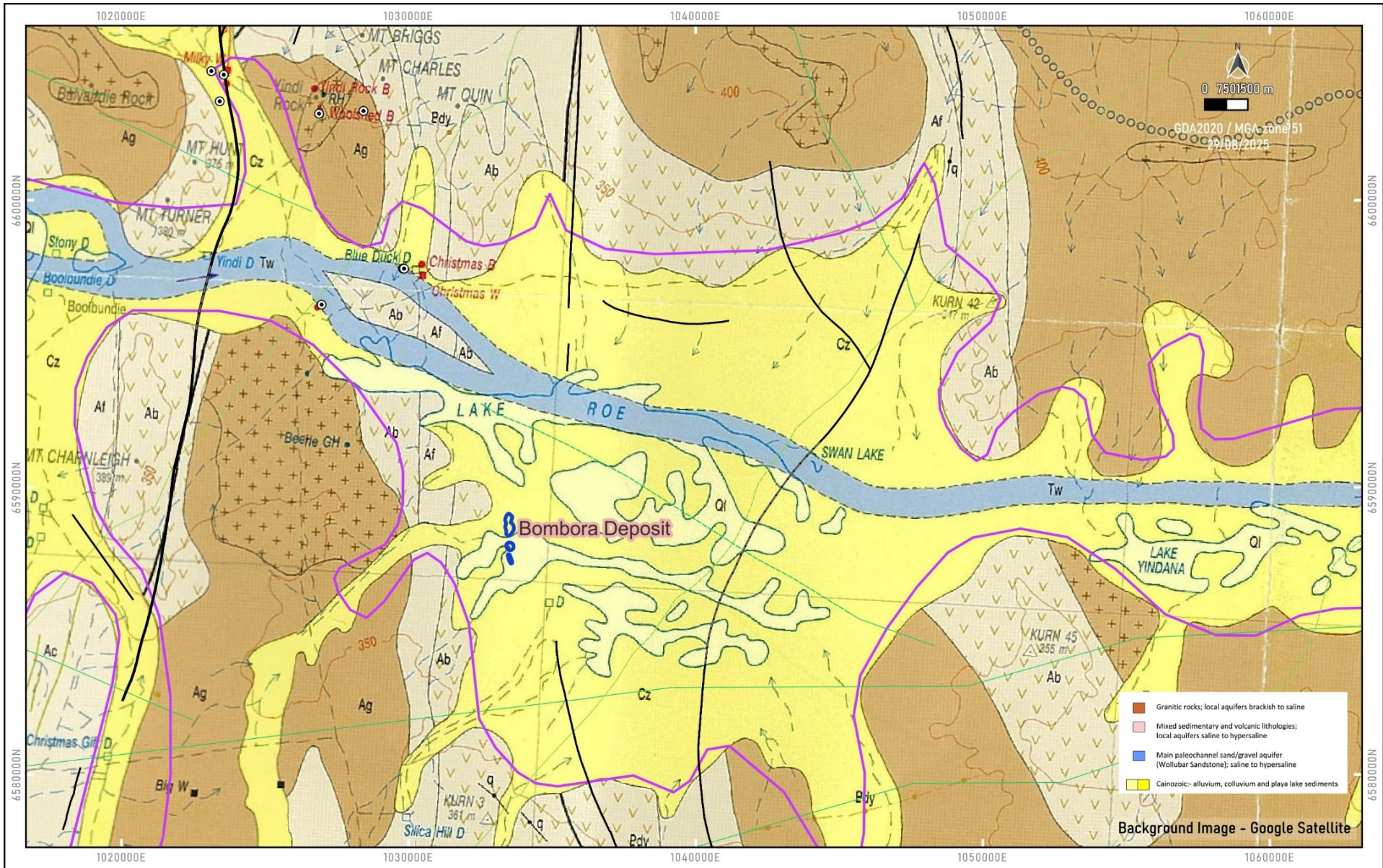


Figure 3.3 Roe Project, Local Outcrop Geology

3.2.2 Local Hydrogeology

The hydrogeology of the Bombora deposit area has previously been documented by GRM (2019a). The current understanding of the site's hydrogeological conditions has been based on the review of all available literature in the region, mineral exploration drilling data for the site, together with the assessment of hydrogeological data collected during the recent fieldwork undertaken by AQ2 (where exploration and production bores were drilled and tested).

The local and regional bedrocks have little to no primary aquifer properties and aquifer potential is associated with fracture and weathering induced secondary permeability and porosity.

It should be noted that there is no evidence of the Roe basal palaeochannel aquifer (i.e. high yielding, hypersaline aquifer associated with alluvial sands and gravels deposited within the base of the palaeovalleys) within the footprint of the mining area.

A more comprehensive description of the local hydrogeology and the conceptual hydrogeological model for the Project area are presented in Sections 5 and 6.

4. EXISTING GROUNDWATER USE

4.1 Groundwater Dependent Ecosystems

4.1.1 Wetlands and Vegetation

Groundwater Dependent Ecosystems (GDE) includes biological assemblages of species such as wetlands or vegetation that use groundwater either opportunistically or as their primary water source.

The Bureau of Meteorology (BOM) has developed the Groundwater Dependent Ecosystems Atlas (GDE Atlas) as a national dataset of Australian GDEs to inform groundwater planning and management (BoM, 2023). The GDE Atlas contains information about three key types of ecosystems:

- Aquatic ecosystems that rely on the surface expression of groundwater; this includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs.
- Terrestrial ecosystems that rely on the subsurface presence of groundwater; this includes all vegetation ecosystems.
- Subterranean ecosystems; this includes cave and aquifer ecosystems.

The Bureau of Meteorology (BOM) GDE Atlas shows no aquatic GDEs (i.e. no wetlands of environmental significance) present in the vicinity (10 km radius) of the Project area. The area is mapped with terrestrial GDEs of low, medium and high potential, which are as follows:

- Low potential terrestrial GDE described as extensive sandplain, with scattered granite outcrop supporting mainly spinifex hummock grasslands and mulga and mallee shrublands.
- Medium potential terrestrial GDE described as fresh or brackish ephemeral lakes and swamps with cane grass, lignum and paperbark shrublands.
- High potential terrestrial GDE described as salt lakes with extensively fringing saline plains, dunes and sandy banks, supporting low halophytic shrublands and scattered tall acacia shrublands.

Notwithstanding, the high, moderate and low potential GDE areas are also mapped as being respectively highly likely, moderately likely and likely to be inflow dependent ecosystems (IDE), reliant on water sources in addition to rainfall, such as water stored in the unsaturated zone, surface water or groundwater (BOM, 2024).

Database searches and a literature review done by Stantec (2018) indicated that the Project area does not lie within any areas of environmental significance. However, there are several reserves within 30 km of the Project area including the Wallaby Rocks Timber Reserve, Cardunia Rocks Nature Reserve and Coonana Timber Reserve. These timber and nature reserves have been set aside by the Department of Biodiversity, Conservation and Attractions (DBCA) for the management of biodiversity values, and specifically for the conservation of flora and fauna in relation to the Cardunia Rocks Nature Reserve (Cowan 2001).

A reconnaissance and targeted flora and basic fauna survey of the Project area was undertaken by Botanica Consulting Pty Ltd (Botanica) in 2025. The results of this assessment concluded the following:

- There are no wetlands of international importance (Ramsar Wetlands) or national importance (Australian Nature Conservation Agency Wetlands) within the survey area.
- No Environmentally Sensitive Areas were identified within the survey area.
- No critical habitat listed under the WA (Biodiversity Conservation Act 2016) BC Act was recorded within the survey area.
- No threatened ecological community (TEC) was located in the survey area.

- Four priority ecological communities (PECs, as listed by DBCA) were identified within the survey area, that are protected by the WA BC Act and are the Ponton Land System PEC, the Emu Land System PEC, Cundlegum Land System and Mount Belches of *Acacia quadrimarginea/Ptilotus obovatus* banded ironstone community; (Figure 4.1). All PECs are Priority 3 listed communities with several occurrences known in the Goldfields region.

The vegetation present in the vicinity (10 km radius) of the Project area is likely to source water from soil moisture in the unsaturated zone above the water table and is likely to rely on sporadic rainfall and overland water flow events, with no association with groundwater (i.e. phreatophytic vegetation). It should be noted that the rooting zone of the vegetation found overlying the palaeochannels in the Kalgoorlie region is relatively shallow, only extending down to 1.5 m depth. In addition, the groundwater is hypersaline (more than 140,000 mg/L Total TDS and does not support any groundwater dependent ecosystems).

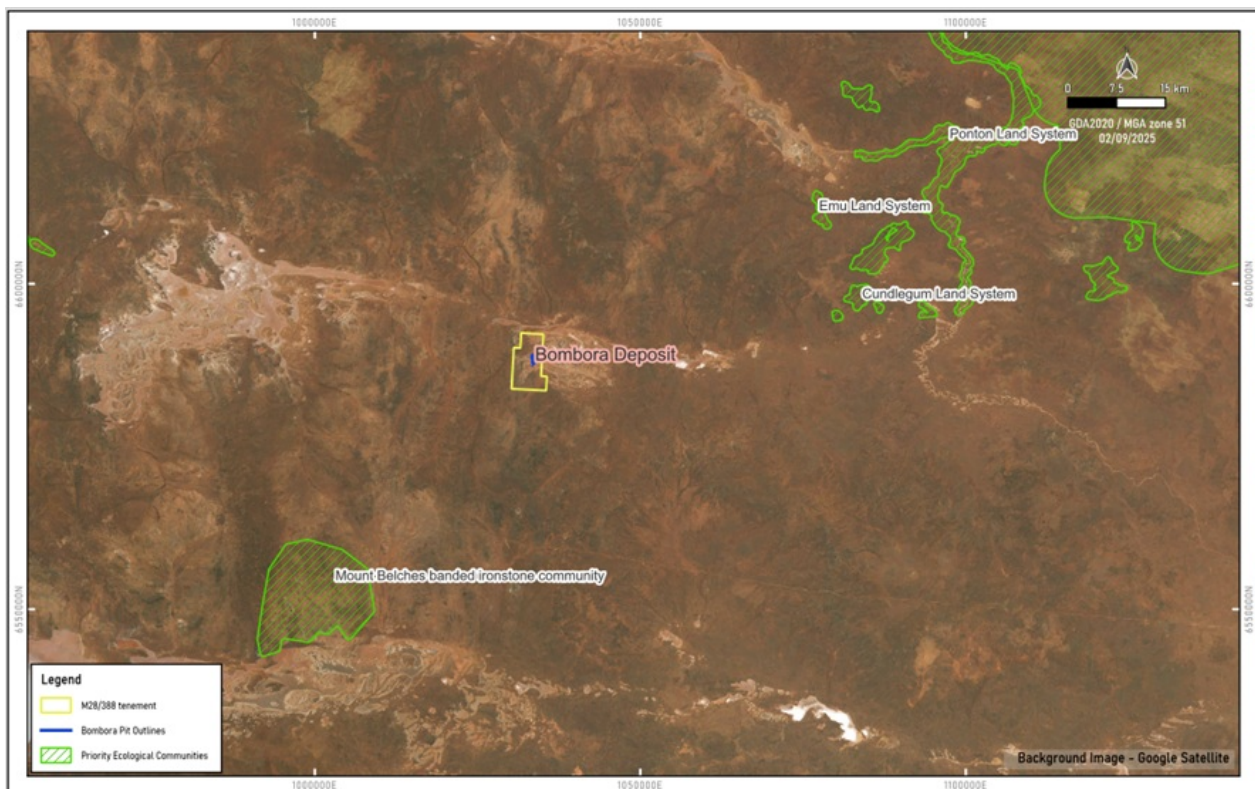


Figure 4.1 Nearest priority ecological communities (PECs, as listed by DBCA)

4.1.2 Stygofauna

The issue of stygofauna and troglofauna has become increasingly prevalent for mining operations throughout WA. Stygofauna are known to exist in the Eastern Goldfields, are mostly prolific in “fresh” calcrete aquifers, but have been found in other types of aquifers with salinity levels in excess of 60,000 mg/L TDS. It is also known (EPA, 2013) that stygofauna are unlikely to occur in deep sands and clays (especially over solid rock) and do not exist in groundwater environments where salinity exceeds marine concentrations (sea water).

The Level 1 subterranean fauna assessment undertaken by Stantec (2019), incorporating a desktop review and pilot survey, has demonstrated that the Project area does not provide prospective habitat for subterranean fauna and does not support stygofauna or troglofauna values. The survey findings confirmed that the clay dominated regolith does not provide the extensive interconnected vugs, voids and open fractures required for subterranean fauna colonisation.

The acidic and hypersaline groundwater conditions within and surrounding the study area, in conjunction with the clay-dominated strata that restricts the influx of resources (e.g., nutrients and oxygen), present unfavourable habitat for stygofauna. For troglofauna, the limited unsaturated strata, due to the shallow water table, lacks the interconnected vugs and voids required for troglofauna habitation.

The findings indicate that stygofauna and troglofauna do not represent an environmental factor for future regulatory approvals of the Project in accordance with EPA (2016), and there is no risk of impacts to subterranean fauna values (i.e. does not pose a threat to maintaining subterranean fauna representation, diversity, viability and ecological function at the species, population or assemblage level). Therefore, no further stygofauna or troglofauna assessment is considered necessary to provide further information on the subterranean fauna values of the study area.

4.2 Surface Water

The Lake Roe ponding behaviour in the vicinity of the Project was assessed by AQ2 (2024) and it was interpreted that groundwater does not contribute to inflow into the Lake Roe, and surface water recession/periodic standing water within the claypan(s) is solely accounted for by evaporative losses and seepage. In other words, ponding in the lake is attributed to infrequent surface water runoff or flooding events rather than surface expression of groundwater. It is noted that it might be possible for groundwater levels to rise close to the surface in low lying areas during and following extreme rainfall events (e.g. cyclones), due to higher than normal recharge. However, at such times, flow within the local lakes and creeks would be dominated by surface water runoff, with a minimal contribution from the groundwater (due to the low flow gradients and the low permeability of the lake beds). Following significant inundation events, the lake may hold water for months. Seepage rate analyses indicated that in the order of 3 mm/day of seepage may occur from the lake bed when it is inundated.

4.3 Other Groundwater Users

Existing groundwater use has been assessed via the DWER Water Register Database of licensed registered users. According to this database there are currently no other groundwater users within a 10 km radius of the Project area. However, there are licensed groundwater users that abstract water from the fractured rock aquifer system further out from the Project area. Licensed drawpoints of the existing groundwater users and their annual allocations are shown in Figure 4.2. The nearest fractured rock aquifer user is located approximately 14 km to the south (Global Lithium Resources Ltd; GWL209352, allocation of 90,000 kL/year).

In addition to the DWER Water Register Database, the DWER Water Information Reporting (WIR) database provides information regarding water bores drilled (including licensed and unlicensed bores). This shows that the closest registered bores to Bombora are the Christmas and F8 bores located around 10 km to the northwest of Bombora (Figure 4.2). Christmas bore is privately owned and may be in use as a stock watering bore by the local pastoralist. However, it will need to be confirmed if this bore is still operational. The F8 bore has no known owner and is likely a historic bore abandoned due to its high salinity (72,000 mg/L TDS).

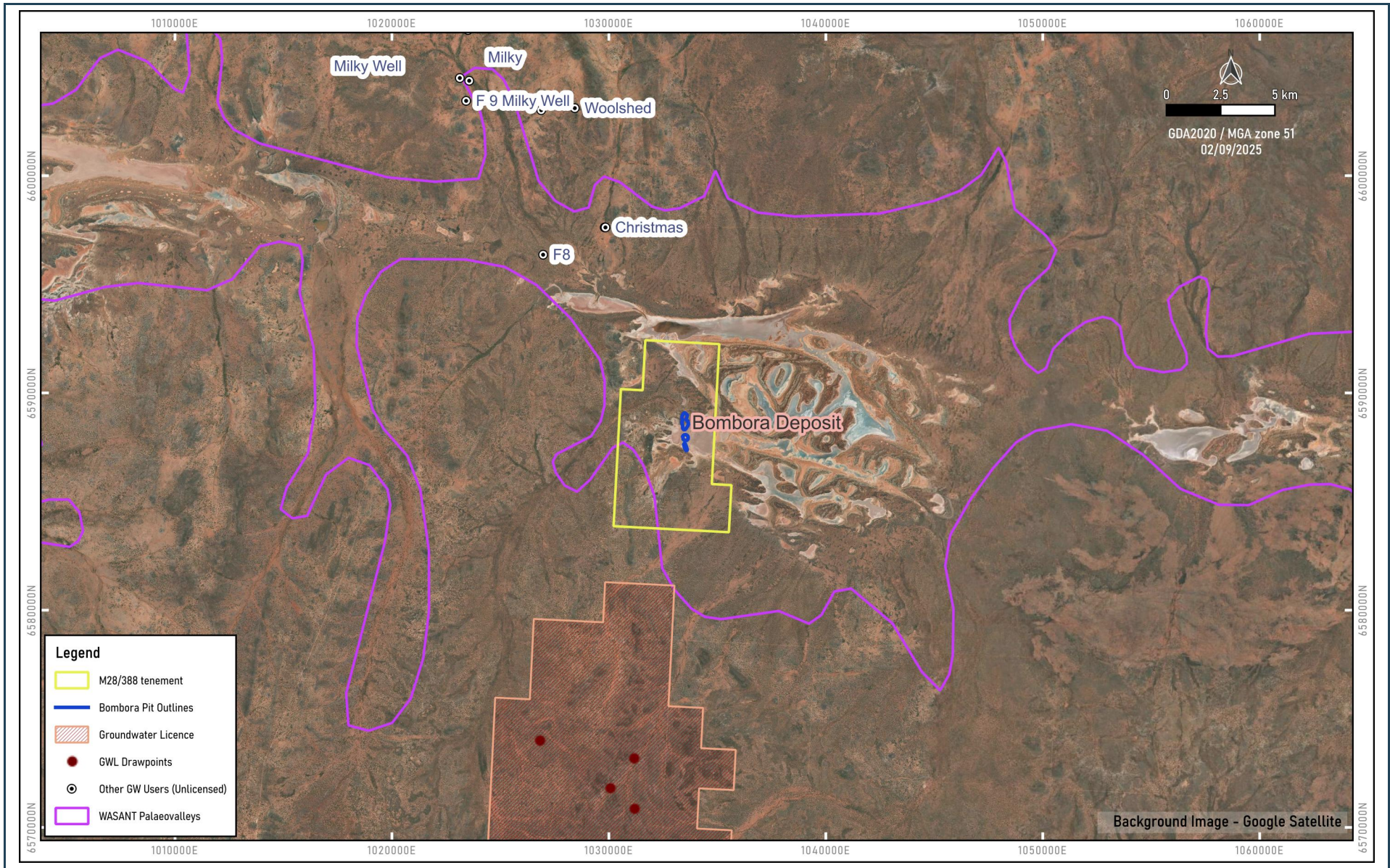


Figure 4.2 Nearest Other Groundwater Users

5. GROUNDWATER INVESTIGATION PROGRAMMES

5.1 Previous Hydrogeological Field Investigation

A prefeasibility study (PFS) level dewatering investigation was previously conducted on Bombora in 2019 by GRM for its former owner, Breaker Resources (GRM, 2019). The field programme comprised the drilling and testing of 17 investigation bores in and around the Bombora deposit, collection of hydrogeological information and assessment of aquifer properties with small scale permeability testing.

Breaker engaged Kalgoorlie based reverse circulation (RC) drilling contractors Raglan Drilling (Raglan), to undertake the hydrogeological investigation drilling. Raglan initially drilled 7 land based targets with an RC rig between 23 January and 2 February 2019. The remaining 10 investigation bores were drilled on the Lake Roe surface between 18 February to 4 March 2019. The lake bores were drilled using the same RC rig, after it had been reconfigured with a tracked drive to allow operation on the soft lake bed. The bores (BWE01 -BWE18) were drilled at 144 mm (5½") diameter with RC air-hammer techniques. Where possible, the completed bores were cased with slotted and blank 50 mm diameter Class 12 PVC casing to allow for small scale permeability testing and construction as long-term groundwater monitoring bores. None of the bores were finished with formal headworks at the time. This was later done during the 2025 drilling programme detailed in this report.

Eleven of the seventeen groundwater exploration bores (BWE01 -BWE11) were drilled to depths of between 130 and 200 m, targeting various structures and higher permeability fracture zones, and the remaining seven bores (BWE12-14, and BWE16-18) were drilled to depths of between 50 and 60 m to confirm if elevated permeabilities were associated with a north striking weathered lamprophyre dyke system on the eastern side of Bombora. Bore BWE15 was not drilled, as it was located adjacent to the deeper BWE03 bore, which had a low yield in the upper part of the hole, removing the need for BWE15 to be drilled. Bore BWE06 collapsed during drilling and PVC casing was not installed in it, other than shallow surface casing. Bore BWE17 partially collapsed and 50 mm PVC casing could only be installed in it to 24 mbgl.

The locations of the GRM monitoring bores at Bombora are shown in Figure 5.1 and the bore details are given in Table 5.1. Bore logs are presented in Appendix A.

Airlift yields and field water quality data were collected during drilling and were measured at the end of each 6 m drill rod by either timed filling of a 10-litre bucket or measuring the water level height over a v notch weir. The airlifting method involved activating the rig's blowdown air valve, which forced all air down the rod string and back up the annulus of the hole. The water flow returns were measured from the discharge pipe leading from the rig's 'T piece'. Maximum airlift yields of between 0.4 to 10 L/s were recorded during RC drilling, with high yields recorded in bores which intersected the transition zone between weathered and highly fractured fresh bedrock (approximately 30-55 m depth). Lower airlift yields were recorded in bores that were targeting a lamprophyre dyke or cross faults.

Small scale permeability testing was undertaken on the completed bores, either by airlift-recovery testing or, in the case of lower yielding bores, falling-head slug testing. Airlift recovery test results indicate aquifer transmissivities ranged between 1.9 and 210 m²/d, with the higher transmissivities from bores BWE02, BWE07 and BWE16, interpreted to lie within a main, north-south trending fractured aquifer zone, that also includes bores BWE01 and BWE10. Falling head test analyses, from the lower airlift rate bores BWE09, BWE12 and BWE18 gave hydraulic conductivities ranging between 3 x 10⁻³ and 1.3 x 10⁻¹ m/d. The results from the investigation were used to develop a conceptual hydrogeological model for the Project area, which was then used to construct a basic calibrated numerical flow model to estimate dewatering rates and drawdown impacts from the mining at Bombora.

Key findings and conclusions drawn by this investigation are as follows (GRM, 2019):

- A highly permeable fracture zone aquifer is present at Bombora, aligning approximately with the main gold mineralising zone, and extending to the north and south beyond the proposed mining areas (refer to Figure 5.1).
- The fracture zone aquifer is interpreted to have a higher permeability central zone, transitioning laterally to low permeability aquifer conditions in the surrounding bedrock. Permeabilities outside the main fracture zone aquifer are generally low, although cross faulting may potentially cause dilation of the main fracture zone in places.
- A significant number of dolerite dykes have been mapped in the project area and may potentially form barriers to downgradient flow. However, dykes can often have fractured chilled margins, allowing groundwater to migrate along them on the upgradient side.
- The groundwater quality at Bombora is hypersaline, slightly acidic and of sodium chloride type. The salinity ranges between 240,000 and 270,000 mg/L TDS, with pH ranging between 6.33 and 7.30. The sulphate concentration was elevated, ranging between 10,700 and 14,200 mg/L, due to playa lake evaporation and resulting gypsum precipitation. Manganese and iron concentrations are elevated, probably as a result of the acidic groundwater.
- The combined dewatering rates required to maintain dry conditions across all stages of mining developments may be up to around 50 to 60 L/s.
- The drawdown impact from mine dewatering may cause an elongated cone of depression to develop up to around 3 km to the north and south, and potentially 1.5 to 2 km laterally (east and west) of the Bombora deposit.

5.2 2025 Hydrogeological Field Investigation

5.2.1 Objectives

A detailed hydrogeological investigation was undertaken by AQ2 between March and July 2025 as part of a DFS level hydrogeological dewatering study to improve the hydrogeological understanding of the Bombora project area. The main aim of the groundwater exploration programme was to:

- Confirm the presence/absence and distribution of the targeted zones of enhanced permeability within potential water bearing structural features (i.e. fractures within slightly weathered and fresh bedrock, broken quartz veins and fractures at the contact between fresh rocks in the mineralised zone, fractures associated with the local and regional faults and chilled margins of lamprophyre dykes)
- Collect hydrogeological information, such as:
 - Lithology.
 - Weathering profiles.
 - Depth of water strikes.
 - Yield.
 - Groundwater quality (electrical conductivity, pH and temperature).
- Understand fracture distribution and permeability versus depth across the site.
- Install test production/dewatering bores to allow hydraulic testing of the aquifer to confirm local aquifer parameters and to more accurately determine dewatering pumping rates likely to be required during mining of the Bombora pits and underground.
- Establish a groundwater monitoring network in the mining area to provide pre-mining baseline, as well as life of mine groundwater monitoring.

Table 5.1 GRM 2019 Drilling and Monitoring Bore Details

Bore ID	Coordinates (MGA 2020)		Ground Elevation (m AHD)	Drilled Depth (m)	Cased Depth (m)	Top of Casing (TOC)		Slotted Interval (mbgl)	Maximum Airlift Yield (L/s)	EC (uS/cm)	pH	Static Water Level		Current Status
	Easting (m)	Northing (m)				(m abgl)	(mAHD)					(m bgl)	(m AHD)	
BWE01	458907	6600253	314.19	132	122	0.69	314.65	56-122	9	110,580	6.74	2.02	311.94	Operational
BWE02	458601	6600799	311.74	150	150	0.37	312.11	69-147	10+	134,600	6.95	1.42	310.32	Operational
BWE03	458812	6601243	311.76	150	150	0.97	312.73	90-150	~1	239,400	6.82	0.81	310.95	Operational
BWE04	459076	6600487	311.79	130	126	0.51	312.30	60-126	Dry	—	—	0.72	311.07	Operational
BWE05	458574	6601346	311.97	150	150	0.87	312.84	72-150	2	137,400	7.08	0.92	311.05	Operational
BWE06	458689	6601458	311.79	60	-	-	-	-	5+	107,600	6.76	-	-	Bore collapsed
BWE07	458609	6601537	311.78	150	150	0.41	312.19	72-150	10	102,000	6.91	0.90	310.88	Operational
BWE08	458934	6601712	311.73	150	148	0.70	312.43	70.5-148	0.04	95,400	6.67	0.67	311.06	Operational
BWE09	458464	6602072	313.93	200	199.4	0.55	314.52	97-199.4	0.4	168,400	6.97	2.50	311.47	Operational
BWE10	458594	6602479	314.25	150	148.5	0.60	314.87	70.5-148.5	8	201,000	6.8	2.68	311.59	Operational
BWE11	458786	6602277	313.62	150	149.4	0.68	314.29	71.4-149.4	0.6	180,600	7.11	2.91	310.70	Operational
BWE12	458678	6602492	315.26	60	60	0.84	316.05	24-60	0.1	158,600	6.83	4.49	310.72	Operational
BWE13	458783	6602183	314.36	50	50	0.66	314.93	24-50	Dry	—	—	3.40	310.87	Operational
BWE14	458761	6601668	311.75	50	50	0.66	312.41	20-50	5	86,000	6.96	0.91	310.84	Operational
BWE16	458606	6600929	311.71	50	50	0.97	312.68	20-50	15	139,600	6.87	0.22	311.49	Operational
BWE17	458852	6600744	312.66	96	24	0.97	313.63	Dec-24	8	146,200	6.97	0.41	312.25	Operational
BWE18	458850	6600459	314.87	60	60	0.63	315.48	24-60	Dry	—	—	3.17	311.68	Operational

Key: TOC= top of casing;, m agl= metres above ground level, m bgl= metres below ground level, EC= electrical conductivity

Note: BWE15 was not drilled

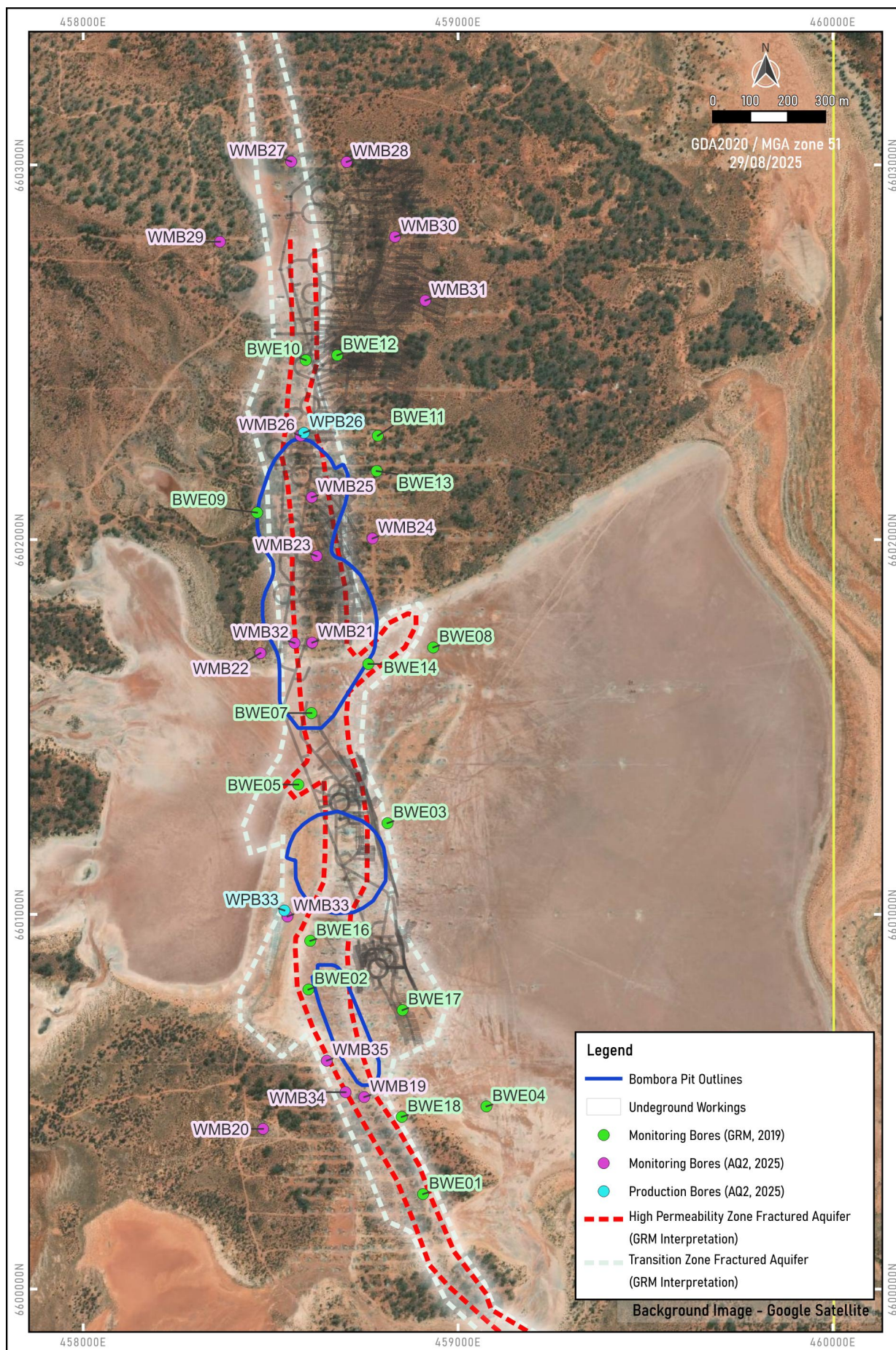


Figure 5.1 Bombora Deposit - Test Production and Monitoring Bore Locations

5.2.2 Drilling and Bore Construction

5.2.2.1 Drilling Methodology

A groundwater exploration drilling programme was carried out in 2025 in the Bombora area surrounding the three proposed open pits (1800, 1100 and 700) and the underground mine.

The drilling targets were selected based on data gathered in the previous drilling campaigns, including:

- Hydrogeological drilling undertaken by GRM in 2019.
- Diamond and RC drilling campaigns undertaken by Breaker and Ramelius.
- Mapped lithologies and structures.
- Proposed surface and underground mine plans.

The drilling programme was conducted from the 10th of March 2025 to the 11th of July 2025 with the drilling carried out by Caswell Drilling, who are a specialist water bore drilling company based in Perth WA. Bores were drilled using a dedicated water well drill rig. Hydrogeological direction of the drilling programme was carried out by AQ2.

Mud rotary drilling methods were used to drill through the near surface unconsolidated material, until competent rock was reached. Steel intermediate casing, (152 mm for monitoring bores and 305 mm for production bores), was installed in the unconsolidated zone and was set in place using cement grout. Drilling then progressed in competent rock using conventional air hammer techniques to final depth. Bore depth was selected based on the proposed depth of mining operations in the respective areas.

Monitoring bores had 50 mm ND blank and slotted PVC Class 18 casing installed and production bores had 203 mm ND blank and slotted PVC Class 18 casing installed. Slots (1 mm aperture) were placed below the water table, to intercept all water strikes. At each bore, the annulus was packed with gravel (1.6 to 3.2 mm graded) from the final depth to approximately 2 to 4 m above the slotted intervals. Above this a 2 to 3 m bentonite seal was placed, followed by backfilling with gravel pack (above the seal) to close to the surface. The bore annulus was then completed with a cement plug to ground level. The bores were completed with a lockable steel collar and a concrete plinth on surface. Similar headworks were also installed on all monitoring bores drilled in the 2019 GRM campaign, other than the collapsed BWE06, to allow them to be incorporated into the Bombora monitoring network.

5.2.2.2 Drilling Results

A total of 17 monitoring bores (WMB19 to WMB35) and 2 test production bores (WPB26 and WPB33) were drilled across the Project area. Bore depths ranged from 50 m (WMB33) to 200 m (WMB23, WMB24 and WMB25). Bore depths were selected based on the planned depth of mining operation in the respective areas, with the intention of having the bores penetrate to the base of the open pits. The locations of the test production and monitoring bores are shown in Figure 5.1. Construction details for the bores are summarised in Table 5.2, while bore completion data, including lithological and construction logs for the test investigation and monitoring bores, are presented in Appendix B.

Table 5.2 2025 Production and Monitoring Bore Details

Bore ID	Coordinates GDA2020 Zone 51 J		Ground Level (m AHD)	Drilled Depth (mbgl)	Cased Depth (mbgl)	TOC (magl)	TOC (mAHD)	Screened Interval (mbgl)	Final Airlift Rate (L/s)	Final pH (pH units)	Final Airlift EC (µS/cm)	SWL (mbgl)	SWL (mAHD)	First Water Strike (mbgl)	Main Fractures (mbgl)
	Eastings	Northings													
Monitoring Bores															
WMB19	458750	6600512	314.49	160	Open Hole	0.55	314.49	N/A	Seepage Only on Bore Completion			3.42	310.52	dry	
WMB20	458480	6600427	312.78	150	150	0.81	313.72	24-150	1.8	6.1	158,900	0.38	312.53	44	44, 56-57
WMB21	458611	6601725	313.71	169	Open Hole	0.62	314.24	N/A	4.4	6.67	166,800	2.34	311.28	14	14, 24,
WMB22	458473	6601697	312.94	160	160	0.86	313.83	38-200	2.5	6.98	197,200	1.07	311.9	40	40, 47-48, 53-54, 69-70
WMB23	458623	6601956	314.88	200	200	0.90	315.81	20-200	Seepage Only on Bore Completion					4.05	310.86
WMB24	458772	6602003	314.88	200	200	0.73	315.71	38-200	1	6.51	160,700	3.86	311.12	34	quartz veins
WMB25	458610	6602113	314.38	200	200	1.04	315.44	26-200	4.3	6.72	163,100	3.44	310.96	29	34, 43, 50-54
WMB26	458580	6602277	314.09	160	160	0.84	314.97	32-160	12.5	6.94	154,200	3.18	310.95	25	24-25, 31-34, 79-82, 87, 90,95, 107
WMB27	458555	6603009	313.98	130	130	0.81	314.71	34-154	Dry on Bore Completion					3.01	310.89
WMB28	458703	6603008	314.39	160	160	1.11	315.46	40-160	1.5	6.74	184,000	3.66	310.69	36	
WMB29	458365	6602795	315.79	130	128.5	1.25	316.80	33-128.5	4.4	6.52	154,100	5.29	310.26	32	32, 49, 53
WMB30	458832	6602808	315.05	150	150	0.98	315.86	36-126	2.5	6.64	168,400	4.05	310.83	30	36
WMB31	458913	6602638	315.68	151	151	0.97	316.52	42-150	8.8	6.97	160,300	3.30	312.25	37	37-41, 47, 55
WMB32	458564	6601724	313.85	141	Open Hole	0.51	314.41		1.8	7.18	162,700	3.20	310.7	31	29-31
WMB33	458545	6600994	312.87	50	43	0.66	313.60	30-43	2.5	6.39	136,700	3.34	309.6	24	32-36
WMB34	458700	6600525	314.84	157	Open Hole	0.53	315.41		Dry on Bore Completion					4.33	310.55
WMB35	458650	6600609	312.89	161	160	0.85	313.81	28-160	0.9	7.01	208,800	1.28	311.68	29	29-30, 63
Production Bores															
WPB26	458589	6602285	313.78	160	160	0.58	314.37	28.4-156.4	15	6.25	159,000	2.01	311.78		40-45, 47-48
WPB33	458537	6601010	313.16	160	160	0.28	313.51	25-160	5	6.4	165,400	2.32	310.91	43	43-49

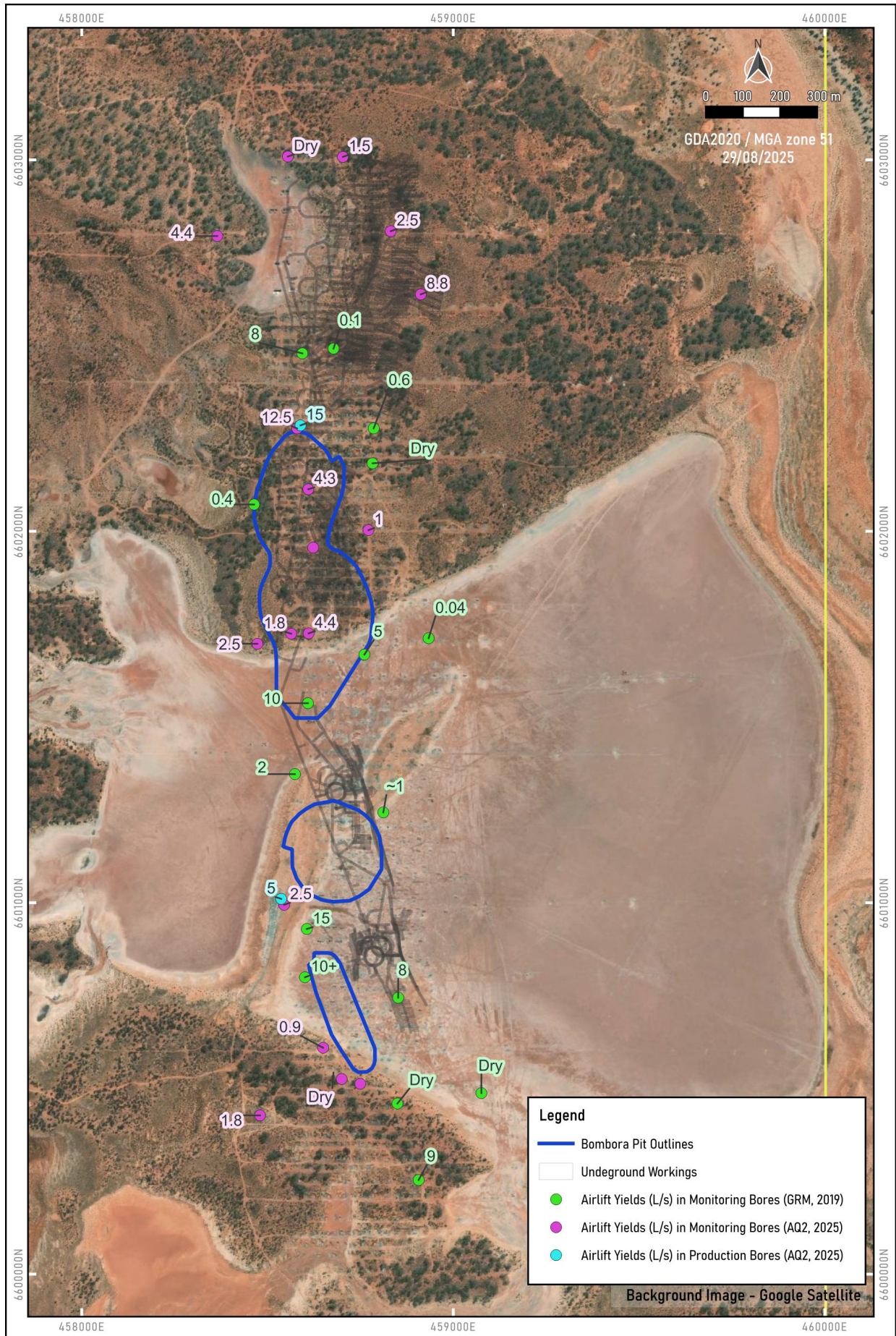


Figure 5.2 Bombora Deposit – Final Airlift Yields (L/s) during Drilling

Bores generally encountered a 5 m transported layer comprised of gravel, sand, silt and clay (but could vary from 3 to 10 m thickness), overlying an in-situ weathered profile of saprolite and saprock overlying fresh bedrock. The bedrock in the majority of the bores was dolerite from the Bombora Sill, while bores in the northern portion of the Project area encountered meta-basalt bedrock outside the sill area. The bores in the southern and central part of the Project area generally had shallower weathering profiles, with the base of the completely oxidised material generally being 6 to 15 m, while bores in the northern portion of the Project area had deeper weathering profiles, with the base of the completely oxidised ranging from 30 to 36 m. The exception to this was WMB33 and WPB33, drilled on the peninsula extending from the southern bank of Lake Roe, which encountered approximately 30 m of completely oxidised material, which was associated with the Peninsula Fault. Depth of weathering across the deposit does not appear to be affected by rock type. The fresh bedrock was generally encountered at 30 m depth, but varied between 15 and 58 mbgl.

Water strikes were recorded during drilling, with water strikes encountered at variable depth (i.e. between 14 and 44 mbgl), mainly within the weathered bedrock (saprock) and fresh fractured zone up to approximately 55 m depth. The airlift yields were also recorded during drilling and were generally between 1 and 4.4 L/s across the site and were associated with the moderately weathered and fractured zones (up to 55 mbgl). Two bores WMB26 and WMB31 had high airlift yields of 12.5 L/s and 8.8 L/s, respectively recorded during drilling, which were associated with fracturing around the chilled margins of the lamprophyre dyke (WMB26) and quartz veins in dolerite (WMB31).

There was no narrow highly permeable fractured zone aquifer (trending north-south and associated with the main gold mineralisation zone) evident as previously interpreted by GRM. Instead, the main aquifer is related to the transition zone between the weathered and fresh fractured bedrock, and the higher permeability depending on the intensity of cross cutting faults and lamprophyre dykes (especially increased in swarms). At all locations, there were no noticeable fractures or increases in airlift yields encountered below 55 m depth, therefore the permeabilities below the main fracture zone aquifer are generally low. Bores WMB19 and WMB34 located south of the 700 Pit targeted the known Peninsula Fault that was also encountered at WMB33 and BWE02 (and produces around 5 L/s). However, bores WMB19 and WMB34 were found being dry during drilling. This indicates that the Peninsula Fault itself is not particularly permeable, although cross faulting/lamprophyre dykes/quartz veins may potentially cause an increase in yields.

5.2.3 Hydraulic Testing

5.2.3.1 Test Pumping of Test Production Bores

Following construction and development of the 2 test production bores (WPB26 and WPB33), an aquifer testing programme was conducted by the test pumping contractor Matix Hydro during the period 22nd June to 9th July 2025, under supervision by an AQ2 hydrogeologist. This supervision was conducted remotely from Perth.

Pumping tests were undertaken on each of the two bores to:

- Calculate the hydraulic conductivity, transmissivity and storage of the weathered/fractured bedrock aquifer,
- Confirm the along-strike continuity of the bedrock fractures inferred from the pre-pumping static water levels,
- Confirm the presence of hydraulic boundaries in the aquifer, which may comprise barrier or recharge boundaries (e.g. low permeability surrounding basement rocks and zones of increased storage via fault zones, respectively); and
- Assess groundwater flow conditions during pumping (i.e. sustainable yield).

At each bore, the aquifer testing comprised:

- A step-rate test (SRT; 4 x 100 minute steps of progressively increasing pumping rates per step).
- A 72 hour (3 day) constant-rate test (CRT).
- Recovery measurements following the cessation of pumping (until groundwater levels were within 90% of the initial water level or after 12 hours of the conclusion of CRT – whichever occurred first).

Pumping test durations and rates of each bore are listed in Table 5.3. After the cessation of pumping, water level recovery was monitored at each production bore and its adjacent monitoring bore(s). It should be noted that the fourth step of the SRT at both WPB26 and WPB33 was cut short to 20 minutes and 35 minutes, respectively due to the cavitation from cascading water (owing to the excessive drawdown). At this point the pump was shut down.

During the tests, pumping rates were measured using an in-line flow meter. Water levels were measured in the test investigation and monitoring bores using a combination of pressure transducers (test bore and closest monitoring bore) and electrical water-level probe (for manual readings of distant monitoring bores).

The hypersaline discharge water was transferred via lay-flat pipe to a salt lake located near each of the tested bores to minimise potential impacts on the vegetated environment. It should be noted that Ramelius was allowed to discharge to the nearby lake (as per their agreement with DWER).

SRT data were used to make a preliminary assessment of bore yield and confirm the target pumping rate for the CRTs. The test data were also graphically analysed using the Hantush–Bierschenk method to estimate bore efficiency. Graphical plots of drawdown versus log time for SRT are presented in Figures 5.3 and 5.4. SRT results are presented in Appendix C.

Graphical plots of drawdown versus log time for the CRTs are presented in Figures 5.5 and 5.6, and also in Appendix C. Water level responses in the adjacent monitoring bores due to pumping are summarised in Table 5.4 and shown in Figures 5.7 and 5.8. The CRT and recovery test analysis results are also presented in Appendix C.

