ATLAS IRON PTY LTD ANNUAL WATER REPORT 2019 / 2020

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Foreword

The outcomes achieved in 2020 highlight the effectiveness of Atlas' indomitable spirit and win-win mindset and demonstrate our commitment to manage and develop water resources in line with the Atlas Water Policy. Key achievements for 2020 include:

- Installation of a secondary crushing plant at Mt Webber during October 2019, bringing the nominal annual processing rate up from 7.4 mtpa to 9.2 mtpa. This increase in processing translated to a slight increase in average water usage of 1,400 kL per month over the same period in the previous year.
- Two new hydrogeologists were hired providing an increase in site presence and level of compliance monitoring coverage.
- Improved water balance and management at Mt Webber. In October of 2019 Atlas commissioned GHD consultants to conduct a water balance review at Mt Webber with the goal of identifying key supply security and sustainability initiatives and impact mitigation measures.
- Corunna Downs approvals and the start of construction.
- Business wide process improvement effort initiated.

Figure 1 shows that overall water usage in 2020 remained similar to 2019 with Mt Webber accounting for the greatest proportionate usage. Total usage over the reporting period amounted to 0.93 GL. Some notable changes from 2019 include a decline in usage at Mt Dove consistent with the care and maintenance regime and the start of a new abstraction license for the Corunna Downs project.

As in previous years Atlas continued to engage with internal and external parties, regulatory agencies and community partners and stakeholders.

Atlas looks forward to building on its foundation of successful water management practices and to the challenges and opportunities that the future holds. We commence FY 2021 with a renewed commitment to operating and managing water resources in accordance with the Atlas Water Policy.

Sean Halpin
Manager, Geology

Date: September 2020

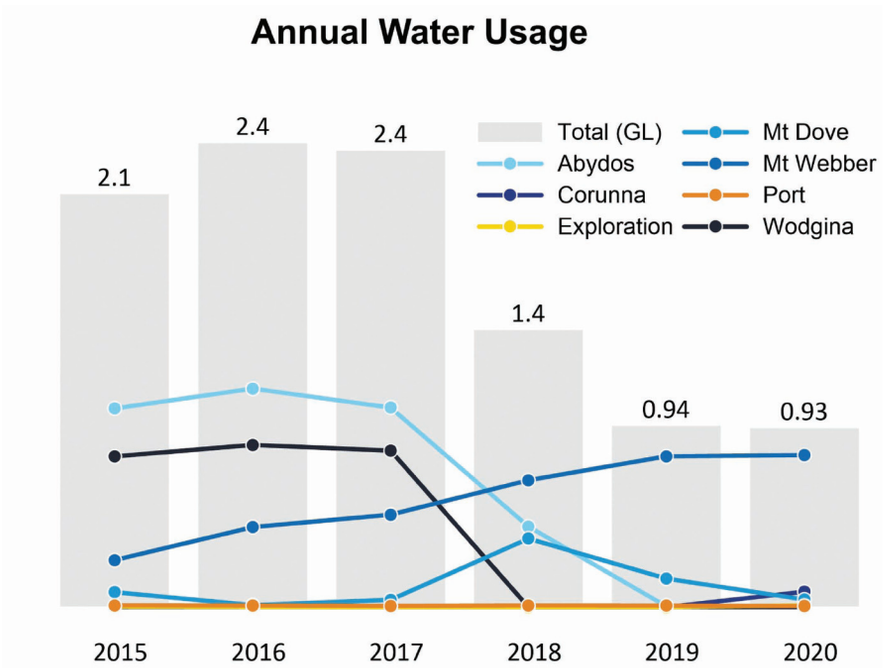

Figure 1 - Atlas Water Usage FY 2015 to 2020

Atlas Water Policy

Atlas Iron recognises that good water management is fundamental to our long term success. Protection of water resources is key to reducing our environmental footprint, building trusting partnerships with our stakeholders and having long term water security.

It is our vision to be seen as a leader in water management and innovative water solutions. To achieve this, we will:

- Strive to identify water opportunities that maximise the benefit to both the community and the business,
- Develop efficient water practices at our mine and port operations,
- Develop long term water management strategies that consider water and energy demands across all operations,
- Use standard scientific practices and performance monitoring to minimise impacts on the community and environment
- Understand the financial and non-financial value of water to the business through effective water accounting and best practice management,
- Recognise that traditional owners have a strong spiritual connection to waterways, and treat these with sensitivity,
- Engage with key stakeholders in the sustainable management of water in our operations ensuring transparency in our decision making and management processes,
- Contribute information to support effective decisions on shared and regional water resources by government,
- Actively participate in development of water policy, legislation and industry best practice, and
- Work co-operatively with other users to share resources where practicable.

This policy is applicable to all Atlas Iron operations, activities and services and shall be communicated to all employees, contractors and made available to the public.

Sanjiv Manchanda
Chief Executive Officer

Date: September 2019

List of Acronyms

AAR - Annual aquifer review

AER - Annual environment report

ALX - Alice extension

BIF - Banded iron formation

BoM - Bureau of Meteorology

CID - Channel iron deposit

DBCA - Department of Biodiversity, Conservation and Attractions (formerly DPaW)

DWER - Department of Water and Environment Regulation

DPaW - Department of Parks and Wildlife

DSO – Direct shipping ore

EC - Electrical conductivity

FBA - Fractured bedrock aquifer

GDE - Groundwater dependent ecosystem

GDV - Groundwater dependent vegetation

GL - Gigalitres

GL/a - Gigalitres per annum

GNH - Great Northern Highway

GWL - Groundwater license

kL - Kilolitres

kL/a - Kilolitres per annum

km - Kilometre

L/s - Litres per second

m Metres

m/d - Metres per day

mAHD Meters above Australian height datum

mbgl - metres below ground level

mbtoc Metres below top of casing

mg/L Milligrams per Litre

ML - Megalitres

mm - Millimetres

mS/cm MilliSiemens per centimetre

Mtpa Million tonnes per annum

RiWI Rights in Water and Irrigation

RL - Relative level

RO - Reverse osmosis

ROM - Run of mine

SWOP - Site water operating plan

TDS - Total dissolved solids

TPH - Total petroleum hydrocarbons

TRH - Total recoverable hydrocarbons

TSS - Total suspended solids

WMP - Water management plan

µS/cm - MicroSiemens per centimetre

Executive Summary

This report covers the Atlas' operational and water management activities undertaken during the 2019/20 financial year. It reports on all Atlas' sites holding groundwater licenses under section 5C of the Rights in Water and Irrigation Act 1914 (RIWI Act), and is submitted to meet the annual reporting requirements.

Over the reporting period Atlas held 15 groundwater licenses with a total allocation of 5.82 GL/annum. Of these, five require annual aquifer reviews which are presented in this report.

With some minor exceptions, Atlas' project water management objectives were met and Atlas was compliant with our responsibilities under the RiWI Act 1914. There were some minor gaps in the monitoring record across sites due to access issues and resourcing.

Key outcomes during the reporting period include:

- Overall water management objectives were met for each license, with the exception of some minor monitoring gaps;
- Continued staff education on monitoring and reporting requirements for all sites;
- Met all operational water supply needs; and
- Highlighted areas for improvement of water management practices within the business including improved monthly water reporting.

1. INTRODUCTION

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1.1 Submission of the 2019/2020 Annual Water Report

This report is submitted to meet the annual reporting requirements under Atlas Iron Pty Ltd ("Atlas") water abstraction licenses. It covers the reporting period of 1 July 2019 to 30 June 2020 and presents water usage and monitoring summaries for all project sites. Annual aquifer reviews (AAR) are presented where required as per the licence conditions.

1.2 Operational Overview

During the reporting period (water year) Atlas held 15 groundwater licenses with a combined allocation of 5,820,736 kL per annum. License locations are shaded in blue in (Figure 1.1) with details provided in Table 1.1 and Table 1.2.

Five groundwater licenses, highlighted in yellow on Figure 1.1, have allocations greater than 100,000 kL/annum and require submission of an AAR to report on aquifer performance and compliance. These sites are the primary focus of this report and include:

- Abydos
- Abydos East Link Road
- Corunna Downs
- Mt Dove
- Mt Webber

AARs are not required for the remaining 10 groundwater licenses. However, usage details for these licenses are included in this report for completeness.

With some minor exceptions Atlas' project water management objectives were met during the reporting period and Atlas was compliant with responsibilities outlined under the *Rights in Water and Irrigation (RiWI) Act 1914*.

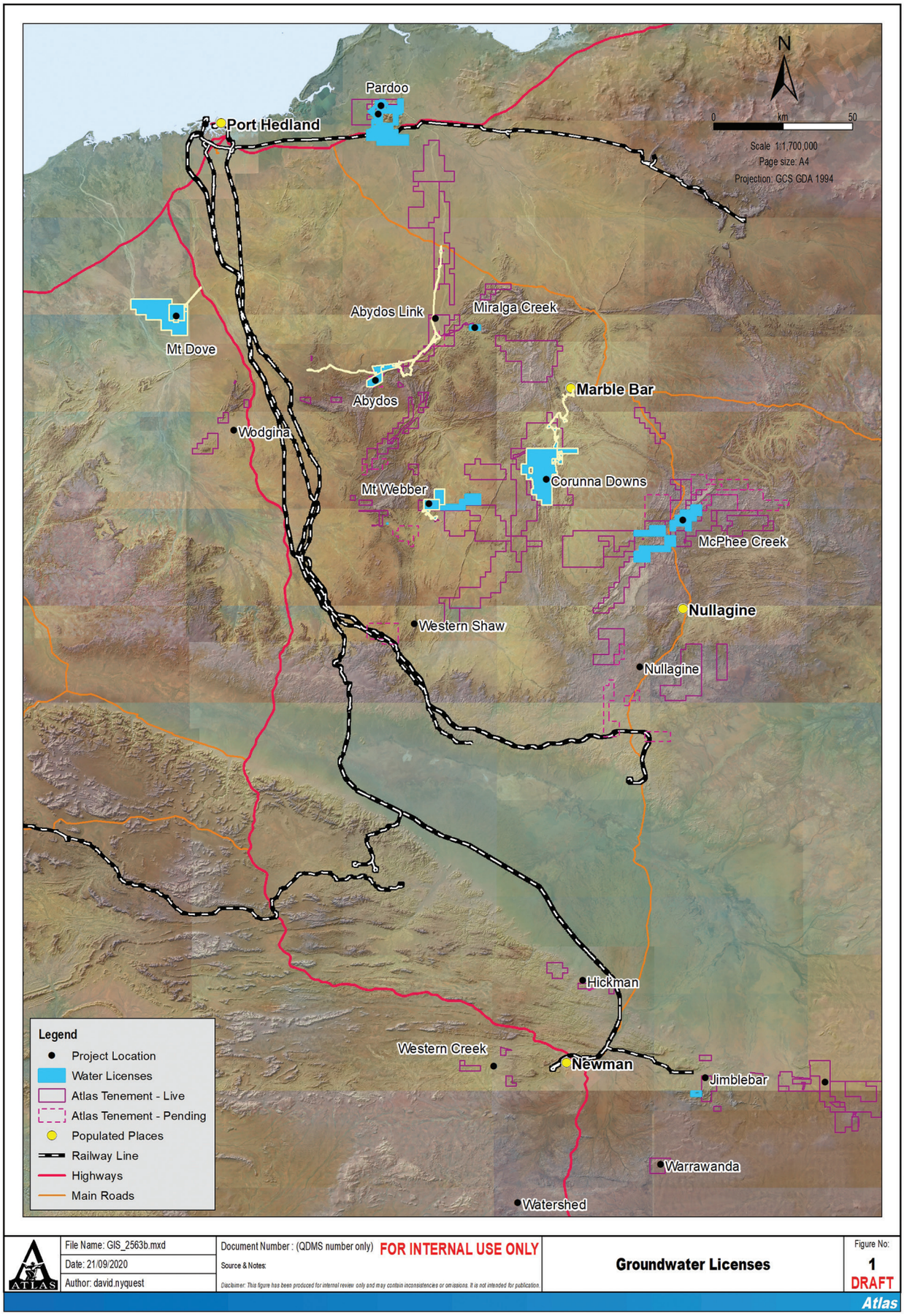

Figure 1 . 1: Atlas Groundwater Licences

Table 1.1 - Volume Reporting for Active Groundwater Licenses 2019/2020

Project	License Number	License status	License Allocation (kL/annum)	2019/20 Usage (kL)	Start Date	Expiry Date	Authorised Activities			
							Potable and Camp	Earthworks, and Dust	Exploratory Drilling	Mining and Processing
Abydos	GWL168045-7	Valid	800,000	1,984	17/06/2015	16/06/2025	•	•	•	•
Abydos Link Road East	GWL176408-4	Valid	1,198,368	0	30/07/2015	29/07/2025	•	•		
Copper Range	GWL200171-2	Valid	20,000	0	26/08/2019	25/08/2029	•	•	•	
Corunna Downs	GWL184565-1	Surrendered	300,000	0	31/05/2017	31/01/2019		•	•	
	GWL176960-5	Valid	1,100,000	80,293	03/04/2020	02/04/2030	•	•	•	•
	GWL179086	Valid	50,000	0	28/03/2014	27/03/2024	•	•	•	
Hales Grave	GWL179423	Valid	50,000	0	28/07/2014	27/07/2024	•		•	
McPhee Ck	GWL175352-2	Valid	95,000	9,396	14/02/2017	13/02/2027	•	•	•	
Miralga Creek	GWL177500-1	Valid	50,000	0	12/06/2013	3/06/2023	•	•	•	
Mt Dove	GWL175319-3	Valid	650,000	39,235	17/06/2015	16/06/2025	•	•	•	
Mt Webber	GWL177240-7	Valid	1,198,368	789,588	19/11/2019	30/10/2027	•	•	•	•
	GWL183228-1	Valid	50,000	0	30/08/2016	29/08/2026	•	•	•	•
	GWL177664	Valid	64,000	0	5/07/2013	4/07/2023	•	•	•	
	GWL168543-4	Valid	95,000	0	26/03/2013	21/03/2023	•	•	•	
Pardoo	GWL166951-5	Valid	100,000	0	24/07/2014	23/07/2024	•	•	•	

Table 1.2 - License Tenure Details and Description of Water Resource

License Number	License status	Location of Water Resource	Location of Activity	Description of Water Resource
GWL166951-6	Valid	E45/2380, L45/210, E45/2330, M45/1158, M45/1194, M45/1170, M45/1157, G45/273, M45/1159, M45/1190, G45/315, L45/154, L45/175, L45/176, L45/202, L45/209	E45/2380, L45/210, E45/2330, M45/1158, M45/1194, M45/1170, M45/1157, G45/273, M45/1159, M45/1190, G45/315, L45/154, L45/175, L45/176, L45/202, L45/209	Pilbara – Fractured Rock
GWL168045-7	Valid	L45/284, M45/1179	L45/204, L45/207, L45/284, M45/1179	Pilbara – Fractured Rock
GWL168543	Valid	M45/1209, E45/2268	M45/1209, E45/2268	Pilbara - Fractured Rock
GWL175319-3	Valid	M47/1449, L47/402	M47/1449, L45/248, E47/891, L47/402	Pilbara – Fractured Rock
GWL175352-2	Valid	E46/733	E46/733	Pilbara – Fractured Rock
GWL176408-4	Valid	L45/189	L45/284, L45/285, L45/188, L45/189, L45/287, L45/369	Pilbara – Fractured Rock
GWL176960-5	Valid	L45/408, G45/339, L45/418, L45/410, L45/407, M45/1257, E45/4639	L45/408, G45/339, L45/418, L45/410, L45/407, M45/1257, E45/4639.	Pilbara – Fractured Rock
GWL177240-5	Valid	M45/1209, L45/394, L45/371, L45/372, L45/280, M45/1197	M45/1209, L45/394, L45/371, L45/372, L45/280	Pilbara – Fractured Rock
GWL177500	Valid	E45/3601	E45/3601	Pilbara – Fractured Rock
GWL177664	Valid	M45/1197	M45/1197	Pilbara – Fractured Rock
GWL179086	Valid	E45/2585	E45/2585	Pilbara – Fractured Rock
GWL179423	Valid	E46/732	E46/732	Pilbara – Fractured Rock
GWL183228	Valid	L45/395	L45/395	Pilbara - Fractured Rock
GWL184565-1	Surrendered	Section 91 LAA Lic 00869-2016_A6435862	Section 91 LAA Lic 00869-2016_A6435862	Pilbara – Fractured Rock
GWL200171	Valid	E52/1772	E52/1772	East Murchison Combined - Fractured Rock

1.3 Atlas Water Management Approach

Improving the management of Atlas' water assets began in 2012 with the introduction of a standard data collection and reporting process. In February of 2014 Atlas developed the Atlas Water Policy. The water policy seeks to formalise best practices across all aspects of water management including economic, social, environmental and cultural factors. Ultimately Atlas aims to standardise the planning, management and usage of water across the company via three core processes;

I. A standard management framework;
II. Adaptive management through performance review, and
III. Standard processes for monitoring, accounting, reporting and auditing.

1.3.1 The Water Management Framework

This framework describes the approach to managing water on operational sites. The framework consists of a three-tiered hierarchy (Figure 1.2) in which management strategies and operational processes sit under a master water plan.

At the top of the hierarchy sits the Water Management Plan (WMP). The WMP presents how Atlas will address the water issues that arise during the operation, decommissioning and closure of a project. Its purpose is to provide a strategy for the management of key risks that the use of water may present to the project. For example, current plans focus on ways to:

- Enable abstraction of groundwater for mining with minimum possible impact on environmental, cultural or social values;
- Mitigate potential impacts from mining on the quality of surface and groundwater resources;
- Maximise the efficient and safe use of water;
- Ensure compliance with the project approvals and other regulatory requirements;
- Minimise post closure impacts of pit lakes and
- Apply adaptive management to achieve ongoing improvement.

The manner in which each strategy will be implemented is then described in a supporting document such as a Discharge Management Strategy. This describes how the strategy will be applied, performance measured and any contingency needs.

The Site Water Operating Plan (SWOP) describes how the strategies will be applied operationally, how outcomes are monitored and the responsibilities for monitoring and reporting.
This tiered structure provides an effective tool to define water management responsibility across the business. It provides strategic direction, project management support and detailed operational tools, all at the appropriate level.

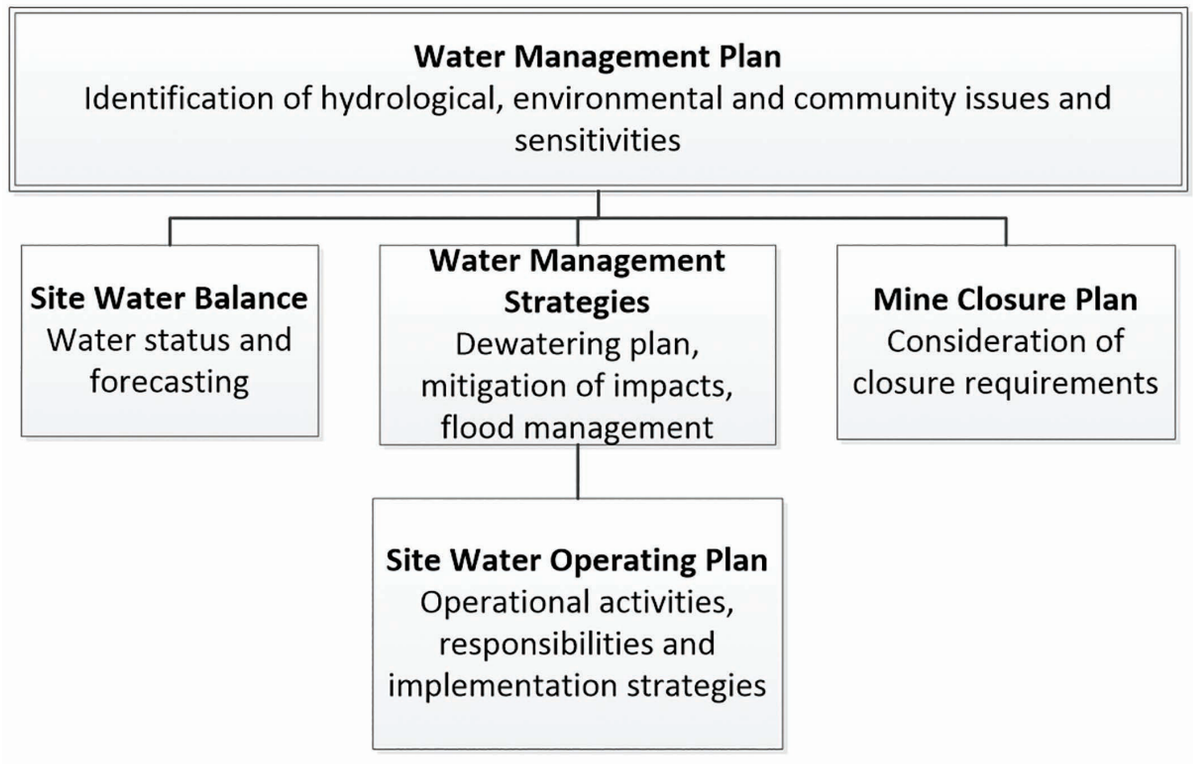

Figure 1.2 - Atlas Water Management Framework

1.3.2 Adaptive Management and Performance Review

Managing the ongoing cycle of improvement occurs via regular project assessments, annual auditing and aquifer reviews. This process enables tracking of the short and medium term performance against the project objectives and licence compliance.

The regular assessments consist of a desktop review of the available allocation, licence compliance, aquifer performance, alignment with the mine plan and water quality. This is then reported back to the business, highlighting items that need to be addressed going forward, as well as changes to the management strategy if needed.

Regular on-site assessments of project activities occur throughout the year. This process provides regular updates to the project status and highlights opportunities for improvement. One of the key aims is to review the site SWOP and update it if required.

An annual review of aquifer performance is completed in line with the licence requirements. Results are then reported annually as required.

1.3.3 Standard Processes for Monitoring, Accounting, Reporting and Auditing

Atlas standard procedures include the following;

- Monitoring procedures;
- Templates for:
  - Monthly and annual reporting;
  - Project planning and investigation proposals;
  - Water Management Plans, SWOP's and management strategies;
  - Usage benchmarking (under development).
- Borehole database management (under development);
- Licence and approvals management; and
- Data storage (under development).

1.4 Key Outcomes for the Reporting Period

Key outcomes for the reporting period include:

- Meeting the overall water management objectives for each license (with the exception of some gaps in bore monitoring and meter reading);
- Providing water to meet operational needs;
- Ongoing development of the life of mine water supply and sustainability planning for Mt Webber; and
- Highlighting areas for improvement of water management practices within the business.

Specific outcomes for each of the key groundwater abstraction licenses are detailed below. A summary of the Pardoo project is included to highlight closure monitoring results.

1.4.1 Abydos DSO Project (GWL168045-7)

During the reporting period 3,284 kL of groundwater was abstracted from two remaining commissioned bores at Abydos representing approximately 0.4% of the annual water allocation (800,000 kL). Abstracted water was used primarily for camp purposes.

Water levels in the Abydos ROM aquifer have recovered to pre-mining levels as a result of cessation in pumping in November 2017. This recovery indicates near full replenishment in aquifer storage and drawdown around the ROM.

Water quality remained relatively consistent since monitoring began suggesting that abstraction in the project area resulted in no deterioration of water quality over the life of the project.

Several gaps in the monitoring data occurred as a result of access issues from ongoing rehabilitation work and staffing resources. The staffing issues have been rectified and regular monitoring is now under way in accordance with the SWOP Addendum (Atlas, 2015).

1.4.2 Abydos Link Road East (GWL176408-4)

Over the reporting period 5,184 kL of groundwater was abstracted from two bores at Abydos representing approximately 0.4% of the annual water allocation (1,198,368 kL). Dust suppression activities accounted for all of the abstracted water.

No water level or water quality trigger values were breached during the reporting period.

Water levels across the borefields have recovered to pre-pumping levels, suggesting that local and regional aquifers remained largely un-impacted.

Water quality has remained relatively consistent since monitoring began, indicating that abstraction in the project area has not resulted in deterioration of water quality over the life of the project.

There were several gaps in the monitoring data, attributed to staffing issues while in care and maintenance. This has been rectified and regular monitoring is now under way in accordance with the Addendum to the SWOP (Atlas, 2015b, 2017a).

1.4.3 Corunna Downs (GWL176960-5)

The Corunna Downs groundwater license was approved on 3/04/2020 for a total annual abstraction limit of 1,100,000 kL. Abstraction in support of construction activities began in April 2020 and continued throughout the reporting period for a total usage of 80,293 kL. This represents 7% of the total annual allocation for the project.

With the exception of a temporary pumping water level exceedance in CRD0084, no water quality, water level or other license conditions were breached over the reporting period. Water levels in the identified production bores recovered quickly after reducing pumping. Resting water levels remain in compliance for all production and monitoring bores at the project.

Monitoring was conducted in accordance with the approved SWOP (Atlas, 2020) and conditions of the license.

1.4.4 Mt Dove (GWL175319-3)

During the reporting period 39,235 kL of groundwater was abstracted from the Mt Dove borefield representing approximately 6% of the annual water entitlement (650,000 kL). Water was used primarily for dust suppression and camp purposes.

Monitoring was conducted in accordance with the approved SWOP and subsequent addendum (Atlas, 2015c). No water quality or water level trigger values were breached during the reporting period. Water levels and water quality generally remained stable over the reporting period.

1.4.5 Mt Webber (GWL177240-7)

The annual allocation under GWL177240(7) is 1,198,368 kL. During the reporting period a total of 789,588 kL was abstracted from the Mt Webber production bores which represents 66% of the annual water entitlement. Water consumption increased by 1% (6,225 kL) over the previous year as a result of increases in mining and crushing.

Water levels in pumping bores remained above trigger levels throughout most of the reporting period. However, in the first half of the review period water levels in some East Fender pumping bores temporarily exceeded the pumping water level trigger but recovered after reductions in pumping rate coupled with seasonal recharge.

In the remaining borefields water level changes related to abstraction were minor.

No water quality trigger values were exceeded during the reporting period. Conductivity and pH measurements in abstraction and observation bores remained relatively constant throughout the monitoring period suggesting negligible pumping impacts.

In general, water level and water quality data indicate that that no long term impact to the aquifer has occurred.

Some minor gaps exist in the monitoring record as a result of access issues and staffing schedules. These issues have been addressed and regular monitoring is now under way in accordance with the approved SWOP (Atlas, 2017b).

1.4.6 Pardoo (GWL166951-5)

Abstraction at Pardoo ceased in June 2014. No water was taken during the reporting period.

GWL166951(5) carries no statutory reporting requirements. However, Atlas conducts regular monitoring to track recovery of water levels in the local aquifers and detect potential changes in groundwater quality. The Pardoo Interim Care and Maintenance Water Monitoring Program (Atlas, 2014a) and Pardoo Mine Closure Plan (Mine Earth, 2013) outline the water monitoring schedule.

Water levels in the Bobby Pit area continued to recover during the reporting period, although remains approximately 2.7 m below the model prediction and approximately 3.4 m below pre-mining water levels, most likely as a result of evaporative effects.

In the alluvial aquifer east of Bobby Pit (PDPIEZ18) water levels increased marginally over the reporting period, though remained within the range of historical variation. Water levels in these areas showed minimal influence from pumping during mining.

In the Chloe and Emma Pit areas water levels have recovered to near pre-pumping levels suggesting negligible long-term drawdown impacts.

At Alice Extension and South Limb Pits water levels continued to recover slowly due to the relatively higher elevation and lower recharge rates in these areas.

In general, salinity (EC) and pH measurements remained relatively constant throughout the monitoring period. EC concentrations in PDPIEZ45 (Emma Pit) and PDPIEZ37s (South Limb) showed an increase from the previous reporting period, however values remained within the historical range. pH values also remained constant over the reporting period, and no significant variation in major ions and metals was identified.

Overall Atlas met water management objectives and remained compliant with obligations under the *RiWI Act 1914*. Some gaps in the field monitoring record occurred as a result of access issues.

2. ABYDOS

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2.1 Introduction

This Annual Aquifer Review relates to instrument GWL168045, which allows Atlas Iron Pty Ltd (Atlas) to take water under section 5C of the RIWI Act 1914. The duration of the licence is from 17 June 2015 to 16 June 2025.

2.2 Background and Location

The Abydos Direct Shipping Ore (DSO) Project (the project) is located in the Pilbara region of Western Australia, situated approximately 100 km southeast of Port Hedland and 85 km west of Marble Bar (Figure 2.1). The Project is located within mining lease M45/1179 in the Shire of East Pilbara, approximately 50 km east of the Great Northern Highway.

Mining at Trigg Pit commenced in June 2013 using conventional drill and blast, load and haul techniques at a rate of 3 - 4.3 Mtpa. Mining at Abydos was completed in October 2017 and the project has since begun closure activities and rehabilitation. The camp and haul road continued to be used throughout the reporting period in support of closure operations.

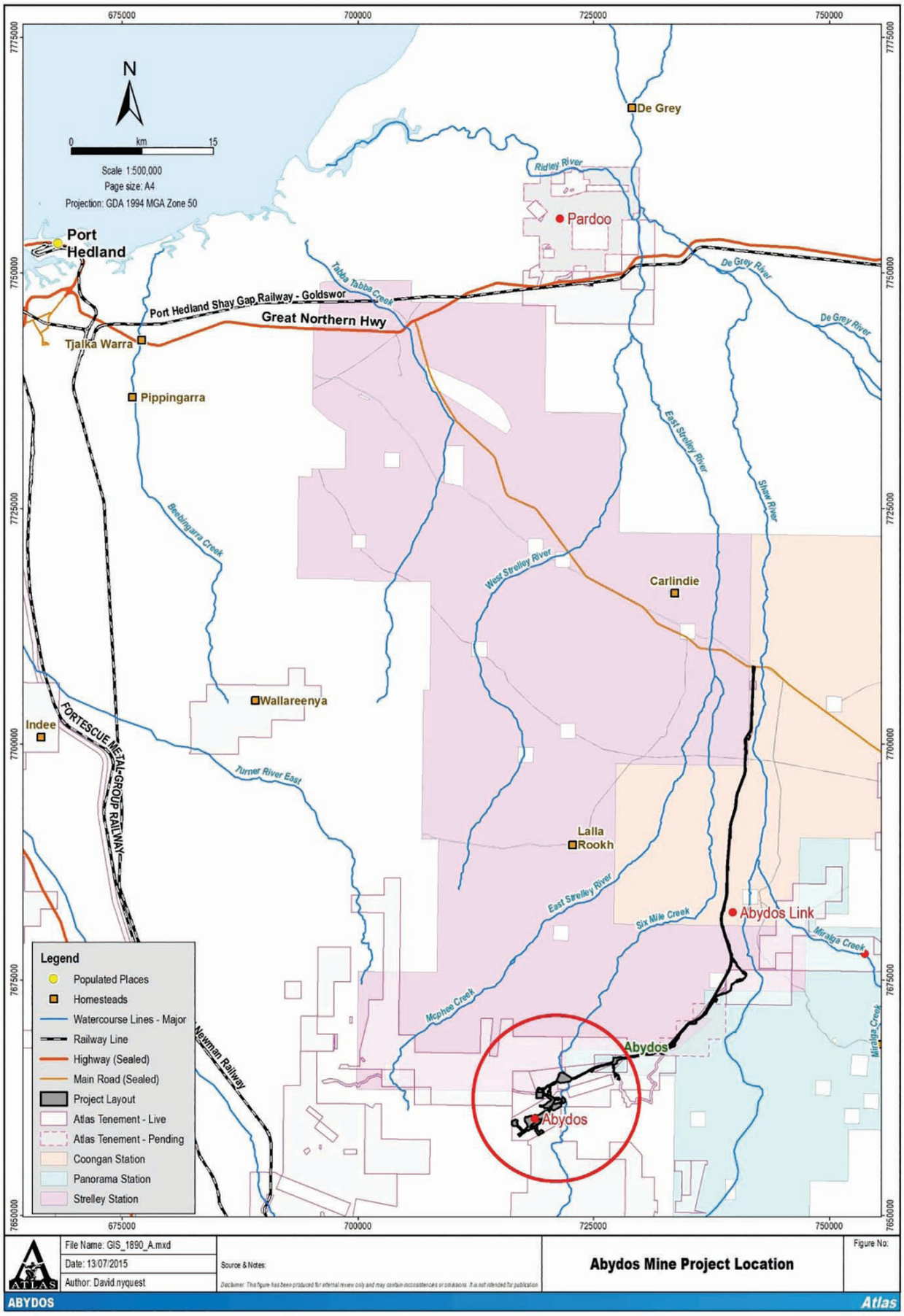

Figure 2.1 - Abydos DSO Project Location

2.3 Groundwater Management Areas

The Project lies within the Pilbara Groundwater Management Area and the Pilbara Groundwater Province. It is not located within a public drinking water source area.

