Robe Mesa Project

H2 Level of Assessment

Groundwater Abstraction from Bore PB13-3 for Mine Water Supply

Prepared for:

CZR Resources

December 2023

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DOCUMENT STATUS

Version	Purpose of Document	Author	Reviewed By	Review Date
A	Draft Report for Client Comment	BDK	AGH	03/03/2023
B	Revised Version	BDK	AGH	28/11/2023
C	Final Version	BDK	AGH	15/12/2023

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Version:	C		
Date:	15/12/2023		
AQ2 Ref:	F:\385\E Tasks\3.C&R\Reports\385E_024c.docx		

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1. INTRODUCTION

The Robe Mesa Project is a part of the Yarraloola Iron Ore Project, which is a joint venture between Zanthus Resources Ltd for CZR Resources (CZR, 85%) and ZanF Pty Ltd (15%). The Yarraloola Iron Ore Project is located approximately 25 km southeast of Yarraloola Homestead, and approximately 140 km southwest of Karratha in the Pilbara Region of Western Australia, between the Rio Tinto owned Mesa-A and Mesa-J iron ore mines. The Yarraloola tenements cover two project areas, comprising the Robe Mesa deposits and the Ashburton Magnetite System.

The Robe Mesa Deposit is a Channel Iron Deposit (CID) ore-type and is hosted by two flat sheets of pisolitic ironstone (i.e. Robe Pisolite) that overlie each other. The Robe Mesa deposits are currently in the preliminary stages of development into an iron ore mine. Mining at Robe Mesa is currently focussed on the upper CID sheet, with proposed pits located above the water table. The project area is depicted on Figures 1.1 and 1.2 and show the Robe Mesa Deposit and the tenement area.

CZR recognises the Robe River Kuruma (RRK) People as the traditional owners of the land that Robe Mesa is located on, and the importance to the RRK People of leaving country as close as possible to the way that it was found. Working collaboratively, CZR and RRK signed the Robe Mesa Native Title Agreement on 21 December 2022 which includes a 'live' Cultural Heritage Management Plan to ensure the parties continue to work together to develop appropriate protection and management measures for the places it contains. CZR acknowledges that within the vicinity of the Robe Mesa Project there are many significant cultural places of great importance to the RRK People, as shown on Figure 1.2. CZR recognises the cultural significance of water, in particular the importance of *Jajiwurra* (the Robe River) to the RRK people. CZR and RRK have agreed the Productive Mining area boundaries and identified No-Go-Areas which must not be entered or impacted by CZR. The area of the Robe Mesa that has been identified for Productive Mining provides for a set back from the mesa edge or buffer that must not be entered or impacted. Additionally, northern aspects of the Robe Mesa and other selected areas off the mesa, also contain No-Go-Areas.

The anticipated long-term (~7 years) mine water demand for the Robe Mesa project is estimated at 17 L/s (i.e. 540,000 kL/year) for construction, dust suppression, processing and camp requirements. It should be noted that the mining operation is not expecting any dewatering to be required, (i.e. deposit is above the water table), to supplement the project's water demand. Therefore, the required project's water demand will need to be sourced from local groundwater. There are a few existing groundwater abstraction bores in the local area, but these are mostly shallow pastoral bores, capable of only limited abstraction rates and not suitable for mine water supply. The exception to these is the existing production bore PB13-3, drilled into the faulted/fractured Duck Creek Dolomite aquifer system, located approximately 8 km southeast from the proposed Robe Mesa mine, which has the potential to fully meet the site's water demand.

API Management Pty Ltd (API) holds a Department of Water and Environmental Regulation (DWER) 5C groundwater licence (GWL) 180637(3) to abstract groundwater from Pilbara Hamersley fractured rock aquifer on tenements E08/2089 and E09/2766-I for geotechnical investigation, mineral exploration and bore construction purposes, with an annual allocation of 95,000 kL (i.e. 3 L/s). Several drawpoints along these tenements have been drilled and are covered under this GWL, including bore PB13-3. CZR is interested in acquiring bore PB13-3 from API for mine water supply for the Robe Mesa project. Therefore, in order for CZR to abstract water from PB13-3, a separate 5C GWL application to abstract 17 L/s from the fractured aquifer (PB13-3) is required to be submitted to DWER for assessment. An H2 hydrogeological assessment report is required to be prepared to assess the suitability of bore PB13-3 to sustain a long-term abstraction rate of 17 L/s and assess the potential impacts that this may have on other existing groundwater users and the environment, and the results are presented herein. This H2 hydrogeological report will support CZR's 5C GWL application.

This report presents the results of groundwater supply investigations completed to date on bore PB-13-3 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 licenc*e (DWER, 2009).

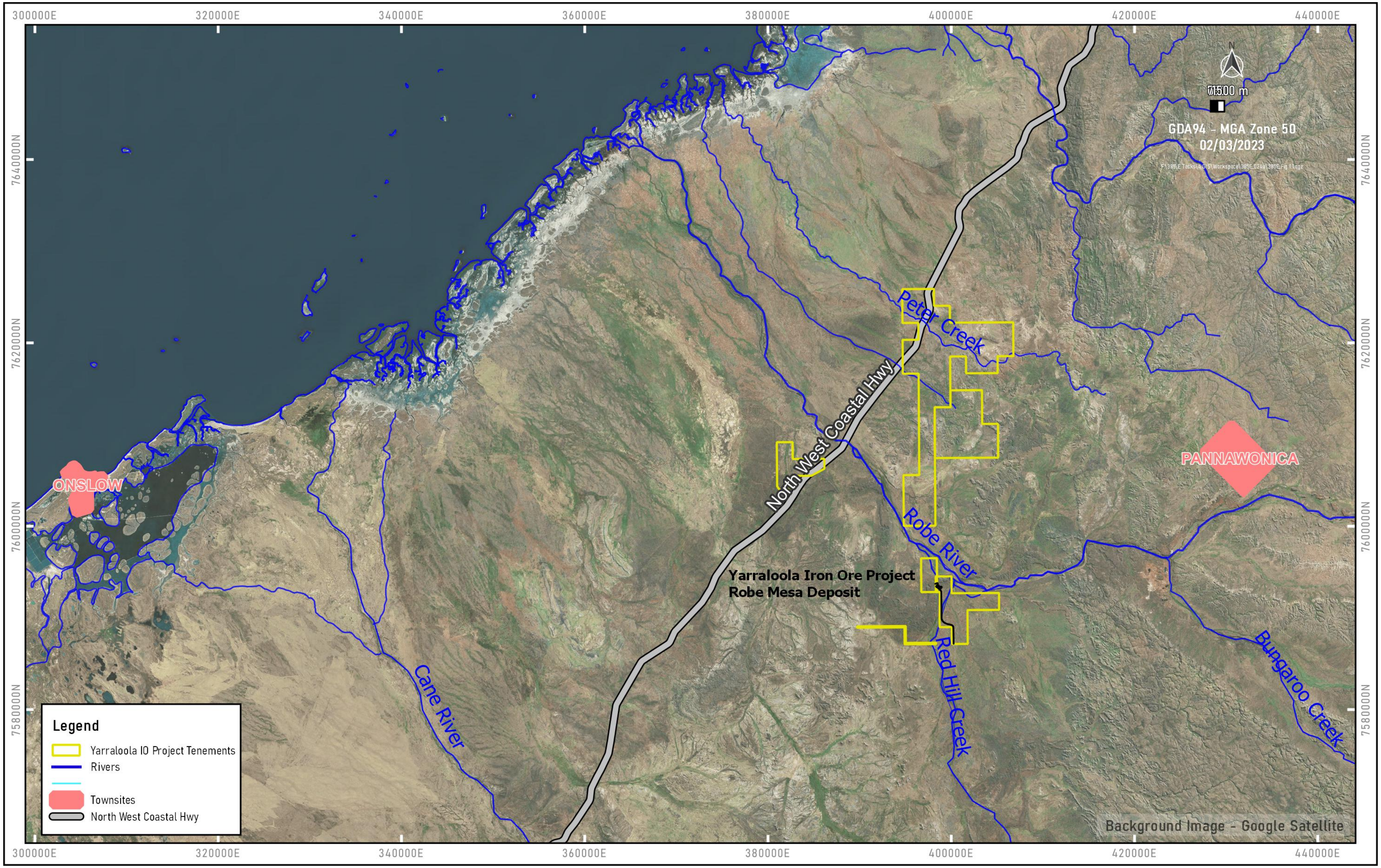


Figure 1.1 Regional Location of Robe Mesa Project

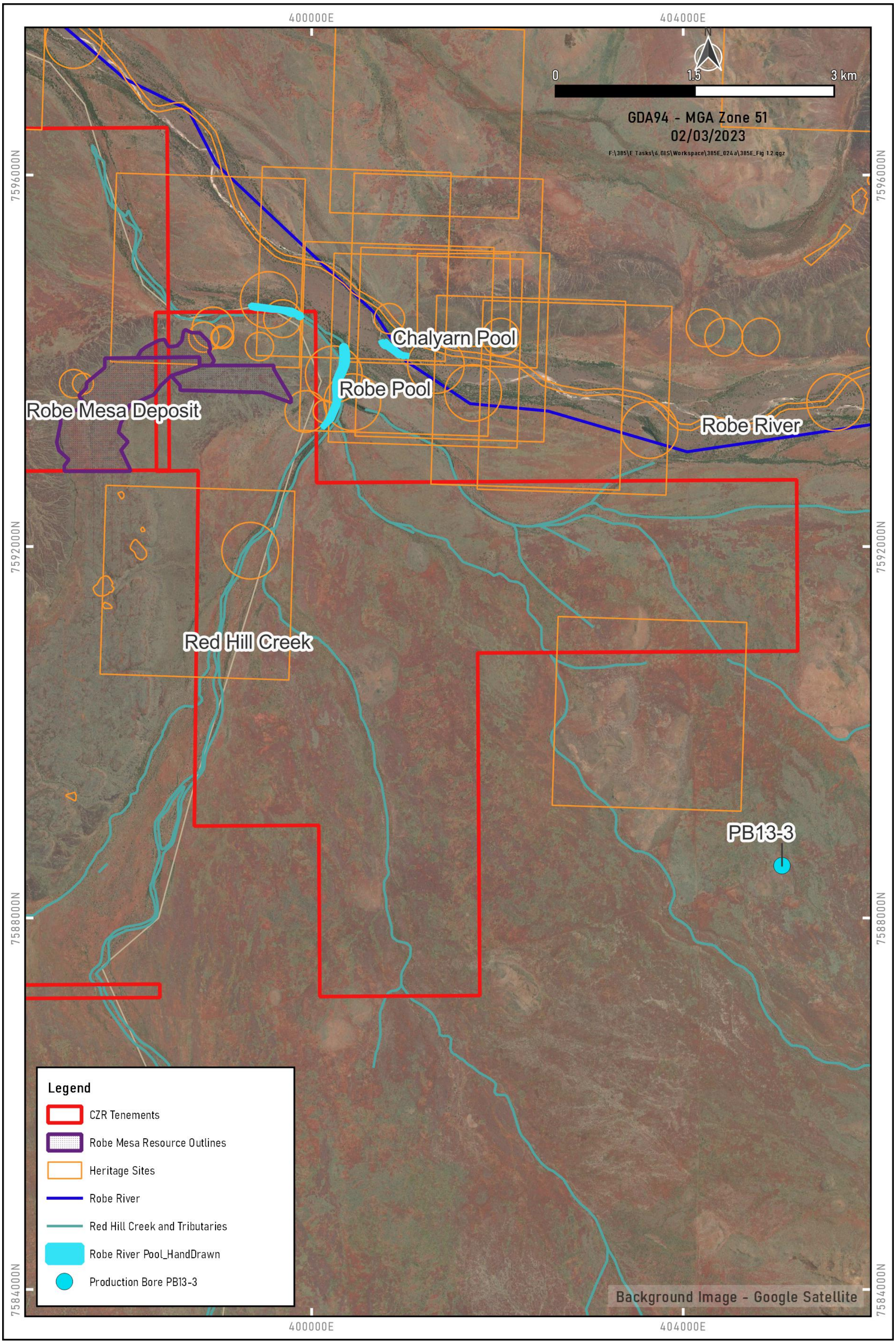


Figure 1.2 Robe Mesa Deposit and Bore PB13-3 Locations

2. PHYSICAL SETTING

2.1 Location

Production bore PB13-3 is located within tenement L08/303, approximately 8 km southeast of Robe Mesa and its position is shown in Figure 1.2. The bore was drilled in December 2010 as part of the water supply network for the construction of a railway for Australian Premium Iron's (API) West Pilbara Iron Ore Project. The railway was never built, but many water supply bores were drilled along its proposed route.

2.2 Climate and Rainfall

The Project area has a semi-arid climate with hot summers and mild winters. In an average year, December is the hottest month and July is the coldest month. Rainfall is highly variable, with larger rainfall events typically resulting from ex-tropical lows during late summer.

The Project is situated mid-way between three rainfall stations, namely Red Hill (Station No. 5022), Yarraloola Homestead (Station No. 5023) and Pannawonica (Station No. 5069). Red Hill and Yarraloola Homestead, both 24 km from the site, have an average rainfall of 365 mm and 300 mm per year, whilst Pannawonica, 35 km from the site with twice the elevation, has an average rainfall of 405 mm per year (Bureau of Meteorology (BOM), 2022). The site has an elevation of approximately 100 mAHD, which is midway between Red Hill and Yarraloola Homestead in elevation. Rainfall is variable throughout the year with the highest rainfall occurring during summer and autumn, which is generally associated with the passage of tropical cyclones, or thunderstorms. On average, the driest months are August to October and the wettest months are January and February.

The annual average pan evaporation is inferred to be approximately 2,970 mm (SILO, 2023), with evaporation greatly exceeding rainfall during every month of the year and being the highest in December. The annual pan evaporation rate is about 5- 10 times higher than the annual rainfall. Groundwater recharge is therefore limited, probably being restricted to extreme rainfall events during which the rainfall exceeds evaporation.

Long-term rainfall and pan evaporation data are summarised in Table 2.1.

Table 2.1 Rainfall and Evaporation Statistics (Station Nos. 5022, 5023 and 5069)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Long-Term Average Rainfall Red Hill (mm) (1898-2022))	67.8	85.7	63.9	21.9	35.7	36.4	16.1	7.5	1.6	1.5	6.5	21.7	364.8
Long-Term Average Rainfall Yarraloola Homestead (mm) (1898-2022)	46.7	67.6	55.8	21.2	37.6	34.7	13.6	7.3	1.5	1.2	2.9	13.7	299.5
Long-Term Average Rainfall Pannawonica (mm)[1] (1971-2022)	79	109	71.2	19.8	33.8	33.5	14.4	7	1.5	1.7	6.6	29.9	405.5
Long-term Average Pan Evaporation (mm)*	278	231	282	231	185	145	152	194	248	321	343	361	2,970

* Evaporation Data from SILO (2023)

2.3 Drainage

The project is located adjacent to the Robe River (Figure 1.2) and is within the DWER surface water management area for the Robe River and its tributaries. The Robe River is a significant river system in the region and drains east to west through the high relief areas of the Hamersley Ranges, then between Mesa formations on the Southern Peneplain, and onto the gently sloping coastal plain prior to discharging into the Ocean (Ruprecht, 2000 and Beard, 1975).

Red Hill Creek, one of the major Robe tributaries, flows through the Project Tenement area from south to north and around the northern part of the Mesa. Figure 2.1 shows the local hydrology and Red Hill Creek subcatchment boundaries (i.e. A, B and C based on the provided DTM data and SRTM elevations where DTM data is absent).

Creeks in the region are ephemeral with runoff responding to sporadic significant rainfall events. Runoff from Red Hill Creek Catchments A, B and C combine prior to discharging to the Robe River, with a total catchment area of 1,519 km^2.

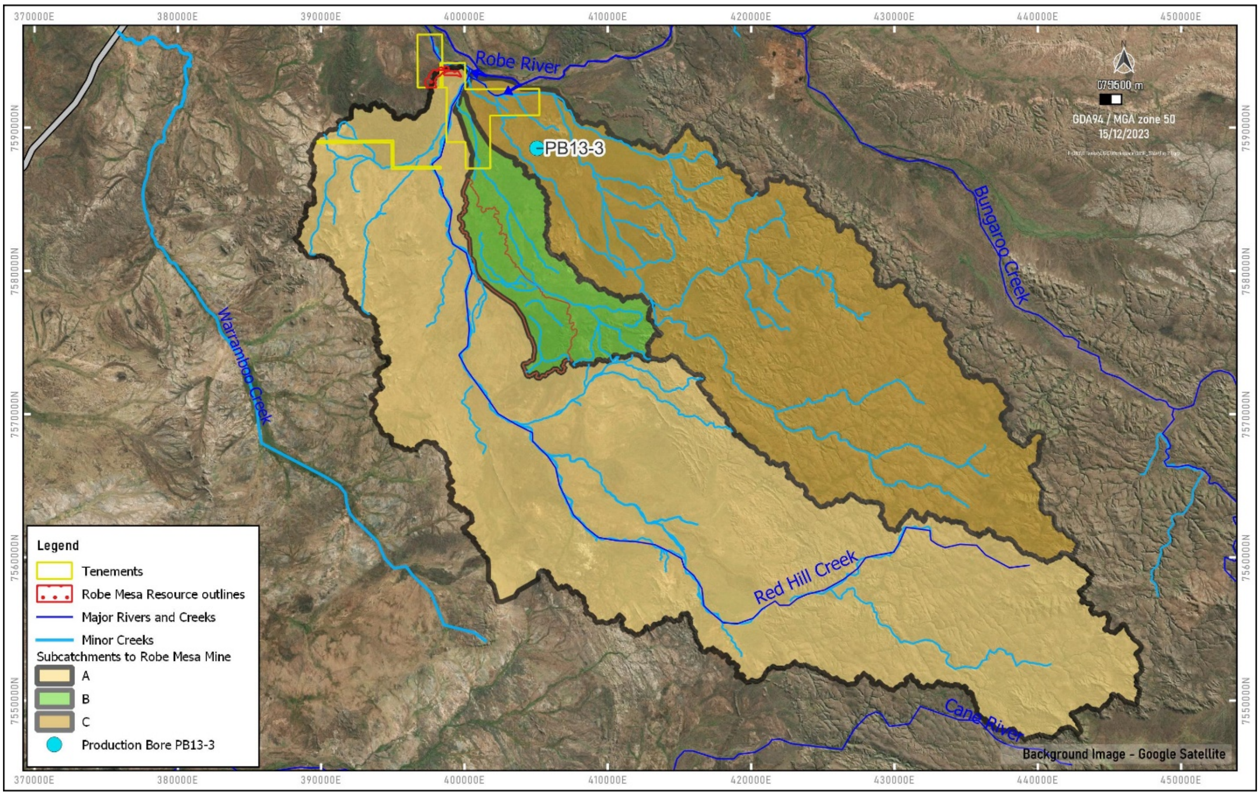


Figure 2.1 Project Area Hydrology and Red Hill Creek Subcatchments to Proposed Mine Area

3. HYDROGEOLOGY

3.1 Geological Setting

The geology of the Robe Mesa Project area (i.e. tenements E08/1060 and E08/1686), including the area of water supply bore PB13-3 (i.e. tenement L08/3033) is dominated by the following geological units (Figure 3.1):

- Quaternary age transported unconsolidated sediments and valley fill material (Quaternary alluvium, elluvium and colluvium – clay, silt, sand and gravel in various proportions).
- Tertiary age Robe Pisolite (pisolitic ironstone, silcrete, clay); ferruginised valley-fill delineating old river channels, which form Channel-Iron deposits (CID) currently remaining as a series of topographic highs (mesa formations).
- Proterozoic age Wyloo Group.
- Ashburton Formation (interbedded shale and fine grained sandstone).
- Duck Creek Dolomite (calcitic dolomite, minor shale).

The thickness of the Quaternary sediments varies across the Robe Mesa Project area and they are generally up to 15 m thick, probably thickening towards the centres of the main drainage systems.

The majority of the Robe Mesa Deposit and the project area is underlain by the Ashburton Formation, with the Duck Creek Dolomite underlying the eastern part of the Project area and where water supply bore PB13-3 is located (Figure 3.2, southeast of the Robe Mesa mine). There are basement outcrops in few places on the eastern part of the Project area mainly comprising chert and chert breccia, which are contained in dolomite and are probably related to faulting (GSWA, 1968). There are two major north northwest to south southwest trending fault zones evident in the eastern and south eastern part of the Project (Figure 3.2).