Table 5.3 Summary of Pumping Tests Conducted

Pumping Bore ID	Step Test				Constant Rate Test		
	Step Number	Duration (mins)	Pumping Rate (L/s)	Final Drawdown (m)	Duration (hours)	Pumping Rate (L/s)	Prod Bore Final Drawdown (m)
WPB26	1	100	4	8.65	71.5	7	38.68
	2	100	6	16.59			
	3	100	8	26.83			
	4	20	11	129.31			
WPB33	1	100	4	27.89	72	4.5	44.47
	2	100	5	29.65			
	3	35	6	96.27			

Table 5.4 Summary of Monitoring Bores Responses to Pumping Tests

Pumped Bore ID	Monitoring Bore ID	Distance from Pumped Bore (m)	SWL (mbtoc)	Final Water Level (mbtoc)	Final Drawdown in Monitoring Bore at the end of test (m)
WPB26	WPB26	0	3.026	41.71	38.68
	WMB26	8	3.51	16.59	13.08
	BWE10	192	3.18	3.93	0.75
	WMB25	175	4.15	11.24	7.09
	WMB32	561	3.37	4.38	1.01
	BWE11	206	3.23	4.89	1.66
	WMB31	485	4.16	4.36	0.20
	WMB28	721	4.70	4.93	0.23
	BWE09	245	2.85	4.12	1.27
	WMB23	333	4.64	6.71	2.07
	BWE12	227	5	6.93	1.93
	WMB22	600	1.59	2.45	0.86
	WMB24	342	4.12	5.84	1.72
WPB33	WPB33	0	3.09	47.55	44.47
	WMB33	17	2.38	4.76	2.38
	WMB35	423	2.56	3.40	0.84
	BWE17	413	1.33	1.55	0.22
	BWE16	107	0.45	1.56	1.11
	BWE05	337	0.86	1.87	1.01
	BWE02	220	0.90	2.05	1.15
	BWE03	360	1.18	1.50	0.32
	BWE01	843	2.43	2.57	0.14
	WMB20	570	2.90	3.15	0.25
	BWE07	530	0.85	1.29	0.44

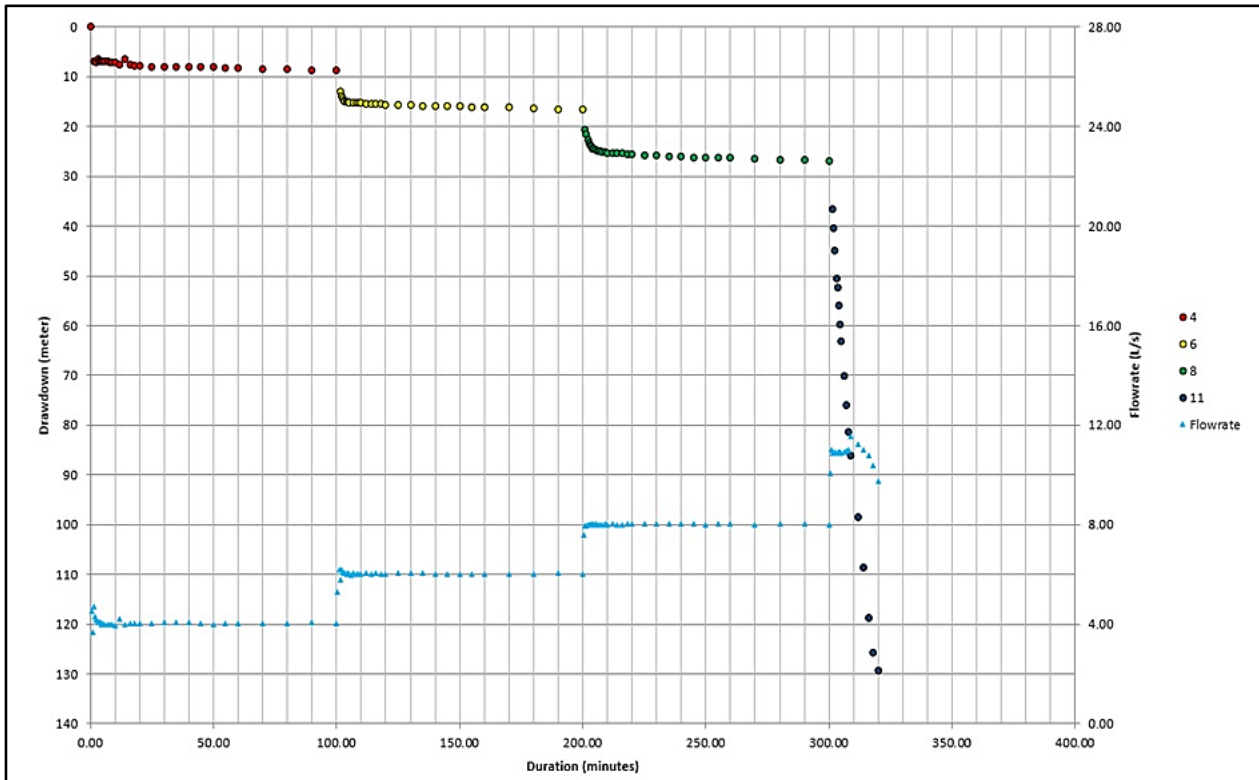


Figure 5.3 Bombora Deposit – Step Rate Test at WPB26

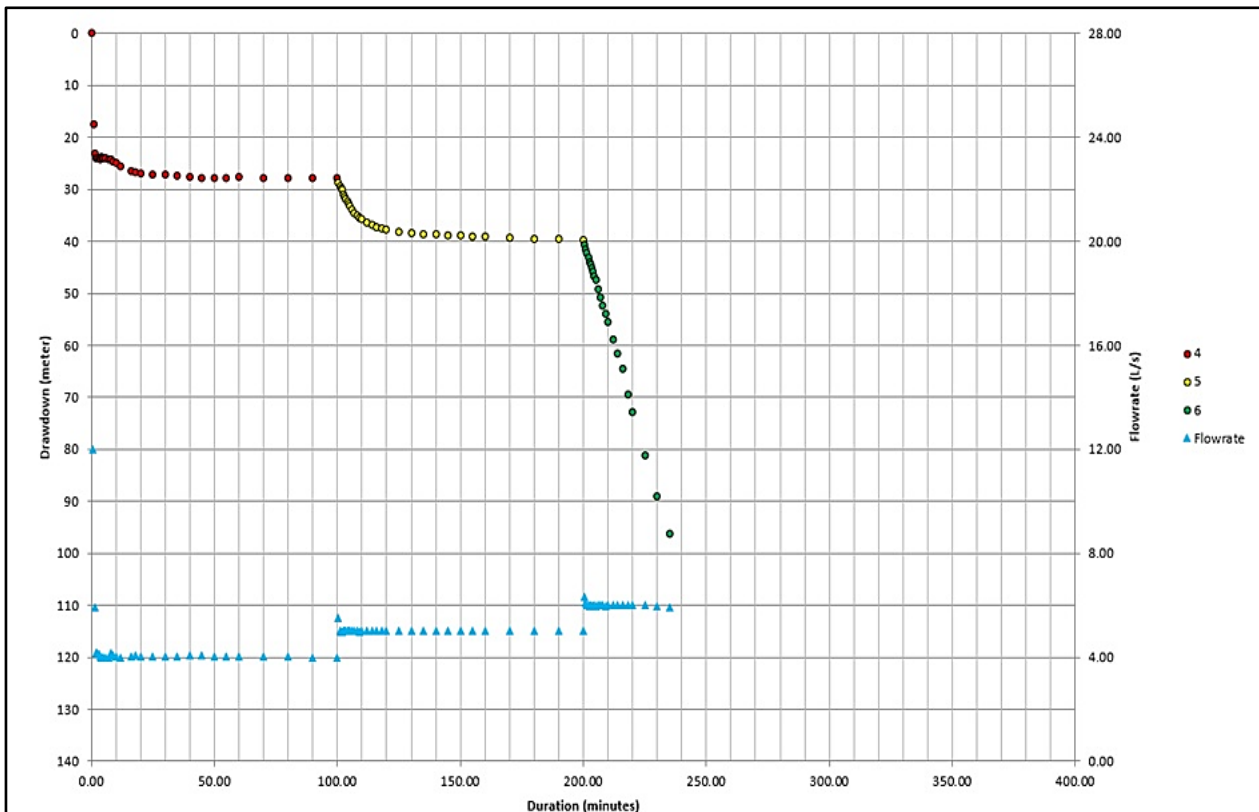


Figure 5.4 Bombora Deposit – Step Rate Test at WPB33

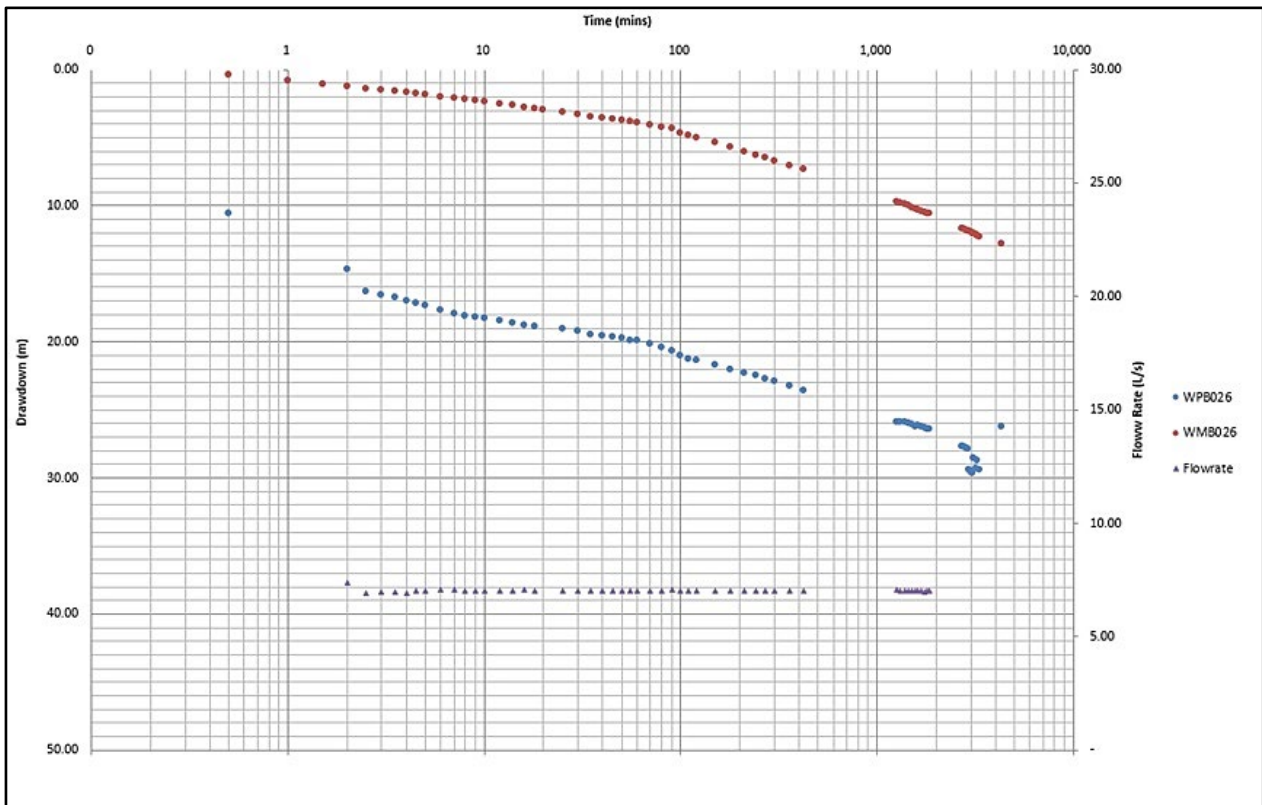


Figure 5.5 Bombora Deposit – Constant Rate Test at WPB26

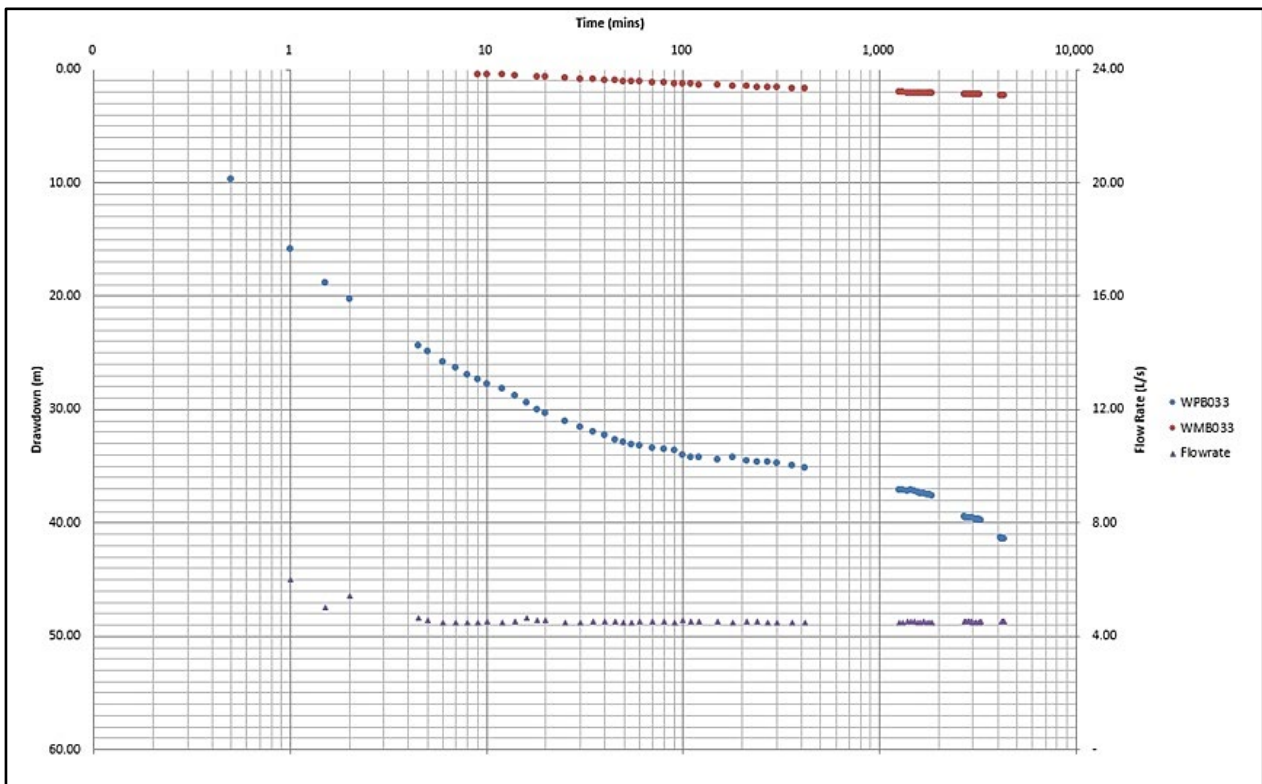


Figure 5.6 Bombora Deposit – Constant Rate Test at WPB33

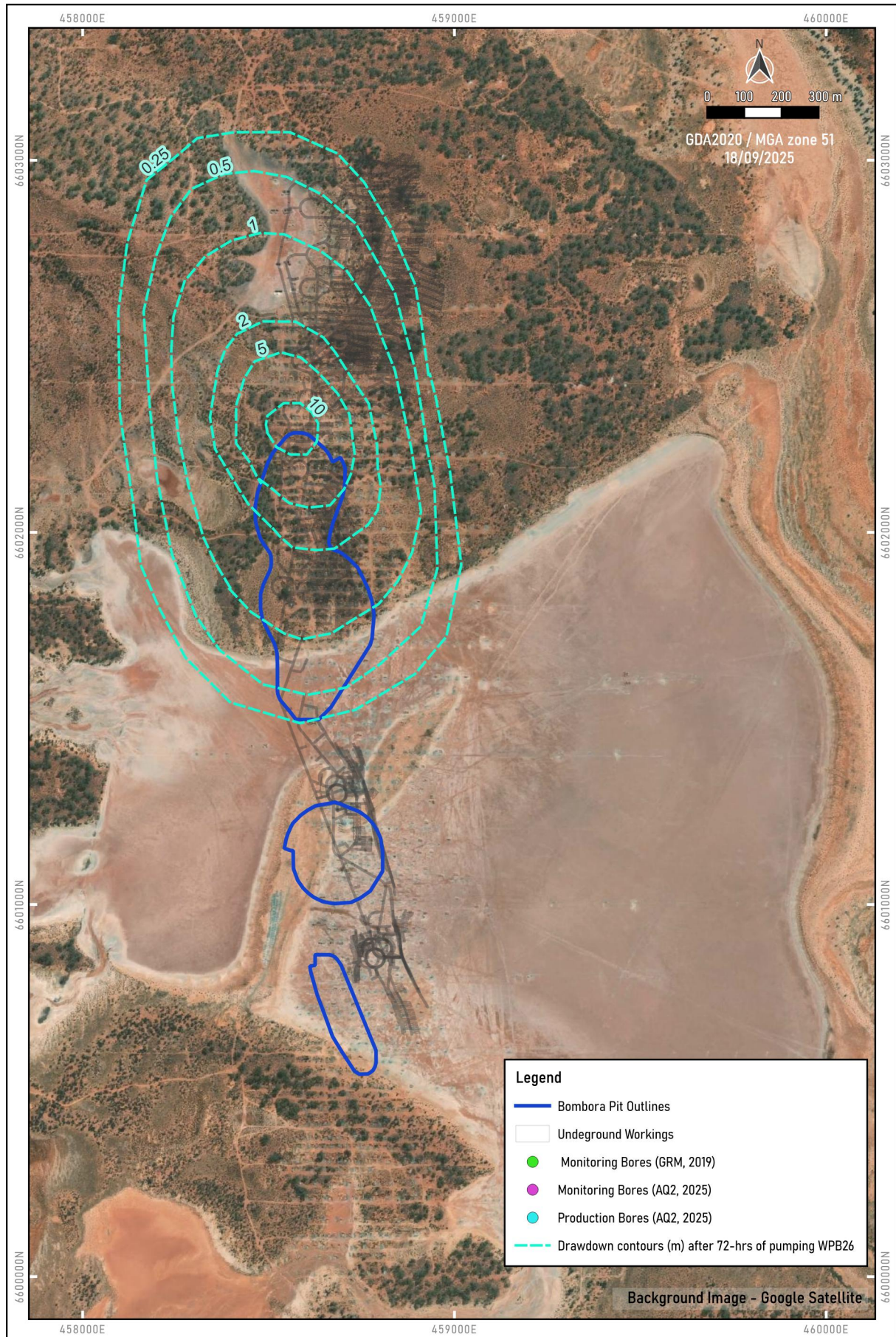


Figure 5.7 Drawdowns in Monitoring Bores after 72 hrs Constant Rate Test at WPB26

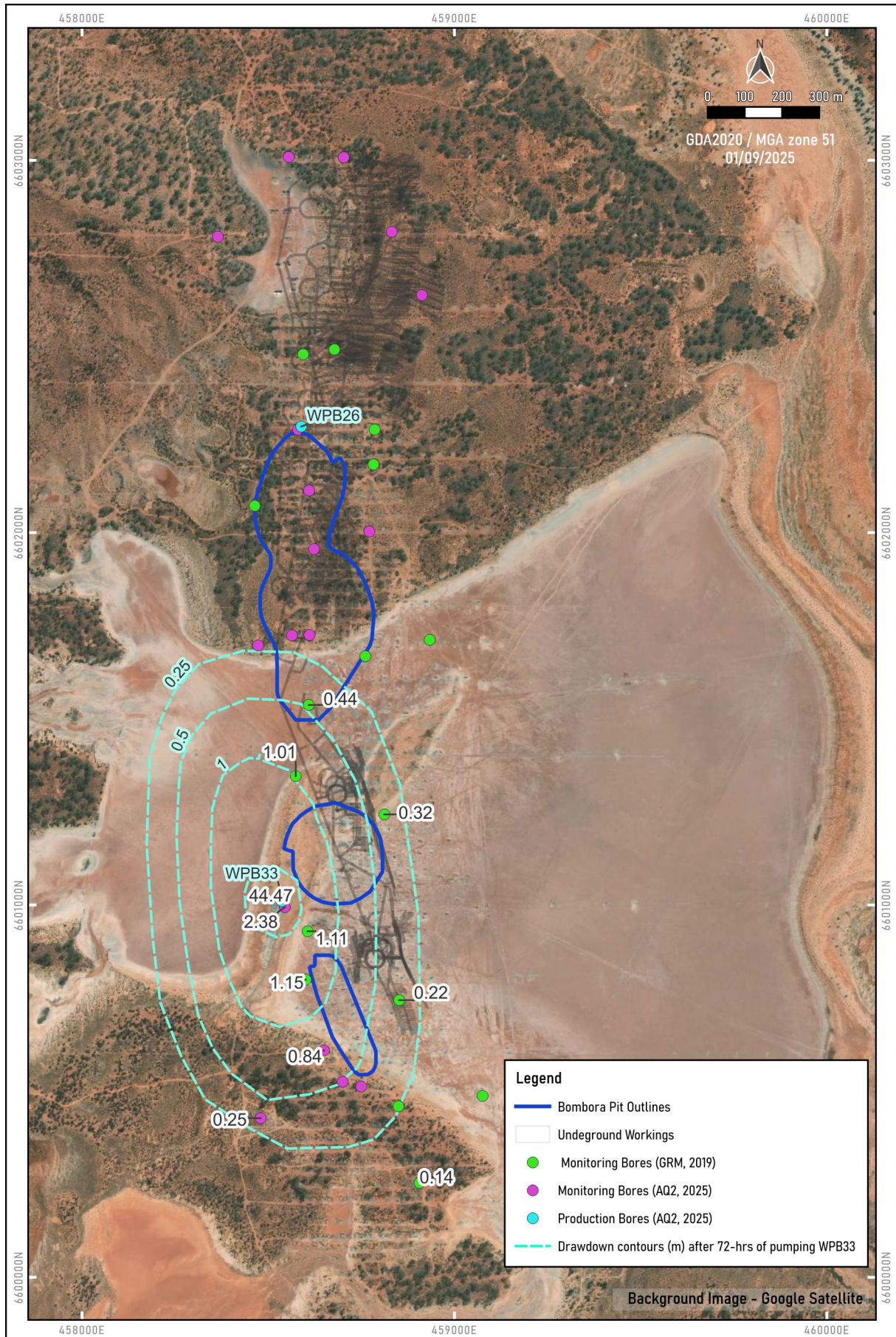


Figure 5.8 Drawdowns in Monitoring Bores after 72 hrs Constant Rate Test at WPB33

Bore WPB26, located immediately north of the proposed 1800 Pit, intersected fractures around the chilled margins of the lamprophyre dyke and quartz veins (i.e. fracture intervals 24–25 mbgl, 31–34 mbgl, 79–82 mbgl, 87, 90, 95, and 107 mbgl). The results from the SRT indicated that bore WPB26 is able to sustain a constant discharge rate of 7 L/s, providing water levels remain within the fractured zone (up to around 35 m depth). Once the water levels pass this point the drawdown rate significantly increases (as seen in the 4th step, refer to Figure 5.3), due to fracture sets becoming dewatered.

Bore WPB26 sustained a constant pumping rate of 7 L/s over the 71.5 hours tested with the final drawdown of 38.7 m recorded from a static water level of 3 mbtoc. A drawdown of 13.1 m was reported at the end of the test in the closest monitoring bore WMB26 (at a distance of 8 m from WPB26), suggesting a very good hydraulic connectivity with the pumped bore. Moreover, drawdowns were recorded in all 11 bores that were monitored throughout the test. This indicates good hydraulic connection within the weathered/fractured bedrock aquifer at a considerable distance (at least up to 720 m) away from the pumped bore (Table 5.3 and Figure 5.7). Bore BWE10 located approximately 190 m north from the WPB26 had a smaller than expected drawdown that could be due to localised discontinuity of the weathered/fractured aquifer.

On a semi-logarithmic scale (Figure 5.5), the production bore WPB26 data shows that the rate of drawdown remained relatively constant for the first 100 minutes of the CRT, after which the drawdown rate significantly increased for the remainder of the test duration. It was evident from the CRT data that drilling at WMB29, located ~600 m to the northeast, influenced the groundwater levels at the pumped bore WPB26 from 60 hours into the test onwards, resulting in greater drawdowns. This indicates a clear hydraulic connection between the fractures at WPB26 and WMB29. The sharp increase in the drawdown rate indicates the fractured bedrock aquifer having limited storage capacity. Recovery data (Appendix C) show a slow recovery, indicating that the upper fractures have been dewatered during the testing and groundwater “recharge” is limited.

Bore WPB33, located on the lake peninsula, was drilled to intersect the Peninsula Fault (i.e. brecciated zone from 40 to 45 mbgl and quartz veins to 48 mbgl were encountered within the fresh bedrock). The results from the SRT indicated that bore WPB33 is able to sustain a constant discharge rate of 4.5 L/s, providing water levels remain within the brecciated zone (up to around 48 m depth). Once the water levels pass this mark, the drawdown rate significantly increases (as seen in the 3rd step, refer to Figure 5.4).

Bore WPB33 sustained a constant pumping rate of 4.5 L/s over the 72 hours tested with the final drawdown of 44.5 m recorded from a static water level of 3.1 mbtoc. A drawdown of 2.4 m was reported at the end of the test in the closest monitoring bore WMB33 (at a distance of 17 m from WPB33). The smaller than expected drawdown in WMB33 is likely due to limited connectivity of this bore with the pumped bore, as WMB33 was installed within weathered bedrock only (brecciated zone from 32 to 36 m depth had extensive clayey matrix). However, drawdowns were recorded in the remaining 9 monitoring bores throughout the test, indicating good hydraulic connection within the weathered/fractured bedrock aquifer at a considerable distance (up to 840 m) away from the pumped bore (Table 5.3 and Figure 5.8). Greater water level responses were encountered in the bores (BWE02, BWE05, BWE07, BWE16) along the north-south trending fracture strike, where there is greater intensity of cross cutting faults, quartz veins and lamprophyre dykes, compared to drawdowns recorded in the less fractured/unfractured bedrock.

On a semi-logarithmic scale (Figure 5.6), the production bore WPB33 data show that the early time data have the effects of well-bore storage, and after 30 minutes of pumping there was a gradual reduction in the drawdown slope. This flatter curve was due to the fractured aquifer of double porosity type being ‘recharged’ from more distant fractures (that are interconnected) and/or from the aquifer matrix (from primary porosity). A sharp increase in the drawdown rate was recorded from around 1,000 minutes and continued for the remainder of the test duration, and indicated the fractured bedrock aquifer having limited storage capacity. Recovery data (Appendix C) show similar trends, with a steep recovery plot in early time data (high values of t/t') and a reduced rate of recovery in late time data.

Data collected during the aquifer testing was analysed using AQTESOLV software (HydroSOLVE Inc.) to infer representative hydraulic parameters of the tested aquifer (i.e. estimates of aquifer transmissivity and storativity), utilising different analysis methods to compare the results for both drawdown and recovery data. A summary of the data and analyses is presented in Table 5.5 and Appendix C.

It should be noted that most existing aquifer test analysis procedures assume that the:

- Aquifer has infinite areal extent.
- Aquifer is homogeneous, isotropic and of uniform thickness.
- Pumping well is fully or partially penetrating.
- Flow is unsteady.
- Water is released instantaneously from storage with decline of hydraulic head.

Under such assumptions of homogeneity, it is possible to devise graphical or analytical methods that can provide estimations of aquifer parameters.

It should also be noted that aquifer test analyses were undertaken using various type curve matching techniques based on the interpreted nature of the aquifer response. The most widely used methods are based on the semi-log /or log-log representation of the drawdown versus time (i.e. the Cooper-Jacob and Theis methods which were used in our assessment). The analysis methods are detailed in Kruseman and de Ridder (1994).

The aquifer transmissivity was calculated from the pumping tests and the transmissivity was divided by the assumed aquifer thickness to provide an estimate of permeability (hydraulic conductivity). Analysis of the late-time drawdown and recovery data from pumped bores WPB26 and WPB33 indicates that the average bulk transmissivity value of the weathered/fractured bedrock (transition zone) aquifer was calculated to be 22 m²/d. Based on an average aquifer thickness of 47 m, the average hydraulic conductivity is 0.47 m/d. The “late” time data was used, which is appropriate for estimations of transmissivity of the fractured aquifer and takes into account the impacts on the aquifer boundaries and limited aquifer storage. The derived transmissivity values are bulk values covering all of the material tested; none of the values apply to individual features (e.g. fractures or shears) of higher permeability. It is likely that the permeability of discrete fracture zones will be higher, but these bulk aquifer properties are appropriate for assessing “whole of pit” inflows.

Table 5.5 Summary of Estimated Aquifer Parameters –Test Production Bores

Pumping Bore	Aquifer Thickness (m)	Average Effective Transmissivity (T m ² /d)	Average Hydraulic Conductivity (k m/d)
WPB26	47	22	0.47
WPB33	45	17	0.4

5.2.3.2 Hydraulic Tests

Following the drilling and casing, hydraulic testing (airlift recovery and/or slug tests) were undertaken at 15 monitoring bores. The purpose of the hydraulic testing was to obtain local hydrogeological data to assess the near-bore aquifer permeability.

For the airlift recovery tests, the bores were airlifted as part of bore development (or until they ran dry). Monitoring of water levels was carried out throughout the pumping and after the pumping ceased. Water levels were measured using a pressure transducer (data logger). All test data collected during recovery

were analysed using standard curve-fitting analysis methods to ascertain aquifer properties (using the Jacob and Theis Recovery Methods).

Each slug test consisted of measuring the static water level in the bore, then introducing a near instantaneous change of water level by adding a slug of water into the bore or temporarily airlifting water out of the bore and then measuring the change in water level (i.e. rise and fall) over time, until the water level returned to its near original static water level. A pressure transducer was used to measure the water level changes over time, at 1 second intervals. The declining water levels were used for analysis of the permeability, utilising the Bower-Rice method.

The results of the hydraulic tests undertaken at each bore are summarised in Table 5.6 and presented in Appendix C.

Table 5.6 Summary of Hydraulic Testing - Monitoring Bores

Bore Number	Drilled Depth	Screened Interval (mbgl)	Static Water Level (mbgl)	Completion Final Airlift Rate (L/s)	Length of test (m)	Bulk Transmissivity (m ² /d)	Adopted aquifer thickness (m)	Bulk Permeability (m/d)	Fractures (mbgl)
WMB19	160	open	3.42	Dry	148	0.7	148	0.004	-
WMB20	150	24-150	1.19	1.8	126	5.3	13	0.41	44, 56-57
WMB21	169	open	2.85	4.4	157	3.5	145	0.024	14, 24,
WMB22	160	38-200	1.09	2.5	122	2.7	122	0.022	40, 47-48, 53-54, 69-70
WMB23	200	20-200	4.05	0	180	0.3	180	0.0015	
WMB24	200	38-200	3.86	1	162	0.7	162	0.005	quartz veins
WMB25	200	26-200	3.44	4.3	174	3.8	11	0.35	34, 43, 50-54
WMB27	130	34-154	3.01	Dry	120	0.4	120	0.003	
WMB28	160	40-160	3.66	1.5	120	1.4	120	0.01	
WMB29	130	33-128.5	5.04	4.4	95.5				32, 49, 53
WMB30	150	36-126	3.96	2.5	90	ND	ND	ND	36
WMB31	151	42-150	3.3	8.8	108	ND	ND	ND	37-41, 47, 55
WMB32	141	open	3.24	1.8	129	23 (upper) 3.9 (lower)	50 110	0.46 0.035	29-31
WMB34	157	open	3.47	Dry	145	0.1	145	0.001	17, 19, 21, 33-35, 38, 44, 49, 54
WMB35	161	28-160	1.28	0.9	132	0.3	132	0.002	29-30, 63

It is noted that the analysis methods calculate bulk aquifer transmissivity. Permeability was derived from the calculated transmissivity and measured aquifer thickness (in each bore). The aquifer thickness for bores that encountered fractures in the transition zone (i.e. weathered/ fractured bedrock) and produced higher airlift yields during drilling were measured from the first water strike to the base of the fractured zone. It is likely that the permeabilities of discrete fracture zones/sandy layers would be higher, but these bulk aquifer properties are appropriate for assessing “whole of pit” inflows. For the bores that had fewer or no fractures encountered and the airlift yields that were low, the aquifer thickness was estimated to be from the top of the fresh bedrock to the total depth of the bore.

The results show that permeability ranges between 0.001 to 0.5 m/d and are consistent with the results from GRM (2019) that were in the range of 0.003 to 0.2 m/d. The variability in permeability values indicate a highly heterogeneous aquifer (as expected in a fractured Archaean bedrock aquifer), likely to reflect the variable nature of the fractured rock and extent of weathering.

5.2.3.3 Summary of Aquifer Response to Pumping

Airlift yields of between 7 and 15 L/s were recorded during the installation of the two production bores WPB26 and WPB33. However, the results from the aquifer step rate tests conducted on these bores indicated that the airlift yields could not be sustained during the 72-hour constant rate tests. Consequently, in all the bores, the pumping rates at which the constant rate tests were undertaken, were reduced to approximately half of the airlift rates. The CRT data showed continuous drawdown of the groundwater levels throughout the durations of the CRTs, with water levels not reaching a state of equilibrium between aquifer inflow and pumping rates in any of the tests. The lack of equilibrium in all test bores was as a result of the applied pumping rates being greater than the aquifer could deliver, likely owing to boundary effects formed by a low-permeability unfractured bedrock limiting groundwater inflows in the long-term.

The weathered / fractured bedrock aquifer (transition zone) at the site is relatively transmissive, with groundwater predominantly occurring in localised geological structures (i.e. shear zones and fractured/broken zones) up to 55 m depth within zones of secondary porosity of the bedrock. There is a good hydraulic connection within the weathered/fractured bedrock aquifer at a considerable distance across the site. Slightly greater water level responses were encountered in the bores along the north-south trending fracture strike, where there is greater intensity of cross cutting faults, quartz veins and lamprophyre dykes, compared to drawdowns recorded in the less fractured/unfractured bedrock. Therefore, the long-term sustainability of this aquifer is constrained by its limited storage and low recharge.

5.2.4 Underground Mine Ground Conditions

The Bombora drill hole database (i.e. geological model, core photographs, rock quality designation (RQD) data, water related comments during drilling) and preliminary geotechnical assessment (Peter O'Bryan & Associates, 2024) were reviewed and the relevant data were viewed using Leapfrog (Hydro) software to assess the deep fresh bedrock aquifer (below 150 m depth). This was to further develop the conceptual hydrogeological model of at Bombora and to better understand potential groundwater inflows to the planned Bombora underground up to 550 m depth. No hydraulic testing (i.e. packer testing) was undertaken as part of this assessment as there was no evidence of significant permeability at depth within the bedrock aquifer.

Key findings and conclusions drawn by this data review are detailed below:

- Bedrock within the proposed underground mining areas essentially comprise fresh quartz dolerite, lamprophyre and dolerite.
- Quartz dolerite is generally extremely strong (UCS > 250 MPa), while lamprophyre is generally very strong (UCS 100 to 250 MPa).
- The RQD index is an indicator of rock mass conditions. From the engineering point of view, the degree of fracturing stands for rock quality. Within assessed geotechnical domains, the underground rock mass at Bombora is typically of good (or better) quality. Limited intervals of very poor quality rock are recorded across assessed domains, and these zones are generally related to drill intersections of discrete shear structures, often comprising broken rock and smooth chlorite infilled defect surfaces.
- From the hydrogeological point of view, the degree of fracturing may be regarded as a factor in evaluating rock mass permeability. The RQD data (from 150 m depth onwards), indicated that the fresh

bedrock across the Project is mostly massive (unfractured). There were some fractures identified in the northern part of the deposit. Most of assessed fractures occur between 300 to 450 mbgl with only minor isolated zones of fractures encountered below 450m depth.

- A review of diamond core photos indicated that all fractures were clean, tight, with no large wide fractures and with only localised Fe staining. There were some zones of intense, closely spaced fracturing, which often corresponded to veins (<1m in length). Overall, the bulk of the core had fractures spaced apart, with no evidence of any water movement.
- Overall, the permeability of the bedrock below 150 m depth is likely to be low to very low (in order of 10^{-3} to 10^{-4} m/d) and would decrease with increasing depth.

5.2.5 Water Levels

Groundwater levels in the Bombora area were recorded during the drilling and testing programme and levels from a final dip round are presented in Table 5.7. The depth to groundwater ranges from 0.2 m below ground level (bgl) to 5.4 m bgl, with shallower water levels recorded in the lake area (0.2 to 1.4 mbgl) and deeper water levels recorded on the land (1 to 5.4 mbgl).

Recent groundwater levels have been combined with surveyed project bore elevations to plot interpreted groundwater elevations and groundwater flow directions in and around the Bombora deposit. These are shown in Figure 5.9 and presented in Table 5.7. The interpreted groundwater levels suggest that the water table elevation ranges between 310 and 312.5 mAHD and is generally around 310.5 and 311.5 mAHD. Groundwater flow is under a very low gradient. The groundwater levels are a subdued representation of the topography, with groundwater flowing from higher areas to low areas and generally in directions towards the lake.

Time series data of water levels is not yet available. An on-going monitoring programme should be implemented to provide data on annual water level variations within the Project area. It is expected there will be some minor seasonal variation in groundwater levels.

Table 5.7 Summary of Groundwater Levels (mbtoc, mbgl and mAHD)

Bore ID	Static Water Levels (8-10 July 2025)		
	(mbtoc)	(mbgl)	(mAHD)
BWE01	2.71	2.02	311.94
BWE02	1.79	1.42	310.32
BWE03	1.78	0.81	310.95
BWE04	1.23	0.72	311.07
BWE05	1.79	0.92	311.05
BWE07	1.31	0.90	310.88
BWE08	1.37	0.67	311.06
BWE09	3.05	2.50	311.47
BWE10	3.28	2.68	311.59
BWE11	3.59	2.91	310.70
BWE12	5.33	4.49	310.72
BWE13	4.06	3.40	310.87
BWE14	1.57	0.91	310.84
BWE16	1.19	0.22	311.49
BWE17	1.38	0.41	312.25
BWE18	3.80	3.17	311.68
WMB19	3.97	3.42	310.52
WMB20	1.19	0.38	312.53
WMB21	2.96	2.34	311.28
WMB22	1.93	1.07	311.90
WMB23	4.95	4.05	310.86
WMB24	4.59	3.86	311.12
WMB25	4.48	3.44	310.96
WMB26	4.02	3.18	310.95
WMB27	3.82	3.01	310.89
WMB28	4.77	3.66	310.69
WMB29	6.54	5.29	310.26
WMB30	5.03	4.05	310.83
WMB31	4.27	3.30	312.25
WMB32	3.71	3.20	310.70
WMB33	4.00	3.34	309.60
WMB34	4.86	4.33	310.55
WMB35	2.13	1.28	311.68
WPB26	2.59	2.01	311.78
WPB33	2.60	2.32	310.91

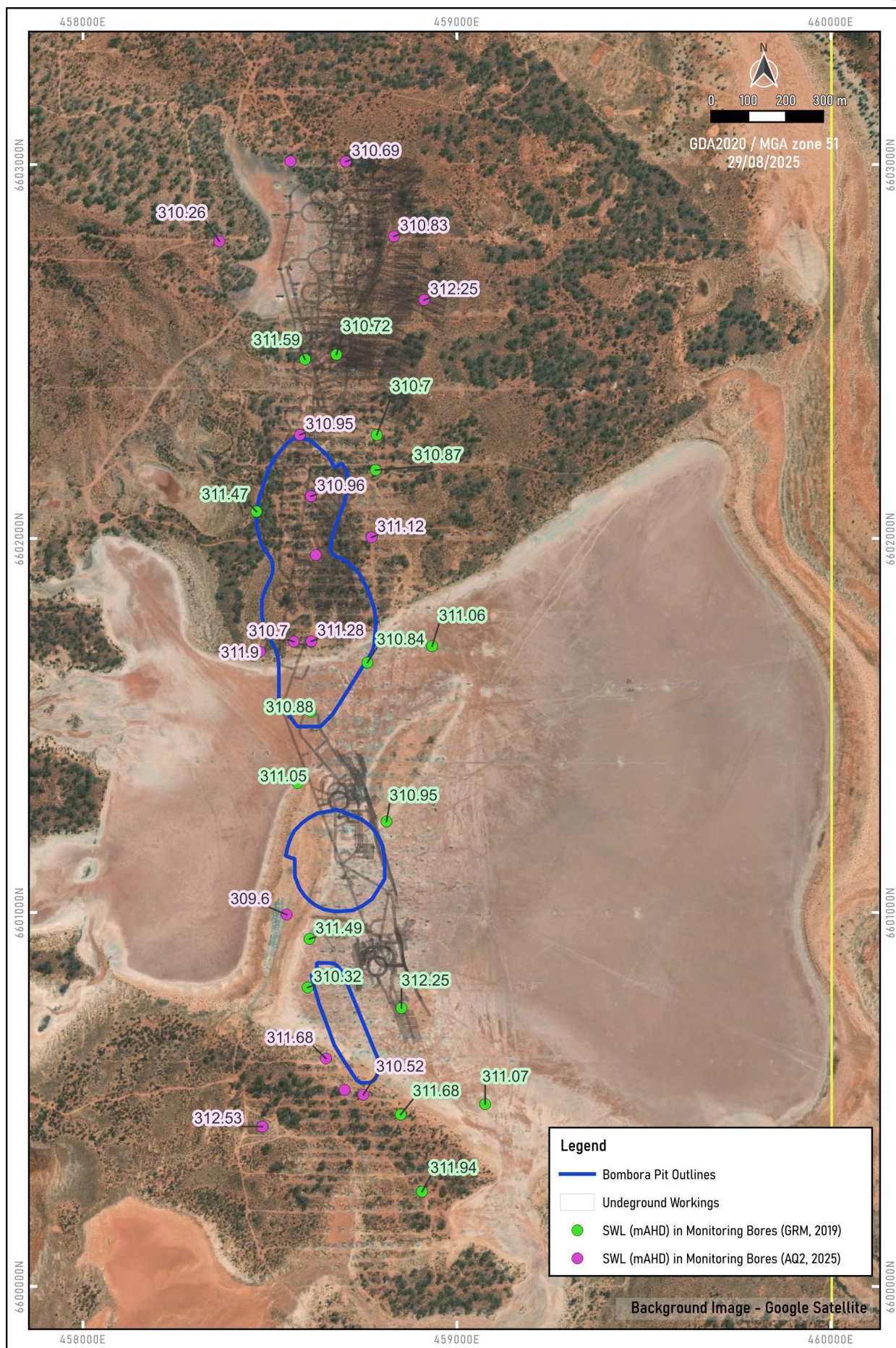


Figure 5.9 Bombora Deposit – Recent Groundwater Level Elevations

5.2.6 Groundwater Quality

Groundwater samples were collected for hydrochemical analyses from the following bores:

- The two test production bores WPB26 and WPB33 at the end of their respective constant rate pumping tests in July and June 2025. These gave the most representative samples of groundwater from the fractured aquifer that could be taken.
- Monitoring bore BWE29 at the end of its bore development by airlifting. Airlifted groundwater samples are not ideal as the groundwater is heavily oxidised during the airlifting and this can change the hydrochemistry. This sample was taken to give a wider spread of groundwater sampling across the Bombora deposit area.

The samples were analysed by SGS laboratories in Perth and the hydrochemical results are listed in Table 5.8 and presented in Appendix D.

This data represents the local Bombora groundwater quality and indicates the following:

- Groundwater is hypersaline with electrical conductivity (EC) values ranging from 200,000 $\mu\text{S}/\text{cm}$ (WPB26) to 210,000 $\mu\text{S}/\text{cm}$ (WPB33 and WMB29). Total dissolved solids (TDS) values were reported between 220,000 to 260,000 mg/L across the 3 bores, but these are considered to be erroneous as they are too high for the EC values measured. The laboratory EC values measured are reasonably consistent with the field EC values collected at the end of each bore's development, which ranged between 154,00 and 208,800 $\mu\text{S}/\text{cm}$ for the full depth bores (Table 5.2).
- Laboratory measurements of pH ranged from 6.8 to 7.1, indicating that the groundwater is mildly acidic to neutral. The laboratory pH values are generally consistent with the field pH values (Table 5.2) of 6.1 to 7.2, with the majority of groundwater sampled being mildly acidic.
- The groundwater is dominantly a sodium chloride type, with subsidiary high concentrations of magnesium and sulphate. It is also extremely hard, with total hardness between 30,000 to 37,000 mg/L CaCO_3 .
- The production and monitoring bores' hydrochemical results are plotted on an expanded Durov plot (Figure 5.10) and show that the sampled waters have a very low variation in chemical composition based on the calculated percentage equivalents of the major ions. All 3 samples plotted tightly together in the 9th quadrant, indicating 'end point' waters that are static and no longer interacting with their environment, with no evidence of recharge influence. This is typical of groundwater found in the Goldfields in areas well down the drainage systems and in a salt lake environment.
- Concentrations of metals were mostly low (below the limit of reporting), with only iron and manganese concentrations being elevated in some samples, together with lower levels of zinc and potassium.

The groundwater is hypersaline everywhere and is between 3 to 4 times the salinity of seawater, which has an electrical conductivity of around 55,000 $\mu\text{S}/\text{cm}$. Hypersaline groundwater is typically found in aquifers that are adjacent to and below alluvial flats and playa lakes, (such as Lake Roe), where salinities of up to 300,000 mg/L TDS have been recorded in the Kalgoorlie region. Overall, the groundwater at Bombora is of very poor quality, with only restricted beneficial use. It is suitable for mineral processing water supply where the industrial process used can cope with hypersaline water. The water is far too saline for any agricultural or domestic use.

Table 5.8 Bombora Bores Hydrochemistry Results

Determinands	Bore	WPB26	WPB33	WMB29
	Units / Sampling Date	07/07/25	28/06/25	11/07/25
pH	pH units	6.8	6.8	7.1
Electrical Conductivity @ 25 C	µS/cm	200,000	210,000	210,000
Total Dissolved Solids*	mg/L	220,000	240,000	260,000
Total Alkalinity as CaCO ₃	mg/L	110	36	51
Total Hardness	mg CaCO ₃ /L	30,000	33,000	37,000
Carbonate Alkalinity as CO ₃	mg/L	<5	<5	<5
Bicarbonate Alkalinity as HCO ₃	mg/L	130	44	62
Nitrite, NO ₂ as N	mg/L	<0.05	<0.05	<0.05
Nitrate, NO ₃ as N	mg/L	<0.05	2.6	<0.05
Ammonia, NH ₃ as N	mg/L	0.06	<0.05	0.12
Total Phosphorous as P	mg/L	0.07	<0.02	<0.02
Silica, SiO ₂	mg/L	0.93	6.5	6.3
Sulphate, SO ₄	mg/L	11,000	13,000	14,000
Chloride, Cl	mg/L	160,000	190,000	210,000
Calcium, Ca	mg/L	730	790	710
Potassium, K	mg/L	400	410	490
Magnesium, Mg	mg/L	6,900	7,500	8,600
Sodium, Na	mg/L	67,000	75,000	78,000
Aluminium	µg/L	<1000	<1000	<1000
Arsenic	µg/L	<100	<100	<100
Barium	µg/L	<100	<100	<100
Beryllium	µg/L	<20	<20	<20
Cadmium	µg/L	<10	<10	<10
Chromium	µg/L	<100	<100	<100
Cobalt	µg/L	<100	<100	<100
Copper	µg/L	<100	<100	410
Iron	µg/L	7,800	<1,000	<1,000
Lead	µg/L	<100	<100	<100
Manganese	µg/L	990	540	1,600
Mercury	µg/L	<0.05	<0.05	<0.05
Nickel	µg/L	<200	<200	<200
Selenium	µg/L	<200	<200	<200
Vanadium	µg/L	<100	<100	<100
Zinc	µg/L	290	310	280

* TDS considered to be erroneously high compared to electrical conductivity values

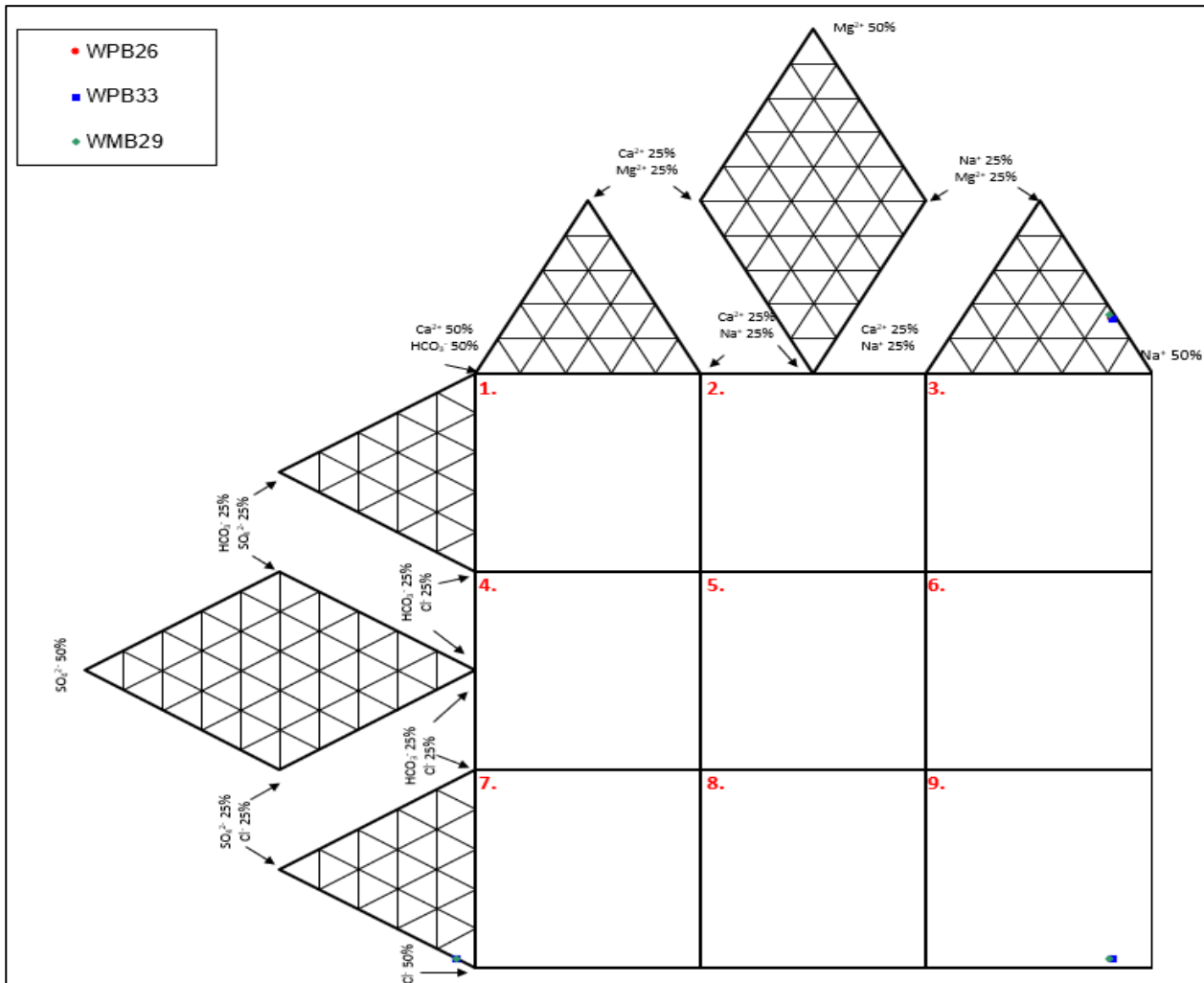


Figure 5.10 Bombora Deposit – Bombora Bores – Hydrochemistry on Expanded Durov Plot

5.3 Site Conceptual Hydrogeological Model

The current understanding of hydrogeological conditions in the Bombora area has been based on the review of all available literature in the region and site specific geological and hydrogeological data, including regional data and site-specific groundwater exploration drilling and hydrogeological investigation data.

The conceptual hydrogeological model for the immediate Bombora deposit area comprises the following key elements:

- The Bombora deposit is characterised by a generally low permeability environment. Aquifer potential (i.e. increased permeability) is limited to weathered /fractured basement (saprock / transition zone) to depth of up to 55 mbgl and discrete fracture zones within the otherwise massive bedrock. Higher permeability values depend upon the intensity of cross cutting faults and lamprophyre dykes (especially increased in swarms). The local faults (e.g. Peninsula Fault) are not considered particularly permeable, although cross faulting/lamprophyre dykes/quartz veins may potentially cause an increase in yields and provide a good hydraulic connection across the site. Below the transition zone aquifer (below 55 m depth), fresh bedrock was intersected with locally fractured zones (highly variable and weakly) that produced minor groundwater yields. The degree of fracturing decreased with increasing depth, with the fresh bedrock being generally massive (unfractured) from about 130 m depth.

- There is also a shallow surficial low permeability aquifer, which consists mainly of clay and silt, with occasionally sand and gravels (i.e. transported deposits). These sediments are generally less than 5 m thick (ranging from 3 to 10m in thickness) and when saturated (below water table) this aquifer is expected to have a permeability of less than 0.03 m/d, with higher permeability for limited sand and gravel lenses present. Slow downward seepage from this aquifer to the underlying weathered/fractured bedrock aquifer is likely to occur, feeding inflow to the open pit.
- While individual hydrostratigraphic units might be considered to be unconfined to semi-confined (e.g. the deeper basement rock aquifers will be partially confined by the low permeability saprolites), overall the aquifers can be considered as one bulk semi-unconfined aquifer system with variable permeability. There is likely to be some hydraulic connection within the units, allowing some groundwater throughflow.
- The summary of bedrock aquifer parameters in presented in Table 5.9 below.

Table 5.9 Summary of Estimated Aquifer Parameters

Aquifer	Average Effective Transmissivity	Average Bulk Permeability	Specific Yield
	(m ² /d)	(m/d)	(%)
Weathered / Fractured Fresh Bedrock (Transition zone up to 55 mbgl)	22	0.47	1
Fresh bedrock with minor fractures (up to 130 mbgl)	2.5	0.03	0.5
Fresh unfractured bedrock (130-200 mbgl)	0.5	0.003	0.5
Fresh unfractured bedrock (200-550 mbgl)	0.25	0.0005-0.001	0.5

This variability of permeability is primarily controlled by the presence of secondary porosity. High values are associated with fractures and shear zones which have been encountered in the bedrock. A decline in transmissivity (increase in the rate of drawdown) typically occurs in fractured rock aquifers with depth as the storage within the fractures is depleted as open fracture occurrence decreases.