2.4 Water Usage

Water taken during the water year is authorised to be used for:

- Dust suppression, earthworks and construction purposes,
- Exploratory drilling operations,
- General campsite purposes,
- Mineral ore processing and other mining purposes, and
- Potable water supply purposes.

A total of 4,218 kL of groundwater was used during the reporting period.

2.5 Licensing

Groundwater abstraction for the Project is authorised by GWL168045(7) (Figure 2.2). This licence grants Atlas an allocation of 800,000 kL/year from the Pilbara Fractured Rock aquifer for the purposes noted above. Table 2.1 lists the details of the historical GWL approvals.

Under this licence the authorised activities listed above can be undertaken within leases L45/204, L45/207, L45/284 and M45/1179.

The reporting period is 1 July 2019 to 30 June 2020. The Project Annual Aquifer Review (AAR) report is scheduled for submission to the Department of Water and Environmental Regulation (DWER) annually in September.

Table 2.1: Licence History

Table 2.1 - Licence History

Licence	Allocation (kL)	Start Date	Expiry Date	Comments
GWL165217(1)	15,000	22/11/2007	22/11/2009	Exploration camp
GWL165422(1)	15,000	7/12/2007	31/12/2009	Drilling requirements
GWL168045(1)	90,000	8/05/2009	7/05/2011	Amalgamation of GWL165217(1) and GWL165422(1)
GWL168045(2)	90,000	11/04/2011	10/04/2013	Renewal
GWL168045(3)	90,000	27/03/2012	26/03/2015	Amended SWOP
GWL168045(4)	800,000	30/07/2012	29/07/2015	Increased allocation and amended SWOP.
GWL168045(5)	800,000	4/09/2012	2/04/2015	Amended SWOP.
GWL168045(6)	800,000	2/04/2015	1/04/2025	Amendment to add ROM bores.
GWL168045(7)	800,000	17/06/2015	16/06/2025	Amended SWOP, Addendum to SWOP.

File No: RF693-04

Government of Western Australia
Department of Water

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Instrument No. GWL168045(7)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Atlas Iron Limited		
Description of Water Resource	Pilbara Pilbara - Fractured Rock	**Annual Water Entitlement**	800000 kL
Location of Water Source	L45/284, M45/1179		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes Earthwork and construction purposes Exploratory drilling operations General campsite purposes Mineral ore processing and other mining purposes Potable Water Supply purposes	L45/204, L45/284, M45/1179, L45/207
Duration of Licence	From 17 June 2015 to 16 June 2025	

This Licence is subject to the following terms, conditions and restrictions:

1 The licensee must install an approved meter to each water draw-point through which water is taken under this licence.

2 The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this licence.

3 The licensee shall comply with the commitments of the 'Abydos DSO Project Site Water Operating Plan 2012 to 2019 (101-DEV-HY-PLN-001 Rev 3)' and 'Addendum 2015' as prepared by Atlas Iron Limited and approved by the Department of Water on 19 June 2015, including any modifications to the commitments as approved during the term of the licence.

4 The annual water year for water taken under this licence is defined as 1 July to 1 June twelve months later.

5 Every 12 month(s) the licensee shall provide to the Department of Water a Groundwater Monitoring Summary for the preceding water year. The first report is due 30/09/2016.

End of terms, conditions and restrictions

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000

Figure 2.2 - Licence to Take Water GWL168045(7)

2.6 Climate

The climate of The Project area is classified as semi-arid to arid and is characterised by hot summers and warm winters. The area experiences a climate of extremes, where severe droughts and major floods can occur at close intervals (MWH, 2011).

The hot summer season occurs from November to February with mean daily maximum and minimum temperatures of approximately 40°C and 25°C respectively. The winter season occurs from June to August with mean daily maximum and minimum temperatures of about 28°C and 13°C respectively.

Long term meteorological data is available from the Port Hedland Airport (Bureau of Meteorological Station No. 004032). Data is available from 1897 to present. This meteorological station is located approximately 100 km northwest of the Project area. A statistical summary of the long term meteorological data from Port Hedland is provided in Table 2.2.

Table 2.2 - Port Hedland climatic data summary (BoM station #4032)

Month	Mean daily temperature (°C) (1948 – 2020)		Mean monthly rainfall (mm) (1942 – 2020)	Mean daily evaporation (mm) (1942 – 2020)
	Maximum	Minimum		
January	36.4	25.6	63.4	10.4
February	36.2	25.5	88.9	9.6
March	36.8	24.6	55.3	9.3
April	35.3	21.5	21.5	8.8
May	30.7	17.3	26.6	7.4
June	27.7	14.2	23.1	6.5
July	27.3	12.4	10.4	6.6
August	29.3	13.2	4.7	7.5
September	32.4	15.5	1.2	8.9
October	35.1	18.6	1.0	10.6
November	36.3	21.5	2.5	11.5
December	36.7	24.2	18.5	11.4
Annual Average	33.4	19.5	319.3	9.0

Source: Port Hedland Station 4032 (BoM, 2020)

Mean annual rainfall for the area can vary from 300 – 400 mm. Rain is to be expected in the summer months, mainly from January to March, and is unusual between July and October. Most of the summer rain comes from scattered thunderstorms, producing heavy localised falls in short periods. In addition, tropical lows and cyclones can bring widespread rain to the region. A secondary peak in the monthly rainfall can occur as a result of rainfall caused by tropical cloud bands, which intermittently affect the area mostly in May and June.

Rainfall is generally unreliable and highly variable, which predominantly relates to the random nature of localised thunderstorms and tropical lows passing through the area (MWH, 2011).

Annual potential evaporation is 3,300 mm (mean daily average 9.0 mm). The excess of evaporation over rainfall, which is greater than a factor of ten, is typical for arid and semi-arid areas in Australia (MWH, 2011).

2.7 Hydrogeology

The hydrogeology of the northern Pilbara is dominated by faulted granitic rocks and associated folded Archaean age greenstone rocks, which has resulted in structurally-induced permeability throughout the region and preferred groundwater flow paths. Where mineralised zones occur below the water table, secondary porosity may result. Additionally, shallow alluvial deposits associated with current surface drainage may host minor, shallow aquifers (RPS Aquaterra, 2013a).

Groundwater depth in the project area ranges from approximately 10 metres below ground level (mbgl) in the valleys and plains, 34 to 50 mbgl in the low hills and 100 mbgl along the ridgelines (RPS Aquaterra, 2013a).

Groundwater quality over the project area varies from near potable to brackish, with fresher groundwater occurring in high topographical areas where rainwater infiltrates directly to recharge the aquifer. Total dissolved solids (TDS) concentrations are lowest at the recharge points and increase along groundwater flow paths. The highest TDS levels are found in areas of longer groundwater residence time, such as low-lying areas (RPS Aquaterra, 2013a).

2.8 Abydos Borefield

The Project Borefield (Figure 2.3) was established between 2012 and 2014 with the installation of twelve production bores and thirteen monitoring bores. Decommissioning of The Project Borefield began in November 2017. During the 2020 reporting period, bores ABPB01, ABPB24 and CBPB02 were operated.

Details of all existing production and monitoring bores are provided in Table 2.3. The water supply scheme is outlined in Figure 2.4.

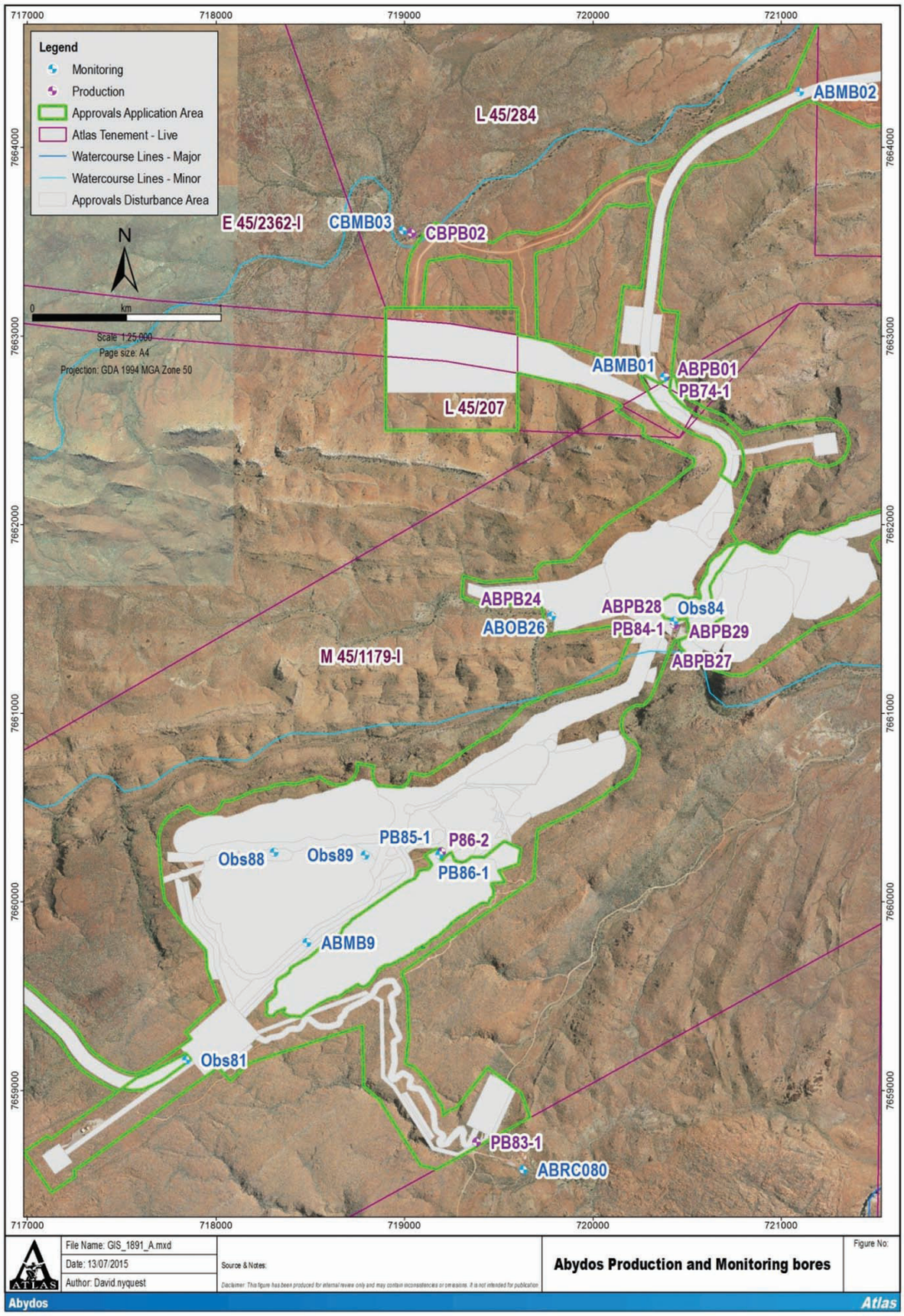

Figure 2.3 - Abydos DSO Project Bore Locations

Table 2.3 - Abydos Production and Observation Bore Details

Bore Name	Coordinates (GDA94, Zone 50)		Total Depth (mbgl)	Nominal Casing Diameter (mm)	Screen Interval (mbgl)	Static Water Level (mbtoc)	Recommended Rate (L/sec)	Recommended Pump Inlet Depth (mbgl)
	Easting	Northing						
Non-potable Production Bores								
ABPB27	720385	7661340	104	205	20 - 104	2.94	6	80
ABPB28	720407	7661512	132	205	18 - 132	4.7	10	80
ABPB29	720459	7661427	140	205	20 - 140	5.98	10	80
PB84-1	720434	7661472	150	205	12 - 150	2.93	15	100
PB86-2	719198	7660265	134	205	33 - 134	35.17	4	120
Potable Production Bores								
ABPB01	720386	7662785	96	205	35.7 - 95.7	32.15	1.5	60
ABPB24	719768	7661541	64	205	16 - 64	2.39	3	55
CBPB02	719039	7663547	60	205	9 - 105	7.8	1.7	80
Monitoring Bores								
ABMB01	720379	7662784	90	n/a	Open hole	32.16	n/a	n/a
ABMB02	721098	7664297	100	n/a	Open hole	15.58	n/a	n/a
ABMB9	718482	7659784	147	50	33 - 147	24.1	n/a	n/a
ABOB26	719781	7661517	100	n/a	Open hole	0.64	n/a	n/a
ABRC080	719632	7658581	Unknown	100	Unknown	5.59	n/a	n/a
CBMB03	718992	7663561	60	50	6 - 60	6.8	n/a	n/a
Obs81-1	717844	7659163	109	50	56 - 109	22.21	n/a	n/a
Obs84-2	720431	7661489	150	50	12 - 150	4	n/a	n/a
Obs88-2	718309	7660263	174	50	54 - 174	38.52	n/a	n/a
PB85-1	719175	7660346	117	205	9 - 117	26.68	n/a	n/a
PB86-1	719188	7660250	115	205	31 - 115	36.3	n/a	n/a

2.8.1 Supply Scheme

Decommissioning of the Abydos supply scheme (Figure 2.4) began in November 2017 after completion of mining activities in October 2017. Bores ABPB01, ABPB24 and CBPB02 continue to supply potable water to the camp in support of closure operations.

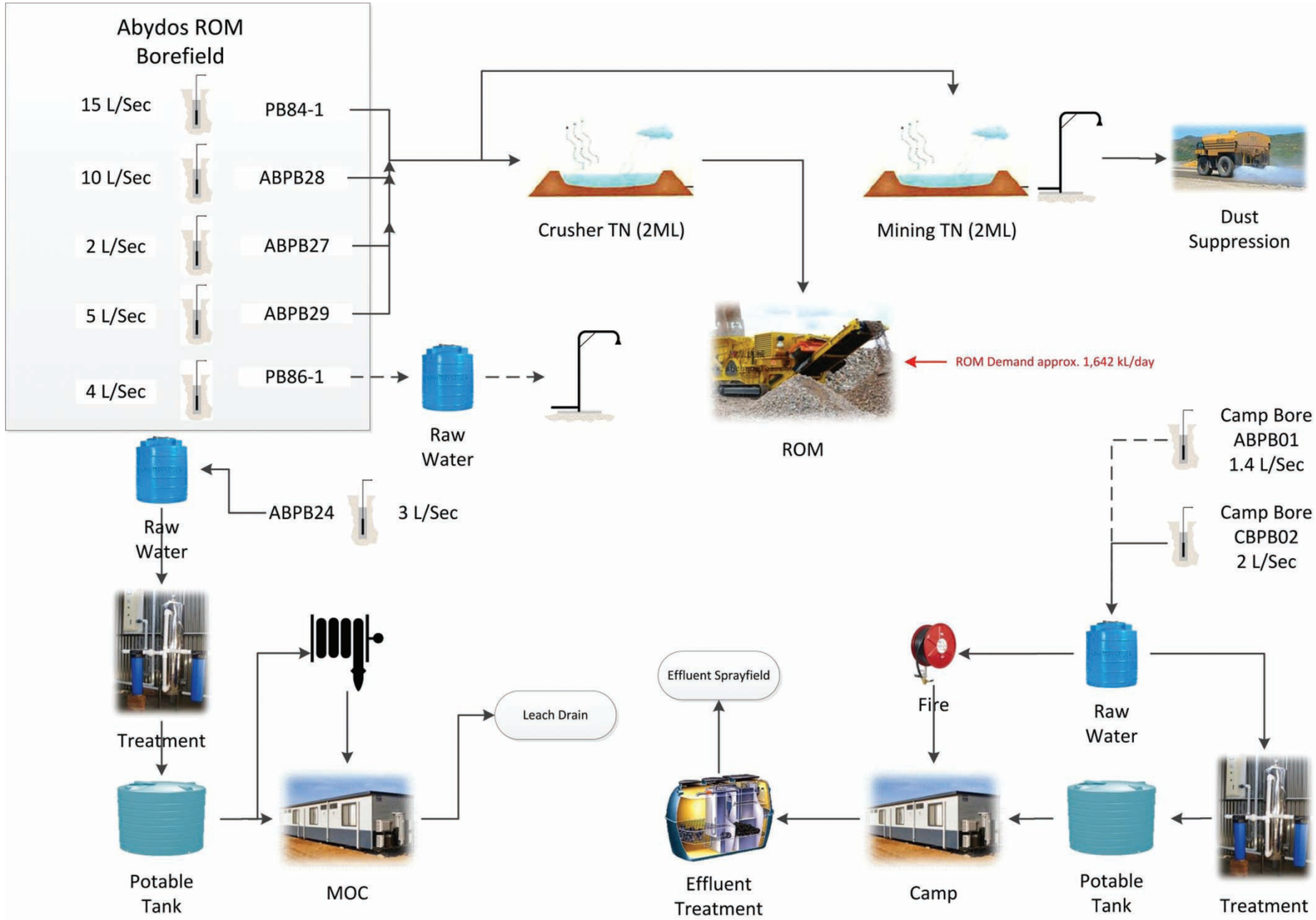

Figure 2.4 - Abydos Water Supply Scheme

2.9 Abstraction

A total of 3,284 kL of groundwater was abstracted from ABPB01, ABPB24 and CBPB02 during the reporting period. This represents 0.4% of the annual water entitlement (800,000 kL).

A complete historical plot of abstraction is shown in Figure 2.5.

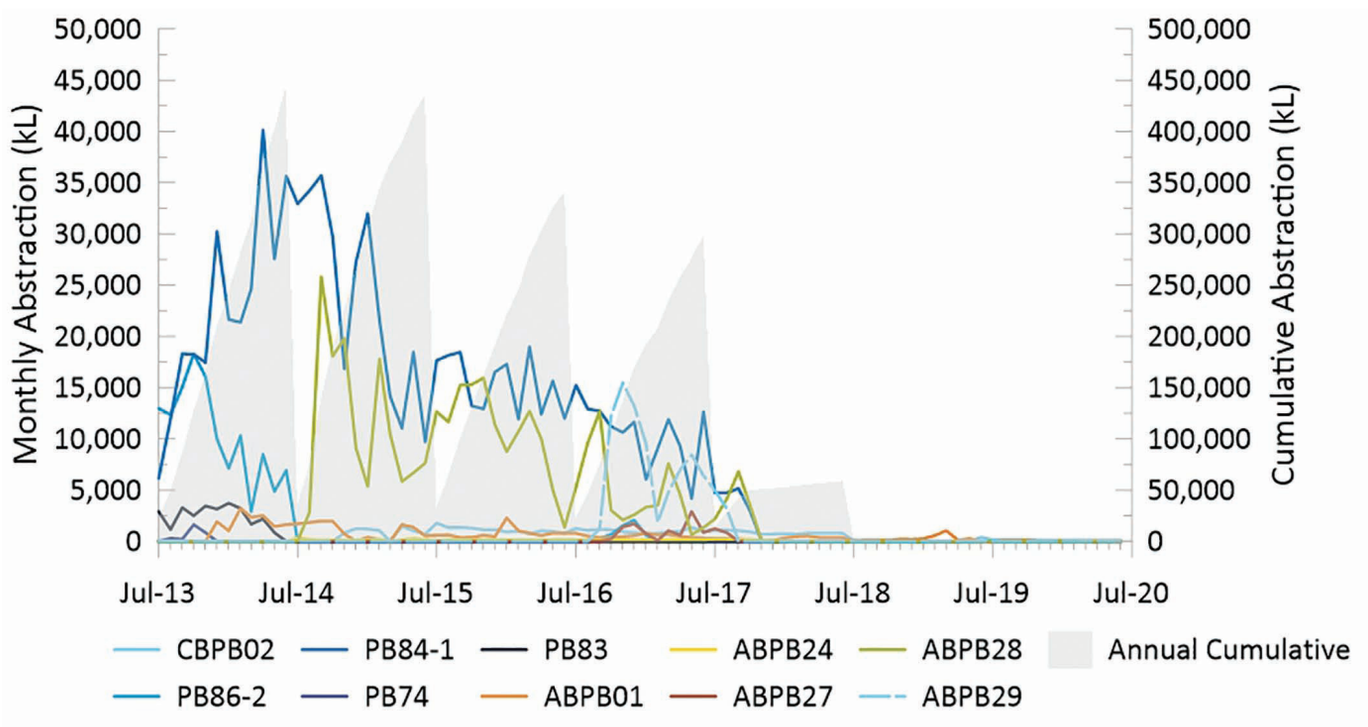

Figure 2.5 - Abydos Monthly and Cumulative Groundwater Abstraction

2.10 Water Balance

As no discharge took place over the reporting period the water balance is equivalent to groundwater abstraction.

All of the 3,284 kL abstracted for the year was used for camp purposes.

Supply requirements for 2021 comprise primarily potable water for camp, and incidental construction and dust suppression purposes in support of exploration, closure and rehabilitation activities. The current allocation is sufficient to meet this demand.

2.11 Monitoring

2.11.1 Objectives

The objectives of the Abydos monitoring program, as described in the Abydos Site Water Operating Plan (SWOP) (Atlas, 2015a), were developed in accordance with the Atlas Water Policy (Atlas, 2018) to meet regulatory requirements/Licence conditions. A care and maintenance monitoring program, as outlined in the SWOP Addendum (Atlas 2015b) was implemented in 2017 following cessation of operations. Bores to be monitored under the Care and Maintenance Monitoring Program are CBPB02, ABPB24, PB84-1, PB86-2 and Obs88-2.

The Project's groundwater monitoring requirements are outlined in Table 2.4.

Table 2.4 - Groundwater Monitoring Schedule

Location	Frequency	Type of monitoring	Parameters
(1)Production bores	Monthly	Field measurement	Water levels Conductivity, pH, and temperature Flow meter readings (instantaneous and cumulative volume)
	Annual (Nov)	Laboratory testing	Major ions Metals Total petroleum hydrocarbons Total suspended solids
		Dataloggers	Download dataloggers
Monitoring and regional bores	Annual (Nov)	Field measurement	Water levels Conductivity, pH, temperature
		Dataloggers	Download dataloggers
		Laboratory testing	Major ions Metals Total suspended solids

(1) Production bores taken out of service or decommissioned are monitored according to "Monitoring and regional bores" frequency. Bores put back into service revert to normal "Production bore" monitoring frequency. DWER to be notified when bore are taken out of service or put back into service.

2.11.2 Regulatory Conditions

There are no specific statutory conditions related to groundwater abstraction other than the standard conditions associated with the groundwater Licence. The Licence conditions are as follows:

- The Licencee must install an approved meter to each water draw-point through which water is taken under this Licence.
- The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this Licence.
- The Licencee shall comply with the commitments of the Abydos DSO Project Site Water Operating Plan 2012 to 2019 (101-DEV-HY-PLN-001 Rev 3) and Addendum 2015 as prepared by Atlas Iron Limited and approved by the Department of Water on 19 June 2015, including any modifications to the commitments as approved during the term of the Licence.
- The annual water year for water taken under this Licence is defined as 1 July to 30 June twelve months later.
- Every 12 months the Licencee shall provide to the Department of Water a Groundwater Monitoring Summary for the preceding water year. First report due 30/09/2016.

2.11.3 Trigger Levels

Using standard industry practices and performance monitoring to minimise impacts on the community and environment are a key part of the Atlas Water Policy. Trigger values and contingency actions as set forth in the SWOP (Atlas, 2015a) provide a framework for detecting and mitigating pumping-related impacts. The Abydos Link Road East is currently under a care and maintenance monitoring program as outlined in the SWOP Addendum, however trigger levels remain valid should the borefields be recommissioned.

Water level trigger values were set to avoid the lowering of the resting water levels below each bore's main water bearing zones identified during drilling and test pumping. The recommended pumping rates reflect the maximum estimated rate at which each bore may be pumped for 365 days before exceeding the trigger value (AECOM 2013, RPS 2013a, RPS 2014a and RPS 2014b).

Background salinity in production bores after installation and testing ranged from 160 to 1,200 µS/cm and is considered to be fresh to slightly brackish. Groundwater salinity trigger values below are based on a 50% increase in salinity during operation. A summary of the Project's contingency actions is provided in Table 2.5.

Table 2.5 - Key Contingency Water Management Actions

Bore_ID	Water quality		Drawdown	
	(1)Trigger value (conductivity, µS/cm)	Contingency actions	(2)Resting water level trigger (mbtoc)	Contingency actions
ABPB01	1,005	Repeat measurement, Notify DWER, review data, Identify source (if possible), Increase frequency of monitoring (if required), Agree on action in consultation with DWER (increase trigger value, reduce pumping, shutdown bore, update SWOP).	70	Stage 1 (90% of predicted) Increase monitoring frequency to fortnightly Stage 2 (100% of predicted) Reduce pumping rate, or rest if possible Increase monitoring frequency to fortnightly Stage 3 (110% of predicted) Shutdown bore
ABPB24	1,700		20	
ABPB27	1,820		70	
ABPB28	1,990		70	
ABPB29	1,030		70	
PB74-1	945		70	
PB83-1	675		40	
PB84-1	1,410		70	
PB86-2	375		110	
CBPB02	1,950		38	

(2) Based on 50% increase from original laboratory analysis of samples taken at the end of each bore's test pumping program.

(3) Based on main water bearing zones identified during drilling and test pumping.

2.12 Monitoring Observations

2.12.1 Water levels

Hydrographs for production bores are presented in Figure 2.6 to Figure 2.13. The hydrographs, plotted against trigger levels and pump setting depths, illustrate the historical performance of each bore.

Both production and observation bores show seasonal fluctuations in water levels and localised drawdown in the vicinity of production bores.

Groundwater abstraction was significantly decreased in October 2017, corresponding with the end of mining activities. Water levels in all production bores have since recovered to near pre-mining levels. This indicates that there has been no long term impact to the aquifer.