The current understanding of the local hydrogeological conditions has been based on a review of available project data and literature in the area and also AQ2's previous experience in the region from other mining projects. As background to this report, the most prospective aquifers within the Robe Mesa area that were identified from the scoping study are summarised below. For more comprehensive details, refer to the scoping study report (AQ2, 2021).

3.2 Local Hydrogeology

The current understanding of the local hydrogeological conditions has been based on the review of all available project data and literature in the region and also AQ2's previous experience in the region from other mining projects (i.e. Rio Tinto Mesa-A and Mesa-J, MRL Buckland Hill and Farquhar Deposits).

The major aquifer systems in the Robe Mesa Project area are encountered within the following main hydrostratigraphic units:

- Valley-fill deposits (alluvium, elluvium and coluvium materials).
- Palaeochannel CID (Robe Pisolite).
- Weathered bedrock that may have formed from the creek/river erosion (if present).
- Faults/shear zones within the bedrock (fractured rock).

CIDs form a significant regional aquifer, where they are found close to and beneath drainage lines. The lower CID layer is generally more permeable due to being friable and granular with minor cementation and less clay. The aquifer is believed to be unconfined to semi-unconfined. However, where the CID is outcropping as mesa landforms, it is elevated and unsaturated (i.e. above the water table). This aquifer has highly variable permeability due to the physical characteristics of the clay rich CID, with permeability for the CID in the Pilbara ranging between 2.5 and 40 m/d, with median values of 11 m/d.

The alluvium, elluvium and coluvium deposits when saturated (i.e. below the water table) can form a localised aquifer consisting of unconsolidated and usually poorly sorted silt, sand and gravel. Permeability is highly variable and depends on the sand-clay contents, with permeability in the Robe River area being reported to be between 0.5 and 100 m/d (DWER, 2016), however it is most likely approximately 2 to 3 m/d (as reported upstream in Mesa J).

If erosion of a creek or river channel has been influenced by the geological structure (such as a shear zone or regional lineament), then there may be a zone of enhanced weathering at the top of the fresh bedrock; this zone, if it exists and is below the water table, may also contribute to aquifer potential associated with the creek/river.

Underlying bedrock (i.e. Ashburton Formation and Duck Creek Dolomite) is generally considered to be of low permeability (in the order 0.001 to 0.1 m/d in the Pilbara region) with limited groundwater storage. Groundwater flow through bedrock is expected to be via fractures and / or shear/fault zones, having enhanced permeability and storage and potentially forming a localised aquifer, in particular within the Duck Creek Dolomite or at the contact of the Duck Creek Dolomite with the Ashburton Formation. Production Bore PB13-3 has been drilled into fault Breccia within the Duck Creek Dolomite (refer to Section 5 for more detail). Bore yields are likely to be variable and range from minor to high flows.

Several shallow station/stock bores have been drilled in the Quaternary sediments within and in the vicinity of the Project area, to depths of 5 to 13 m bgl, however with limited information on geology and hydrogeology (i.e. water levels). Additionally, two perennial pools in the Robe River can be used to determine a maximum elevation of the groundwater table in the Robe Mesa mine area (i.e. if they are groundwater fed, they will provide an indication of the water table elevation and if not, then the water table elevation will be lower than the elevation of the pools.). All of these data sources have been combined and provide an interpolation of groundwater levels for the Project area (Figure 3.3). Depths to groundwater in the nearby stock bores (cased in the valley-fill sediments) range between 3.5 to 7 m bgl (i.e. 82 to 115 mAHD). The elevation of the adjacent pool is around 90 mAHD, which result in an estimated maximum water table elevation within the Robe Mesa deposit. Regionally, the groundwater flow direction is likely to be from the south southeast to the north northwest towards the Robe River and subsequently the coast. Locally, groundwater contours are likely to reflect topography and local drainage patterns.

The main aquifers are recharged by infiltration of rainfall and surface water flows. Recharge would be seasonal (wet season) with most recharge occurring through the valley-fill sediments (alluvium and colluvium) and also into the CID during significant rainfall/runoff events, and limited recharge into the faulted/fractured aquifer. It should be noted that relatively large surface water runoff volumes from the Red Hill Creek Catchments are expected to occur in the Project area (Figure 2.1), which will likely recharge the shallow groundwater.

Groundwater discharge is likely to occur by evapotranspiration from the shallow aquifers (i.e. valley-fill) when groundwater levels are elevated after wet season and also by throughflow to creeks/river (due to valley-fill aquifer being hydraulically connected to the surface water features).

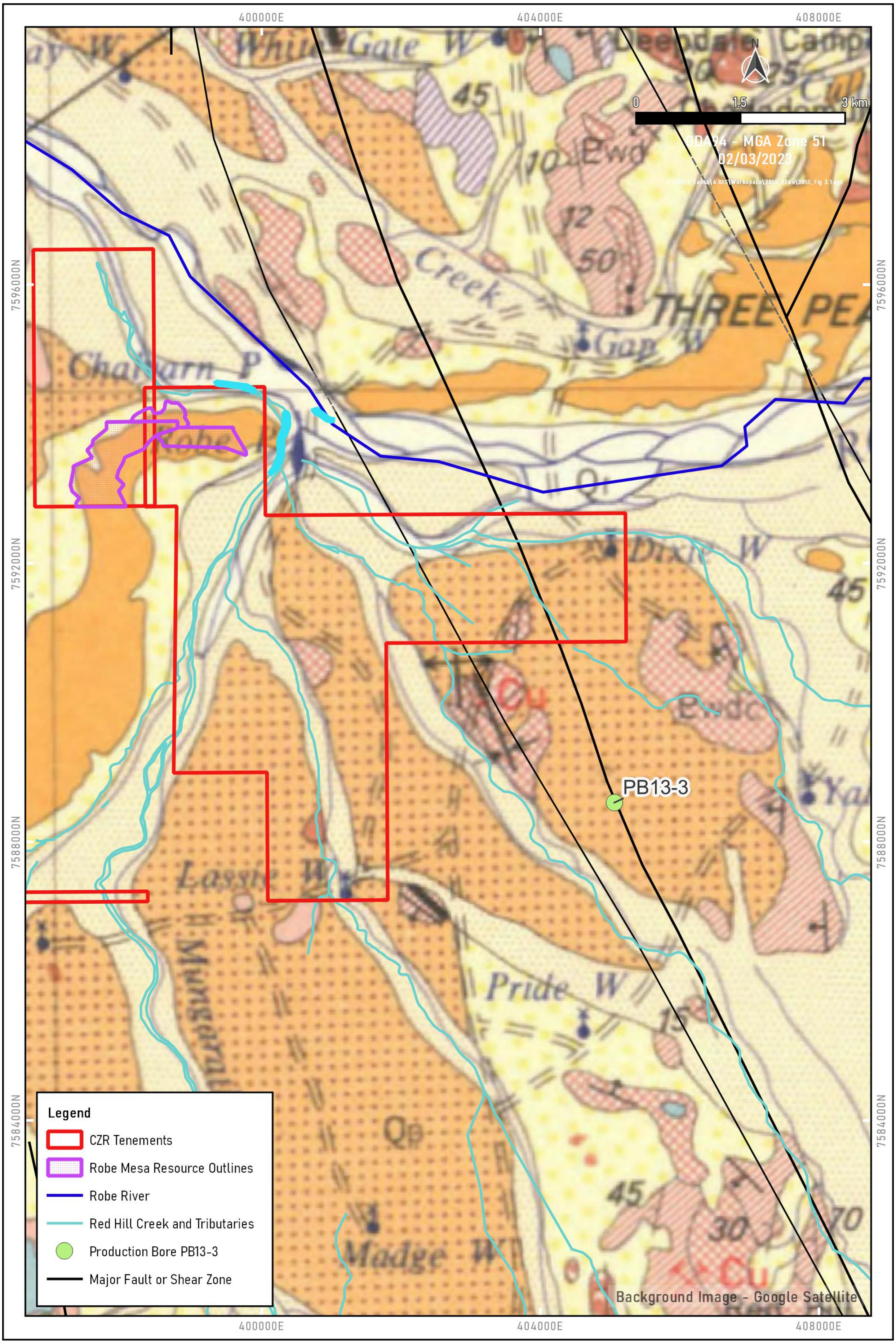


Figure 3.1 Outcrop Geology in Robe Mesa Project and PB13-3 Areas

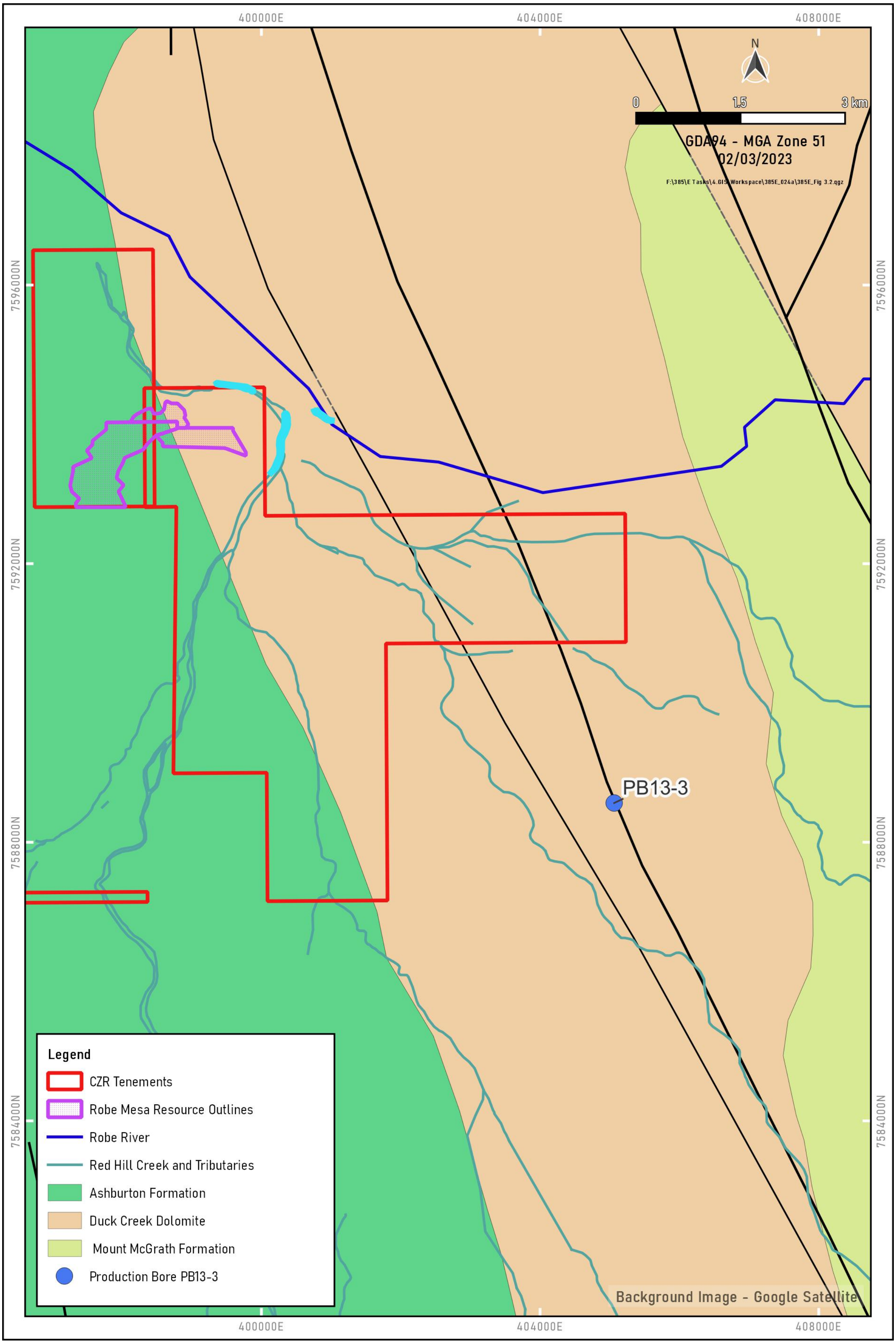


Figure 3.2 Basement Geology in Robe Mesa and PB13-3 Areas

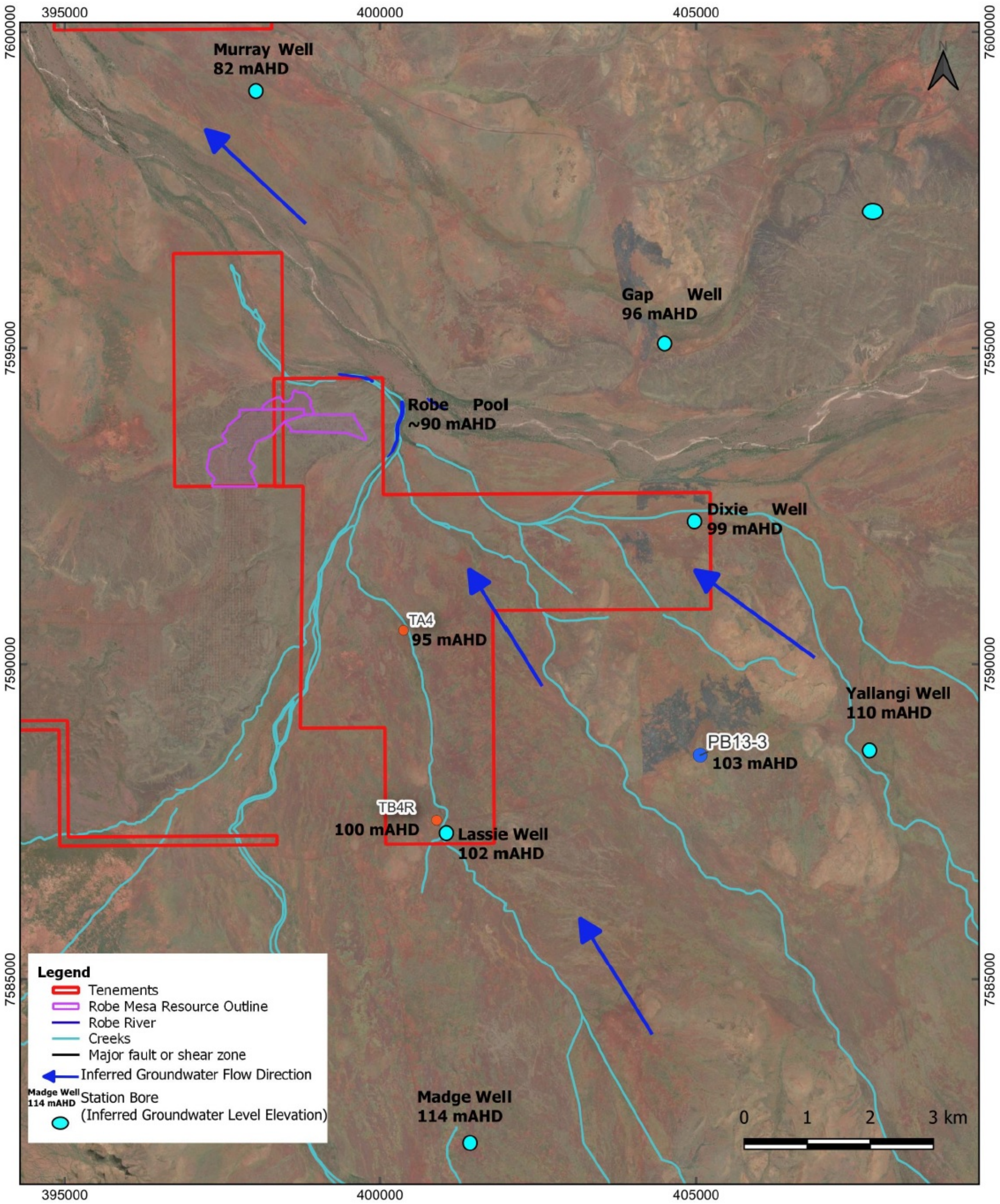


Figure 3.3 Inferred Groundwater Level Elevation and Flow Direction at Robe Mesa and PB13-3 Areas

4. EXISTING GROUNDWATER USE

4.1 Groundwater Dependent Ecosystems

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 BOM GDE Atlas shows no wetlands of environmental significance present in the vicinity (5 km radius) of the water supply bore PB13-3 (Figure 4.2).

Pools in the Robe River immediately adjacent to the Robe Mesa deposit may be groundwater dependent (GDEs) and if so, would be sensitive to hydrological changes. Available vegetation studies conducted along the Robe River (Rio Tinto, 2018) indicated the presence of groundwater dependent vegetation (GDV, mature dominated closed and open forest) in the Robe Mesa Project area. This study concluded a strong correlation between the distribution of mature GDV and alluvial bed intersection/interactions with underlying porous lithologies such as CIDs. It is therefore possible that pools in the Robe River immediately adjacent to the Robe Mesa deposit are in direct or indirect (through the valley-fill sediments) hydraulic connection with the CID aquifer; this is known from other CID / creek settings in the Pilbara where groundwater stored in the CID supports perennial pools in adjacent creeks. However, registered pools (i.e. Robe and Chalyarn Pools) in the Robe River are located approximately 7 km to the northeast of water supply bore PB13-3, as shown in Figure 4.1. It is noted that there may be another non-registered pool in the Robe River, located approximately 6 km north of PB13-3 that may be a GDE. Additionally, the BOM's GDE Atlas does not show any GDEs within 5 km radius from PB13-3 (Figure 4.2).

There is the potential of stygofauna and troglofauna habitats being present within and immediately adjacent to the Project area (as shown on Figure 4.1 as Threatened Ecological Communities (TEC)/ Priority Ecological Community (PEC) buffer within Mesas); these subterranean invertebrate communities were recorded in the other pisolotic hills (mesas) in the Pilbara and in the Robe Valley region. Due to the proposed mining at Robe Mesa being significantly above the water table (i.e. Upper CID sheet) stygofauna habitats are unlikely to be at risk. Biota undertook a single sampling event at bore PB13-3 itself in November 2022, along with nearby monitoring bore MB13-3, using methods in accordance with relevant technical guidance. No stygofauna were recorded from bore PB13-3 and MB13-3 during the November 2022 sampling. Biota have completed a Stygofauna Assessment of the water supply area of the Robe Mesa Project, providing information on potential impacts to stygofauna GDEs from bore PB13-3 pumping (refer to Biota, 2023 for more detail).

In addition, Figure 4.1 shows the occurrence of a PEC where bore PB13-3 is located. CZR have provided a summary of the Priority Ecological Communities (PECs) and the results of the surveys and investigations that have been undertaken in the Robe Mesa Project area, including the area of potential pumping influence from bore PB13-3 (CZR, 2023). The key points are:

- The area associated with PB13-3 is restricted to the plains and is not associated with topographical landforms required to represent the *Triodia pisoliticola* PEC (i.e. commonly found on the edge of mesas in a specialised habitat known in geomorphological terms as the 'stripped margin').
- *Acacia pruinocarpa* is found as part of the *Triodia pisoliticola* PEC, it usually occurs as a tall shrub and rarely exceeds 3m tall, which reflects the harsh conditions of this environment. However,

Acacia pruinocarpa is found from the hardpan plains to the hills and has no particular affinity with creek lines.

- Three vegetation units recorded across the broader Robe Mesa Project area and surrounds (E2; E5; and M1) contain elements of groundwater dependent vegetation. These units comprise drainage systems that support *Eucalyptus victrix* (low to moderate dependence), *Eucalyptus camaldulensis* subsp. *refulgens* (moderate dependence) and/or *Melaleuca argentea* (high dependence). These three species are all indicator species of groundwater dependent vegetation (Rio Tinto 2020). Of these vegetation units, only E2 is mapped within the Robe Mesa Project disturbance envelope and only represents 0.5 ha of the disturbance footprint (associated with a drainage crossing point along the transport corridor).
- The production bore PB13-3 is located approximately 7.5-8 km southeast from the Robe River pools and any mapped groundwater dependent vegetation, with no E2 vegetation unit mapped in the vicinity.