- The groundwater levels across the deposits are between and 0.2 and 5.4 mbgl, and at elevations of between 310 and 312.5 mAHD. Groundwater flow is under a very low gradient. The groundwater levels are a subdued representation of the topography, with groundwater flowing generally in the directions towards the Lake Roe.
- Recharge to the aquifers is limited, as indicated by the hypersaline nature of the groundwater quality, and pit inflows are, and will be sustained by groundwater through flow. Groundwater throughflow will be principally through the main aquifer zones (fault/fractured zones) but with minor throughflow in the basement rocks aquifers.

The implications of this conceptual hydrogeological model, with respect to mine dewatering, are discussed in the following section.

6. ASSESSMENT OF DEWATERING REQUIREMENTS

The future groundwater inflow rates to the pits and underground and dewatering requirements at Bombora have been estimated, using an analytical groundwater flow model, based on the conceptual pit dewatering model, the proposed mine development plans, and considering prevailing water level and aquifer conditions.

The following sections:

- Outline the current mine plan and how the pits and underground were simulated in the model.
- Describe the pit and underground inflow models developed and used to confirm the modelling approach and define model geometry and aquifer parameters.
- Describe the analytical model and the model input parameters.
- Present model predictions in terms of individual pit inflows, underground inflows and total inflow volumes.

6.1 Current Mine Plan

Ramelius plans to develop the Bombora mine approximately to 2.5 km in length, which will consist of three open-cut pits (1800, 1100 and 700 pits) together with an underground mine over a total period of 9 years. Current proposed mining development schedules are presented in Figure 6.1, and are summarised in Table 6.1. Details of mining conditions for each open pit and underground are presented in Table 6.2. It should be noted that the underground mining consists of a number of mining areas with varying mine depths and timing. Thus, for the purpose of this assessment four underground areas have been selected and are shown in Figure 6.2.

Table 6.1 Bombora Mine Plan

Mining Pit	2028			2029				2030				2031	2032	2033	2034	2035	2036
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1-Q4	Q1-Q4	Q1-Q4	Q1-Q4	Q1-Q4	Q1-Q4
1800 Pit																	
1100 Pit																	
700 Pit																	
UG																	

Table 6.2 Mine Plan Stage Details

Pits	Start RL	Finish RL	Depth	Mine Life	Duration of dewatering
	(m AHD)	(m AHD)	(mbgl)	(months)	(months)
1800 Pit	315	200	115	24	105
1100 Pit	315	215	100	12	84
700 Pit	315	285	30	6	6
1800 UG Shallow		110	205	74	74
1800 UG Deep		-230	545	74	74
1100 UG		20	295	60	60
700 UG		-50	365	48	48

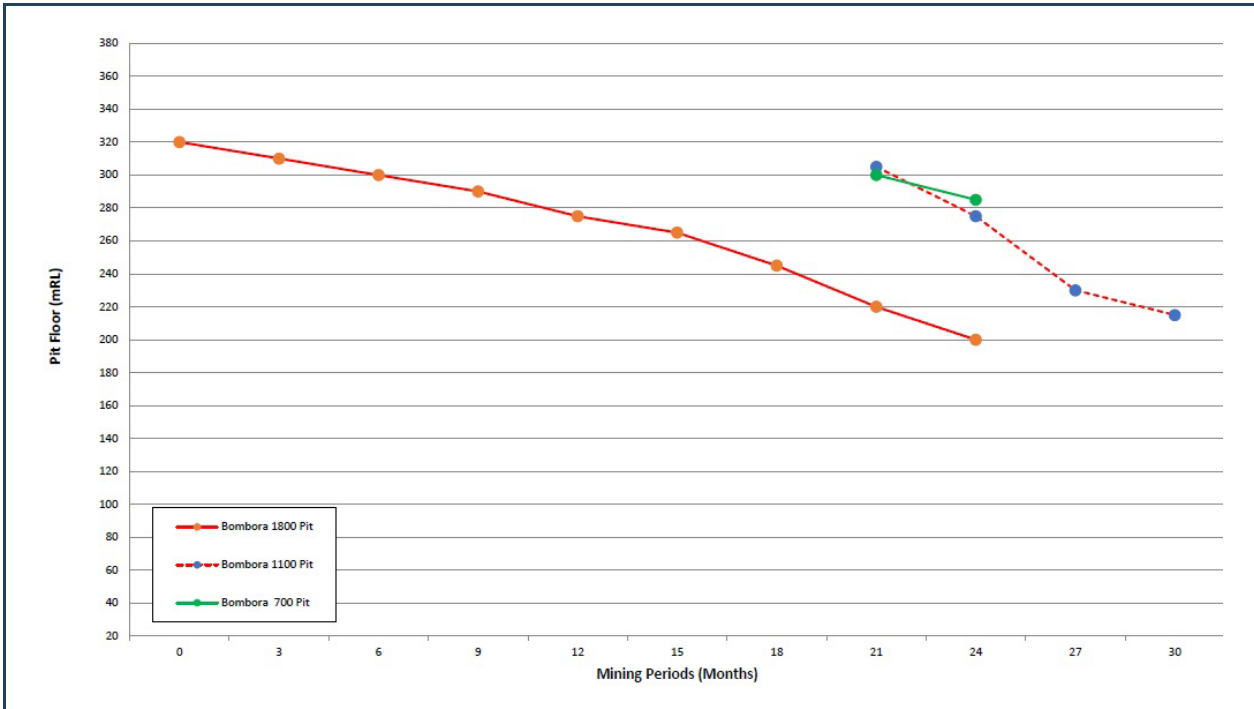


Figure 6.1 Current Proposed Bombora Open Pit Mining Development Schedules

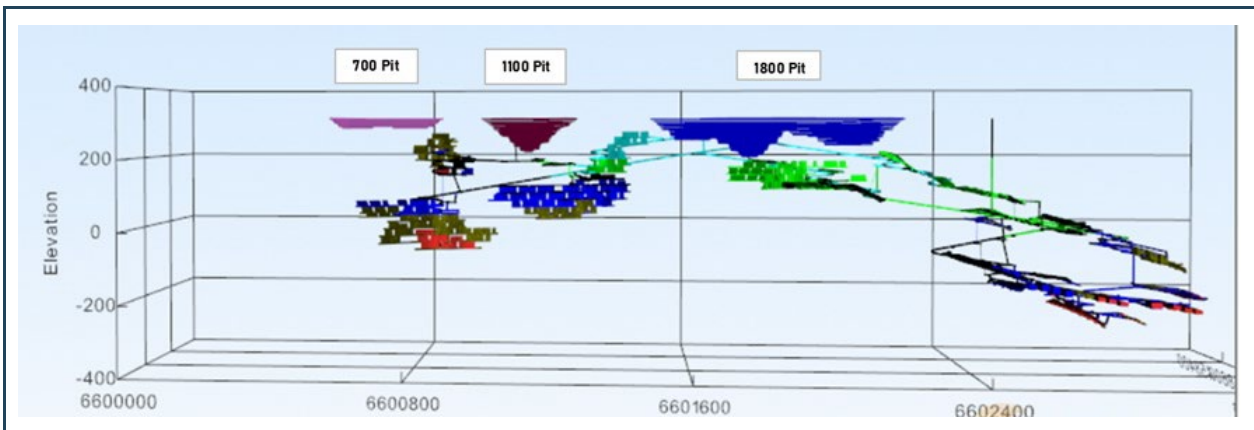


Figure 6.2 Long Section Through Bombora Pits and Underground

Mining of all open pits will be completed prior to the commencement of the underground mining operation. The proposed underground mine will be accessed from three portals located in the 1800 pit and the underground workings will extend some 750 m north of the 1800 pit and beneath the 1100 and 700 pits (Figure 6.2).

These proposed mine schedules were used to develop the simulated “pit shapes” used in pit inflow modelling (refer Section 6.3). Dewatering will only take place once mining is below the groundwater level. Advanced dewatering of the 1800 Pit, will result in parts of the 1100 and 700 Pits being dewatered ahead of mining.

6.2 Conceptual Pit Inflow Model

The following presents a description of a simplified conceptual pit inflow model derived from all available data (presented in Section 5) and AQ2's experience in similar hydrogeological environments. This conceptual model forms the basis for the pit inflow modelling undertaken and comprises the following key elements:

- The bedrock aquifer is underlain by essentially impermeable rocks at depth. While in practice, the aquifer is bounded laterally by very low permeability rocks outside the main mineralised/fractured zones, the conceptual model assumes an aquifer of infinite radial extent. As such, this is a conservative assumption, although it is noted that the proposed 9-year mine life and relatively low bulk permeability mean that the drawdown influence of dewatering will be constrained to a local area around the mine site.
- Two aquifer units, are modelled with:
 - Bulk transmissivity of 22 m²/d (i.e. bulk permeability of 0.5 m/d) for the weathered / fractured bedrock aquifer (a zone of moderate permeability) and specific yield of 1%.
 - Bulk transmissivity of 2.5 m²/d (i.e. bulk permeability of 0.03 m/d) for the fresh bedrock aquifer with locally fractured zones (highly variable, generally of low hydraulic conductivity when fresh) and specific yield of 0.5%.
 - A pre-mining water table of 3 m below surface across the model.
- Groundwater inflow to the pits will commence as soon as they are developed below the water table and will increase as the pits increase in size and depth over the life of mine.
- The potential impacts of localised higher permeability zones within the weathered / fractured bedrock aquifer are captured in the bulk transmissivity adopted for this aquifer. Chilled margins of lamprophyre dykes have been identified within the Bombora deposit and have possible locally higher permeability (i.e. fractures) that could increase groundwater inflow to the pits. It is likely that these fracture zones are local and of low storage, thus the increased groundwater inflow will be short lived.
- Given the proximity of the 1800, 1100 and 700 Pits to one another and the conceptual hydrogeological model, there will be significant hydraulic connection between the pits and all pits will tend to act as one large pit (in terms of intersecting groundwater flow).
- There is no direct aquifer recharge to the mine area during the mine life. Recharge to the aquifers is limited, as indicated by the hypersaline nature of the groundwater quality, and pit inflows are, and will be sustained by groundwater through flow. However, at the lake area some groundwater recharge may occur by infiltration of wet season surface water runoff to the shallow surficial aquifer, followed by leakage to the deep aquifer. The groundwater quality discussed in Section 5.2.6 indicates a very slow recharge process to the deep aquifer.

6.3 Pit Inflow Model

6.3.1 Modelling Approach

An analytical modelling approach was adopted to simulate groundwater inflows and provide estimates of pit dewatering requirements. The approach predicts groundwater inflow to the pit from aquifers surrounding the pit over set time periods.

Like all models, this approach makes a number of simplifying assumptions (principally that the aquifer system is homogeneous and isotropic) and model predictions cannot be considered to be precise. However, this approach does allow for the broad estimation of pit inflows based on limited data and has historically proven to be very close to observed inflows. At other nearby mines in the Goldfields, this modelling approach has provided predicted dewatering rates comparable with those derived from more complex (and more time consuming and expensive) numerical modelling.

Notwithstanding the above, there are inherent constraints to any modelling (due to limited aquifer distribution data) and it is generally considered that predicted dewatering requirements should be considered (at best) to be plus or minus 25%.

The model used is a two-dimensional analytical model based on the Theim and Dupuit-Forchheimer equations for flow to a large diameter well. Key steps in the model approach are as follows:

- Average aquifer parameters are applied to each equivalent well (representing stages of the pit).
- The aquifer systems present at Bombora are lumped into two single aquifer units with bulk average aquifer transmissivity for each unit (refer to Section 6.2).
- The pit, or various sections of the pit, are represented by a series of large diameter “equivalent wells” of similar area and depth at various time steps, representing various stages of pit development.
- The model is used to calculate the pumping rate required to maintain pumping water levels in each equivalent well at or below the base of each equivalent well (pit base) at the end of each time step. For each time-step, the groundwater level is lowered to the base of the pit active during that time-step and the inflows calculated at the end of the time step.
- The results provide a good approximation of the inflows to the pit.

6.3.2 Model Setup

The Project area was divided into three discrete model areas for each three pits (1800, 1100 and 700 Pits). Figure 6.3 shows long section through the Bombora area and the vertical pit shape (and depths of the final equivalent wells representing the various sections of each pit), simulated in the model. The distances of the equivalent wells representing the pits were derived from the plan areas.

Pit inflows were then simulated as follows:

- In all models, the inflows do not take into account short duration (higher) inflows associated with discrete, low storage structures (i.e. faults, shears, fractures). Individual structures could have burst flows of between 5 and 15 L/s, but for limited time periods. The short duration higher inflows will not significantly modify average long term inflows.
- The starting groundwater level in each pit model was set at:
 - 311 mAHD at 1800 Pit.
 - 290 mAHD at 1100 Pit, assuming that by the time mining of 1100 Pit starts, the groundwater level is likely to have dropped by 22 m due to dewatering of the adjacent 1800 Pit.
 - 297 mAHD at 700 Pit (i.e. 15 m below the pre-mining water levels), assuming that advanced dewatering of the adjacent 1800 Pit will result in part of the 700 Pit being dewatered ahead of mining.
- The effective base of the weathered / fractured bedrock aquifer was assumed to be at 265 mAHD (i.e. 55 mbgl), while the base of the fresh bedrock was assumed to be at 190 mAHD (i.e. 130 mbgl) approximately 10 m below the base of the deepest pit (i.e. 1800 Pit).
- Aquifer parameters (permeability and specific yield) for each modelled pit were adopted based on the conceptual model described in Section 6.1.

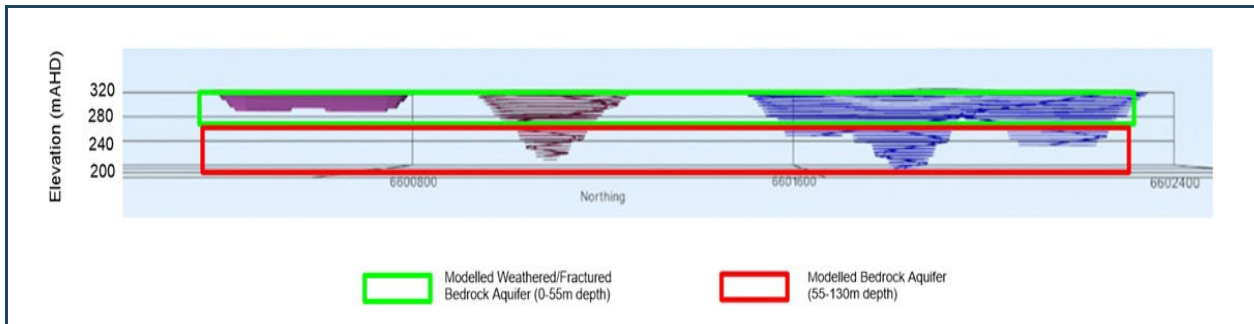


Figure 6.3 Long Section Through Bombora Pits Showing Modelled Vertical Pit Shape

6.3.3 Predicted Pit Inflows

Table 6.3 summarises the pit inflow predictions (i.e. base case) for required dewatering rates over the open pit mining (Year 1 to Year 3). The base case model runs use average values for aquifer permeability (as determined from hydraulic testing) and are considered the most reliable based on available data.

Table 6.3 Summary of Pit Inflow Predictions

Mining Schedule	Mining Year	Mining Months	Bombora 1800 Pit			Bombora 1100 Pit			Bombora 700 Pit			Total Inflows (All Pits) (L/s)
			Upper Aquifer (L/s)	Lower Aquifer (L/s)	Total (L/s)	Upper Aquifer (L/s)	Lower Aquifer (L/s)	Total (L/s)	Upper Aquifer (L/s)	Lower Aquifer (L/s)	Total (L/s)	
FY2028 Q1	1	0-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FY2028 Q2		4-6	2.9	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	3
FY2028 Q3		7-9	11.2	0.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11
FY2028 Q4		10-12	15.1	0.0	15.1	0.0	0.0	0.0	0.0	0.0	0.0	15
FY2029 Q1	2	13-15	17.5	0.0	17.5	0.0	0.0	0.0	0.0	0.0	0.0	17
FY2029 Q2		16-18	16.2	0.0	16.2	0.0	0.0	0.0	0.0	0.0	0.0	16
FY2029 Q3		19-21	15.6	3.0	18.6	0.0	0.0	0.0	0.0	0.0	0.0	19
FY2029 Q4		22-24	15.1	2.9	18.0	0.0	0.0	0.0	0.0	0.0	0.0	18
FY2030 Q1	3	25-27	14.7	2.3	17.1	0.0	0.0	0.0	3.9	0.0	3.9	21
FY2030 Q2		28-30	14.4	2.2	16.6	3.6	0.0	3.6	0.0	0.0	0.0	20
FY2030 Q3		31-33	14.1	2.2	16.2	4.6	2.7	7.3	0.0	0.0	0.0	24
FY2030 Q4		34-36	13.8	2.1	15.9	4.3	2.0	6.3	0.0	0.0	0.0	22

Salient points of the estimated inflows are as followed:

- The base case models predict total groundwater inflows to the pits of between 3 L/s (260kL/d) to 24 L/s (2,100 kL/d), averaging about 17 L/s (1,500 kL/d).
- Potential total groundwater inflows to the pits will possibly be as high as:
 - up to 19 L/s at the end of mining 1800 Pit (Year 2).
 - up to 7 L/s at the end of mining 1100 Pit (Year 3).
 - up to 4 L/s at the end of mining 700 Pit (Q1 Year 3).

- It should be noted, however, that the above predictions take no account of evaporative losses from the pit wall (from seepage faces) or from the pit base (sumps and ponded areas). Net inflows (i.e. those requiring dewatering pumping) could be only 50 to 60% of those predicted (especially during the summer period). Therefore, actual dewatering abstraction (from pit sumps) is likely to be less than predicted (in order of 2 to 10 L/s).
- It should also be noted that the above does not account for any surface water runoff, which may report to the pits during high rainfall events (i.e. pit floor, pit walls and area of pit crest within flood protection bunding). In an average rainfall year, potential evaporation far exceeds rainfall and while there may be some minor runoff to the pits during a rainfall event, on average there should be no net recharge to the pits. However, there could be significant runoff to the pits during extreme rainfall events which would need to be pumped from the pits along with groundwater inflows. Thus, total inflows (and dewatering requirements) will, at times, be in excess of the predicted groundwater inflow.

These estimated pumping rates can be compared to dewatering rates achieved historically from open pits in the Kalgoorlie region, where mining occurs on or adjacent to the salt lake, with no presence of palaeochannel, indicate dewatering at rates between 6 and 29 L/s (Johnson et al (1999).

6.4 Predicted Inflows to Underground Workings

6.4.1 Modelling Approach

The same model used to predict pit inflows (refer to Section 6.4) was modified to predict groundwater inflows to the planned underground development. An analytical modelling approach was adopted to simulate groundwater inflows from aquifers surrounding the mine workings and provide estimates of underground dewatering requirements.

The model is a simple analytical groundwater flow model based on the Dupuit-Forcheimer and Theim Equations for groundwater flow to a large diameter well. Key steps in the model are as follows:

- The mine workings are represented by a large diameter “equivalent well” of similar area and depth as the final underground mine workings.
- The model is used to calculate the pumping rate required to maintain pumping water levels in the equivalent well at or below the base of the mine workings. The results provide a good approximation of the total groundwater inflows to the mine workings.
- The Project area was divided into four discrete model areas for each underground section (i.e. 1800 UG Shallow, 1800 UG Deep, 1100 UG and 700 UG). Figure 6.4 shows long section through the Bombora area and the vertical pit shape (and depths of the final equivalent wells representing the various sections of each underground area), simulated in the model. The distances of the equivalent wells representing the pits were derived from the plan areas.
- It noted that the planned underground workings are adjacent to the planned pits and underground mine inflows will be influenced by drawdowns around the pits. That is, inflows to the underground workings cannot be considered in isolation from pit inflows. Taking the above into account, it was assumed that the 1800 and 1100 Pits will need to be maintained dry throughout the LOM (i.e. local water level will be effectively lowered to the level of the base of the pit) and that the pits will intercept most/all groundwater inflows.
- Average aquifer parameters are adopted (refer to Table 5.9).

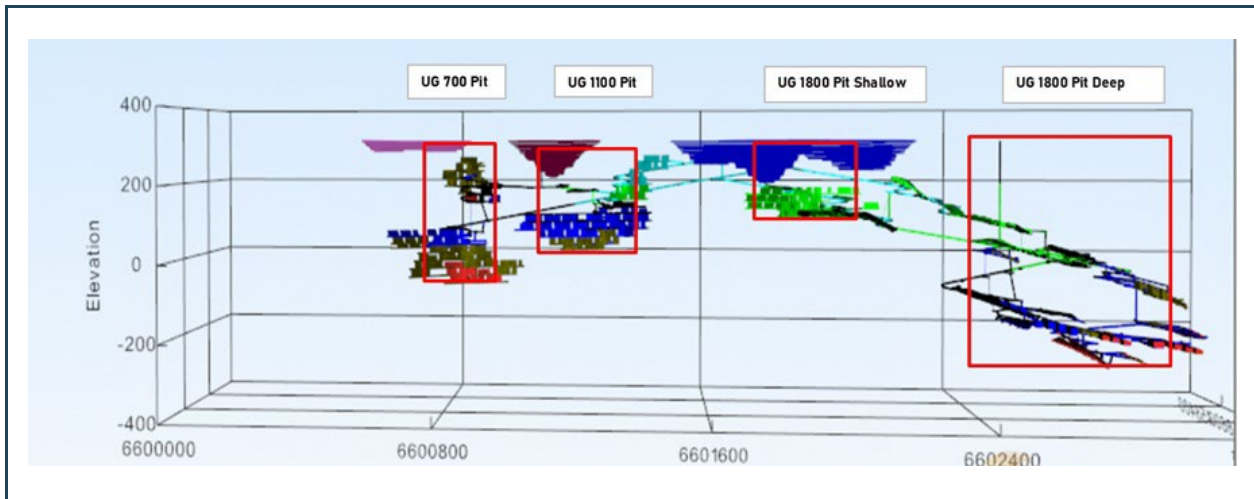


Figure 6.4 S-N Long Section Through Bombora Underground Showing Modelled Vertical Pit Shape

6.4.2 Predicted Underground Inflows

Table 6.3 summarise the pit and underground inflow predictions (i.e. base case) for required dewatering rates over the underground mining (Year 4 to Year 9).

Table 6.4 Summary of Underground Inflow Predictions

Year	Mine Months	Bombora UG					Total Inflows (UG and Pits)	
		UG 1800 Pit Shallow	UG 1800 Pit Deep	UG 1100 Pit	UG 700 Pit	Total (L/s)	Total(L/s)	
4	34-48	2.2		2.9		5.1	23.3	
5	49-60	2.7	6.5	2.0		11.2	28.6	
6	61-72	2.2	6.3	1.7	1.9	12.1	32.0	
7	73-84	2.0	6.9	1.7	1.8	12.4	31.7	
8	85-96	1.8	5.7	1.6	1.7	10.8	29.5	
9	97-108	1.7	5.0		1.5	8.2	26.5	

Total inflows to the underground mine workings are in order of 5 to 12.5 L/s, however for each separate underground area (i.e. nearby 700, 1100 and 1800 Pits) groundwater inflows are predicted to be between 1.5 L/s and 7 L/s (2 L/s on average for the shallower underground workings and 5 to 7 L/s for the deep underground workings).

6.5 Predicted Total Mine Inflows

It should be noted that Bombora 1800 and 1100 Pits will have to be kept dry to allow the underground mining (i.e. local water level will be effectively lowered to the level of the base of the pits). Therefore, 1800 and 1100 Pits will be pumped over the life of mine, with 700 Pit being pumped later in Year 3 of underground mining (i.e. Year 6 of mine life).

Total groundwater inflows (all open pits and underground areas) are predicted to be up to 32 L/s (in Year 6 and 7) and are summarised in Table 6.5 and presented in Figure 6.4.

The key aquifer parameter in determining pit and underground inflows is aquifer permeability. There is always some inherent uncertainty in any model prediction, particularly in fractured rock aquifers. The base case predictions adopted conservative approaches and can be considered as high case (i.e. “worse case” for water management perspective). However, it is generally considered that predicted dewatering requirements should be considered to be plus or minus 25%.

Table 6.5 Predicted Total Groundwater Inflows to Pits and Underground

Mining Schedule	Mining Year	Mining Months	Bombora 1800 Pit	Bombora 1100 Pit	Bombora 700 Pit	Bombora Underground	Total Inflows (All Pits & UG)
			Total (L/s)	Total (L/s)	Total (L/s)	Total (L/s)	(L/s)
FY2028 Q1	1	0-3	0.0	0.0	0.0	0.0	0
FY2028 Q2		4-6	2.9	0.0	0.0	0.0	3
FY2028 Q3		7-9	11.2	0.0	0.0	0.0	11
FY2028 Q4		10-12	15.1	0.0	0.0	0.0	15
FY2029 Q1	2	13-15	17.5	0.0	0.0	0.0	17
FY2029 Q2		16-18	16.2	0.0	0.0	0.0	16
FY2029 Q3		19-21	18.6	0.0	0.0	0.0	19
FY2029 Q4		22-24	18.0	0.0	0.0	0.0	18
FY2030 Q1	3	25-27	17.1	0.0	3.9	0.0	21
FY2030 Q2		28-30	16.6	3.6	0.0	0.0	20
FY2030 Q3		31-33	16.2	7.3	0.0	0.0	24
FY2030 Q4		34-36	15.9	6.3	0.0	0.0	22
FY2031 Q1-Q4	4	37-48	14.3	3.9	0.0	5.1	23
FY2032 Q1-Q4	5	49-60	13.8	3.6	0.0	11.2	29
FY2033 Q1-Q4	6	61-72	13.3	3.4	3.2	12.1	32
FY2034 Q1-Q4	7	73-84	13.0	3.3	3.0	12.4	32
FY2035 Q1-Q4	8	85-96	12.7	3.2	2.8	10.8	30
FY2036 Q1-Q4	9	97-108	12.4	3.2	2.7	8.2	27

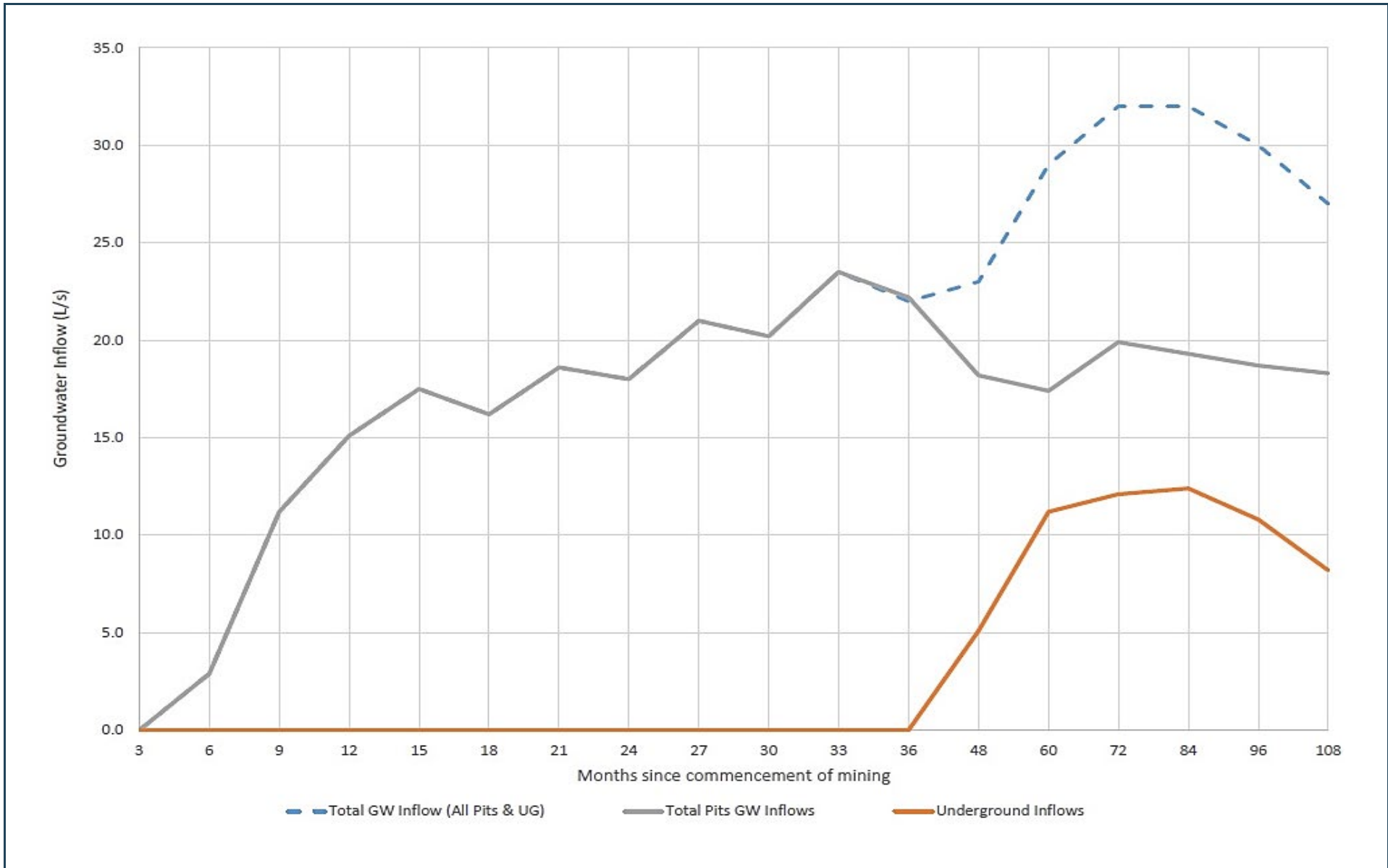


Figure 6.5 Predicted Life of Mine Groundwater Inflows

7. RECOMMENDED DEWATERING MANAGEMENT APPROACH

Given that predicted groundwater inflows into the 1800, 1100 and 700 Pits are relatively low (Section 6), the most practical and cost-effective water management (dewatering) strategy will be to manage all net pit inflows including any rainfall runoff inflows with pit floor sump pumping at each pit. It should be noted that due to the generally low permeability environment, the local bedrock aquifer is highly unlikely to sustain borehole pumping and the use of pit-perimeter dewatering bores will not be feasible (i.e. pumping yields from bores would be low and the bores would have a small radius of influence).

Pit sump pumps would be sized to accommodate runoff from peak rainfall events. As such, sump pumps would only pump irregularly during normal operation (as individual pump capacity would exceed groundwater inflows). Pit sumps would pump to evaporation ponds on site where water can be used for dust suppression and other non-potable mine site uses as required. There should not be any discharge of the surplus dewatering into the environment.

Underground dewatering should be achieved through a series of sumps at increasing depths as the mine progresses. This can easily be managed by standard “off-the-shelf” mine dewatering pumping equipment. Sump pumping capacity (far in excess of the pumping capacity to manage groundwater inflows) will be required to manage runoff to the open pits and the box-cut following high rainfall events.

In terms of further investigation work required to improve the reliability of inflow predictions and reduce potential water risks, there is little practical work that we can recommend other than:

- Monitor pit inflows as these provide the best guide to what will happen at depth below the pits.
- During underground development, consider cover drilling ahead of any new drive into areas of suspected faulting or shearing. The cover holes will provide advanced warning of any potential “burst” and also help to dewater/depressurise any such wet structures.
- If pore pressure is considered a potential geotechnical risk, install underground piezometers in lateral drill-holes at various mine levels to allow for the derivation of pore pressures acting on drive walls, backs and floors.

8. ASSESSMENT OF POTENTIAL IMPACT OF DEWATERING

8.1 Predicted Extent of Drawdowns

Due to the low permeability of the ground in the Project area, drawdown extents from dewatering of the Bombora open pits and underground are not anticipated to be extensive.

The maximum extent of the drawdown (radius of influence) has been calculated using the analytical model derived from the Cooper-Jacob equation below:

$$r_0 = \sqrt{\frac{2.25 * k * h_0 * t}{S_y}}$$

where: r_0 = radius of maximum extent of cone of drawdown (m)
 k = hydraulic conductivity (m/d)
 h_0 = height of SWL above base of aquifer (m)
 t = time since pumping or inflow started (days)
 S_y = specific yield (unitless).

This analytical model adopted parameters based on conceptual model referred in Section 5. The predicted maximum extent of drawdowns (i.e. the distance where there is no lowering of water table or potentiometric surface) in response to active dewatering depends upon the depth of mining, the permeability of the aquifer material and the duration of mining. The model predicts the maximum distance that drawdown extends in response to active dewatering at Bombora is up to 4 km along the weathered / fracture zones and less than 2 km in areas of no fracturing with a lower bulk permeability. It should be borne in mind that this distance is based on the prevailing aquifer conditions extending over that full distance; in reality, in a basement rock aquifer environment, aquifers are unlikely to be that extensive and some types of barriers would be expected (i.e. dyke intrusions, or changes in geology), thus reducing the extent of drawdown. The 4 km distance should therefore be seen as a theoretical maximum.

In addition, a simple analytical model based on the Theis equation (refer to Kruseman and de Ridder, 1994 for more details) was used to predict drawdowns along and across the fracture zones as a result of dewatering pumping for 1, 2 and 3 years (open pit mining) and 9 years (LOM). Cumulative drawdown impacts at Bombora due to combined abstractions have been assessed based on a simple interference drawdown assessment (addition) and the cumulative drawdown contours after 1, 2, 3 and 9 years are shown in Figures 8.1 to 8.4. The predicted maximum extent of the 1 m drawdown contour is approximately up to 2.7 km (from the edge of the pits) at the end of mining.

It should also be pointed out that the weathered / fractured bedrock aquifer (transition zone) was modelled using the bulk permeability of 0.5 m/d (i.e. 5×10^{-6} m/s), which is considered to be free draining (while dewatering of the fresh bedrock aquifer below). In the low permeability rocks (i.e. below 55 mbgl), the area affected by dewatering would not extend far from the dewatering stress (i.e. far from pit wall into the aquifer) and there may be some high hydrostatic pressure behind the pit walls (subject to geotechnical analysis, depressurisation of the pit walls may be required, at least in susceptible areas).

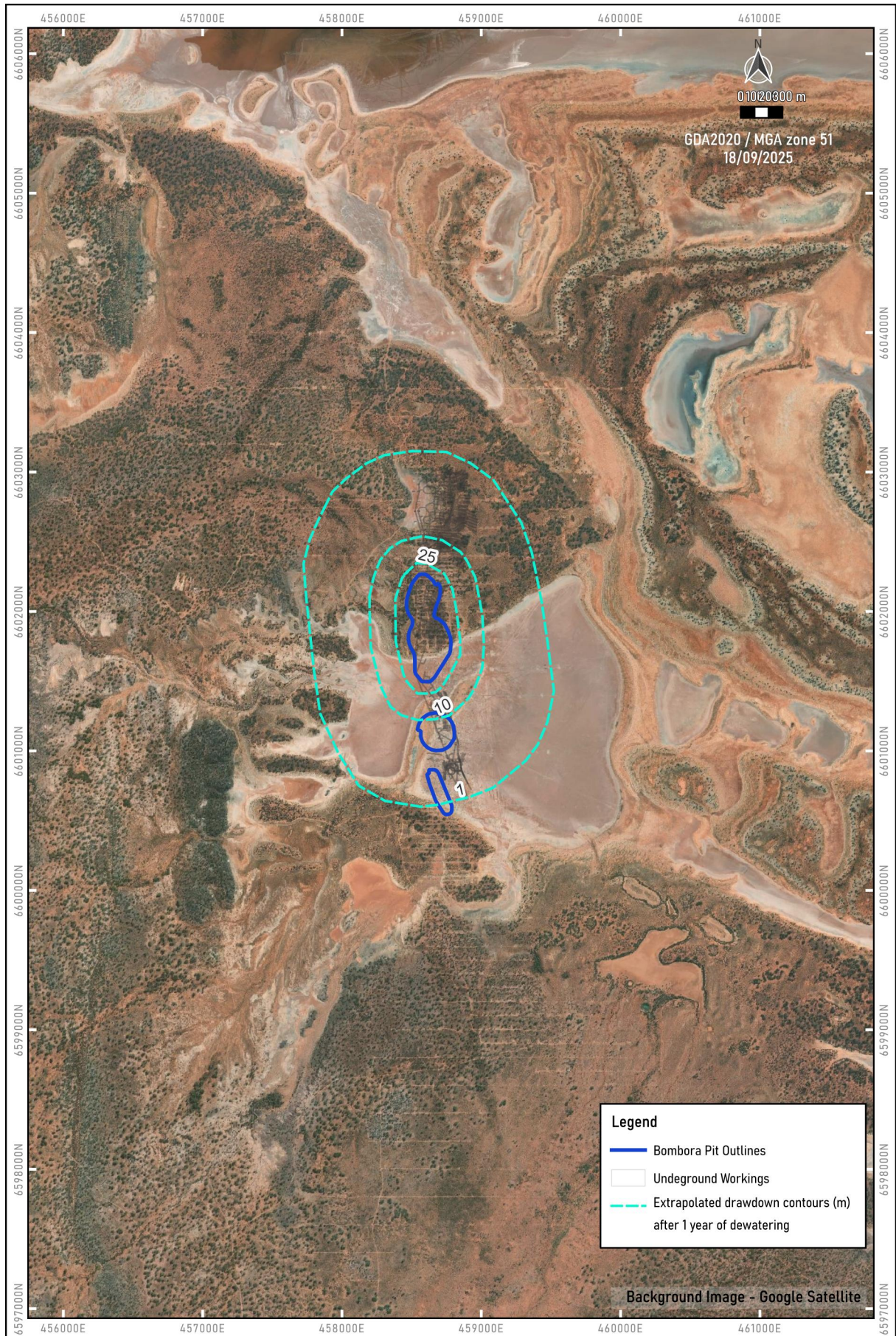


Figure 8.1 Predicted Long Term Cumulative Drawdowns After 1 Year of Dewatering

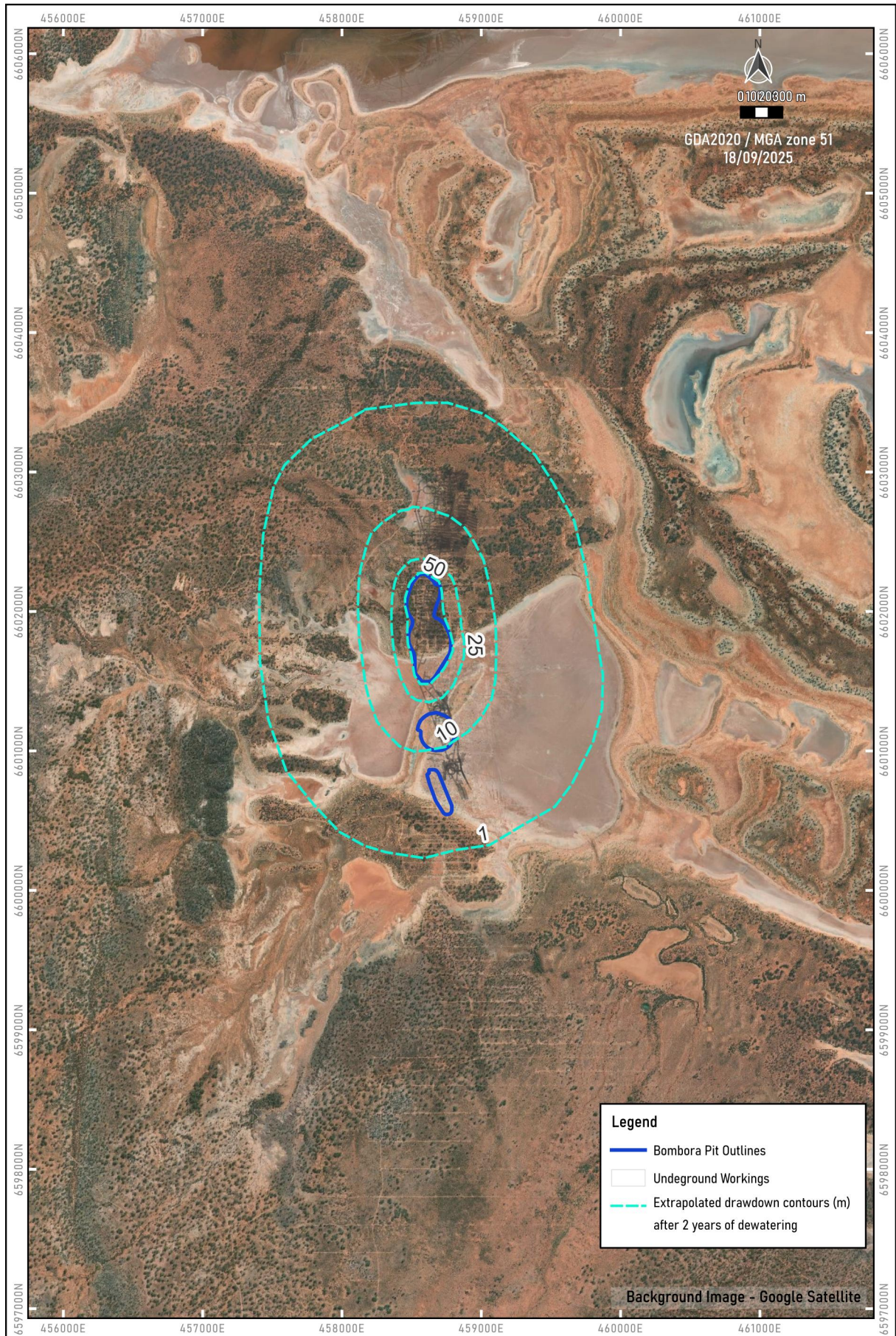


Figure 8.2 Predicted Long Term Cumulative Drawdowns After 2 Years of Dewatering

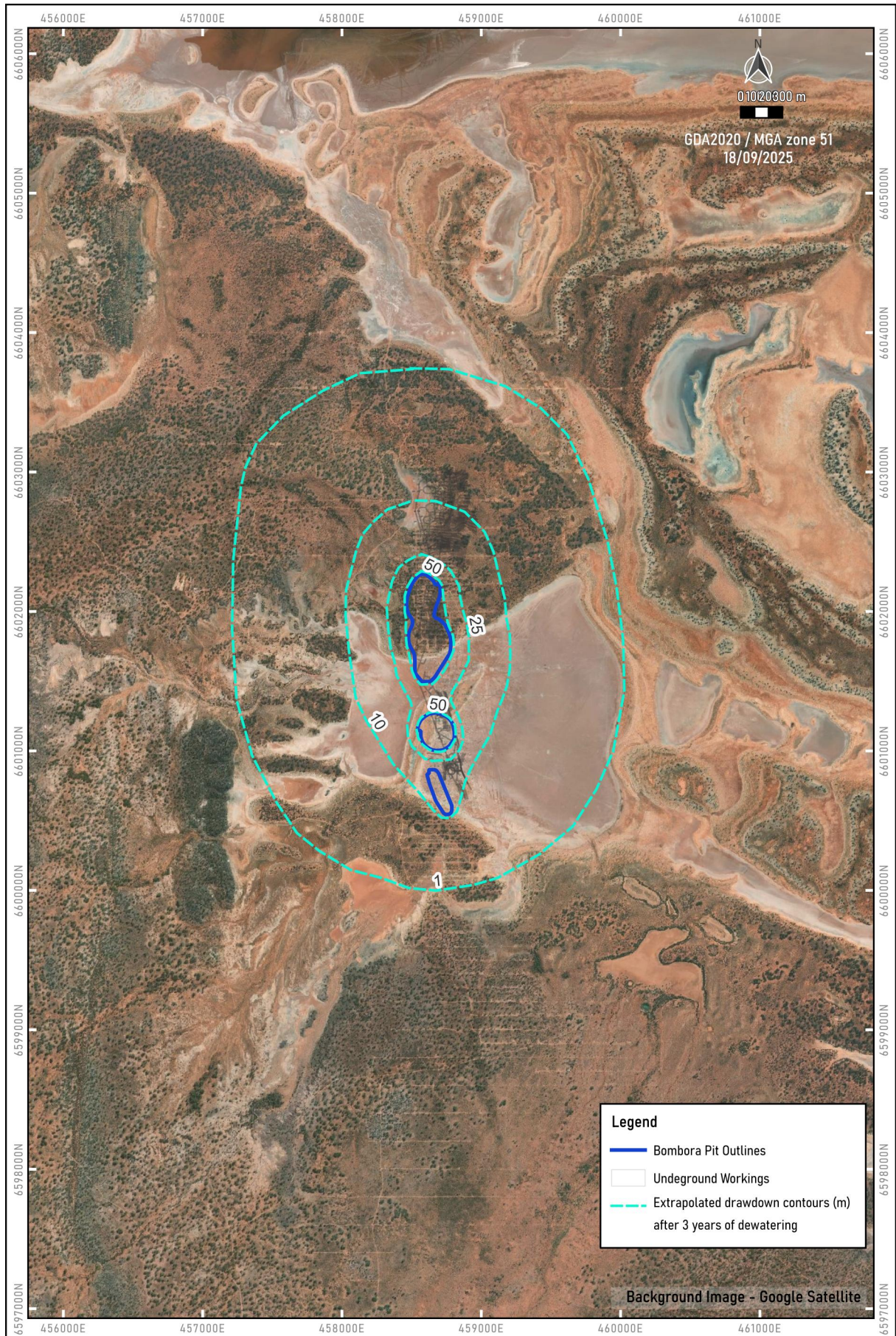


Figure 8.3 Predicted Long Term Cumulative Drawdowns After 3 Years of Dewatering

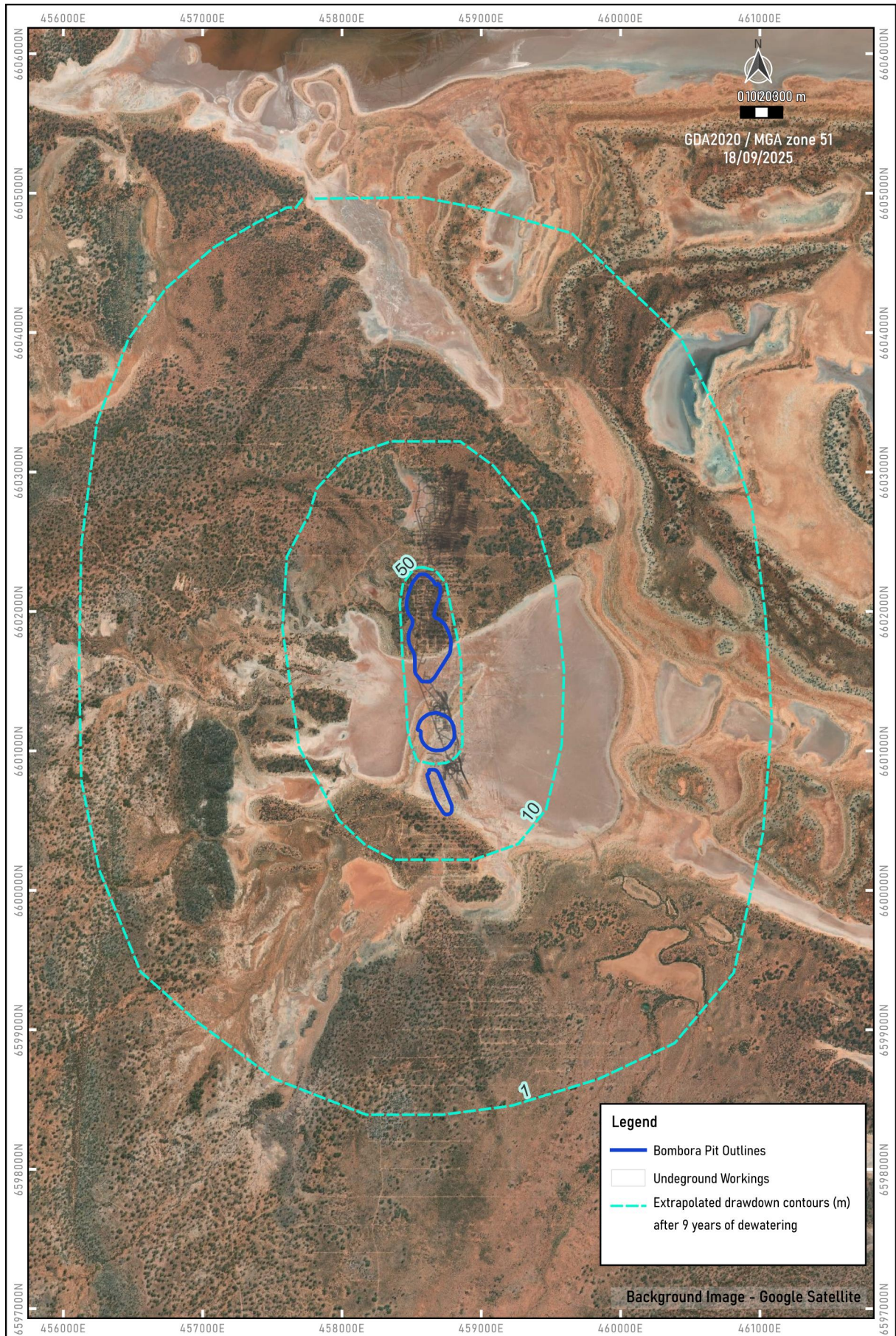


Figure 8.4 Predicted Long Term Cumulative Drawdowns After 9 Years of Dewatering

8.2 Potential Impacts

Potential impacts caused by dewatering abstraction from the Bombora pits and underground mining on hydrogeological processes are discussed below.

8.2.1 Aquifers

The predicted dewatering abstraction from the weathered / fractured bedrock aquifers is highly unlikely to have any adverse impacts on the water supply potential of the overall aquifer system outside of the immediate mining area.

Groundwater at the Project is hypersaline (more than 140,000 mg/L TDS). As the beneficial use of the groundwater is ore processing and mine water usage, any decrease in water quality (if evident) is unlikely to have any environmental impact.

8.2.2 Impact on Existing Other Groundwater Users

Based on the data available through the DWER databases (Section 4.3), the nearest other weathered/fractured bedrock aquifer groundwater user is located approximately 14 km to the south from the Project (Figure 4.4), therefore no groundwater users are likely to be impacted by the proposed Project dewatering.