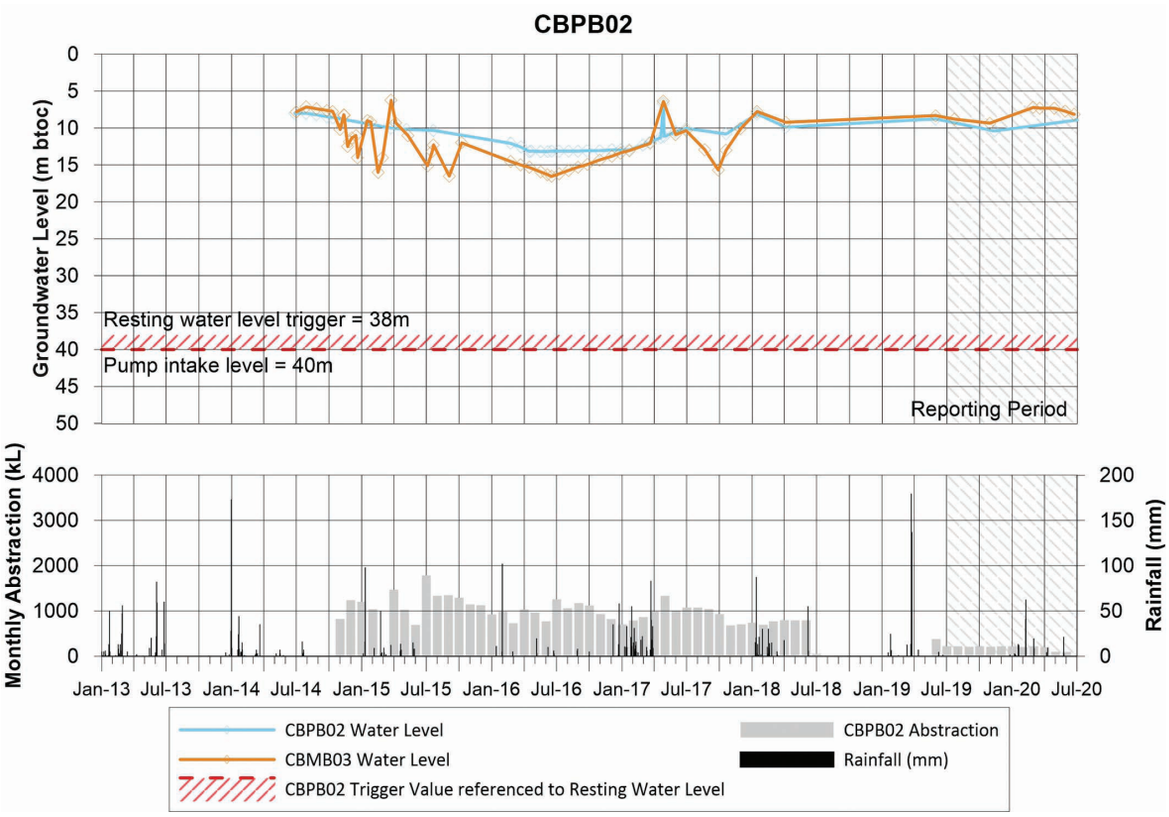

Figure 2.6 - CBPB02 Water Level vs Abstraction and Rainfall

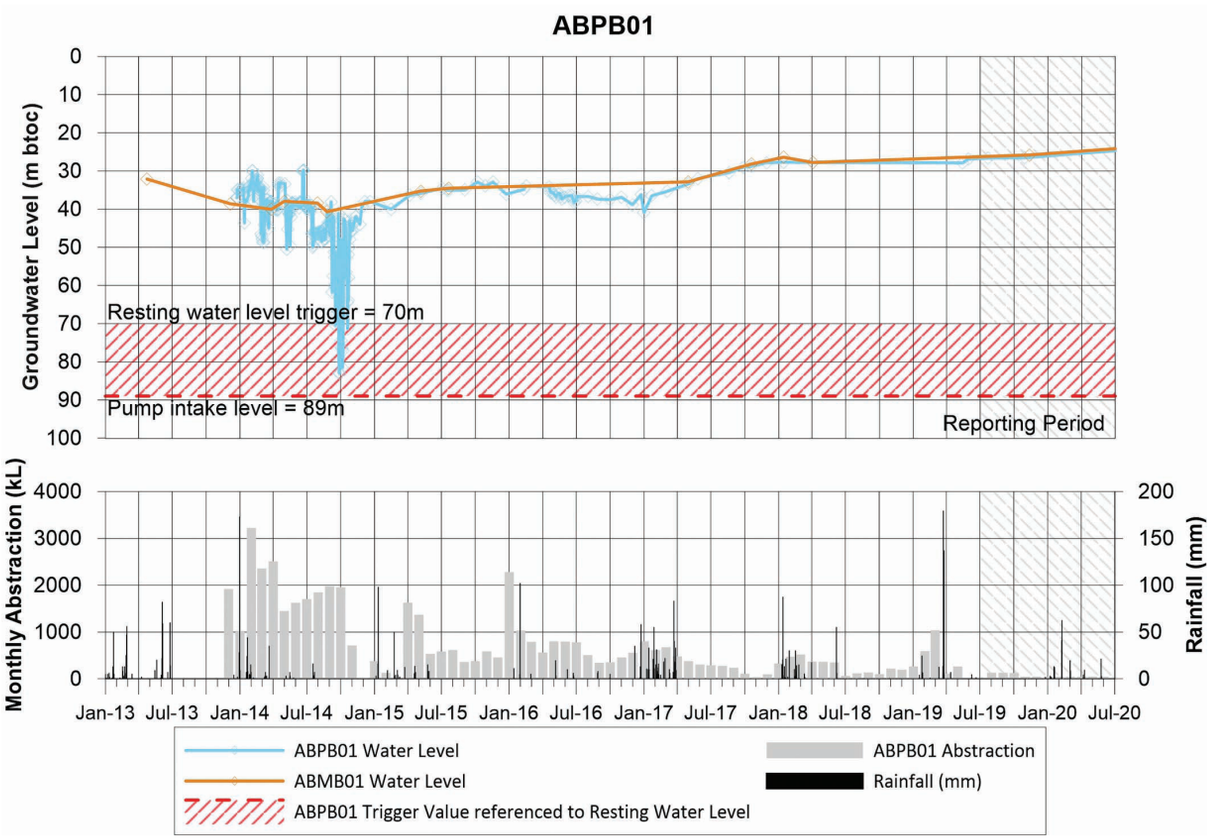

Figure 2.7 - ABPB01 Water Level vs Abstraction and Rainfall

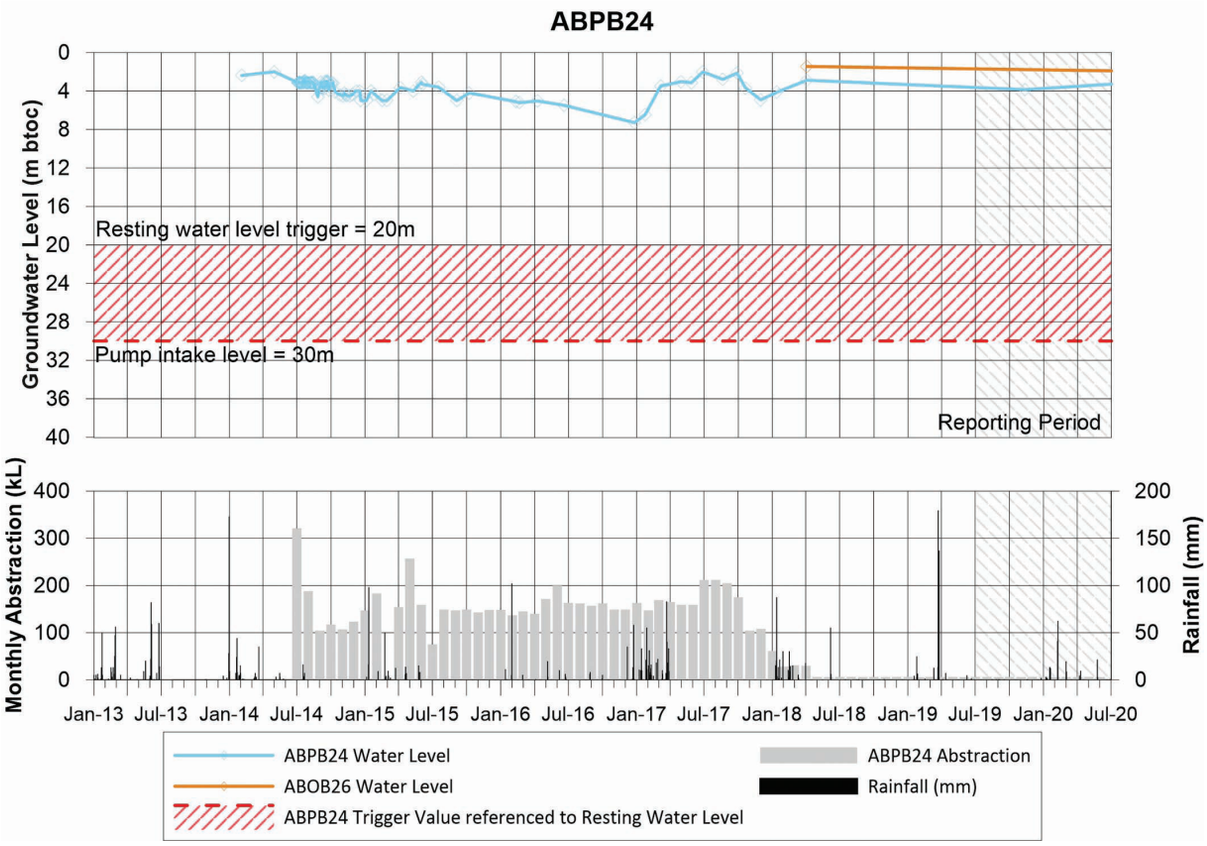

Figure 2.8 - ABPB24 Water Levels vs Abstraction and Rainfall

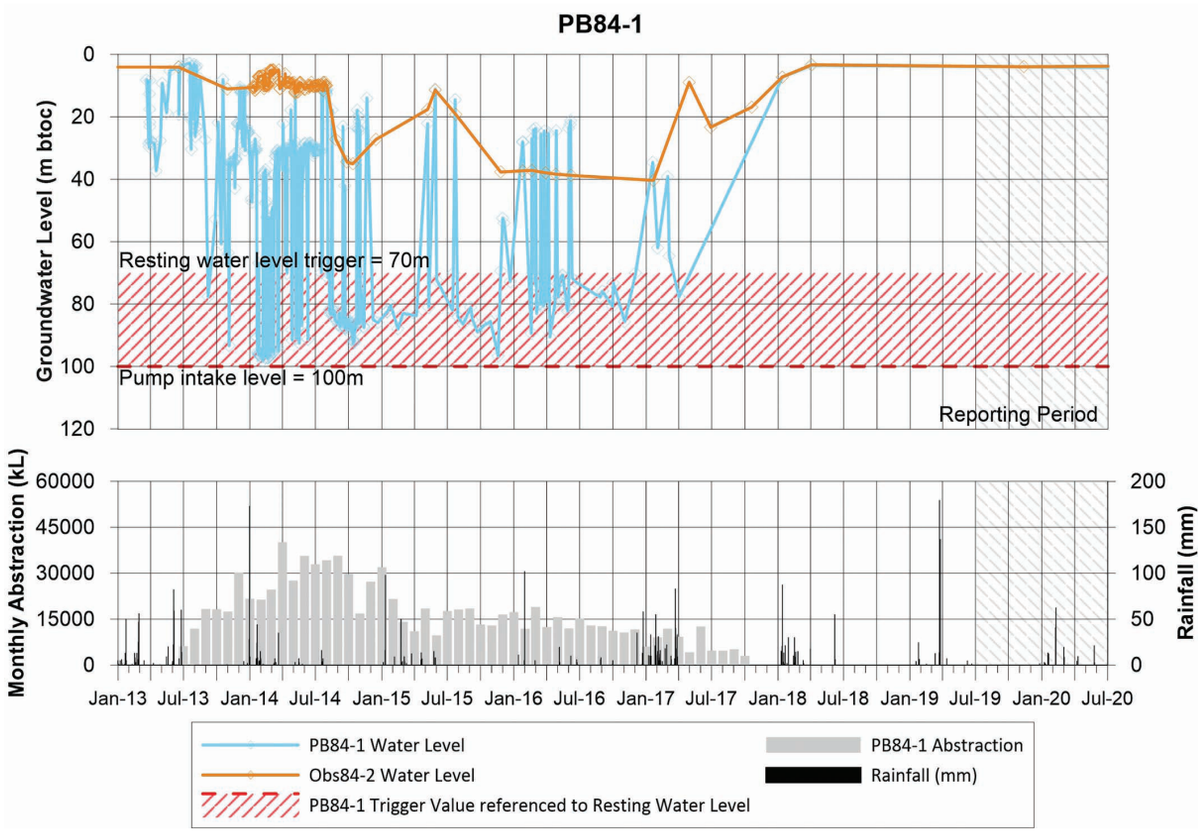

Figure 2.9 - PB84-1 Water Levels vs Abstraction and Rainfall

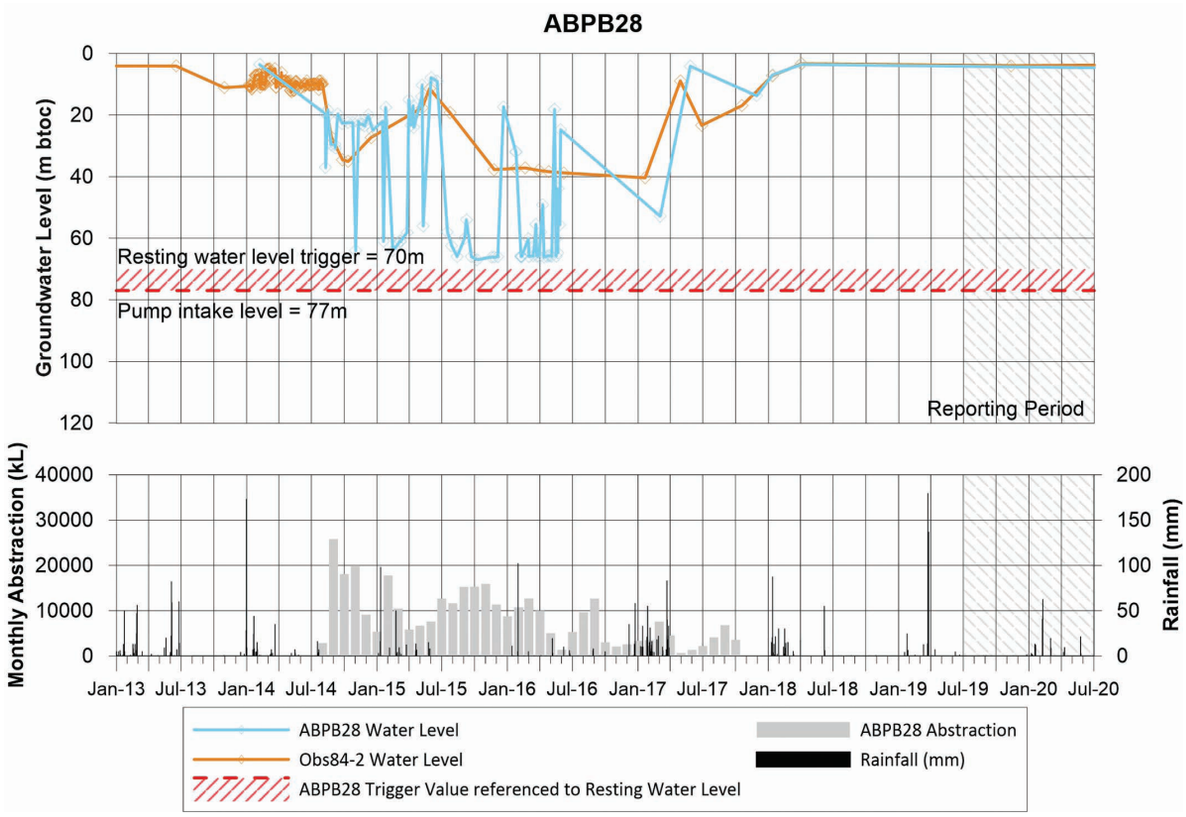

Figure 2.10 - ABPB28 Water Levels vs Abstraction and Rainfall

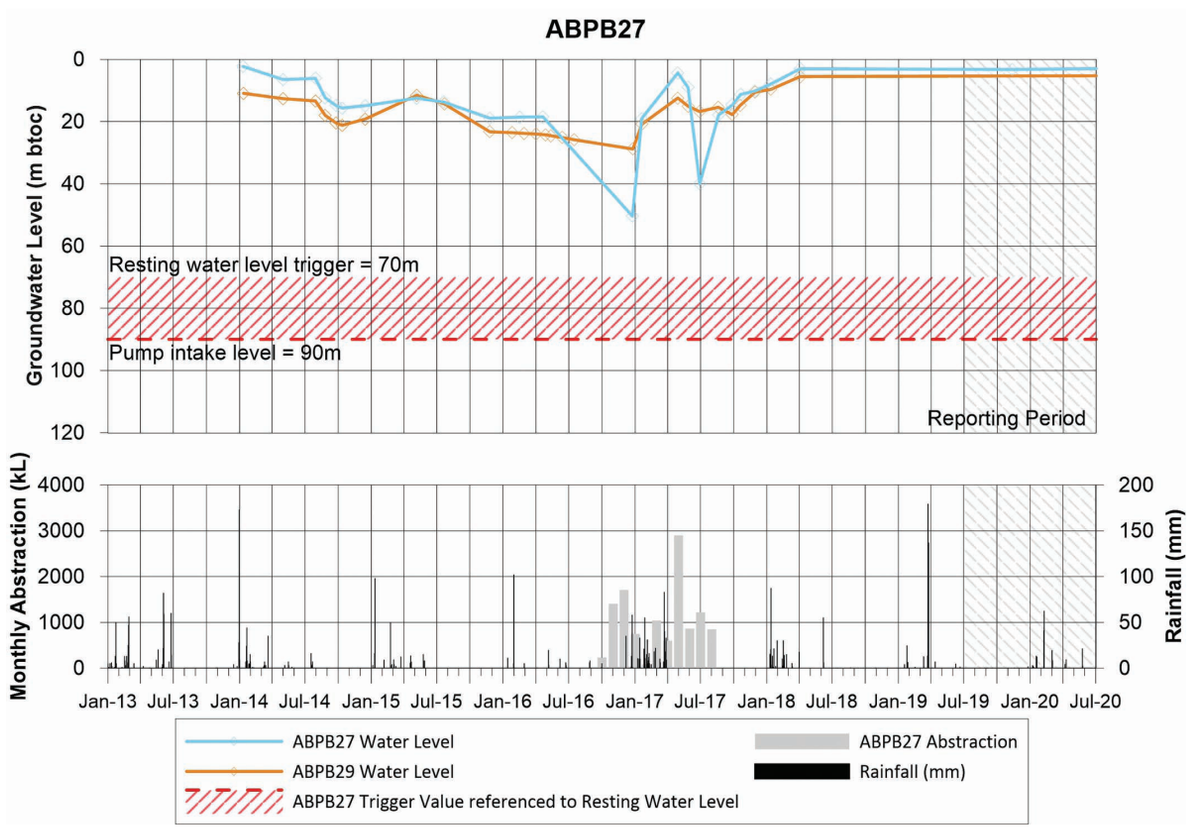

Figure 2.11 - ABPB27 Water Levels vs Abstraction and Rainfall

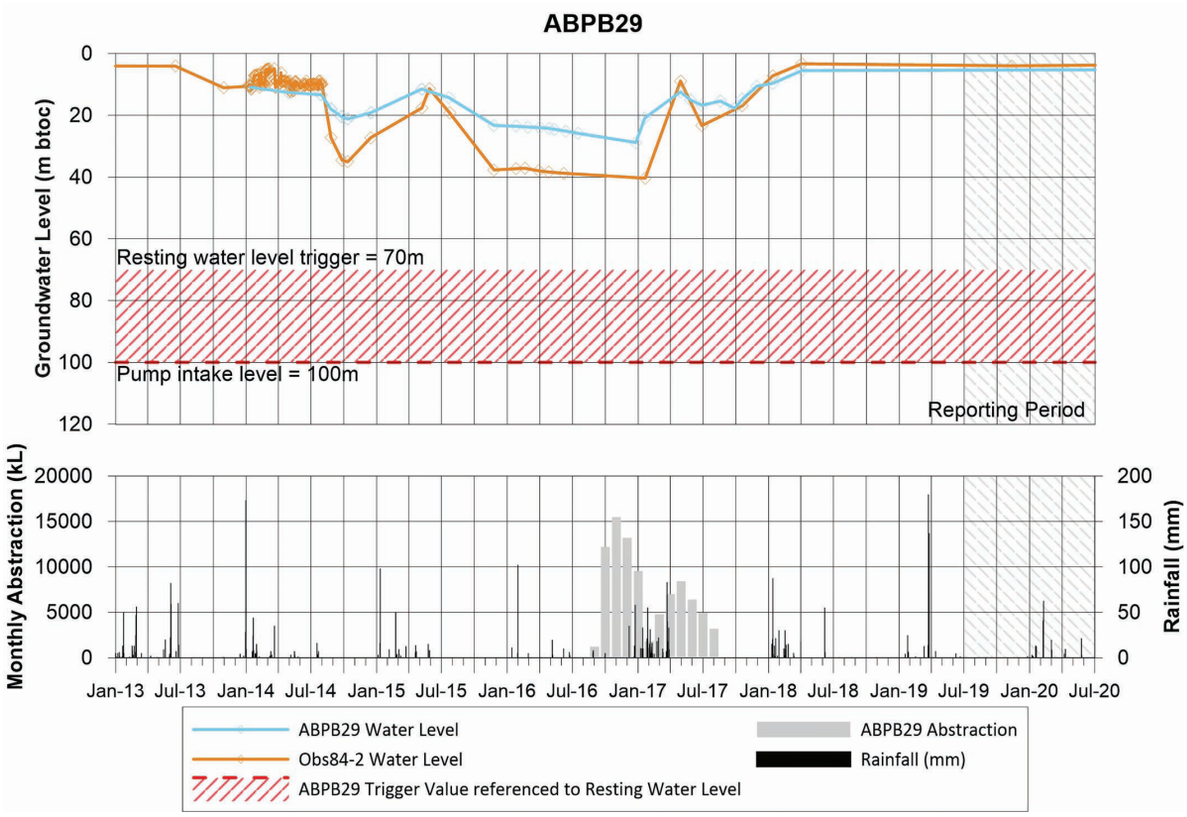

Figure 2.12 - ABPB29 Water Levels vs Abstraction and Rainfall

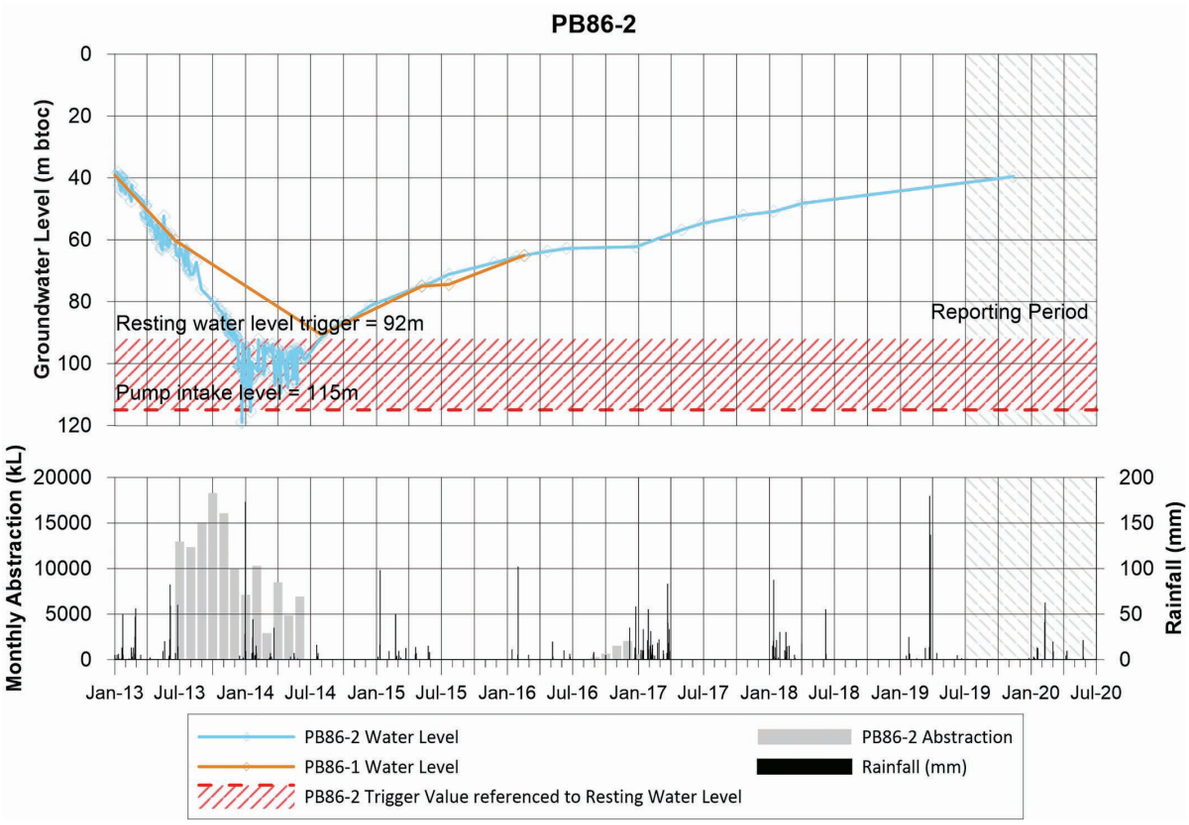

Figure 2.13 - PB86-2 Water Levels vs Abstraction and Rainfall

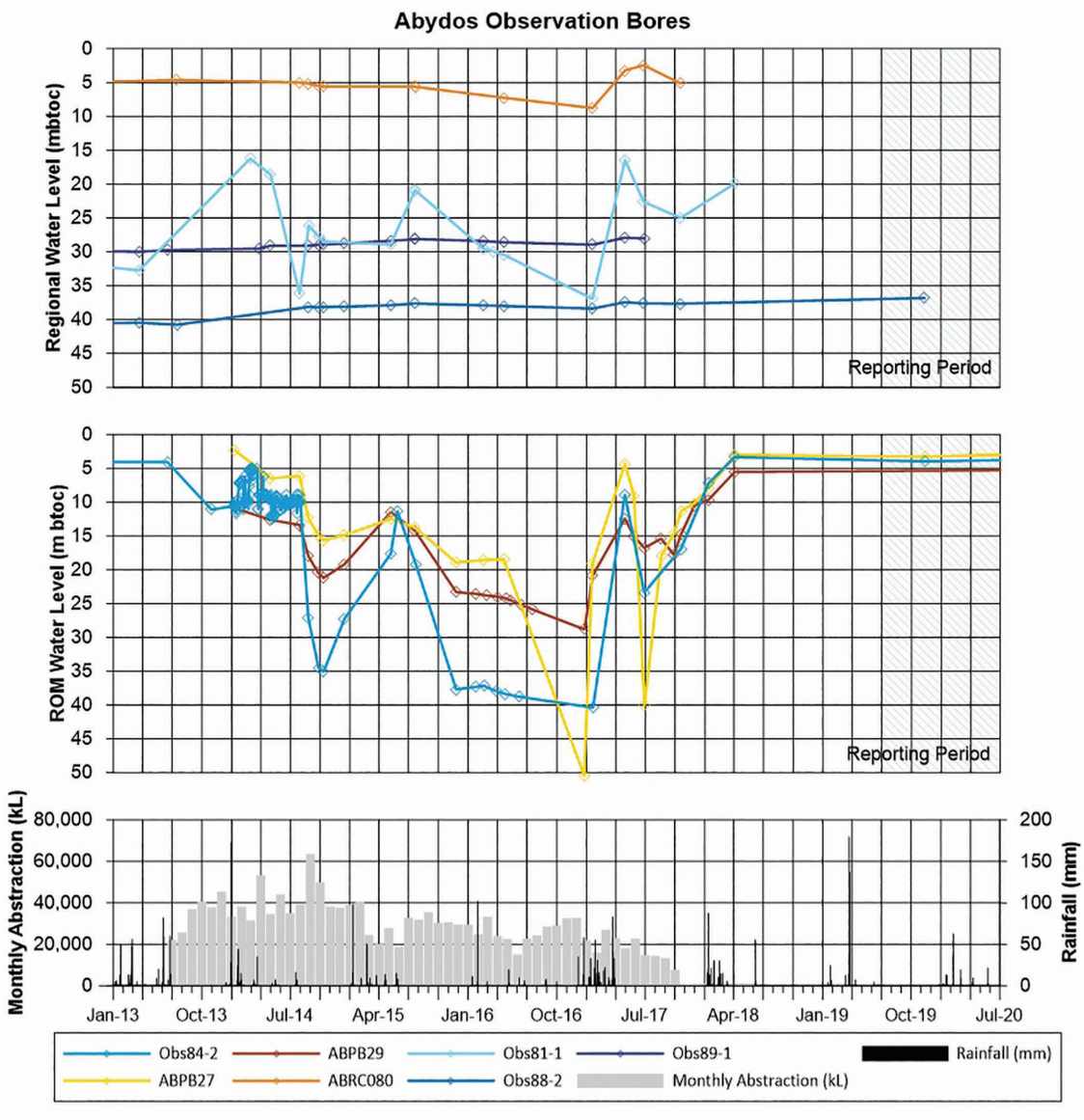

Figure 2.14 - Observation Bore Water Levels vs Abstraction and Rainfall

2.12.2 Water Quality

Groundwater in the project area ranges from fresh (<1,000 mg/L Total Dissolved Solids [TDS]) in recharge areas to slightly brackish (<2,000 mg/L TDS) in areas further along the groundwater flow path (valleys and lower lying areas).

Conductivity and pH measurements in abstraction and observation bores remained relatively constant over time (Figure 2.15 and Figure 2.16) indicating negligible impacts from pumping.

Table 2.6 and Table 2.7 present a summary of the analytical data for abstraction and observation bores.

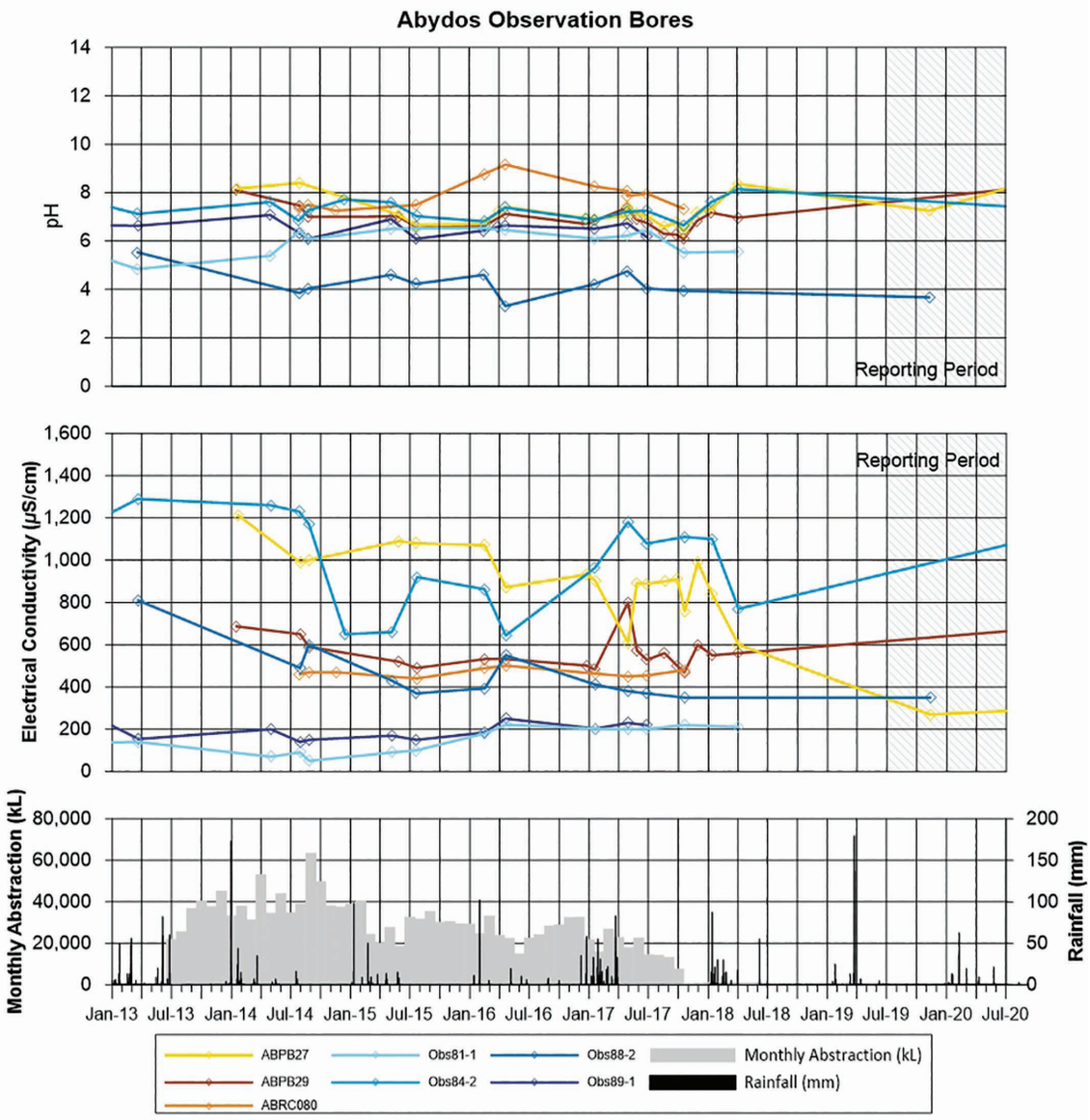

Figure 2.15 - Observation Bore pH and EC

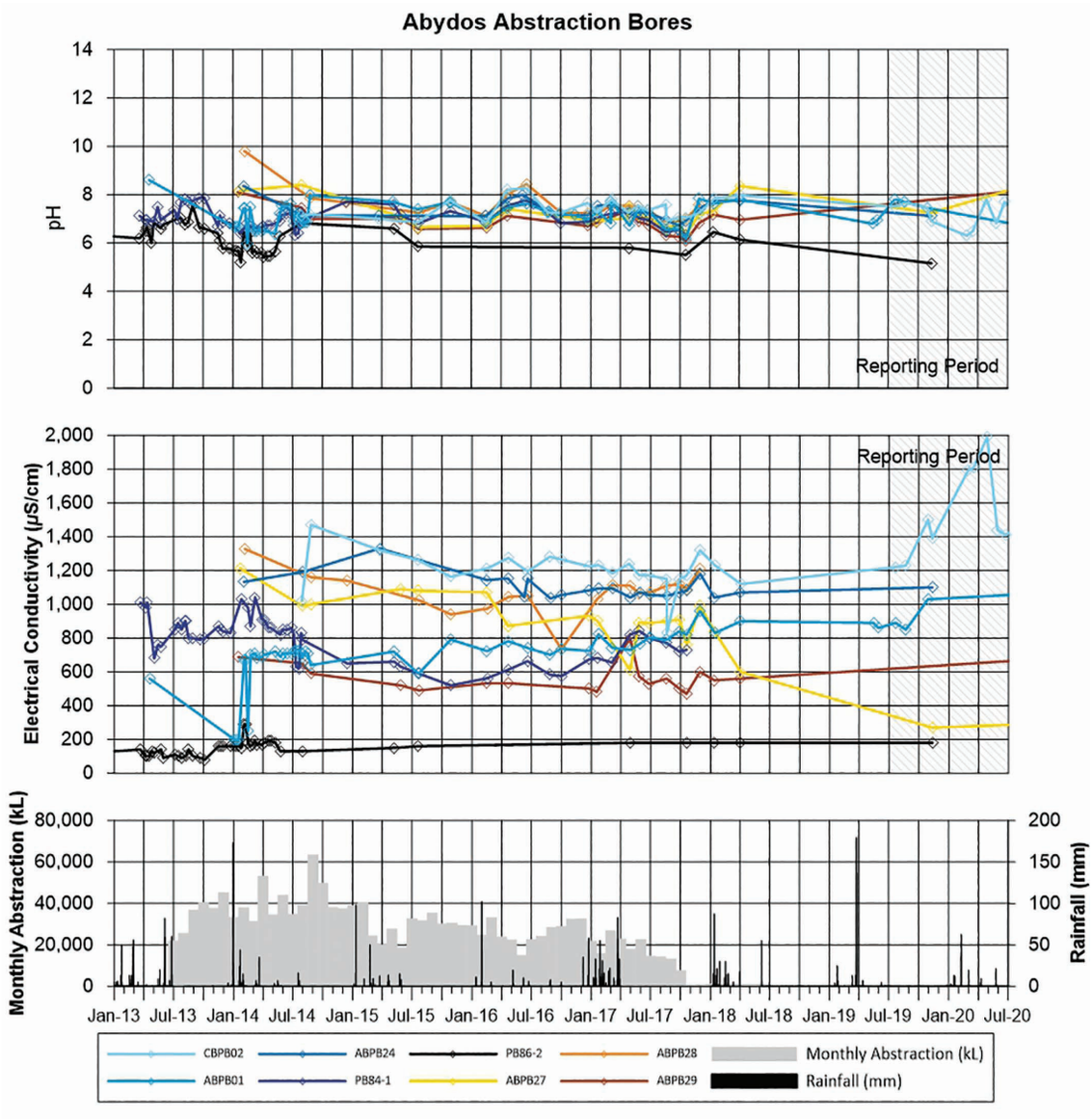

Figure 2.16 - Abstraction Bores pH and EC

Table 2.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
ABPB01	15/12/2012	8.3	1,800	1,020	290	510	64	16.0	83	13.0	230		
	16/12/2012	8.2	2,400	1,390	490	590	93	72.0	120	3.8	270		
	30/04/2013	7.4	670	350	73	280	15	39.0	38	1.7	42		
	29/03/2014	7.7	650	360	70	300	16	31.0	32	1.4	35	11.0	
	6/05/2015	7.7	720	380	78	290	19		41	1.7	43	12.0	<5
	28/10/2015	8.1		400		330		41.0	42	1.7	43	12.0	
	20/04/2016	7.2	690	410		240		42.0	40	1.7	42		2.5
	30/04/2017	7.5	760	460	81	250	17	46.0	42	1.5	46	2.7	<5
	29/11/2017	7.7	920	550	65	380	19	55.0	53	1.4	58	4.2	<5
	04/04/2018	6.6	950	570	82	270	14	55.0	55	2.2	57	3.0	<5
	10/06/2020	6.8	910	550	160	270	31	44.0	49	2.1	60		10.0
ABPB24	3/02/2014	8.2		600	94	<5	22	34.0	70	0.4	66	8.4	
	21/02/2014	7.8		700	99	610	30	73.0	76	0.2	77	19.0	
	24/03/2015	8.1	1,200	680	140	590	40		74	0.3	72	16.0	
	20/04/2016	7.6	1,100	630		510		67.0	69	0.3	80		2.5
	29/04/2017	7.3	1,100	610	79	470	19	67.0	68	<0.5	73	4.6	<5
	29/11/2017	7.3	1,200	670	84	500	20	65.0	74	<0.5	78	8.9	<5
	04/04/2018	6.5	1,100	640	67	500	15	53.0	64	<0.5	68	2.5	<5
	11/11/2019	7.3	1,200	650	110	460	20	75.0	83	0.3	57	2.0	<5
ABPB27	21/01/2014	8.3		670	120	470	57	37.0	68	3.7	100	5.3	
	21/02/2014	8.0		740	130	580	59	35.0	78	2.4	120	12.0	
	21/04/2016	7.2	810	490		290		38.0	45	4.1	72		45.0
	29/04/2017	7.6	640	390	32	240	27	21.0	42	1.2	43	5.4	<5