As stated above, the BOM GDE Atlas does not show any GDE within a 5 km radius from PB13-3 (Figure 4.2). Local vegetation within the PB13-3 area is identified as "shrubby soft spinifex grasslands" (BOM, 2023). This 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 the groundwater (i.e. phreatophytic vegetation) and has identified "low potential GDE from the national assessment" (BOM, 2023). Additionally, the groundwater table at PB13-3 is around 12 to 14 mbgl, well below most plants' rooting depths.

There are no major ephemeral surface water features in the vicinity of water supply bore PB13-3 and due to the depth to water table (i.e. ~12 to 14 mbgl), it is unlikely that groundwater and surface water systems are in direct hydraulic connection (the water table is below the base of the local creek beds). 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 creek would be dominated by surface water runoff, with a minimal contribution from the groundwater.

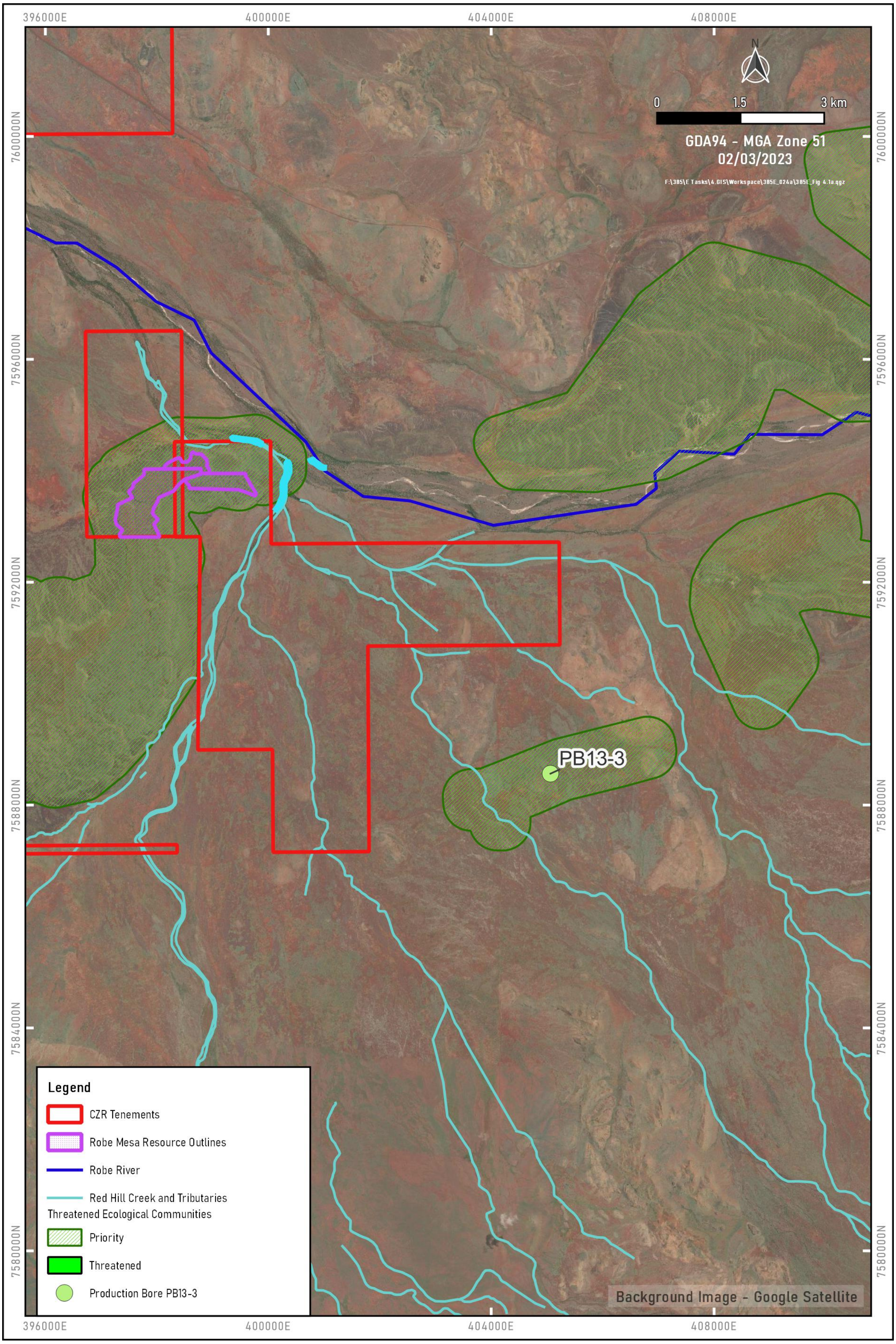


Figure 4.1 Locations of TECs and PECs in the Robe Mesa and PB13-3 Areas (DWER)

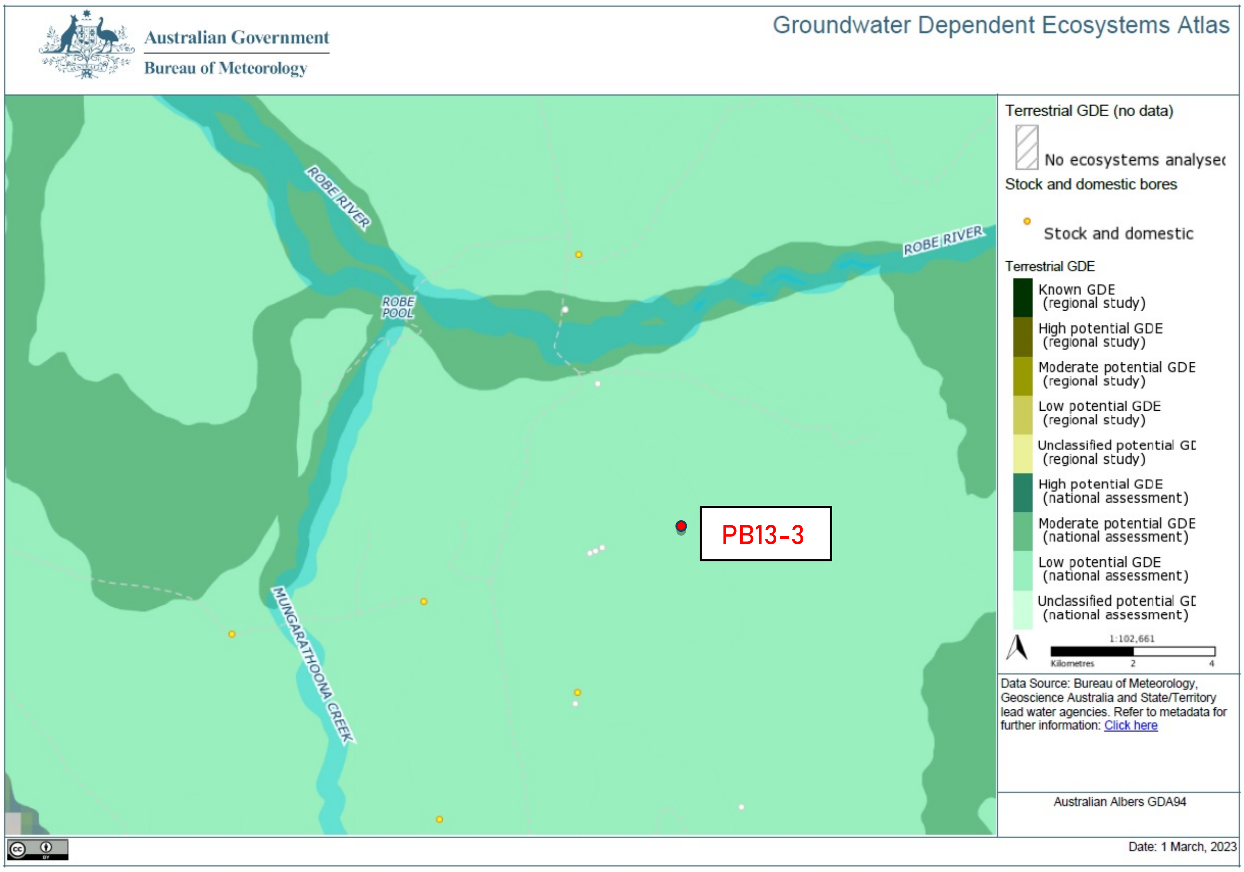


Figure 4.2 Desktop Search Results of GDEs Within 5 km Radius of PB13-3 (BOM GDE Atlas Map)

4.2 Other Groundwater Users

Existing groundwater use has been assessed via the DWER Water Register Database of licenced registered users. According to this database there are currently several licenced groundwater users that abstract water, mainly from the fractured rock aquifer system, in the local area, but there are only five licenced groundwater users within a 5 km radius of bore PB13-3. However, none of the licenced groundwater users have a licenced drawpoint within this 5 km radius. The closest licenced drawpoint is located approximately 5.8 km to the south of PB13-3 and sources water from the fractured aquifer (a part of the API GWL167780). It should be noted that there are 18 licenced drawpoints that are part of GWL167780 (which allows the abstraction of a total of 38,000 kL/year; 1.2 L/s). Licenced drawpoints of the existing groundwater users and the annual allocations are shown in Figure 4.3 and are summarised in Table 4.1.

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) and shows that there are 4 sites within a 5 km radius from PB13-3 (Figure 4.3). All these sites are shallow station/stock bores that have been drilled in the Quaternary sediments to depths of 5 to 13 mbgl. There is limited information on geology and hydrogeology (i.e. water levels) or status/conditions of these stock bores. However, based on information from a recent field trip, Lassie Well is still operational.

Table 4.1 Current Groundwater Licences Within 5 km Radius of PB13-3 (DWER)

GWL Number	Issue Date	Expiry Date	Licence Allocation (kL/year)	Licence Holder	Aquifer
167780	7/12/17	7/12/27	38,000	API Management Pty Ltd	Hamersley - Fractured Rock
174888	10/8/17	10/8/27	500,000	API Management Pty Ltd	Hamersley - Fractured Rock
179197	1/8/17	1/8/27	14,020	Bungaroo South Pty Ltd	Hamersley - Fractured Rock
180637	1/12/22	30/11/32	95,000	API Management Pty Ltd	Hamersley - Fractured Rock
180642	7/5/15	23/2/25	15,000	API Management Pty Ltd	Pilbara - Fractured Rock

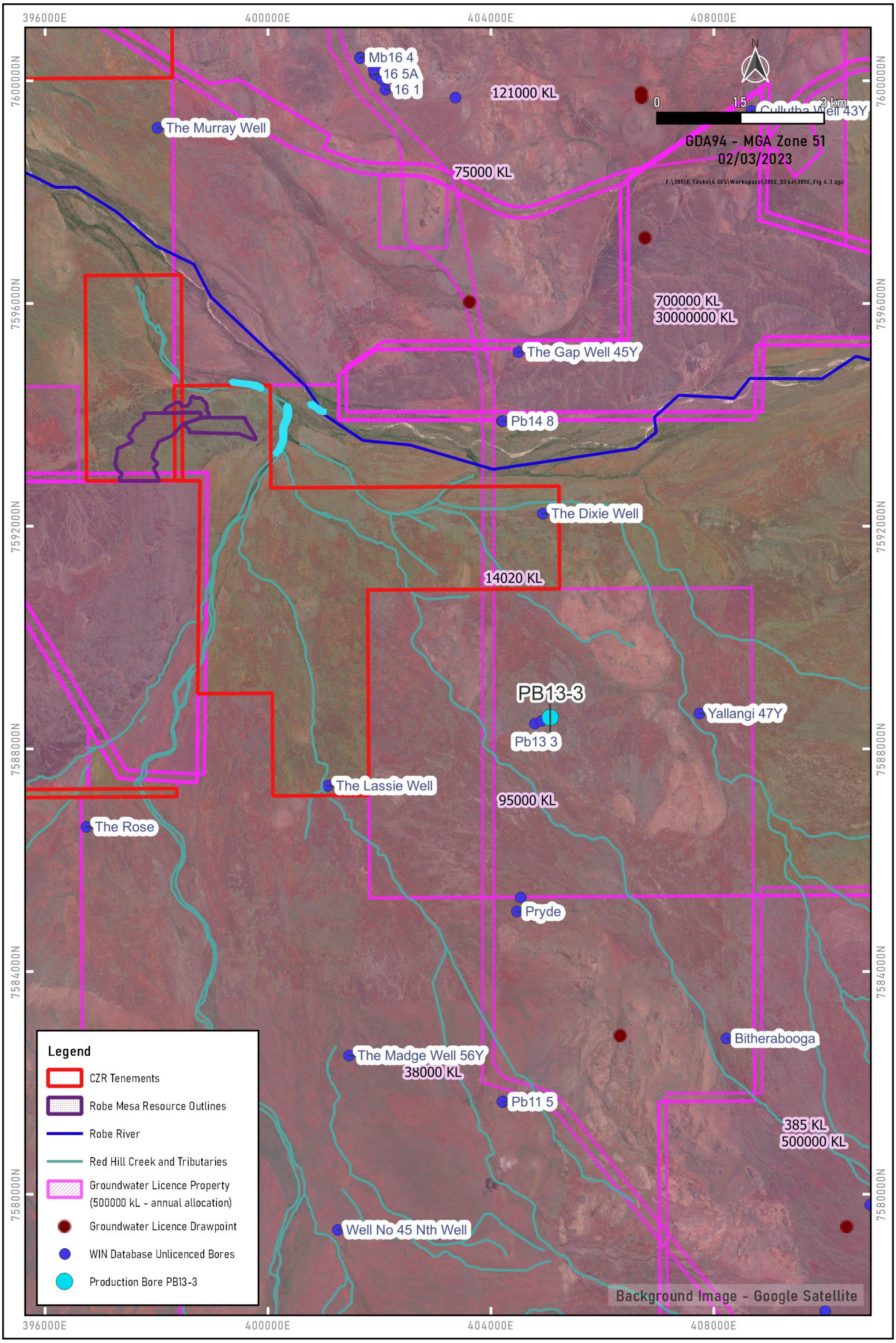


Figure 4.3 Current Licenced Drawpoints, Groundwater Users and WIN Database Bores within 5 km Radius of PB13-3 (DWER)

5. INVESTIGATION PROGRAMMES

As outlined in Section 1, Robe Mesa mine will have a water demand of 17 L/s and this is likely to be entirely sourced from bore PB13-3. Data collected to-date during the drilling, bore construction and testing of the water supply bore PB13-3 is presented in the following sections.

5.1 Drilling and Bore Construction (2010)

Production bore PB13-3 was drilled and constructed by Welldrill with hydrogeological support from RPS Aquaterra personnel on behalf of API Management in December 2010 (RPS, 2021). PB13-3 was drilled within the Duck Creek Dolomite Formation to a depth of 94 mbgl. Its lithological and construction log is presented in Appendix A. It should be noted that the lithological log records the bore having been drilled into gravel, but it is thought that this is actually fault Breccia within the Duck Creek Dolomite. Breccia is a common rock type found in fault zones (like the regional fault that runs through PB13-3). It should also be noted that breccia is outcropping north and south of PB13-3 (as shown on Figure 3.1). Breccia is generally composed of coarse rock fragments (at least 30% of gravel-sized particles) held together by cement or a fine-grained matrix.

Bore PB13-3 was cased with 200 mm internal diameter (ID) PVC casing from the ground surface to 91.5 mbgl. Slotted casing was installed from 16.5 to 88.5 mbgl with a blank sump from 88.5 to 91.5 mbgl and plain blank casing from ground level to 16.5 mbgl. On completion, the bore was airlift developed with an airlift yield of 25 L/s and a water electrical conductivity (EC) of 913 µS/cm.

Monitoring bore MB13-3 was drilled on the same drill pad as PB13-3 and it was cased with 50 mm ID PVC casing from the ground surface to 60 mbgl. Slotted casing was installed from 18 to 60 mbgl and plain blank casing from ground level to 18 mbgl. On completion, the bore was airlift developed with an airlift yield of 8.5 L/s and a groundwater electrical conductivity (EC) of 906 µS/cm.

The location of PB13-3 is shown in Figure 1.2. Construction details for the bores are summarised in Table 5.1. Lithological and construction logs for PB13-3 and MB13-3 are presented in Appendix A.

Table 5.1 Bore Construction Details

Bore Name	Easting	Northing	Ground Level (mAHD)	Casing Material & Internal Diameter	Cased Depth (mbgl)	TOC PVC (magl)	Screen Depth (mbgl)	Static Water Level (mbTOC)	Static Water Level (mbgl)	Final Airlift Yield (L/s)
PB13-3	405066	7588562	115	PVC 200mm	91.5	0.23	16.5 to 88.5	12.80 04/07/22	12.57 04/07/22	25
MB13-3	405074	7588576	115	PVC 50mm	60.0	0.90	18 to 60	13.78 04/07/22	12.88 04/07/22	8.5

Note: coordinate projection is GDA94 Zone 50K, mAHD – metres above Australian Height Datum, mbgl – metres below ground level, TOC – top of casing, mbgl – metres below ground level, mbTOC – metres below top of casing, L/s – litres per second

5.2 Initial Bore Appraisal

Following the drilling and bore construction in December 2010, bore PB13-3 was test pumped in May 2011. Details and results of the original test pumping at PB13-3 are presented in Appendix B (RPS, 2011) and summarised below.

The pumping tests consisted of:

- 3 x 60 minute step rate test (SRT) with steps of 17, 22 and 30 L/s and final water level drawdown of 4.31 m.
- 24 hour constant rate test (CRT) at 30 L/s with a final drawdown of 5.06 m in pumping bore PB13-3 and 2.13 m in monitoring bore MB13-3.

The results have shown that the bore is clearly high yielding in the short term, however following recent review of the data there were concerns that PB13-3 had not been tested sufficiently to determine its suitability to supply CZR water demand of 17 L/s over the long term. It should be noted that bore PB13-3 was originally installed for railway construction water supply, which entails use for a relatively short timescale of only a few weeks or months. Therefore, longer term testing would not have been required as long term yield did not have to be assessed. Bores installed within fracture zones around faults often have high transmissivity values, but can have low storage, due to high secondary porosity provided by the fractures, but low water bearing primary porosity within the main rock mass.

Bore PB13-3 and monitoring bore MB13-3 were initially visited by CZR and AQ2 on 4th July 2022 to assess their condition at surface. Both bores were found to be in relatively good condition and their headworks are pictured in Figure 5.2. Both bores were dipped and their groundwater levels are recorded in Table 5.1. Both bores were assessed as being suitable to be tested in further pumping tests over a longer time period to determine longer term water yield.

Figure 5.2 Bore Headworks

5.3 Recent Pumping Tests (2022)

A second test pumping programme was carried out on bore PB13-3 by Matrix Hydro from 12 December 2022 to 4 January 2023, under the remote supervision of an AQ2 hydrogeologist. Water levels were monitored in production bore PB13-3 and monitoring bore MB13-3, which is 14.8 m from the pumping bore.

Pumping tests were undertaken on PB13-3 to:

- Estimate the hydraulic conductivity of the fractured/faulted aquifer (for use in the impact assessment).
- Confirm the along-strike continuity of the fractured/faulted aquifer.
- Confirm the presence of either barrier or recharge boundaries in the aquifer (e.g. low permeability fault zones and zones of increased storage, respectively).
- Determine the long-term pumping rate (i.e. sustainable yield) and pump depth settings.

The pumping tests comprised:

- Step-rate test (SRT; 4 steps at 100 minutes each).
- 7-day (168-hour) constant rate test (CRT).
- Recovery measurements following the cessation of pumping (until groundwater levels were within 90% of the pre-constant rate test level).

An electric submersible pump was set at a depth of 71.6 mbgl within the bore with a water discharge approximately 200 m to the northwest of the bore. The discharge was down the topographic gradient from the bore to allow drainage away from it and minimise the possibility of water recirculation during the test. During the test, pumping rates were measured using an in-line flow meter. Water levels were measured in production bore PB13-3 and adjacent monitoring bore MB13-3 using an electrical water-level probe (taking manual readings at set time intervals) and data loggers/pressure transducers (taking continuous readings) installed at these bores.

5.3.1 Step Rate Test

A step rate test (SRT) was carried out on bore PB13-3 on 13th December 2022 by Matrix Hydro and comprised a 4 x 100 minute duration test at progressively increasing rates of 5, 10, 15 and 20 L/s.

SRT data were used to make a preliminary assessment of bore yield and confirm the target pumping rate for the CRT. Drawdowns in the pumping bore of 0.43 m, 0.99 m, 1.66 m and 2.44 m were recorded at the end of each respective step. Step test drawdown values are shown graphically in Figure 5.3.