8.2.3 Impact on Groundwater Dependent Ecosystems

There are no known GDEs within the predicted maximum radius of the cone of depression (i.e. drawdowns up to 4 km), thus the proposed groundwater abstraction from the project area is highly unlikely to have any adverse impacts on any GDEs. The local groundwater is saline and does not support any groundwater dependent ecosystems. There are no known subterranean fauna in the area and local vegetation is likely to rely on sporadic rainfall and overland water flow events (i.e. supported by fresh soil moisture in the vadose zone above the local water table.)

9. PROPOSED GROUNDWATER MONITORING

A detailed proposed management framework for the Bombora mine will be outlined in the Groundwater Operating Strategy (GWOS), which will be prepared and submitted to DWER to support a 5C licence application (i.e. together with this H2 Level Assessment report). The GWOS includes a groundwater monitoring programme that is designed to assess aquifer performance, the potential impacts of proposed groundwater abstraction and specify operational requirements. GWOS data will be compiled in regular monitoring reports and the monitoring programme will be amended as necessary.

The following two monitoring schedules are proposed as part of the GWOS (Table 9.1), which cover periods of active and inactive mining and dewatering:

- Active mining and dewatering – when groundwater is abstracted from the water source for dewatering purposes, an extensive monitoring programme is undertaken.
- Inactive dewatering and mining (Care and Maintenance) - when there is no dewatering pumping, due to temporary shutdown of mining operations or the mine is placed in Care of Maintenance status, limited monitoring only is required.

Table 9.1 Proposed Groundwater Monitoring Programme

Monitoring Site Location	Data Requirement	Frequency
Active Dewatering and Mining		
Mining pits & UG (when active)	Groundwater Abstraction Volume (cumulative flow readings)	Monthly
	Field Water Quality – pH, EC, temp	Quarterly
	Laboratory Analysis (Comprehensive Component Analysis*)	Annually
Monitoring Bores	Water levels	Monthly
Care and Maintenance		
Mining pits (when inactive)	Pit water level	Annually
	Field Water Quality – pH, EC and temp	Annually
Monitoring Bores	Water levels	Annually

* pH, Conductivity (EC), Total Dissolved Solids (TDS), Total Hardness (as CaCO₃), Total Alkalinity (as CaCO₃), carbonate (CO₃), bicarbonate (HCO₃), calcium (Ca), potassium (K), magnesium (Mg), sodium (Na), ammonia (NH₃), phosphate (PO₄), chloride (Cl), sulphate (SO₄), nitrate (NO₃), silica (SiO₂), aluminium (Al), iron (Fe), manganese (Mn), arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), mercury (Hg), selenium (Se) and zinc (Zn).

10. SUMMARY AND CONCLUSIONS

Ramelius Resources are currently undertaking a Definitive Feasibility Study for the Roe Gold Project, associated with the Bombora gold deposit, located approximately 100 km east of Kalgoorlie and about 45 km southwest of Ramelius' Rebecca Gold Project.

Ramelius plans to develop Bombora mine to approximately 2.5 km in length, which will consist of three open-cut pits (1800, 1100 and 700 Pits) together with an underground mine over a total period of 9 years. Mining of all open pits will be completed prior to the commencement of the underground mining operation. The proposed underground mine will be accessed from three portals located in the 1800 pit and the underground workings will extend some 750 m north of the 1800 pit and beneath the 1100 and 700 pits. Parts of all 3 pits lie within one of the larger salt lakes of the Lake Roe system, with the southern half of the underground mine beneath it.

To enable optimal resource recovery, the mining at Bombora will occur below the groundwater level and hence, dewatering of the open-cut pits and underground workings is required to provide dry mining conditions. Any dewatering volumes abstracted from the Bombora mine is planned to be used on-site for dust suppression and construction purposes, with any excess water being discharged into the evaporation ponds located at Bombora. There will be no discharge of surplus dewatering into the environment (i.e. Lake Roe). Mineral processing is planned to take place at Rebecca, with ore being transported from Roe to it. A 65 km long haul road is planned to be constructed to link the Rebecca and Roe Project sites together.

A hydrogeological drilling investigation was carried out. A total of 17 monitoring bores (WMB19 to WMB35) and 2 test production bores (WPB26 and WPB33) were drilled across the Project area. Bore depths ranged from 50 m (WMB33) to 200 m (WMB23, WMB24 and WMB25). Bore depths were selected based on the planned depth of mining operation in the respective areas, with the intention of having the bores penetrate to the base of the open pits. Following their completion, the 2 test production bores were test pumped to determine aquifer parameters. In addition, all of the installed monitoring bores had hydraulic tests carried out on them.

Using the testing and drilling data, a conceptual hydrogeological model was formulated. Pit and underground inflows (and thus dewatering requirements) were then predicted for Bombora using analytical groundwater flow models and using aquifer parameters derived from both literature historical dewatering records and recent field investigation. The key outcomes of this assessment are:

- Total groundwater inflows (all open pits and underground areas) up to 32 L/s (in Year 6 and 7).
- Total inflows from the open pits between 3 L/s and 24 L/s:
 - up to 19 L/s at the end of mining 1800 Pit (Year 2).
 - up to 7 L/s at the end of mining 1100 Pit (Year 3).
 - Up to 4 L/s at the end of mining 700 Pit (Q1 Year 3).
- Total inflows to the underground mine workings are in order of 5 to 12.5 L/s, however for each separate underground area (i.e. nearby 700, 1100 and 1800 Pits) groundwater inflows are predicted to be between 1.5 L/s and 7 L/s (i.e. 2 L/s on average for the shallower underground workings and 5 to 7 L/s for the deep underground workings).
- The 1800 and 1100 Pits will have to be kept dry to allow the underground mining (i.e. local water level will be effectively lowered to the level of the base of the pits). Therefore, 1800 and 1100 Pits will be pumped over the life of mine, with the 700 Pit being pumped later in Year 3 of underground mining (i.e. Year 6 of mine life).
- The above open pit inflow predictions take no account of evaporative losses from the pit wall (from seepage faces) or from the pit base (sumps and ponded areas). Net inflows (from the pit sumps) are likely to be less than predicted.

- The above open pit rates do not account for any surface water runoff, which may report to the pits during high rainfall events (i.e. pit floor, pit walls and area of pit crest within flood protection bunding). Thus, total inflows (and dewatering requirements) will, at times, be in excess of the predicted groundwater inflow (but only in the short term).
- The most practical and cost-effective water management (dewatering) strategy will be to manage all inflows including any rainfall runoff inflows with pit floor sump pumping at each pit. It should be noted that the local bedrock aquifer is highly unlikely to sustain borehole pumping and the use of pit-perimeter dewatering bores will not be feasible.
- Underground dewatering should be achieved through a series of sumps at increasing depths as the mine progresses. This can easily be managed by standard “off-the-shelf” mine dewatering pumping equipment. Sump pumping capacity (far in excess of the pumping capacity to manage groundwater inflows) will be required to manage runoff to the open pits and the box-cut following high rainfall events.
- The extent of the cone of depression in the groundwater level due to dewatering depends on the depth of mining and the duration of pumping. Regional drawdowns will be constrained by the low permeability of the bedrock away from the immediate mine area. The maximum theoretical extent of the drawdowns is likely to be constrained to within 4 km of the mine.
- The predicted drawdown extent is unlikely to impact on any other groundwater users (the closest other GWL user is approximately 14 km away from the Bombora mine). There are also no known groundwater dependent ecosystems within the radius of the influence of dewatering pumping.
- A groundwater monitoring programme as a part of the proposed project has been designed to assess potential aquifer-impacts and operational requirements.

11. REFERENCES

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APPENDIX A
BORE LOGS (GRM, 2019)

GROUNDWATER

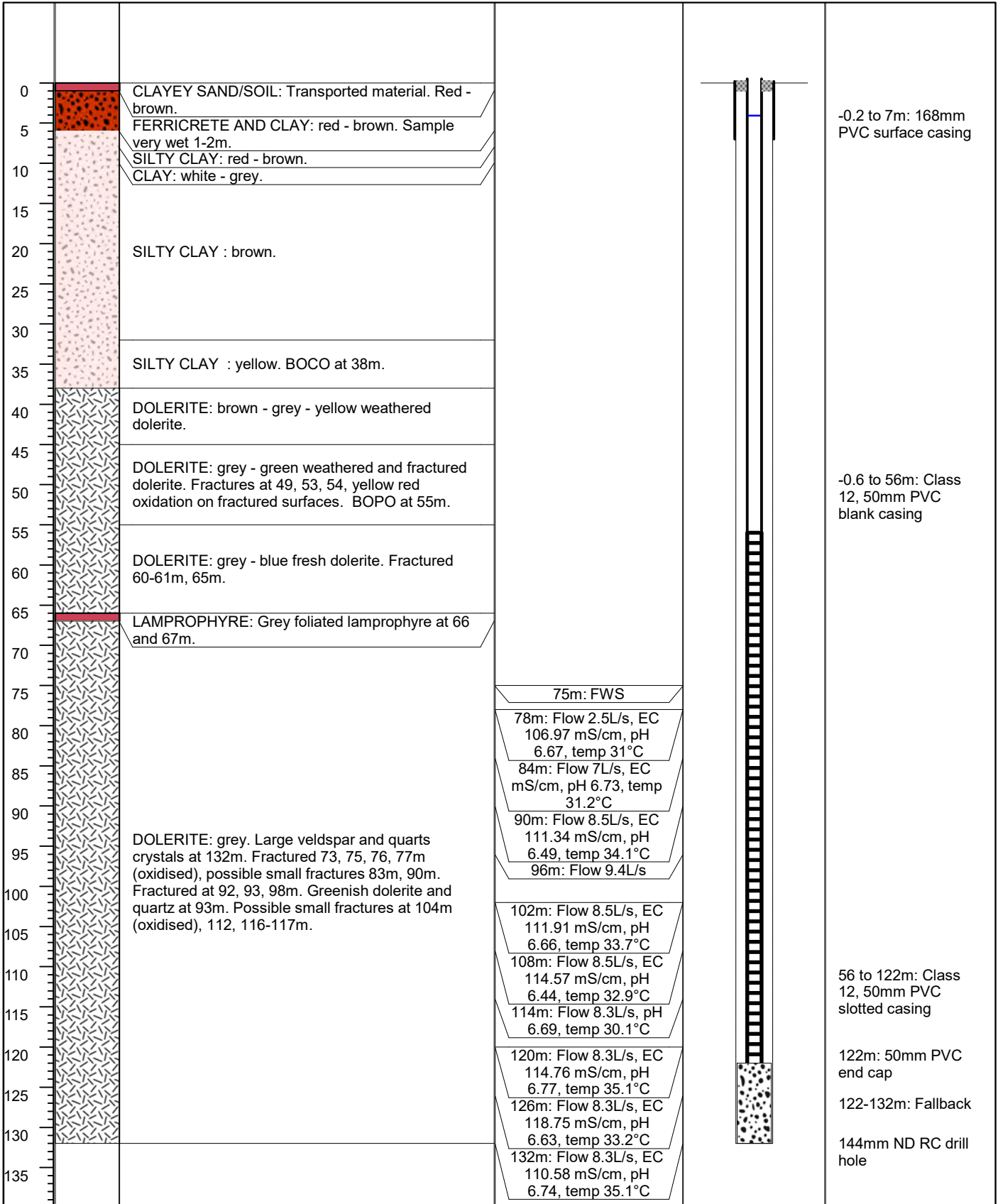


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ID:	BWE01		JOB NUMBER:	J1842	
CLIENT:	Breaker Resources		PROJECT:	Lake Roe FS	
COMMENCED:	1/30/2019	EASTING:	458906	INCLINATION:	-90 degrees
COMPLETED:	1/30/2019	NORTHING:	6600256	AZIMUTH:	0 degrees
DRILLED BY:	Raglan Rig15	ELEVATION:	314	SWL (date):	4.13 mbtoc (01-Feb-19)
LOGGED BY:	KR	GRID SYSTEM:	MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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56 to 122m: Class 12, 50mm PVC slotted casing

122m: 50mm PVC end cap

122-132m: Fallback

144mm ND RC drill hole

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ID: **BWE02**

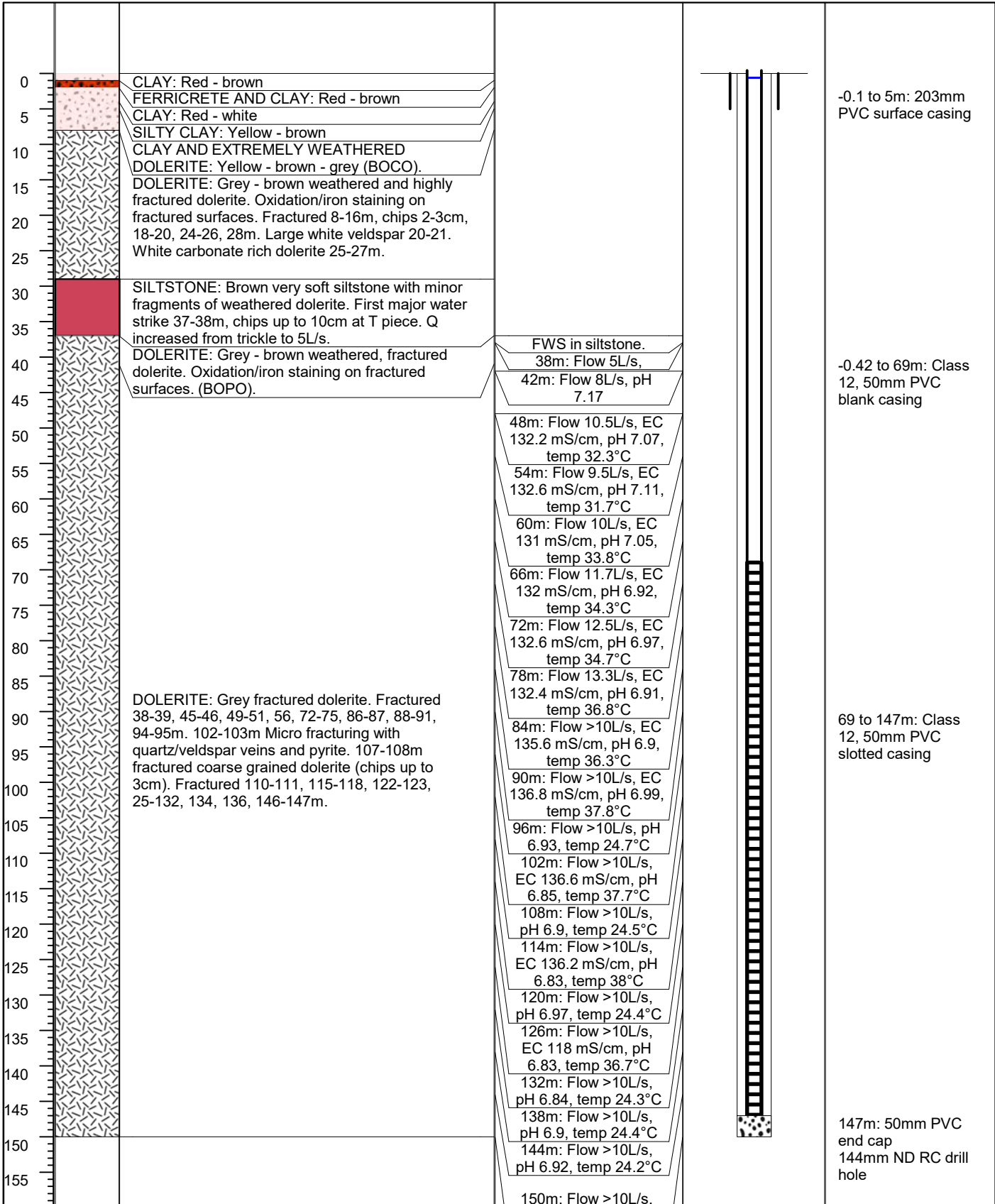
JOB NUMBER: **J1842**

CLIENT: **Breaker Resources**

PROJECT: **Lake Roe FS**

COMMENCED: 2/26/2019	EASTING: 458602	INCLINATION: -90 degrees
COMPLETED: 2/27/2019	NORTHING: 6600815	AZIMUTH: 0 degrees
DRILLED BY: Raglan Rig15	ELEVATION:	SWL (date): 0.7 mbtoc (03-Mar-19)
LOGGED BY: KR	GRID SYSTEM: MGA94 zn51	

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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ID: **BWE03**

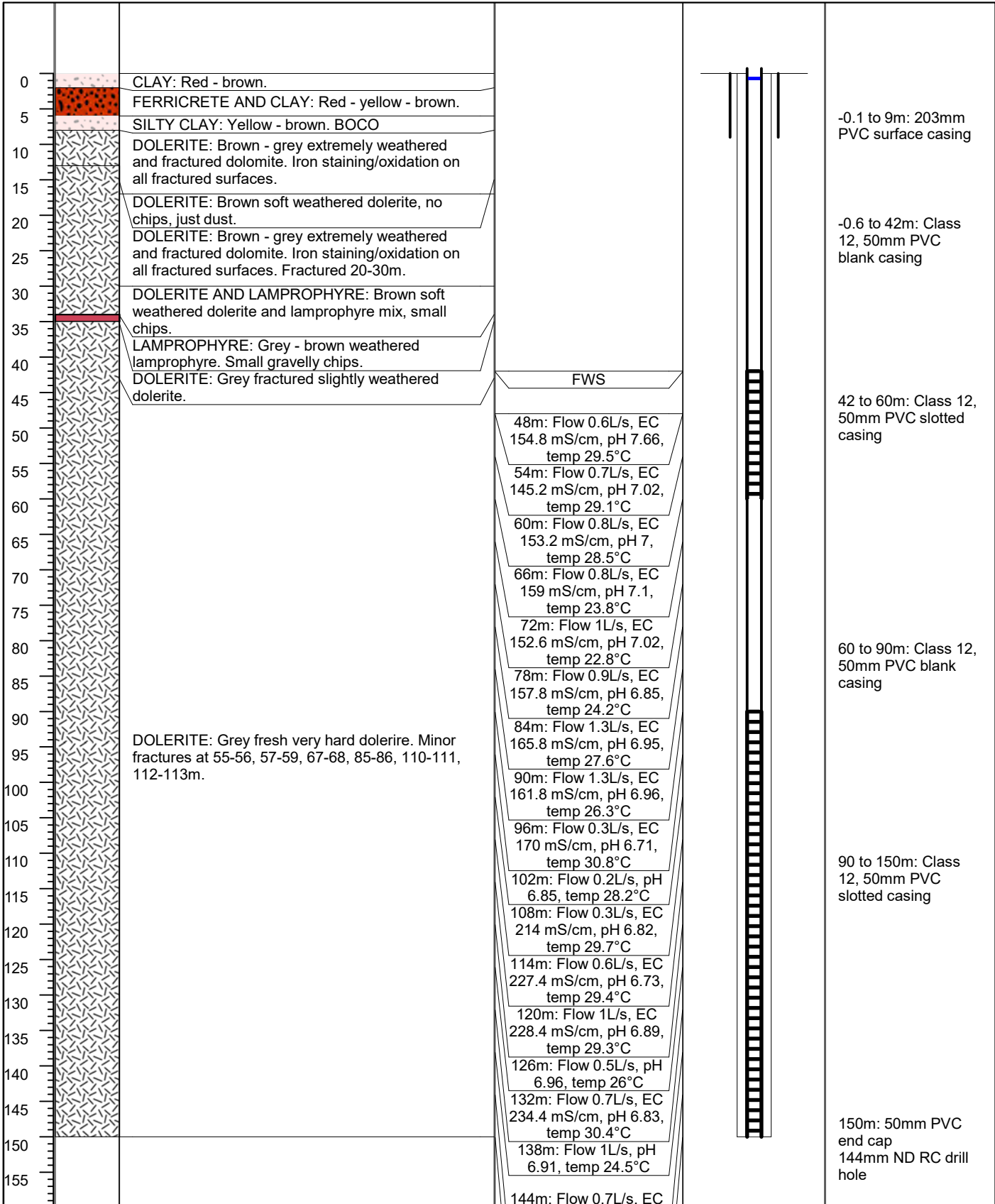
JOB NUMBER: **J1842**

CLIENT: **Breaker Resources**

PROJECT: **Lake Roe FS**

COMMENCED: 3/3/2019	EASTING: 458815	INCLINATION: -90 degrees
COMPLETED: 3/5/2019	NORTHING: 6601244	AZIMUTH: 0 degrees
DRILLED BY: Raglan Rig15	ELEVATION:	SWL (date): 0.9 mbtoc (05-Mar-19)
LOGGED BY: KR	GRID SYSTEM: MGA94 zn51	

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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ID: **BWE04**

JOB NUMBER: **J1842**

CLIENT: **Breaker Resources**

PROJECT: **Lake Roe FS**

COMMENCED: 2/28/2019

EASTING: 459076

INCLINATION: -90 degrees

COMPLETED: 3/1/2019

NORTHING: 6600486

AZIMUTH: 0 degrees

DRILLED BY: Raglan Rig15

ELEVATION:

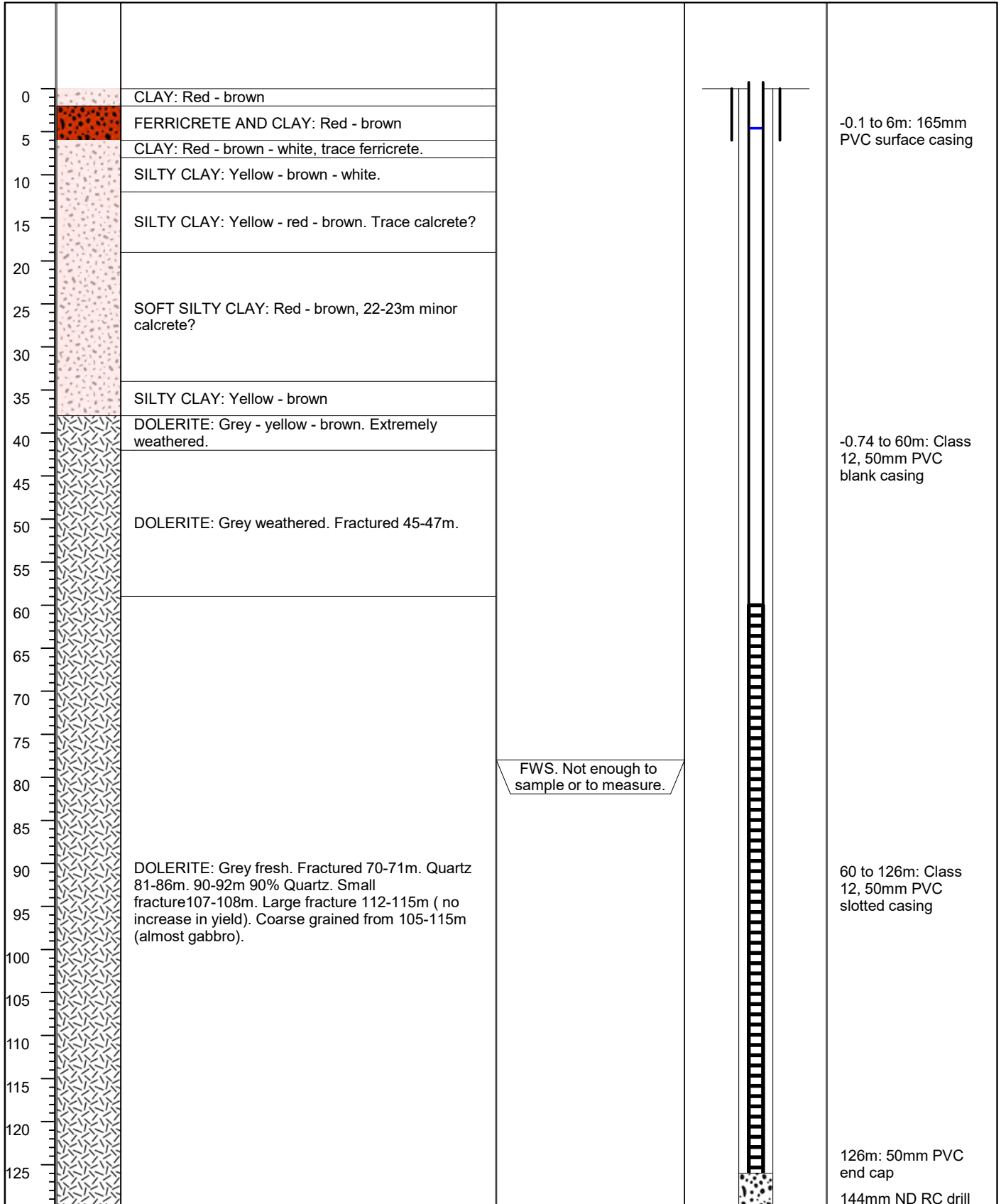
SWL (date):

LOGGED BY: KR

GRID SYSTEM: MGA94 zn51

4.71 mbtoc (02-May-19)

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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ID:	BWE05		JOB NUMBER:	J1842	
CLIENT:	Breaker Resources		PROJECT:	Lake Roe FS	
COMMENCED:	2/24/2019	EASTING:	458574	INCLINATION:	-90 degrees
COMPLETED:	2/25/2019	NORTHING:	6601347	AZIMUTH:	0 degrees
DRILLED BY:	Raglan Rig15	ELEVATION:		SWL (date):	0.72 mbtoc (03-Mar-19)
LOGGED BY:	KR	GRID SYSTEM:	MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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0		CLAY: Red - yellow - white		
5		FERRICRETE AND CLAY: Red - white - brown ferricrete and clay		
10		SILTY CLAY: Brown - yellow		
15		DOLERITE: Grey - green extremely weathered and fractured dolerite. Fractured with Iron staining/oxidation 13-36m. Large quartz crystals up to 2cm 18-20m. Intense iron staining 24-37m. Chips from 13 to 36m large, 2 to 3cm diam.		
20			FWS	
24			24m: Flow 0.1L/s, EC 114.8 mS/cm, pH 6.74, temp 35.2°C	
30			30m: Flow 0.1L/s, EC mS/cm, pH, temp °C	
36			36m: Flow 0.1L/s, EC 119.6 mS/cm, pH 6.58, temp 34.6°C	
42			42m: Flow 0.45L/s, EC 124.8 mS/cm, pH 6.72, temp 35.7°C	
48			48m: Flow 0.3L/s, EC mS/cm, pH 6.87, temp °C	
54			54m: Flow 0.63L/s, EC 125.8 mS/cm, pH 6.93, temp 34.2°C	
60			60m: Flow 0.6L/s, EC mS/cm, pH 6.86, temp 28.4°C	
66			66m: Flow 0.6L/s, EC 128.8 mS/cm, pH 6.9, temp 35.3°C	
72			72m: Flow 0.6L/s, EC mS/cm, pH 6.87, temp 29.4°C	
78			78m: Flow 0.7L/s, EC 131 mS/cm, pH 6.86, temp 34.2°C	
84			84m: Flow 0.7L/s, EC mS/cm, pH 6.84, temp °C	
90			90m: Flow 0.8L/s, EC 128.6 mS/cm, pH 6.78, temp 34.7°C	
96			96m: Flow 1L/s, EC mS/cm, pH 6.87, temp 27°C	
102			102m: Flow 1.25L/s, EC 131.6 mS/cm, pH 6.93, temp 34.9°C	
108			108m: Flow 1.66L/s, pH 6.9, temp 26.3°C	
114			114m: Flow 1.66L/s, EC 133.8 mS/cm, pH 6.95, temp 35.4°C	
120			120m: Flow 1.66L/s, pH 6.83, temp 27.9°C	
126			126m: Flow 2L/s	
132			132m: Flow 1.42L/s, EC 133.4 mS/cm, pH 7.26, temp 25.9°C	
138			138m: Flow 2L/s, EC 137.2 mS/cm, pH 7.08, temp 25.9°C	
144			144m: Flow 1.66L/s,	
150				150m: 50mm PVC end cap
155				144mm ND RC drill hole
				-0.1 to 6m: 203mm PVC surface casing
				-0.18 to 72m: Class 12, 50mm PVC blank casing
				72 to 150m: Class 12, 50mm PVC slotted casing

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ID: **BWE06**

JOB NUMBER: **J1842**

CLIENT: **Breaker Resources**

PROJECT: **Lake Roe FS**

COMMENCED: 2/22/2019

EASTING: 458691

INCLINATION: -90 degrees

COMPLETED: 2/23/2019

NORTHING: 6601460

AZIMUTH: 0 degrees

DRILLED BY: Raglan Rig15

ELEVATION:

SWL (date):

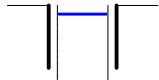
LOGGED BY: KR

GRID SYSTEM: MGA94 zn51

0.38 mbtoc (03-Mar-19)

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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0		CLAY: Red - brown		
		CLAY AND FERRICRETE: Red - yellow - grey clay and ferricrete		
5		<p>DOLERITE: Grey - yellow - brown extremely weathered, fractured and oxidised dolerite. Large oxidised chips 4 to 16m. Driller becoming stuck when reaming bore due to large rock fragments falling on hammer. Pieces of white veldspar and black hornblend surrounded by calcrete 16-17m, probably in cavity. Fractured with large chips (1-2cm) 20-24, 25-26, 27-28, 33-34m.</p>		
10				
15				
20				
25				
30			FWS	
35		<p>DOLERITE: dark grey fresh dolerite with several large fractures with iron staining on the fractured surfaces, yield increased from 0.6L/s to >10L/s at 60m. Difficult to measure because water flowing out everywhere. Fractured 38-39, 42-43, 44-46, 49-51, 58-59m. Chips in fractures 1-3cm in diam.</p>	36m: Flow 0.6L/s, EC 106.8 mS/cm, pH 6.93, temp 31.4°C	
40			42m: Flow 1.5L/s, EC 111 mS/cm, pH 6.88, temp 31.6°C	
45			48m: Flow 5L/s, EC 101.6 mS/cm, pH 6.79, temp 34.6°C	
50			54m: Flow L/s, EC 107.2 mS/cm, pH 6.6, temp 34.7°C	
55			60m: Flow 5L/s, EC 107.6 mS/cm, pH 6.76, temp 33.5°C	
60				



-0.1 to 2.5m:
203mm PVC surface casing



9 to 60m: Hole collapsed. Fallback

0 to 60m: 203mm ND RC drill hole

GROUNDWATER

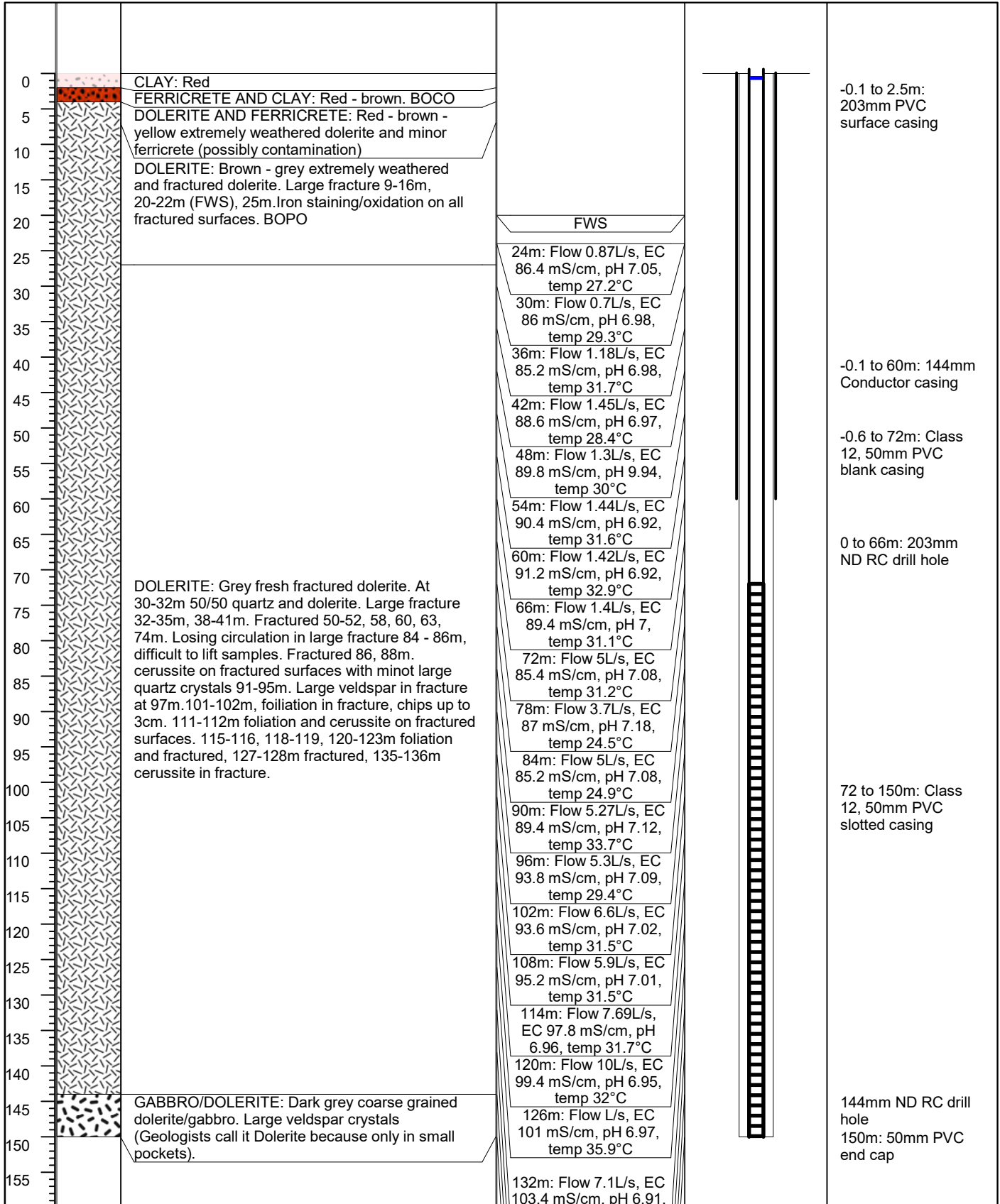


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ID:	BWE07		JOB NUMBER:	J1842	
CLIENT:	Breaker Resources		PROJECT:	Lake Roe FS	
COMMENCED:	2/20/2019	EASTING:	458608	INCLINATION:	-90 degrees
COMPLETED:	1/21/2019	NORTHING:	6601537	AZIMUTH:	0 degrees
DRILLED BY:	Raglan Rig15	ELEVATION:		SWL (date):	0.86 mbtoc (03-Mar-19)
LOGGED BY:	KR	GRID SYSTEM:	MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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ID: **BWE08**

JOB NUMBER: **J1842**

CLIENT: **Breaker Resources**

PROJECT: **Lake Roe FS**

COMMENCED: 2/18/2019

EASTING: 458933

INCLINATION: -90 degrees

COMPLETED: 2/19/2019

NORTHING: 6601711

AZIMUTH: 0 degrees

DRILLED BY: Raglan Rig15

ELEVATION:

SWL (date):

LOGGED BY: KR

GRID SYSTEM: MGA94 zn51

0.96 mbtoc (03-Mar-19)

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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0		CLAY: Red - brown, wet samples.		
5		CLAY AND FERRICRETE: red - brown.		
		CLAY: Yellow - brown - white clay		
10		CLAY AND DOLERITE: grey - green - brown clay and extremely weathered dolerite. BOCO at 16m.		
15				
20				
25		DOLERITE: grey - green weathered and fractured dolerite. Fractures at 25-30, 33m yellow red oxidation on fractured surfaces. BOPO at 33m.		
30				
35			FWS at 34m, not enough to sample or to measure yield. Muddy trickle rest of bore.	
40				
45				
50				
55				
60				
65				
70				
75				
80				
85		DOLERITE: Grey fresh dolerite. Fractured 35-37, 40, 44, 49m pyrite, 53, 74-pyrite, 76, 77, 87, 96, 103, 113, 118, 124, 137-139, 142, 146, 148m. Fractured with foliation at 87m, 103m, 146m. Pyrite on fractured surfaces at 103m.		
90				
95				
100				
105				
110				
115			114m: Flow 0.04L/s, EC 92 mS/cm, pH 6.45, temp 31.2°C	
120				
125				
130				
135				
140				
145				
150			150m: Flow 0.03L/s, EC 95.4 mS/cm, pH 6.67, temp 31.4°C	
155				

-0.1 to 6m: 168mm PVC surface casing


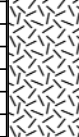
-0.6 to 70m: Class 12, 50mm PVC blank casing


70 to 148m: Class 12, 50mm PVC slotted casing

148m: 50mm PVC end cap
 144mm ND RC drill hole

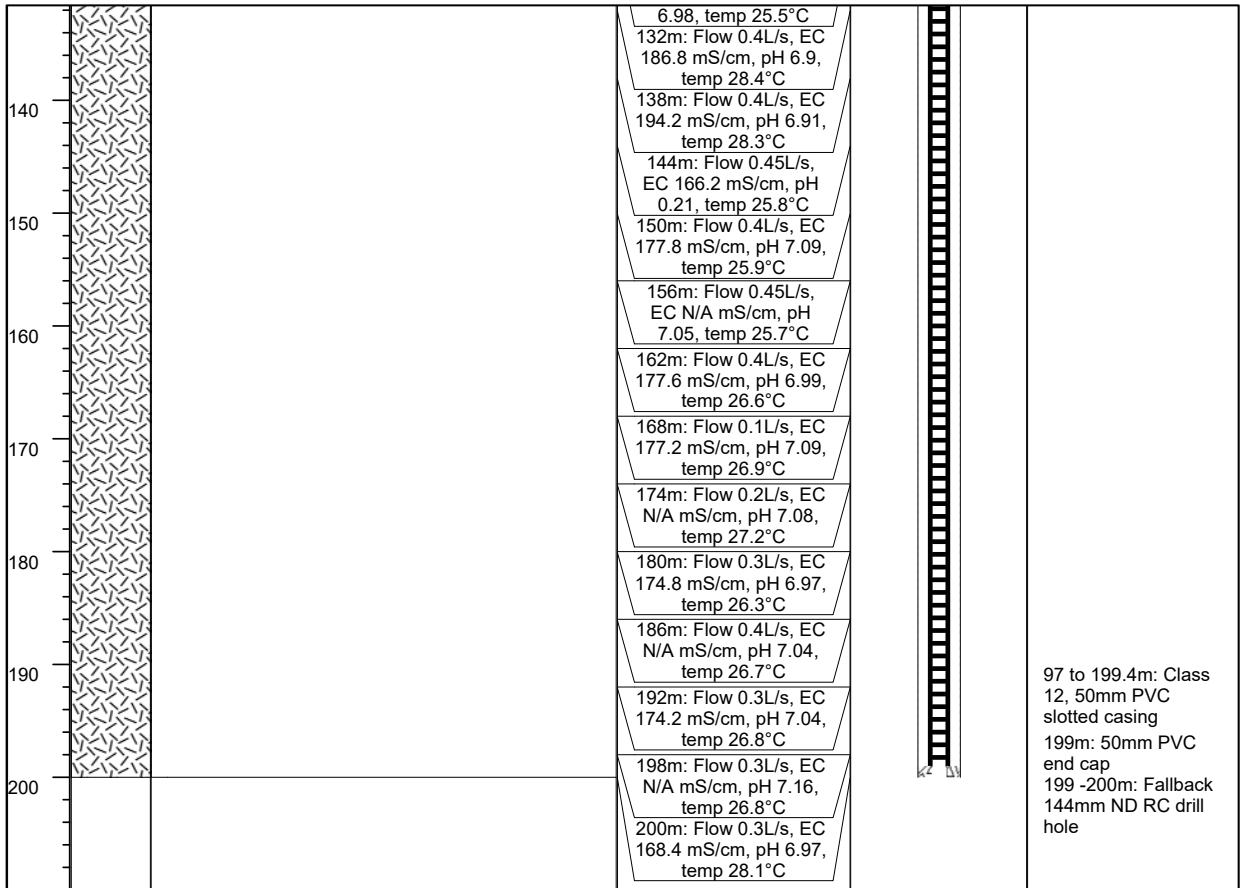
GROUNDWATER  RESOURCE MANAGEMENT PO Box 442 Bayswater WA 6933 15 Harborne Street Wembley WA 6014 Ph: +61 8 9433 2222 Fx: +61 8 9433 2322 Email: water@g-r-m.com.au	ID:	BWE09	JOB NUMBER:	J1842		
	CLIENT:	Breaker Resources		PROJECT:	Lake Roe FS	
	COMMENCED:	1/27/2019	EASTING:	458468	INCLINATION:	-90 degrees
	COMPLETED:	1/28/2019	NORTHING:	6602071	AZIMUTH:	0 degrees
	DRILLED BY:	Raglan Rig15	ELEVATION:		SWL (date):	3.06 mbtoc (29-Jan-19)
LOGGED BY:	KR	GRID SYSTEM:	MGA94 zn51			

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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0		CLAYEY SAND/SOIL: red - brown. Transported material. FERRICRETE AND CLAY: red - brown. CLAY: yellow - white - brown. BOCO		
10		DOLERITE: brown - grey weathered and fractured dolerite. Fractured 8-15m (cerussite crystal growth on most surfaces). Large chips up to 2cm. Seepage/water collecting at the end of each rod from 12m. Iron staining at 22m. Large fracture 25-28m, iron stained, chips 2.5cm. BOPO	12m: Flow 0.01L/s, EC 12.4 mS/cm, pH 6.9, temp 29.1°C	-0.1 to 8m: 168mm PVC surface casing
18			18m: Flow L/s, EC N/A mS/cm, pH N/A, temp N/A°C	
24			24m: Flow L/s, EC N/A mS/cm, pH N/A, temp N/A°C	
30			30m: Flow 0.03L/s, EC 159.2 mS/cm, pH 6.6, temp 31°C	
36			36m: Flow 0.06L/s, EC 189.6 mS/cm, pH 6.7, temp 30.3°C	
42			42m: Flow 0.05L/s, EC 223.8 mS/cm, pH 6.6, temp 30.1°C	
48			48m: Flow 0.1L/s, EC 213.2 mS/cm, pH 6.6, temp 30.9°C	
54			54m: Flow 0.1L/s, EC 203.4 mS/cm, pH 6.7, temp 32.8°C	
60			60m: Flow 0.13L/s, EC 208.6 mS/cm, pH 6.77, temp 31.3°C	
66			66m: Flow 0.13L/s, EC 208 mS/cm, pH 6.83, temp 28.7°C	
72			72m: Flow 0.13L/s, EC N/A mS/cm, pH 6.92, temp 27.9°C	
78			78m: Flow 0.13L/s, EC 192 mS/cm, pH 6.84, temp 32.2°C	
84			84m: Flow 0.2L/s, EC 190 mS/cm, pH 6.92, temp 28.4°C	
90			90m: Flow 0.2L/s, EC N/A mS/cm, pH 6.87, temp 29.8°C	
96			96m: Flow 0.26L/s, EC 182 mS/cm, pH 7.06, temp 26.6°C	-0.5 to 97m: Class 12, 50mm PVC blank casing
102			102m: Flow 0.2L/s, EC 191.2 mS/cm, pH 6.86, temp 30.6°C	
108			108m: Flow 0.2L/s, EC N/A mS/cm, pH 6.81, temp 32.4°C	
114			114m: Flow 0.33L/s, EC 186.2 mS/cm, pH 6.93, temp 29.9°C	
120			120m: Flow 0.4L/s, EC 189.2 mS/cm, pH 6.96, temp 30.8°C	
126			126m: Flow 0.33L/s, EC N/A mS/cm, pH	
130		DOLERITE: grey - blue fresh. Large fracture 29 - 35m with large feldspar crystals. Small fractures 40-42, 45, 48, 53, 54m. Bigger fractures at 60-63, 78, 82, 92m. Large gypsum crystal at 91m. Fractures at 103, 109, 128, 129 (chips 2cm), 131, 145m. Small quartz vein at 118m. Foliation 149m but no fractures. Possible small fractures at 153, 171, 172 and 197m.		