Table 2.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	29/11/2017	6.9	950	570	86	330	49	40.0	52	4.5	77	<0.5	6.0
	11/11/2019	7.9	0	160	17	86	12	16.0	14	1.7	14	1.4	<5
ABPB28	21/02/2014	8.0	1,200	720		610		54.0	75	0.4	98	16.0	
	5/02/2014	8.2	1,200	710		3		46.0	79	0.7	98	5.1	
	24/07/2015	7.7	1,100	610	85	560	34		66	0.9	71	8.0	
	28/10/2015	8.1	990			490		51.0	57	1.3	76	2.8	
	21/04/2016	7.8	960	580		400		53.0	55	1.3	80		2.5
	29/04/2017	7.9	1,200	640	75	460	28	53.0	71	<0.5	95	12.0	<5
	29/11/2017	7.6	1,200	730	86	460	30	56.0	76	<0.5	87	58.0	7.0
ABPB29	16/01/2014	8.3	640	380		250		32.0	38	3.5	43	1.6	
	21/02/2014	7.8	900	540		410		39.0	53	2.9	71	11.0	
	21/04/2016	7.0	470	280		140			27	3.2	28		110.0
	29/04/2017	7.2	710	420	53	240	32	30.0	47	1.1	74	2.5	<5
	29/11/2017	6.7	530	320	43	160	47	28.0	31	3.6	34	<0.5	<5
	04/04/2018	6.3	600	360	39	190	35	28.0	32	3.7	40	0.9	<5
CBPB02	24/03/2015	8.2	1,300	770	180	580	40		56	0.3	140	5.1	
	28/10/2015	8.2	1,200	710		590	140	59.0	54	0.3	140	6.2	
	21/04/2016	7.6	1,200	690			140	62.0	54	0.3	140		5.0
	26/04/2017	7.7	1,300	680	160	420	45	62.0	57	<0.5	140	1.1	35.0
	29/11/2017	7.2	1,300	740	130	470	36	62.0	55	<0.5	130	5.0	190.0
	04/04/2018	6.6	1,200	680	120	470	35	56.0	52	0.7	120	1.0	<5
	11/11/2019	7.9	1,500	820	220	460	46	86.0	75	0.4	120	2.3	<5
	10/06/2020	7.7	1,600	930	210	520	58	77.0	72	0.4	140		<5
PB74-1	15/04/2012	7.0	640	380	80	250	19	36.0	37	2.0	43	12.0	
	16/04/2012	7.0	630	380	73	250	18	34.0	36	1.9	42	12.0	

Table 2.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	21/03/2013	7.9	660		70	250	17	36.0	37	2.3	48	11.0	
PB83-1	29/01/2012	8.1	360	220		180		28.0	24	4.4	13	0.0	
	25/03/2012	6.9	340	200		180		24.0	23	4.0	13	0.0	
	18/05/2012	8.1	1,200	720		340		22.0	41	6.1	170	4.7	
	21/03/2013	7.8	320		15	160	17	22.0	21	4.6	13	0.1	
	18/01/2014	7.6	320	190		180		21.0	21	4.0	11	0.1	
	29/03/2014	7.5	300			180		17.0	18	3.2	9	0.0	
	8/05/2015	8.0	580	330	32	260	47		37	6.7	24	<0.05	<5
	21/04/2016	6.5	510	310		55		11.0	26	2.9	42		2.5
	30/04/2017	7.7	330	200	56	59	9	8.1	16	2.6	24	0.4	<5
	18/10/2017	7.2	330	200	57	63	9	8.3	18	3.0	24	<0.005	<5
PB84-1	31/03/2012	8.5	900	540		430		46.0	52	1.8	77	0.3	
	21/03/2013	7.9	910		73	430	42	46.0	54	1.8	87	0.1	
	18/01/2014	7.8	820	490		360		42.0	48	2.1	63	0.1	
	29/03/2014	7.8	840			410		36.0	43	1.9	59	0.7	
	7/05/2015	7.6	660	360	56	250	52		36	2.3	47	<0.05	<5
	28/10/2015	7.7	560	290				26.0	30	2.3	37	0.1	
	21/04/2016	7.4	540	320		170		26.0	32	2.3	38		2.5
	29/04/2017	7.3	850	510	67	310	43	44.0	47	1.7	64	0.1	<5
PB86-2	7/05/2015	6.6	150	89	19	52	10		6	0.8	10	<0.05	20.0
	21/04/2016	6.0	160	95		48		4.0	7	0.7	10		34.0
	30/04/2017	6.3	170	100	16	51	8	3.6	6	0.7	10	0.0	<5
	04/04/2018	5.2	180	110	12	57	5	3.9	6	1.4	12	0.0	6.0
	11/11/2019	6.0	0	96	24	39	10	4.7	7	0.7	9	0.0	7.0
ABMB01	1/05/2014	8.1	1,900	1,100	280	620	61	6.0	84	15.0	250	26.0	

Table 2.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	6/05/2015	7.4	670	340	67	270	17		38	1.8	38	12.0	5.0
	20/04/2016	7.0	670	400		230		41.0	39	2.0	40		7.0
	30/04/2017	6.9	720	430	74	230	18	43.0	39	1.9	44	2.8	8.0
ABMB02	24/03/2015	8.1	1,300	750	180	400	39		53	0.9	95	48.0	
	20/04/2016	7.5	1,500	960		360			68	0.9	120		10.0
	26/04/2017	7.5	1,400	840	190	360	96	98.0	60	0.5	120	5.2	24.0
	04/04/2018	6.4	1,200	730	120	380	66	81.0	51	1.7	110	4.4	<5
ABMB09	7/05/2015	5.7	76	57	12	7	5		1	0.4	6	8.9	110.0
	21/04/2016	5.0	84	50		5		5.0	2	0.6	8		830.0
Obs81-1	7/05/2015	6.5	91	59	11	22	4		2	0.8	8	4.2	<5
	21/04/2016	5.9	180	110		34		6.0	4	1.0	13		2.5
	30/04/2017	6.1	190	110	26	31	3	7.4	5	0.7	16	4.3	<5
	04/04/2018	5.1	210	130	27	23	2	7.3	5	1.6	17	6.8	<5
Obs84-2	1/05/2014	8.0	1,200	720	120	610	27	47.0	68	1.2	120	21.0	
	29/04/2017	7.5	1,200	700	83	480	38	49.0	69	<0.5	120	14.0	29.0
	04/04/2018	6.7	820	490	34	340	15	35.0	49	1.2	67	6.0	5.0
Obs88-2	7/05/2015	4.6	430	340	23	<5	170		9	3.9	16	<0.05	24.0
	21/04/2016	3.4	430	260		3		5.0	9	3.9	16		2.5
	30/04/2017	4.3	390	240	22	<5	120	6.2	9	3.6	18	0.0	<5
	11/11/2019	4.1	0	210	32	<5	71	12.0	11	2.0	20	6.7	6.0
Obs89-1	7/05/2015	6.9	170	93	18	66			8	1.1	10	0.4	<5
	21/04/2016	6.2	230	140		76			14	0.6	13		5.0
	30/04/2017	6.7	220	130	17	80	2	8.9	9	1.7	13	0.1	<5
ABRC080	22/05/2012	7.3	500	300	56	200	9	27.0	32	1.9	19	3.0	
PB86-1	7/05/2015	5.7	77	55	11	6	3		2	0.6	7	9.1	13.0
PB86-2	30/04/2017	6.3	170	100	16	51	8	3.6	6	0.7	10	0.0	<5

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).

Table 2.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
ABPB01	15/12/2012	<0.02	0.6	<0.001	<0.005	0.014	<0.02	<0.005	<0.005	0.006	<0.02			<0.05	0.03
	16/12/2012	<0.02	1	<0.001	<0.005	0.005	0.06	<0.005	<0.005	0.006	<0.02			<0.05	0.06
	30/04/2013	0.01	0.12	<0.100	<0.001	0.003	<0.005	<0.001	0.004	<0.001	<2.00			<1	0.014
	29/03/2014	<0.02	<0.20	<0.001	<0.005	<0.005	<0.02	<0.02	0.014	<0.005	<0.05	<0.005	0.14	<0.05	0.02
	6/05/2015	<0.02	0.17	<0.001	<0.005	<0.005	0.09	<0.02	0.02	0.006	<0.05	<0.005	0.17	<0.05	0.001
	28/10/2015	0.02	0.19	<0.0001	0.001	<0.001	<0.005	<0.001	0.008	<0.001	0.001	0.0005	0.17	0.0005	0.023
	20/04/2016	0.01	0.14	<0.0001	0.001	<0.001	0.02	<0.001	0.017	<0.001	0.001		0.18	0.0005	0.66
	30/04/2017	0.02	0.21	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	<0.001		0.19	<0.001	0.003
	29/11/2017	0.05	0.32	<0.0001	<0.001	<0.001	0.03	<0.001	0.014	<0.001	<0.001		0.21	<0.001	0.003
	04/04/2018	0.01	0.2	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.001		0.25	<0.001	0.006
	10/06/2020	0.01	0.15	<0.0001	<0.001	<0.001	0.01	<0.001	<0.01	<0.001	0.001	<0.001	0.23	<0.010	<0.005
ABPB24	3/02/2014	0.01		<0.100	0.001	<0.001	<0.005	<0.001		<0.001					0.008
	21/02/2014	0.01		<0.100	0.001	0.002	0.027	<0.001		0.009					0.016
	24/03/2015	<0.02	0.37	<0.001	<0.005	0.007	<0.02	<0.02	0.008	0.023	<0.05	<0.005	0.27	<0.05	0.02
	20/04/2016	0.01	0.26	<0.0001	0.001	0.048	<0.01	0.008	0.003	0.002	0.001		0.27	0.0005	0.53
	29/04/2017	0.01	0.36	<0.0001	<0.001	0.009	<0.01	<0.001	<0.005	0.001	0.001		0.26	<0.001	0.008
	29/11/2017	0.01	0.43	<0.0001	<0.001	0.005	<0.01	<0.001	<0.005	<0.001	0.001		0.29	<0.001	0.006
	04/04/2018	0.01	0.35	<0.0001	<0.001	0.012	<0.01	<0.001	<0.005	<0.001	0.002		0.26	<0.001	0.022
	11/11/2019	0.01	0.27	<0.0001	<0.001	0.310	<0.01	0.008	<0.01	0.004	0.001	<0.001	0.24	<0.001	0.45

Table 2.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
ABPB27	21/01/2014	0.03		<0.001	0.001	0.002	0.085	<0.001		0.003					<0.005
	21/02/2014	0.04		<0.001	0.001	0.005	<0.005	<0.001		0.001					0.01
	21/04/2016	0.01	0.22	<0.0001	0.001	<0.001	<0.01	<0.001	0.23	<0.001	0.001		0.22	0.0005	0.002
	29/04/2017	0.03	0.26	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	0.002	<0.001		0.16	<0.001	0.006
	29/11/2017	0.02	0.45	<0.0001	<0.001	0.001	<0.01	<0.001	0.47	0.002	0.006		0.25	<0.001	0.009
	11/11/2019	0.00	0.07	<0.0001	<0.001	0.014	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001	0.06	<0.001	0.02
ABPB28	5/02/2014	0.09		<0.001	<0.001	<0.001	<0.005	<0.001		0.005					0.009
	21/02/2014	0.09		<0.001	<0.001	0.004	<0.005	<0.001		0.004					0.013
	24/07/2015	0.15	0.31	<0.001	<0.005	<0.005	<0.02	<0.02	0.056	0.007	<0.05	<0.005	0.27	<0.05	0.02
	28/10/2015	0.22	0.34	<0.0001	0.001	0.004	<0.005	<0.001	0.43	0.009	0.001	0.0005	0.22	0.0005	0.035
	21/04/2016	0.23	0.26	<0.0001	0.001	0.010	0.01	<0.001	0.43	0.011	0.001		0.22	0.0005	0.057
	29/04/2017	0.04	0.36	<0.001	<0.001	0.004	<0.01	0.001	<0.005	0.001	0.003		0.29	<0.001	0.021
	29/11/2017	0.04	0.44	<0.0001	<0.001	0.005	<0.01	<0.001	<0.005	0.002	0.002		0.32	<0.001	0.025
ABPB29	16/01/2014	0.03		<0.0001	<0.001	0.002	0.19	<0.001		0.003					<0.005
	21/02/2014	0.03		0.0001	<0.001	0.012	0.056	0.001		0.006					0.037
	21/04/2016	0.01	0.14	<0.0001	0.001	<0.001	0.05	<0.001	1.5	0.005	0.001		0.14	0.0005	0.006
	29/04/2017	0.04	0.32	<0.0001	<0.001	0.001	<0.01	0.002	0.34	0.003	0.003		0.19	<0.001	0.013
	29/11/2017	0.01	0.31	<0.0001	<0.001	0.001	<0.01	<0.001	0.89	0.005	<0.001		0.15	<0.001	0.008
	04/04/2018	0.004	0.24	<0.0001	<0.001	<0.001	0.01	<0.001	0.056	0.001	<0.001		0.16	<0.001	0.009
CBPB02	24/03/2015	<0.02	0.44	<0.001	<0.005	<0.005	<0.02	<0.02	0.007	<0.005	<0.05	<0.005	0.27	<0.05	0.02

Table 2.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	28/10/2015	0.001	0.39	<0.0001	0.001	<0.001	<0.005	<0.001	0.001	<0.001	0.002	0.0005	0.26	0.0005	0.008
	21/04/2016	0.001	0.31	<0.0001	0.001	<0.001	<0.01	<0.001	0.003	0.005	0.002		0.28	0.0005	0.005
	26/04/2017	<0.001	0.38	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.002		0.27	<0.001	0.075
	29/11/2017	<0.001	0.46	<0.0001	<0.001	0.001	<0.01	<0.001	<0.005	<0.001	0.002		0.3	<0.001	0.06
	04/04/2018	<0.001	0.4	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.007	0.002		0.26	<0.001	0.26
	11/11/2019	<0.001	0.36	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	0.002	<0.001	0.29	<0.001	0.011
	10/06/2020	<0.001	0.4	<0.0001	<0.001	0.004	<0.01	<0.01	0.02	0.003	0.002	<0.001	0.37	<0.010	1.3
PB74-1	15/04/2012	0.02		<0.0001		0.041	0.04	<0.001	0.14						0.058
	16/04/2012	0.02		<0.0001		0.044	<0.02	0.002	0.13						0.054
	21/03/2013	0.02	0.21	<0.0001	<0.001	0.001	0.026	<0.001	0.005	<0.001	<0.002			<0.001	0.1
PB83-1	29/01/2012						0.42								
	25/03/2012						0.36								
	20/04/2012	0.003		<0.0001		<0.001	1.1	<0.001	0.26						0.042
	22/04/2012	0.003		<0.0001		0.023	1.1	<0.001	0.27						0.031
	18/05/2012	0.003		<0.0001		0.001	0.3	<0.001	0.077						0.034
	21/03/2013	<0.001	0.095	<0.0001	<0.001	0.003	2.3	0.001	0.47	0.1	<0.002			<0.001	0.08
	18/01/2014	<0.001		<0.0001	<0.001	<0.001	0.008	<0.001		0.084				0.01	
	29/03/2014	<0.02	<0.20	<0.001	<0.005	<0.005	<0.02	<0.02	0.54	0.32	<0.05	<0.005	0.069	<0.05	0.03
	8/05/2015	<0.02	0.21	<0.001	<0.005	<0.005	0.61	<0.02	0.15	0.077	<0.05	<0.005	0.15	<0.05	<0.01
	21/04/2016	0.001	0.067	0.0003	0.001	0.009	<0.01	<0.001	0.024	0.3	0.001		0.15	0.0005	0.044

Table 2.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	30/04/2017	<0.001	0.07	<0.0001	<0.001	0.002	<0.01	0.055	0.006	<0.001	<0.001		0.088	<0.001	0.002
	18/10/2017	<0.001	0.09	<0.0001	<0.001	<0.001	<0.01	<0.001	0.018	0.11	<0.001		0.087	<0.001	0.009
PB84-1	31/03/2012	0.17		<0.001		<1.000	<0.02	<1	0.36						5
	18/01/2014	0.06		<0.001	0.001	<1.000	<5	<1		2					27
	29/03/2014	0.06	0.2	<0.001	0.003	<0.005	0.04	<0.02	0.46	<0.005	0.025	0.0025	0.19	0.025	0.01
	7/05/2015	0.08	0.25	<0.001	<0.005	<0.005	1.4	<0.02	0.77	0.008	<0.05	<0.005	0.15	<0.05	0.06
	28/10/2015	0.04	0.24	<0.0001	0.001	<0.001	<0.005	<0.001	0.8	0.005	0.001	0.0005	0.13	0.0005	0.19
	21/04/2016	0.03	0.17	<0.0001	0.001	<0.001	0.08	<0.001	0.8	0.006	0.001		0.14	0.0005	0.062
	29/04/2017	0.05	0.32	<0.0001	0.001	0.001	0.05	0.003	0.6	0.002	<0.001		0.2	<0.001	0.014
PB86-2	7/05/2015	<0.02	0.08	<0.001	<0.005	0.018	17	<0.02	0.95	0.01	<0.05	<0.005	0.04	<0.05	<0.01
	21/04/2016	0.001	0.056	<0.0001	0.001	<0.001	12	<0.001	0.86	0.007	0.001		0.038	0.0005	0.006
	30/04/2017	<0.001	0.07	<0.0001	0.003	<0.001	12	0.008	0.89	<0.001	<0.001		0.038	<0.001	0.019
	04/04/2018	<0.001	0.07	<0.0001	<0.001	0.002	11	<0.001	0.85	0.008	<0.001		0.035	<0.001	0.066
	11/11/2019	<0.001	0.06	<0.0001	<0.001	<0.001	7.6	<0.001	0.84	0.006	<0.001	<0.001	0.03	<0.001	<0.005
ABMB01	6/05/2015	<0.02	0.15	<0.001	<0.005	<0.005	0.17	<0.02	0.015	<0.005	<0.05	<0.005	0.16	<0.05	<0.01
	20/04/2016	0.01	0.13	<0.0001	0.001	<0.001	<0.01	<0.001	0.003	<0.001	0.001		0.17	0.003	0.009
	30/04/2017	0.01	0.2	<0.0001	<0.001	0.001	<0.01	<0.001	0.011	<0.001	<0.001		0.18	<0.001	0.013
ABMB02	24/03/2015	<0.02	0.39	<0.001	<0.005	<0.005	<0.02	<0.02	0.006	<0.005	<0.05	<0.005	0.64	<0.05	<0.01
	20/04/2016	0.003	0.31	<0.0001	0.001	0.002	<0.01	<0.001	0.003	<0.001	0.003		0.079	0.0005	0.003
	26/04/2017	0.004	0.87	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.003		0.55	<0.001	0.001

Table 2.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	04/04/2018	0.003	0.8	<0.0001	<0.001	0.003	0.04	<0.001	0.017	0.001	0.003		0.51	<0.001	0.023
ABMB09	7/05/2015	0.02	0.05	0.001	0.005	0.005	0.02	0.02	0.005	0.005	0.05	0.005	0.005	0.05	0.01
	21/04/2016	0.001	0.065	<0.0001	0.001	0.004	<0.01	<0.001	0.048	0.015	0.001		0.039	0.0005	0.045
Obs81-1	7/05/2015	<0.02	0.07	<0.001	<0.005	<0.005	0.14	<0.02	0.47	0.095	<0.05	<0.005	0.037	<0.05	0.72
	21/04/2016	0.001	0.05	<0.0001	0.001	<0.001	0.35	<0.001	0.45	0.042	0.001		0.067	0.0005	4.1
	30/04/2017	<0.001	0.05	0.0001	0.014	0.004	<0.01	0.05	0.98	<0.001	<0.001		0.092	<0.001	6.2
	04/04/2018	<0.001	0.06	<0.0001	<0.001	0.003	<0.01	<0.001	0.34	0.034	<0.001		0.082	<0.001	3
Obs84-2	29/04/2017	0.05	0.41	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	0.001	0.003		0.3	<0.001	0.002
	04/04/2018	0.04	0.22	<0.0001	0.003	0.001	<0.01	<0.001	0.01	<0.001	0.002		0.21	<0.001	0.007
Obs88-2	7/05/2015	<0.02	0.13	0.002	<0.005	<0.005	46	<0.02	1.4	0.089	<0.05	<0.005	0.065	<0.05	0.18
	21/04/2016	0.001	0.078	0.0003	0.001	0.002	23	0.001	1.3	0.07	0.001		0.066	0.0005	0.11
	30/04/2017	<0.001	0.09	0.0003	0.026	0.003	24	0.069	1.5	<0.001	<0.001		0.079	<0.001	0.16
	11/11/2019	<0.001	0.08	0.0002	<0.001	0.031	0.02	0.001	1	0.072	<0.001	<0.001	0.11	0.006	0.028
Obs89-1	7/05/2015	<0.02	0.09	<0.001	0.010	<0.005	2.4	<0.02	1.1	0.053	<0.05	<0.005	0.049	<0.05	0.08
	21/04/2016	0.001	0.072	<0.0001	0.001	<0.001	13	<0.001	1.3	0.016	0.001		0.037	0.0005	0.054
	30/04/2017	<0.001	0.07	<0.0001	0.002	0.001	1.9	0.006	1.3	<0.001	<0.001		0.055	<0.001	0.023
PB86-1	7/05/2015	<0.02	0.06	<0.001	<0.005	0.009	2.3	<0.02	0.024	0.011	<0.05	<0.005	0.032	<0.05	0.02
PB86-2	30/04/2017	<0.001	0.07	<0.0001	0.003	<0.001	12	0.008	0.89	<0.001	<0.001		0.038	<0.001	0.019

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).
Values highlighted orange exceed the Australian Drinking Water Guidelines for health impacts (NHMRC, 2012).

2.13 Compliance

No water level triggers were exceeded during the current reporting period. The water quality triggers were exceeded at two locations, as summarised in Table 2.8.

Table 2.8 - Summary of water quality trigger exceedances

Bore ID	Trigger (mS/cm)	Date of exceedance	Measured EC (mS/cm)
ABPB01	1.005	29/10/2019	1.03
CBPB02	1.950	27/04/2020	1.99

A summary of compliance with the commitments for the project is provided in Table 2.9.

Table 2.9 - Summary of Commitments and Compliance

Activity	Action	Compliance	Comments
Administration	Submit the aquifer review to DWER annually on 30 September. This report will contain: • Compliance with the monitoring schedule and assess results. • Aquifer performance against that predicted.	Compliant	Report submitted 30th September 2020.
	Review SWOP in conjunction with annual/final reporting.	Compliant	SWOP reviewed August 2019.
Monitoring	Implementation of monitoring schedule as per SWOP.	Mostly compliant	Some gaps in record due to accessibility issues.
Water use efficiency	Monthly infrastructure checks/maintenance.	Compliant	Infrastructure checks completed monthly.
	Site water balance review as required.	Compliant	N/A, site currently in care and maintenance/closure.
Contingency plans	Review triggers annually or as required.	Compliant	N/A, site currently in care and maintenance/closure.

A summary of the monitoring completed during the current reporting period and confirmation of compliance requirements is provided in Table 2.10. It is noted that there were some gaps in the monitoring as the site is currently under care and maintenance with limited staffing capacity. This has since been rectified to ensure compliance with the Addendum to the SWOP (Atlas, 2015).

Table 2.10 - Summary of Monitoring Completed

Monitoring Area or Topic	Source Document	Requirement	Frequency	Monitoring Completed
Production bores	SWOP	Water levels, field pH, EC, and Temperature	Monthly	CBPB02 monitored monthly. All other bores listed in SWOP Addendum monitored during November only.
		Laboratory Sample	Annually (Nov)	Samples collected in Nov 2019
Monitoring bores	SWOP	Field pH, EC, and Temperature	Annual	Completed
		Laboratory Sample	Annually (Nov)	Samples collected in Nov 2019

2.14 Assessment of Impacts

2.14.1 Aquifer Levels

Water levels in regional monitoring bores show a response to recharge events and seasonal recession but over the life of mine show no discernible influence from pumping. This suggests no impact outside the local aquifers as a result of abstraction over the life of mine.

Water levels in the Abydos ROM aquifer recovered to near pre-mining levels as a result of cessation in pumping in November 2017. This recovery indicates near full replenishment in aquifer storage and a significant reduction or elimination of the cone-of-depression around the ROM. Water levels will continue to be monitored as required under the Addendum to the SWOP (Atlas, 2015a).

2.14.2 Water Quality

Over the life of The Project water from the ROM borefield was used for dust suppression at the ROM and haulroads, and for product conditioning at the crusher. The project's ROM borefield was completed in fractured BIF of the Cleaverville Formation and shows water quality typical of BIF.

Water for potable uses is treated at the camp RO plant. The camp bore (CBPB02) is completed in alluvium and weathered granite and is fresh with low concentrations of major ions. The potable MOC bore (ABPB24) and backup camp bore (ABPB01) are completed in fractured BIF. ABPB24 (decommissioned) was treated at the MOC RO treatment plant while ABPB01 is treated at the camp RO plant. ABPB01 has previously had some detections of arsenic slightly above the Australian drinking water guidelines (NHMRC, 2012), however these were not observed during the current reporting period.

Other than the sporadic detections of metals slightly above the Australian drinking water guidelines (NHMRC, 2012) there are no water quality implications on the project operations as Atlas treats the water to drinking standard and tests regularly.

Water quality remained relatively consistent since monitoring began suggesting that abstraction in The Project area resulted in no deterioration of water quality over the life of the project.

2.15 Recommendations

It is recommended that the Care and Maintenance Monitoring Plan be continued in accordance with the Addendum to the Site Water Operating Plan (Atlas, 2015a).

3. ABYDOS LINK RD EAST

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3.1 Introduction

This Annual Aquifer Review (AAR) relates to instrument GWL176408(4), which allows Atlas Iron Limited (Atlas) to take water under section 5C of the RIWI Act 1914. The duration of the licence is from 30 July 2015 to 29 July 2025.

3.2 Background and Location

The Abydos Link Road East Project (the project) is a 57 kilometre haul road located approximately 100 kilometres southeast of Port Hedland, between the Abydos mine and the Marble Bar Road and lies within the Strelley, Coongan and Panorama Pastoral Leases (Figure 3.1).

Construction of the road was completed in August 2013 and the first load of iron ore was trucked to port in September 2013. Mining ceased at the Abydos mine in October 2017 with associated haulage ending in November 2017. The project now serves as an access road to the existing camp in support of ongoing rehabilitation activities.

While in operation, the project had a designed water supply requirement of 1,198,368 kL/annum (38 L/s) for ongoing maintenance of the link road.

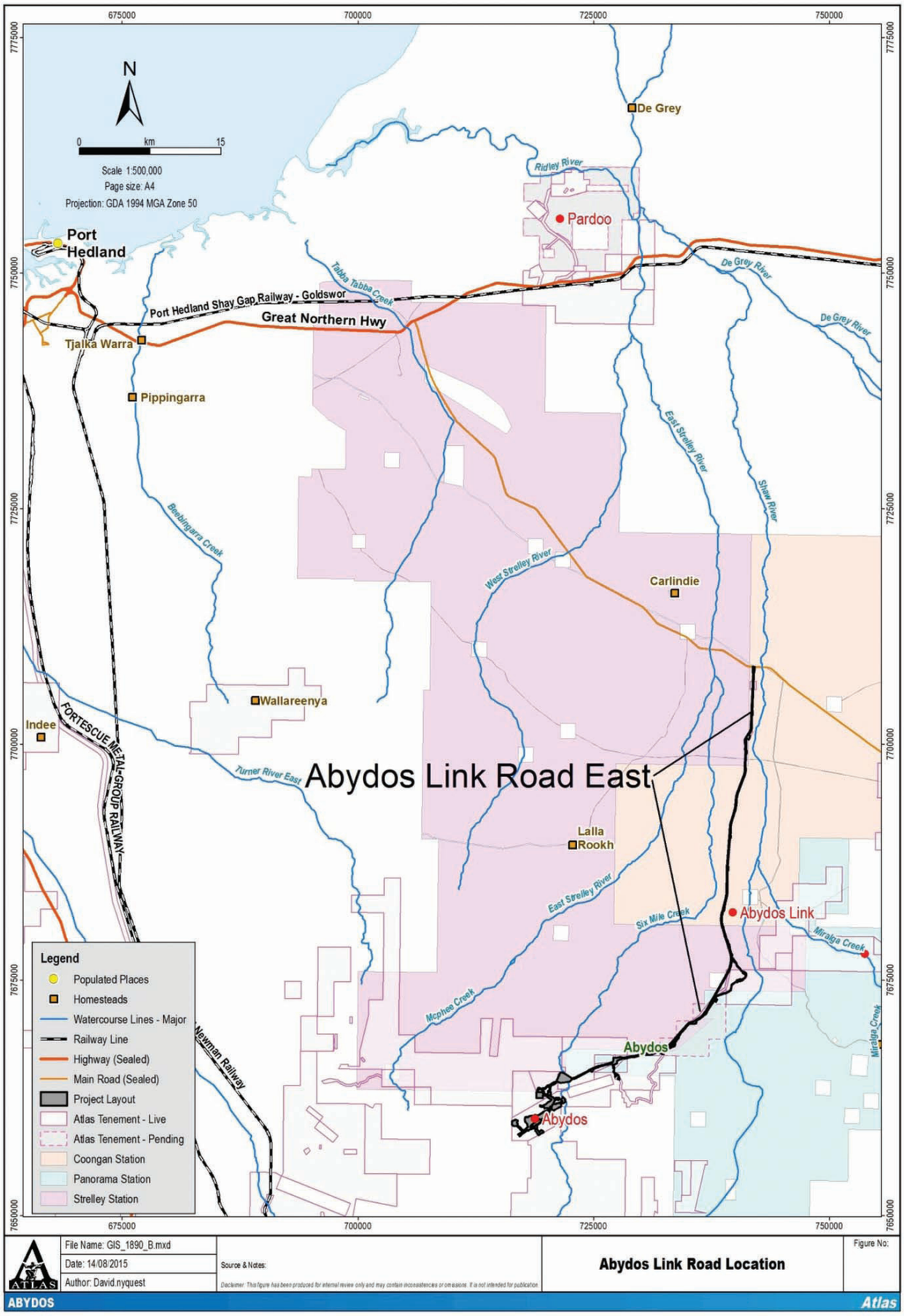

Figure 3.1 - Abydos Link Road Location

3.3 Groundwater Management Areas

The project lies within the Pilbara Groundwater Management Area and the Pilbara Groundwater Province. It is not located within a public drinking water source area.

3.4 Water Usage

Water taken during the water year is authorised to be used for:

- Dust suppression for earthworks and construction purposes,
- Earthworks and construction purposes, and
- Potable water supply purposes.

A total of 5,184 kL of groundwater was used during the reporting period.

3.5 Licensing

Groundwater abstraction for the project is authorised by GWL176408(4) (Figure 3.2). This groundwater license (GWL) authorises the abstraction of up to 1,198,368 kL/year from the Pilbara Fractured Rock aquifer for the purposes noted above. Table 3.1 summarises the historic GWL approvals for the project.

Under this licence, the authorised activities listed above can be undertaken within leases L45/284, L45/285, L45/188, L45/189, L45/287, and L45/369.

The reporting period is 1 July 2019 to 30 June 2020. The AAR report is scheduled for submission to the Department of Water and Environmental Regulation (DWER) annually in September.