Analysis of the SRT data showed a linear relationship between pumping rate (Q) and drawdown divided by pumping rate (s/Q) for the 5 to 20 L/s rates tested and this is shown in Figure 5.3.

The SRT data were also graphically analysed using the Hantush-Bierschenk method to estimate bore efficiency. Bore efficiency rates are also shown in Figure 3.1 and were calculated at 89% at 5 L/s, decreasing to 67% at 20 L/s. These values represent the percentage of the total drawdown (at 100 minutes of pumping) caused by friction losses in the formation, rather than in the bore itself, indicating that PB13 3 is efficient.

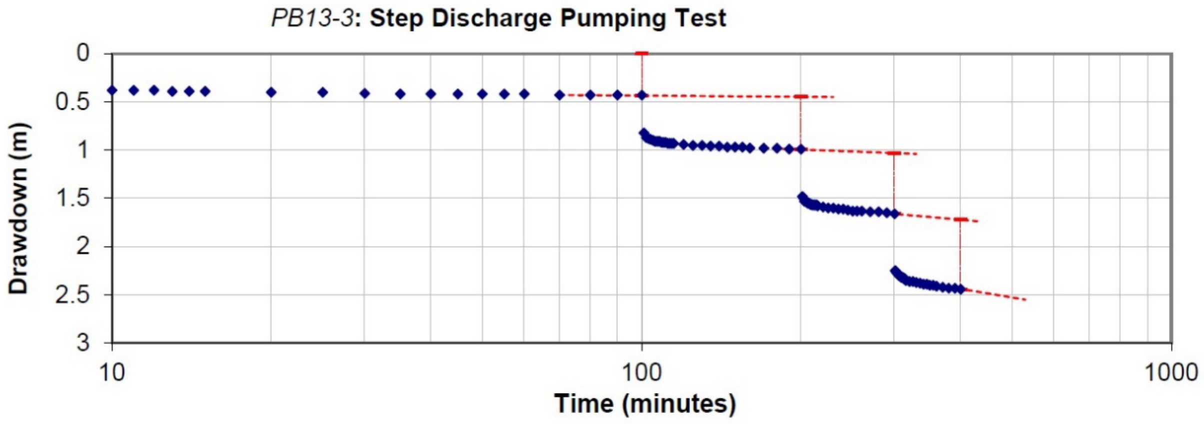
The SRT data showed the bore to be very productive and suggested that it should be able to cope with a pumping rate of 17 L/s to meet the mine water demand. This would be confirmed by the 7 day constant rate test.

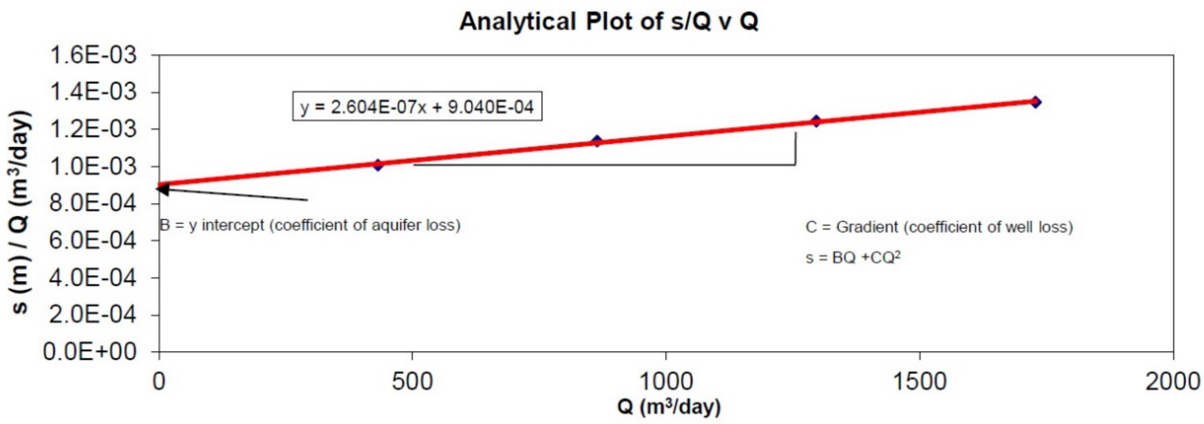
5.3.2 Constant Rate Test and Recovery

Based on the SRT results, bore PB13-3 was tested at average pumping rate of 17 L/s during a 7 day (168 hours) constant rate test (CRT), which commenced on 14 December 2022. Measured drawdowns for the production bore PB13-3 and monitoring bore MB13-3 versus time on semi-log (linear versus logarithmic) are shown in Figure 5.4.

At the end of the CRT, the water level in PB13-3 had drawn down 3.16 m from a pre-pumping level at 13.79 mbgl. A proportion of the drawdown resulted from well loss caused by turbulent or non-linear laminar flow across the aquifer-bore interface. The monitoring bore MB13-3, located 14.8 m from PB13-3, had a maximum drawdown of 1.85 m, suggesting a very good hydraulic connectivity with the pumped bore.

At the production and monitoring bores, the rate of drawdown remained relatively constant for the first 500 minutes of the CRT, after which the drawdown rate increased for the remainder of the test duration (Figure 5.4). This increase in drawdown indicates a boundary, likely to be a result of the cone of depression reaching the edge of the fractured/faulted bedrock aquifer system.





$s_{w(n)} = BQ_n + CQ_n^P$ (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.

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

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

From plot of s/Q v Q (trend line equation): **Intercept (B)** 9.040E-04
Gradient (C) 2.604E-07

ANALYSIS TABLE

Calculation of well efficiency and comparison of observed and predicted drawdowns							
Step (60 minute duration)	Discharge (l/s)	Discharge (Q) (m^3/d)	Measured Incremental Drawdown (metres)	Corrected Drawdown (metres)	Predicted Drawdown (metres)	s/Q	Apparent Efficiency (Ew) %
1	5.0	432	0.44	0.44	0.44	1.01E-03	88.9
2	10.0	864	0.55	0.98	0.98	1.14E-03	80.1
3	15.0	1296	0.63	1.61	1.61	1.25E-03	72.8
4	20.0	1728	0.72	2.33	2.34	1.35E-03	66.8

Figure 5.3 Bore PB13-3 Step Rate Test

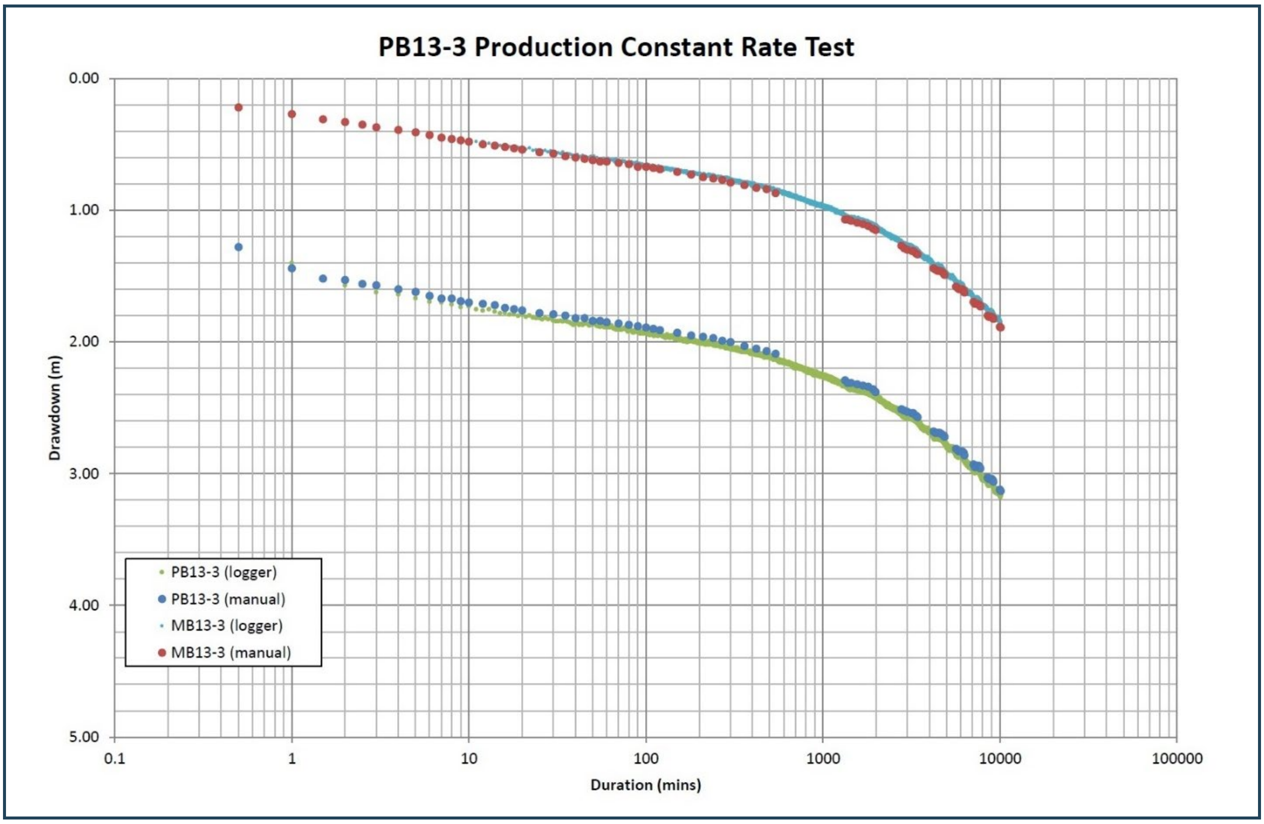


Figure 5.4 Bore PB13-3 Constant Rate Test Drawdown

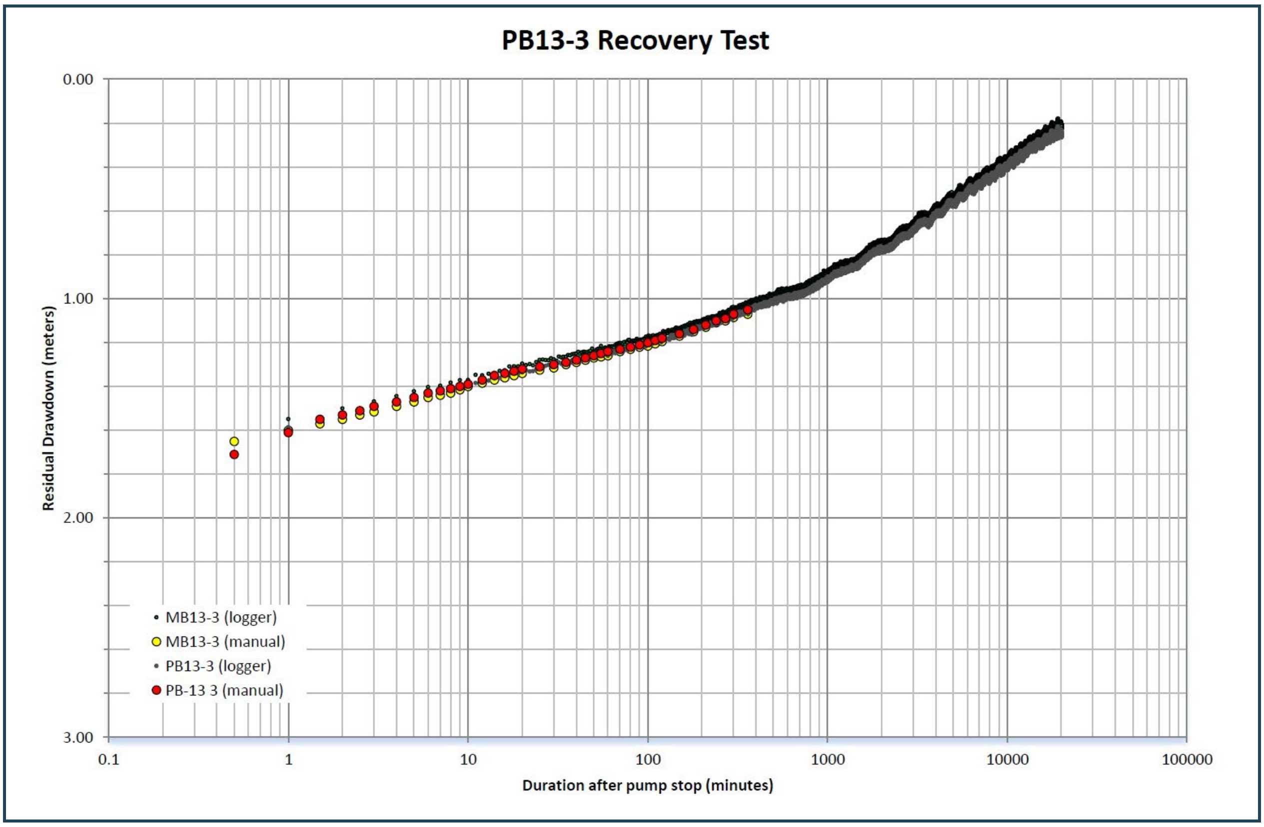


Figure 5.5 Bore PB13-3 Recovery Test

Recovery data (Figure 5.5) shows that the water levels in both production and monitoring bores recovered by 40% within the first 10 minutes after the cessation of pumping, demonstrating a transmissive aquifer. However, the remaining 60% of the initial water level recovery took several days to recover, indicating some removal of water from storage and a restricted groundwater aquifer inflow rate.

Drawdown data collected during the aquifer testing was analysed using AQTESOLV software (HydroSOLVE Inc.) to infer representative hydraulic parameters of the tested aquifer. 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 the estimations of aquifer parameters.

It should also be noted that aquifer test analyses have been 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 the time (i.e. the Cooper-Jacob and Theis methods were used in our assessement). The analysis methods are detailed in Kruseman and de Ridder (1994).

A summary of the data and analyses for the fractured aquifer is presented in Table 5.2. Time-drawdown plots for the production and monitoring bores and the results are presented in Appendix C and discussed below.

Table 5.2 Summary of Test Pumping Results

Bore	Distance from PB13-3 (m)	SWL[1] (mbgl)	Pump Depth Setting (mbgl)	Average Pumping Rate (L/s)	Drawdown at End of Test (m)	Aquifer Thickness (m)	Average T [2] (m^2/d)	Average K[2] (m/day)
PB13-3	0	13.79	71.6	17	3.16	72	220	3.1
MB13-3	14.8	14.00	NA	NA	1.85	72	235	3.3

Static water Level (SWL) was taken before start of CRT (14/12/23)
Geometric mean
NA not applicable
T Transmissivity
K Permeability/hydraulic conductivity

Analysis of the late-time drawdown and recovery data from the pumped bore PB13-3 and monitoring bore MB13-3 indicates that the average transmissivity value of the fractured/faulted Duck Creek Dolomite was calculated to be 230 m^2/d. It should be noted that values of aquifer hydraulic conductivity (permeability; k) were derived from the transmissivity data calculated from the tests, by dividing the transmissivity by the aquifer thickness (screen interval). Therefore, based on an aquifer thickness of 72 m, the average hydraulic conductivity is 3.2 m/d. It should also be noted that the calculated transmissivity and permeability values are bulk values for all of the aquifer material - none of the values apply to individual features (e.g. faults, fractures or shears) of higher permeability.

5.3.3 Pumping Tests Conclusions

The pumping tests show that production bore PB13-3 is able to sustain an abstraction rate of 17 L/s, having a drawdown of only 3.16 m after 7 days of continuous pumping at 17 L/s. Monitoring bore MB13-3 had a drawdown of only 1.85 m after the same time period. Projection of pumped water levels in bore PB13-3 at 17 L/s shows a production bore water level drawdown of approximately 6 m after 2 years of continuous pumping and about 7.0 m after 10 years of pumping at 17 L/s, conservatively assuming no recharge. Under the same scenario, monitoring bore MB13-3, which is more representative of overall aquifer water levels, has a predicted drawdown of approximately 5 m after 2 years and about 6 m after 10 years of continuous pumping at 17 L/s, assuming no recharge. This projection assumes that there are no significant hydraulic changes, such as major fracture set dewatering and consequent increase in the drawdown rate.

In conclusion, bore PB13-3 should be able to deliver the full 17 L/s mine water demand of Robe Mesa Project.

5.4 Groundwater Chemistry

A groundwater sample was taken from production bore PB13-3 just prior to the end of the constant rate test on 21/12/22. The sample was shipped to SGS labs in Perth for analysis and the results are listed in Table 5.3, with the original laboratory data presented in Appendix D. The results are compared with the Australian Drinking Water Guidelines (ADWG) values (Version 3.8, September 2022).

At PB13-3, groundwater is fresh, with salinity of 540 mg/L total dissolved solids (TDS) and is slightly alkaline (pH of 7.9). The water quality is good and is of potable quality. All determinands tested were well below the ADWG health based maximum guideline values and the water has a relatively low electrical conductivity of 950 µS/cm. Only one determinand exceeded the ADWG aesthetic maximum value, with hardness being 250 mg/L CaCO3, compared to the guideline maximum value of 200 mg/L CaCO3. This has no health implications and simply means that the water is hard and may cause some carbonate scaling in pipework.

Table 5.3 PB13-3 Hydrochemistry

Determinand	Units	PB13-3 (21/12/22)	Australian Drinking Water Guideline Values*	
			Health	Aesthetic
pH	pH Units	7.9	-	6.5 - 8.5
Conductivity @ 25 C	µS/cm	950	-	-
Bicarbonate Alkalinity as HCO_3	mg/L	350	-	-
Carbonate Alkalinity as CO_3	mg/L	<5	-	-
Total Alkalinity as $CaCO_3$	mg/L	280	-	-
Sulphate, SO_4	mg/L	27	-	250
Chloride, Cl	mg/L	130	-	250
Total Dissolved Solids Dried at 175-185°C	mg/L	540	-	600
Calcium, Ca	mg/L	44	-	-
Magnesium, Mg	mg/L	33	-	-
Potassium, K	mg/L	7.4	-	-
Sodium, Na	mg/L	92	-	180
Total Hardness by Calculation	mg CaCO3/L	250	-	200

Determinand	Units	PB13-3 (21/12/22)	Australian Drinking Water Guideline Values*	
			Health	Aesthetic
Nitrate, NO_3 as NO_3	mg/L	9.5	50	-
Fluoride by ISE	mg/L	0.7	1.5	-
Aluminium	µg/L	<5	-	200
Arsenic	µg/L	<1	10	-
Cadmium	µg/L	<0.1	2	-
Copper	µg/L	<1	200	100
Iron	µg/L	<5	-	300
Manganese	µg/L	<1	500	100
Lead	µg/L	<1	10	-
Zinc	µg/L	<5	-	300

Key: * Version 3.8, September 2022, Blue denotes ADWG aesthetic exceedances, Red denotes ADWG health exceedances

The water is bicarbonate dominant with sodium, calcium and magnesium important. On an Expanded Durov plot shown in Figure 5.6, it plots in the second subfield, which is often indicative of waters that are associated with dolomites, in this case the Duck Creek Dolomite. Water within this sub field also indicates younger water with fairly active recharge.