GROUNDWATER  RESOURCE MANAGEMENT PO Box 442 Bayswater WA 6933 15 Harborne Street Wembley WA 6014 Ph: +61 8 9433 2222 Fx: +61 8 9433 2322 Email: water@g-r-m.com.au	ID:	BWE09	JOB NUMBER:	J1842		
	CLIENT:	Breaker Resources	PROJECT:	Lake Roe FS		
	COMMENCED:	1/27/2019	EASTING:	458468	INCLINATION:	-90 degrees
	COMPLETED:	1/28/2019	NORTHING:	6602071	AZIMUTH:	0 degrees
	DRILLED BY:	Raglan Rig15	ELEVATION:		SWL (date):	3.06 mbtoc (29-Jan-19)
LOGGED BY:	KR	GRID SYSTEM:	MGA94 zn51			

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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210				
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GROUNDWATER

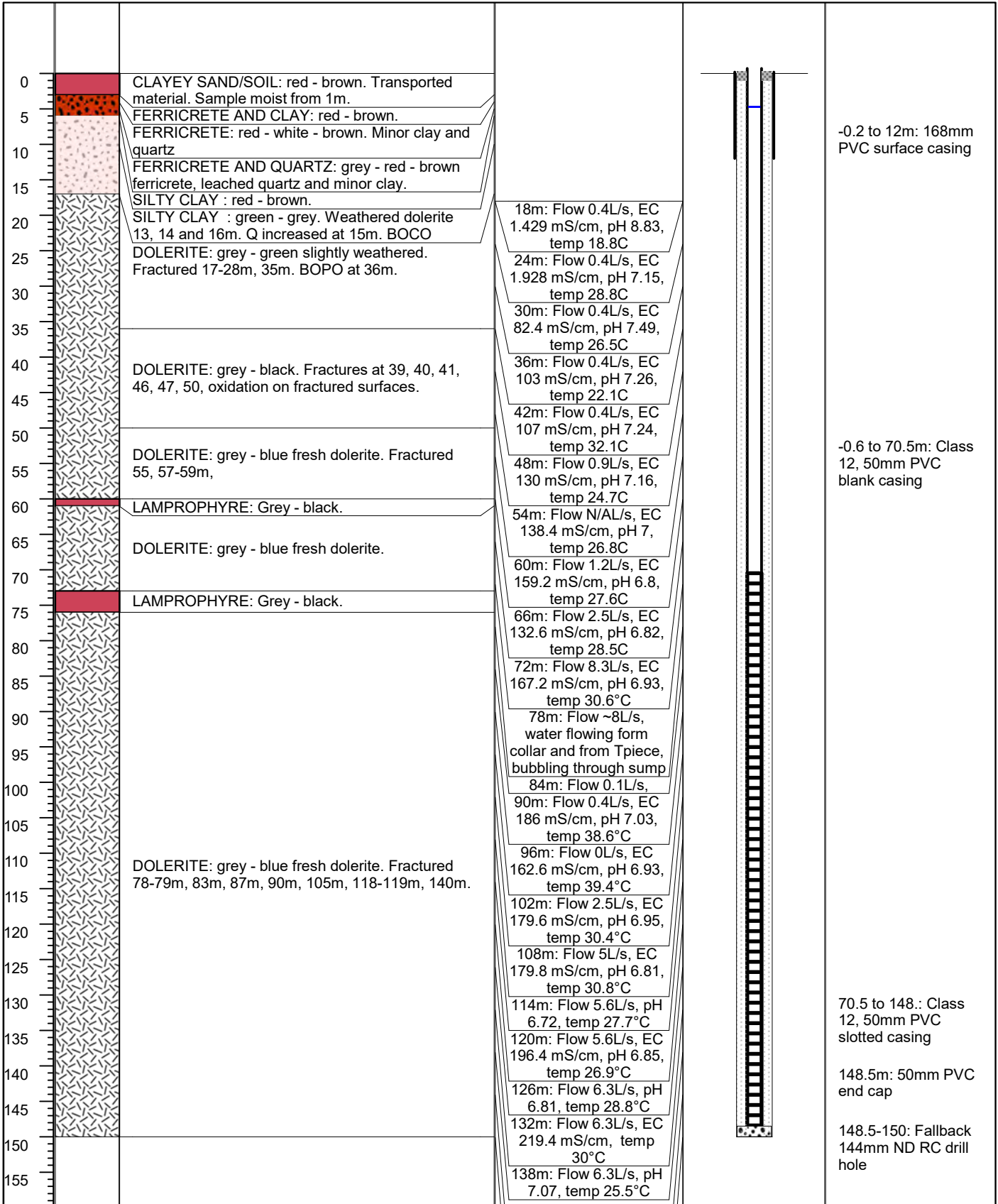


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ID:	BWE10		JOB NUMBER:	J1842	
CLIENT:	Breaker Resources		PROJECT:	Lake Roe FS	
COMMENCED:	1/23/2019	EASTING:	458595	INCLINATION:	-90 degrees
COMPLETED:	1/24/2019	NORTHING:	6602480	AZIMUTH:	0 degrees
DRILLED BY:	Raglan Rig15	ELEVATION:	314	SWL (date):	4.82 mbtoc (25-Jan-19)
LOGGED BY:	KR	GRID SYSTEM:	MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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GROUNDWATER

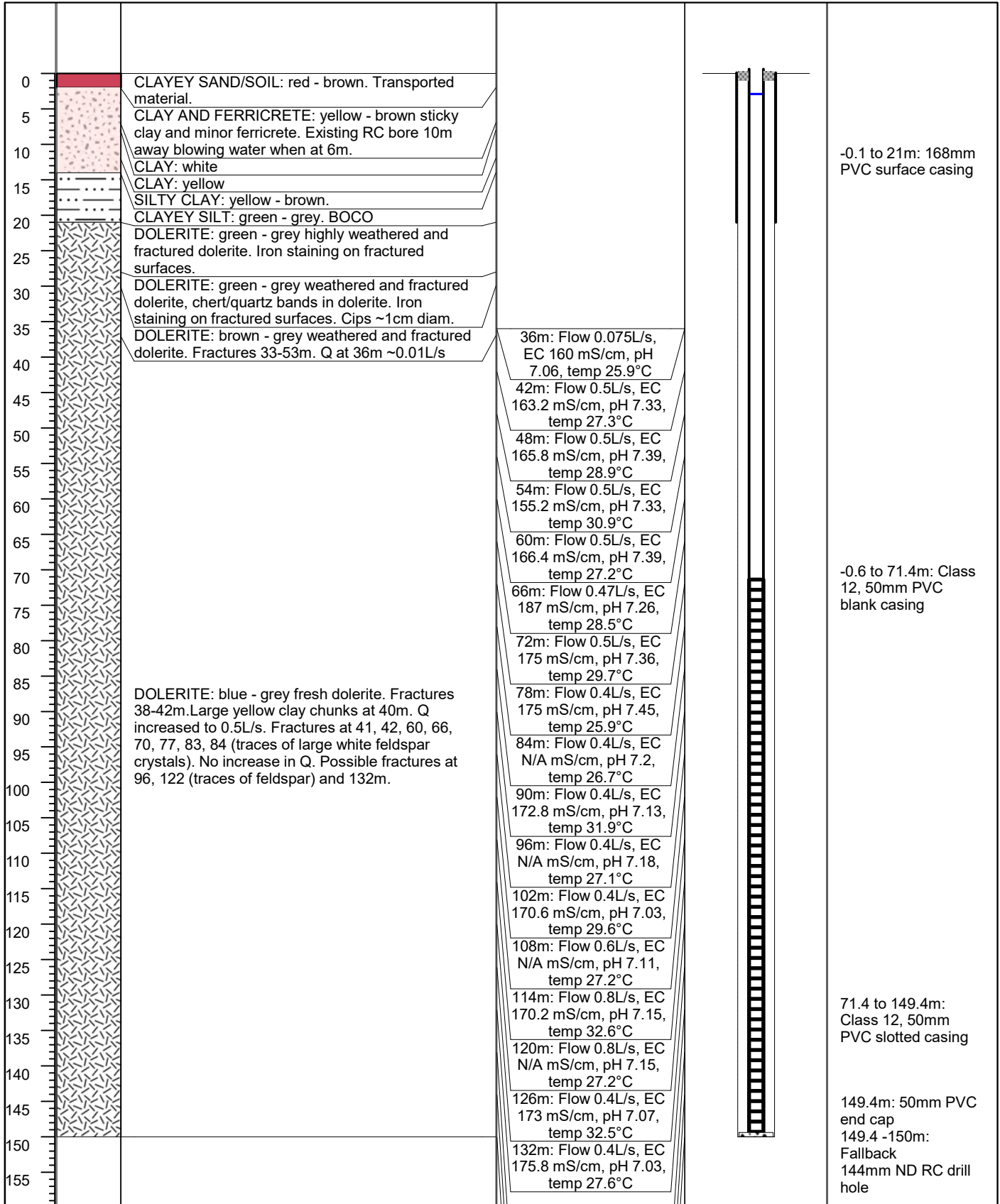


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 Email: water@g-r-m.com.au

ID:	BWE11		JOB NUMBER:	J1842	
CLIENT:	Breaker Resources		PROJECT:	Lake Roe FS	
COMMENCED:	1/26/2019	EASTING:	458740	INCLINATION:	-90 degrees
COMPLETED:	1/27/2019	NORTHING:	6602278	AZIMUTH:	0 degrees
DRILLED BY:	Raglan Rig15	ELEVATION:	307	SWL (date):	3.02 mbtoc (27-Jan-19)
LOGGED BY:	KR	GRID SYSTEM:	MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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GROUNDWATER



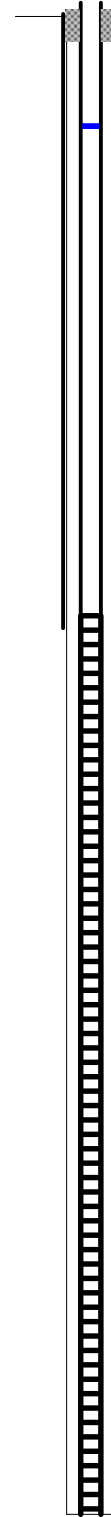
RESOURCE MANAGEMENT

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 Email: water@g-r-m.com.au

ID: BWE12		JOB NUMBER: J1842	
CLIENT: Breaker Resources		PROJECT: Lake Roe FS	
COMMENCED: 1/28/2019	EASTING: 458672	INCLINATION: -90 degrees	
COMPLETED: 1/29/2019	NORTHING: 6602487	AZIMUTH: 0 degrees	
DRILLED BY: Raglan Rig15	ELEVATION: 314	SWL (date): 4.49 mbtoc (02-Feb-19)	
LOGGED BY: KR	GRID SYSTEM: MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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0		CLAYEY SAND/SOIL: red - brown. Transported material.		-0.1 to 24.5m: 168mm PVC surface casing
		SANDY CLAY: white - red. FWS 3m, not enough for a sample		
5		FERRICRETE AND CLAY: red - brown.		-0.55 to 24m: Class 12, 50mm PVC blank casing
		CLAY: red - brown clay and minor ferricrete.		
		CLAY: white - brown		
10		SILTY CLAY: yellow - brown		
15				
20		CLAY AND DOLERITE: yellow - brown clay and extremely weathered dolerite. BOCO		
25				
30		DOLERITE: brown - grey extremely weathered and fractured dolomite. Large quartz fragments up to 2cm. Cerussite and iron staining on most fractured surfaces. 37-38m extra large chips. No water. BOPO		
35			36m: mud flow, not possible to sample.	
40			42m: Flow 0.1L/s, EC 155.4 mS/cm, pH 7.05, temp 31.5°C	
45			48m: Flow 0.08L/s, EC 164.2 mS/cm, pH 6.75, temp 29.5°C	
50		DOLERITE: blue - grey fresh dolerite. Fractures 47, 51, 58m.		24 to 60m: Class 12, 50mm PVC slotted casing
55			54m: Flow 0.08L/s, EC 163 mS/cm, pH 6.85, temp 30.5°C	
60			60m: Flow 0.1L/s, EC 158.8 mS/cm, pH 6.83, temp 28.1°C	



GROUNDWATER



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 Email: water@g-r-m.com.au

ID: **BWE13**

JOB NUMBER: **J1842**

CLIENT: **Breaker Resources**

PROJECT: **Lake Roe FS**

COMMENCED: 1/29/2019

EASTING: 458776

INCLINATION: -90 degrees

COMPLETED: 1/29/2019

NORTHING: 6602187

AZIMUTH: 0 degrees

DRILLED BY: Raglan Rig15

ELEVATION: 315

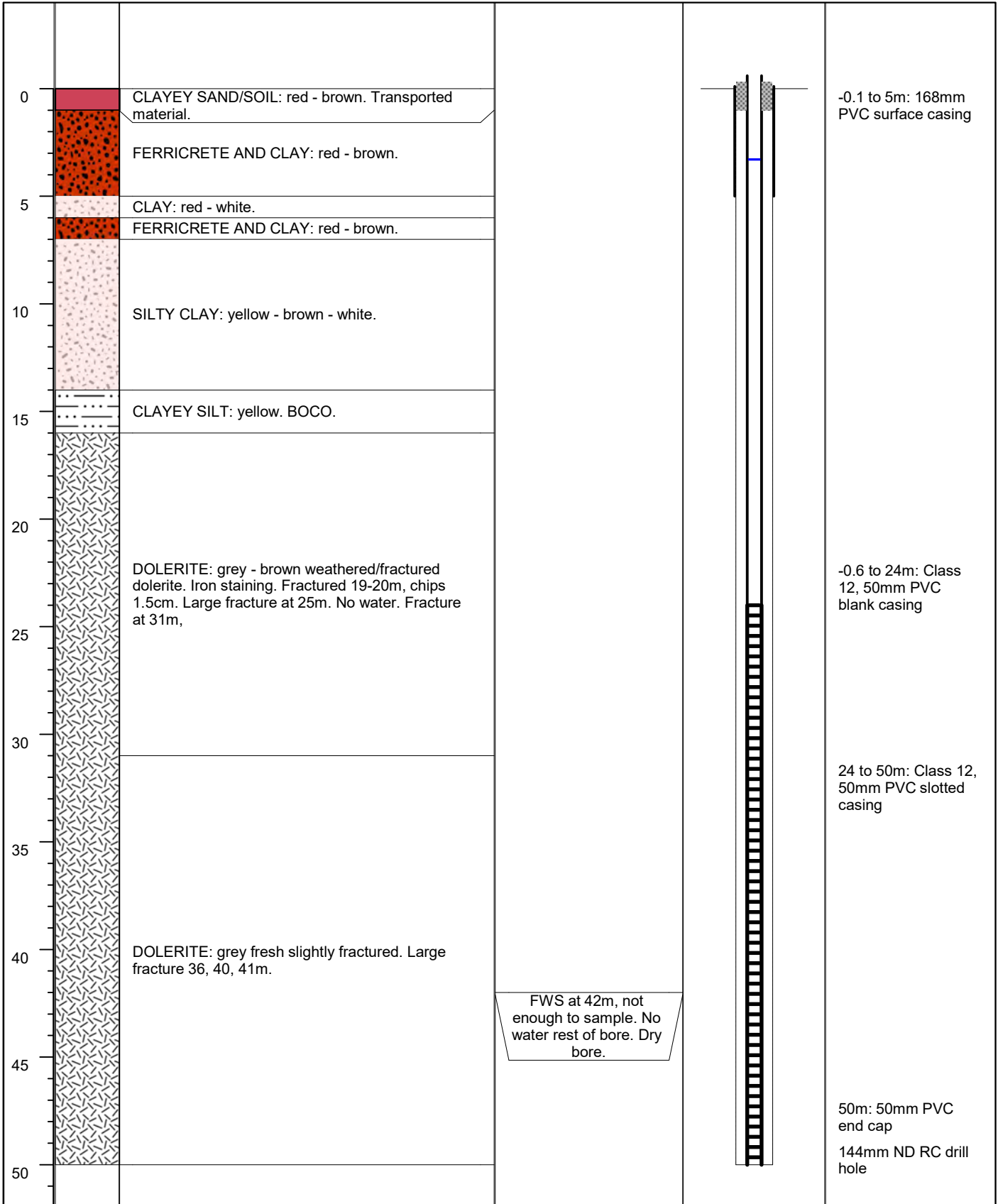
SWL (date):

LOGGED BY: KR

GRID SYSTEM: MGA94 zn51

3.33 mbtoc (02-Feb-19)

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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 Email: water@g-r-m.com.au

ID: **BWE14**

JOB NUMBER: **J1842**

CLIENT: **Breaker Resources**

PROJECT: **Lake Roe FS**

COMMENCED: 2/19/2019

EASTING: 458762

INCLINATION: -90 degrees

COMPLETED: 2/19/2019

NORTHING: 6601669

AZIMUTH: 0 degrees

DRILLED BY: Raglan Rig15

ELEVATION:

SWL (date):

LOGGED BY: KR

GRID SYSTEM: MGA94 zn51

1.12 mbtoc (03-Mar-19)

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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0		CLAY: Red - brown - white.		
5		FERRICRETE AND CLAY: Red - brown.		
		CLAY: Red - yellow - brown silty clay		
		CLAY: Yellow - orange silty clay		
10		SANDY SILT: Yellow - orange slightly clayey, 11-12 fine silt		
15		DOLERITE: Grey - brown extremely weathered and fractured dolerite. Oxidation on fractured surfaces. Large fractures 24-26m, foliation, chips 2-3cm. cerussite on surfaces.		
20		LAMPROPHYRE: Grey - brown weathered lamprophyre. Small gravelly chips.		
25		DOLERITE: Grey - brown weathered and fractured dolerite. Oxidation on fractured surfaces. Large fractures 30-33m, chips 2-3cm, 39-40m.		
30		DOLERITE: Grey - blue fresh dolerite. Small fracture at 42 and 49m with minor quartz at 48 and 50m.		
35			Too muddy for pH and EC.	
40			36m: Flow 0.7L/s, EC 87.4 mS/cm, pH 6.95, temp 28.6°C	
45			42m: Flow 2L/s, EC 95.6 mS/cm, pH 6.83, temp 29.6°C	
50			48m: Flow 3.3L/s, EC 93.6 mS/cm, pH 6.93, temp 30.1°C	
			50m: Flow 5L/s, EC 86 mS/cm, pH 6.96, temp	
				-0.1 to 6m: 168mm PVC surface casing
				-0.6 to 20m: Class 12, 50mm PVC blank casing
				20 to 50m: Class 12, 50mm PVC slotted casing
				50m: 50mm PVC end cap
				144mm ND RC drill hole

GROUNDWATER

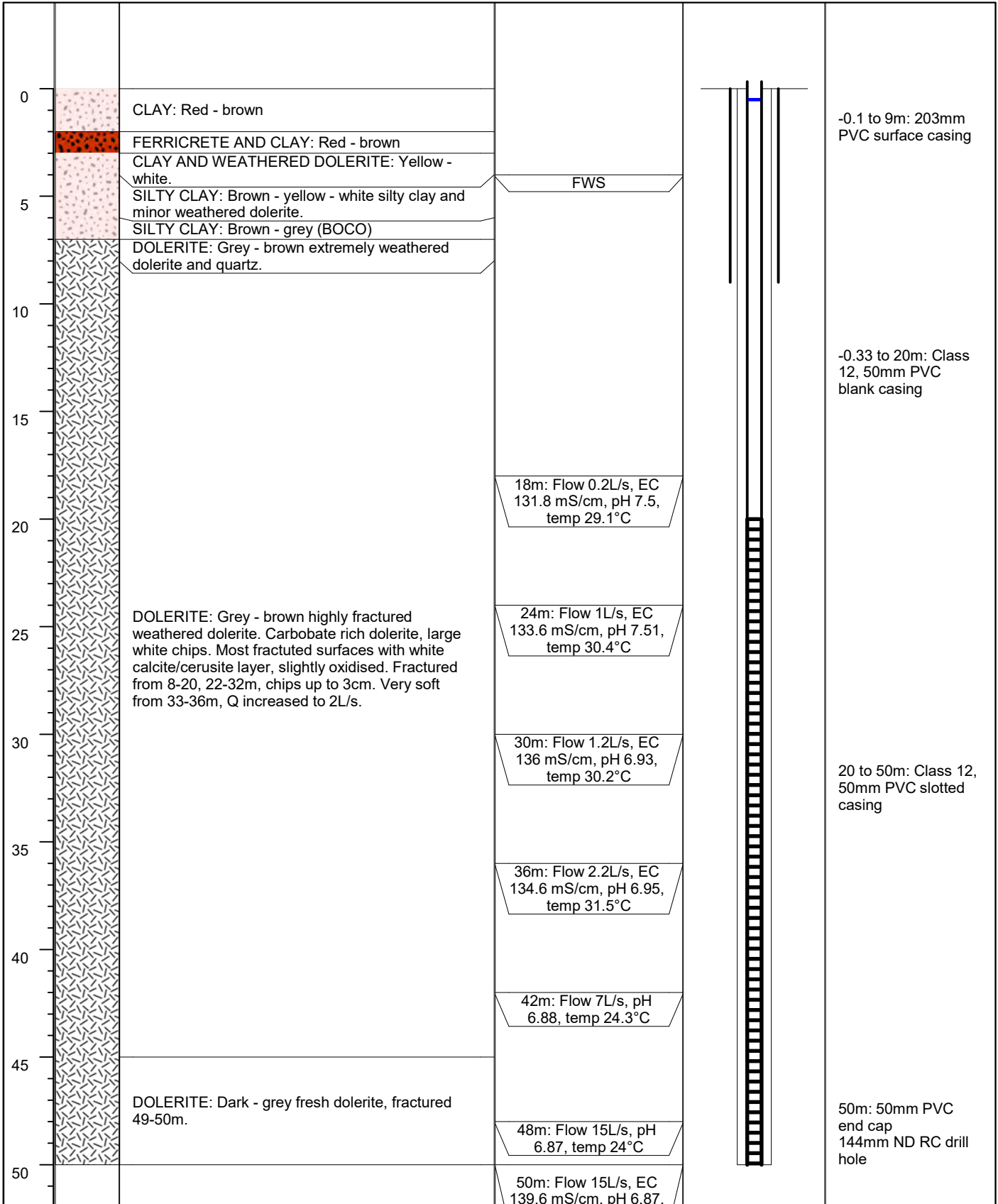


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 Email: water@g-r-m.com.au

ID:	BWE16		JOB NUMBER:	J1842	
CLIENT:	Breaker Resources		PROJECT:	Lake Roe FS	
COMMENCED:	2/26/2019	EASTING:	458606	INCLINATION:	-90 degrees
COMPLETED:	2/26/2019	NORTHING:	6600929	AZIMUTH:	0 degrees
DRILLED BY:	Raglan Rig15	ELEVATION:		SWL (date):	0.57 mbtoc (03-Mar-19)
LOGGED BY:	KR	GRID SYSTEM:	MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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GROUNDWATER



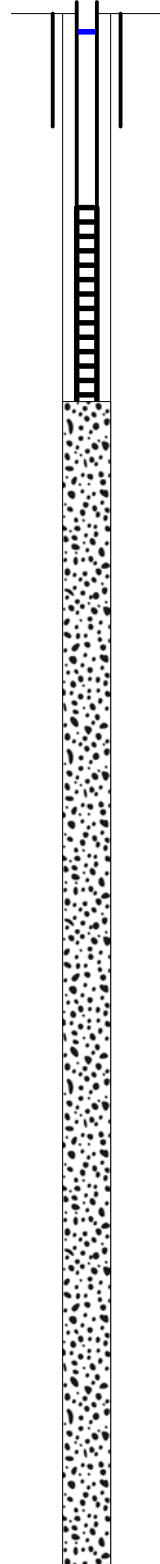
RESOURCE MANAGEMENT

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 Email: water@g-r-m.com.au

ID: BWE17		JOB NUMBER: J1842	
CLIENT: Breaker Resources		PROJECT: Lake Roe FS	
COMMENCED: 3/1/2019	EASTING: 458856	INCLINATION: -90 degrees	
COMPLETED: 3/3/2019	NORTHING: 6600761	AZIMUTH: 0 degrees	
DRILLED BY: Raglan Rig15	ELEVATION:	SWL (date): 1.27 mbtoc (04-Mar-19)	
LOGGED BY: KR	GRID SYSTEM: MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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0		CLAY: Red - brown.		
5		FERRICRETE AND CLAY: Red - grey - brown.		
5		SILTY CLAY; Yellow - brown.		
10		DOLERITE: Grey - brown extremely weathered/fractured dolerite. Oxidised/iron staining on most fractured surfaces. Large fracture 15-17m.		
20		SILTSTONE AND DOLERITE: Brown - grey, weathered dolerite. Small chips.		
25		DOLERITE: Brown - grey highly weathered and fractured dolerite. Oxidised/iron staining. Dolerite gravel. Large fracture 23-24m.	FWS. Not enough to sample or to measure. Muddy trickle	
25		LAMPROPHYRE: Grey - brown weathered lamprophyre. Small gravelly chips.		
30		DOLERITE: Brown - grey highly weathered and fractured dolerite. Oxidised/iron staining. Possible cavity at 33-34m (layered calcite ?).	30m: Flow 0.8L/s, EC 118 mS/cm, pH 7.19, temp 33.7°C	
35			36m: Flow 1.8L/s, pH 6.74, temp 2°C	
40			42m: Flow 2L/s,	
45				
50		DOLERITE: Grey weathered slightly oxidised fractured broken gravelly dolerite. 37-38m very coarse grained. 43-44m, 54-58m, very soft, no chips, just fine dust. Difficult drilling with bore collapsing.	48m: Flow 6L/s, EC 147.4 mS/cm, pH 6.82, temp 26.2°C	
55			54m: Flow >6L/s, EC 150.4 mS/cm, pH 6.87, temp 26.8°C	
60				
65			66m: Flow >10L/s, EC 149.0 mS/cm, pH 6.8, temp 27.3°C	
70			72m: Flow 0L/s,	
75				
80		DOLERITE: Dark grey fresh. Small chips. No fractures.		
85			84m: Flow 0L/s,	
90			90m: Flow 7L/s,	
95				



-0.1 to 7m: 165mm PVC surface casing

-0.7 to 12m: Class 12, 50mm PVC blank casing

12 to 24m: Class 12, 50mm PVC slotted casing

24m: 50mm PVC end cap

24 to 96m: Fallback

144mm ND RC drill hole

GROUNDWATER



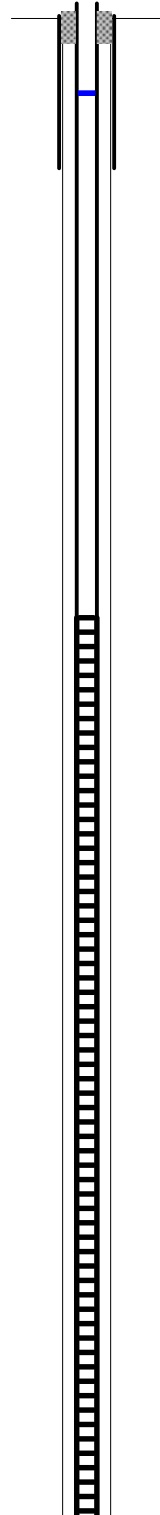
RESOURCE MANAGEMENT

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 Email: water@g-r-m.com.au

ID: BWE18		JOB NUMBER: J1842	
CLIENT: Breaker Resources		PROJECT: Lake Roe FS	
COMMENCED: 1/31/2019	EASTING: 458852	INCLINATION: -90 degrees	
COMPLETED: 1/31/2019	NORTHING: 6600458	AZIMUTH: 0 degrees	
DRILLED BY: Raglan Rig15	ELEVATION: 314	SWL (date): 3.07 mbtoc (01-Feb-19)	
LOGGED BY: KR	GRID SYSTEM: MGA94 zn51		

Depth (m bgl)	Graphic + Stratigraphy	Lithological Description	Field Notes	Bore Construction
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0		CLAYEY SAND/SOIL: red - brown. Transported material.		-0.1 to 6m: 168mm PVC surface casing
5		CLAY: red - brown		
		CLAY AND FERRICRETE: red - brown.		
		FERRICRETE AND CLAY: red - brown.		
10		SILTY CLAY: yellow - brown. BOCO		
15		DOLERITE: grey - brown weathered oxidised dolerite.		
20		METASEDIMENT: yellow - brown metasediment (shale, chert etc, extremely weathered. Small gravelly chips. Possibl FWS. No actual flow.	Possible FWS at metasediments, difficult to determine.	-0.6 to 24m: Class 12, 50mm PVC blank casing
25		DOLERITE: grey - brown foliated/sheared dolerite. Small to medium chips.		
30		DOLERITE: grey - brown weathered dolerite. Fractured 29-32m, chips up to 2cm in diam. Fractured with iron staining 37-39m, 45, 46m. BOPO		
35		DOLERITE: grey. Possible fractures at 49, 50, 54m. Bigger chips up to 1.5cm.		
40				24 to 60m: Class 12, 50mm PVC slotted casing
45				
50				
55				
60				60m: 50mm PVC end cap 144mm ND RC drill hole



APPENDIX B
Bore Logs (AQ2, 2025)



Ground Floor, 1 Howard St
Perth
WA 6000
Australia
t: +61 (8) 9322 9733
e: aq2general@aq2.com.au

COMPOSITE WELL LOG

Bore No: WMB19

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 05/05/2025

Method: AH/MR/OH (0-3/3-12/12-160)

Area: Bombora

Completed: 09/05/2025

Fluid: Air/Mud

Elevation: 314.49

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458750

Logged By: Gareth L

Bit Record 2: 8" (4-EOH)

Northing: 6600512

Projection: GDA94 Z51

Static Water Level: 3.83mbtc

Date: 08/06/2025

Remarks: stick up = 0.55m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Reddish-brown, poorly sorted, clayey silt				12" steel surface collar (0-3m) Grout in intermediate casing (0-12m) 6" Intermediate steel casing (0-12m)
10			Clay: Red-brown, silty clay with white clay particles. Some highly weatehred brown dolorite clasts				
20			Dolerite : Green-mafic, partially serpented, slightly weathered, hard, dolorite.				
30			Dolerite: Fresh, mafic, very hard dolorite. No major water strikes				
40							
50							
60							
70							
80							Open hole 12-160m due to low yield (no PVC installed)
90							
100					No development done		
110							
120							
130							
140							
150							
160							



Ground Floor, 1 Howard St
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e: aq2general@aq2.com.au

COMPOSITE WELL LOG

Bore No: WMB20

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 15/06/2025

Method: AH/MR/OH (0-6/6-23/23-150)

Area: Bombora

Completed: 19/06/2025

Fluid: Air/Mud

Elevation: 312.78

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458480

Logged By: Alastair H

Bit Record 2: 8" (4-EOH)

Northing: 6600427

Projection: GDA94 Z51

Static Water Level: 2.3mbtc

Date: 04/07/2025

Remarks: stick up = 0.81m

Depth (m bgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Clay: Dark red clayey silt, very clay rich, poorly sorted, some fine sand				Cement plug (0-6m) Cement grout to set in surface collar - with tremie line (0-6m) 12" steel surface collar (0-6m) Cement grout to set in intermediate casing - with tremie line (0-23m) 6" Intermediate steel casing (0-23m) DN50 PN18 PVC Casing - Blank (0-24m)
10			Clay: Dark russet red clay, mottled yellow green in places, plastic, poorly sorted, silty				
20			Clay: Moderate yellowish brown clay, soft to firm, with relict chips of dolomite				
30			Dolorite: Dark green/grey, weathered dolomite, weathered to mid brown, SAPROCK				
40			Dolorite: Dark green/grey dolomite, fresh, competent, metamorphosed				
50							
60							
70					1.2L/s, -, -µS/cm, - pH, -°C		
80					1.2L/s, 168,400µS/cm, 6.1 pH, 20.1°C		
90					1.5L/s, 168,600µS/cm, 6.3 pH, 19.8°C		
100					1.2L/s, 164,100µS/cm, 6.1 pH, 20.1°C		3.2 - 6.4 mm gravel pack (2-150m)
110					1.2L/s, 168,100µS/cm, 6.3 pH, 21°C		DN50 PN18 PVC Casing - 1mm slotted (24-150m)
120					1.8L/s, 159,500µS/cm, 6.1 pH, 22.1°C		
130					1.5L/s, 163,500µS/cm, 6.1 pH, 23.1°C		
140					1.8L/s, 159,300µS/cm, 6 pH, 24.5°C		
150					1.8L/s, 162,900µS/cm, 6.1 pH, 22.6°C		
160					1.8L/s, µS/cm, pH, °C		
					1.6L/s, µS/cm, pH, °C		
					1.8L/s, µS/cm, pH, °C		
					1.8L/s, µS/cm, pH, °C		
					1.8L/s, µS/cm, pH, °C		
					Airlift: 1.23L/s, µS/cm, 6.53 pH, 21.3°C		DN50 PN18 PVC Casing - End Cap



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Perth
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COMPOSITE WELL LOG

Bore No: WMB21

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 13/04/2025

Method: AH/OH (0-6/6-12/12-169)

Area: Bombora

Completed: 03/05/2025

Fluid: Air/Mud

Elevation: 313.71

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458611

Logged By: Gareth L

Bit Record 2: 8" (4-EOH)


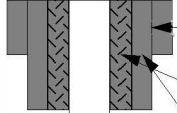
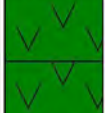













Northing: 6601725

Projection: GDA94 Z51

Static Water Level: 2.96mbtc

Date: 17/06/2025

Remarks: stick up = 0.62m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, slightly sandy, clayey silt.				12" steel surface collar (0-6m) Grout in intermediate casing (SG 1.64) (0-12m) 6" Intermediate steel casing (0-12m)
10			Dolerite : Green-mafic, partially serpentised, highly weathered dolerite with abundant quartz. Large quartz clasts at 12m. Water strike at 12 m.		0.8L/s, $\mu\text{S/cm}$, 8.7 pH, 23.8°C		
20			Dolerite : Fresh, mafic, very hard dolerite. Fracture encountered at 24m, with associated increase in weathered dolerite clasts. Yield: ~3.8-4.4l/s. Prominent quartz veins encountered at 64-66m. Some minor quartz throughout remaining profile		3.1L/s, $\mu\text{S/cm}$, 7.64 pH, 23.6°C		
30					3.8L/s, $\mu\text{S/cm}$, 7.01 pH, 23.7°C		
40					3.8L/s, $\mu\text{S/cm}$, 6.8 pH, 24.4°C		
50					3.9L/s, $\mu\text{S/cm}$, 6.83 pH, 24.4°C		
60					3.9L/s, $\mu\text{S/cm}$, 6.85 pH, 24.5°C		
70					3.9L/s, $\mu\text{S/cm}$, 6.86 pH, 25°C		
80					3.9L/s, $\mu\text{S/cm}$, 6.82 pH, 24.8°C		
90					3.9L/s, $\mu\text{S/cm}$, 6.82 pH, 24.2°C		
100					3.9L/s, $\mu\text{S/cm}$, 6.9 pH, 24.1°C		
110					3.9L/s, $\mu\text{S/cm}$, 6.88 pH, 23.8°C		
120					3.9L/s, $\mu\text{S/cm}$, 6.83 pH, 22.3°C		
130					3.9L/s, $\mu\text{S/cm}$, 6.77 pH, 24.2°C		
140					3.9L/s, $\mu\text{S/cm}$, 6.64 pH, 23.8°C		
150					3.9L/s, $\mu\text{S/cm}$, 6.62 pH, 23.5°C		
160					3.9L/s, $\mu\text{S/cm}$, 6.39 pH, 23.5°C		
170					3.9L/s, $\mu\text{S/cm}$, 6.29 pH, 25.2°C		
180					3.9L/s, $\mu\text{S/cm}$, 6.66 pH, 23.1°C		
190					3.9L/s, $\mu\text{S/cm}$, 6.71 pH, 23.5°C		
200					4.4L/s, $\mu\text{S/cm}$, 6.75 pH, 23.9°C		
210					4.4L/s, $\mu\text{S/cm}$, 6.67 pH, 22.2°C		
220					4.4L/s, $\mu\text{S/cm}$, 6.82 pH, 21.8°C		
230					4.4L/s, $\mu\text{S/cm}$, 6.65 pH, 21.6°C		
240					4.4L/s, $\mu\text{S/cm}$, 6.67 pH, 22.1°C		
250					4.4L/s, $\mu\text{S/cm}$, - pH, -°C		
260					4.4L/s, $\mu\text{S/cm}$, - pH, -°C		
270					No development done		

Not installed - left open hole due to low yields 169m (no PVC installed)



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COMPOSITE WELL LOG

Bore No: WMB23

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 19/03/2025

Method: AH/MR/OH (0-6/6-15/15-200)

Area: Bombora

Completed: 25/03/2025

Fluid: Air/Mud

Elevation: 314.88

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458623

Logged By: Gareth L

Bit Record 2: 8" (4-EOH)


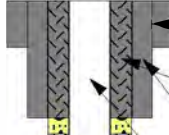

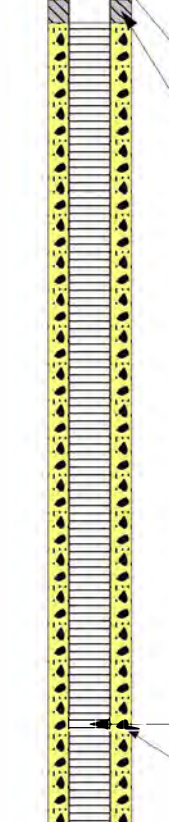




















Northing: 6601956

Projection: GDA94 Z51

Static Water Level: 4.42mbtc

Date: 17/06/2025

Remarks: stick up = 0.90m

Depth (m bgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Gravel: Red-brown, poorly sorted, very silty, sandy, sub-angular to sub-rounded, medium-coarse grained gravel				12" steel surface collar (0-6m) Grout in intermediate casing (SG 1.64) (0-15m) 6" Intermediate steel casing (0-15m) DN50 PN18 PVC Casing - Blank (0-20m) Bentonite seal (17-20m)
10			Gravel: Grey-brown, highly weathered saprock. Contains poorly sorted, gravelly, sub-angular to sub-rounded clasts of dolorite				DN50 PN18 PVC Casing - 1mm slotted (20-200m) 3.2-6.4mm gravel (20-200m)
20			Dolorite: Greenish black, partially weathered dolorite.				
30			Dolorite: Fresh, hard, mafic dolorite basement. No fracture zones or water strikes noted. Minor quartz veining intersected at 141m and 196-199m. No weathering/staining associated with veining.				DN50 PN18 PVC Casing - End Cap (200-200m)
40							
50							
60							
70							
80							
90							
100							
110					Airlift: 0.3L/s, $\mu\text{S/cm}$, - pH, - $^{\circ}\text{C}$		
120							
130							
140							
150							
160							
170							
180							
190							
200							



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COMPOSITE WELL LOG

Bore No: WMB24

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 27/03/2025

Method: AH/MR/OH (0-6/6-23/23-200)

Area: Bombora

Completed: 05/04/2025

Fluid: Air/Mud

Elevation: 314.88

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458772

Logged By: Kevin M

Bit Record 2: 8" (4-EOH)

Northing: 6602003

Projection: GDA94 Z51

Static Water Level: 3.9mbtc

Date: 17/06/2025

Remarks: stick up = 0.73m

Depth (m bgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, very slightly sandy, clayey silt				12" steel surface collar (0-6m)
10			Clay: Grey-green-white, soft, silty clay with medium-coarse sand. Sand content increasing with depth				Grout in intermediate casing (SG 1.64) (0-23m)
20			Dolorite: Grey-green-mafic, partially serpentinised, weathered dolerite.				6" Intermediate steel casing (0-23m)
30			Dolorite: Fresh, mafic dolerite with quartz noted at 99-100m, 110-116m, 139m, 144-146m, 180-181m and 197-200m. Quartz very hard. Fractures at 25m and 30-31m (major water strikes), 134m and 144-146m.		0.02L/s, $\mu\text{S/cm}$, - pH, - $^{\circ}\text{C}$		DN50 PN18 PVC Casing - Blank (0-38m)
40					0.07L/s, $\mu\text{S/cm}$, 5.76 pH, 33.7 $^{\circ}\text{C}$		Bentonite seal (32-35m)
50					0.07L/s, $\mu\text{S/cm}$, - pH, - $^{\circ}\text{C}$		
60					0.07L/s, $\mu\text{S/cm}$, 6.19 pH, 34.1 $^{\circ}\text{C}$		
70					0.07L/s, $\mu\text{S/cm}$, - pH, - $^{\circ}\text{C}$		
80					0.07L/s, $\mu\text{S/cm}$, 6.68 pH, 36.2 $^{\circ}\text{C}$		
90					0.07L/s, $\mu\text{S/cm}$, - pH, - $^{\circ}\text{C}$		
100					0.1L/s, $\mu\text{S/cm}$, 6.33 pH, 30.4 $^{\circ}\text{C}$		
110					0.15L/s, $\mu\text{S/cm}$, 6.24 pH, 33.9 $^{\circ}\text{C}$		
120					0.15L/s, $\mu\text{S/cm}$, 6.65 pH, 32.6 $^{\circ}\text{C}$		
130					0.22L/s, $\mu\text{S/cm}$, 6.69 pH, 29.6 $^{\circ}\text{C}$		
140					0.22L/s, $\mu\text{S/cm}$, 6.59 pH, 33.9 $^{\circ}\text{C}$		
150					0.22L/s, $\mu\text{S/cm}$, 6.42 pH, 30.5 $^{\circ}\text{C}$		
160					0.4L/s, $\mu\text{S/cm}$, 6.24 pH, 29.1 $^{\circ}\text{C}$		
170					0.4L/s, $\mu\text{S/cm}$, 6.39 pH, 26.5 $^{\circ}\text{C}$		
180					0.4L/s, $\mu\text{S/cm}$, 6.59 pH, 25.5 $^{\circ}\text{C}$		
190					0.4L/s, $\mu\text{S/cm}$, 6.85 pH, 20.3 $^{\circ}\text{C}$		
200					0.5L/s, $\mu\text{S/cm}$, 6.71 pH, 18.5 $^{\circ}\text{C}$		
					0.5L/s, $\mu\text{S/cm}$, 6.64 pH, 19.4 $^{\circ}\text{C}$		
					0.6L/s, $\mu\text{S/cm}$, 6.59 pH, 22.2 $^{\circ}\text{C}$		
					0.67L/s, $\mu\text{S/cm}$, 6.51 pH, 24.2 $^{\circ}\text{C}$		
					0.63L/s, $\mu\text{S/cm}$, 7.13 pH, 28.3 $^{\circ}\text{C}$		
					0.63L/s, $\mu\text{S/cm}$, 7.02 pH, 26.7 $^{\circ}\text{C}$		
					0.74L/s, $\mu\text{S/cm}$, 7.11 pH, 30.7 $^{\circ}\text{C}$		
					0.78L/s, $\mu\text{S/cm}$, 6.39 pH, 37.2 $^{\circ}\text{C}$		
					0.78L/s, $\mu\text{S/cm}$, 6.45 pH, 37.8 $^{\circ}\text{C}$		
					0.78L/s, $\mu\text{S/cm}$, 6.37 pH, 33.8 $^{\circ}\text{C}$		
					0.99L/s, $\mu\text{S/cm}$, 6.51 pH, 20.1 $^{\circ}\text{C}$		
					Airlift: 0.54L/s, $\mu\text{S/cm}$, 6.49 pH, 15.7 $^{\circ}\text{C}$		
							3.2-6.4mm gravel (35-200m)
							DN50 PN18 PVC Casing - 1mm slotted (38-200m)
							DN50 PN18 PVC Casing - End Cap (200-200m)



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COMPOSITE WELL LOG

Bore No: WMB25

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 08/04/2025

Method: AH/MR/OH (0-6/6-12/12-200)

Area: Bombora

Completed: 23/04/2025

Fluid: Air/Mud

Elevation: 314.38

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458610

Logged By: Gareth L

Bit Record 2: 8" (4-EOH)

Northing: 6602113

Projection: GDA94 Z51

Static Water Level: 3.79mbtc

Date: 17/06/2025

Remarks: stick up = 1.04m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, slightly sandy, clayey silt.				
10			Clay: Red-brown, silty clay with white clay particles. Some highly weathred brown dolomite clasts				
20			Dolerite : Green-mafic, partially serpented, slightly weathered, hard, dolerite.				
30			Dolerite : Fresh, mafic, very hard dolerite. Prominent quartz veins encountered at 112 and 147m . Fractures encountered at 29,34, 43, 50, 52 and 54m. Main water strikes were at 34 and 43 meters		0.2L/s, $\mu\text{S/cm}$, - pH, -C		
40					0.78L/s, $\mu\text{S/cm}$, 6.2 pH, 25C		
50					0.63L/s, $\mu\text{S/cm}$, 5.75 pH, 26.4C		
60					3.59L/s, $\mu\text{S/cm}$, 6.31 pH, 24.2C		
70					3.78L/s, $\mu\text{S/cm}$, 6.97 pH, 24.4C		
80					3.78L/s, $\mu\text{S/cm}$, 7.12 pH, 24.8C		
90					3.78L/s, $\mu\text{S/cm}$, 7.12 pH, 25.2C		
100					3.78L/s, $\mu\text{S/cm}$, 7.11 pH, 24.8C		
110					3.99L/s, $\mu\text{S/cm}$, 7.12 pH, 24.8C		
120					3.89L/s, $\mu\text{S/cm}$, 7.13 pH, 24.8C		
130					3.78L/s, $\mu\text{S/cm}$, 7.18 pH, 24.1C		
140					3.78L/s, $\mu\text{S/cm}$, 7.19 pH, 24.1C		
150					3.78L/s, $\mu\text{S/cm}$, 7.19 pH, 22C		
160					3.78L/s, $\mu\text{S/cm}$, 7.17 pH, 22C		
170					3.89L/s, $\mu\text{S/cm}$, 6.62 pH, 21.8C		
180					3.99L/s, $\mu\text{S/cm}$, 6.03 pH, 21.6C		
190					3.99L/s, $\mu\text{S/cm}$, 6.66 pH, 22.2C		
200					3.59L/s, $\mu\text{S/cm}$, 6.86 pH, 22.6C		
					3.89L/s, $\mu\text{S/cm}$, 6.92 pH, 22.8C		
					3.89L/s, $\mu\text{S/cm}$, 7.09 pH, 23.3C		
					3.89L/s, $\mu\text{S/cm}$, 7.09 pH, 23.1C		
					3.89L/s, $\mu\text{S/cm}$, 7.08 pH, 23.1C		
					2.86L/s, $\mu\text{S/cm}$, 6.74 pH, 22.8C		
					3.39L/s, $\mu\text{S/cm}$, 6.66 pH, 23.1C		
					3.12L/s, $\mu\text{S/cm}$, 7.03 pH, 23.9C		
					3.39L/s, $\mu\text{S/cm}$, 7.09 pH, 22.6C		
					3.89L/s, $\mu\text{S/cm}$, 7.06 pH, 22.4C		
					3.89L/s, $\mu\text{S/cm}$, 6.21 pH, 21.8C		
					4.31L/s, $\mu\text{S/cm}$, 6.72 pH, 21.6C		
					Airlift: 2.3L/s, $\mu\text{S/cm}$, 6.8 pH, 22.6C		
							3.2-6.4mm gravel (24-200m)
							DN50 PN18 PVC Casing - 1mm slotted (26-200m)
							DN50 PN18 PVC Casing - End Cap (200-200m)



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COMPOSITE WELL LOG

Bore No: WMB26

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 12/03/2025

Method: AH/MR/OH (0-8/8-13/13-160)

Area: Bombora

Completed: 26/03/2025

Fluid: Air/Mud

Elevation: 314.09

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458580

Logged By: Kevin M

Bit Record 2: 8" (4-EOH)


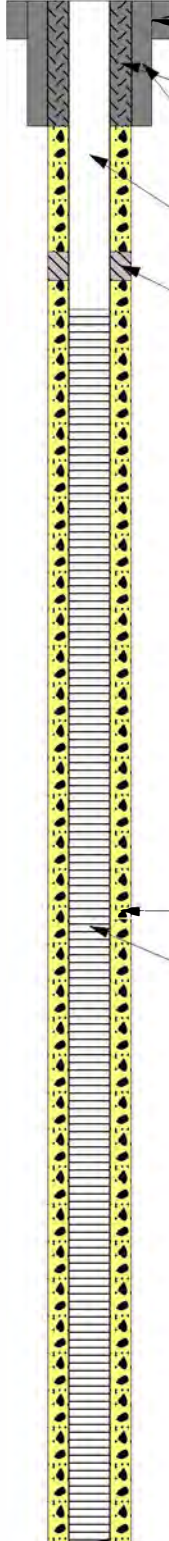
















Northing: 6602277

Projection: GDA94 Z51

Static Water Level: 4.17mbtc

Date: 08/06/2025

Remarks: stick up = 0.84m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Gravel: Red-brown, poorly sorted, very silty, sandy, sub-angular to sub-rounded, medium-coarse grained gravel		0.2L/s, $\mu\text{S/cm}$, - pH, -C	 <p>12" steel surface collar (0-4m) Grout in intermediate casing (SG 1.64) (0-13m) 6" Intermediate steel casing (0-13m) DN50 PN18 PVC Casing - Blank (0-32m) Bentonite seal (26-29m)</p>	
10			Gravel: Grey-green-brown, poorly sorted, very gravelly, silty clay. Gravel is sub-angular to sub-rounded, weathered dolerite clasts				
20			Dolerite: Green-grey-mafic, partially serpentinised, slightly weathered dolerite		0.5L/s, $\mu\text{S/cm}$, 7.08 pH, 20.2°C		
30			Dolerite: Fresh, hard, mafic dolerite basement. Quartz noted at 33-35m, 60m, 63m, 70m, 94m, 117-118m, 127-131m, 133-135m, 153-154m. Fractures encountered at 25m (broken, weathered chips), 31m, 34m, 79m, 80m, 82m, 87m, 90m, 95m and 107m. WMB26 located within the lamprohyres dyke zone. Lamprohyre dykes weather easily, behave somewhat like karst and are known to store lots of water.		4L/s, $\mu\text{S/cm}$, 6.49 pH, 19.4°C		
40					-L/s, $\mu\text{S/cm}$, 6.26 pH, 19.2°C		
50					6L/s, $\mu\text{S/cm}$, 6.39 pH, 19.1°C		
60					-L/s, $\mu\text{S/cm}$, 6.31 pH, 19.9°C		
70					8L/s, $\mu\text{S/cm}$, 6.29 pH, 19.8°C		
80					-L/s, $\mu\text{S/cm}$, 6.3 pH, 19.2°C		
90					8L/s, $\mu\text{S/cm}$, 6.04 pH, 19.3°C		
100					-L/s, $\mu\text{S/cm}$, 6.01 pH, 21.6°C		
110					8L/s, $\mu\text{S/cm}$, 5.79 pH, 22.4°C		
120					-L/s, $\mu\text{S/cm}$, 5.84 pH, 22.1°C		
130					8.5L/s, $\mu\text{S/cm}$, 5.86 pH, 23.8°C		3.2-6.4mm gravel (29-160m)
140					-L/s, $\mu\text{S/cm}$, 5.89 pH, 23.3°C		DN50 PN18 PVC Casing - 1mm slotted (32-160m)
150					10L/s, $\mu\text{S/cm}$, - pH, -C		
160					10L/s, $\mu\text{S/cm}$, 5.92 pH, 23.3°C		
170					-L/s, $\mu\text{S/cm}$, 6.13 pH, 16.7°C		
					12L/s, $\mu\text{S/cm}$, 6.45 pH, 19.1°C		
					12L/s, $\mu\text{S/cm}$, 6.89 pH, 24.4°C		
					12L/s, $\mu\text{S/cm}$, 6.95 pH, 34.2°C		
					12.5L/s, $\mu\text{S/cm}$, 6.85 pH, 36.3°C		
					12.5L/s, $\mu\text{S/cm}$, 6.91 pH, 37.2°C		
					12.5L/s, $\mu\text{S/cm}$, 6.9 pH, 36.8°C		
					12.5L/s, $\mu\text{S/cm}$, 6.93 pH, 37.2°C		
					12.5L/s, $\mu\text{S/cm}$, 6.94 pH, 41.9°C		
					Airlift: 1.3L/s, $\mu\text{S/cm}$, - pH, 24.8°C		DN50 PN18 PVC Casing - End Cap (160-160m)



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COMPOSITE WELL LOG

Bore No: WMB27

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 30/06/2025

Method: AH/MR/OH (0-6/6-32/32-130)

Area: Bombora

Completed: 04/06/2025

Fluid: Air/Mud

Elevation: 313.98

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458555

Logged By: Gareth L

Bit Record 2: 8" (4-EOH)

Northing: 6603009

Projection: GDA94 Z51

Static Water Level: 2.3mbtc

Date: 23/07/2025

Remarks: stick up = 0.81m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion		
						Diagram	Notes	
0			Silt: Red-brown, slightly sandy, clayey silt.		-L/s, -, -µS/cm, - pH, -°C	<p>Cement plug (0-3m) Cement grout to set in surface collar - with tremie line (0-3m) 12" steel surface collar (0-3m) Cement grout to set in intermediate casing - with tremie line (0-33m) 6" Intermediate steel casing (0-33m) DN50 PN18 PVC Casing - Blank (0-40m) Bentonite seal (34-36m) 3.2 - 6.4 mm gravel pack (2-160m) DN50 PN18 PVC Casing - 1mm slotted (40-160m) DN50 PN18 PVC Casing - End Cap (150-150m)</p>		
10			Clay: Whitish brown, high plasticity clay. Saprolite		-L/s, -, -µS/cm, - pH, -°C			
20			Clay: Orange-grey, high plasticity clay. Saprolite		-L/s, -, -µS/cm, - pH, -°C			
30			Basalt: Green-grey, weathered basalt		-L/s, -, -µS/cm, - pH, -°C			
40			Basalt: Blue-grey fresh basalt		-L/s, -, -µS/cm, - pH, -°C			
50					-L/s, -, -µS/cm, - pH, -°C			
60					-L/s, -, -µS/cm, - pH, -°C			
70					-L/s, -, -µS/cm, - pH, -°C			
80					-L/s, -, -µS/cm, - pH, -°C			
90					-L/s, -, -µS/cm, - pH, -°C			
100					-L/s, -, -µS/cm, - pH, -°C			
110					-L/s, -, -µS/cm, - pH, -°C			
120					-L/s, -, -µS/cm, - pH, -°C			
130					-L/s, -, -µS/cm, - pH, -°C			
140					-L/s, -, -µS/cm, - pH, -°C			
150					-L/s, -, -µS/cm, - pH, -°C			
160					-L/s, -, -µS/cm, - pH, -°C			
170					No development done			
180								
190								
200								



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COMPOSITE WELL LOG

Bore No: WMB28

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 25/06/2025

Method: AH/MR/OH (0-3, 3-33, 33-160)

Area: Bombora

Completed: 30/06/2025

Fluid: Air/Mud

Elevation: 314.39

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458703

Logged By: James W

Bit Record 2: 8" (4-EOH)

Northing: 6603008

Static Water Level: 2.3mbtc

Date: 07/07/2025

Remarks: stick up = 1.11m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, slightly sandy, clayey silt.		-L/s, -, -µS/cm, - pH, -°C	<p>Cement plug (0-3m) Cement grout to set in surface collar - with tremie line (0-3m) 12" steel surface collar (0-3m) Cement grout to set in intermediate casing - with tremie line (0-33m) 6" Intermediate steel casing (0-33m) DN50 PN18 PVC Casing - Blank (0-40m) Bentonite seal (34-36m) 3.2 - 6.4 mm gravel pack (2-160m) DN50 PN18 PVC Casing - 1mm slotted (40-160m) DN50 PN18 PVC Casing - End Cap (160m)</p>	
10			Clay: Yellow/grey, plastic, poorly sorted, silty, minor ferruginous clasts		-L/s, -, -µS/cm, - pH, -°C		
20					-L/s, -, -µS/cm, - pH, -°C		
30			Clay: Dark green/grey, high plasticity clay. Saprolite		-L/s, -, -µS/cm, - pH, -°C		
40			Dolorite: Dark green/grey, weathered dolorite, weathered to mid brown, saprock.		-L/s, -, -µS/cm, - pH, -°C 0L/s, 784,400µS/cm, - pH, -°C		
50			Dolorite: Dark green/grey dolorite, fresh, competent, metamorphosed		0L/s, 862,200µS/cm, - pH, -°C		
60					0.1L/s, 974,400µS/cm, 5.82 pH, 13.3°C		
70					0.2L/s, 983,300µS/cm, 4.62 pH, 10.1°C		
80					0.3L/s, 158,000µS/cm, 5.72 pH, 7.9°C		
90					0.4L/s, 178,000µS/cm, 6.41 pH, 8.2°C		
100					0.4L/s, 171,000µS/cm, 6.23 pH, 14.8°C		
110					0.5L/s, 167,000µS/cm, 6.37 pH, 9.1°C		
120					0.8L/s, 164,000µS/cm, 6.81 pH, 11°C		
130					1L/s, 191,000µS/cm, 6.38 pH, 10.5°C		
140					1.2L/s, 184,000µS/cm, 3.94 pH, 18.9°C		
150					1.2L/s, 190,000µS/cm, 6.01 pH, 11.1°C		
160					1.4L/s, 186,000µS/cm, 5.58 pH, 13.5°C		
170					1.5L/s, 171,000µS/cm, 6.7 pH, 12.9°C		
					1.5L/s, 172,000µS/cm, 6.6 pH, 12.6°C		
					1.5L/s, 186,000µS/cm, 6.68 pH, 12.9°C		
					1.5L/s, 192,000µS/cm, 5.81 pH, 17.2°C		
					1.5L/s, 187,000µS/cm, 6.7 pH, 12.3°C		
					1.5L/s, 181,000µS/cm, 6.78 pH, 12.7°C		
					1.5L/s, 194,000µS/cm, 6.74 pH, 12.3°C		
					1.5L/s, 181,000µS/cm, 6.74 pH, 11.4°C		
					Airlift: 0.6L/s, µS/cm, 5.26 pH, 16.8°C		