Table 3.1 - License History

License	Allocation (kL)	Start Date	Expiry Date	Comments
GWL176745(1)	90,000	19/02/2013	31/08/2013	Abydos Link Rd construction
GWL176408(1)	315,000	8/02/2013	03/02/2014	Abydos Link Rd construction
GWL176408(2)	1,198,368	24/04/2013	30/06/2015	License merger and SWOP update
GWL176408(3)	1,198,368	17/06/2015	16/06/2025	Renewal and SWOP update
GWL176408(4)	1,198,368	30/07/2015	29/07/2025	Added stockyard tenure L45/369

Table 3.2 - Port Hedland climatic data summary (BoM station #4032)

Month	Mean daily temperature (°C) (1948 – 2020)		Mean monthly rainfall (mm) (1942 – 2020)	Mean daily evaporation (mm) (1942 – 2020)
	Maximum	Minimum		
January	36.4	25.6	63.4	10.4
February	36.2	25.5	88.9	9.6
March	36.8	24.6	55.3	9.3
April	35.3	21.5	21.5	8.8
May	30.7	17.3	26.6	7.4
June	27.7	14.2	23.1	6.5
July	27.3	12.4	10.4	6.6
August	29.3	13.2	4.7	7.5
September	32.4	15.5	1.2	8.9
October	35.1	18.6	1.0	10.6
November	36.3	21.5	2.5	11.5
December	36.7	24.2	18.5	11.4
Annual Average	33.4	19.5	319.3	9.0

Source: Bureau of Meteorology Port Hedland Station 4032 (BoM, 2020)

3.6 Climate

The climate of the project area is classified as semi-arid to arid and is characterised by hot summers and warm winters. The area experiences a climate of extremes, where severe droughts and major floods can occur at close intervals (MWH, 2011).

The hot summer season occurs from November to February with mean daily maximum and minimum temperatures of approximately 40°C and 25°C respectively. The winter season occurs from June to August with mean daily maximum and minimum temperatures of 28°C and 13°C respectively.

Long term meteorological data is available from the Port Hedland Airport (Bureau of Meteorological Station No. 004032). This meteorological station is located at latitude: 20.37°S, longitude: 118.63°E, approximately 100 km northwest of the project area. A summary of long term meteorological data from Port Hedland is shown in Table 3.2.

Mean annual rainfall for the area can vary from 300 – 400 mm. Rain is to be expected in the summer months, mainly from January to March, and is unusual between July and October. Most of the summer rain comes from scattered thunderstorms, producing heavy localised falls in short periods. In addition, tropical lows and cyclones can bring widespread rain to the region. A secondary peak in the monthly rainfall can occur as a result of rainfall caused by tropical cloud bands, which intermittently affect the area mostly in May and June. Rainfall in general is unreliable and highly variable, which predominantly relates to the random nature of localised thunderstorms and tropical lows passing through the area (MWH, 2011).

Annual potential evaporation is 3,300 mm (mean daily average 9.0 mm). The excess of evaporation over rainfall, which is greater than a factor of ten, is typical for arid and semi-arid areas in Australia (MWH, 2011).

3.7 Hydrogeology

There are two primary aquifers in the vicinity of the Project area:

- Alluvial Aquifers: Generally, alluvial aquifers are associated with alluvial deposits along coastal plains and within the valleys associated with the drainage lines. Alluvial aquifers commonly have high aquifer storage (specific yield) and moderate hydraulic conductivity, and exhibit radial flow characteristics during groundwater abstraction.
- Fractured Rock Aquifers: Fractured rock aquifers are predominant within the project area and are likely to underlie alluvial aquifers. Fractured rock aquifers are generally associated within structural fracture zones or faulting, igneous intrusions, sedimentary rocks and banded iron formations. They frequently exhibit high hydraulic conductivity and low aquifer storage, but these aquifers are generally heterogeneous and anisotropic, and drawdown tends to propagate preferentially along the permeable zones. The drawdown characteristics are influenced by linear flow and may extend many hundreds of metres along the fractures but only a few metres across strike of the structure.

A number of northeast-southwest striking faults are present in the area. Groundwater is found in the fracture zones and drawdown data shows a cone of depression aligned with fault zones. This suggests that drawdown will be localised given that there is limited hydraulic connection between fracture controlled aquifers (MWH, 2012).

Groundwater levels in the vicinity of the project range from approximately 8 - 12 m below ground level (bgl), and flowing towards the northwest. This is generally consistent with the topographic and surface water drainage patterns of the Shaw and Strelley River catchments.

Groundwater quality over the project area varies from near potable to brackish, with fresher groundwater occurring in high topographical areas where rainwater infiltrates directly to recharge the aquifer. Concentrations of total dissolved solids (TDS) are lowest at the recharge zones and increase along groundwater flow paths. The highest TDS levels are found in areas of longer groundwater residence time, such as low-lying areas (RPS Aquaterra, 2013a).

3.8 Abydos Link Road East Borefields

The Northern and Venturex borefields comprise the Abydos Link Road East water supply (Figure 3.3) with a total of 9 production bores and 8 monitoring bores distributed along the 57 km length of the link road. These two borefields are operated conjunctively for a total allocation of 1,198,368 kL/yr.

The Northern borefield provides water for the northern 42 km of link road and includes 6 production bores and 6 monitoring bores. These bores were installed during construction of the link road between 2012 and 2013. Production bore ALB0066 and monitoring bore ALB0063 were installed in July 2016.

The Venturex borefield provides water for the remaining 15 km of link road to the south and includes 3 production bores and 2 monitoring bores. The Venturex borefield (owned by Venturex Resources Ltd.) was established prior to development of the project. Atlas currently operates the Venturex borefield under an asset sharing agreement with Venturex.

Four regional monitoring bores provide broader monitoring coverage along the link road. Details of all existing production and monitoring bores are provided in Table 3.3.

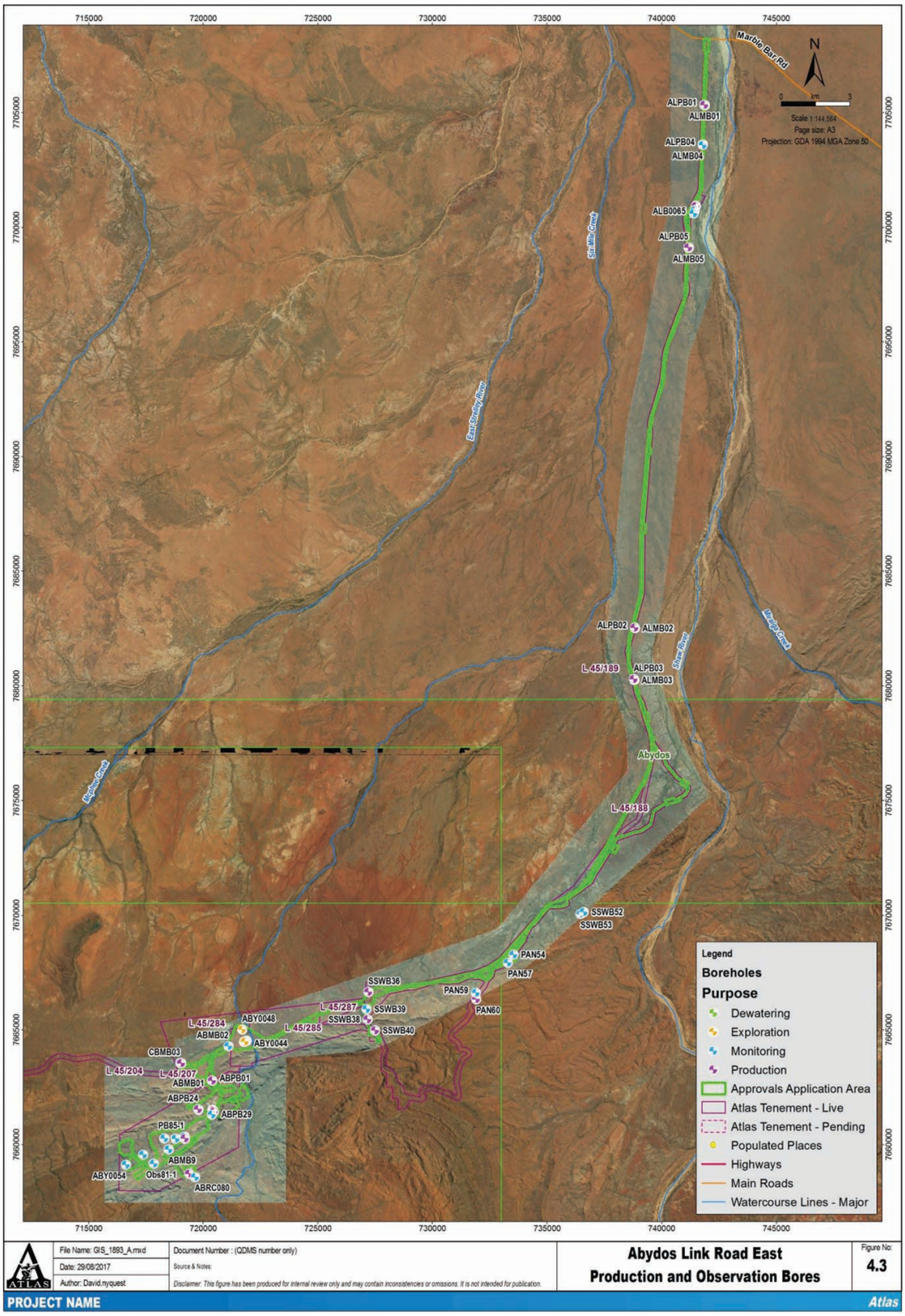

Figure 3.3 - Abydos Link Road East Bore Locations

File No: RF1987

Government of Western Australia
Department of Water

Instrument No. GWL176408(4)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Atlas Iron Limited		
Description of Water Resource	Pilbara Pilbara - Fractured Rock	**Annual Water Entitlement**	1198368 kL
Location of Water Source	L45/189		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes Earthwork and construction purposes Potable Water Supply purposes	L45/284, L45/285, L45/369, L45/189, L45/188, L45/287
Duration of Licence	From 30 July 2015 to 29 July 2025	

This Licence is subject to the following terms, conditions and restrictions:

1 The licensee must install an approved meter to each water draw-point through which water is taken under this licence.

2 The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this licence.

3 The licensee shall comply with the commitments of both the Abydos Link Road East Site Water Operating Plan 2013 to 2020' (971-DEV-HY-PLN-0001 Rev 5) and 'Addendum 2015' as prepared by Atlas Iron Limited and approved by the Department of Water on 19 June 2015, including any modifications to the commitments as approved during the term of the licence.

4 The annual water year for water taken under this licence is defined as 1 July to 30 June twelve months later.

5 Every 12 month(s) the licensee shall provide to the Department of Water a Groundwater Monitoring Summary for the preceding water year. The first report is due 30/09/2016.

End of terms, conditions and restrictions

Notation: This Licence is subject to clause 20, Schedule 1 of the Rights in Water and Irrigation Act 1914.

Agreement Party	**Agreement Period**
Venturex Resources Limited	From 6 May 2013

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000

Figure 3.2 - L se to Take Wat GWL176408(4)

Bore Name	Coordinates (GDA94, Zone 50)		Total Depth (mbgl)	Nominal Casing Diameter (mm)	Screen Interval (mbgl)	Static Water Level (mbtoc)	Recommended Rate (L/sec)	Recommended Pump Inlet Depth (mbgl)
	Easting	Northing						
Northern Production Bores								
ALPB01	741873	7705352	79.7	200	7.7 - 79.7	8.37	4	40
ALPB02	738829	7682534	71.4	200	5.4 - 71.4	7.51	0.5	30
ALPB03	738787	7680305	29.3	200	5.3 - 29.3	8.27	2.3	27
ALPB04	741792	7703621	29.2	200	5.2 - 29.2	8.70	10.5	27
ALPB05	741172	7699140	35.3	200	5.3 - 35.3	9.55	15	32
ALB0066	741489	7700936	66.0	200	6.0 – 65.0	8.15	5.0	50
Venturex Production Bores								
SSWB36	727199	7666652	75	100	12 - 75	14.32	5.5	36
SSWB38	727171	7665457	72	100	12 - 72	18.25	1.6	51
SSWB40	727496	7664976	48	100	14.75 - 48	14.75	4.5	36
Northern Monitoring Bores								
ALMB01	741879	7705335	23.7	50	5.7 - 23.7	8.29	n/a	n/a
ALMB02	738836	7682525	30	50	6 - 30	7.47	n/a	n/a
ALMB03	738803	7680260	29.8	50	5.8 - 29.8	8.44	n/a	n/a
ALMB04	741798	7703603	30.9	50	5.9 - 30.9	8.31	n/a	n/a
ALMB05	741172	7699108	29.9	50	5.9 - 29.9	9.44	n/a	n/a
Venturex Monitoring Bores								
SSWB39	727123	7665911	48	100	12-48	9.15	n/a	n/a
PAN59	731890	7666616	48	50	42-48	1.71	n/a	n/a
Regional Monitoring Bores								
SSWB52	736602	7670142	85.8	50	1.0-85.8	18.93	n/a	n/a
SSWB53	736452	7670057	96	50	78-96	16.6	n/a	n/a
PAN54	733535	7668283	54	50	48-54	10.21	n/a	n/a
PAN57	732674	7667663	50	50	48-54	10.38	n/a	n/a

Table 3.3 - Abydos Link Road Easts Production and Monitoring Bore Details

3.8.1 Supply Scheme

The Abydos Link Road supply scheme is shown in Figure 3.4. Decommissioning of the borefields and associated infrastructure began in December 2017 after completion of mining in October 2017. All pumps, headworks and associated pipework was removed, with the exception of bores ALPB01 and SSWB36.

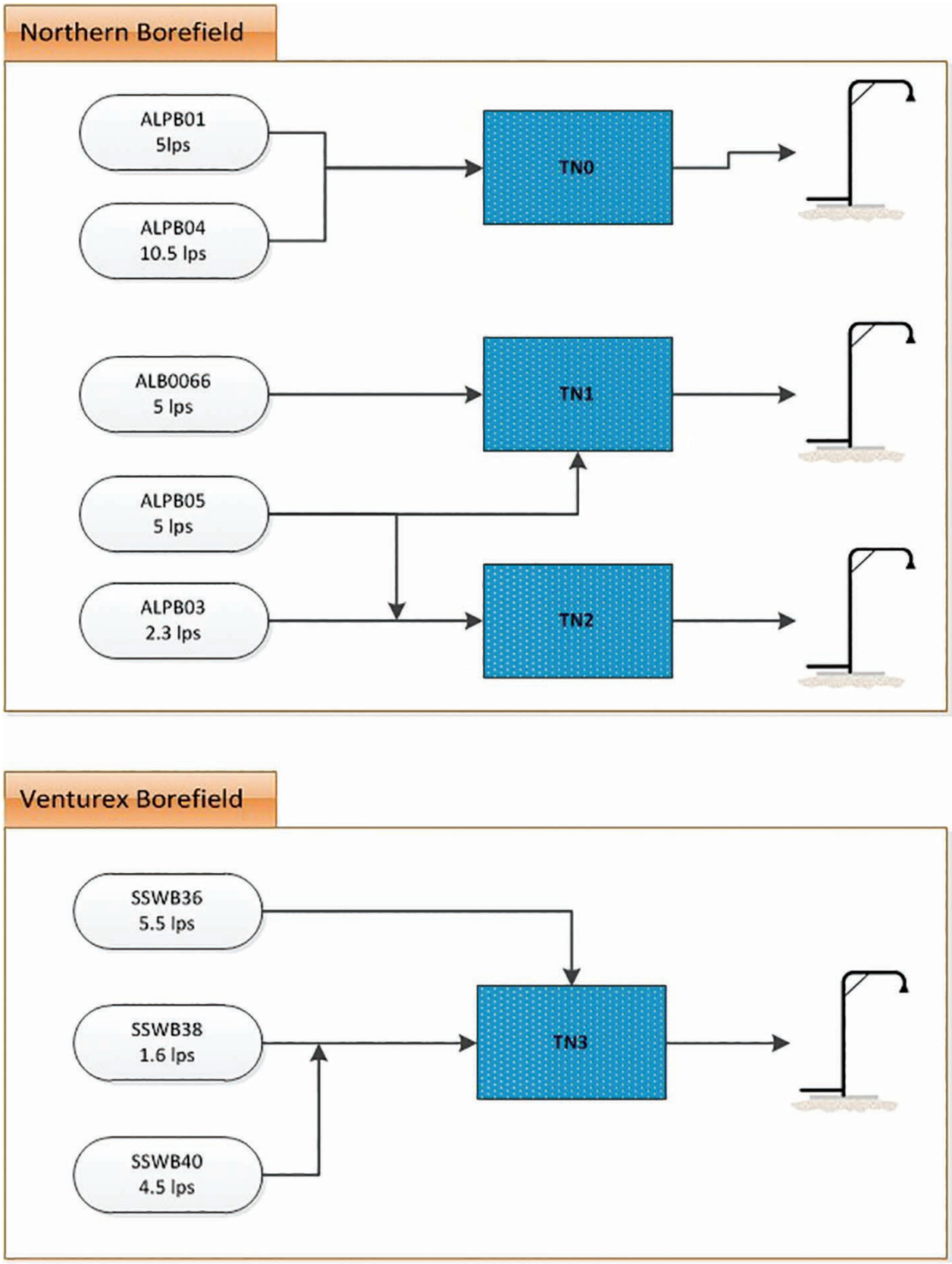

Figure 3.4 - Abydos Link Road East Water Supply Scheme

3.9 Abstraction

A volume of 5,184 kL was abstracted from the project area during the reporting period, representing approximately 0.4% of the annual groundwater allocation (1,198,368 kL). Dust suppression activities accounted for all of the abstracted water.

3.10 Monitoring

3.10.1 Objectives

The objectives of the Abydos Link Road East monitoring program, as described in the Abydos Link Road East Site Water Operating Plan (SWOP) (Atlas, 2015b, 2017a), were developed in accordance with the Atlas Water Policy (Atlas, 2018) to meet regulatory requirements/license conditions.

A care and maintenance monitoring program, as outlined in the SWOP Addendum (Atlas, 2015) was mplemented in 2017 following cessation of operations at the Abydos mine, with monitoring to be limited to bores ALPB05, SSWB36, ALPB01 and ALPB03. The care and maintenance monitoring requirements for the project are summarised in Table 3.4.

Table 3.4 - Groundwater Monitoring Schedule

Location	Frequency	Type of monitoring	Parameters
Production bores	6 monthly (November and April)	Field measurement	Water Levels pH, EC, and Temperature Flow meter readings (instantaneous and cumulative volume)
	Annually (Nov)	Laboratory testing	Major ions Metals Total Petroleum Hydrocarbons Total Suspended Solids
	Annually (Nov)	Dataloggers	Download dataloggers
Monitoring and regional bores	Annually (Nov)	Field measurement	Water Levels pH, EC, and Temperature
	Annually (Nov)	Dataloggers	Download dataloggers

3.10.2 Regulatory conditions

There are no specific statutory conditions related to groundwater abstraction other than the standard conditions associated with the groundwater license. The license conditions are as follows:

- The licensee must install an approved meter to each water draw-point through which water is taken under this license.
- The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this license.
- The licensee shall comply with the commitments of both the Abydos Link Road East Site Water Operating Plan 2013 to 2020 (971-DEV-HY-PLN-0001 Rev 5) and 'Addendum 2015' as prepared by Atlas Iron Limited and approved by the Department of Water on 19 June 2015, including any modifications to the commitments as approved during the term of the license.
- The annual water year for water taken under this license is defined as 1 July to 30 June twelve months later.
- Every 12 months the licensee shall provide to the Department of Water a Groundwater Monitoring Summary for the preceding water year. The first report is due 30/09/2016.

3.10.3 Trigger levels

Water level and water quality triggers and contingency actions were developed with regulatory input during review of the SWOP in May 2016. Trigger values and contingency actions as set forth in the SWOP (Atlas, 2015b, 2017a) provide a framework for detecting and mitigating pumping-related impacts. The Abydos Link Road East project is currently under a care and maintenance monitoring program as outlined in the SWOP Addendum, however trigger levels remain valid should the borefields be recommissioned.

Water level trigger values were set to avoid the lowering of the resting water levels below each bore's main water bearing zones identified during drilling and test pumping. The water level triggers are based on maximum long term drawdown assuming a 30 month period of no aquifer recharge (AECOM 2013a, AECOM 2013b). The trigger level is calculated as the maximum long term pumping water levels in mbgl plus 50% of the remaining available drawdown.

During commissioning of the bore fields, electrical conductivity (EC) in the production bores ranged from 330 to 2,100 S/cm and is considered to be fresh to brackish. Groundwater quality trigger values below are based on a 50% increase in EC during operation. A summary of the project's trigger values and contingency actions are presented in Table 3.5.

Table 3.5 - Key Contingency Water Management Actions

Bore ID	Water quality		Drawdown	
	(1)Trigger value (EC, µS/cm)	Contingency actions	(2)Resting water level trigger (mbtoc)	Contingency actions
SSWB36	1,772	Repeat measurement, Notify DoW, review data, Identify source (if possible), Increase frequency of monitoring (if required), Agree on action in consultation with DoW (increase trigger value, reduce pumping, shutdown bore, update SWOP).	39.0	Stage 1 (90% of predicted) Increase monitoring frequency to fortnightly Stage 2 (100% of predicted) Reduce pumping rate, or rest if possible Increase monitoring frequency to fortnightly Stage 3 (110% of predicted) Shutdown bore
SSWB38	1,800		47.0	
SSWB40	1,785		45.0	
ALPB01	2,700		19.0	
ALPB02	2,250		17.4	
ALPB03	3,600		20.7	
ALPB04	2,100		22.9	
ALPB05	1,950		22.3	
ALB0066	2,700		38.0	

(1) Based on 50% increase from original laboratory analysis of samples taken at the end of each bore's test pumping program.

(2) Based on main water bearing zones identified during drilling and test pumping.

3.11 Monitoring Observations

3.11.1 Water Levels

Since the cessation of mining activities in 2017, water levels in all bores have recovered to pre-pumping levels, suggesting that the local aquifers remain largely un-impacted. Hydrographs for active production bores in the Northern and Venturex borefields are presented in Figure 3.5 to Figure 3.12. The hydrographs, plotted against trigger levels and pump setting depths, illustrate the historical performance of each bore.

Local and regional observation bores show seasonal fluctuations in water levels throughout the year (Figure 3.13). Water levels in the borefield observation bores show localised drawdown during abstraction but recovered during rainfall events and when bores were not in use. In general, all of the observation bore data show no significant declining trends suggesting no or minimal impact to the aquifers.