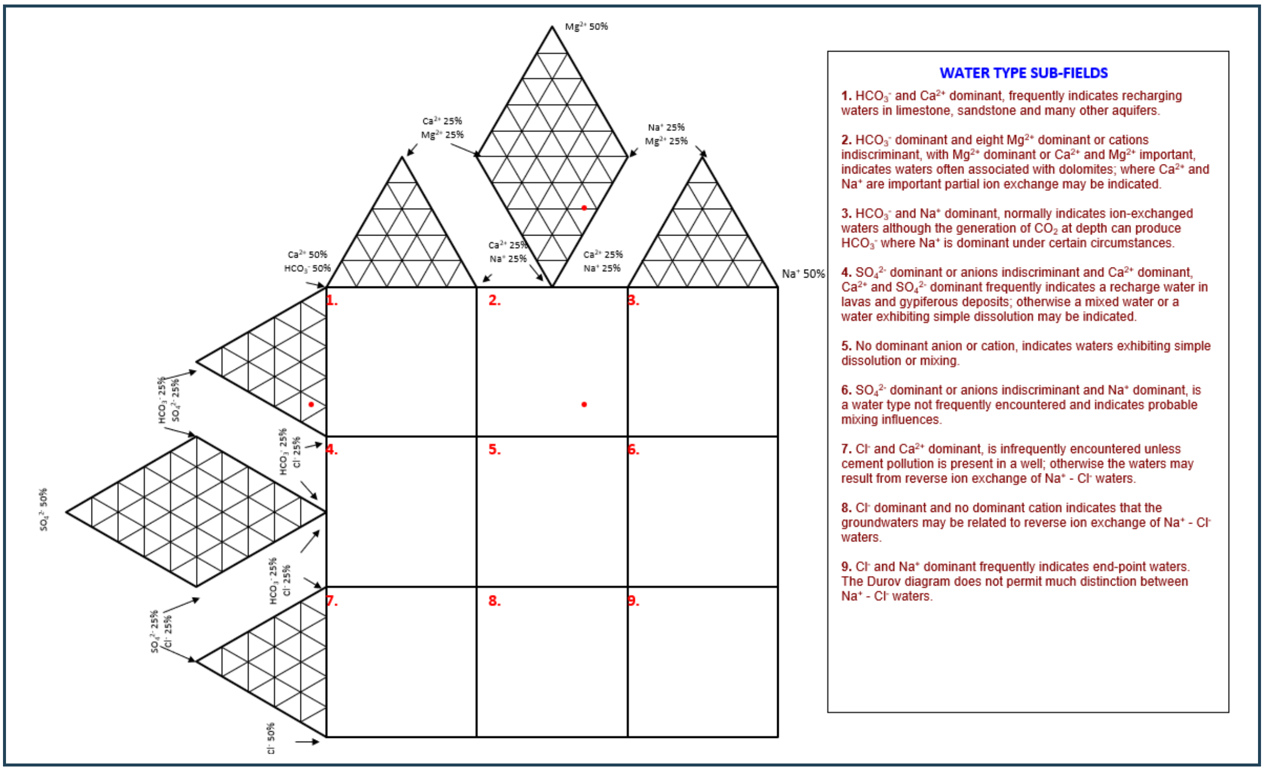


Figure 5.1 PB13-3 Expanded Durov Plot

In summary, the groundwater from PB13-3 is of potable quality with respect to dissolved determinands and should be able to be used for most applications. It is also hard, which may lead to scaling in pipework. If the water is to be used for potable supply, it will need to be analysed for an expanded suite of toxic metals and microbiology, including pathogens and amoeba.

6. ASSESSMENT OF POTENTIAL IMPACTS

6.1 Predicted Drawdowns

Extrapolation of the test pumping late-time drawdown data at PB13-3 (Figure 6.1) indicate that the required pumping rate of 17 L/s is sustainable in the long-term, i.e. the water level over the 7-year mine life will drop to approximately 20 mbgl (i.e. 6.2 m drawdown), which is well above a pump depth set at 72 m. However, the maintenance of trend of the aquifer test data, will depend on the fractured aquifer response to longer term pumping, assuming that no further boundaries are intersected or major fracture set dewatering (with consequently increase in the drawdown rate). These drawdown predictions conservatively assume that there is no rainfall recharge, however the reality is that the water quality results from PB13-3 (refer to Section 5.4) indicate younger water with fairly active recharge.

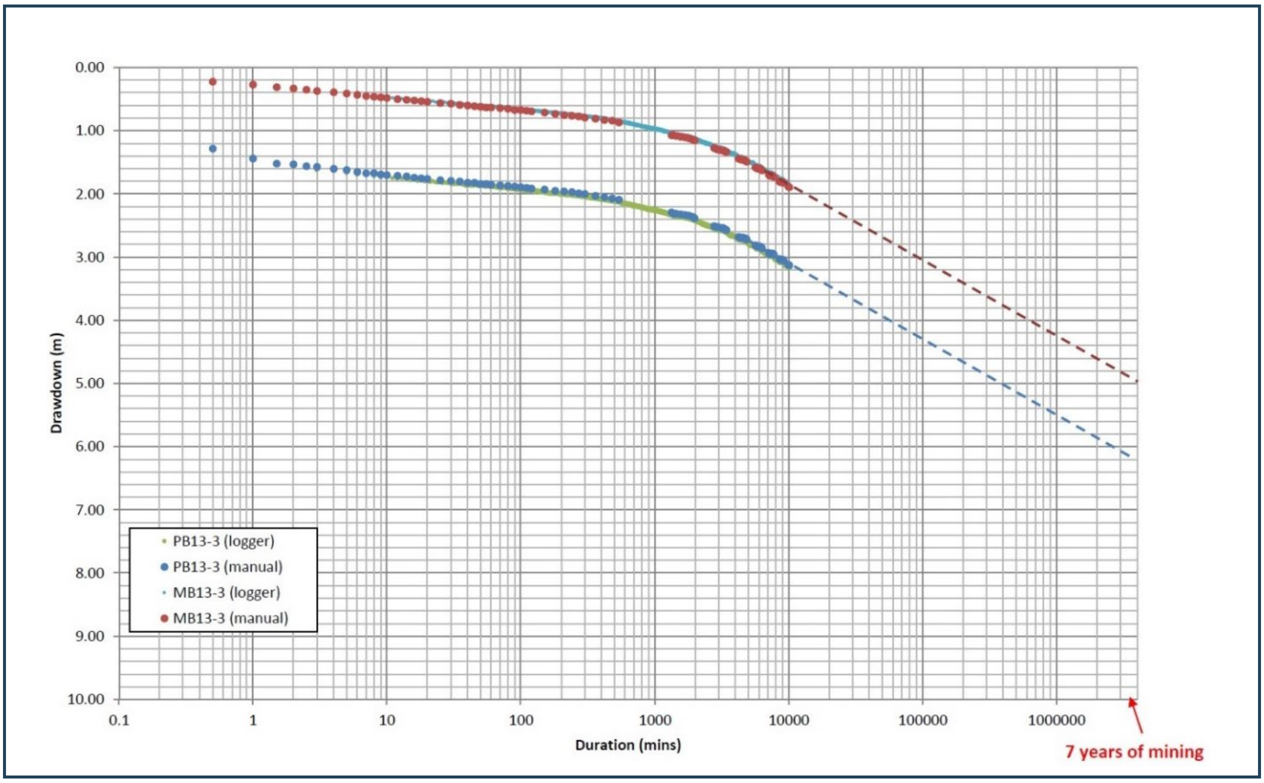


Figure 6.1 Extrapolated Long-Term Drawdown at PB13-3 and MB13-3

Additionally, the maximum extent of the drawdown (radius of influence) from pumping from PB13-3 at a total rate of 17 L/s for 7 years was predicted using an analytical model derived from the Jacob Equation below:

$$r_o = \sqrt{\frac{2.25*k*b*t}{Sy}}$$

where: ro = radius of maximum extent of cone of drawdown (m)

k=hydraulic conductivity (m/d)

b=aquifer thickness (m)

t=time since pumping or inflow started (days)

Sy=specific yield (unitless).

It should be noted that two separate Jacob equations were used to predict the maximum distances that drawdown extends in the fractured/faulted aquifer (along the north to south strike of the fault zone) as well as in the unfractured basement rock to the east and west.

The analytical model in the fractured/faulted aquifer adopted the following parameters:

- Transmissivity of 230 m^2/d – derived from late-time test pumping data (i.e. permeability of 3.2 m/d and aquifer thickness of 72 m).
- Specific yield of 5%.

The model in the unfractured basement rock adopted the following parameters:

- Transmissivity of 3.6 m^2/d – typical value in the Pilbara region based on permeability of 0.05 m/d and aquifer thickness of 72 m).
- Specific yield of 1%.

The models predict that the maximum distance that drawdown extends (i.e. the distance where there is no lowering of water table or potentiometric surface) from pumping bore PB13-3 is up to 5.2 km along the fault/fracture zones (extending in a northwest direction) and less than 1.5 km in areas of no fracturing with a lower bulk permeability (across the fault zone).

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 the 1 m drawdown along and across the fault/fracture zones as a result of pumping from PB13-3 at a total rate of 17 L/s for 7 years. Figure 6.2 shows the model predicted drawdown contour of 1 m only extending up to 2 km each way along the fault/fracture zones with drawdown extending up to 500 m perpendicular from the fault in the unfractured bedrock, assuming the fault zone is approximately 800 m wide (i.e. 400 m both sides from PB13-3).

In addition, sensitivity analyses have been undertaken on the key aquifer parameters (i.e. hydraulic conductivity and specific yield) in determining drawdown predictions for impact assessment. At this basic level of assessment, the uncertainty is considered appropriate based on a 50% reduction in the hydraulic conductivity and 50% decrease in specific yield of the faulted/fractured aquifer (tested aquifer) to provide even more conservative cases. The Jacob equation was used and the results of the sensitivity analyses are as follows:

- Reducing the hydraulic conductivity in the fractured aquifer by 50 % of the value obtained from the late-time CRT and recovery data (i.e. reduced hydraulic conductivity of 1.6 m/d) resulted in an increase in the drawdown rate at the pumped bore PB13-3, however the maximum distance that drawdown extends (i.e. the distance where there is no lowering of water table or potentiometric surface = “zero” drawdown) would decrease to 3.6 km (as opposed to 5.2 km for the expected case).
- Very conservatively decreasing both the specific yield of the fractured aquifer by 50 % (i.e 0.025) together with a 50 % decrease in hydraulic conductivity (i.e 1.6 m/d) would result in a similar maximum extent of the drawdown as the base case values obtained from the pumping tests.

That is, the drawdown impacts of water supply pumping will be localised. It should also be borne in mind that this drawdown distance is based on the prevailing aquifer conditions extending over that full distance; in reality, in a basement aquifer environment, fractured aquifers are unlikely to be extensive and some types of hydraulic barriers would be expected (i.e. dyke intrusions, or changes in geology), therefore reducing the extent of drawdown. As such, the predicted distance-drawdowns should be seen as theoretical maxima.

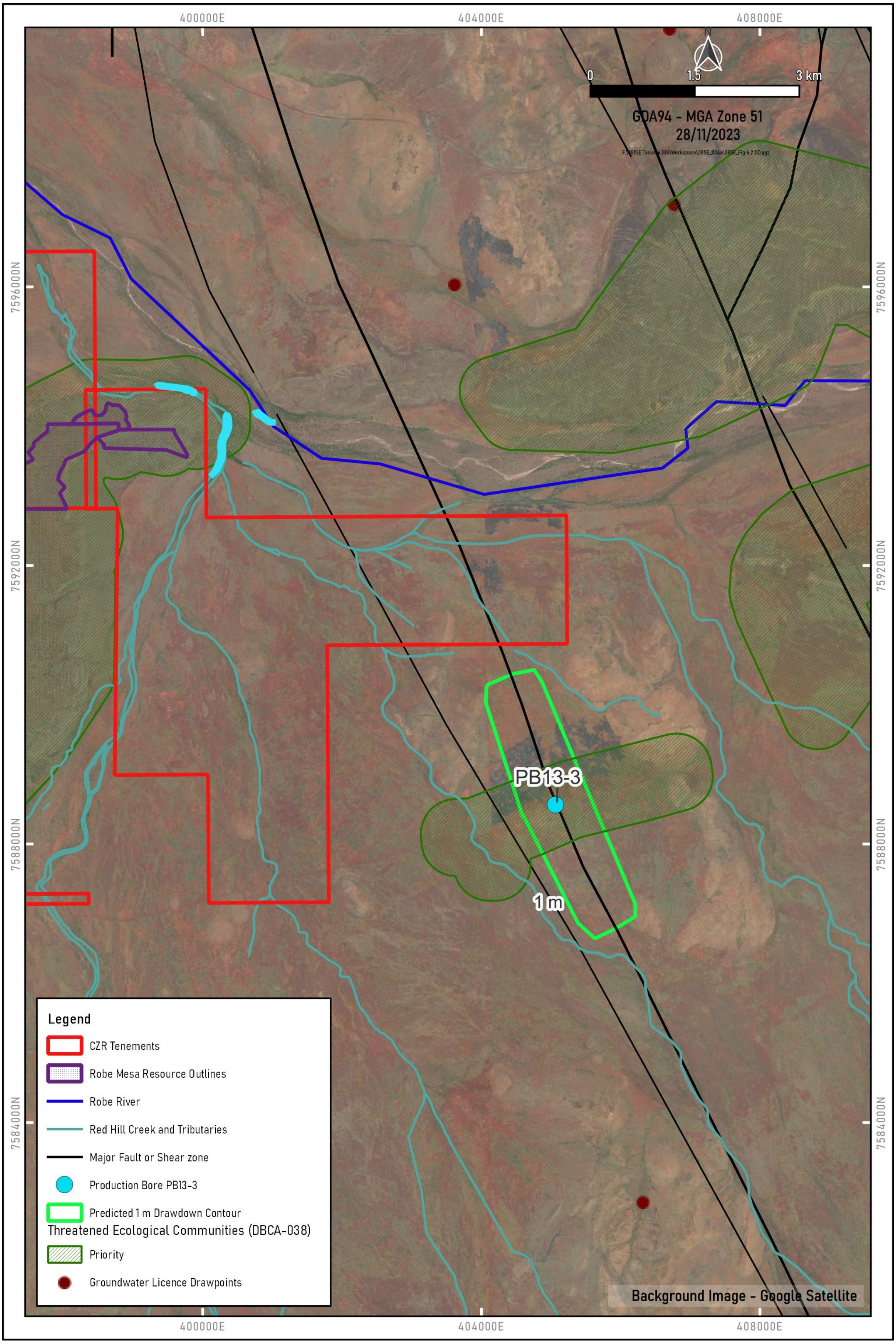


Figure 6.2 Predicted 1 m Drawdown Contour in the Bedrock Aquifer (Fractured and Unfractured) Due to Pumping PB13-3 at 17 L/s for 7 Years

6.2 Potential Impacts

Potential impacts caused by pumping from the single production bore PB13-3 on hydrogeological processes are discussed below.

6.2.1 Aquifers

The predicted drawdowns impact of abstraction of 17 L/s from bore PB13-3 are minimal. Drawdown will largely be confined to the fractured/faulted aquifer system and likely to be elongated along strike from the pumping bore. There will be minimal drawdown outside the fractured aquifer.

Regular monitoring of groundwater levels in the fractured/faulted aquifer during the pumping operations will provide information on the actual induced drawdowns and impacts on this aquifer.

6.2.2 Existing Other Groundwater Users

Based on the data available through the DWER databases (Section 4.2), there are no water supply bores within the maximum drawdown extent predicted in response to pumping from PB13-3 (up to 5.2 km). As a result, no licensed groundwater users would be impacted by the proposed abstraction. The closest licensed drawpoint is located approximately 5.8 km to the south of PB13-3 (Figure 6.2).

Additionally, none of the four stock bores located within a 5.2 km radius of PB13-3 are sited along the north south fault zone. The maximum drawdown extent of 1.5 km predicted across the fault zone (within the unfractured bedrock) does not reach the closest stock bore (i.e. Yallangi Well, located approximately 2.6 km to the east of PB13-3).

6.2.3 Groundwater Dependent Ecosystems

Based on the Biota 2023 stygofauna impact assessment of the water supply area of the Robe Mesa Project, it was concluded that:

- There will be no impact on stygofauna from the operation of production bore PB13-3.
- The very small magnitude and limited duration of the predicted aquifer drawdown and the relatively low significance of the affected groundwater habitats, mean that there will be no significant impact on stygofauna values in the locality or the region.

In addition, the vegetation surveys (CZR, 2023) concluded that:

- There are no Groundwater Dependent Ecosystems or Vegetation (GDEs or GDVs) associated with the location of production bore PB13-3 (as per BOM, GDEs Atlas).
- Five vegetation units were mapped within the maximum theoretical extent of the cone of depression (up to 1 m). Based on the species present and description of the vegetation, no key indicators species for GDV were recorded (i.e. no presence of *Eucalyptus victrix*, *Eucalyptus camaldulensis* subsp. *refulgens* and/or *Melaleuca argentea)*.
- The E2 vegetation unit recorded across the broader Robe Mesa Project area and surrounds that contain elements of groundwater dependent vegetation is not associated with PB13-3 and is not located within its conservative drawdown zone.

Local vegetation identified within the Project area obtain water from the soil moisture in the unsaturated zone above the water table, and are likely to rely on sporadic rainfall and overland water flow events, with no association to the groundwater (i.e. phreatophytic vegetation). Additionally, the groundwater table at PB13-3 is in the range of around 12 to 14 mbgl.

7. GROUNDWATER MANAGEMENT AND MONITORING

A groundwater monitoring programme is proposed to monitor aquifer performance and the potential impacts of ongoing groundwater abstraction upon commencement of bore PB13-3 abstraction and specify operational requirements. The monitoring data are to be compiled in regular monitoring reports and the monitoring programme will be amended as necessary.

Monitoring bore MB13-3 located approximately 15 m away from production bore PB13-3 is screened in fault Breccia and is considered suitable to efficiently monitor groundwater levels and water quality of the pumped aquifer (i.e. fractured bedrock aquifer system). The monitoring data collected from MB13-3 are essential in predicting drawdowns due to pumping, that can be used to determine impacts on the aquifer, GDEs (if any) or current groundwater user (~5.8km away from PB13-3) or any future users.

In addition, three monitoring bores are proposed to be included in the groundwater monitoring programme and are as follows:

- Existing monitoring bore TB4R – located approximately 4.2 km south-west of PB13-3 drilled and screened into the Ashburton Formation.
- Existing monitoring bore TA4 – located approximately 5 km north-west of PB13-3 drilled and screened in the Duck Creek Dolomite.
- Proposed monitoring bore East-01 – located approximately 3 km north of PB13-3, to be drilled and screened in the same fault zone as PB13-3.

Proposed groundwater monitoring bore locations are shown in Figure 7.1.

The following monitoring schedule is proposed at PB13-3 (Table 7.1).

Table 7.1 Proposed Groundwater Monitoring Programme

Bore Type	Data Requirement	Frequency
Active Production Bore PB13-3	Groundwater Abstraction Volume (cumulative flow readings)	Monthly
	Field Water Quality – pH and EC	Bi-annually
	Laboratory Analysis (Comprehensive Component Analysis*)	Annually
	Water levels	Monthly
Monitoring Bores MB13-3 TA4 TB4R Proposed East-01#	Water levels	Monthly

* 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).

still yet to be drilled and completed

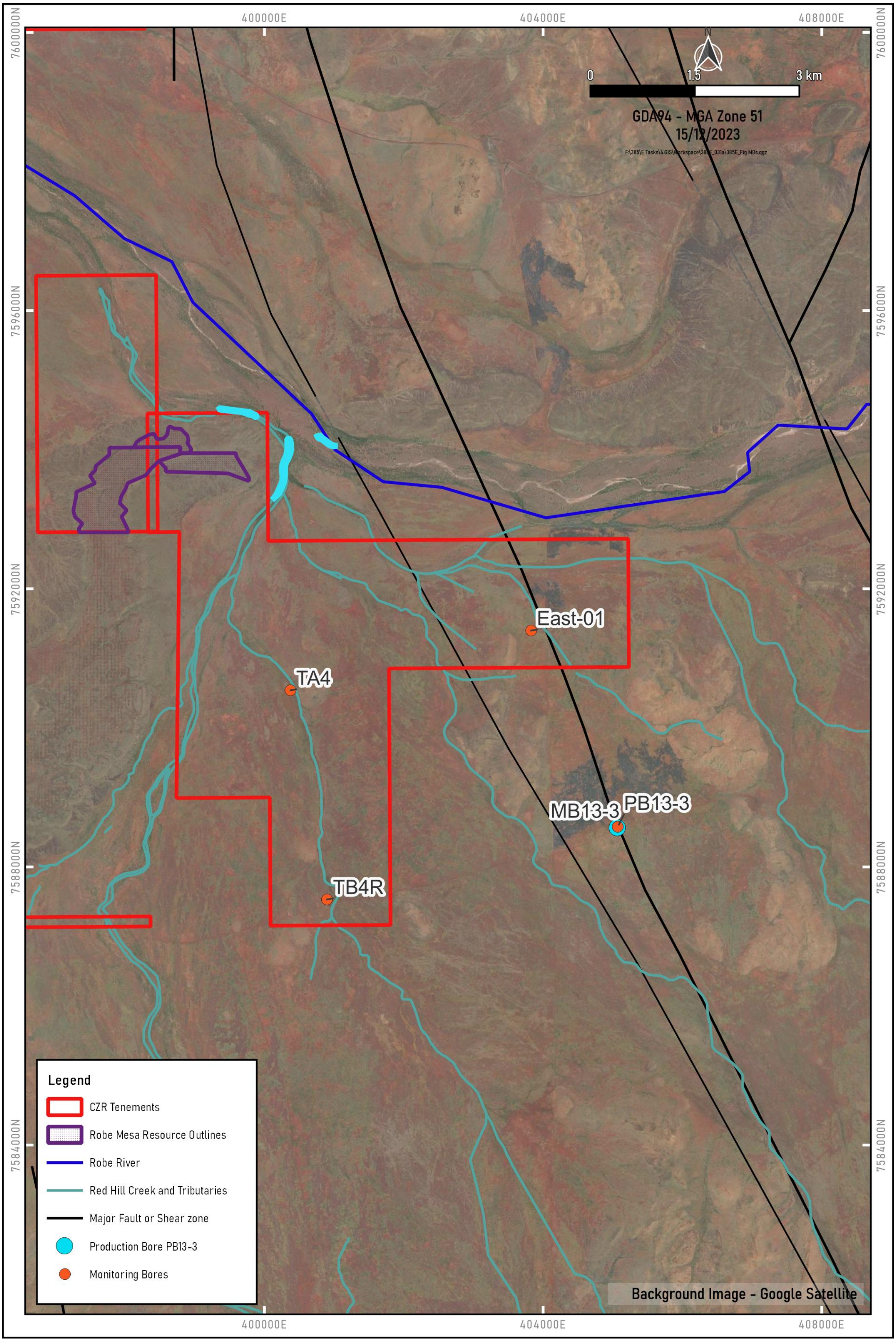


Figure 7.1 Proposed Groundwater Monitoring Network

A totalising flow meter should be installed at production bore PB13-3 and be read monthly and inspected regularly for faults and maintenance undertaken as required, with calibration as per the manufacturer's specifications. Details of any significant meter maintenance and replacement will be collated throughout the water year and incorporated into the annual monitoring summary.