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COMPOSITE WELL LOG

Bore No: WMB29

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 04/07/2025

Method: AH/MR/OH (0-3/3-31/31-130)

Area: Bombora

Completed: 08/07/2025

Fluid: Air/Mud

Elevation: 315.79

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458365

Logged By: Gareth L

Bit Record 2: 8" (4-EOH)

Northing: 6602795

Static Water Level: 2.3mbtc

Date: 23/07/2025

Remarks: stick up = 1.25m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, slightly sandy, clayey silt.		-L/s, -, -µS/cm, - pH, -°C	<p>Cement plug (0-2m)</p> <p>Cement grout to set in surface collar - with tremie line (0-3m)</p> <p>12" steel surface collar (0-3m)</p> <p>Cement grout to set in intermediate casing - with tremie line (0-31m)</p> <p>6" Intermediate steel casing (0-31m)</p> <p>DN50 PN18 PVC Casing - Blank (0-34m)</p> <p>Bentonite seal (31-33m)</p> <p>DN50 PN18 PVC Casing - Blank (2-128.5m)</p> <p>DN50 PN18 PVC Casing - 1mm slotted (34-128.5m)</p> <p>DN50 PN18 PVC Casing - End Cap (128.5m)</p> <p>3.2 - 6.4 mm gravel pack (128.5-130m)</p>	
10			Clay: Orangish-brown, high plasticity clay. Saprolite		-L/s, -, -µS/cm, - pH, -°C		
20			Gravel : Grey-green-brown, poorly sorted, very gravelly, silty clay. Gravel is sub-angular to sub-rounded, weathered basalt clasts		-L/s, -, -µS/cm, - pH, -°C		
25			Basalt: Green-grey, weathered basalt. Seepage at 32m		-L/s, -, -µS/cm, - pH, -°C		
30			Basalt: Blue-grey fresh basalt. Minor water strike at 49m. Main water strike at 53m (4.42 l/s)		-L/s, -, -µS/cm, - pH, -°C		
40					0.3L/s, -, -µS/cm, - pH, -°C		
50					0.3L/s, 15,680µS/cm, 6.1 pH, 18.6°C		
60					2L/s, 16,140µS/cm, 6.25 pH, 18.8°C		
70					4.42L/s, 16,010µS/cm, 6.01 pH, 18.8°C		
80					4.42L/s, 16,280µS/cm, 5.3 pH, 18.5°C		
90					4.42L/s, 17,550µS/cm, 6.29 pH, 19.4°C		
100					4.42L/s, 17,240µS/cm, 6.51 pH, 19.6°C		
110					4.42L/s, 17,160µS/cm, 6.4 pH, 20.4°C		
120					4.42L/s, 17,160µS/cm, 6.4 pH, 20.4°C		
130					4.42L/s, 15,760µS/cm, 6.62 pH, 22.6°C		
					4.42L/s, 17,200µS/cm, 6.42 pH, 22.2°C		
					4.42L/s, 17,420µS/cm, 6.55 pH, 22.5°C		
					4.42L/s, 17,140µS/cm, 6.21 pH, 22.6°C		
					4.42L/s, 17,420µS/cm, 6.35 pH, 20.8°C		
					4.42L/s, 17,390µS/cm, 6.59 pH, 21.5°C		
					4.42L/s, 17,470µS/cm, 6.68 pH, 20.9°C		
					4.42L/s, 18,000µS/cm, 6.65 pH, 18.5°C		
					4.42L/s, 17,980µS/cm, 6.52 pH, 19°C		
					Airlift: 0.45L/s, 15,100µS/cm, 6.13 pH, 19.5°C		



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COMPOSITE WELL LOG

Bore No: WMB31

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 03/04/2025

Method: AH/MR/OH (0-6/6-31/31-151)

Area: Bombora

Completed: 07/04/2025

Fluid: Air/Mud

Elevation: 315.05

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458913

Logged By: Kevin M

Bit Record 2: 8" (4-EOH)

Northing: 6602638

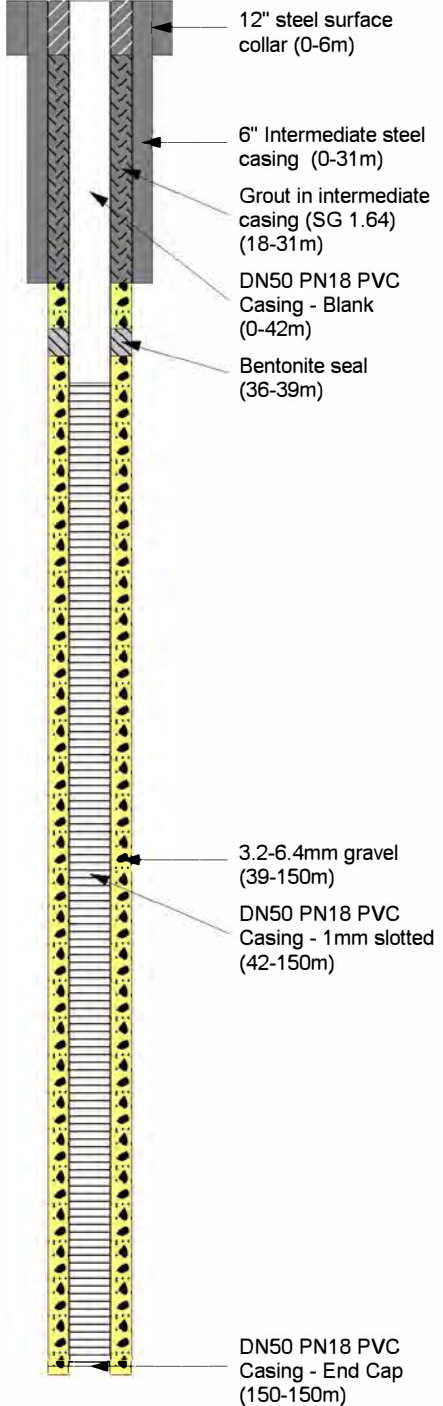
Projection: GDA94 Z51

Static Water Level: 5.49mbtc

Date: 17/06/2025

Remarks: stick up = 0.98m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, slightly sandy, clayey silt.				12" steel surface collar (0-6m)
10			Sand : Red-purple, slightly silty, very clayey, quartz rich sand				6" Intermediate steel casing (0-31m)
20			Clay: Red-purple-brown, silty clay with abundant angular quartz granules at 14-15m				Grout in intermediate casing (SG 1.64) (18-31m)
30			Clay: Grey-brown, sticky, slightly silty clay.				DN50 PN18 PVC Casing - Blank (0-42m)
40			Dolerite : Green-mafic, partially serpentinised, slightly weathered, very hard, quartz rich dolerite. Major water bearing fractures at 31m, 37m, 40m and 41m.		0.3L/s, $\mu\text{S/cm}$, - pH, - $^{\circ}\text{C}$		Bentonite seal (36-39m)
50			Dolerite : Fresh, mafic, very hard dolerite with abundant quartz throughout. Major water bearing fractures at 47m and 55m.		0.99L/s, $\mu\text{S/cm}$, 6.87 pH, 30.9 $^{\circ}\text{C}$		
60					6.26L/s, $\mu\text{S/cm}$, 7.52 pH, 26.7 $^{\circ}\text{C}$		
70					6.26L/s, $\mu\text{S/cm}$, 7.32 pH, 29.4 $^{\circ}\text{C}$		
80					6.26L/s, $\mu\text{S/cm}$, 7.2 pH, 33 $^{\circ}\text{C}$		
90					6.97L/s, $\mu\text{S/cm}$, 7.07 pH, 36.1 $^{\circ}\text{C}$		
100					6.97L/s, $\mu\text{S/cm}$, 7.04 pH, 29.1 $^{\circ}\text{C}$		
110					6.97L/s, $\mu\text{S/cm}$, 6.93 pH, 29.1 $^{\circ}\text{C}$		
120					6.97L/s, $\mu\text{S/cm}$, 7.14 pH, 24.8 $^{\circ}\text{C}$		
130					6.97L/s, $\mu\text{S/cm}$, 7.03 pH, 36.8 $^{\circ}\text{C}$		
140					8.84L/s, $\mu\text{S/cm}$, 7.11 pH, 25.5 $^{\circ}\text{C}$		
150					7.72L/s, $\mu\text{S/cm}$, 7.02 pH, 29.1 $^{\circ}\text{C}$		
160					7.72L/s, $\mu\text{S/cm}$, 7.14 pH, 25.2 $^{\circ}\text{C}$		
170					8.84L/s, $\mu\text{S/cm}$, - pH, - $^{\circ}\text{C}$		
180					8.84L/s, $\mu\text{S/cm}$, 7.21 pH, 26.7 $^{\circ}\text{C}$		
190					8.84L/s, $\mu\text{S/cm}$, 7.35 pH, 25.4 $^{\circ}\text{C}$		
200					8.84L/s, $\mu\text{S/cm}$, 7.36 pH, 22.2 $^{\circ}\text{C}$		
210					8.51L/s, $\mu\text{S/cm}$, 7.19 pH, 21.8 $^{\circ}\text{C}$		
220					8.51L/s, $\mu\text{S/cm}$, 7.24 pH, 22.9 $^{\circ}\text{C}$		
230					6.97L/s, $\mu\text{S/cm}$, 6.97 pH, 12.8 $^{\circ}\text{C}$		
240					Airlift: 1.45L/s, $\mu\text{S/cm}$, 6.8 pH, 22.3 $^{\circ}\text{C}$		
250							
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COMPOSITE WELL LOG

Bore No: WMB32

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 20/04/2025

Method: AH/OH (0-6/6-12/12-141)

Area: Bombora

Completed: 03/05/2025

Fluid: Air/Mud

Elevation: 313.85

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458564

Logged By: Kevin M

Bit Record 2: 8" (4-EOH)

Northing: 6601724

Projection: GDA94 Z51

Static Water Level: 2.3mbtc

Date: 17/05/2025

Remarks: stick up = 0.51m

Depth (m bgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, poorly sorted, slightly clayey, sandy silt.				12" steel surface collar (0-6m) Grout in intermediate casing (SG 1.64) (0-12m) 6" Intermediate steel casing (0-12m)
10			Dolerite: Grey-black, very slightly serpentinised, very hard, partially weathered dolerite with minor quartz. Minor fractures at 25m and 29-31m.				
20							
30							
40			Dolerite: Fresh, mafic, very hard dolerite. Minor fractures at 84m and 127m. No major water strikes. Quartz noted at 40m, 70m, 76m, 79m, 84m and 127m. At 141m, bit sheared off, recovered by Caswell. Shank remains down hole. Ramelius reported to database manager to log in register.		0.05L/s, $\mu\text{S/cm}$, - pH, -C		
50					0.05L/s, $\mu\text{S/cm}$, - pH, -C		
60					0.6L/s, $\mu\text{S/cm}$, 6.49 pH, 23.1C		
70					0.6L/s, $\mu\text{S/cm}$, 6.31 pH, 23.8C		
80					0.78L/s, $\mu\text{S/cm}$, 6.87 pH, 21.6C		
90					0.78L/s, $\mu\text{S/cm}$, 6.33 pH, 25.3C		
100					1.18L/s, $\mu\text{S/cm}$, 6.9 pH, 22.2C		
110					1.18L/s, $\mu\text{S/cm}$, 6.9 pH, 28.1C		
120					1.13L/s, $\mu\text{S/cm}$, 7.04 pH, 29.1C		
130					1.23L/s, $\mu\text{S/cm}$, 7.06 pH, 25.2C		
140					1.23L/s, $\mu\text{S/cm}$, 7.13 pH, 24.6C		
150					1.5L/s, $\mu\text{S/cm}$, 7.21 pH, 25.9C		
160					1.5L/s, $\mu\text{S/cm}$, 6.76 pH, 28.1C		
170					1.5L/s, $\mu\text{S/cm}$, 7.08 pH, 23.9C		
					1.56L/s, $\mu\text{S/cm}$, 7.1 pH, 22.4C		
					1.62L/s, $\mu\text{S/cm}$, 7.39 pH, 24.1C		
					1.62L/s, $\mu\text{S/cm}$, 7.12 pH, 28.8C		
					1.81L/s, $\mu\text{S/cm}$, - pH, -C		
					Airlift: 2L/s, $\mu\text{S/cm}$, 6.79 pH, 28.5C		
							Not installed - left open hole due to low yields to 141m (no PVC installed)



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COMPOSITE WELL LOG

Bore No: WMB33

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 10/05/2025

Method: AH/MR/OH (0-6/6-23-23-50)

Area: Bombora

Completed: 18/05/2025

Fluid: Air/Mud

Elevation: 312.87

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458545

Logged By: Gareth L

Bit Record 2: 8" (4-EOH)

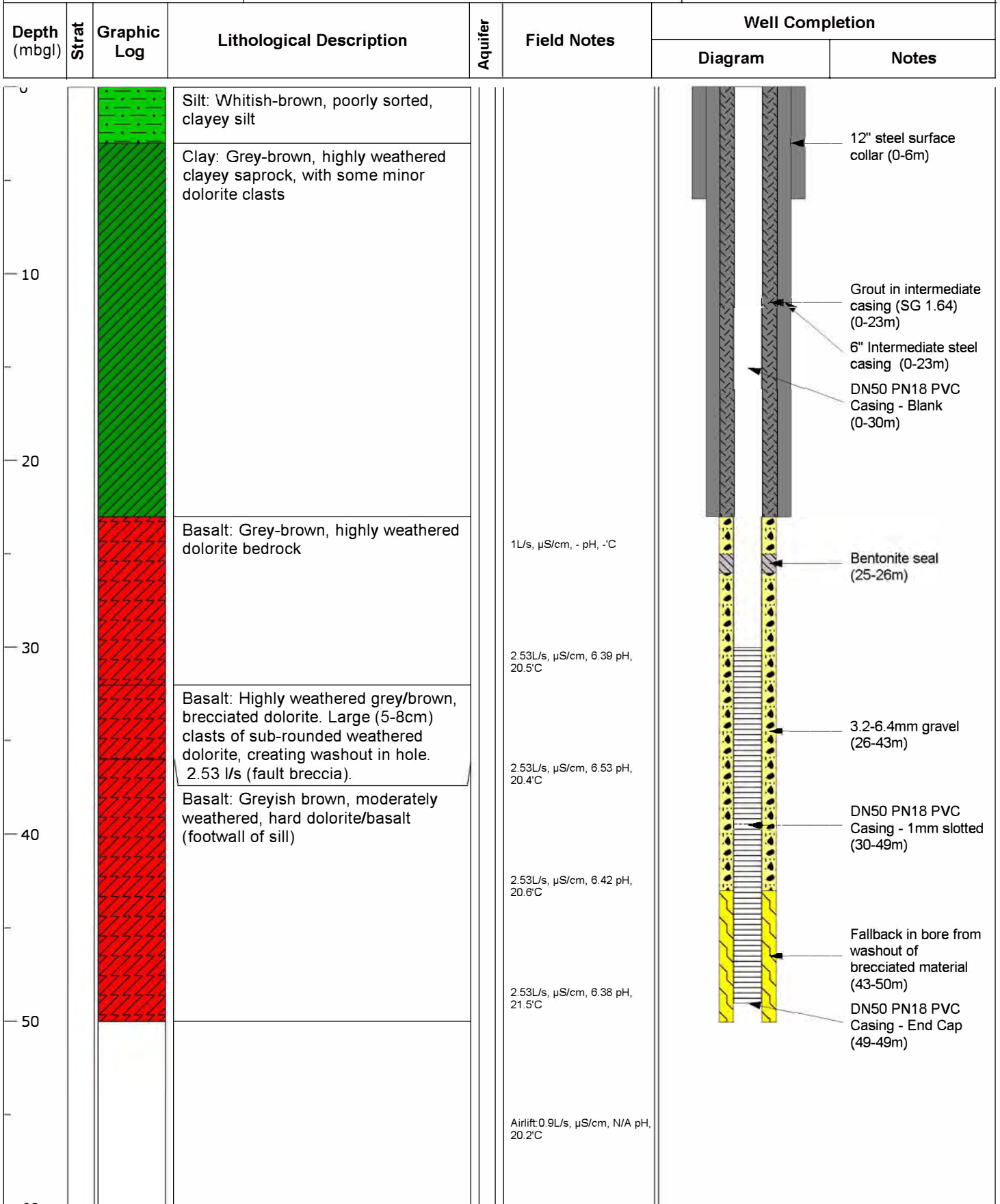
Northing: 6600994

Projection: GDA94 Z51

Static Water Level: 2.3mbtc

Date: 17/05/2025

Remarks: stick up = 0.66m





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COMPOSITE WELL LOG

Bore No: WMB34

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 17/05/2025

Method: MR/OH (0-12/12-157)

Area: Bombora

Completed: 21/05/2025

Fluid: Air/Mud

Elevation: 314.84

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458700

Logged By: Kevin M

Bit Record 2: 8" (4-EOH)

Northing: 6600525

Projection: GDA94 Z51

Static Water Level: 2.3mbtc

Date: 17/05/2025

Remarks: stick up = 0.53m

Depth (m bgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, very slightly sandy, clayey silt with occasional angular-sub-angular gravel clasts		-L/s, $\mu\text{S/cm}$, - pH, °C		
10			Silt: Brown-white, sandy, clayey silt				
20			Dolerite: Mafic-green, alternating bands of very soft and very hard, slightly weathered, partially serpentinised dolerite. Dry fractures at 17m, 19m, 21m		0L/s, $\mu\text{S/cm}$, 6.56 pH, 16.8°C		Open hole 12-157m as no water strikes (No PVC installed)
30			Dolerite: Mafic, fresh, alternating bands of extremely soft and extremely hard dolerite. Quartz absent. Dry fractures at 33-35m, 38m, 44m, 49m, 54m, 134m.				
40					No development done		
50							
60							
70							
80							
90							
100							
110							
120							
130							
140							
150							
160							



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COMPOSITE WELL LOG

Bore No: WMB35

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 21/05/2025

Method: MR/OH (0-7/7-161)

Area: Bombora

Completed: 27/05/2025

Fluid: Air/Mud

Elevation: 312.89

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458650

Logged By: Kevin M

Bit Record 2: 8" (4-EOH)

Northing: 6600609

Projection: GDA94 Z51

Static Water Level: 2.46mbtc

Date: 17/06/2025

Remarks: stick up = 0.85m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, silty clay				12" steel surface collar (0-3m) Grout in intermediate casing (SG 1.64) (0-8.5m) 6" Intermediate steel casing (0-8.5m) DN50 PN18 PVC Casing - Blank (0-28m) Bentonite seal (24-25m)
10			Clay : White-brown, clayey silt with increasing dolerite/quartz gravel content with depth.		0.1L/s, $\mu\text{S/cm}$, - pH, -C		
20			Dolerite: Mafic-green, partially serpentinised, highly weathered dolerite		0.2L/s, $\mu\text{S/cm}$, - pH, -C		
30			Dolerite: Mafic, slightly weathered dolerite		0.2L/s, $\mu\text{S/cm}$, - pH, -C		
40			Dolerite: Fresh, very hard dolerite with a large fracture at 29-30m, and a fracture/abundant quartz at 63m		0.2L/s, $\mu\text{S/cm}$, - pH, -C		
50					0.2L/s, $\mu\text{S/cm}$, - pH, -C		
60					0.2L/s, $\mu\text{S/cm}$, - pH, -C		
70					0.8L/s, $\mu\text{S/cm}$, - pH, -C		
80					0.8L/s, $\mu\text{S/cm}$, 6.29 pH, 6°C		
90					0.8L/s, $\mu\text{S/cm}$, - pH, -C		
100					0.8L/s, $\mu\text{S/cm}$, 6.9 pH, 20.9°C		
110					0.8L/s, $\mu\text{S/cm}$, 6.74 pH, 22.4°C		3.2-6.4mm gravel (25-160m)
120					0.8L/s, $\mu\text{S/cm}$, 6.81 pH, 20.8°C		DN50 PN18 PVC Casing - 1mm slotted (28-160m)
130					0.8L/s, $\mu\text{S/cm}$, - pH, -C		
140					0.8L/s, $\mu\text{S/cm}$, 7.14 pH, 25.8°C		
150					0.8L/s, $\mu\text{S/cm}$, 7.22 pH, 21.9°C		
160					0.8L/s, $\mu\text{S/cm}$, - pH, -C		
170					0.8L/s, $\mu\text{S/cm}$, 6.79 pH, 14.7°C		
					0.8L/s, $\mu\text{S/cm}$, 6.86 pH, 10.3°C		
					0.8L/s, $\mu\text{S/cm}$, 6.91 pH, 19.8°C		
					0.8L/s, $\mu\text{S/cm}$, 7.07 pH, 14.2°C		
					0.9L/s, $\mu\text{S/cm}$, 7.22 pH, 16.3°C		
					0.9L/s, $\mu\text{S/cm}$, 7.01 pH, 22.4°C		DN50 PN18 PVC Casing - End Cap (160-160m)
					Airlift: 0.45L/s, $\mu\text{S/cm}$, 5.31 pH, 17°C		



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COMPOSITE WELL LOG

Bore No: WPB26

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 30/05/2025

Method: AH/MR/OH (0-6/6-11/11-160)

Area: Bombora

Completed: 07/06/2025

Fluid: Air/Mud

Elevation: 313.78

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458589

Logged By: Alastair H


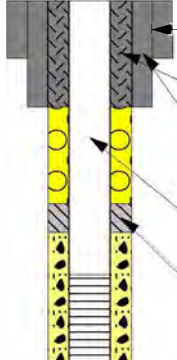















Bit Record 2: 8" (4-EOH)

Northing: 6602285

Static Water Level: 2.14mbtc

Date: 12/06/2025

Remarks: stick up = 0.58m

Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Gravel: Red-brown, poorly sorted, very silty, sandy, sub-angular to sub-rounded, medium-coarse grained gravel				16" steel surface collar (0-6m) Grout in intermediate casing (SG 1.64) (0-11m) 12" Intermediate steel casing (0-11m) 8" Class 18 PVC plain casing (0-28.4m) Bentonite seal in annulus (21-24m)
10			Gravel: Grey-green-brown, poorly sorted, very gravelly, silty clay. Gravel is sub-angular to sub-rounded, weathered dolerite clasts		3.89L/s, $\mu\text{S/cm}$, 6.64 pH, 23.3°C		
20			Dolerite: Green-grey-mafic, partially serpentinised, slightly weathered dolerite		11.18L/s, $\mu\text{S/cm}$, 6.77 pH, 22.4°C		
30			Dolerite: Fresh, hard, mafic dolerite basement. Quartz noted at various intervals. Gypsum also seen occasionally.		11.18L/s, $\mu\text{S/cm}$, 6.91 pH, 22.7°C		
40					8.51L/s, $\mu\text{S/cm}$, 6.98 pH, 21.8°C		
50					8.51L/s, $\mu\text{S/cm}$, 6.75 pH, 21.7°C		
60					8.51L/s, $\mu\text{S/cm}$, 6.66 pH, 21.7°C		
70					5.81L/s, $\mu\text{S/cm}$, 6.93 pH, 21.6°C		
80					7.72L/s, $\mu\text{S/cm}$, 6.94 pH, 21.3°C		
90					10.24L/s, $\mu\text{S/cm}$, 6.15 pH, 20.5°C		
100					10.24L/s, $\mu\text{S/cm}$, 6.61 pH, 21.1°C		
110					14.3L/s, $\mu\text{S/cm}$, 6.54 pH, 22.9°C		
120					14.3L/s, $\mu\text{S/cm}$, 6.73 pH, 22.6°C		
130					14.3L/s, $\mu\text{S/cm}$, 5.64 pH, 21.5°C		
140					15L/s, $\mu\text{S/cm}$, 6.63 pH, 22.4°C		
150					15L/s, $\mu\text{S/cm}$, 6.71 pH, 22.6°C		
160					15L/s, $\mu\text{S/cm}$, 6.82 pH, 22.5°C		
170					15L/s, $\mu\text{S/cm}$, 8.82 pH, 21.2°C		
					15L/s, $\mu\text{S/cm}$, 6.11 pH, 20.5°C		
					15L/s, $\mu\text{S/cm}$, 6.34 pH, 20.3°C		
					15L/s, $\mu\text{S/cm}$, 6.13 pH, 20.2°C		
					15L/s, $\mu\text{S/cm}$, 6.15 pH, 21.1°C		
					15L/s, $\mu\text{S/cm}$, 6.07 pH, 20.7°C		
					15L/s, $\mu\text{S/cm}$, 6.25 pH, 21.2°C		
					Airlift: 7L/s, $\mu\text{S/cm}$, 6.6 pH, 22.8°C		
							3.2 - 6.4 mm gravel pack (24-160m) 8" Class 18 PVC slotted casing with 1 mm slots (28.4-156.4m)
							8" Class 18 PVC plain casing as 3 m bore sump (156.4-159.4m)



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COMPOSITE WELL LOG

Bore No: WPB33

Client: Ramelius

Project: Bombora Dewatering Investigation

Commenced: 08/06/2025

Method: MR/OH/OH (0-8/8-30/30-160)

Area: Bombora

Completed: 14/06/2025

Fluid: Air/Mud

Elevation: 313.16

Drilled: Caswell

Bit Record: 14" (0-4m)

Easting: 458537

Logged By: Alastair H

Bit Record 2: 8" (4-EOH)

Northing: 6601010

Projection: GDA94 Z51

Static Water Level: 2.3mbtc

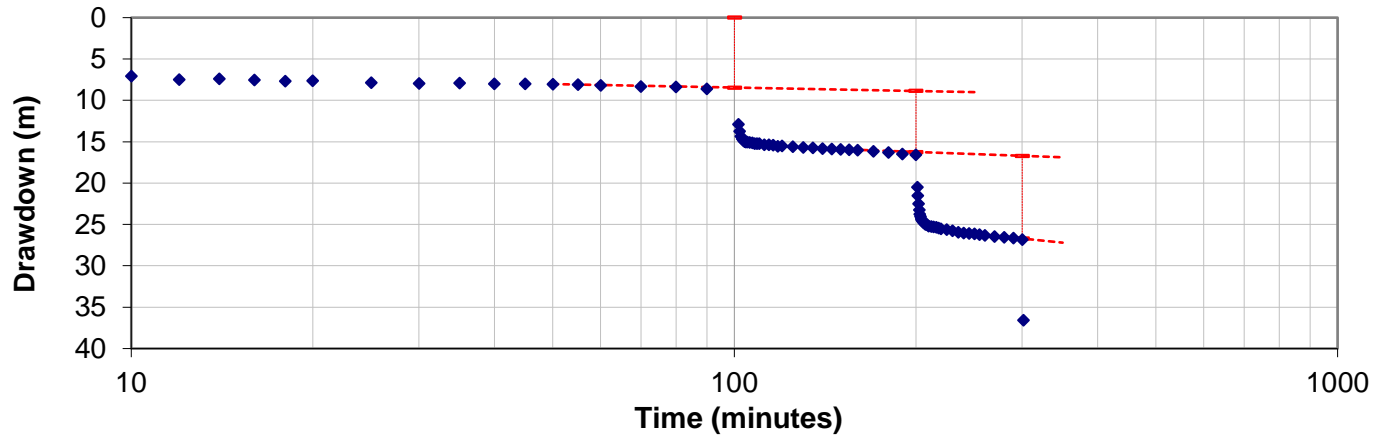
Date: 17/05/2025

Remarks: stick up = 0.28m

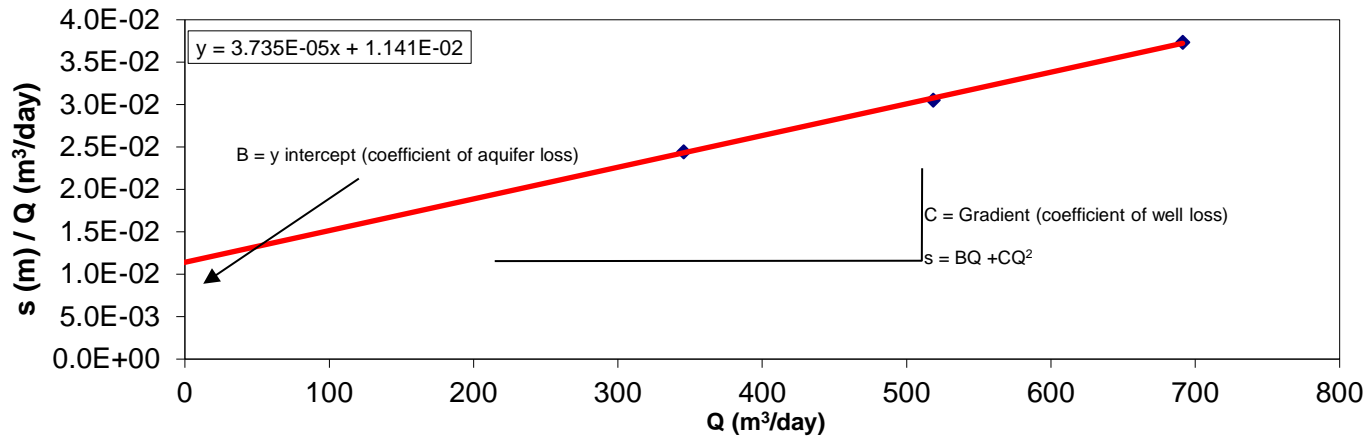
Depth (mbgl)	Strat	Graphic Log	Lithological Description	Aquifer	Field Notes	Well Completion	
						Diagram	Notes
0			Silt: Red-brown, poorly sorted, very silty, sandy, fine to medium grained gravel Alluvium				16" steel surface collar (0-6m) 12" Intermediate steel casing (0-11m) 8" Class 18 PVC plain casing (0-25m) Grout in intermediate casing (SG 1.64) (0-30m)
10			Clay: Buff brown Clay, containing clasts of meta Basalt				
20			Basalt: Dark green grey to black meta Basalt, brecciated zone from 40 to 45, with quartz veining from 47 to 48 mbgl.				
30					5 to 7L/s, $\mu\text{S/cm}$, - pH, -C		
40							
50					1 to 3L/s, $\mu\text{S/cm}$, - pH, -C		
60					3 to 5L/s, $\mu\text{S/cm}$, - pH, -C		
70					3.4L/s, $\mu\text{S/cm}$, - pH, -C		
80					3.4L/s, $\mu\text{S/cm}$, - pH, -C		
90					3.4L/s, $\mu\text{S/cm}$, 6.8 pH, 16.4C		
100					3L/s, $\mu\text{S/cm}$, 6.4 pH, 17C		
110					3.4L/s, $\mu\text{S/cm}$, - pH, -C		
120					3.4L/s, $\mu\text{S/cm}$, 6.5 pH, 16.2C		
130					3.4L/s, $\mu\text{S/cm}$, 6.8 pH, 18.4C		
140					3.4L/s, $\mu\text{S/cm}$, 6.9 pH, 16.9C		
150					2.9L/s, $\mu\text{S/cm}$, 6.8 pH, 17.2C		
160					3L/s, $\mu\text{S/cm}$, 6.9 pH, 15.7C		
					3.4L/s, $\mu\text{S/cm}$, 6.8 pH, 16.2C		
					3.4L/s, $\mu\text{S/cm}$, 6.4 pH, 17.8C		
					3.4L/s, $\mu\text{S/cm}$, 6.7 pH, 16.7C		
					3.4L/s, $\mu\text{S/cm}$, 6.4 pH, 16.1C		
					3.4L/s, $\mu\text{S/cm}$, 6.5 pH, 17C		
					2.5L/s, $\mu\text{S/cm}$, 6.4 pH, 16.2C		
					2.5L/s, $\mu\text{S/cm}$, 6.4 pH, 16.8C		
							8" Class 18 PVC slotted casing with 1 mm slots (25-157m) 3.2 - 6.4 mm gravel pack (2-160m)
							8" Class 18 PVC plain casing as 3 m bore sump (157-160m)

APPENDIX C
RESULTS OF HYDRAULIC TESTING

WPB26: Step Discharge Pumping Test



Analytical Plot of s/Q v Q



$s_{w(n)} = BQ_n + CQ_n^P$ (Rorabaugh's equation)

Where: B = Intercept with y axis (coefficient of aquifer loss or laminar flow)
 C = Gradient (coefficient of turbulent flow loss or apparent well loss)
 s = Drawdown in the borehole
 P = Value determined using Rorabaugh's method of superposition

Components of Jacob's (1947) equation BQ and CQ^2 are termed the aquifer loss and apparent well loss respectively. They give an indication of the proportion of total drawdown caused by laminar and turbulent flow.

- Please note:*
1. In thin or fissured aquifers large components of well loss are due to high flow velocities in the aquifer rather than inefficient bore design. Therefore, the term "apparent well loss" is better than well loss.
 2. In aquifers where the flow horizons are vertically anisotropic, changes in bore performance often relate to changes in the rest water level with respect to the primary aquifer horizons.

$E_w = (BQ / (BQ + CQ^P)) \times 100$

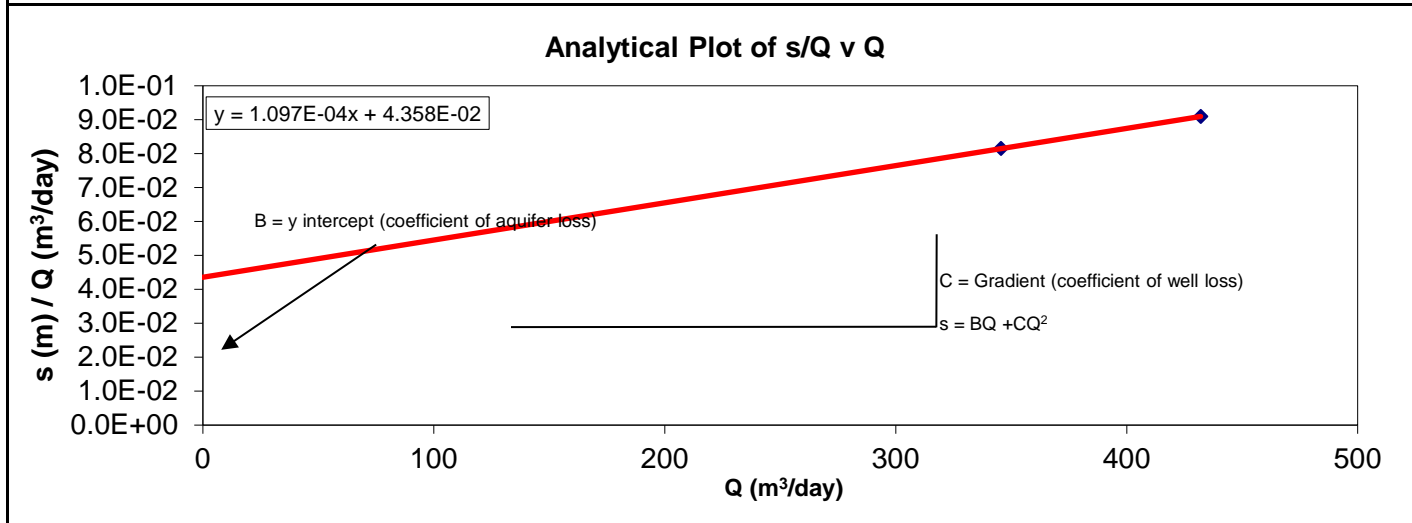
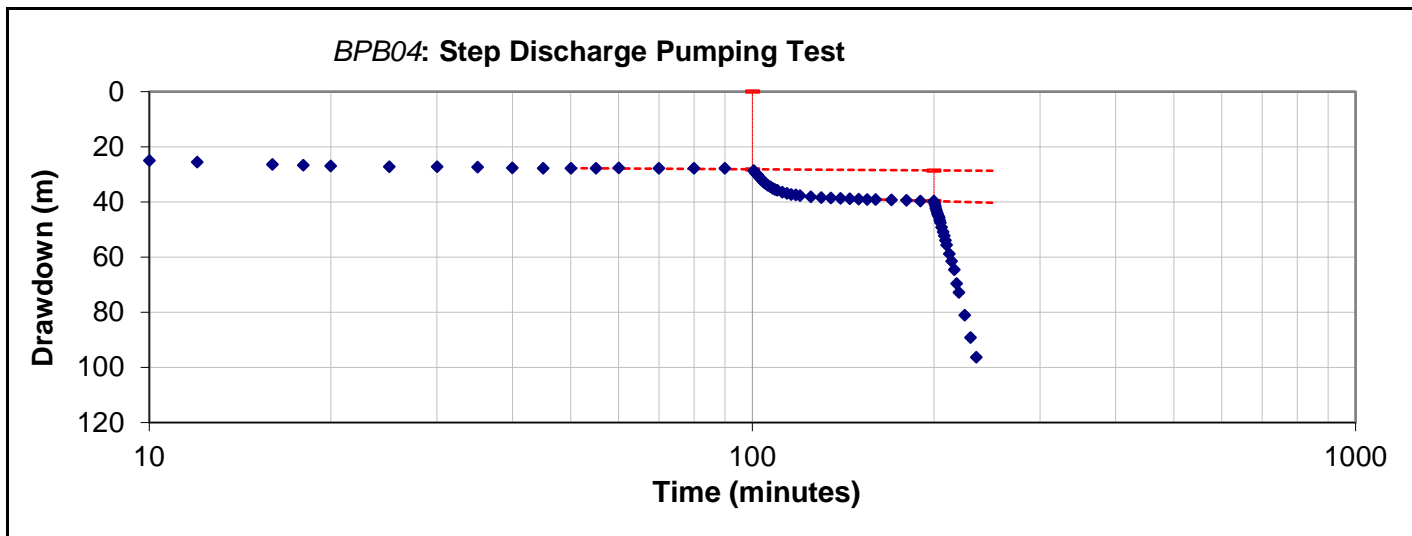
E_w or Well Efficiency represents the proportion of drawdown caused by laminar flow

From plot of s/Q v Q (trend line equation):

Intercept (B) 1.141E-02
 Gradient (C) 3.735E-05

ANALYSIS TABLE

Calculation of well efficiency and comparison of observed and predicted drawdowns							
Step (60 minute duration)	Discharge (l/s)	Discharge (Q) (m³/d)	Measured Incremental Drawdown (metres)	Corrected Drawdown (metres)	Predicted Drawdown (metres)	s/Q	Apparent Efficiency (E_w) %
1	4.0	346	8.45	8.45	8.41	2.44E-02	46.9
2	6.0	518	7.38	15.83	15.95	3.05E-02	37.1
3	8.0	691	9.99	25.82	25.73	3.74E-02	30.7
4							



$$s_{w(n)} = BQ_n + CQ_n^P \text{ (Rorabaugh's equation)}$$

Where:

- B = Intercept with y axis (coefficient of aquifer loss or laminar flow)
- C = Gradient (coefficient of turbulent flow loss or apparent well loss)
- s = Drawdown in the borehole
- P = Value determined using Rorabaugh's method of superposition

Components of Jacob's (1947) equation BQ and CQ^2 are termed the aquifer loss and apparent well loss respectively. They give an indication of the proportion of total drawdown caused by laminar and turbulent flow.

- Please note:*
1. In thin or fissured aquifers large components of well loss are due to high flow velocities in the aquifer rather than inefficient bore design. Therefore, the term "apparent well loss" is better than well loss.
 2. In aquifers where the flow horizons are vertically anisotropic, changes in bore performance often relate to changes in the rest water level with respect to the primary aquifer horizons.

$$E_w = (BQ / (BQ + CQ^P)) \times 100$$

E_w or Well Efficiency represents the proportion of drawdown caused by laminar flow

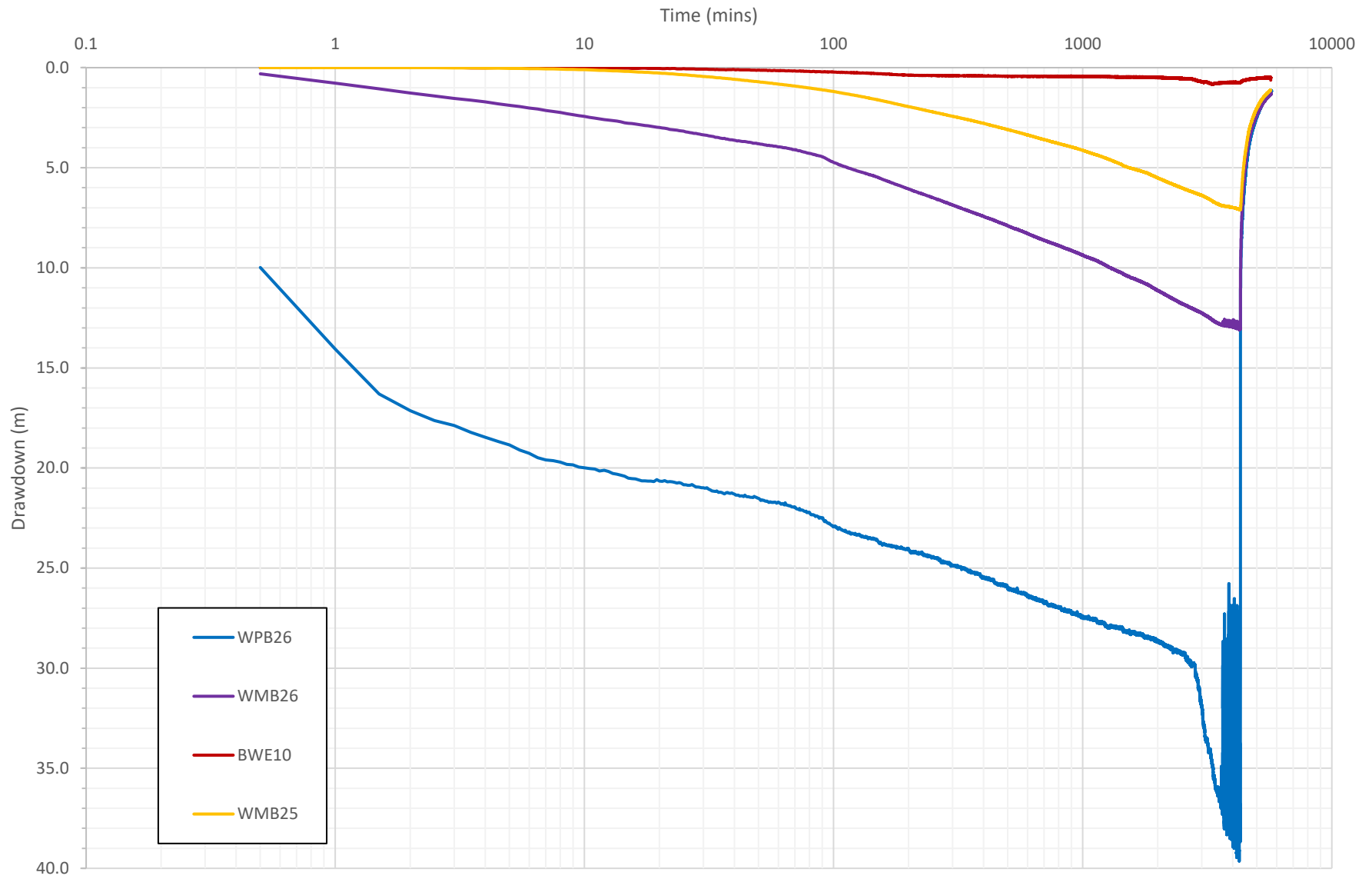
From plot of s/Q v Q (trend line equation):

Intercept (B) 4.358E-02
Gradient (C) 1.097E-04

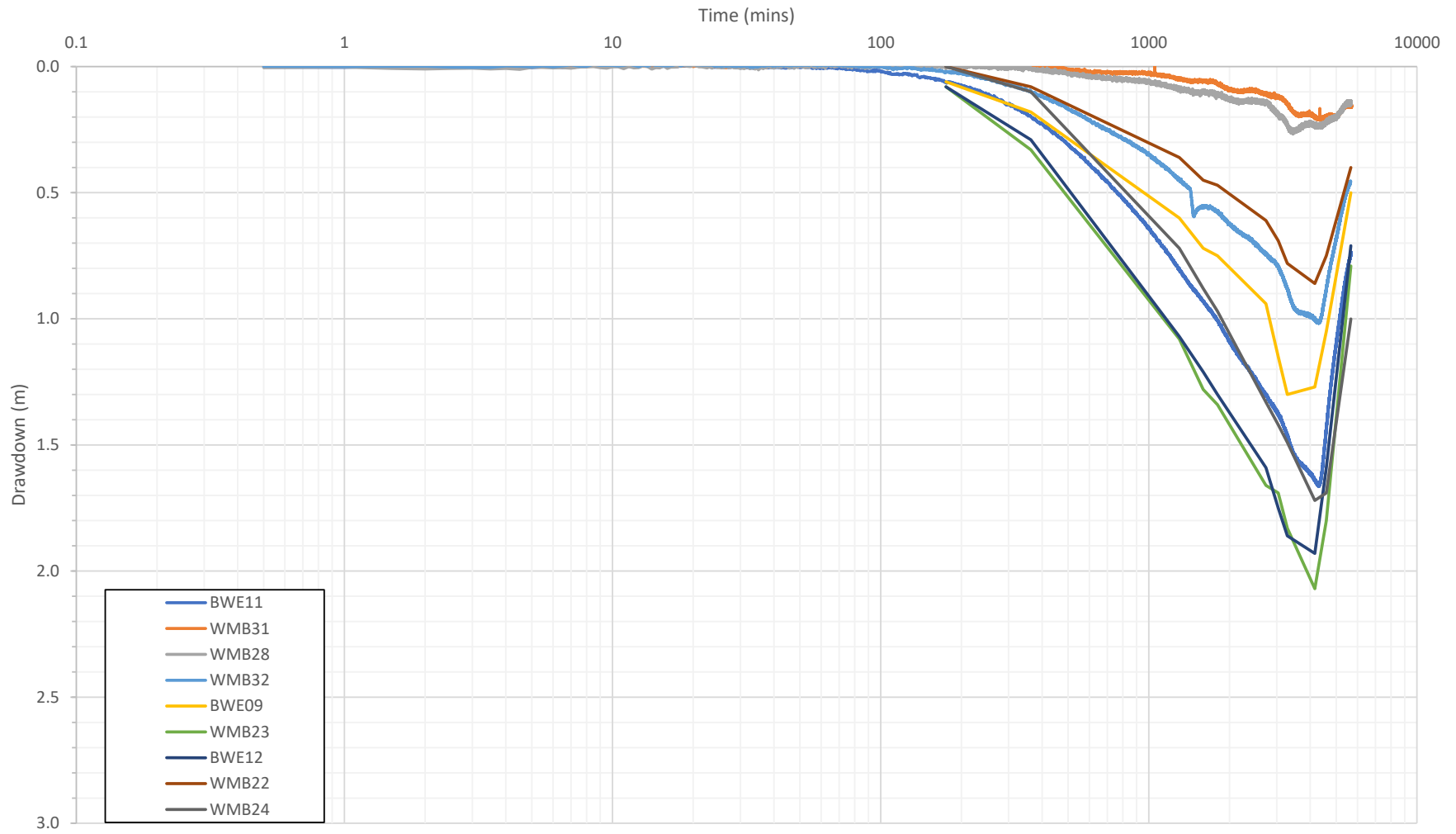
ANALYSIS TABLE

Calculation of well efficiency and comparison of observed and predicted drawdowns							
Step (60 minute duration)	Discharge (l/s)	Discharge (Q) (m³/d)	Measured Incremental Drawdown (metres)	Corrected Drawdown (metres)	Predicted Drawdown (metres)	s/Q	Apparent Efficiency (E_w) %
1	4.0	346	28.16	28.16	28.16	8.15E-02	53.5
2	5.0	432	11.13	39.29	39.29	9.10E-02	47.9
3							
4							