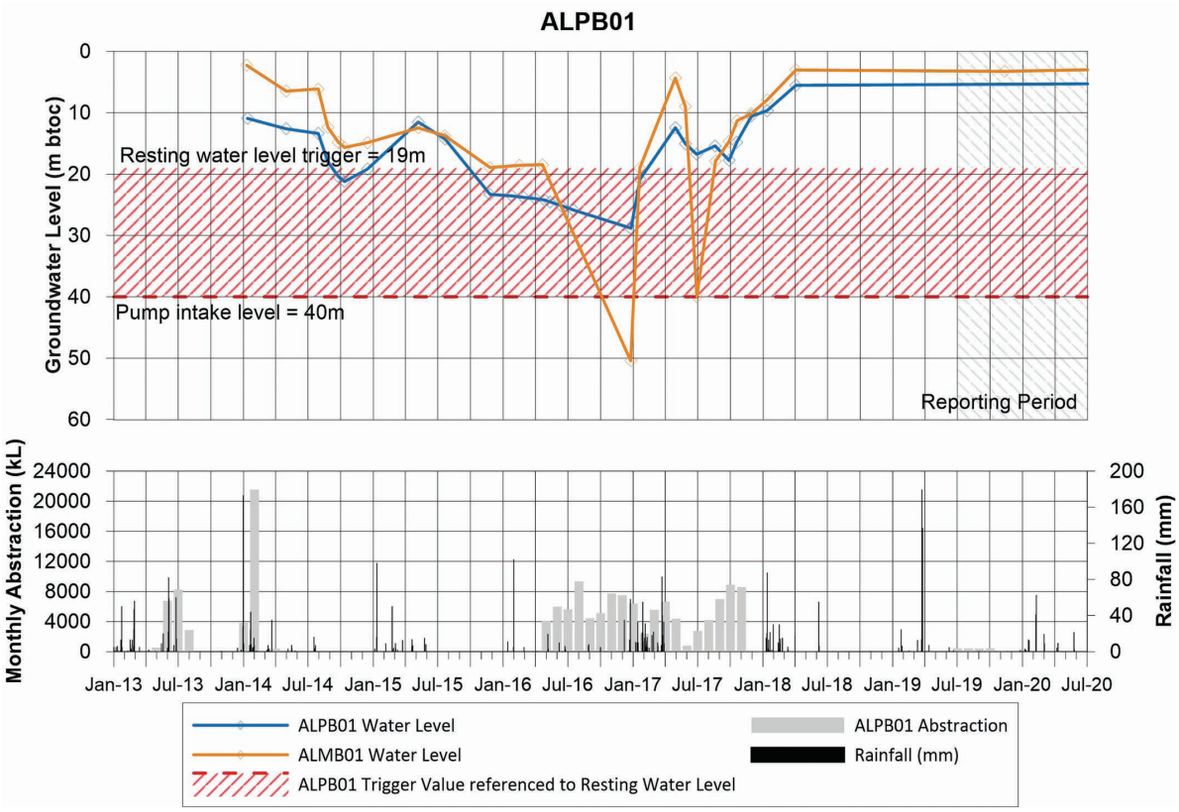

Figure 3.5 - ALPB01 Water Level vs Abstraction and Rainfall

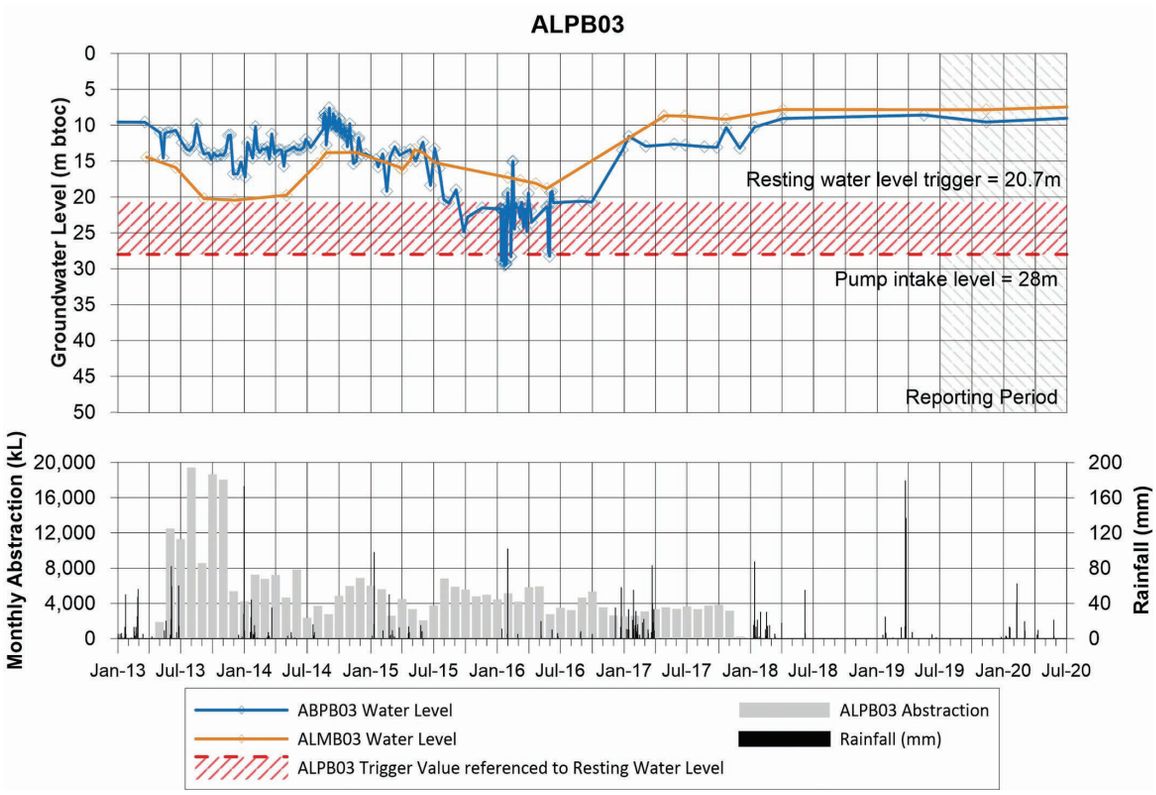

Figure 3.6 - ALPB03 Water Level vs Abstraction and Rainfall

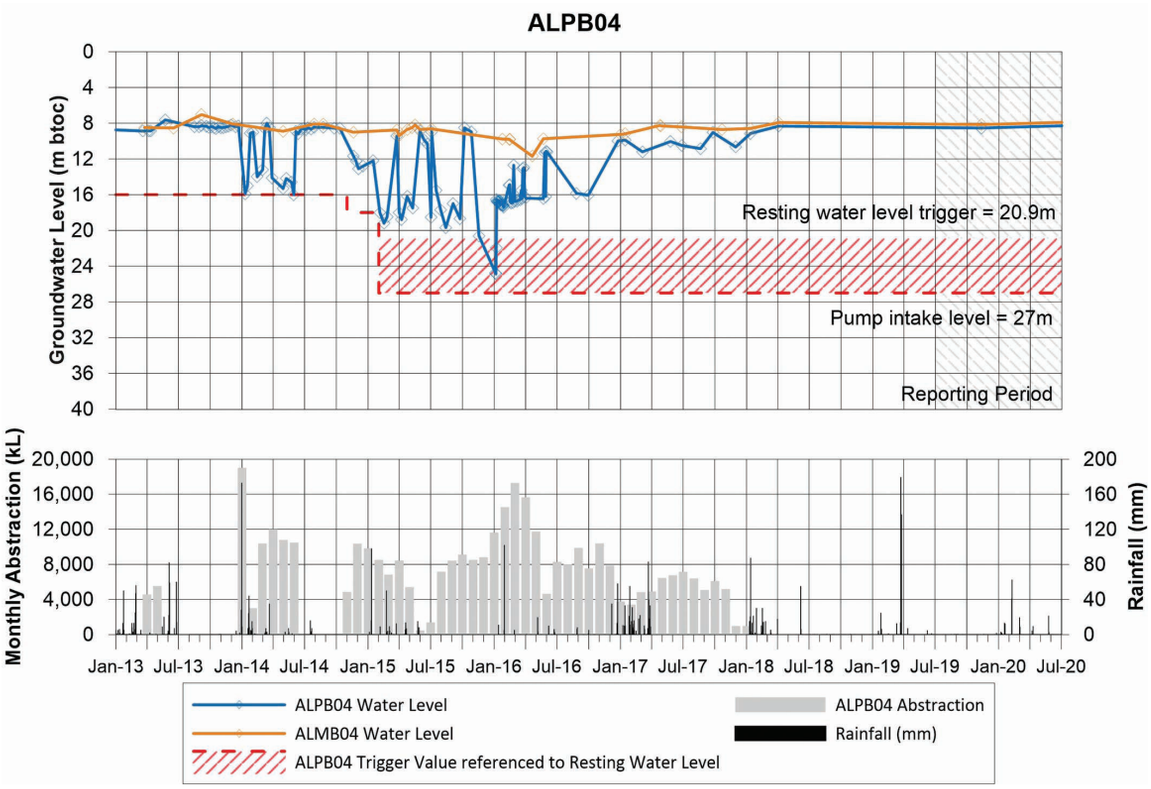

Figure 3.7 - ALPB04 Water Levels vs Abstraction and Rainfall

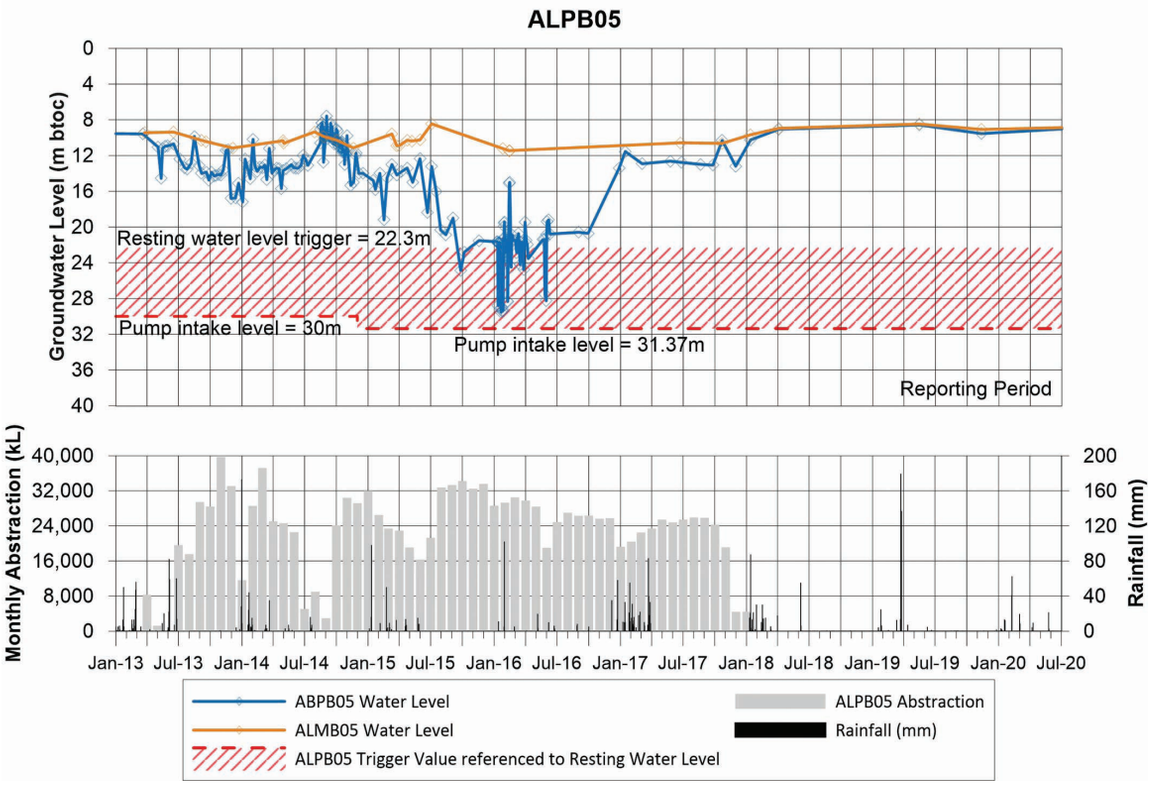

Figure 3.8 - ALPB05 Water Levels vs Abstraction and Rainfall

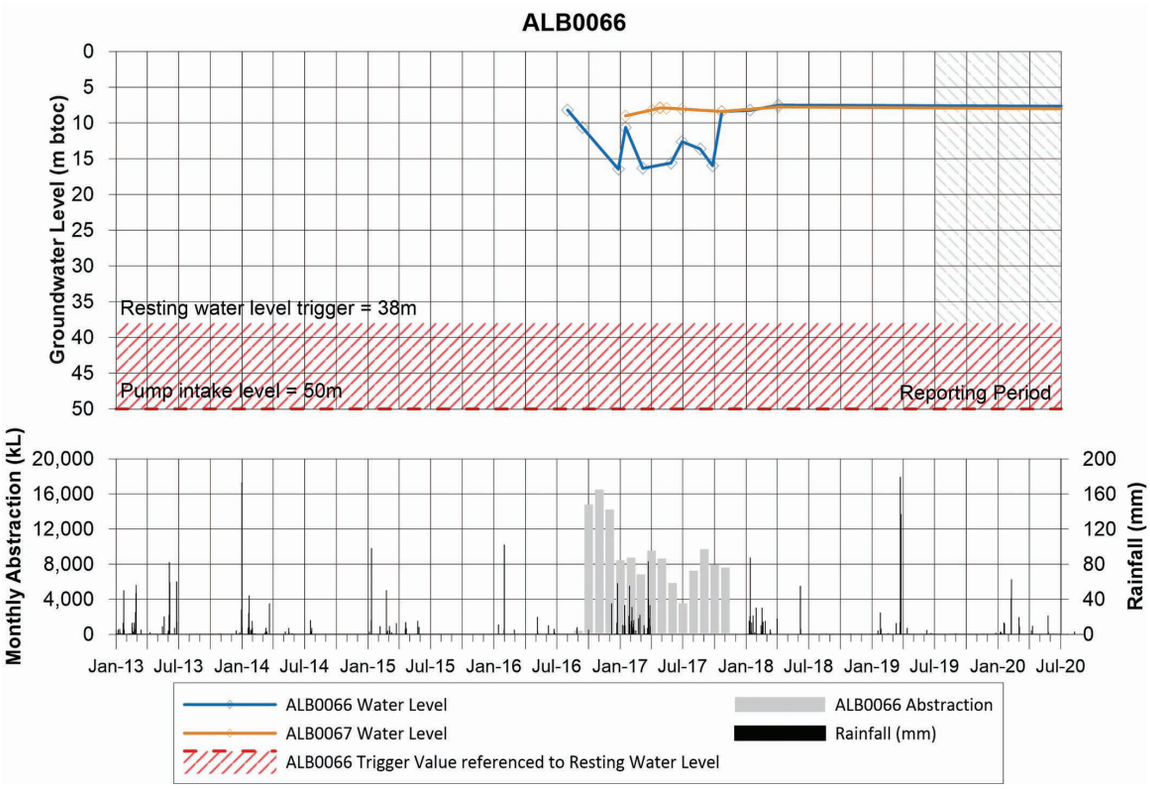

Figure 3.9 - ALB0066 Water Levels vs Abstraction and Rainfall

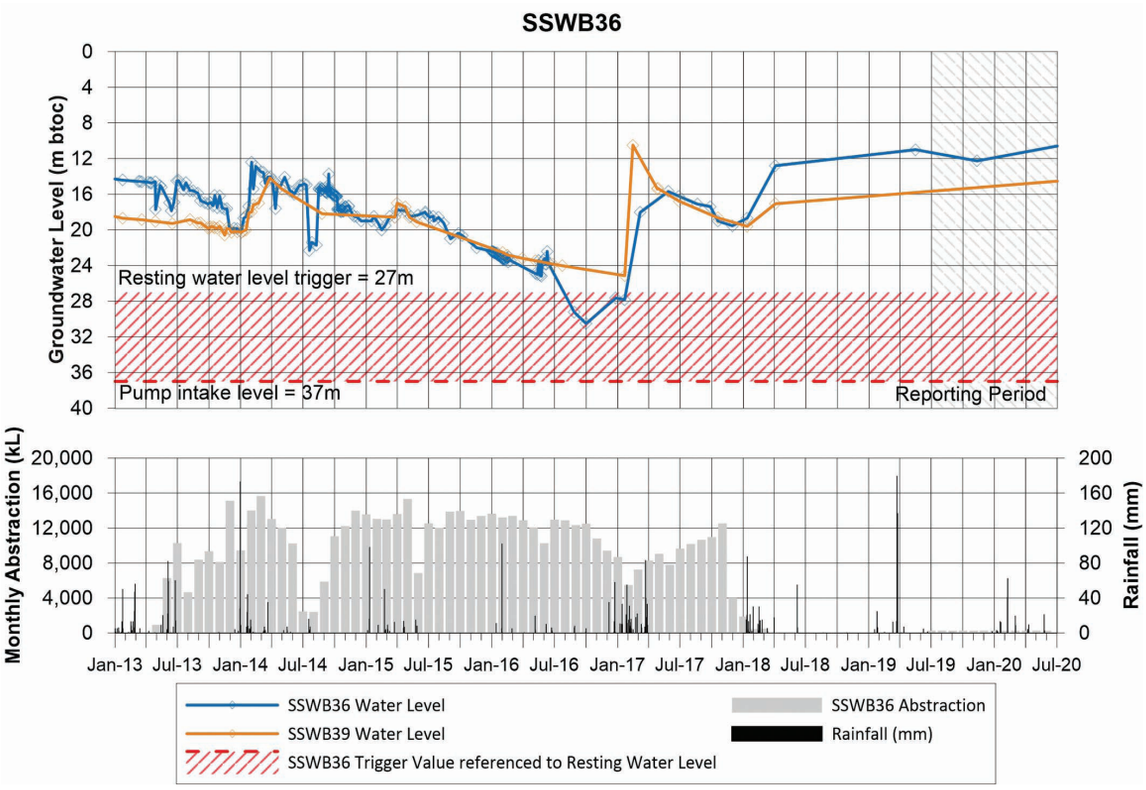

Figure 3.10 - SSWB36 Water Levels vs Abstraction and Rainfall

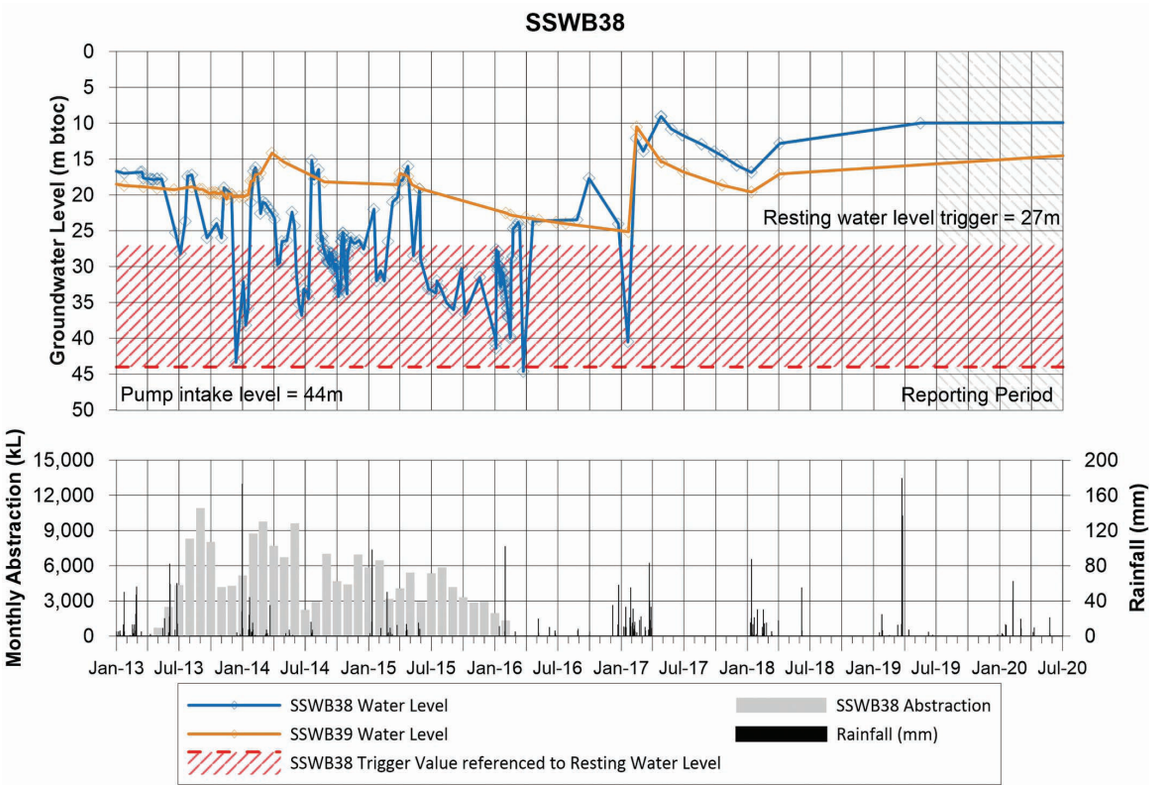

Figure 3.11 - SSWB38 Water Levels vs Abstraction and Rainfall

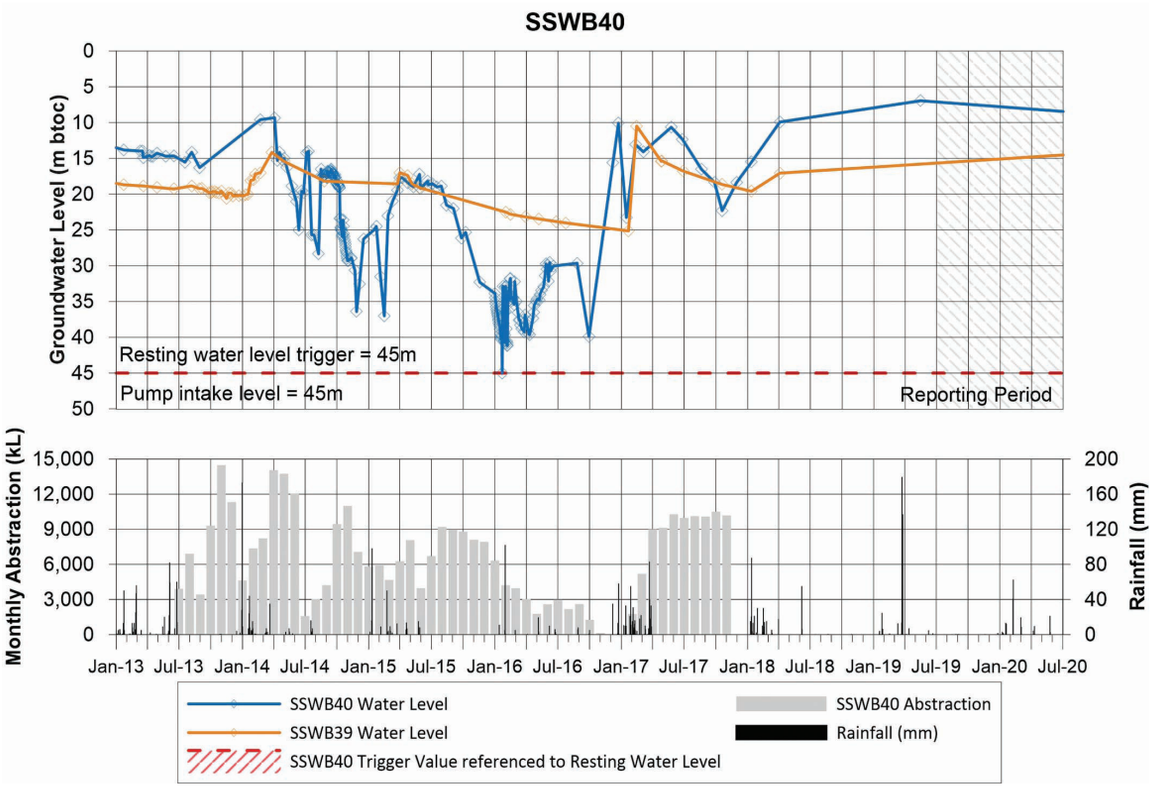

Figure 3.12 - SSWB40 Water Levels vs Abstraction and Rainfall

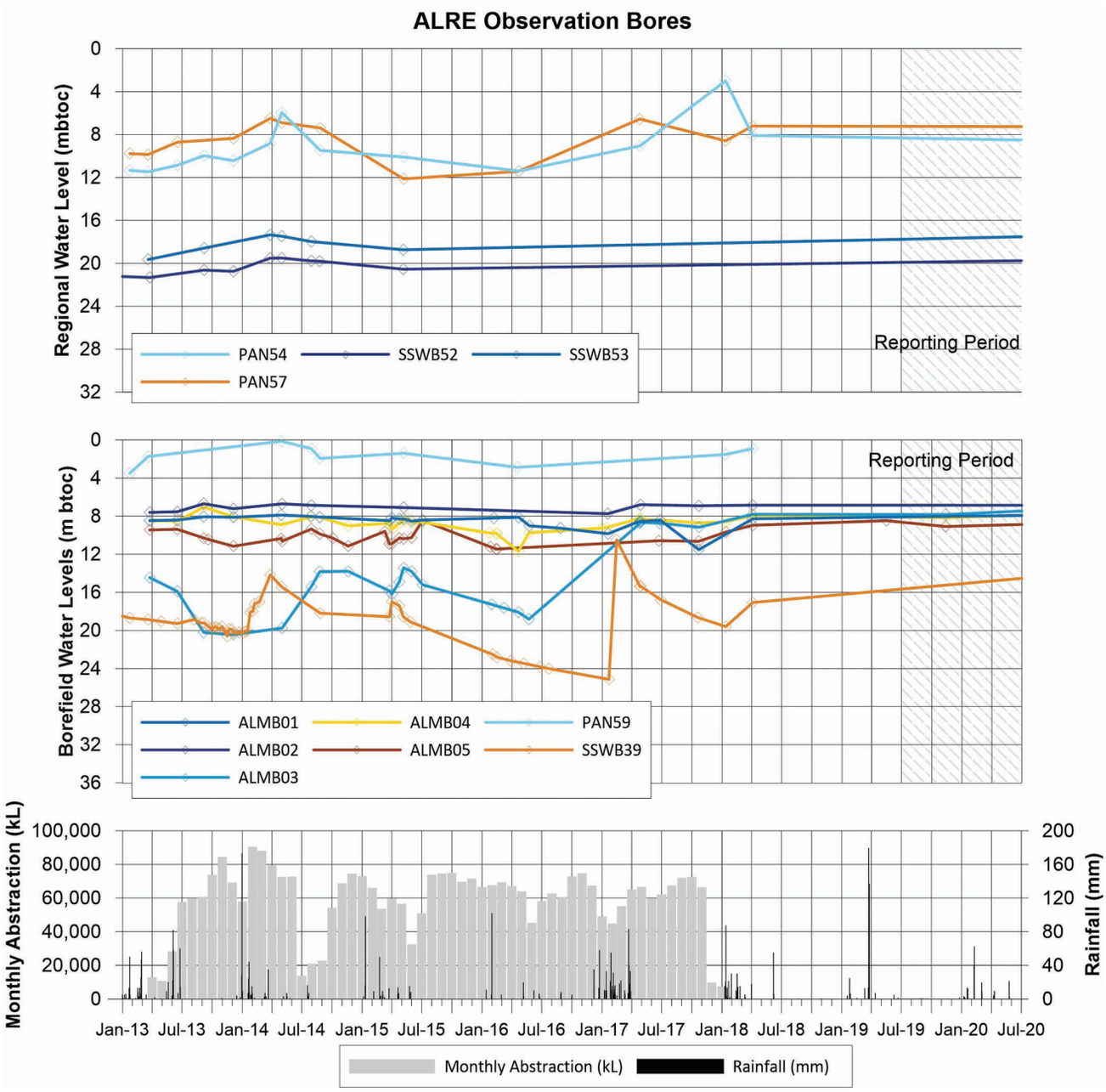

Figure 3.13 - ALRE Observation Bore Water Levels vs Abstraction and Rainfall

3.11.2 Water Quality

All of the abstraction bores in the project area draw water from shallow aquifers replenished seasonally by direct rainfall recharge and the network of local streams. Groundwater quality ranges from fresh (<1,000 mg/L TDS) to slightly brackish (<2,000 mg/L TDS), reflecting the influence of surface water recharge.

Conductivity and pH measurements in abstraction and observation bores have remained relatively constant over time (Figure 3.14 through Figure 3.16) indicating negligible impacts from pumping. Table 3.6 and 3.7 present a summary of the analytical data for abstraction and observation bores. Note that laboratory analysis was not performed during the current reporting period, as described in Section 3.12. The data presented in Table 3.6 and Table 3.7 are therefore representative of historic water quality.

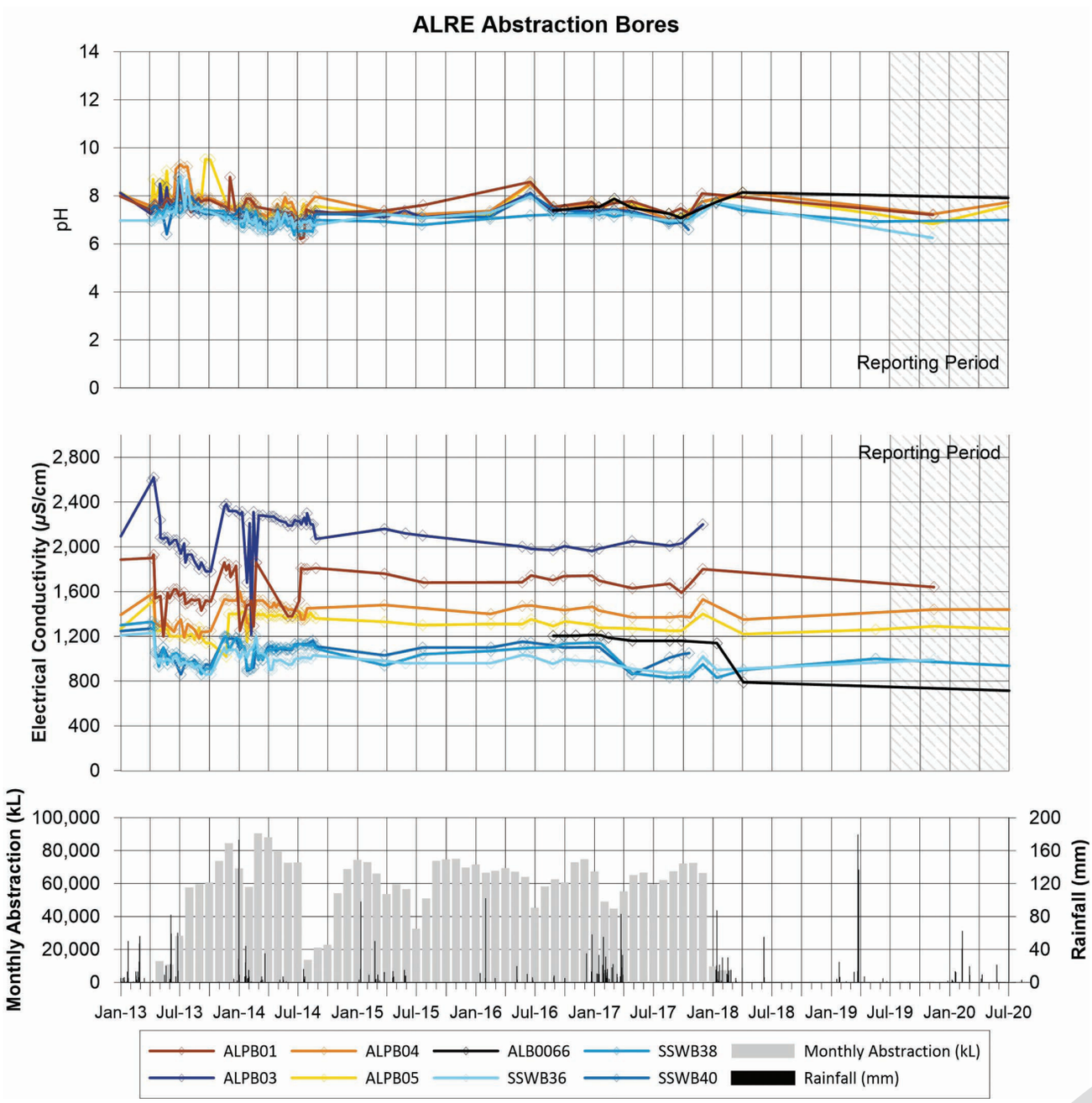

Figure 3.14 - Abstraction Bores pH and EC

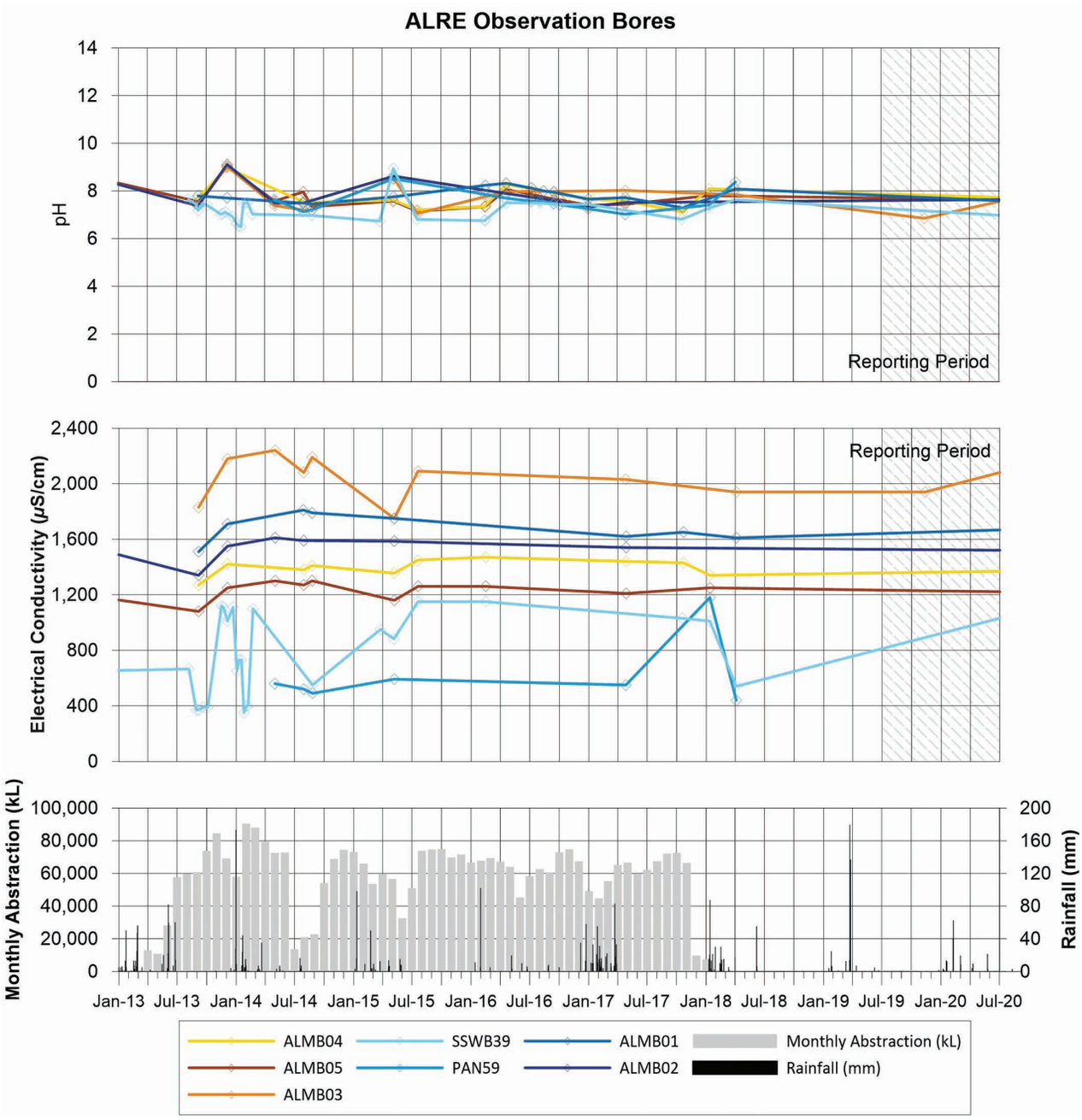

Figure 3.15 - Observation Bores pH and EC

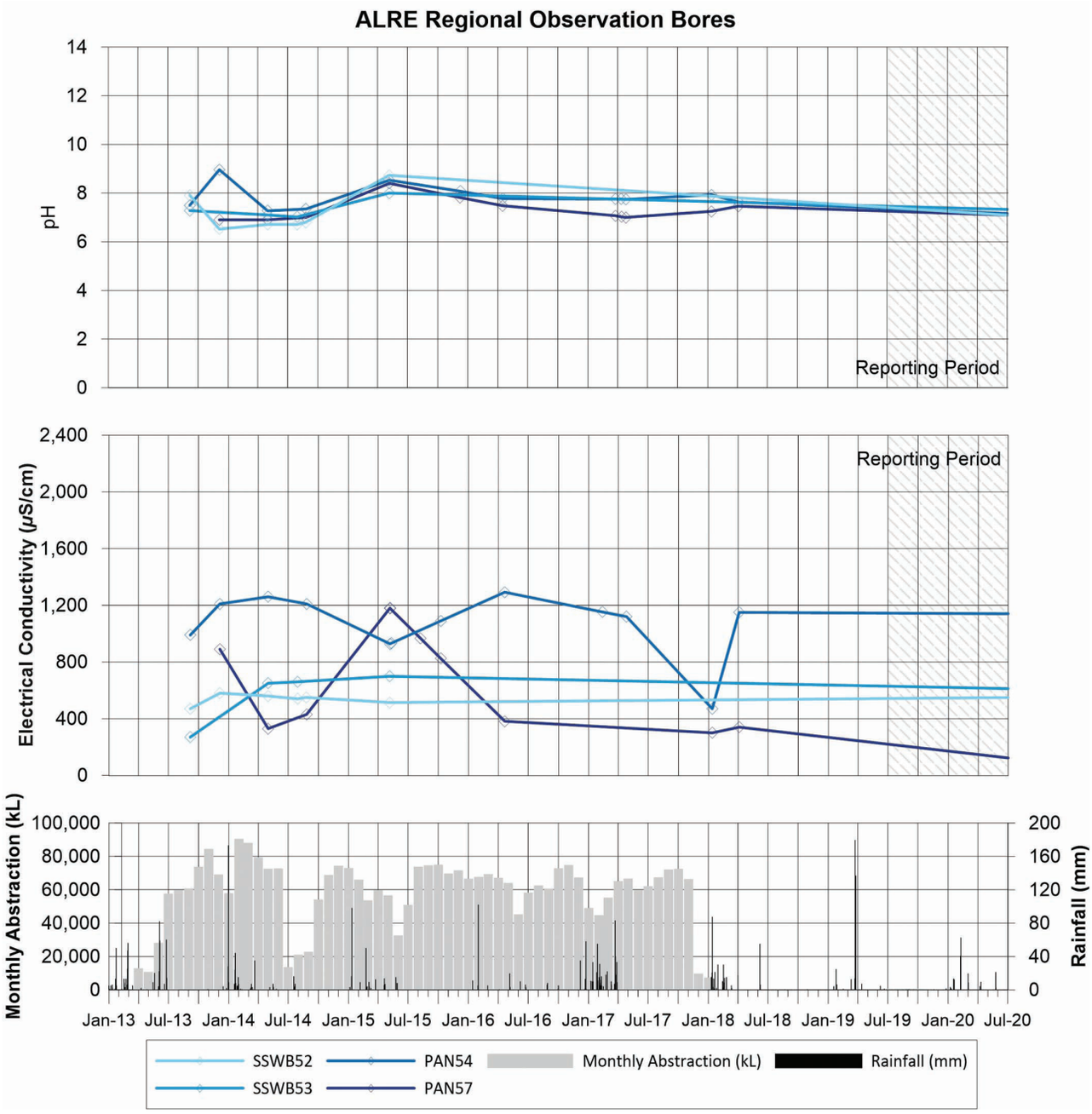

Figure 3.16 - ALRE Regional Bores pH and EC

Table 3.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
ALMB01	5/12/2013	7.90	620	370		290		37.0	39.0	1.7	40	13.00	
	04/04/2018	6.90	1,800	1,100	220	490	41	5.6	86.0	14.0	230	5.30	220
ALMB02	8/05/2014	7.90	1,600										
ALPB01	15/12/2012	8.30	1,800		290	510	64	16.0	83.0	13.0	230		
	30/04/2013	7.40	670		73	280	15	39.0	38.0	1.7	42		
	5/12/2013	8.20	1,600	960		540		24.0	86.0	14.0	230	29.00	
	25/03/2015	8.30	1,800	1,000	290	550	61	24.0	81.0	13.0	210	24.00	
	27/10/2015	8.10	1,800	1,000		560		23.0	82.0	13.0	220	26.00	
	21/04/2016	7.80	1,700	1,000		460		25.0	86.0	13.0	230		3
	27/04/2017	8.20	1,800	980	260	470	50	15.0	86.0	13.0	230	5.30	<5
	29/11/2017	7.90	1,800	1,100	270	470	53	15.0	84.0	14.0	220	23.00	<5
ALPB02	1/02/2013	7.80	1,500	807	220	530	57	42.0	94.0	5.5	170	14.00	
	8/05/2014	8.00	1,500	930	220	580	55					15.00	
	7/05/2015	8.00	1,600	910	220	550	58		92.0	5.5	140	13.00	<5
	27/10/2015	8.10	1,600	920		540		42.0	97.0	5.5	150	14.00	
	21/04/2016	7.80	1,600	980		440		43.0	96.0	5.2	150		26
	27/04/2017	8.00	1,400	810	160	470	40	36.0	83.0	4.5	140	2.60	<5
	29/11/2017	7.50	1,700	1,000	260	450	61	46.0	100.0	5.5	150	12.00	<5
	15/05/2019	7.55	1,630	920	246	521	60	40.1	100.0	5.1	150	2.90	
ALPB03	16/12/2012	8.20	2,400		490	590	93	72.0	120.0	3.8	270		
	6/12/2013	8.10	2,000	1,200	460	490	94	73.0	120.0	3.7	220	22.00	
	8/05/2014	7.90	2,300	1,300	450	510	94					20.00	
	25/03/2015	8.10	2,200	1,300	430	490	96	71.0	110.0	3.8	210	19.00	

Table 3.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	27/10/2015	8.00	2,200	1,300		510		71.0	110.0	3.7	200	21.00	
	20/04/2016	7.60	2,100	1,300		420		73.0	110.0	3.3	210		3
	26/04/2017	7.90	2,200	1,300	380	500	99	72.0	110.0	3.2	230	4.60	<5
	29/11/2017	7.20	950	570	84	350	39	47.0	65.0	1.5	51	6.80	<5
ALPB04	29/01/2013	7.90	1,400		210	500	46	12.0	100.0	15.0	160	23.00	
	5/12/2013	8.20	1,300	790		540		17.0	97.0	14.0	150	26.00	
	29/03/2014	8.20	1,300			530		11.0	86.0	13.0	130	24.00	
	25/03/2015	8.20	1,500	860	220	510	43	10.0	99.0	14.0	140	22.00	
	21/04/2016	7.90	1,400	870		430		12.0	98.0	13.0	140		3
	27/04/2017	8.00	1,500	830	190	430	37	14.0	99.0	13.0	150	5.30	<5
	29/11/2017	7.60	1,500	910	210	420	40	13.0	100.0	14.0	140	23.00	<5
	15/05/2019	7.66	1,700	920	230	488	44	13.9	99.6	13.0	143	5.70	
ALPB05	3/02/2013	7.90	1,300		190	480	43	19.0	99.0	11.0	130	33.00	
	5/12/2013	8.20	1,200	730		480		17.0	99.0	11.0	110	34.00	
	29/03/2014	8.10	1,300			490		15.0	84.0	10.0	110	32.00	
	25/03/2015	8.30	1,300	820	180	480	38	15.0	90.0	11.0	110	29.00	
	27/10/2015	8.10	1,400	810		480		15.0	91.0	11.0	110	31.00	
	21/04/2016	7.80	1,400	840		410		17.0	94.0	11.0	120		3
	27/04/2017	8.00	1,400	810	170	400	36	17.0	95.0	11.0	120	6.00	<5
	29/11/2017	7.70	1,400	860	180	400	36	16.0	95.0	12.0	120	26.00	<5
	14/05/2019	7.59	1,390	770	173	486	38	15.2	93.7	10.4	101	5.60	
PAN 54	04/04/2018	6.60	1,200	630	220	300	29	90.0	53.0	1.6	79	0.19	5
PAN 57	04/04/2018	5.80	280	170	11	120	<1	15.0	8.2	4.3	11	1.70	14
PAN60	14/03/2013	6.80	280		35	71	27	11.0	12.0	5.2	21	0.03	

Table 3.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	6/12/2013	7.70	240	140		57		11.0	12.0	4.5	18	0.80	
	7/05/2015	6.70	330	180	46	25	30		12.0	6.7	21	34.00	<5
PAN59	7/05/2015	7.90	660	290	23	360	10		20.0	9.2	29	<0.05	34
	20/04/2016	7.40	720	430		360		48.0	24.0	9.5	30		22
	26/04/2017	7.70	570	340	37	230	20	47.0	22.0	5.8	31	0.02	5
	04/04/2018	6.90	470	280	14	210	16	37.0	17.0	5.8	27	0.10	5
SSWB36	25/03/2015	8.10	970	560	100	410	46	47.0	68.0	1.5	52	6.70	
	27/10/2015	7.90	970	540		420		48.0	69.0	1.5	49	8.40	
	20/04/2016	7.40	970	580		360		51.0	70.0	1.4	52		3
	26/04/2017	7.80	960	570	86	340	41	47.0	67.0	1.3	57	1.80	<5
	29/11/2017	7.40	2,300	1,400	410	480	100	71.0	110.0	3.7	230	19.00	<5
SSWB38	25/03/2015	8.10	940	550	84	440	42	42.0	68.0	1.5	53	5.10	
	26/04/2017	7.40	880	530	64	350	34	40.0	62.0	3.0	57	1.00	260
	29/11/2017	7.30	910	550	64	380	28	38.0	58.0	3.4	55	<0.5	<5
	30/05/2019	7.30	1,000		62	410	26	38.0	57.0	4.4	56		<5
SSWB39	7/05/2015	7.50	930	570	66	460	25		69.0	2.9	54	12.00	31
	20/04/2016	7.10	1,100	660		410		52.0	83.0	2.0	70		95
	26/04/2017	7.40	1,100	610	110	390	53	44.0	80.0	1.8	73	1.00	5
SSWB40	25/03/2015	8.10	1,000	590	110	440	51	40.0	75.0	1.4	55	2.60	
	28/10/2015	8.00	1,100	610		490		43.0	83.0	1.5	64	2.40	
	20/04/2016	7.50	1,100	610		410		46.0	82.0	1.5	68		7
	26/04/2017	7.80	920	550	85	320	44	36.0	68.0	1.1	56	0.56	<5
ALB0063	29/11/2017	7.60	1,300	760	170	370	29	18.0	85.0	11.0	100	16.00	<5
ALB0066	27/04/2017	8.00	1,200	710	150	380	28	17.0	89.0	11.0	110	4.60	<5
	16/05/2019	8.00	1,250	720	168	446	35	17.9	90.7	10.0	94	3.40	

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2011).