Water levels in the production and monitoring bores should be measured monthly.

Water samples will be collected bi-annually from the operational production bore PB13-3, for field measurement of pH and electrical conductivity (EC) and collected annually for full chemical analysis (a Comprehensive Suite) by a reputable laboratory.

Monitoring data are and will be regularly reviewed by a hydrogeologist throughout the mining period to analyse trends and to guide operational water supply management. In the event that the extraction does have detrimental effects on the surrounding aquifers, environment or other users contrary to predictions, mitigation measures will be implemented (which could include adjustment of pumping rates to reduce impacts).

8. FURTHER WORK

8.1 Bore PB13-3

It is considered that sufficient work has been completed to assess the water supply potential of production bore PB13-3 under the H2 level assessment. As such, no further hydrogeological investigation work on this bore is recommended at this time. Monitoring bore MB13-3, adjacent to production bore PB13-3, has groundwater level and barometric pressure monitoring dataloggers already installed within it to provide a comprehensive record of groundwater level fluctuations and response to groundwater abstraction.

8.2 Further Production and Monitoring Bores

CZR is planning to drill at several other locations within their Robe Mesa mining tenements to investigate the water supply potential of the faulted/fractured aquifer north of the PB13-3 (along the fault line) and the combined valley fill deposits/weathered/fractured aquifer (along creek lines). This is to de-risk the required 17 L/s water supply and have other production bores that can be used as well as bore PB13-3. Exploratory water supply drilling work for this is currently being formulated.

Additionally, CZR is planning to drill and install other monitoring bores within the Robe Mesa tenements to assist in monitoring of potential pumping impacts.

9. SUMMARY AND CONCLUSIONS

The Robe Mesa project is currently under development. The anticipated long-term (~7 years) mine water demand for the Robe Mesa project is estimated at 17 L/s (i.e. 540,000 kL/year) for construction, dust suppression, processing and camp requirements. Due to the mining operation not requiring dewatering (i.e. the deposit is above the water table), the project's water demand will need to be sourced from local groundwater. There are a few existing groundwater abstraction bores in the local area, but these are mostly shallow pastoral bores, capable of only limited abstraction rates and not suitable for mine water supply. The exception to these is the existing production bore PB13-3, drilled into the faulted/fractured Duck Creek Dolomite aquifer system, located approximately 8 km southeast from the proposed Robe Mesa mine, which has the potential to fully meet the site's water demand.

Abstraction from bore PB13-3 is currently licenced under API GWL180637(3), with annual allocation of 95,000 kL (i.e. 3 L/s). CZR is interested in acquiring bore PB13-3 from API. Therefore, in order for CZR to abstract water from PB13-3, a separate 5C GWL application to abstract 17 L/s from the fractured aquifer (PB13-3) is required to be submitted to DWER for assessment. An H2 hydrogeological assessment report is required to be prepared to assess the suitability of bore PB13-3 to sustain a long-term abstraction rate of 17 L/s and assess the potential impacts that this may have on other existing groundwater users and the environment.

The key results from this H2 hydrogeological assessment are summarised below:

- The production bore PB13-3 and adjacent monitoring bore MB13-3 were initially visited in July 2022 and were found to be in reasonable condition and suitable to be test pumped to assess the long term yield from PB13-3.
- Test pumping contractor Matrix Hydro was appointed to conduct pumping tests on PB13-3 and these were carried out in December 2022 under remote supervision from AQ2. The tests first comprised a 4 x 100 minute step test at rates of 5, 10, 15 and 20 L/s, with drawdowns in the pumping bore of 0.43 m, 0.99 m, 1.66 m and 2.44 m at the end of each respective step. This was followed by a 7 day constant rate test at a pumping rate of 17 L/s, with a final drawdown in the pumping bore of 3.16 m and 1.85 m in the monitoring bore. Water level recovery was then monitored.
- Analysis of pumping and recovery data give transmissivity values between 220 to 235 m2/d and permeability values of between 3.1 and 3.3 m/d for the faulted Duck Creek Dolomite aquifer. The pumping tests show that production bore PB13-3 should be able to sustain an abstraction rate of 17 L/s over the long term.
- A water sample taken from PB13-3 just prior to switching off the constant rate test shows the water to be fresh and of potable quality with an EC of 950 µS/cm. The water is bicarbonate dominant with sodium, calcium and magnesium important and is typical of a dolomite water. It is good quality water.
- Extrapolation of the test pumping late-time drawdown data at PB13-3 indicates that the required pumping rate of 17 L/s is sustainable in the long-term, i.e. the water level over the 7-year mine life will drop to approximately 20 mbgl (i.e. 6.2 m drawdown), which is well above a pump depth set at 72 m.
- The predicted drawdown impact of abstraction of 17 L/s from the PB13-3 are minimal. The cone of depression that would be generated by water supply pumping would be elliptical in shape, elongated in a north-south direction (along the fault zone). The maximum theoretical extent of the cone of depression is predicted to be 5.2 km along the fault zone and 1.5 km across the fault zone (in unfractured bedrock). This is a conservative assessment that assumes no recharge.
- The predicted drawdown extent is unlikely to impact on any other groundwater users.

- 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.

In conclusion, bore PB13-3 has been hydrogeologically assessed for both water quality and yield. It produces potable quality water representative of the dolomite that it is installed within and should be able to sustain the required Robe Mesa mine water demand of 17 L/s, with no predicted impacts on other groundwater users or GDEs from the proposed abstraction.

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APPENDIX A
PB13-3 and MB13-3 LITHOLOGICAL AND CONSTRUCTION LOGS

COMPOSITE WELL LOG

Well No: PB13-3

RPS Aquaterra
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Client: API Management
Project: WPIOP, chainage 205

Commenced: 03/12/10
Completed: 14/12/10
Drilled: Welldrill
Logged By: JS

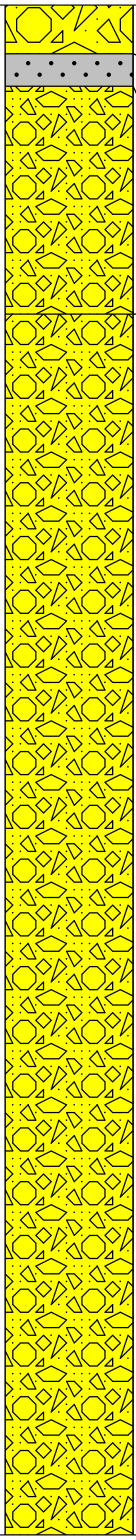
Method: Mud Rotary
Fluid: Mud
Bit Record: 6-93m: 12 1/4" 6-94m: 6 1/2" 0-6m: 17"

Area: West Pilbara
East: 405066
North: 7588562
Projection: GDA94 Z50

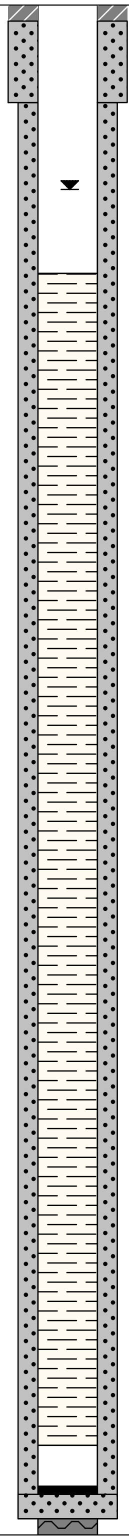
Static Water Level: 11.34 mbgl
Date: May 7th, 2011

Depth (mbgl)	Lithological Description	Field Notes
0	SANDY GRAVEL: Red orange with gravel and BIF, dry.	
	SAND: Brown red, poorly sorted with gravel, BIF, goethite and quartz.	
	GRAVEL: Brown white, sub angular with medium coarse calcrete and sand. First water strike at 18m.	
20	GRAVEL: Brown grey coarse, sub rounded to sub angular and weathered with calcrete, quartz, chert, iron ore and goethite. Clay banding throughout and presence of fractures. Larger pieces of quartz and chert (ressembling river bedding) from 78 to 94m. Traces of very weathered basalt between 46m and 54m.	Field readings: Airlift yield: 25L/s, EC:0.913 mS/cm, PH:8.2
		Good water strike with fractures from 78m to 94m
		Very hard between 90 and 94m.

Graphic Log:



Well Completion Diagram:



Well Completion Notes:

- 0-6m: 360mm steel surface casing
- 0-16.5m: blank 205mm PVC casing
- 1-94m: 3.2-6.4mm Gravel pack
- 16.5-88.5m: slotted 205mm PVC casing
- 88.5-91.5: blank 205mm PVC casing
- Fallback

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COMPOSITE WELL LOG

Well No: MB13-3

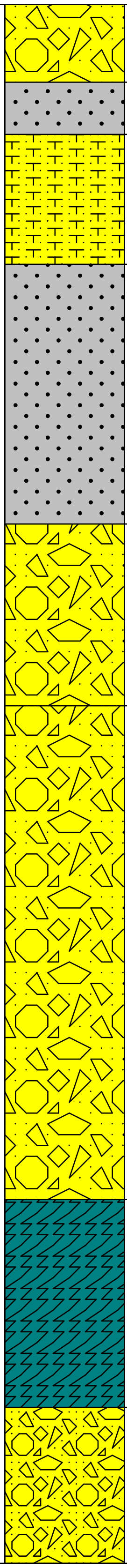
Client: API Management **Project:** WPIOP, chainage 205

Commenced:	01/12/10	**Method:**	Conventional Hammer	**Area:**	West Pilbara
Completed:	02/12/10	**Fluid:**	Air	**East:**	405073
Drilled:	Welldrill	**Bit Record:**	0-6m: 12 1/2"	**North:**	7588576
Logged By:	JC		6-60m: 6 1/2"	**Projection:**	GDA94 Z50

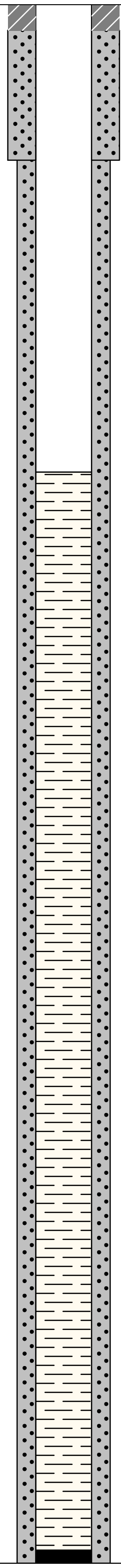
Static Water Level: TBD **Date:** TBD

Depth (mbgl)	Geology	Graphic Log	Lithological Description	Field Notes	Well Completion Notes
0–3			SANDY GRAVEL: Red orange with BIF.		0-6m: 200mm steel surface casing
3–5			SAND: Brown red, poorly sorted with some gravel and BIF.		
5–10			Silty Sand: Orange yellow, moderated sorted with some loose gravel.		0-18m: blank 50mm PVC casing
10–20			SAND: Brown orange, poorly sorted with gravels and clay bands from 19-20m.		
20–27			SANDY GRAVEL: Brown grey, poorly sorted and weathered with BIF.		18-60m: slotted 50mm PVC casing
27–46			SANDY GRAVEL: Orange brown, poorly sorted with gravel up to 30mm diameter.		1-60m: 3.2-6.4mm Gravel pack
46–54			Basalt: Brown grey, sub angular, poorly sorted and weathered with weathered BIF and gravels.		
54–60			GRAVEL: Orange yellow with some sand. Increased gravel content, quartz and some chert. Appears to be ancient creek bed.	Field readings: Airlift yield: 8.51L/s, EC:0.906mS, PH:8.19	EOH: 60m

Graphic Log:



Well Completion Diagram:



APPENDIX B
RPS, 2011, PB13-3 BORE COMPLETION REPORT

RPS Aquaterra

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MEMORANDUM

COMPANY:	API Management		
ATTENTION:	Phil Davidson		
FROM:	Jon Shudra / Kevin O'Connell		
DATE:	19 July 2011	JOB NO: 898C	DOC NO: 052a
SUBJECT:	PB13-3 Bore Completion Report		

In 2010, API Management Pty Ltd appointed RPS Aquaterra to undertake a groundwater supply investigation for the construction of a proposed rail line in the Western Pilbara. This bore completion report provides a brief factual summary of the drilling, bore construction, pump testing and hydrogeological information which was recorded during the installation of production bore PB13-3.

1. PRODUCTION BORE PB13-3

Production bore PB13-3 is situated approximately 4km south of the Robe River at rail chainage CH205. The grid reference for the bore location is 0405066 Easting, 7588562 Northing (MGA94, Zone 50) and is shown in Figure 1. A summary of the drilling details are shown in Table 1, along with a summary of the pump testing in Tables 2 and 3.

The bore was drilled and constructed by Welldrill with hydrogeological support from RPS Aquaterra personnel, from 03/12/10 to 14/12/10. A 17.5" hole was drilled to 6 meters, followed by the installation and cementing of a (14") 350mm ND steel surface collar casing. The exploration hole was drilled with a 6.5" diameter drill bit to a total depth of 94m by mud rotary drilling. The exploration hole was reamed out using a 12.75" drill bit to 93m to equip the hole as a production bore. A 205mm PVC casing was used to construct the production bore to a depth of 91.5m by installing blank casing from 91.5m to 88.5m, slotted casing from 88.5m to 16.5m, and blank casing from 16.5m to surface. The annulus was backfilled with 3.2 to 6.4mm graded quartz gravel pack from 93m to surface. The bore headworks were completed with a 1m x 1m x 0.3m concrete block, and a lockable steel post protecting the capped PVC casing. Monitoring bore MB13-3 was installed approximately 18m away from PB13-3, and was used as an observation bore during the pump testing of PB13-3.

1.1 Geology/Hydrogeology

The bore target location is located approximately 4km south of the Robe River. The drilling for PB13-3 exposed a succession of detritals with gravel, calcrete and medium to coarse grained sand with banded iron formation (BIF) in the top 19m (first water strike 18m). Underlying this was a succession of gravels, with chert and highly weathered basalt, with clay banding and weathered quartz to 94m. Within this zone is a 16m thick layer of coarse quartz rich gravels located between 78m and 94m. A final airlift yield of 25L/s was recorded, with a predominant water infiltration zone between 78m and 94m.

Table 1: Drilling and Bore Construction Details

Bore	Easting	Northing	Max Yield (L /s)	Final EC (mS/cm)	pH	Depth Drilled (mbgl)	Static water Level (mbgl)	Bore Construction (205mm PVC)
PB13-3	0405066	7588562	25.0	0.913	8.20	94	11.34	Blank: 0m to 16.5m Screen: 16.5m to 88.5m Sump: 88.5m to 91.5m

1.2 Aquifer Testing

The aquifer test pumping undertaken on PB13-3 comprised of both multi-rate step tests and a 24 hour constant rate pumping test. The constant rate test was followed by a two hour recovery test. Aquifer testing was undertaken by Welldrill between the 8th and 10th of May 2011.

1.2.1 Step Tests

Table 2: Summary of PB13-3 Step Test Analysis

Bore	Step Number	Discharge Rate (L/s)	Initial Static Water (mbtoc)	Pump depth (mbtoc)	Corrected Drawdown (m)	Apparent Well Efficiency (%)
PB13-3	1	17	11.54	70	1.98	75.5
	2	22		50	2.72	70.4
	3	30		50	4.14	63.6

(mbtoc) meters below top of casing

The step test was designed to pump the bore at three different rates, for 60min at each rate. The pump was set in the production bore at a depth of 50mbtoc. The initial discharge rate was 17L/s, resulting in a drawdown of 1.98m. The bore was then pumped at 22L/s and 30L/s, and had a final drawdown of 4.31m with a pumping water level of 15.85mbtoc.

1.2.2 Constant Rate Test

A 24 hour constant rate test was conducted on May 9th 2011, which was followed by a two hour water level recovery period once pumping had ceased. Based on the results of the step test data, the constant rate discharge was undertaken at 30L/s. The drawdown of the water level was recorded in both the pumping bore (PB13-3) and the observation bore (MB13-3), which was located approximately 18m from PB13-3.

Drawdown in PB13-3 was recorded at 5.06m, while a drawdown of 2.13m was recorded in the observation bore. Evaluating the mid to late time pumping data using the Cooper-Jacob method and the early to mid time recovery data using Theis-Recovery analysis, resulted in a transmissivity of 587m2/d being established. With the bore location's close proximity to the Robe River, the pump bore data set shows a significant yield which is most likely due to a leaky confined aquifer. Estimates of bulk aquifer permeability and storativity derived from the data collected from observation bore PB13-3 were taken into consideration.

A storativity of 1.03E-2 was adopted from the observation bore based on Theis and Cooper-Jacob analysis from early to mid time pumping data and early to mid time recovery data. The adopted storage value was chosen based on pumping data and hydrogeological considerations. A leaky aquifer with a recharge may affect the bore's yield potential, hence a transmissivity value of 587m2/d has been used to calculate sustainable pumping yields.

RPS Aquaterra

1.3 Sustainable Pumping Yield and Recommendations

The recommended safe pumping yield in PB13-3 estimates a recommended maximum average discharge rate without exceeding an acceptable water level draw- down in the bore. A maximum allowable pumping water level of 20mbgl has been selected for the SRO assessment, which sets the drawdown limit to roughly the top of the screened bore interval. During the constant rate test, water levels were drawn down to 16.60mbgl without any detrimental effects on bore performance.

The assessment is based on the hydrogeological information that was gathered during drilling and pump testing. For PB13-3, the SRO calculation indicates a safe pumping yield of 35L/s (3,000m3/d) with a recommended pump setting situated 50m below top of casing (btoc) based on a pumping time frame of 90 days. Engineering constraints on a submersible pump that will fit into the bores 8" casing will limit the maximum pumping rate to ~32L/s. The SRO estimates should only be regarded as indicative, as this yield might vary when considering different factors like transmissivity variations, pumping time or interference effects due to surrounding bores.