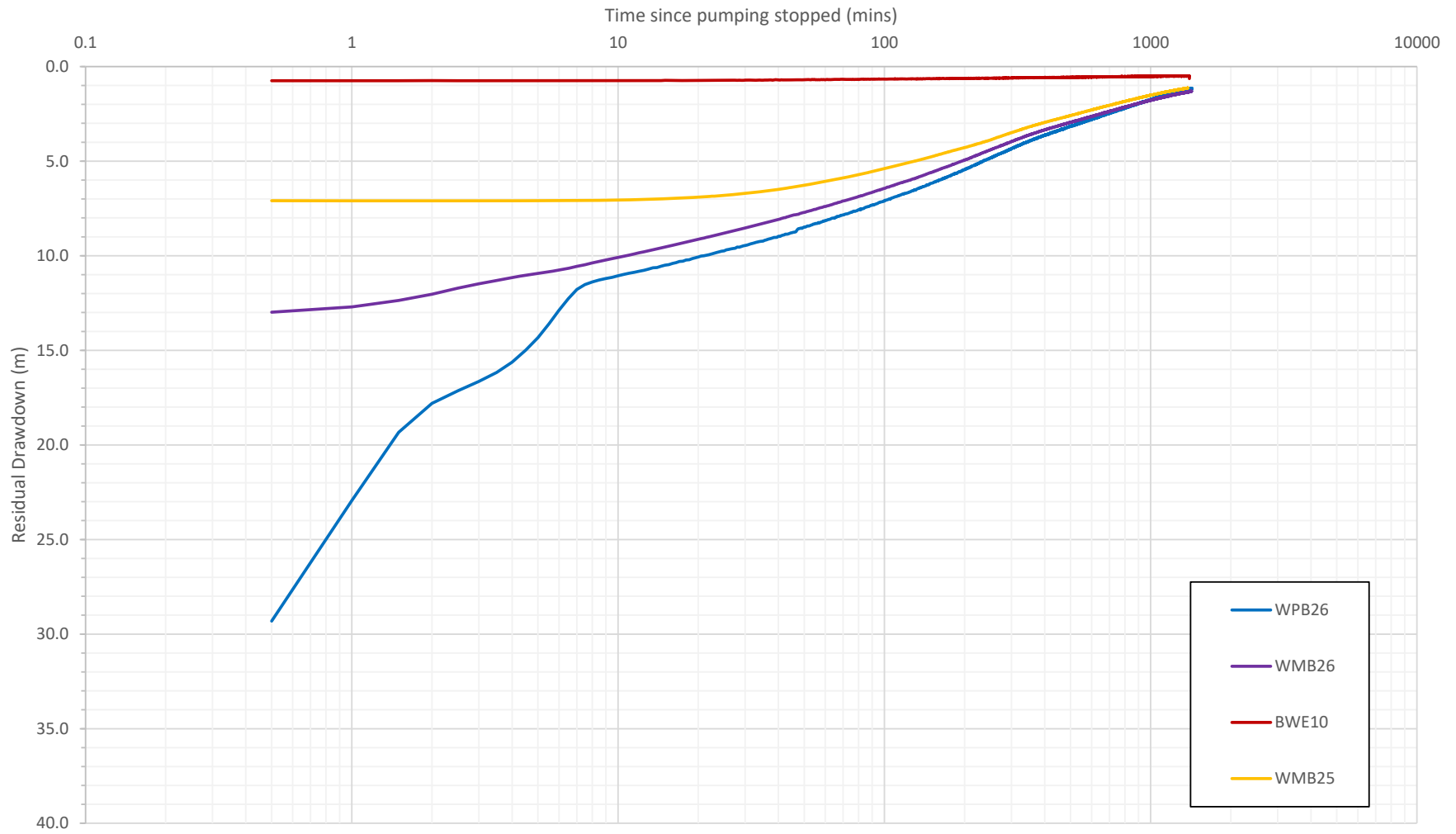
Bombora Constant Rate Tests: WPB26



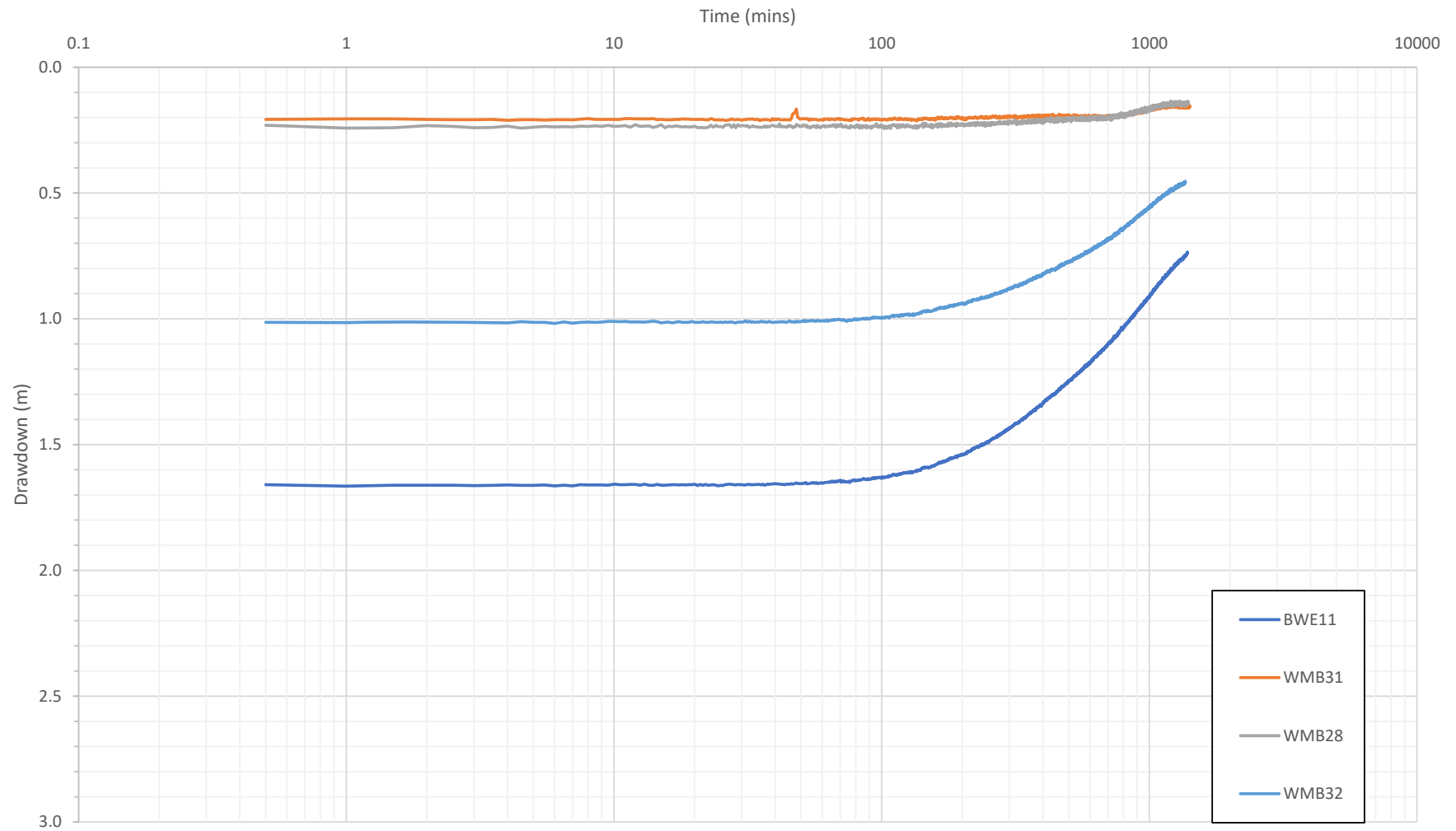
Bombora Constant Rate Tests: WPB26



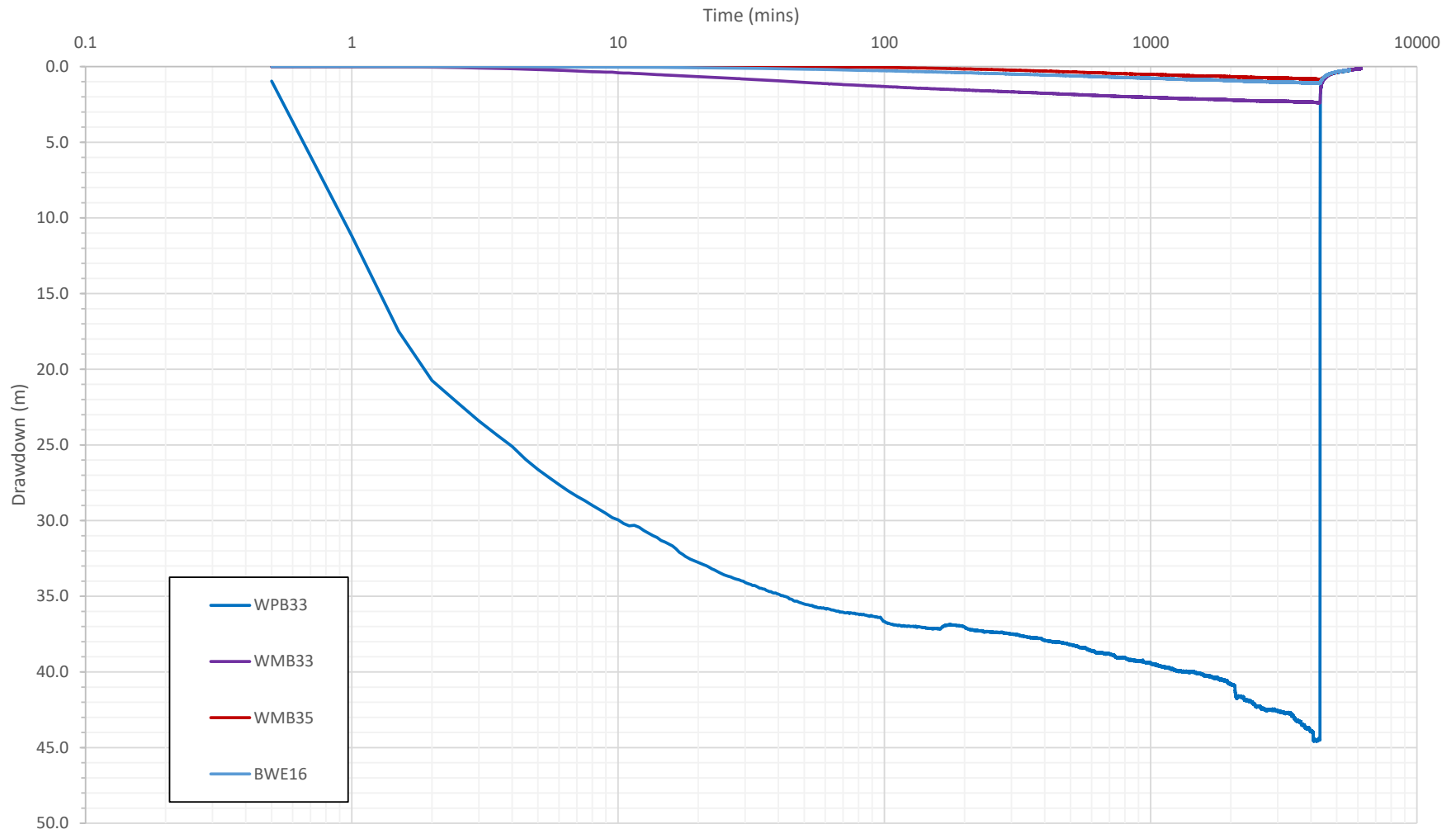
Bombora Recovery Test: WPB26



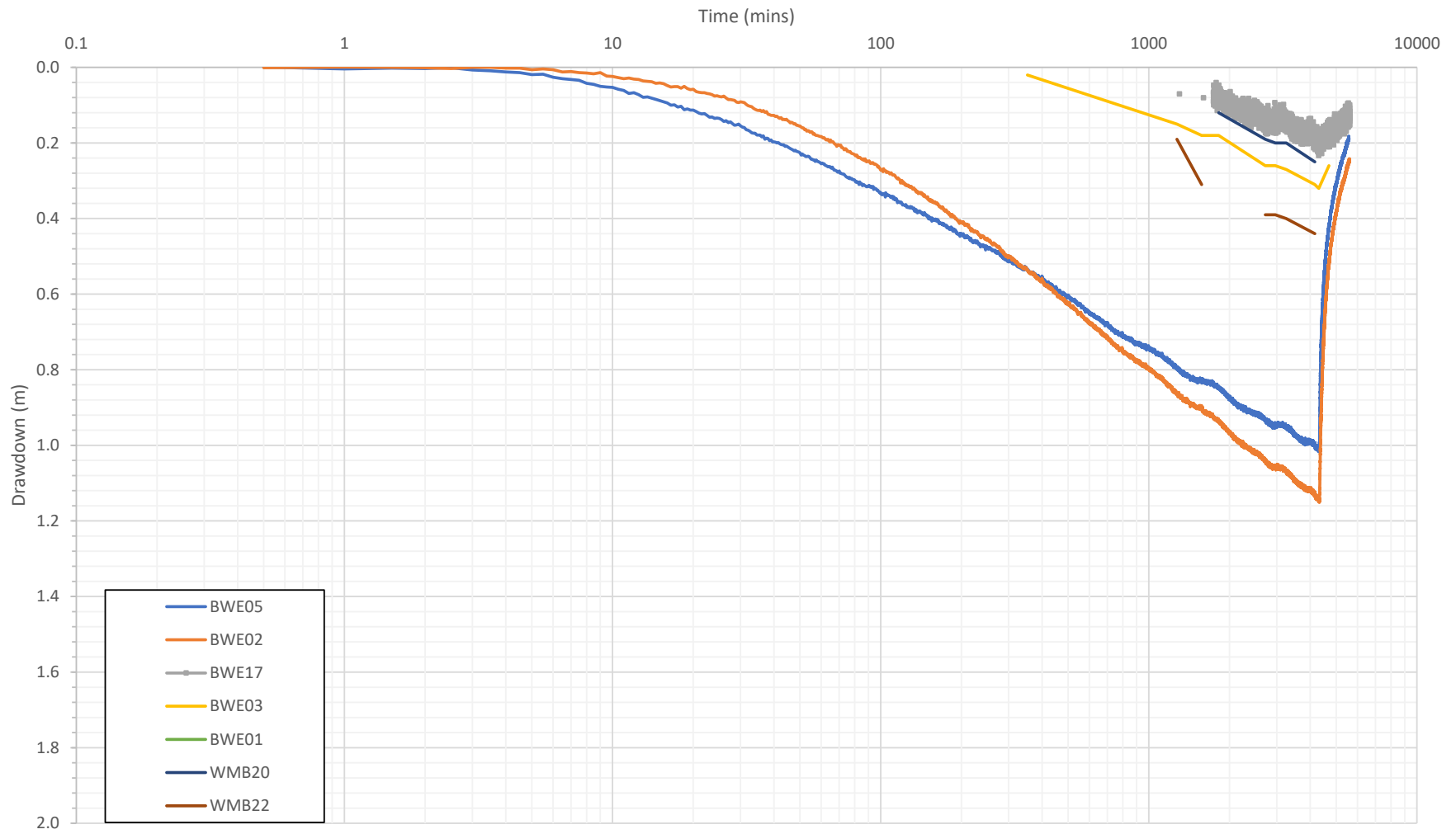
Bombora Recovery Test: WPB26



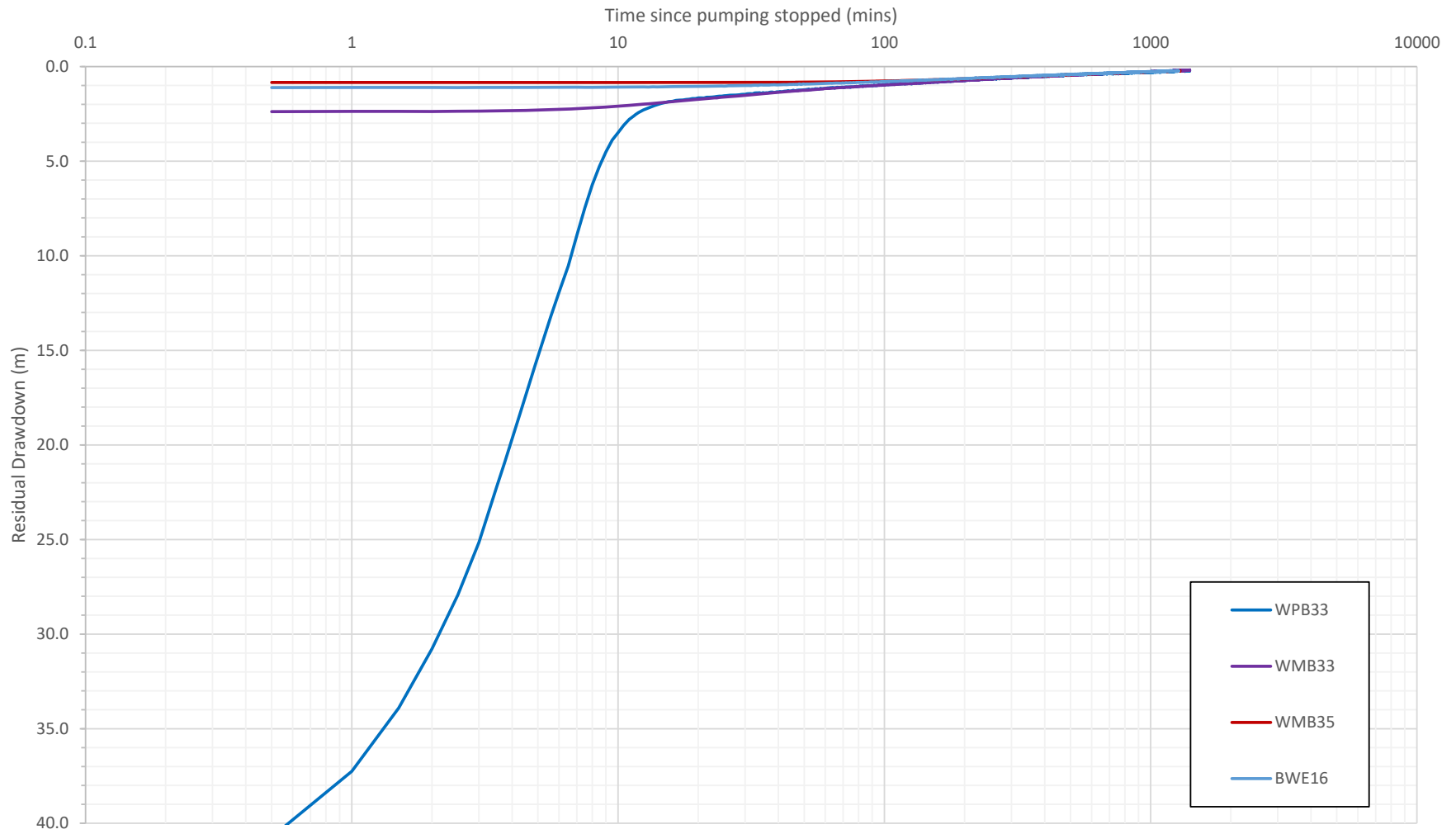
Bombora Constant Rate Test: WPB33



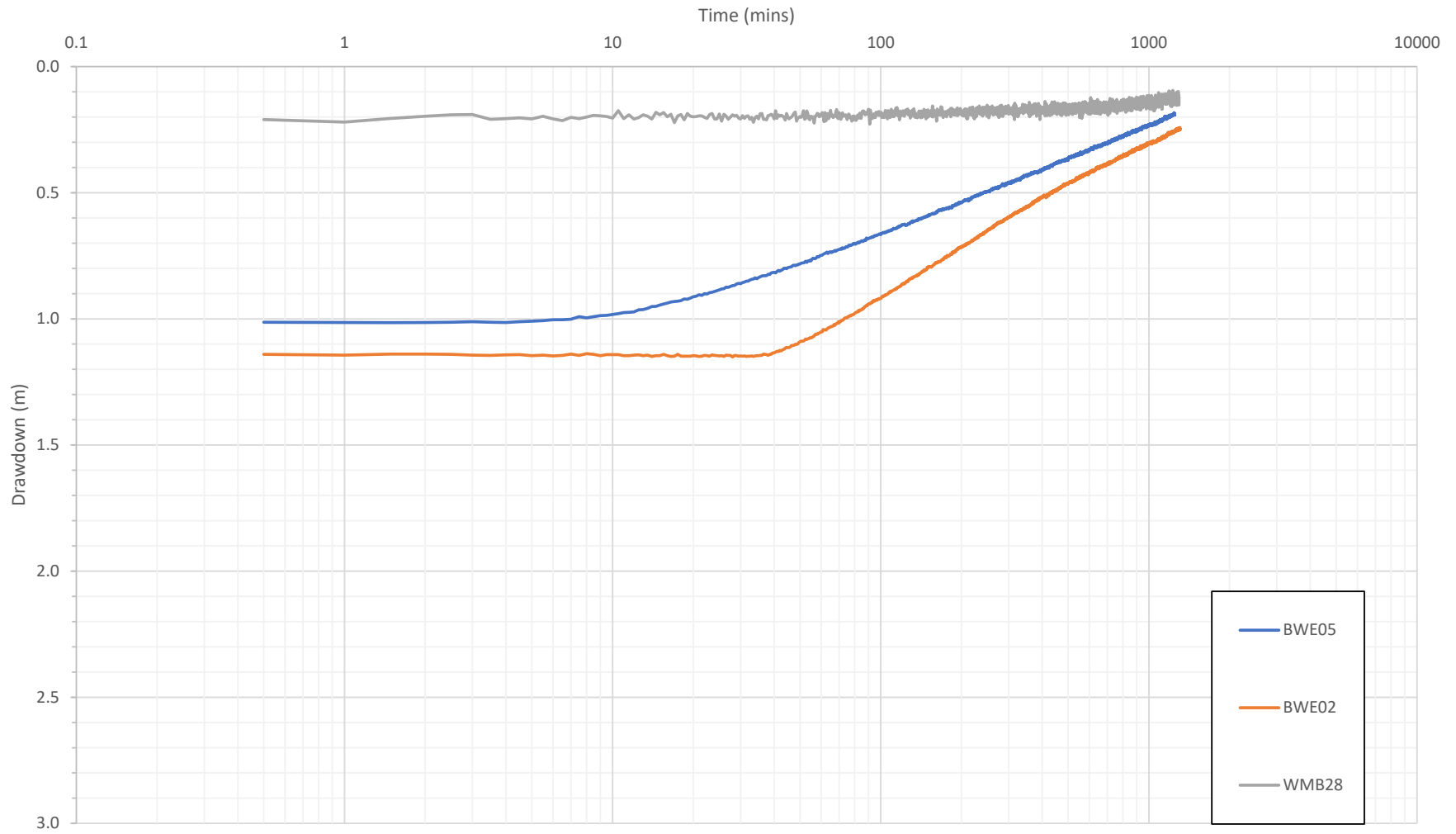
Bombora Constant Rate Test: WPB33

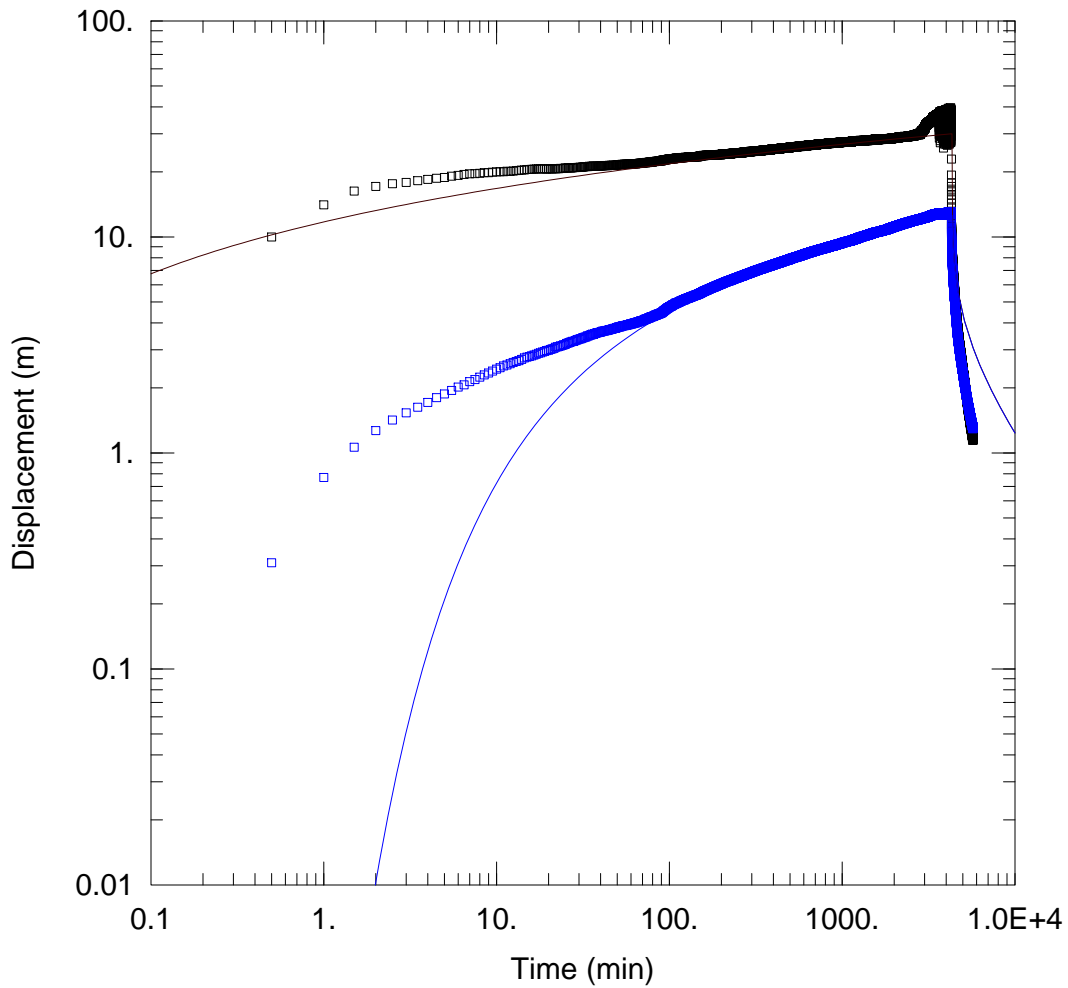


Bombora Recovery Test: WPB33



Bombora Recovery Test: WPB33





PROJECT INFORMATION

Company: AQ2
 Client: Ramelius
 Project: 514F
 Location: Lake Roe
 Test Well: WPB26

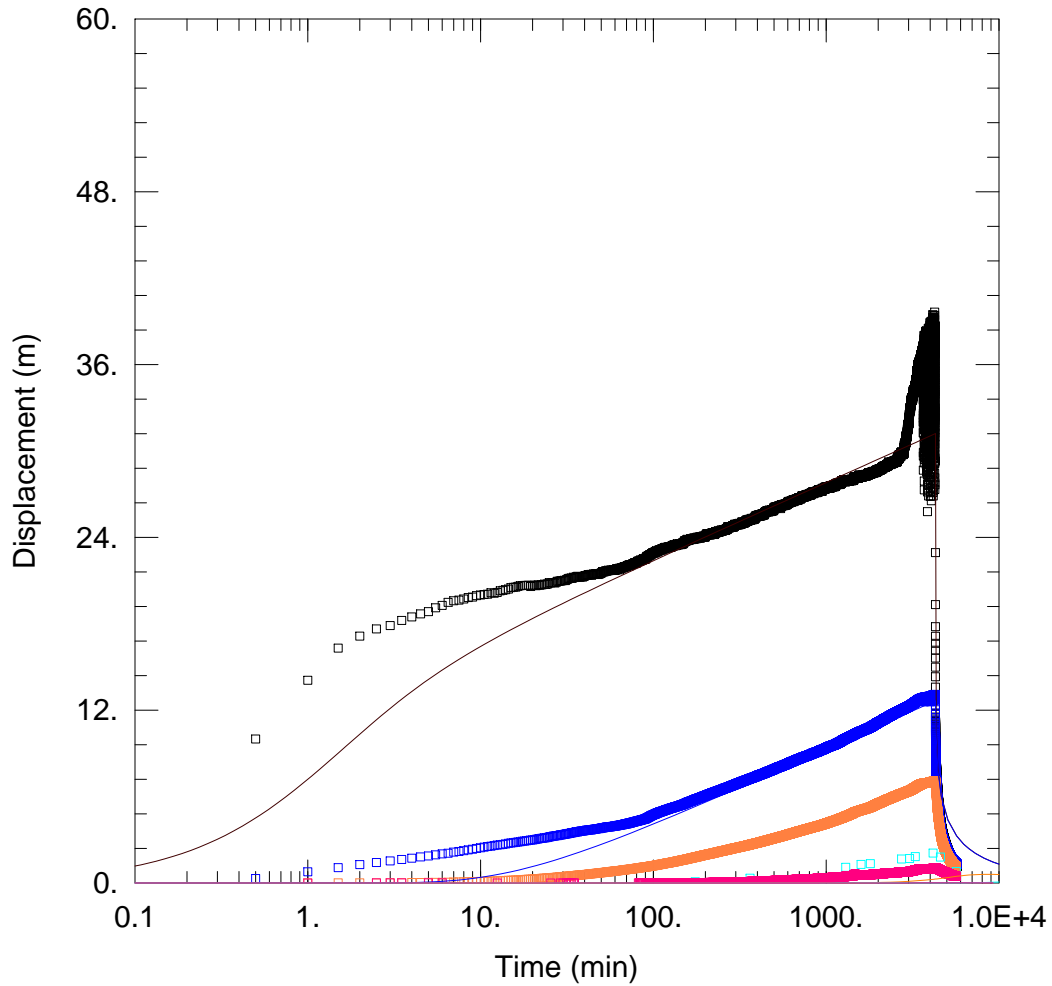
WELL DATA

Pumping Wells			Observation Wells		
Well Name	X (m)	Y (m)	Well Name	X (m)	Y (m)
WPB26	458580	6602287	□ WPB26	458580	6602287
			□ WMB26	458580	6602280

SOLUTION

Aquifer Model: Confined
 $T = 22. \text{ m}^2/\text{day}$
 $Kz/Kr = 1.$

Solution Method: Theis
 $S = 0.00953$
 $b = 50. \text{ m}$



PROJECT INFORMATION

Company: AQ2
 Client: Ramelius
 Project: 514F
 Location: Lake Roe
 Test Well: WPB26

AQUIFER DATA

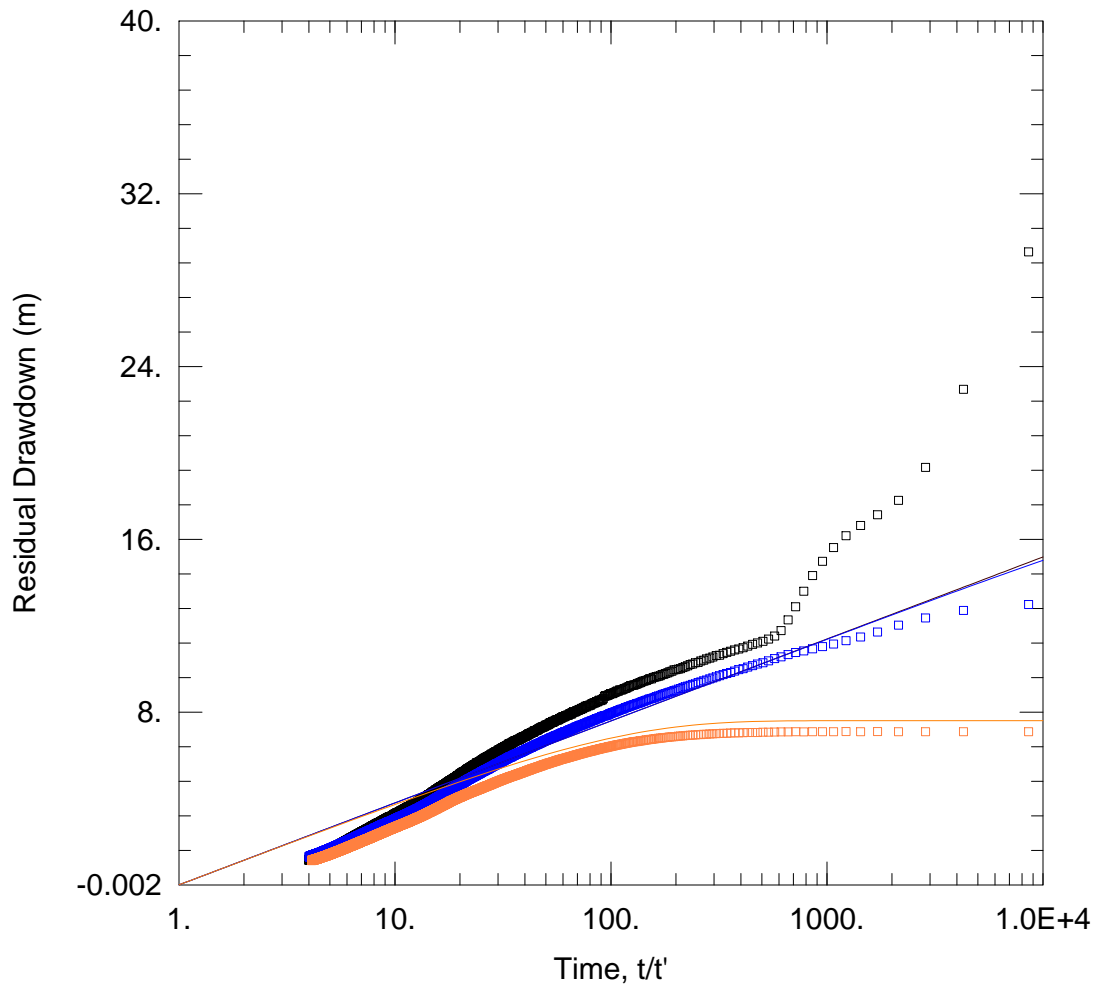
Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells			Observation Wells		
Well Name	X (m)	Y (m)	Well Name	X (m)	Y (m)
WPB26	458580	6602287	□ WPB26	458580	6602287
			□ WMB26	458580	6602280
			□ WMB25	458595	6602120
			□ WMB23	458625	6601955
			□ WMB32	458568	6601717

SOLUTION

Aquifer Model: Confined Solution Method: Papadopoulos-Cooper
 $T = 20.67 \text{ m}^2/\text{day}$ $S = 0.01236$
 $r(w) = 0.13 \text{ m}$ $r(c) = 0.1 \text{ m}$



PROJECT INFORMATION

Company: AQ2
 Client: Ramelius
 Project: 514F
 Location: Lake Roe
 Test Well: WPB26

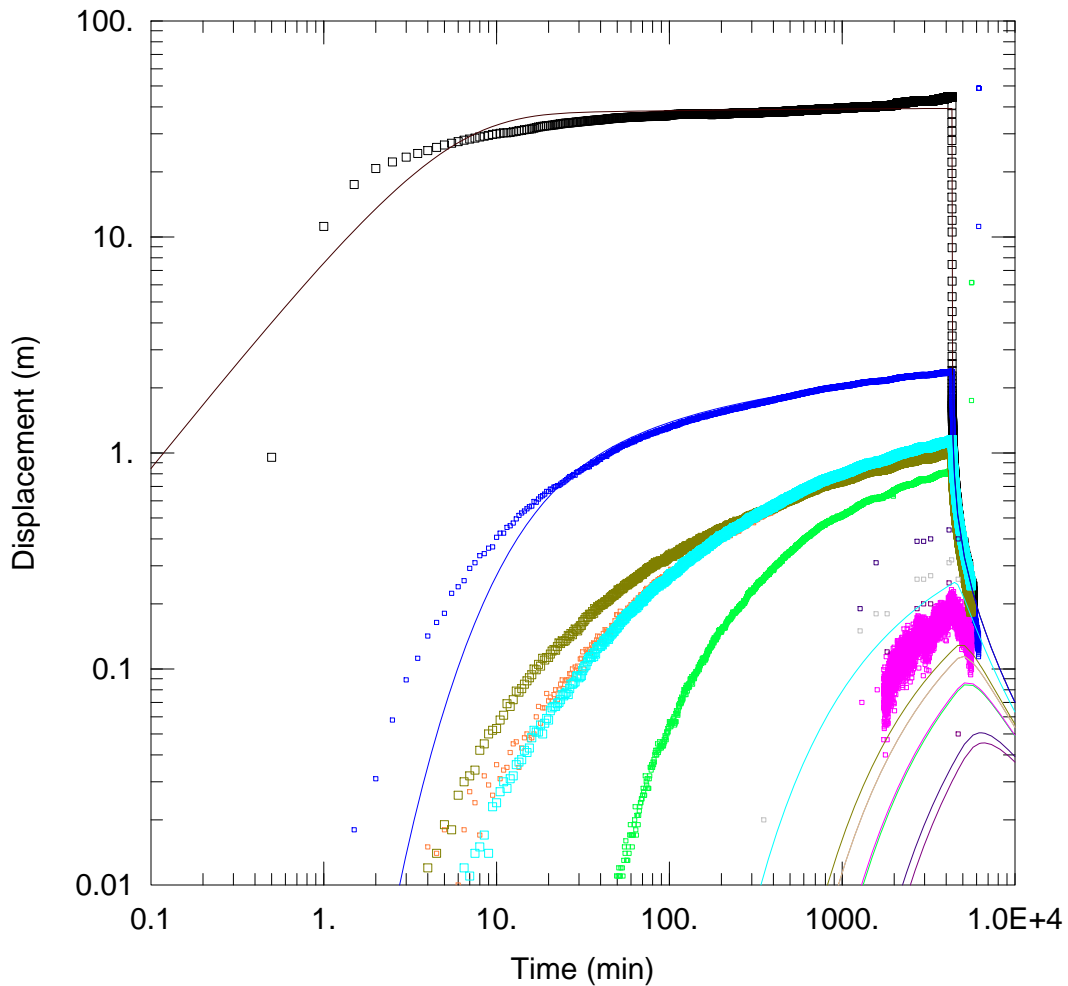
WELL DATA

Pumping Wells			Observation Wells		
Well Name	X (m)	Y (m)	Well Name	X (m)	Y (m)
WPB26	458580	6602287	□ WPB26	458580	6602287
			□ WMB26	458580	6602280
			□ WMB25	458595	6602120

SOLUTION

Aquifer Model: Confined
 $T = 29.2 \text{ m}^2/\text{day}$
 $Kz/Kr = 1.$

Solution Method: Theis
 $S = 6.951E-5$
 $b = 50. \text{ m}$



PROJECT INFORMATION

Company: AQ2
 Client: Ramelius
 Project: 514F
 Location: Lake Roe
 Test Well: WPB33

AQUIFER DATA

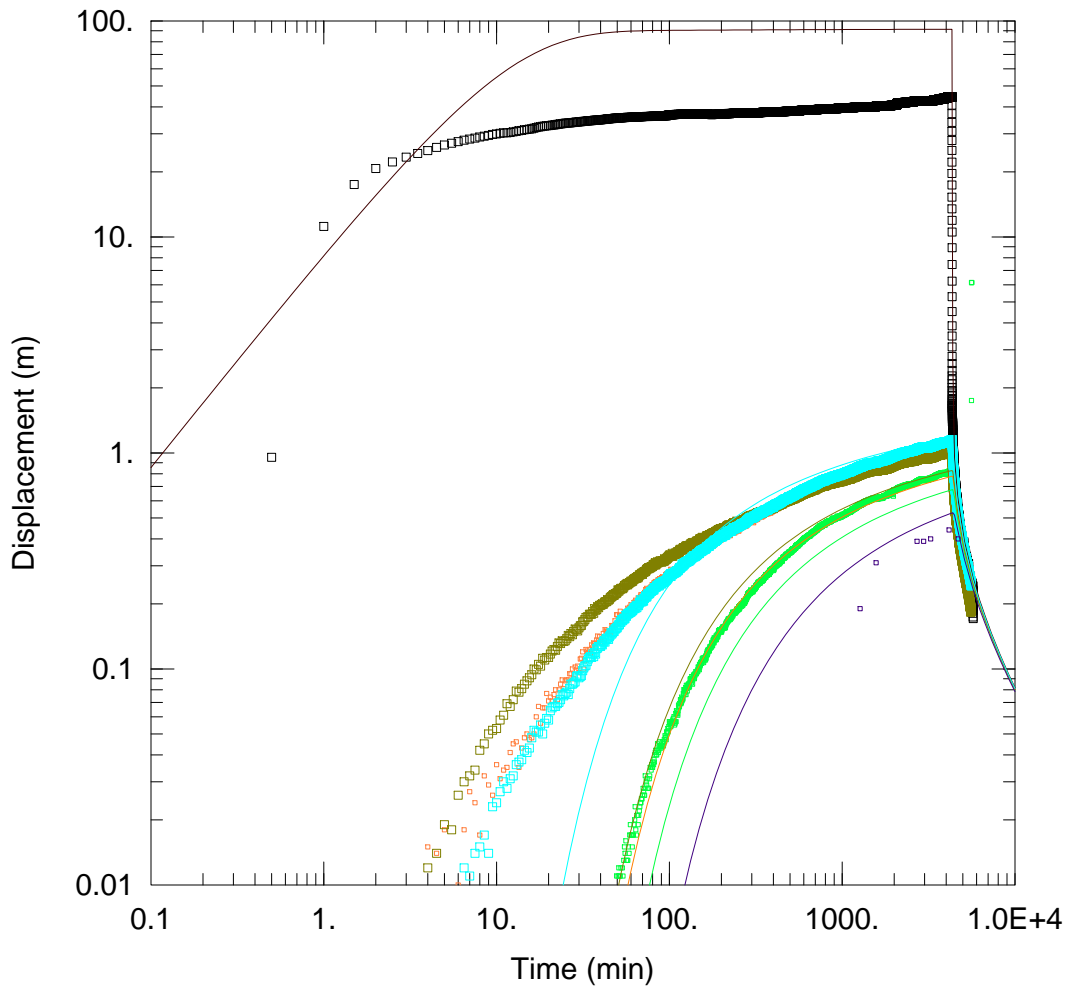
Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells			Observation Wells		
Well Name	X (m)	Y (m)	Well Name	X (m)	Y (m)
WPB33	458537	6601011	□ WPB33	458537	6601011
			▣ WMB33	458545	6600995
			▣ WMB35	458650	6600610
			▣ BWE17	458850.56	6600742.91
			▣ BWE16	458811.14	6601241.64
			▣ BWE05	458572.64	6601344.26
			▣ BWE02	458600.39	6600797.69
			▣ BWE03	458811.2	6601241.75
			▣ WMB20	458440	6600465
			▣ BWE07	458607.97	6601535.12

SOLUTION

Aquifer Model: Confined Solution Method: Barker
 K = 0.5205 m/day Ss = 2.217E-5
 n = 2.509 b = 180. m
 Sw = 0. r(w) = 0.1 m
 r(c) = 0.1 m



PROJECT INFORMATION

Company: AQ2
 Client: Ramelius
 Project: 514F
 Location: Lake Roe
 Test Well: WPB33

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 2.5E+4

WELL DATA

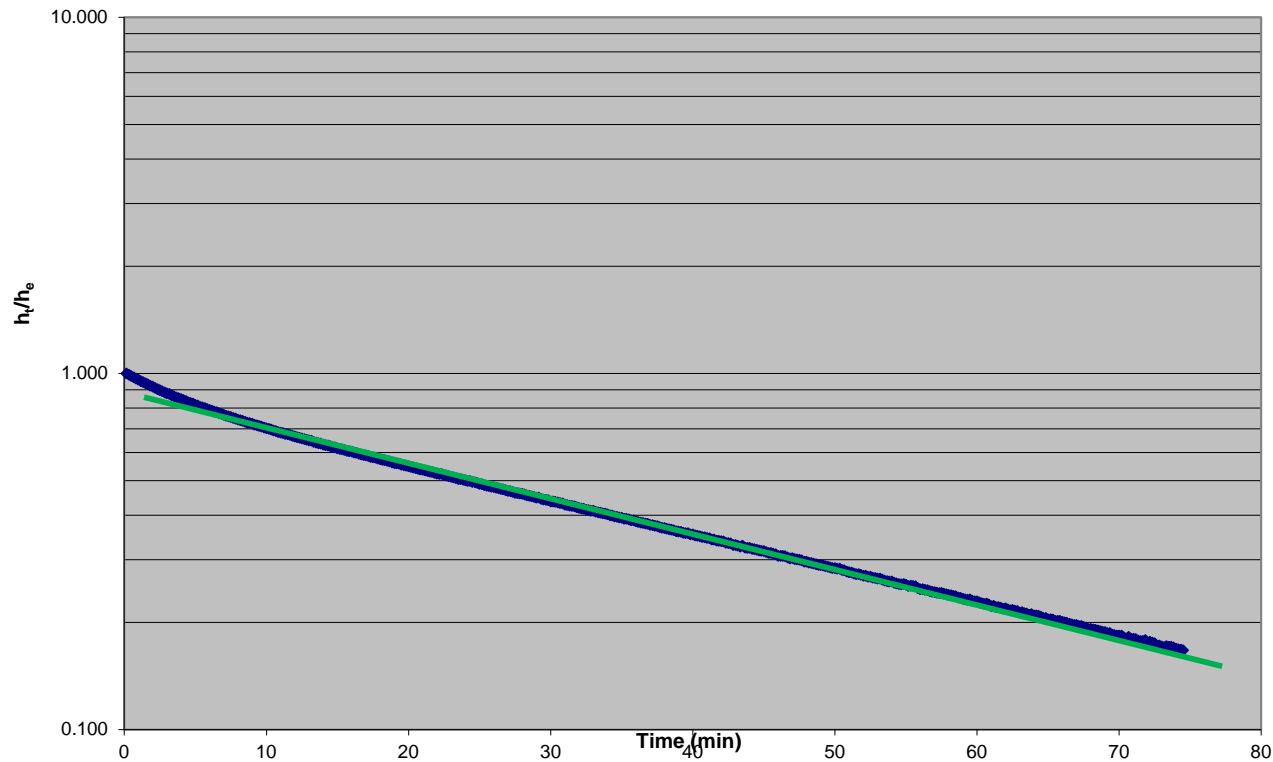
Pumping Wells			Observation Wells		
Well Name	X (m)	Y (m)	Well Name	X (m)	Y (m)
WPB33	458537	6601011	□ WPB33	458537	6601011
			▣ WMB35	458650	6600610
			▣ BWE16	458811.14	6601241.64
			▣ BWE05	458572.64	6601344.26
			▣ BWE02	458600.39	6600797.69
			▣ BWE07	458607.97	6601535.12

SOLUTION

Aquifer Model: Confined Solution Method: Barker
 K = 0.4225 m/day Ss = 1.229E-6
 n = 2.509 b = 50. m
 Sw = 0. r(w) = 0.1 m
 r(c) = 0.1 m

Bore No:	WMB19	Test No:	1	Job No:	514F F3	Date:	17-May-25	Logged by:	KM
Borehole co-ordinates: Easting:		458750		Northing:		6600525		Collar elevation (m): TBC	
Depth to top of test section (m):		12		Length of test section, L (m):		148			
Depth of static water level, H_w (m):		27.41		Radius of borehole, r (m):		0.076			
Excess head, h_e (m):		3.57		Radius of standpipe or casing, r_c (m):		0.076			

Head - time graph (slope of graph is S)



Calculations:

	Early Time	Late Time
h₁	0.70	0.40
t₁	10.0	33.00
h₂	0.20	0.20
t₂	66.0	66.00
S	9.7E-03	9.1E-03
k (m/s)	5.04E-08	4.73E-08

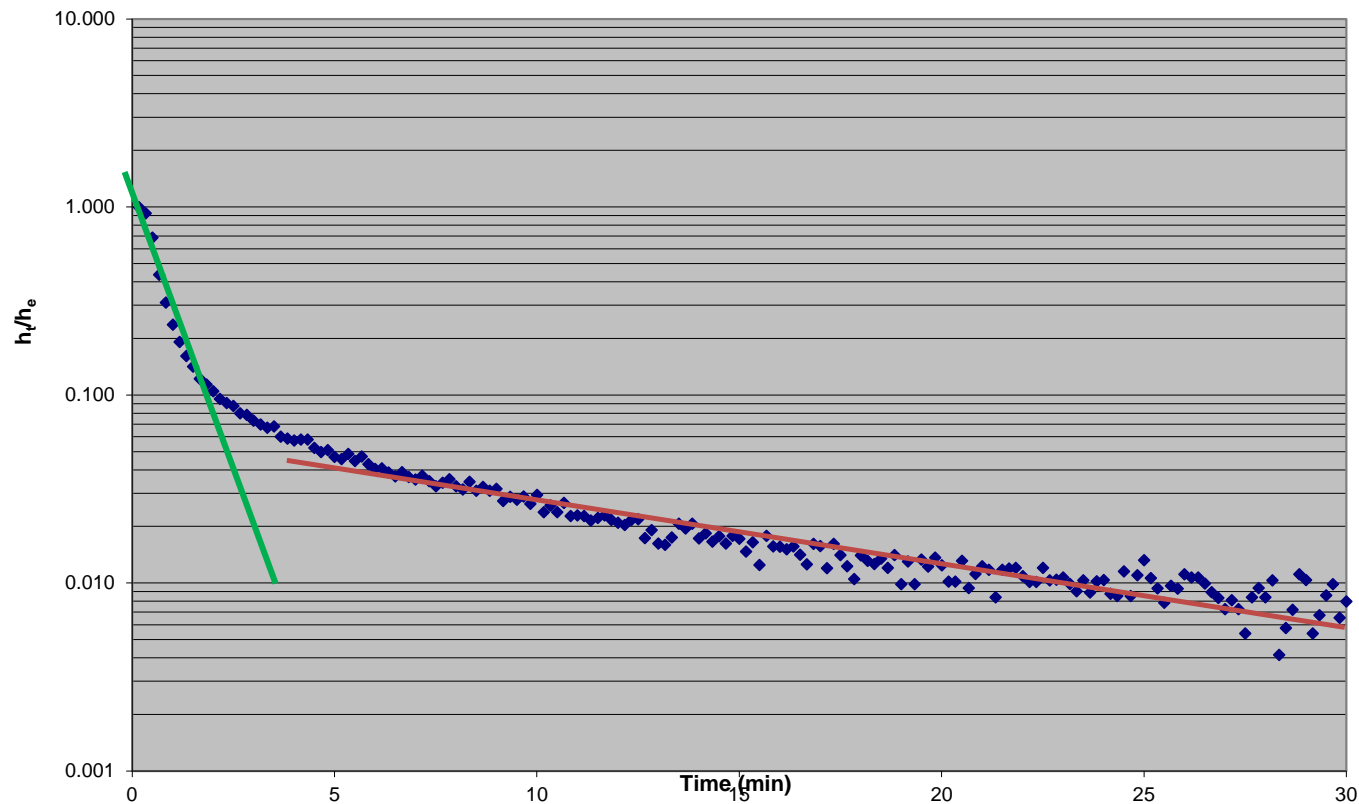
m/d **4.36E-03** **4.09E-03**
T (m²/d) 6.45E-01 6.05E-01
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2))/(t_2 - t_1)$,
 (ie slope of plot, t in mins)

K	0.0044	0.004
T	0.645	0.61

Notes: WMB19 is open hole from 12-160m, no PVC or gravel pack installed. Open hole section is through fresh, dolerite bedrock. No major or minor water strikes encountered during drilling.