Table 3.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
ALMB01	5/12/2013	0.016		<0.100	0.001	0.007	<0.005	0.01		0.006					43
	04/04/2018	0.011	0.79	<0.0001	<0.001	<0.001	0.020	<0.001	<0.005	<0.001	0.005		0.93	<0.001	0.002
ALPB01	15/12/2012	0.01	0.6	<0.001	0.003	0.014	<0.02	<0.005	0.0025	0.006	0.01			0.025	0.03
	30/04/2013	0.013	0.12		0.001				0.004		0.001			0.005	
	5/12/2013	0.009		<0.100	0.001	0.003	<0.005	<1		<1					28
	25/03/2015	<0.020	0.62	<0.001	<0.005	<0.005	<0.02	<0.02	0.009	<0.005	<0.05	<0.005	0.92	<0.05	<0.01
	27/10/2015	0.009	0.6	<0.0001	0.001	<0.001	<0.02	<0.001	0.0005	<0.001	0.003	0.0005	0.86	0.0005	<0.005
	21/04/2016	0.01	0.49	<0.0001	0.001	<0.001	<0.005	<0.001	0.0025	<0.001	0.005		0.095	0.0005	<0.001
	27/04/2017	0.009	0.69	<0.0001	<0.001	0.002	0.180	<0.001	0.011	<0.001	0.004		0.85	<0.001	0.051
	29/11/2017	0.01	0.79	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	<0.001	0.004		0.96	<0.001	0.002
ALPB02	1/02/2013	0.007		0.00005		0.001	0.003	0.0005	0.005						0.012
	15/05/2014	0.006													0.014
	7/05/2015	<0.020	0.55	<0.001	<0.005	<0.005	0.030	<0.02	0.012	<0.005	<0.05	<0.005	0.82	<0.05	<0.01
	27/10/2015	0.007	0.46	<0.0001	0.001	<0.001	<0.005	<0.001	0.0005	<0.001	0.003	0.0005	0.82	0.0005	<0.005
	21/04/2016	0.008	0.38	<0.0001	0.001	0.003	<0.01	<0.001	0.0025	<0.001	0.003		0.086	0.0005	0.002
	27/04/2017	0.007	0.57	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.002		0.7	<0.001	<0.001
	29/11/2017	0.007	0.61	<0.0001	<0.001	0.001	<0.01	<0.001	0.006	<0.001	0.002		0.94	<0.001	0.002
	15/05/2019	0.008	0.4	<0.0001	<0.0005	0.000	<0.005	<0.0001	0.0001	<0.001	0.003	<0.0001		<0.0001	<0.001
ALPB03	16/12/2012	0.01	1	<0.001	0.003	0.005	0.060	<0.005	0.0025	0.006	0.01			0.025	0.06
	6/12/2013	0.005		<0.100	0.001	0.002	0.006	0.001		0.001					0.086
	15/05/2014	0.004				0.001									0.025
	25/03/2015	<0.020	0.63	<0.001	<0.005	<0.005	<0.02	<0.02	0.01	<0.005	<0.05	<0.005	1.5	<0.05	0.02
	27/10/2015	0.004	0.61	<0.0001	0.001	<0.001	<0.02	<0.001	0.0005	<0.001	0.004	0.0005	1.5	0.0005	0.014
	20/04/2016	0.005	0.49	<0.0001	0.001	0.001	<0.02	<0.001	0.0025	0.002	0.003		1.5	0.0005	0.017

Table 3.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	26/04/2017	0.007	0.88	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.003		1.4	<0.001	0.006
	29/11/2017	0.002	0.33	<0.0001	<0.001	0.003	0.030	<0.001	0.007	<0.001	<0.001		0.18	<0.001	0.029
ALPB04	29/01/2013	0.01		0.00005		0.002	0.003	0.0005	0.001						0.006
	5/12/2013	0.008		<0.1000	0.001	0.003	<0.005	<1.000		<1.000					0.031
	29/03/2014	0.01	0.4	<0.001	0.003	<0.005	<0.02	<0.02	0.009	<0.005	0.025	0.0025	0.85	0.025	<0.01
	25/03/2015	<0.02	0.47	<0.001	<0.005	<0.005	<0.02	<0.02	0.01	0.007	<0.05	<0.005	1	<0.05	0.02
	21/04/2016	0.009	0.35	<0.0001	0.001	<0.001	<0.01	<0.001	0.0025	<0.001	0.004		1	0.0005	0.005
	27/04/2017	0.008	0.46	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.003		0.98	<0.001	0.008
	29/11/2017	0.008	0.53	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.004		1	<0.001	0.002
	15/05/2019	0.009	0.39	<0.0001	0.001	0.0003	<0.005	<0.0001	0.0002	<0.001	0.004	<0.0001		<0.0001	<0.001
ALPB05	3/02/2013	0.007		<0.1000		0.002									
	5/12/2013	0.007		<0.1000	0.001	0.001	<5.00	<1.000		<1.000					0.04
	29/03/2014	0.01	0.4	<0.001	0.003	<0.005	<0.02	<0.02	0.009	0.005	0.025	0.0025	0.91	0.025	0.01
	25/03/2015	<0.02	0.47	<0.001	<0.005	<0.005	<0.02	<0.02	0.009	<0.005	<0.05	<0.005	1	<0.05	0.03
	27/10/2015	0.006	0.45	<0.0001	0.001	<0.001	<0.02	<0.001	0.0005	<0.001	0.005	0.0005	1	0.0005	0.01
	21/04/2016	0.007	0.37	<0.0001	0.001	<0.001	<0.02	<0.001	0.0025	<0.001	0.004		1.1	0.0005	0.013
	27/04/2017	0.006	0.47	<0.0001	<0.001	<0.001	0.010	<0.001	<0.005	<0.001	0.003		1	<0.001	0.021
	29/11/2017	0.006	0.57	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.003		1.1	<0.001	0.006
	15/05/2019	0.007	0.35	<0.0001	<0.0005	0.000	<0.005	<0.0001	0.0001	<0.001	0.004	<0.0001		<0.0001	<0.001
PAN 54	04/04/2018	<0.001	0.2	<0.0001	<0.001	0.003	0.010	<0.001	0.014	<0.001	<0.001		0.56	<0.001	0.022
PAN 57	04/04/2018	0.004	0.04	<0.0001	<0.001	<0.001	7.300	<0.001	0.44	<0.001	<0.001		0.088	<0.001	0.006
PAN 60	14/03/2013	0.001	0.075	<0.1000	0.001	0.001	7.020	0.0005	0.0012	0.063	0.001			0.0005	0.042
	6/12/2013	0.0005		<0.100	0.001	<1.000	<0.005	<1.00	0.0005	0.031					0.056
	7/05/2015	<0.02	0.13	<0.001	<0.005	<0.005	0.160	<0.02	0.0013	0.083	<0.05	<0.005	0.11	<0.05	0.03
PAN59	7/05/2015	<0.02	0.12	<0.001	<0.005	<0.005	0.360	<0.02	0.24	<0.005	<0.05	<0.005	0.36	<0.05	<0.01

Table 3.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	20/04/2016	0.002	0.06	<0.0001	0.001	<0.001	0.140	<0.001	0.2	<0.001	0.0005		0.39	0.0005	0.003
	26/04/2017	0.009	0.06	<0.0001	<0.001	<0.001	0.040	<0.001	0.19	<0.001	<0.001		0.36	<0.001	<0.001
	04/04/2018	0.006	0.08	<0.0001	<0.001	<0.001	<0.01	<0.001	0.11	<0.001	<0.001		0.33	<0.001	0.002
SSWB36	25/03/2015	<0.02	0.29	<0.001	<0.005	<0.005	<0.02	<0.02	0.008	<0.005	<0.05	<0.005	0.17	<0.05	<0.01
	27/10/2015	0.002	0.26	<0.0001	0.001	0.019	0.006	<0.001	0.0005	0.002	0.001	0.0005	0.17	0.0005	0.053
	20/04/2016	0.002	0.2	<0.0001	0.001	0.014	<0.01	<0.001	0.0025	0.004	0.001		0.19	0.0005	0.047
	26/04/2017	0.003	0.28	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	<0.001	0.001		0.16	<0.001	0.012
	29/11/2017	0.006	0.98	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.003		1.5	<0.001	0.014
SSWB38	25/03/2015	<0.02	0.29	<0.001	<0.005	<0.005	<0.02	<0.02	0.007	<0.005	<0.05	<0.005	0.16	<0.05	0.05
	28/10/2015	0.002	0.3	<0.0001	0.001	0.004	<0.005	0.001	0.0005	0.007	0.002	0.0005	0.18	0.0005	0.032
	26/04/2017	0.003	0.26	<0.0001	<0.001	0.002	<0.01	<0.001	0.014	0.001	0.001		0.14	<0.001	0.009
	29/11/2017	0.003	0.34	<0.0001	<0.001	<0.001	<0.01	<0.001	0.044	<0.001	<0.001		0.15	<0.001	0.003
	30/05/2019	0.003	0.25	<0.0001	<0.001	0.001	<0.01	0.001	0.06	<0.001	<0.001		0.14	<0.001	0.009
SSWB39	7/05/2015	<0.02	0.17	<0.001	<0.005	0.022	0.230	<0.02	0.77	0.008	<0.05	<0.005	0.17	<0.05	0.02
	20/04/2016	0.004	0.23	<0.0001	0.001	0.002	0.120	<0.001	0.72	0.002	0.0005		0.22	0.0005	0.022
	26/04/2017	0.005	0.29	<0.0001	<0.001	0.005	<0.01	<0.001	0.096	<0.001	<0.001		0.2	<0.001	0.011
SSWB40	25/03/2015	<0.02	0.29	<0.001	<0.005	<0.005	<0.02	<0.02	0.008	<0.005	<0.05	<0.005	0.16	<0.05	0.02
	28/10/2015	0.002	0.3	<0.0001	0.001	0.002	<0.005	0.001	0.0005	<0.001	0.001	0.0005	0.18	0.0005	0.012
	20/04/2016	0.001	0.23	<0.0001	0.001	0.002	<0.01	<0.001	0.022	0.001	0.0005		0.19	0.0005	0.05
	26/04/2017	0.002	0.23	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.001		0.14	<0.001	0.007
ALB0063	29/11/2017	0.006	0.45	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.003		1	<0.001	0.003
ALB0066	27/04/2017	0.006	0.36	0.0001	<0.001	0.015	<0.01	0.004	<0.005	0.002	0.003		0.93	<0.001	0.072
	16/05/2019	0.007	0.31	<0.0001	<0.0005	0.000	<0.005	<0.0001	0.0004	<0.001	0.004	<0.0001		<0.0001	0.002

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2011).
Values highlighted orange exceed the Australian Drinking Water Guidelines for health impacts (NHMRC, 2011).

3.12 Compliance

Monitoring results indicate that no trigger values were exceeded during the reporting period. Table 3.8 summarises the compliance commitments at the project.

Table 3.8 - Summary of Commitments and Compliance

Activity	Action	Compliance	Comments
Administration	Submit the aquifer review to DoW annually on 30 September. This report will contain: • Compliance with the monitoring schedule and assess results. • Aquifer performance against that predicted.	Compliant	Report submitted 30th September 2020.
	Review SWOP in conjunction with annual/final reporting.	Compliant	SWOP currently being reviewed.
Monitoring	Implementation of monitoring schedule as per SWOP.	Mostly compliant	Some gaps in record due to accessibility issues.
Water use efficiency	Monthly infrastructure checks/maintenance.	Compliant	N/A, borefields currently out of commission.
	Site water balance review as required.	Compliant	N/A, borefields currently out of commission.
Contingency plans	Review triggers annually or as required.	Compliant	N/A, borefields currently out of commission

In general, the monitoring requirements were met during the reporting period. However, some gaps occurred in record primarily as a result of access issues from decommissioning of bores. Table 3.9 provides details of completed monitoring.

Table 3.9: Summary of Monitoring Completed

Monitoring Area or Topic	Source Document	Requirement	Frequency	Non-compliances
Abstraction bores (ALPB05 and SSWB36 – note that these bores are currently decommissioned and should revert to monitoring bore monitoring frequency.)	SWOP	Field WL, pH, EC, and Temperature	6 Monthly (November and April)	Readings taken only in November 2019.
		Laboratory testing	Annual (November)	Laboratory testing not completed during the 2019/20 reporting year.
Observation bores (ALPB01 and ALPB03)	SWOP	Field WL, pH, EC, and Temperature	Annual (November)	ALPB03 not monitored.

3.13 Assessment of Impacts

3.13.1 Aquifer Levels

Water levels in all bores have recovered to pre-pumping levels, suggesting that the local aquifers remain largely un-impacted.

Local and regional observation bores show seasonal fluctuations in water levels throughout the year (Figure 3.13). Water levels in the borefield observation bores show localised drawdown during abstraction but recovered during rainfall events and when bores were not in use. In general, all of the observation bore data show no significant declining trends suggesting no or minimal impact to the aquifers.

3.13.2 Water Quality

While it is acknowledged that the annual laboratory sampling event was not completed for this reporting period, it is noted that water quality at the site has remained relatively consistent since monitoring began. This indicates that operations at the site have not caused a deterioration of water quality, and that impacts to the groundwater resource and associated receptors are very unlikely to have occurred during the reporting period. Laboratory analysis will be conducted during the 2020-21 reporting period, with results summarised in the 2021 annual report.

3.14 Recommendations

It is recommended that the Care and Maintenance Monitoring Plan be continued in accordance with the Addendum to the Site Water Operating Plan (Atlas, 2015a).

4. MT DOVE

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4.1 Introduction

This Groundwater Monitoring Summary Report relates to instrument GWL175319(3), which allows Atlas to take water under section 5C of the RiWI Act 1914. The duration of the licence is from 15 May 2012 to 16 June 2025.

Mining at 2 Mtpa began at Mt Dove in 2012 and continued until October 2013. Since that time Mt Dove has variously served as a crushing hub for Wodgina and Mt Webber projects and as a staging and accommodation area for trucking operations. Additional crushing of lithium DSO occurred between April 2018 and December 2018 under a mine gate sale agreement with Pilbara Minerals Ltd.

4.2 Background and Location

The Mt Dove DSO Project is located in the Pilbara region of Western Australia approximately 68 kilometres south of Port Hedland along the Great Northern Highway (GNH) (Figure 4.1). The project consists of the Mt Dove mine site and a 13.5 km haul road to access the GNH.

The Mt Dove DSO Project area lies within Indee Station Pastoral Lease (3114/1197). The lease is predominantly savannah-scrubland and is grazed with cattle. Several mining and exploration tenements exist in the area of Mt Dove with exploration activity focused on gold and base metals.

The predominant landforms of the local area are isolated east-west trending ridges surrounded by low lying alluvial plains. The small solitary rocky ridge of Mt Dove rises approximately 70 m above the plains between the Yule and Turner Rivers.

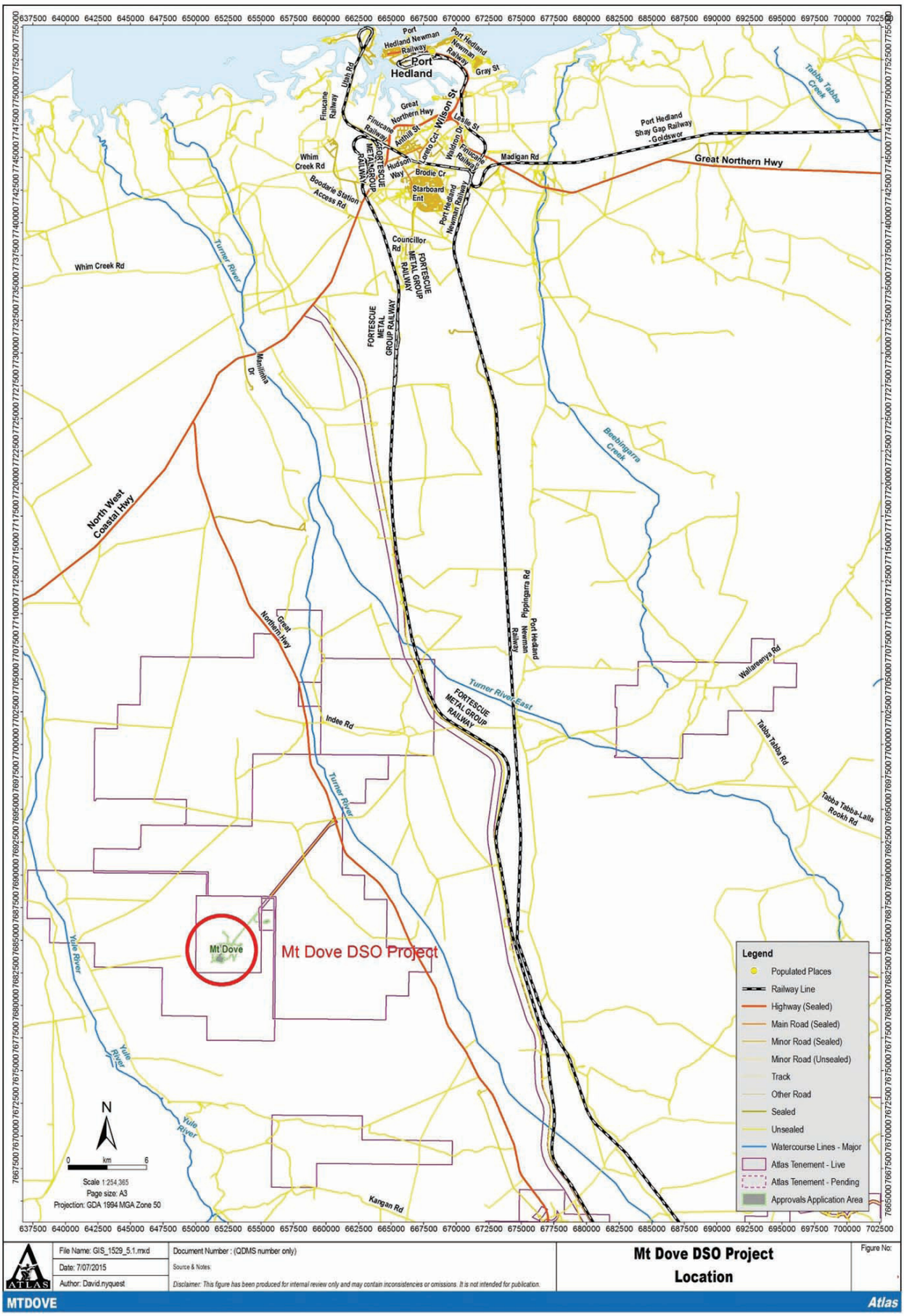

Figure 4.1 - Mt Dove DSO Project Location

4.3 Groundwater Management Areas

The Yule River Water Reserve (No. 31427) is located approximately 6 km to the north of the project area and supplies potable water to Port Hedland and South Hedland. The Yule River Water Reserve was gazetted under the Country Areas Water Supply Act 1947 in March 2001. This area has been assigned a Priority 1 under the Water Source Protection Classification System. No impacts were observed outside the local aquifer system at Mt Dove as a result of groundwater abstraction during operations.

4.4 Water Usage

Water taken under GWL175319(3) is authorised to be used for:

- Dust suppression, earthworks and construction purposes,
- General campsite purposes,
- Mineral ore processing and other mining purposes, and
- Potable water supply purposes.

Activities listed above can be undertaken within leases M47/1449 and L45/248. L47/402 was relinquished in 2015.

A total of 39,235 kL of groundwater was abstracted from the Mt Dove borefield over the reporting period.

4.5 Licensing

Groundwater abstraction for the project is authorised by GWL175319(3) (Figure 4.2). This provides an allocation of up to 650,000 kL/year from the Pilbara Fractured Rock aquifer for the purposes noted above. Table 4 1 lists the details of the historical GWL approvals.

The reporting period for the project is 1 July 2019 to 30 June 2020. The project AAR report is scheduled for submission to the Department of Water and Environmental Regulation (DWER) annually in September.

Table 4.1 - License History

License	Allocation (kL)	Start Date	Expiry Date	Comments
GWL175319(1)	600,000	15/05/2012	14/05/2017	Original license for operations.
GWL175319(2)	650,000	17/09/2012	16/09/2017	Added two bores and increased allocation.
GWL175319(3)	650,000	17/06/2015	16/06/2025	Added addendum for Care and Maintenance.

File No: RF8108

Government of Western Australia
Department of Water

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Instrument No. GWL175319(3)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Atlas Iron Limited		
Description of Water Resource	Pilbara Pilbara - Fractured Rock	**Annual Water Entitlement**	650000 kL
Location of Water Source	M47/1449, L47/402		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes Earthwork and construction purposes General campsite purposes Mineral ore processing and other mining purposes Potable Water Supply purposes	M47/1449, L45/248, L47/402 and E47/891
Duration of Licence	From 17 June 2015 to 16 June 2025	

This Licence is subject to the following terms, conditions and restrictions:

1 The licensee must install an approved meter to each water draw-point through which water is taken under this licence.

2 The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this licence.

3 The licensee shall comply with the commitments of the 'Mt Dove DSO Project Site Water Operating Plan 2012 to 2017 (128-DEV-HY-PLN-0001' and 'Addendum 2015' as prepared by Atlas Iron Liminted and approved by the Department of Water on 19 June 2015, including any modifications to the commitments as approved during the term of the licence.

4 Every 12 month(s) the licensee shall provide to the Department of Water a Groundwater Monitoring Summary for the preceding water year. The first report is due 30/09/2016.

5 The annual water year for water taken under this licence is defined as 1 July to 30 June twelve months later.

End of terms, conditions and restrictions

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000

Figure 4.2 - License to Take Water GWL175319(3)

4.6 Climate

The climate of the Mt Dove DSO Project area is classified as semi-arid to arid and is characterised by hot summers and warm winters. The area experiences a climate of extremes, where severe droughts and major floods can occur at close intervals (MWH, 2011).

Long term meteorological data is available from the Port Hedland Airport (Bureau of Meteorological Station No. 004032), spanning from 1897 to present. This meteorological station is located at latitude: 20.37°S, longitude: 118.63°E, approximately 65 km north east of the Project area.

A summary of long term meteorological data from Port Hedland is shown in Table 4 2.

Table 4.2 - Port Hedland Climatic Data Summary

Month	Mean Daily Maximum Temperature (°C) (1948-2020)	Mean Daily Minimum Temperature (°C) (1948-2020)	Mean Monthly Rainfall (mm)
January	36.4	25.6	63.4
February	36.2	25.5	88.9
March	36.8	24.6	55.3
April	35.3	21.5	21.5
May	30.7	17.3	26.6
June	27.7	14.2	23.1
July	27.3	12.5	10.4
August	29.3	13.2	4.7
September	32.4	15.5	1.2
October	35.1	18.6	1.0
November	36.3	21.5	2.5
December	36.7	24.2	18.5

The hot summer season occurs from November to February with mean daily maximum and minimum temperatures of approximately 40°C and 25°C respectively. The winter season occurs from June to August with mean daily maximum and minimum temperatures of about 28°C and 13°C respectively.

Mean annual rainfall for the area can vary from 300 – 400 mm. Rain is to be expected in the summer months, mainly from January to March, and is unusual between July and October. Most of the summer rain comes from scattered thunderstorms, producing heavy localised falls in short periods. In addition, tropical lows and cyclones can bring widespread rain to the region. A secondary peak in the monthly rainfall can occur as a result of rainfall caused by tropical cloud bands, which intermittently affect the area mostly in May and June. Rainfall in general is unreliable and highly variable, which predominantly relates to the random nature of localised thunderstorms and tropical lows passing through the area (MWH, 2011).

Annual potential evaporation is 3,300 mm (mean daily average 9.0 mm). The excess of evaporation over rainfall, which is greater than a factor of ten, is typical for arid and semi-arid areas in Australia (MWH, 2011).

4.7 Hydrogeology

The local geology of the low lying areas of the Mt Dove Project area consists of Quaternary to Tertiary alluvial sediments overlying Archaean rocks, including granite, schist, quartzite, and banded iron formation (BIF). Local stock bores draw water from discontinuous shallow alluvium consisting of sand, silt, clay and gravel ranging from 25 to 50 metres in thickness. Calcrete deposits exist throughout the alluvial sediments and have developed either through weathering of the bedrock material, or from the seasonal fluctuation of the water table. The water table in the shallow alluvial aquifer surrounding Mt Dove lies approximately 6 to 12 metres below the ground level (mbgl). Discontinuous lenses of silty clay may be present below the water table, which may act as a semi-confining layer (MWH, 2011).

Most of the recharge to the alluvial aquifer occurs through direct infiltration during periods of intense rainfall or when the Yule and Turner Rivers are in flood, where river water rapidly infiltrates into the river bed and then moves slowly into the alluvium away from the river (MWH, 2011). In the vicinity of Mt Dove, it is anticipated that regional groundwater flow is to the north while local groundwater flows radially away from the flanks of Mt Dove. Comparison of drillhole data, planned pit depth, and surface topography suggested that dry mining conditions would exist throughout the mine plan at Mt Dove. These results were corroborated during mining.

There is no documented evidence of specific groundwater conditions within the bedrock beneath the local alluvial deposits. However, as with other consolidated rock areas within Australia, variable degrees of fractured, dual porosity conditions are anticipated. Secondary permeability will predominate, with structural controls exerted by prevailing lineaments such as major joint patterns, fault lines or thrust planes, as well as any intrusive dykes.

4.8 Mt Dove Borefield

The Mt Dove Borefield (Figure 4.3) comprises four equipped production bores (MDEX2, MDEX3, MDEX5, and MDEX6) with two unequipped backup bores (MDEX1 and MDEX4).

MDEX2 provides potable water for camp purposes while MDEX3, MDEX5 and MDEX6 are utilised for dust suppression activities as required. The pumping infrastructure and bore details are summarised in Table 4 3. The water supply scheme is outlined in Figure 4.4.

Monitoring bores MDOBS1 and MDOBS4 provide water level and water quality monitoring in the vicinity of the mine. A regional groundwater monitoring program is in place to assess the water levels and quality outside the main abstraction areas and any wider potential environmental impacts. This regional monitoring program consists of four existing bores/wells (Mt Dove Bore, Granite Well, Unknown Stock and Stock Bore 2).