Table 3: Summary of Safe Pumping Yield and Pump Setting for Bore PB13-3

Bore	SWL (mbgl)	ID (mm)	Material	Slotted Intervals (mbgl)	Total Depth (mbgl)	Recommended Pumping Rate(L/S)	Max. Allowable Pumping WL (mbgl)	Pump Setting (mbgl)
PB13-3	11.61	205mm	PVC	17 – 89	94	32.0	20	50

Yours sincerely,
RPS Aquaterra

Jon

Jon Shudra
Hydrogeologist

Kevin

Kevin O'Connell
Senior Hydrogeologist

APPENDIX A: LITHOLOGICAL LOG AND BORE CONSTRUCTION DETAILS

COMPOSITE WELL LOG

Well No: PB13-3

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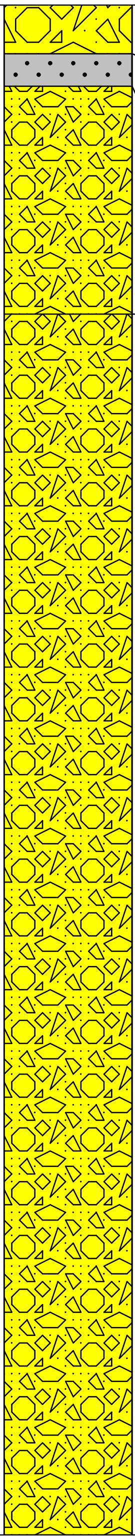
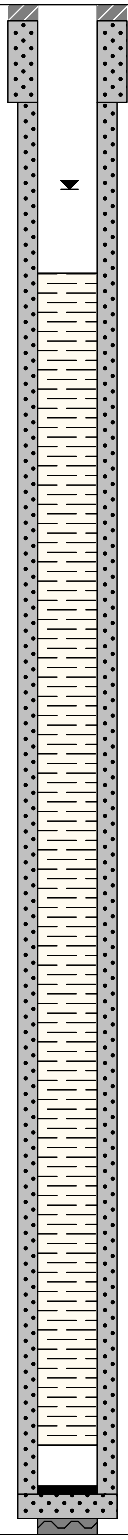
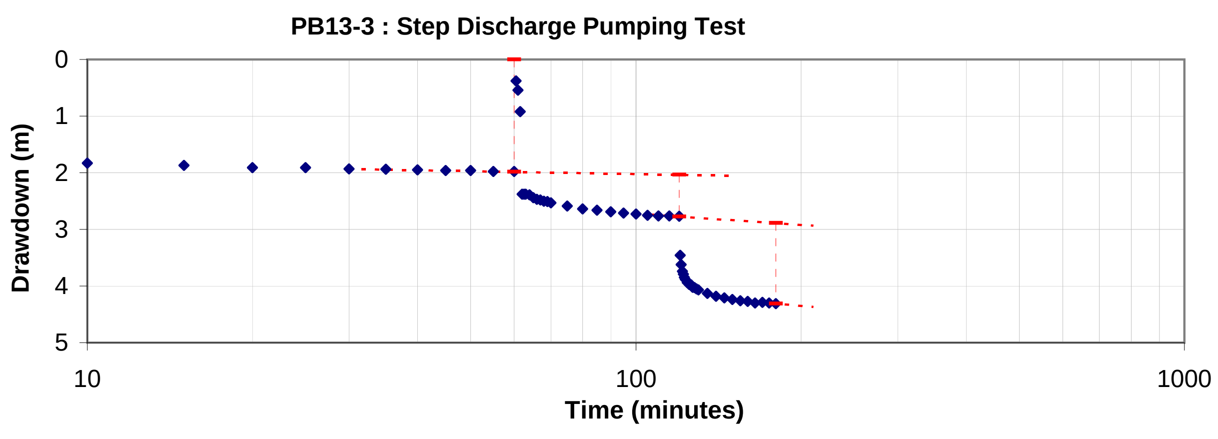
Client: API Management | **Project:** WPIOP, chainage 205

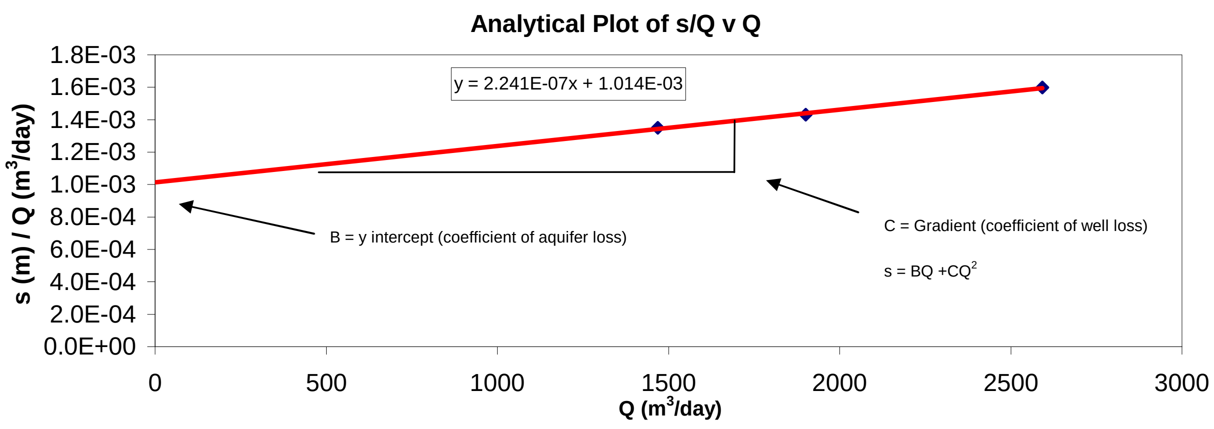
Commenced:	03/12/10	**Method:** Mud Rotary		**Area:**	West Pilbara
Completed:	14/12/10	**Fluid:** Mud		**East:**	405066
Drilled:	Welldrill	**Bit Record:** 6-93m: 12 1/4" 6-94m: 6 1/2"		**North:**	7588562
Logged By:	JS	0-6m: 17"		**Projection:**	GDA94 Z50

Static Water Level: 11.34 mbgl | **Date:** May 7th, 2011

Depth (mbgl)	Geology	Graphic Log	Lithological Description	Field Notes	Well Completion: Diagram	Well Completion: Notes
0			SANDY GRAVEL: Red orange with gravel and BIF, dry.			0-6m: 360mm steel surface casing
			SAND: Brown red, poorly sorted with gravel, BIF, goethite and quartz.			
10			GRAVEL: Brown white, sub angular with medium coarse calcrete and sand. First water strike at 18m.			0-16.5m: blank 205mm PVC casing
20			GRAVEL: Brown grey coarse, sub rounded to sub angular and weathered with calcrete, quartz, chert, iron ore and goethite. Clay banding throughout and presence of fractures. Larger pieces of quartz and chert (ressembling river bedding) from 78 to 94m. Traces of very weathered basalt between 46m and 54m.			
30						1-94m: 3.2-6.4mm Gravel pack
40				Field readings: Airlift yield: 25L/s, EC:0.913 mS/cm, PH:8.2		
50						
60						16.5-88.5m: slotted 205mm PVC casing
70						
80				Good water strike with fractures from 78m to 94m		
90				Very hard between 90 and 94m.		88.5-91.5: blank 205mm PVC casing
						Fallback

APPENDIX B: TEST PUMPING RESULTS





$s_{w(n)} = BQ_n + CQ_n^P$ (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.

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

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

From plot of s/Q v Q (trend line equation): **Intercept (B)** 1.014E-03

Gradient (C) 2.241E-07

ANALYSIS TABLE

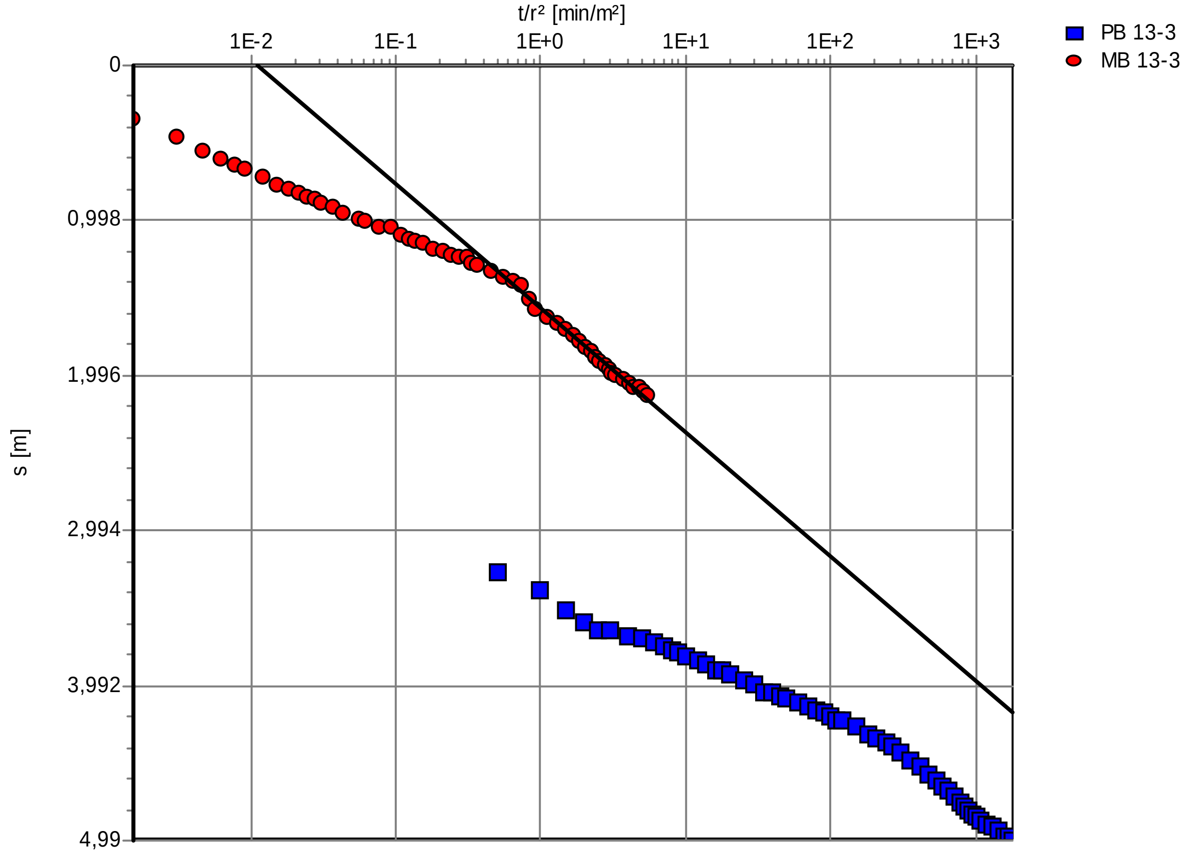
Calculation of well efficiency and comparison of observed and predicted drawdowns

Step (60 minute duration)	Discharge (l/s)	Discharge (Q) (m^3/d)	Measured Incremental Drawdown (metres)	Corrected Drawdown (metres)	Predicted Drawdown (metres)	s/Q	Apparent Efficiency (Ew) %
1	17.0	1469	1.98	1.98	1.97	1.35E-03	75.5
2	22.0	1901	0.74	2.72	2.74	1.43E-03	70.4
3	30.0	2592	1.42	4.14	4.13	1.60E-03	63.6

RPS Aquaterra

Waterloo Hydrogeologic Inc. 180 Columbia St. Unit 1104 Waterloo, Ontario, Canada Phone 519 746-1798	**Pumping Test Analysis Report** Project: WPIOP (PB13-3) Number: 898C Client: API Management

CR PB 13-3 [Cooper-Jacob Time-Distance-Draw dow n]



Pumping Test: **CR PB 13-3**

Analysis Method: **Cooper-Jacob Time-Distance-Drawdown**

Analysis Results:	Transmissivity:	5,93E+2 [m²/d]	
	Storativity:	1,03E-2	
Test parameters:	Pumping Well:	PB 13-3	Aquifer Thickness:
	Casing radius:	0,1025 [m]	Confined Aquifer
	Screen length:	72 [m]	
	Boring radius:	0,1625 [m]	
	Discharge Rate:	30 [l/s]	

Comments: A Stotativity of 4.24E-4 was adopted using the late time data.

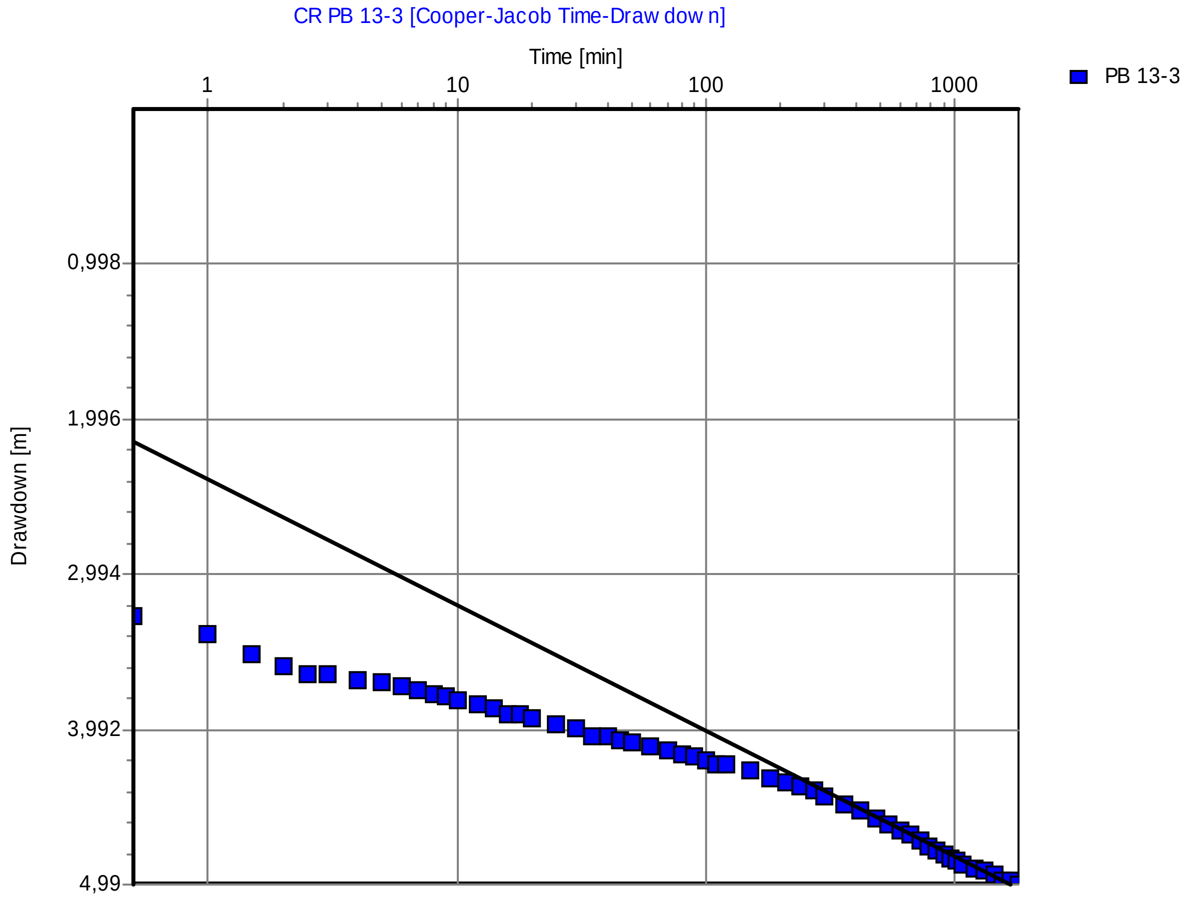
Evaluated by: Jon Shudra

Evaluation Date: 14/07/2011

Waterloo Hydrogeologic Inc.
180 Columbia St. Unit 1104
Waterloo, Ontario, Canada
Phone 519 746-1798

Pumping Test Analysis Report

Project:	WPIOP (PB13-3)
Number:	898C
Client:	API Management



Pumping Test: **CR PB 13-3**

Analysis Method: **Cooper-Jacob Time-Drawdown**

Analysis Results: Transmissivity: 5,87E+2 [m²/d]

Test parameters:			
Pumping Well:	PB 13-3	Aquifer Thickness:	
Casing radius:	0,1025 [m]	Confined Aquifer	
Screen length:	72 [m]		
Boring radius:	0,1625 [m]		
Discharge Rate:	30 [l/s]		

Comments:

Evaluated by: Jon Shudra
Evaluation Date: 14/07/2011

Source Reliable Output Calculations **Bore No:** PB13-3

Notes:
Calculates SRO and expected pumping water levels for newly constructed bores
Pumping Test Analysis must have been undertaken first
Pumping water levels calculated from assumed average conditions - as seen during drilling
Assumes transient radial flow conditions prevail (eg Theis Equation)

Data Input

Rest Water Level = 11,61 mbgl

Top of Aquifer/Max PWL = 20 mbgl

Step Test Data

Enter parameters of step test equation $s=BQ+CQ^2$

B = 1,01E-03
C = 2,24E-07
valid time 60 mins

Constant Rate Test Data

Enter parameters from constant rate analysis

T = 587 m^2/d (transmissivity)
s = 1,03E-02 (storativity)
r = 0,155 m (radius of bore)

Enter Operational Data

Assumed period between recharge events

t2 = 90 days

Range of discharges to be considered

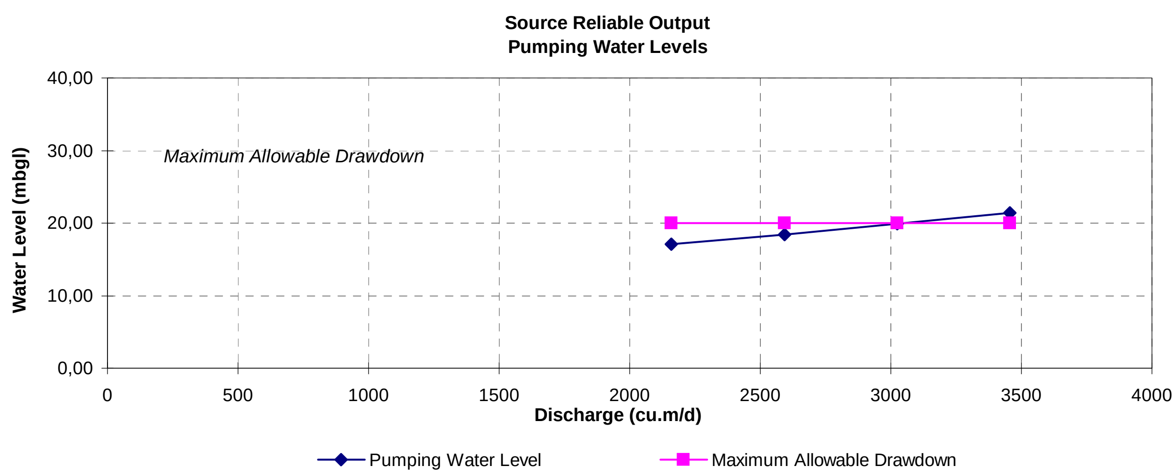
Q1	2160 m^3/d	25	l/s
Q2	2592 m^3/d	30	l/s
Q3	**3024** **m^3/d**	**35**	l/s
Q4	3456 m^3/d	40	l/s