Bore No:	WMB31	Test No:	1	Job No:	514F F3	Date:	25-Apr-25	Logged by:	
Borehole co-ordinates: Easting:		458568		Northing:		6601717		Collar elevation (m): TBC	
Depth to top of test section (m):		24		Length of test section, L (m):		126		Radius of borehole, r (m):	
Depth of static water level, H_w (m):		2.64		Radius of standpipe or casing, r_c (m):		0.025		Excess head, h_e (m):	
		1.23							

Head - time graph (slope of graph is S)



Calculations:

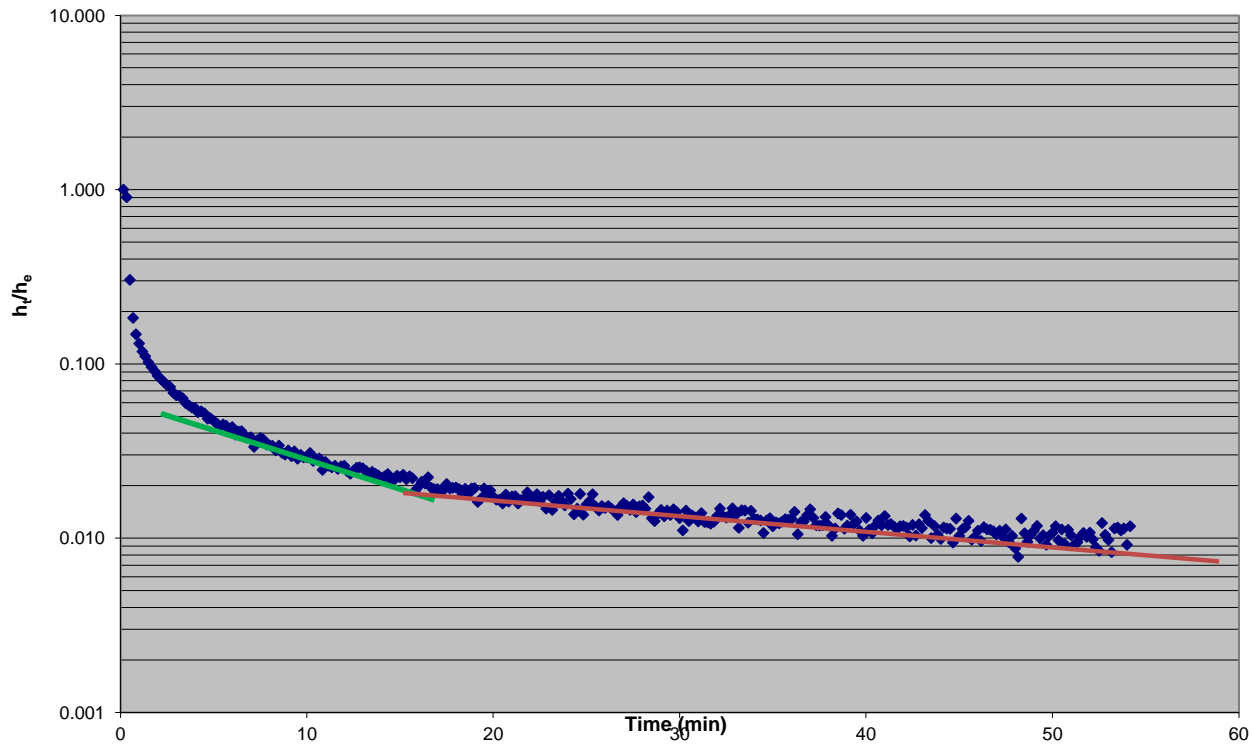
	Early Time	Late Time
h₁	1.00	0.029
t₁	0.2	10.00
h₂	0.24	0.010
t₂	1.0	22.16
S	7.4E-01	3.8E-02
k (m/s)	4.87E-07	2.51E-08

m/d	4.21E-02	2.17E-03
T (m²/d)	5.30E+00	2.73E-01
Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/s)		
where $S = (\log (h_1/h_2))/(t_2 - t_1)$, (ie slope of plot, t in mins)		
K	0.0421	0.0022
T	5.299	0.27

Notes: BWE32 is open hole from 12-141m, no PVC or gravel pack installed. Open hole section is through fresh, dolerite bedrock.

Bore No:	BWE32	Test No:	1	Job No:	514F F3	Date:	25-Apr-25	Logged by:	KM
Borehole co-ordinates: Easting: 458625		Northing: 6601720		Collar elevation (m):		TBC			
Depth to top of test section (m): 12				Length of test section, L (m):		157			
Depth of static water level, H_w (m): 33.59				Radius of borehole, r (m):		0.076			
Excess head, h_e (m): 1.97				Radius of standpipe or casing, r_c (m):		0.076			

Head - time graph (slope of graph is S)



Calculations:

	Early Time	Late Time
h_1	0.05	0.02
t_1	4.5	17.00
h_2	0.02	0.009
t_2	12.2	54.00
S	5.2E-02	9.4E-03
k (m/s)	2.54E-07	4.59E-08

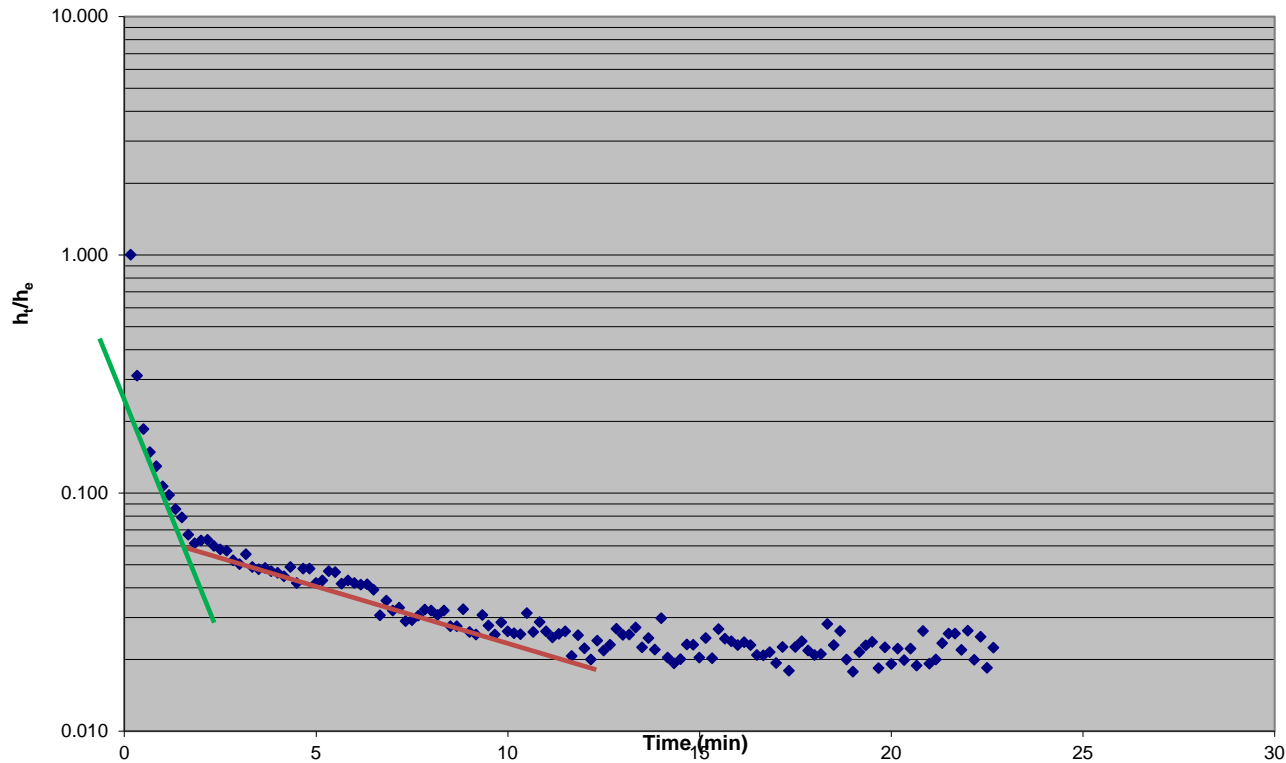
m/d **2.20E-02** **3.96E-03**
T (m²/d) **3.45E+00** **6.22E-01**
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2))/(t_2 - t_1)$,
 (ie slope of plot, t in mins)

K	0.0220	0.0040
T	3.448	0.62

Notes: BWE21 is open hole from 12-169m, no PVC or gravel pack installed. Open hole section is through fresh, dolerite bedrock.

Bore No:	WMB22	Test No:	1	Job No:	514F F3	Date:	25-Apr-25	Logged by:	KM
Borehole co-ordinates: Easting:		458568	Northing:		6601717	Collar elevation (m):		TBC	
Depth to top of test section (m):		38	Length of test section, L (m):		122	Radius of borehole, r (m):		0.076	
Depth of static water level, H_w (m):		2.71	Radius of standpipe or casing, r_c (m):		0.025				
Excess head, h_e (m):		0.82							

Head - time graph (slope of graph is S)



Calculations:

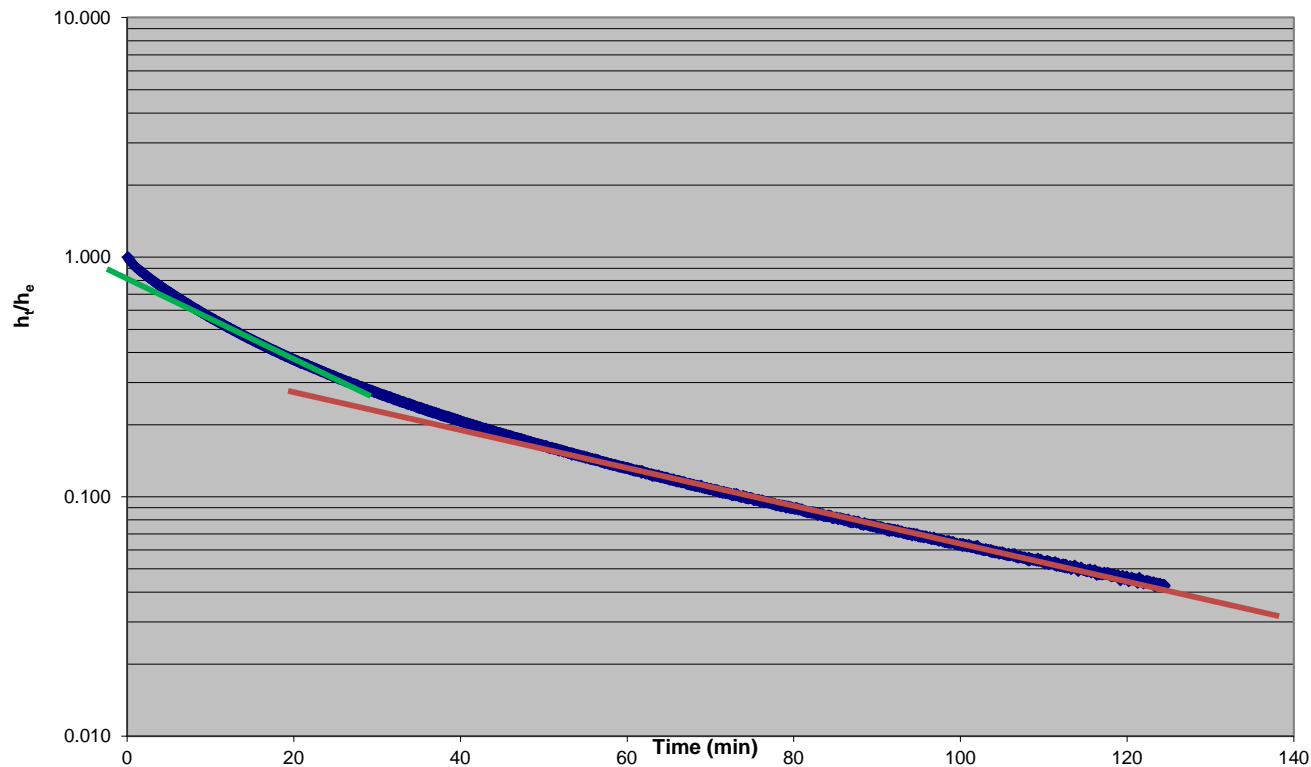
	Early Time	Late Time
h₁	0.19	0.07
t₁	0.5	1.66
h₂	0.07	0.030
t₂	1.7	7.16
S	3.7E-01	6.7E-02
k (m/s)	2.55E-07	4.56E-08

m/d **2.20E-02** **3.94E-03**
T (m²/d) 2.68E+00 4.81E-01
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2)/(t_2 - t_1))$,
 (ie slope of plot, t in mins)

K	0.0220	0.0039
T	2.685	0.48

Bore No:	BWE23	Test No:	1	Job No:	514F F3	Date:	2-Apr-25	Logged by:	KM
Borehole co-ordinates: Easting:		458625		Northing:		6601955		Collar elevation (m): TBC	
Depth to top of test section (m):		20		Length of test section, L (m):		180			
Depth of static water level, H_w (m):		4.33		Radius of borehole, r (m):		0.076			
Excess head, h_e (m):		4.52		Radius of standpipe or casing, r_c (m):		0.025			

Head - time graph (slope of graph is S)



Calculations:

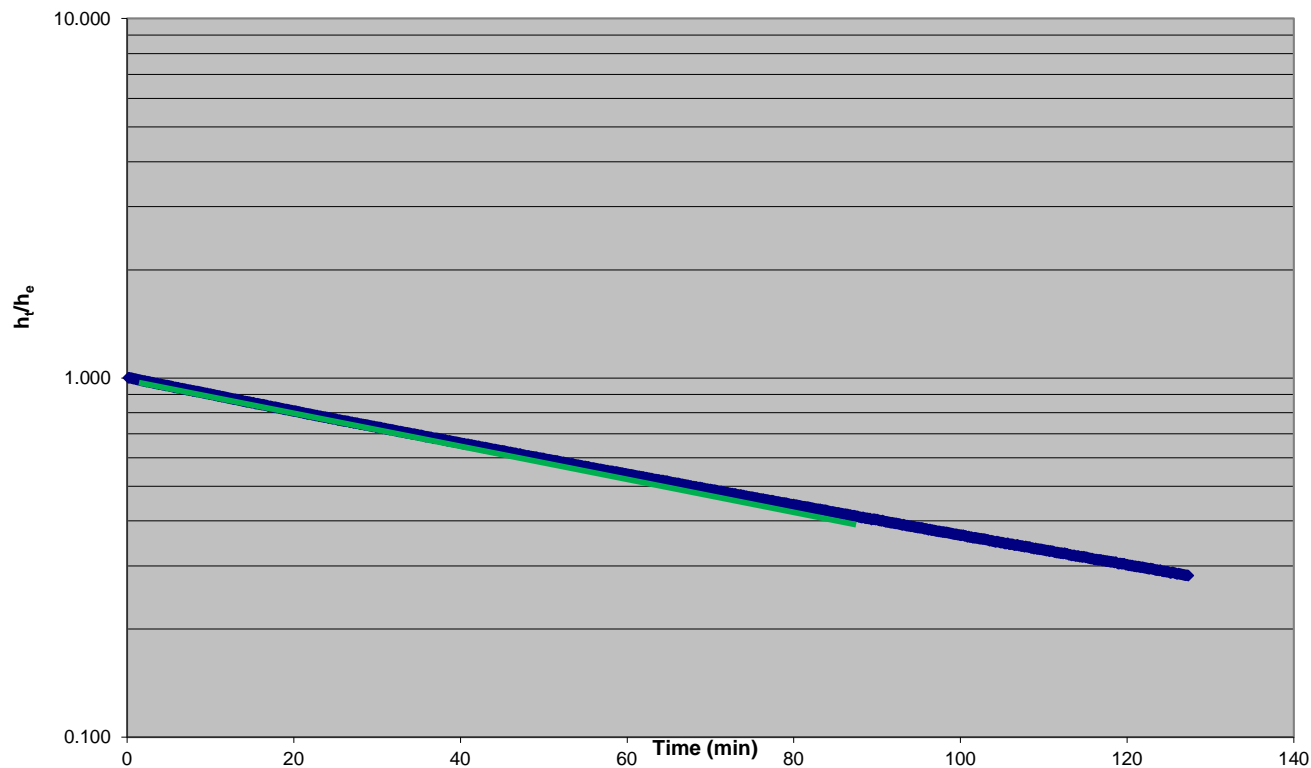
	Early Time	Late Time
h₁	1.00	0.15
t₁	0.083	52.30
h₂	0.63	0.05
t₂	7.66	108.60
S	2.6E-02	8.5E-03
k (m/s)	1.22E-08	3.91E-09

K (m/d) 0.00106 0.00034
T (m²/d) 0.19 0.06
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2))/(t_2 - t_1)$,
 (ie slope of plot, t in mins)

Notes: BWE23 is screened in fresh dolerite bedrock. Yields reported as 0 L/s when drilling. Very few water bearing fractures encountered in bedrock at this location.

Bore No:	WMB24	Test No:	1	Job No:	514F F3	Date:	28-Mar-25	Logged by:	GL
Borehole co-ordinates: Easting:		458772		Northing:		6602280		Collar elevation (m): 314.8954	
Depth to top of test section (m):		38		Length of test section, L (m):		162			
Depth of static water level, H_w (m):		4.59		Radius of borehole, r (m):		0.076			
Excess head, h_e (m):		3.75		Radius of standpipe or casing, r_c (m):		0.025			

Head - time graph (slope of graph is S)



Calculations:

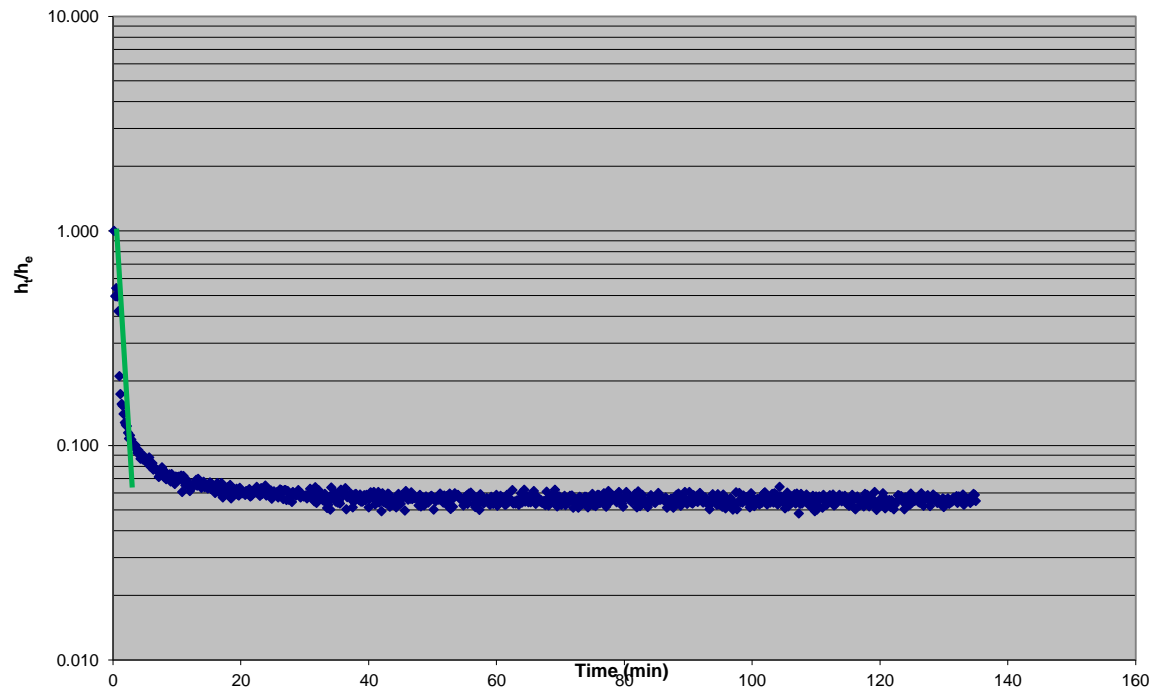
Early Time		
h₁	1.00	
t₁	0.17	
h₂	0.40	
t₂	4.00	
S	1.0E-01	
k (m/s)	5.33E-08	

K (m/d) **0.0046**
T (m²/d) 0.7
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log (h_1/h_2))/(t_2 - t_1)$,
 (ie slope of plot, t in mins)

Notes: BWE24 is screened within the fresh bedrock aquifer / dolerite basement.

Bore No:	BWE25	Test No:	1	Job No:	514F F3	Date:	25-Apr-25	Logged by:	KM
Borehole co-ordinates: Easting:		458595	Northing:		6602120	Collar elevation (m):		TBC	
Depth to top of test section (m):		26	Length of test section, L (m):		174	Adopted thickness (m)		11	
Depth of static water level, H_w (m):		43.1	Radius of borehole, r (m):		0.076				
Excess head, h_e (m):		0.87	Radius of standpipe or casing, r_c (m):		0.025				

Head - time graph (slope of graph is S)



Calculations:

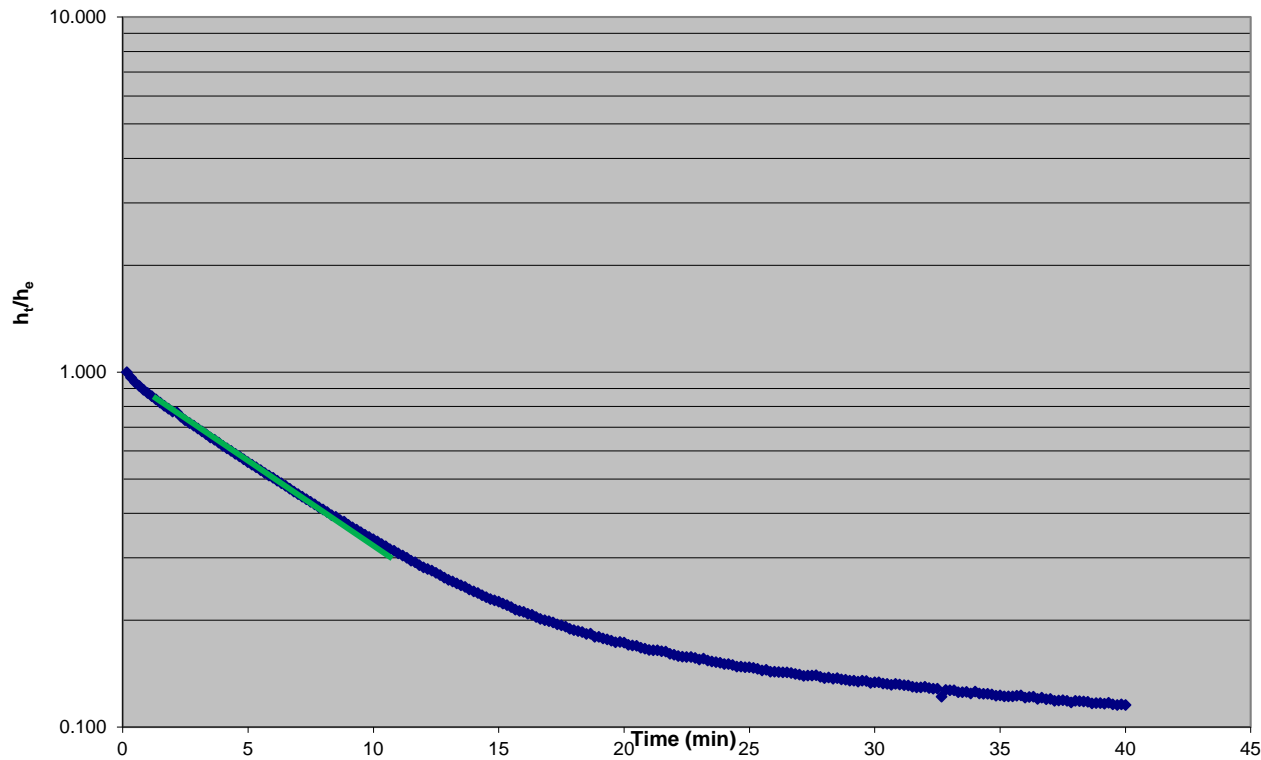
Early Time			
h_1	1.00		
t_1	0.2		
h_2	0.120		
t_2	1.8		
S	5.5E-01		
k (m/s)	4.17E-06		

m/d **3.60E-01**
 T (m²/d) 6.26E+01
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2))/(t_2 - t_1)$,
 (ie slope of plot, t in mins)

 K 0.3600
 T 62.641

Bore No:	WMB27	Test No:	1	Job No:	514F F3	Date:	10-Jul-25	Logged by:	GL
Borehole co-ordinates: Easting:		458540	Northing:		6603000	Collar elevation (m):		TBC	
Depth to top of test section (m):		34	Length of test section, L (m):		120	Radius of borehole, r (m):		0.076	
Depth of static water level, H_w (m):		3.82	Radius of standpipe or casing, r_c (m):		0.025				
Excess head, h_e (m):		3.25							

Head - time graph (slope of graph is S)



Calculations:

Early Time		
h₁	1.00	
t₁	0.2	
h₂	0.40	
t₂	8.2	
S	5.0E-02	
k (m/s)	3.45E-08	

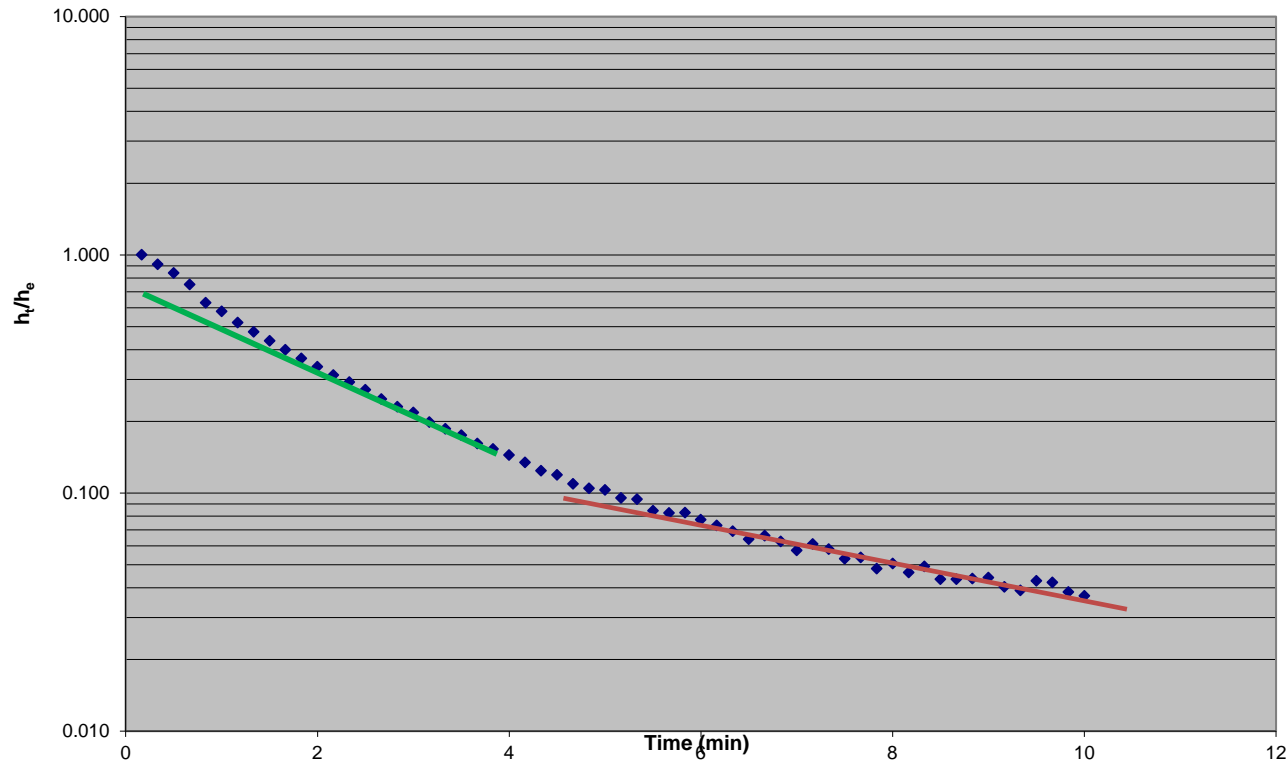
m/d 2.98E-03
T (m²/d) 3.57E-01
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2)/(t_2 - t_1))$,
 (ie slope of plot, t in mins)

K 0.0030
T 0.357

Notes: Cased in fresh bedrock

Bore No:	WMB28	Test No:	1	Job No:	514F F3	Date:	10-Jul-25	Logged by:	GL
Borehole co-ordinates: Easting:		458690	Northing:		6603000	Collar elevation (m):		TBC	
Depth to top of test section (m):		40	Length of test section, L (m):		120	Radius of borehole, r (m):		0.076	
Depth of static water level, H_w (m):		4.77	Radius of standpipe or casing, r_c (m):		0.025				
Excess head, h_e (m):		1.02							

Head - time graph (slope of graph is S)



Calculations:

	Early Time	Late Time
h₁	0.47	0.08
t₁	1.3	5.50
h₂	0.13	0.04
t₂	4.2	10.00
S	2.0E-01	7.4E-02
k (m/s)	1.37E-07	5.16E-08

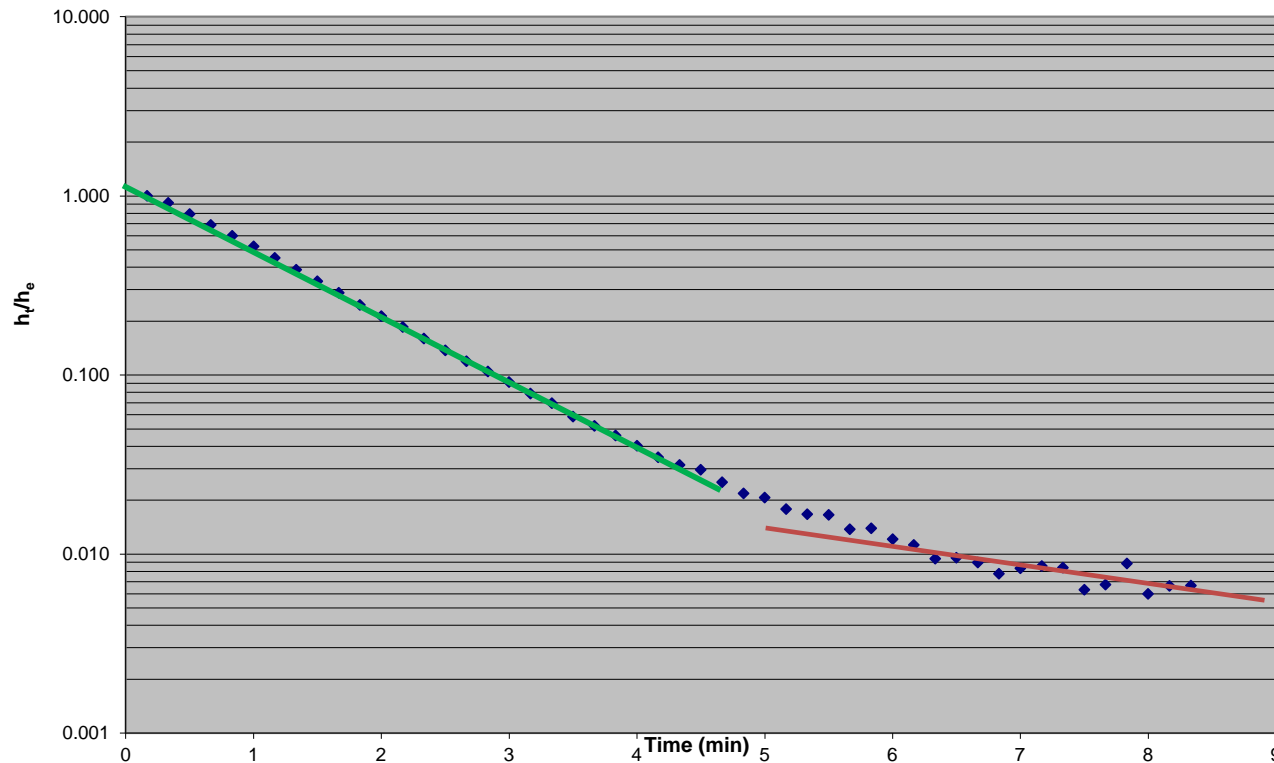
m/d 1.18E-02 4.45E-03
T (m²/d) 1.42E+00 5.34E-01
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2))/(t_2 - t_1)$,
 (ie slope of plot, t in mins)

K	0.0118	0.004
T	1.416	0.53

Notes: Cased in fresh bedrock

Bore No:	BWE32	Test No:	1	Job No:	514F F3	Date:	25-Apr-25	Logged by:	KM
Borehole co-ordinates: Easting:		458568	Northing:		6601717	Collar elevation (m):		TBC	
Depth to top of test section (m):		12	Length of test section, L (m):		129	Radius of borehole, r (m):		0.076	
Depth of static water level, H_w (m):		22.04	Radius of standpipe or casing, r_c (m):		0.076				
Excess head, h_e (m):		2.76							

Head - time graph (slope of graph is S)



Calculations:

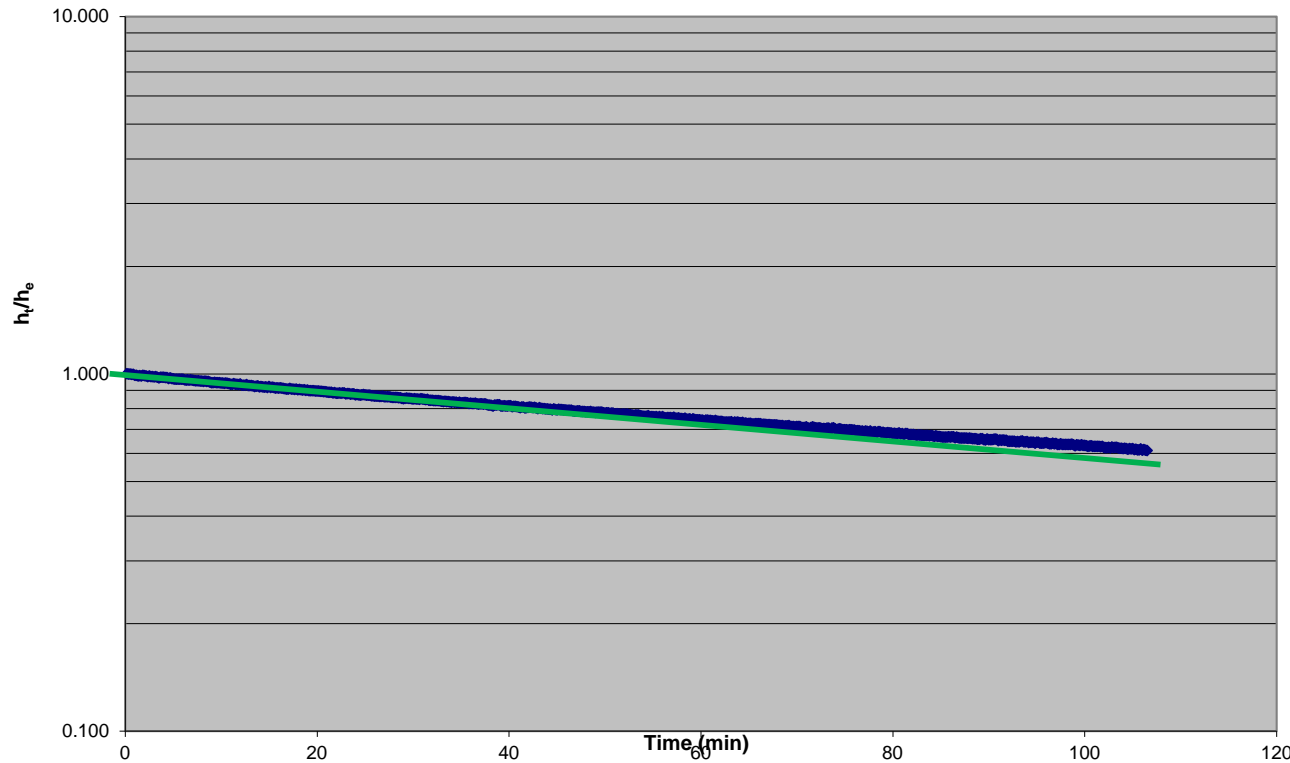
	Early Time	Late Time
h₁	1.00	0.009
t₁	0.2	6.30
h₂	0.03	0.007
t₂	4.5	8.10
S	3.5E-01	6.1E-02
k (m/s)	2.11E-06	3.61E-07

m/d 1.82E-01 3.12E-02
T (m²/d) 2.35E+01 4.02E+00
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2)/(t_2 - t_1))$,
 (ie slope of plot, t in mins)

K	0.1822	0.031
T	23.507	4.02

Bore No:	WMB34	Test No:	1	Job No:	514F F3	Date:	25-Apr-25	Logged by:	KM
Borehole co-ordinates: Easting:		458568	Northing:		6601717	Collar elevation (m):		TBC	
Depth to top of test section (m):		12	Length of test section, L (m):		145	Radius of borehole, r (m):		0.076	
Depth of static water level, H_w (m):		4.18	Radius of standpipe or casing, r_c (m):		0.076				
Excess head, h_e (m):		1.09							

Head - time graph (slope of graph is S)



no recovery?

Calculations:

Early Time		
h₁	1.00	
t₁	0.2	
h₂	0.61	
t₂	105.5	
S	2.0E-03	
k (m/s)	1.08E-08	

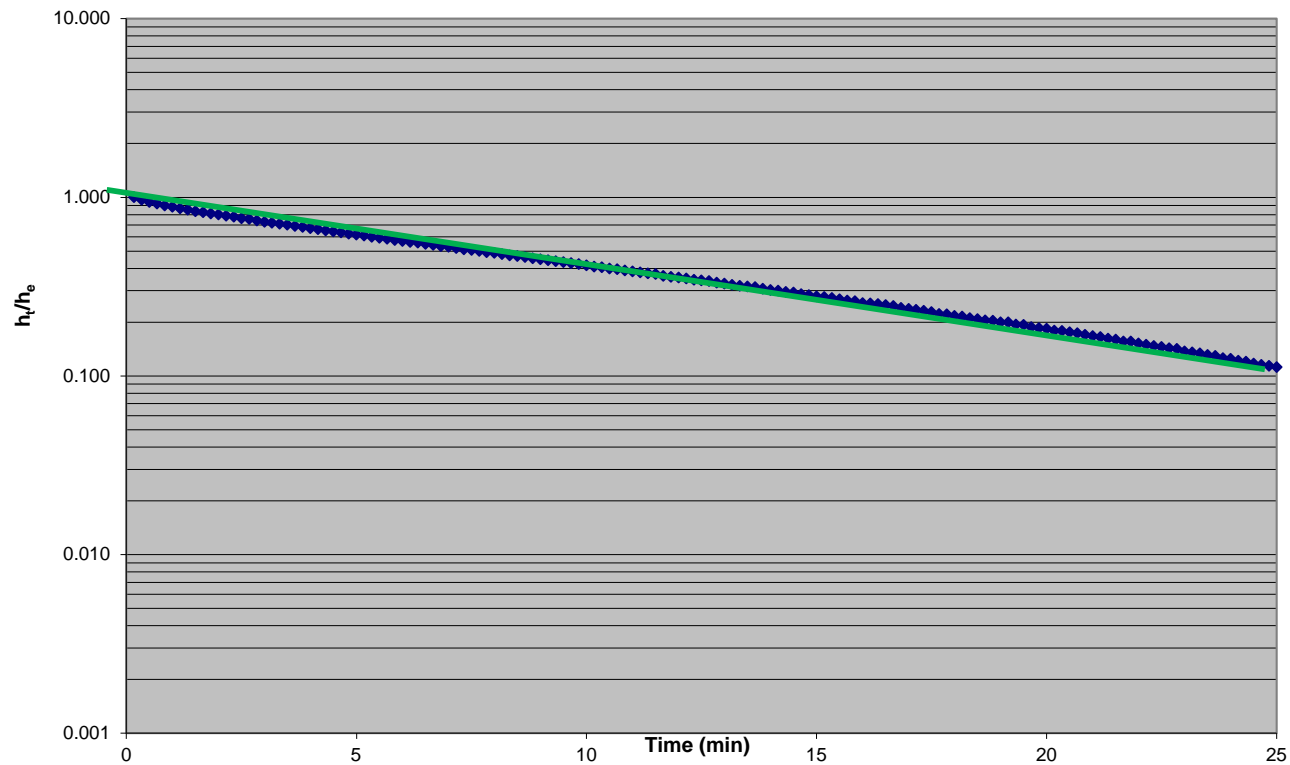
m/d 9.33E-04
T (m²/d) 1.35E-01
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2)/(t_2 - t_1))$,
 (ie slope of plot, t in mins)

K 0.0009
T 0.135

Notes: BWE34 is open hole

Bore No:	WMB35	Test No:	1	Job No:	514F F3	Date:	25-Apr-25	Logged by:	KM
Borehole co-ordinates: Easting:		458568	Northing:		6601717	Collar elevation (m):		TBC	
Depth to top of test section (m):		25	Length of test section, L (m):		132	Radius of borehole, r (m):		0.076	
Depth of static water level, H_w (m):		1.28	Radius of standpipe or casing, r_c (m):		0.025				
Excess head, h_e (m):		2.07							

Head - time graph (slope of graph is S)



no recovery?

Calculations:

Early Time		
h₁	1.00	
t₁	0.2	
h₂	0.20	
t₂	19.0	
S	3.7E-02	
k (m/s)	2.34E-08	

m/d 2.02E-03
T (m²/d) 2.66E-01
 Permeability, $k = 0.133 \times S \times (rc^2/L)$, (m/sec)
 where $S = (\log(h_1/h_2)/(t_2 - t_1))$,
 (ie slope of plot, t in mins)

K 0.0020
T 0.266

APPENDIX D
RESULTS OF CHEMICAL ANALYSES

CLIENT DETAILS

LABORATORY DETAILS

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 Email alastair.hoare@aq2.com.au

Project **Bombora**
 Order Number **514F Task F3**
 Samples 3

Manager Merene Hwang
 Laboratory SGS Perth Environmental
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SGS Reference **PE184380 R0**
 Date Received 15 Jul 2025
 Date Reported 23 Jul 2025

COMMENTS

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

Nitrate and Nitrite: Samples analysed outside holding time.

PH in Water: Samples received and analysed outside holding time.

TDS: Samples received and analysed out of holding time.

The upper limit for Conductivity in Water is 100,000 uS/cm. Any result above this is an estimate. This will also cause the TDS on EC ratio to bias high.

Metals: Dissolved Al, Mn & Zn : Spike recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).

Metals: LORs raised due to high conductivity.

TDS: EC of samples is over 100, 000us so TDS gravimetric results will be biased high.

SIGNATORIES

Chiara CAPORALE
 Team Leader

Hue Thanh LY
 Metals Team Leader

Louise HOPE
 Laboratory Technician

Merene HWANG
 Lab Manager

Murray O'NEILL
 Lab Technician-Nutrients Signatory

Sanaa HUSSAIN
 Chemist



ANALYTICAL REPORT

PE184380 R0

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Sample Number			PE184380.001	PE184380.002	PE184380.003
Sample Matrix			Water	Water	Water
Sample Date			7/7/25 14:05	28/6/25 9:00	11/7/25 10:10
Sample Name			WPB 26	WPB 33	WPB 29

pH in water Method: AN101 Tested: 15/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
pH**	pH Units	0.1	6.8	6.8	7.1

Conductivity and TDS by Calculation - Water Method: AN106 Tested: 15/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Conductivity @ 25 C	µS/cm	2	200000	210000	210000

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 16/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Total Dissolved Solids Dried at 175-185°C	mg/L	10	220000	240000	260000

Alkalinity Method: AN135 Tested: 15/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Bicarbonate Alkalinity as HCO3	mg/L	5	130	44	62
Carbonate Alkalinity as CO3	mg/L	5	<5	<5	<5
Total Alkalinity as CaCO3	mg/L	5	110	36	51

Sulfate in water Method: AN275 Tested: 18/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Sulfate, SO4	mg/L	1	11000	13000	14000

Chloride by Discrete Analyser in Water Method: AN274 Tested: 18/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Chloride, Cl	mg/L	1	160000	190000	210000

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Sample Number			PE184380.001	PE184380.002	PE184380.003
Sample Matrix			Water	Water	Water
Sample Date			7/7/25 14:05	28/6/25 9:00	11/7/25 10:10
Sample Name			WPB 26	WPB 33	WPB 29

Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 16/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Calcium, Ca	mg/L	0.2	730	790	710
Magnesium, Mg	mg/L	0.1	6900	7500	8600
Potassium, K	mg/L	0.1	400	410	490
Sodium, Na	mg/L	0.5	67000	75000	78000
Total Hardness by Calculation	mg CaCO3/L	1	30000	33000	37000

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA Method: AN258 Tested: 16/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Nitrite Nitrogen, NO ₂ as N	mg/L	0.05	<0.05	<0.05	<0.05
Nitrate Nitrogen, NO ₃ as N	mg/L	0.05	<0.05	2.6	<0.05

Ammonia Nitrogen by FIA Method: AN261/AN262 Tested: 16/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Ammonia Nitrogen, NH ₃ as N	mg/L	0.05	0.06	<0.05	0.12

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 17/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Total Kjeldahl Nitrogen	mg/L	0.05	1.2	1.3	1.6

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 17/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Total Phosphorus (Kjeldahl Digestion) as P	mg/L	0.02	0.07	<0.02	<0.02

Trace Metals (Dissolved) in Water by ICPMS TQe Method: AN318 Tested: 17/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Aluminium	µg/L	5	<1000 †	<1000 †	<1000 †
Arsenic	µg/L	0.5	<100 †	<100 †	<100 †
Barium	µg/L	0.5	<100 †	<100 †	<100 †
Beryllium	µg/L	0.1	<20 †	<20 †	<20 †
Cadmium	µg/L	0.05	<10 †	<10 †	<10 †
Chromium	µg/L	0.5	<100 †	<100 †	<100 †
Cobalt	µg/L	0.5	<100 †	<100 †	<100 †
Copper	µg/L	0.5	<100 †	<100 †	410
Iron	µg/L	5	7800	<1000 †	<1000 †
Lead	µg/L	0.5	<100 †	<100 †	<100 †
Manganese	µg/L	1	990	540	1600
Nickel	µg/L	1	<200 †	<200 †	<200 †
Selenium	µg/L	1	<200 †	<200 †	<200 †
Vanadium	µg/L	0.5	<100 †	<100 †	<100 †
Zinc	µg/L	1	290	310	280

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Sample Number			PE184380.001	PE184380.002	PE184380.003
Sample Matrix			Water	Water	Water
Sample Date			7/7/25 14:05	28/6/25 9:00	11/7/25 10:10
Sample Name			WPB 26	WPB 33	WPB 29

Mercury (dissolved) in Water Method: AN311(Perth)/AN312 Tested: 21/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005

Reactive Silica by Discrete Analyser Method: AN270 Tested: 16/7/2025

Parameter	Units	LOR	PE184380.001	PE184380.002	PE184380.003
Reactive Silica, SiO ₂	mg/L	0.1	0.93	6.5	6.3

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	DUP %RPD	LCS %Recovery
Bicarbonate Alkalinity as HCO3	LB231941	mg/L	5	<5		
Carbonate Alkalinity as CO3	LB231941	mg/L	5	<5		
Total Alkalinity as CaCO3	LB231941	mg/L	5	<5	2 - 9%	101%

Ammonia Nitrogen by FIA Method: ME-(AU)-[ENV]AN261/AN262

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH ₃ as N	LB231925	mg/L	0.05	<0.05	5%	91%

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	LB231990	mg/L	1	<1	0 - 4%	97 - 98%	107%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB231942	µS/cm	2	<2	0%	99%

Mercury (dissolved) in Water Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB232054	mg/L	0.00005	<5e-005	61%	111%	99%

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	LB231915	mg/L	0.2	<0.2	0%	93%	92%
Magnesium, Mg	LB231915	mg/L	0.1	<0.1	2%	96%	97%
Potassium, K	LB231915	mg/L	0.1	<0.1	0%	99%	
Sodium, Na	LB231915	mg/L	0.5	<0.5	1%	98%	
Total Hardness by Calculation	LB231915	mg CaCO3/L	1	<1			

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrite Nitrogen, NO ₂ as N	LB231925	mg/L	0.05	<0.05	0%	95%
Nitrate Nitrogen, NO ₃ as N	LB231925	mg/L	0.05	<0.05	0%	NA

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB231942	pH Units	0.1	5.7	0%	100%

Reactive Silica by Discrete Analyser Method: ME-(AU)-[ENV]AN270

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Reactive Silica, SiO ₂	LB231905	mg/L	0.1	<0.10	0 - 2%	100%	98%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Sulfate, SO ₄	LB231990	mg/L	1	<1	0 - 6%	94 - 99%	74%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB231966	mg/L	0.05	<0.05	6%	104%

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	LB231909	mg/L	10	<10	2%	98%		NA
	LB231944	mg/L	10	<10	0 - 1%	98%	96%	0%

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.

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion) as P	LB231966	mg/L	0.02	<0.02	0%	112%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium	LB231932	µg/L	5	<5		109%	-54%
Arsenic	LB231932	µg/L	0.5	<0.5	0%	101%	91%
Barium	LB231932	µg/L	0.5	<0.2		101%	95%
Beryllium	LB231932	µg/L	0.1	<0.1		103%	102%
Cadmium	LB231932	µg/L	0.05	<0.05	2%	103%	102%
Chromium	LB231932	µg/L	0.5	<0.5	3%	104%	117%
Cobalt	LB231932	µg/L	0.5	<0.5		105%	104%
Copper	LB231932	µg/L	0.5	<0.5	0%	106%	100%
Iron	LB231932	µg/L	5	<5	1%	101%	86%
Lead	LB231932	µg/L	0.5	<0.5	2%	104%	114%
Manganese	LB231932	µg/L	1	<1		114%	309%
Nickel	LB231932	µg/L	1	<1	0%	106%	107%
Selenium	LB231932	µg/L	1	<1		100%	88%
Vanadium	LB231932	µg/L	0.5	<0.5		104%	93%
Zinc	LB231932	µg/L	1	<1	1%	110%	-43%

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 $\mu\text{mhos/cm}$ or $\mu\text{S/cm}$ @ 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.
AN262	Ammonia in solution is reacted with o-phthalaldehyde (OPA) to form a fluorescent compound. The reaction product is detected by a fluorimeter and the response is measured via FIA using a photomultiplier detector . The response is directly proportional to the concentration of ammonia in the sample.
AN270	Reactive forms of silicon in acid solution below pH 2 react with ammonium molybdate ions to form a yellow silicomolybdate which is then reduced with ascorbic acid to produce a blue silicomolybdate complex. Oxalic acid is added to destroy any molybdophosphoric acid. Colourimetric determination by Discrete Analyser .
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.
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K ₂ SO ₄ and CuSO ₄ . All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.

METHOD

METHODOLOGY SUMMARY

AN281

An unfiltered water or soil sample is first digested in a block digester with sulfuric acid, K₂SO₄ and CuSO₄. The ammonia produced following digestion is then measured colourimetrically using the Discrete Analyser . A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.

AN311(Perth)/AN312

Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.

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
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
***	Indicates that both * and ** apply.	-	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 calculated 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.

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