Are there interference effects (Y/N) N

Dist to first bore m
pumping rate m^3/d
Dist to second bore m
pumping rate m^3/d

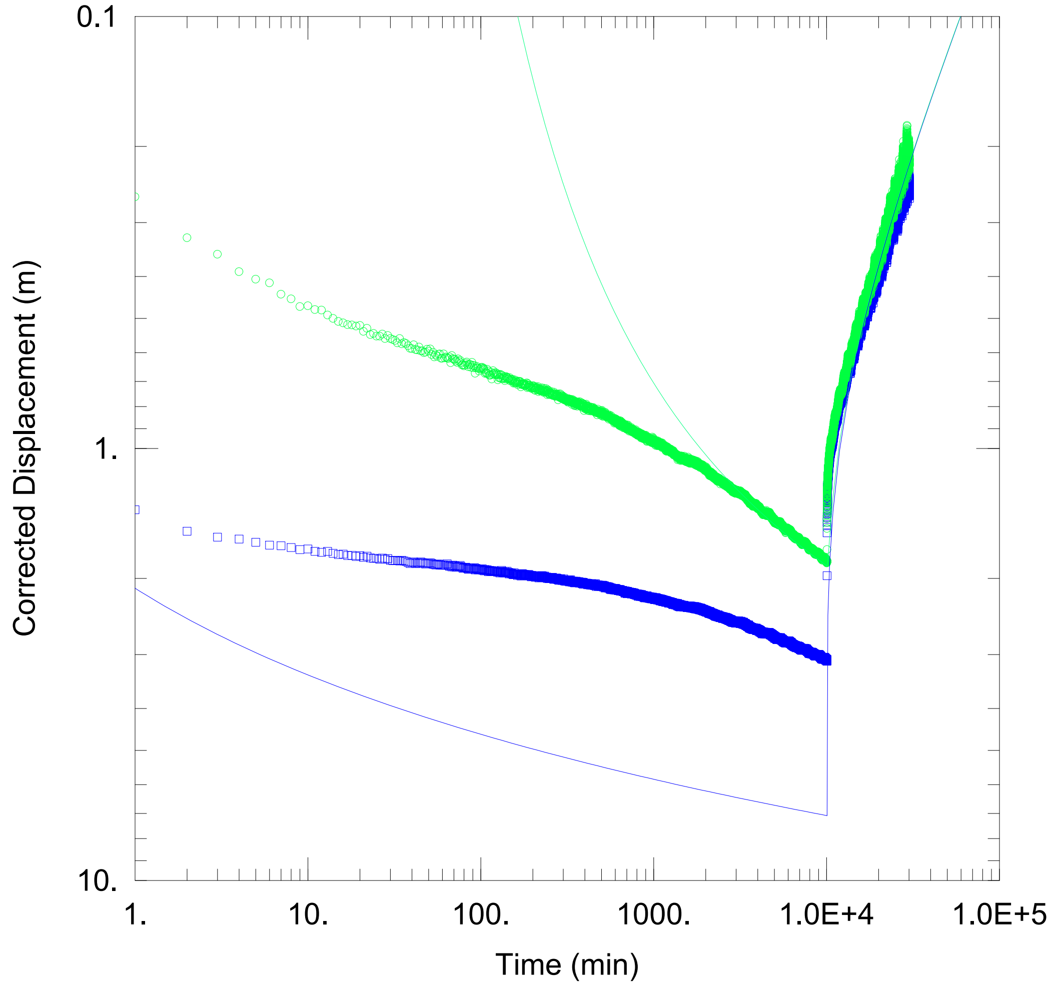
Calculations of Drawdown

Discharge	Short Term Drawdown	Long Term Drawdown	Interference Effects	Total Drawdown	Pumping Water Level
2160	3,24	2,25	0,00	5,48	17,09
2592	4,13	2,69	0,00	6,83	18,44
3024	5,12	3,14	0,00	8,26	19,87
3456	6,18	3,59	0,00	9,77	21,38



RPS Aquaterra

APPENDIX C
PB13-3 PUMPING TESTS ANALYSES



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: AQ2
Client: CZR Resources
Project: 385E
Test Well: PB13-3
Test Date: 14/12/2023

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB13-3	405066	7588562

Observation Wells

Well Name	X (m)	Y (m)
□ PB13-3	405066	7588562
○ MB13-3	405073	7588576

SOLUTION

Aquifer Model: Unconfined

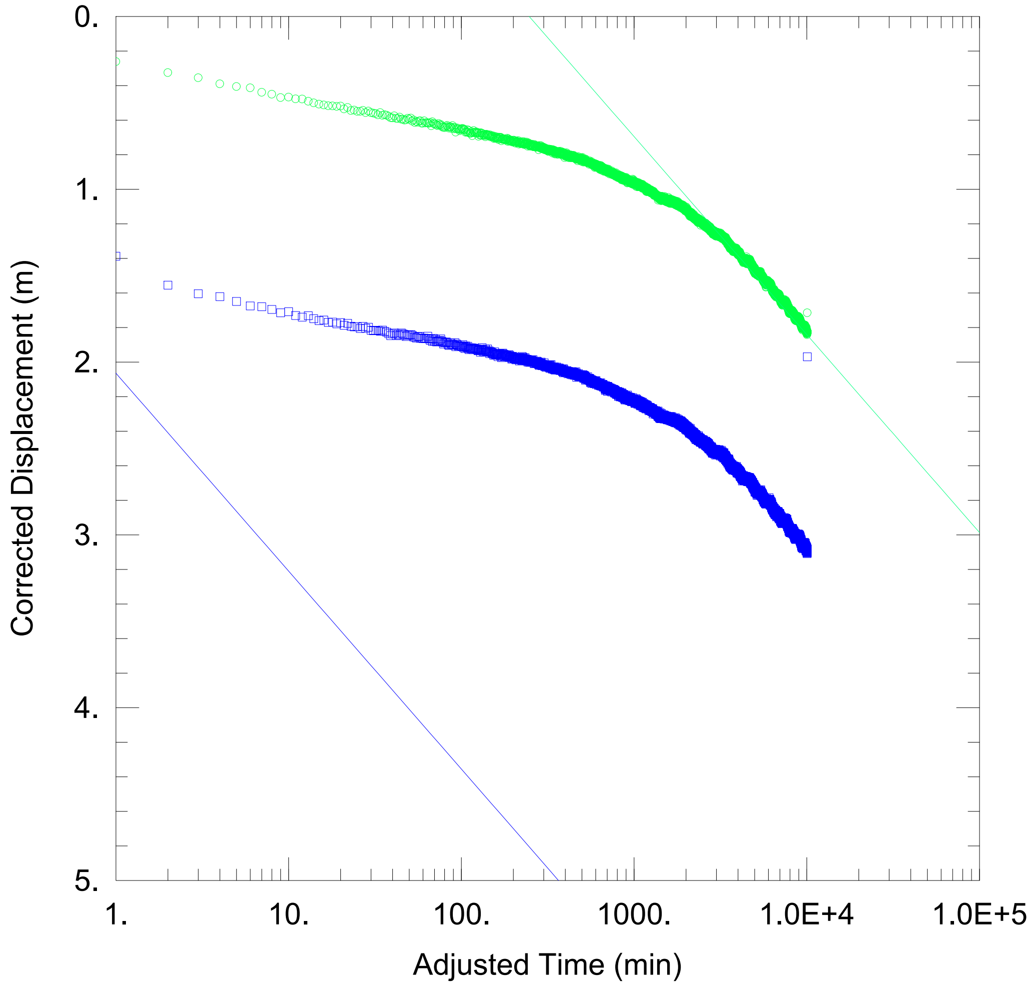
Solution Method: Theis

T = 216.3 m^2/day

S = 0.4432

Kz/Kr = 1.

b = 72. m



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: AQ2
Client: CZR Resources
Project: 385E
Test Well: PB13-3
Test Date: 14/12/2023

AQUIFER DATA

Saturated Thickness: 72. m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB13-3	405066	7588562

Observation Wells

Well Name	X (m)	Y (m)
□ PB13-3	405066	7588562
○ MB13-3	405073	7588576

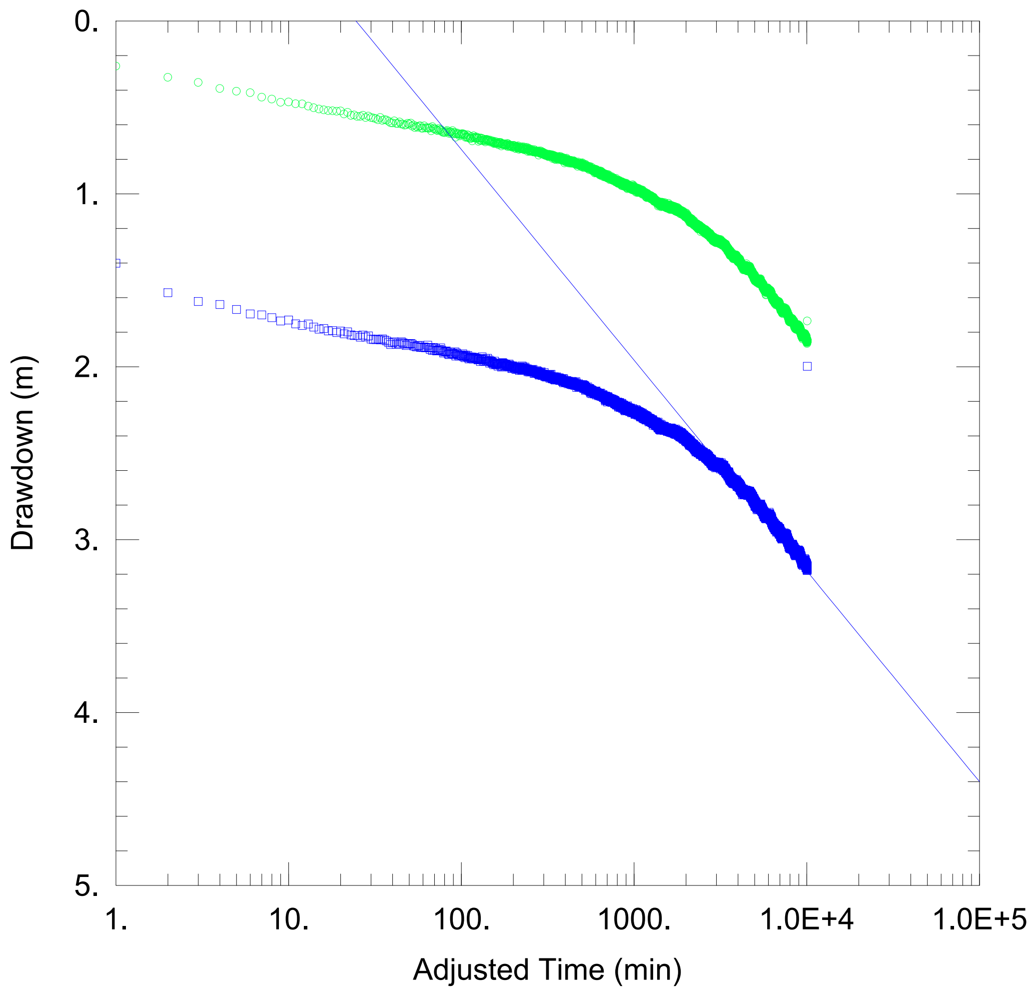
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 235. m^2/day

S = 0.3696



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: AQ2
Client: CZR Resources
Project: 385E
Test Well: PB13-3
Test Date: 14/12/2023

AQUIFER DATA

Saturated Thickness: 72. m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB13-3	405066	7588562

Observation Wells

Well Name	X (m)	Y (m)
□ PB13-3	405066	7588562
○ MB13-3	405073	7588576

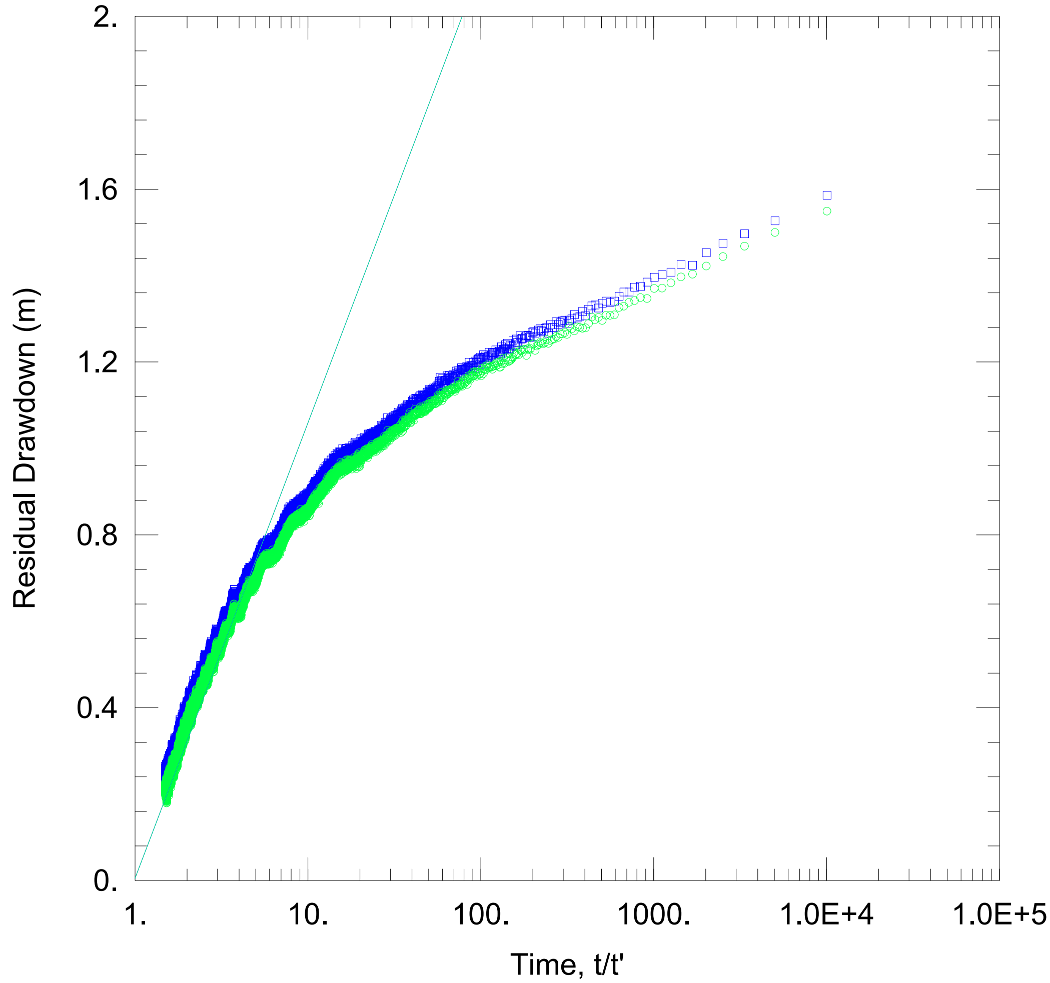
SOLUTION

Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 220.8 m^2/day

S = 541.5



WELL TEST ANALYSIS

PROJECT INFORMATION

Company: AQ2
Client: CZR Resources
Project: 385E
Test Well: PB13-3
Test Date: 14/12/2023

AQUIFER DATA

Saturated Thickness: 72. m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB13-3	405066	7588562

Observation Wells

Well Name	X (m)	Y (m)
□ PB13-3	405066	7588562
○ MB13-3	405073	7588576

SOLUTION

Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 255.3 m^2/day

S/S' = 0.9901

APPENDIX D
PB13-3 HYDROCHEMICAL ANALYSES

SGS

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Alastair Hoare
Client	AQ2
Address	PO BOX 976 SOUTH PERTH WA 6951
Telephone	61 8 93238821
Facsimile	(Not specified)
Email	alastair.hoare@aq2.com.au
Project	**385E C2R Robe Mesa**
Order Number	**385E C2R Robe Mesa**
Samples	1

LABORATORY DETAILS

Manager	Kieran Hopkins
Laboratory	SGS Perth Environmental
Address	28 Reid Rd Perth Airport WA 6105
Telephone	(08) 9373 3500
Facsimile	(08) 9373 3556
Email	au.environmental.perth@sgs.com
SGS Reference	**PE165613 R0**
Date Received	22 Dec 2022
Date Reported	03 Jan 2023

COMMENTS

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

SIGNATORIES

Hue Thanh LY
Metals Team Leader

Mary Ann OLA-A
Inorganics Team Leader

Melissa WHITE
Laboratory Technician

Rene DIADOO
Laboratory Technician

Tommy CHENG
ICP Chemist

Parameter	Units	LOR	Sample Number: PE165613.001 Sample Matrix: Water Sample Date: 21/12/22 7:30 Sample Name: PB13-3

pH in water Method: AN101 Tested: 22/12/2022

pH**	pH Units	0.1	7.9

Conductivity and TDS by Calculation - Water Method: AN106 Tested: 22/12/2022

Conductivity @ 25 C	µS/cm	2	950

Alkalinity Method: AN135 Tested: 22/12/2022

Bicarbonate Alkalinity as HCO3	mg/L	5	350
Carbonate Alkalinity as CO3	mg/L	5	<5
Total Alkalinity as CaCO3	mg/L	5	280

Sulfate in water Method: AN275 Tested: 23/12/2022

Sulfate, SO4	mg/L	1	27

Chloride by Discrete Analyser in Water Method: AN274 Tested: 23/12/2022

Chloride, Cl	mg/L	1	130

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 29/12/2022

Total Dissolved Solids Dried at 175-185°C	mg/L	10	540

Parameter	Units	LOR	Sample Number PE165613.001 Sample Matrix Water Sample Date 21/12/22 7:30 Sample Name PB13-3
Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 23/12/2022			
Calcium, Ca	mg/L	0.2	44
Magnesium, Mg	mg/L	0.1	33
Potassium, K	mg/L	0.1	7.4
Sodium, Na	mg/L	0.5	92
Total Hardness by Calculation	mg CaCO3/L	1	250
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by FIA Method: AN258 Tested: 23/12/2022			
Nitrate Nitrogen, NO_3 as N	mg/L	0.05	2.2
Nitrate, NO_3 as NO_3	mg/L	0.2	9.5
Fluoride by Ion Selective Electrode in Water Method: AN141 Tested: 23/12/2022			
Fluoride by ISE	mg/L	0.1	0.7
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 23/12/2022			
Aluminium	μg/L	5	<5
Arsenic	μg/L	1	<1
Cadmium	μg/L	0.1	<0.1
Copper	μg/L	1	<1
Iron	μg/L	5	<5
Lead	μg/L	1	<1
Manganese	μg/L	1	<1
Zinc	μg/L	5	<5

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	LB202647	mg/L	5	<5		
Carbonate Alkalinity as CO3	LB202647	mg/L	5	<5		
Total Alkalinity as CaCO3	LB202647	mg/L	5	<5	0%	100%

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	LB202618	mg/L	1	<1	0 - 1%	108%	96%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB202646	µS/cm	2	<2	1%	100%

Fluoride by Ion Selective Electrode in Water Method: ME-(AU)-[ENV]AN141

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Fluoride by ISE	LB202615	mg/L	0.1	<0.1	0 - 1%	98%	80 - 98%

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	LB202611	mg/L	0.2	<0.2	1%	97%	92%
Magnesium, Mg	LB202611	mg/L	0.1	<0.1	0 - 1%	102%	99%
Potassium, K	LB202611	mg/L	0.1	<0.1	0 - 1%	97%	84%
Sodium, Na	LB202611	mg/L	0.5	<0.5	0%	95%	89%
Total Hardness by Calculation	LB202611	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
Nitrate Nitrogen, NO_3 as N	LB202614	mg/L	0.05	<0.05	0 - 1%	NA

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB202646	pH Units	0.1	5.7	0%	100%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Sulfate, SO4	LB202618	mg/L	1	<1	0 - 1%	106%	84 - 87%

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	LB202674	mg/L	10	<10	1%	106%	104%	3%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium	LB202605	µg/L	5	<5	0%	107%	101%
Arsenic	LB202605	µg/L	1	<1	0%	108%	104%
Cadmium	LB202605	µg/L	0.1	<0.1	0%	110%	100%
Copper	LB202605	µg/L	1	<1	4%	110%	97%
Iron	LB202605	µg/L	5	<5	0%	106%	107%
Lead	LB202605	µg/L	1	<1	0%	116%	106%
Manganese	LB202605	µg/L	1	<1	2%	96%	97%
Zinc	LB202605	µg/L	5	<5	1%	109%	128%

METHOD	METHODOLOGY SUMMARY
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN106	Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN113	The Total Dissolved Solids residue may also be ignited at 550 C and volatile TDS (Organic TDS) and non-volatile TDS (Inorganic) can be determined.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN141	Determination of Fluoride by ISE: A fluoride ion selective electrode and reference electrode combination, in the presence of a pH/complexation buffer, is used to determine the fluoride concentration. The electrode millivolt response is measured logarithmically against fluoride concentration. Reference APHA F- C.
AN258	Nitrate and Nitrite by FIA: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Without the cadmium reduction only the original nitrite is determined. Reference APHA 4500-NO3- F.
AN274	Chloride by Discrete Analyse: Chloride reacts with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference APHA 4500Cl-
AN275	Sulfate by Discrete Analyse: sulfate is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulfate concentration in the sample. Reference APHA 4500-SO42-. Internal reference AN275.
AN318	Determination of elements at trace level in waters by ICP-MS technique,, referenced to USEPA 6020B and USEPA 200.8 (5.4).
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components .

METHOD	METHODOLOGY SUMMARY
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
Calculation	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.

FOOTNOTES

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

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

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

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

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

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

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

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

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