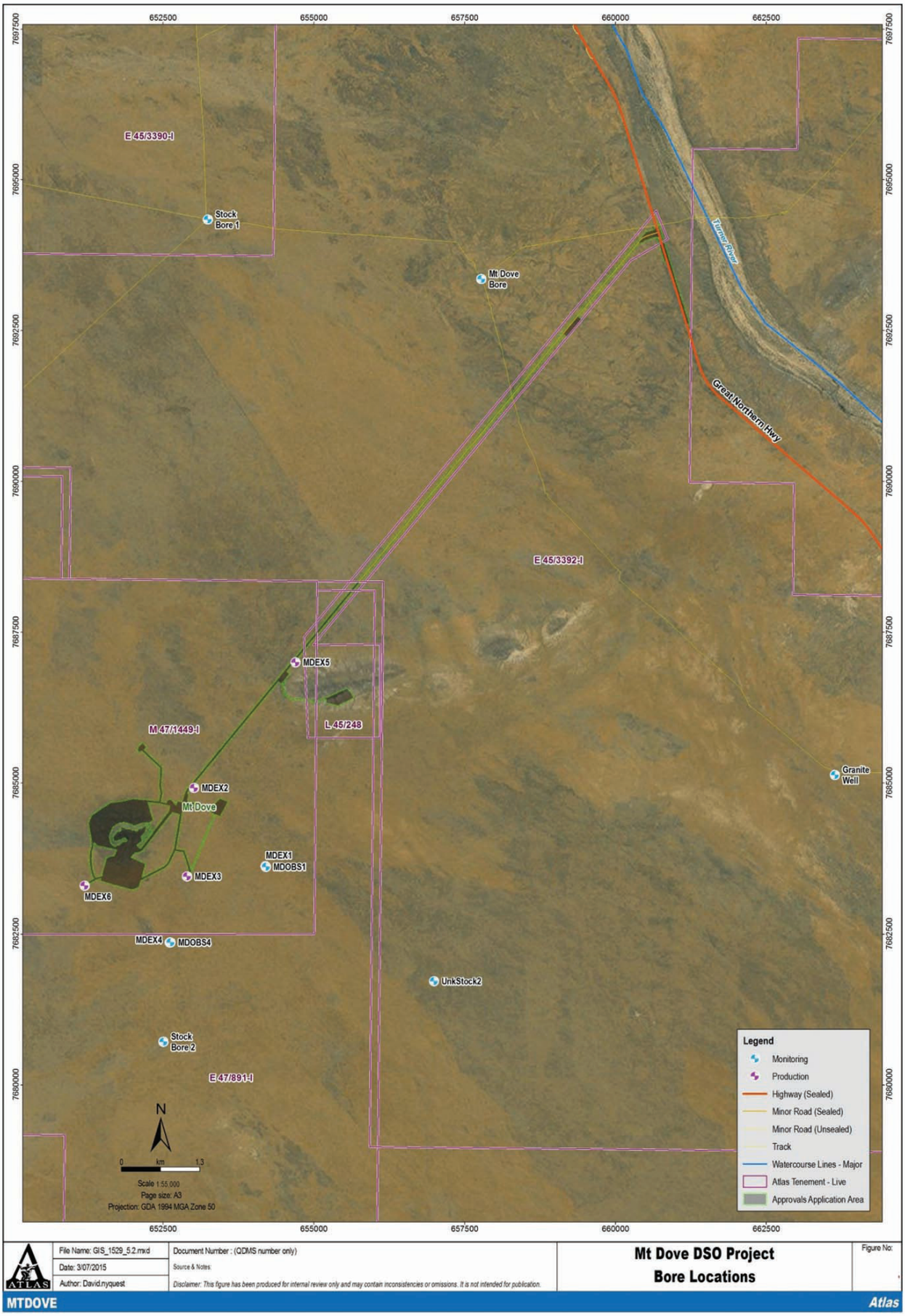

Figure 4.3: Mt Dove DSO Project Bore Locations

Table 4.3 - Mt Dove Production and Observation Bore Details

Bore Name	Coordinates (GDA94, Zone 50)		Total Depth (mbgl)	Nominal Casing Diameter (mm)	Screen Interval (mbgl)	Static Water Level (mbtoc)	Recom-mended Rate (L/sec)	Recom-mended Pump Inlet Depth (mbgl)
	Easting	Northing						
Production Bores								
(1)MDEX1	654204	7683630	71.5	203	17.5-65.5	7.25	3	40
MDEX2	653016	653016	35.0	203	11 - 35	6.70	8	30
MDEX3	652897	7683453	24.9	203	6.9 - 24.9	7.00	10	16
(1)MDEX4	652601	7682368	95.5	203	17.5-89.5	9.30	6	35
(3)MDEX5	654695	7687001	67.0	203	19 - 67	9.12	5	60
(2)MDEX6	651197	7683300	48.0	203	12 - 48	7.49	20	45
Observation Bores								
MDOBS1	654205	7683612	42.0	50	12-42	6.96	NA	NA
MDOBS4	652624	7682359	35.5	50	11.5-35.5	8.70	NA	NA
Regional Monitoring Bores								
Mt Dove Bore	657781	7693360	Unknown	100	Unknown	11.82	NA	NA
Granite Well	663642	7685134	Unknown	NA	NA	7.15	NA	NA
Unknown Stock	656994	7681716	Unknown	100	Unknown	6.24	NA	NA
Stock bore 2	652508	7680711	Unknown	100	Unknown	9.65	NA	NA

(1) Not equipped. Monitoring purposes only.
(2) Equipped May 2017.
(3) Equipped May 2018.

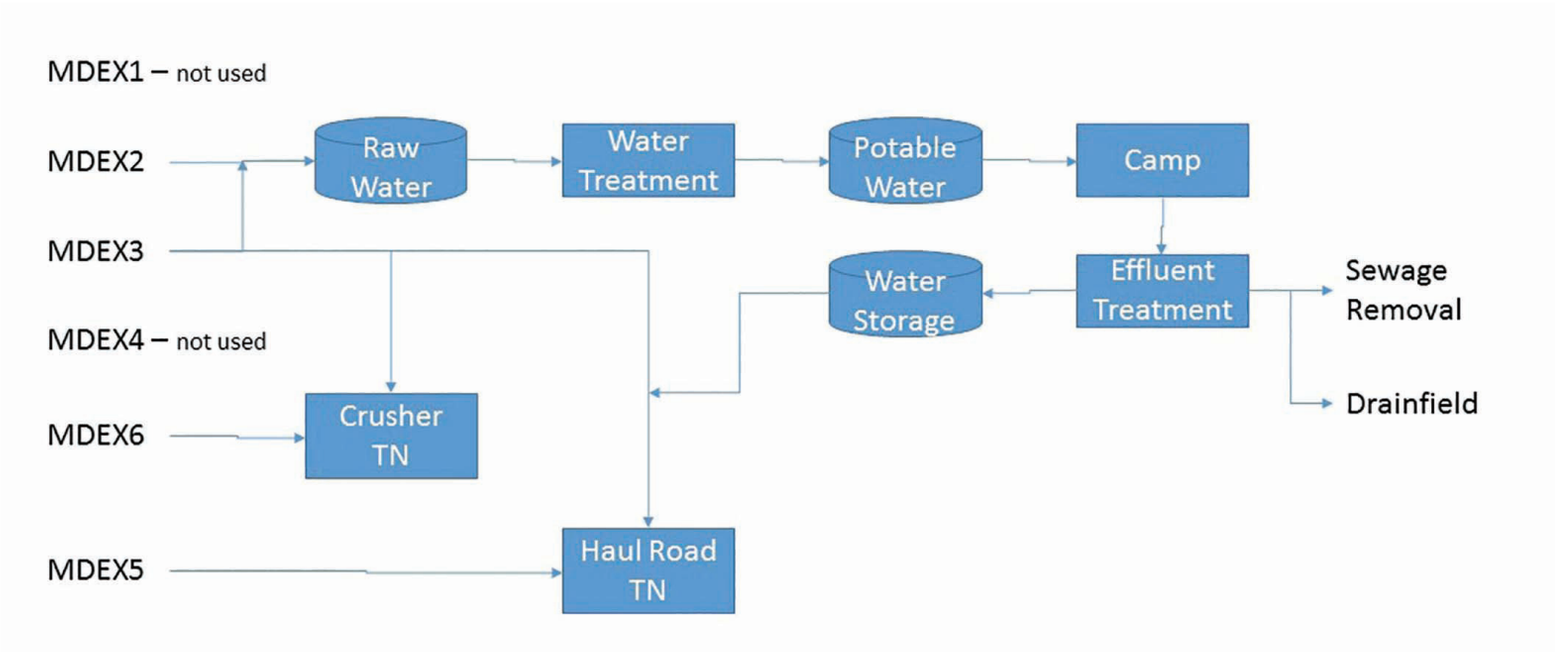

Figure 4.4: Mt Dove Water Supply Scheme

4.9 Abstraction

A total of 39,235 kL of groundwater was abstracted from the Mt Dove borefield over the reporting period. This corresponds to 6% of the annual water entitlement (650,000 kL).

A breakdown of each production bore abstraction is provided in Table 4 4 and shown graphically in Figure 4.5.

Table 4.4 - Monthly Groundwater Abstraction (kL)

Date	MDEX02	MDEX03	MDEX5	MDEX6	Total
July 2019	2,747	342	-	439	**3,527**
August 2019	3,173	110	-	1,511	**4,795**
September 2019	2,653	107	-	829	**3,588**
October 2019	2,150	167	-	3	**2,320**
November 2019	2,423	352	-	-	**2,775**
December 2019	2,952	-	-	-	**2,952**
January 2020	3,098	-	-	-	**3,098**
February 2020	3,132	-	-	-	**3,132**
March 2020	3,411	-	-	-	**3,411**
April 2020	3,301	-	-	-	**3,301**
May 2020	3,411	-	-	-	**3,411**
June 2020	2,923	2	-	-	**2,925**
Total	**35,372**	**1,080**	**-**	**2,782**	**39,235**

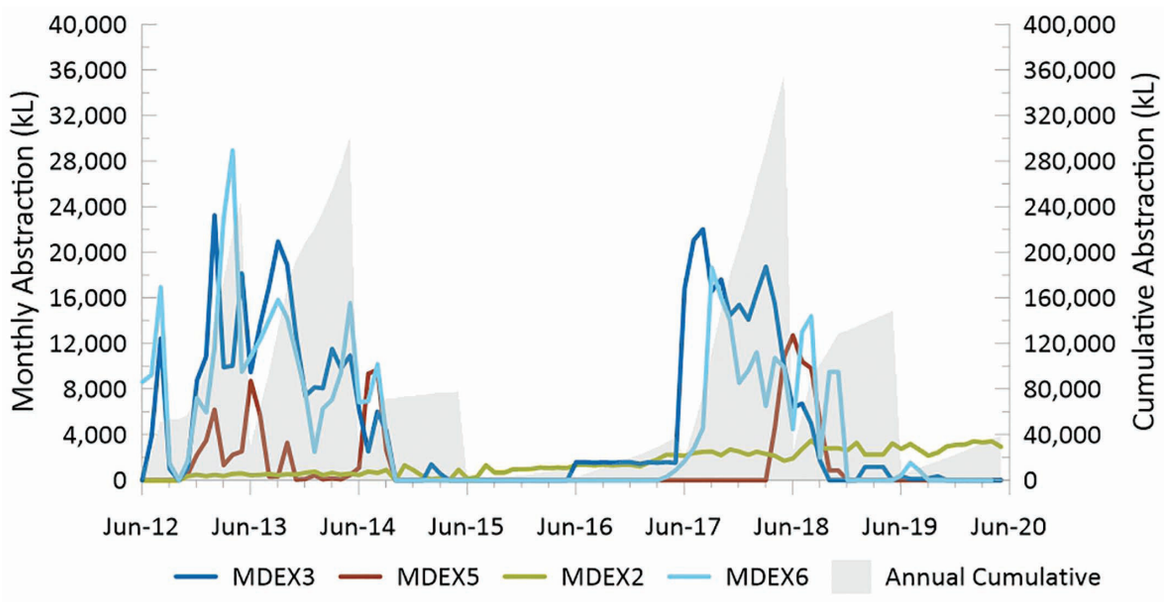

Figure 4.5: Mt Dove Monthly and Cumulative Groundwater Abstraction

4.10 Water Balance

As no discharge took place the water balance is equivalent to the groundwater abstraction.

A total of 39,235 kL of groundwater was abstracted across all production bores associated with the project during the reporting period. Camp usage accounted for the majority of abstracted water (Figure 4.6).

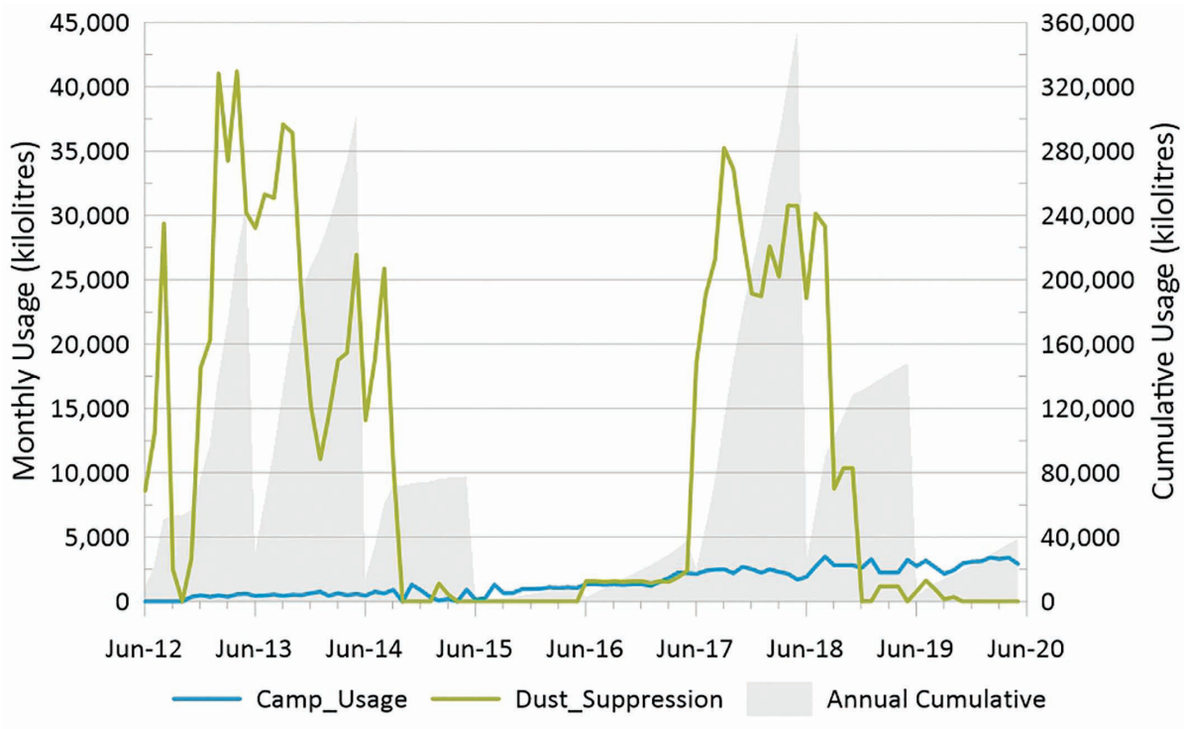

Figure 4.6 – Mt Dove Usage by Type

4.11 Monitoring Objectives

The objectives of the Mt Dove monitoring program, as described in the Mt Dove Site Water Operating Plan (SWOP) (Atlas, 2015c), were developed in accordance with the Atlas Water Policy (Atlas, 2016a) to meet regulatory requirements/license conditions.

4.11.1 Regulatory Conditions

There are no specific statutory conditions related to groundwater abstraction other than the standard conditions associated with a groundwater license. The groundwater license conditions are as follows:

- The licensee must install an approved meter to each water draw-point through which water is taken under this license.
- The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this license.
- The licensee shall comply with the commitments of the "Mt Dove DSO Project Site Water Operating Plan 2012 to 2017 (128-DEV-HY-PLN-001) and Addendum 2015 as prepared by Atlas Iron Limited and approved by the Department of Water on 19 June 2015, including any modifications to the commitments as approved during the term of the license.
- Every 12 months the licensee shall provide to the Department of Water a Groundwater Monitoring Summary for the preceding water year. The first report became due on 30/09/2016.
- The annual water year for water taken under this license is defined as 1 July to 30 June twelve months later.

4.11.2 Trigger Levels

Water level and water quality (conductivity) trigger levels, as set forth in the SWOP (Atlas, 2015c), were developed to protect the local and regional aquifers from excessive pumping related impacts including dewatering and influx of saline water. Resting water level triggers are based on maximum pumping water levels over a 180 day period (MWH, 2011a). Trigger levels and contingency actions are listed below in Table 4 5.

Table 4. 5: Mt Dove Trigger Levels

Trigger for Action	Justification	Contingency Actions
Pumping water levels		
Predicted maximum resting water level (mbgl): • MDEX2 – 18 m • MDEX3 – 14 m • MDEX5 – 20 m • MDEX6 – 11 m	Based on test pumping analysis.	Stage 1 (90% of predicted) • Increase monitoring frequency to fortnightly Stage 2 (100% of predicted) • Reduce pumping rate, or rest if possible Stage 3 (110% of predicted) • Shutdown bore
Water quality		
• Increasing annual trend identified, and • Average annual concentration 20% greater than the Expected Site Maximum (8,424 µS/cm).	Based on the laboratory analysis of samples taken at the end of each bore's test pumping program.	• Repeat measurement • Data reviewed • Identify source if possible • Act to remove source or reduce abstraction • Increase frequency of monitoring if required.

4.12 Monitoring Observations

4.12.1 Water Levels

Production bore hydrographs are presented in Figure 4.7 to Figure 4.10. The hydrographs, plotted against trigger levels and pump setting depths, illustrate the historical performance of each bore.

Resting water levels in all bores are above pre-mining water levels, seemingly receiving significant recharge from Cyclone Veronica in March of 2019. Similarly in the monitoring bores, water levels showed no major fluctuations during the reporting period (Figure 4.11).

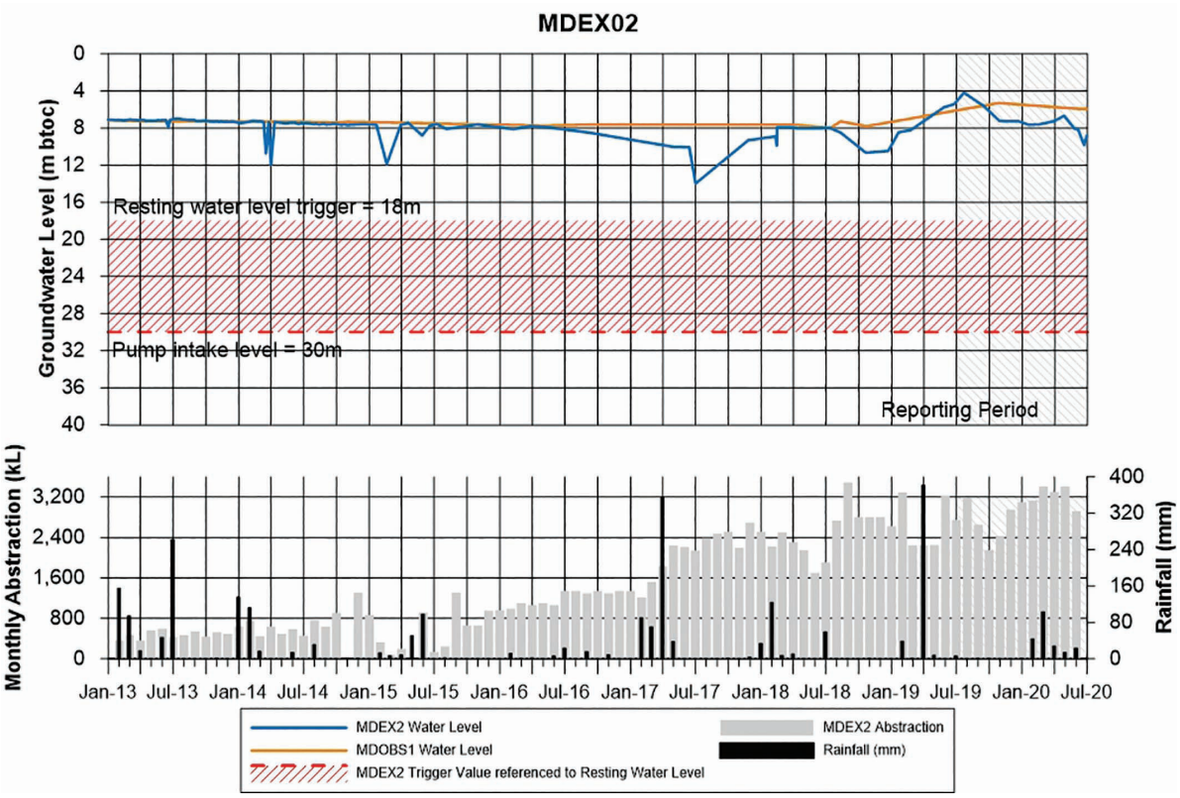

Figure 4.7: MDEX02 Water Level vs Abstraction and Rainfall

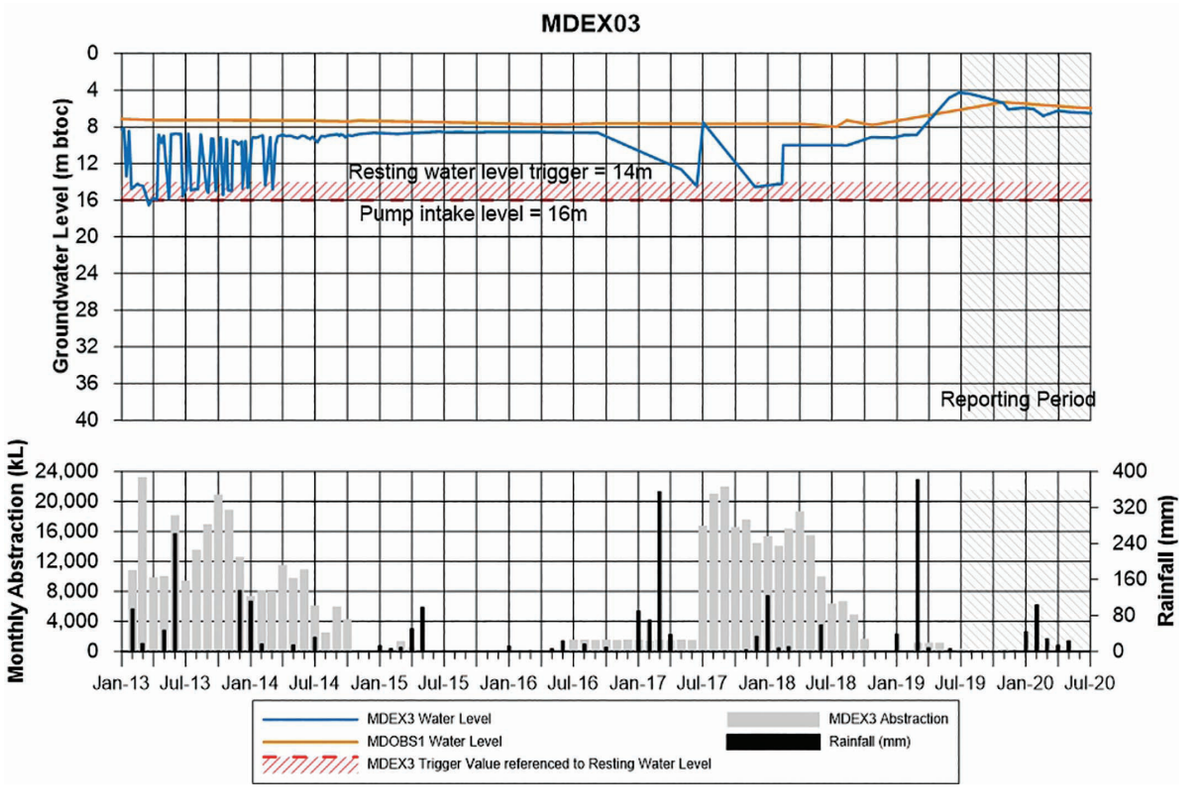

Figure 4.8: MDEX03 Water Level vs Abstraction and Rainfall

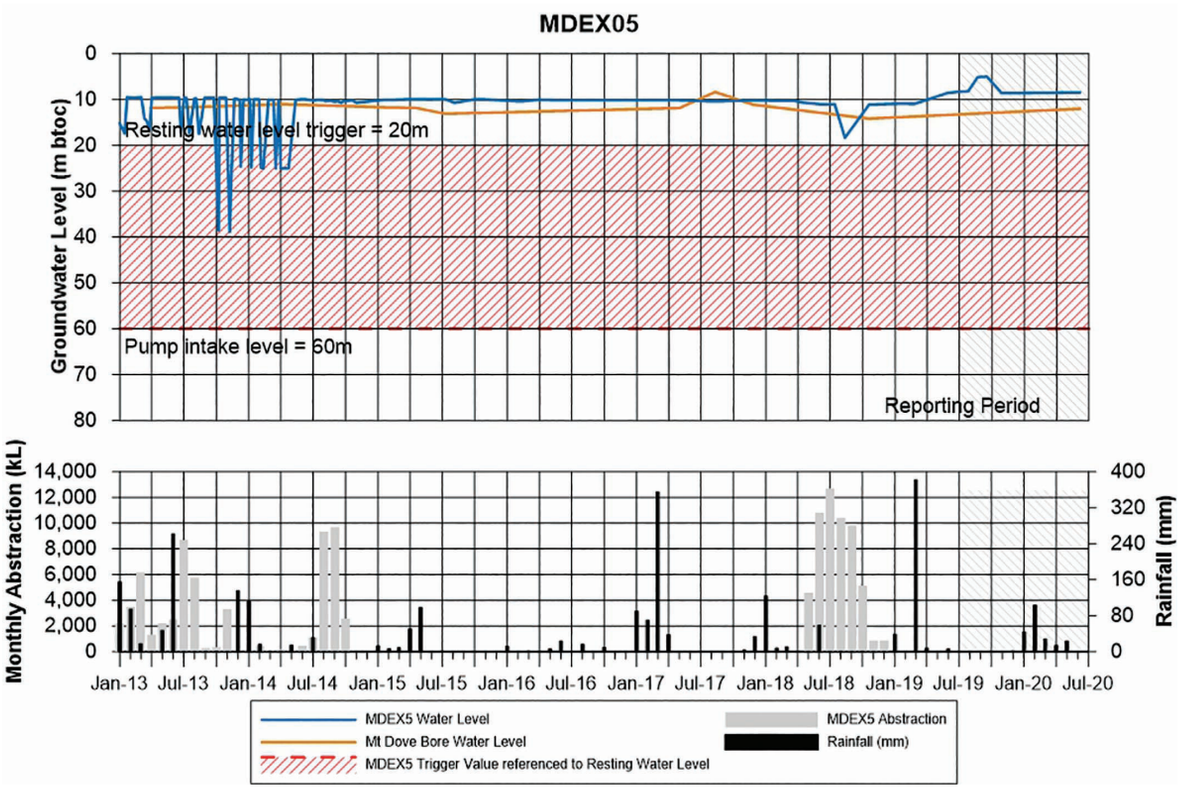

Figure 4.9: MDEX05 Water Level vs Abstraction and Rainfall

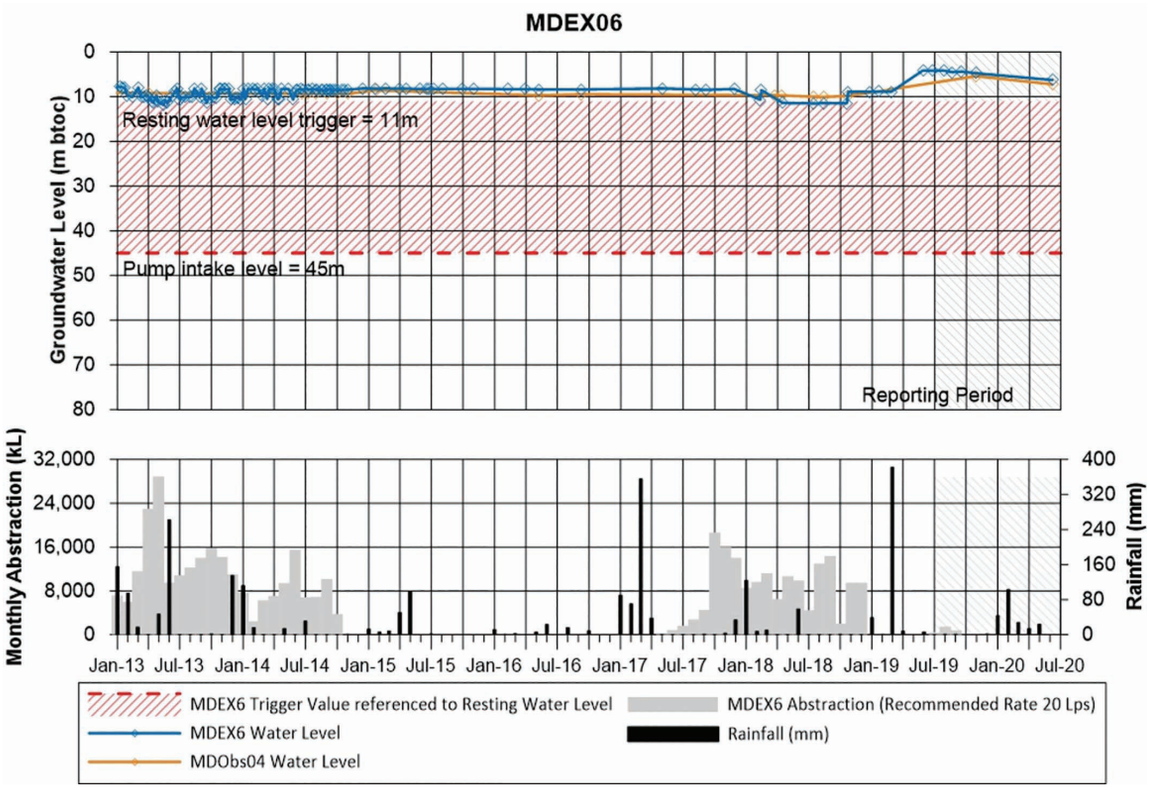

Figure 4.10: MDEX06 Water Level vs Abstraction and Rainfall

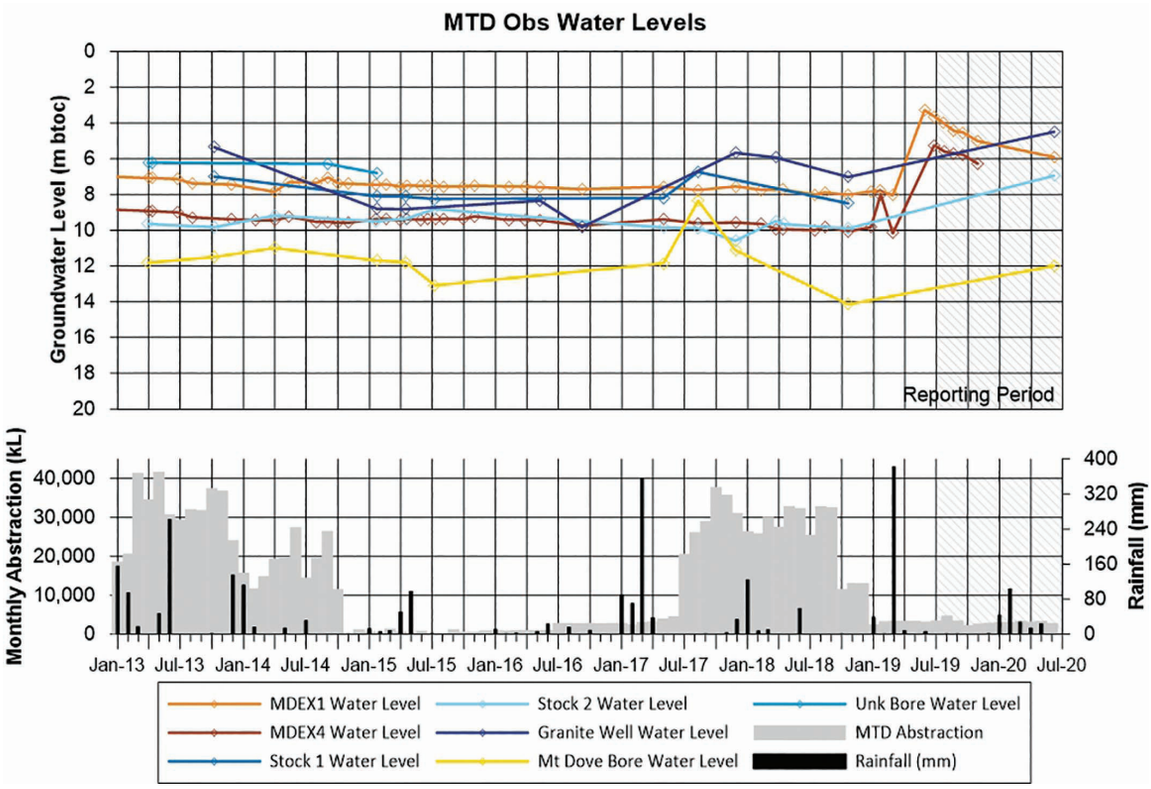

Figure 4.11: Observation Bore Water Levels vs Total Abstraction and Rainfall

4.12.2 Water Quality

Monitoring requirements at Mt Dove include field and laboratory analyses. Data from the field monitoring program is presented in Figure 4.12 and Figure 4.13. Analytical results are summarised in Table 4 6, Table 4 7, and Table 4 8. No water quality trigger values were exceeded over the reporting period.

Electrical conductivity (salinity) remained relatively consistent over the reporting period in line with historical readings. Historical salinity values range from 1,020 to 8,110 µS/cm, indicating fresh to slightly brackish groundwater quality. A seasonal fluctuation in pH and EC is observed in all bores, which is indicative of the influence of rainfall recharge. pH levels have also remained fairly stable over time, with moderate variation from time to time.

Metals concentrations (As, Pb, Ni and Se) have historically had minor, isolated exceedances of the ADWG guideline values, however all metals were reported to be within the ADWG guidelines for the currently reporting period.

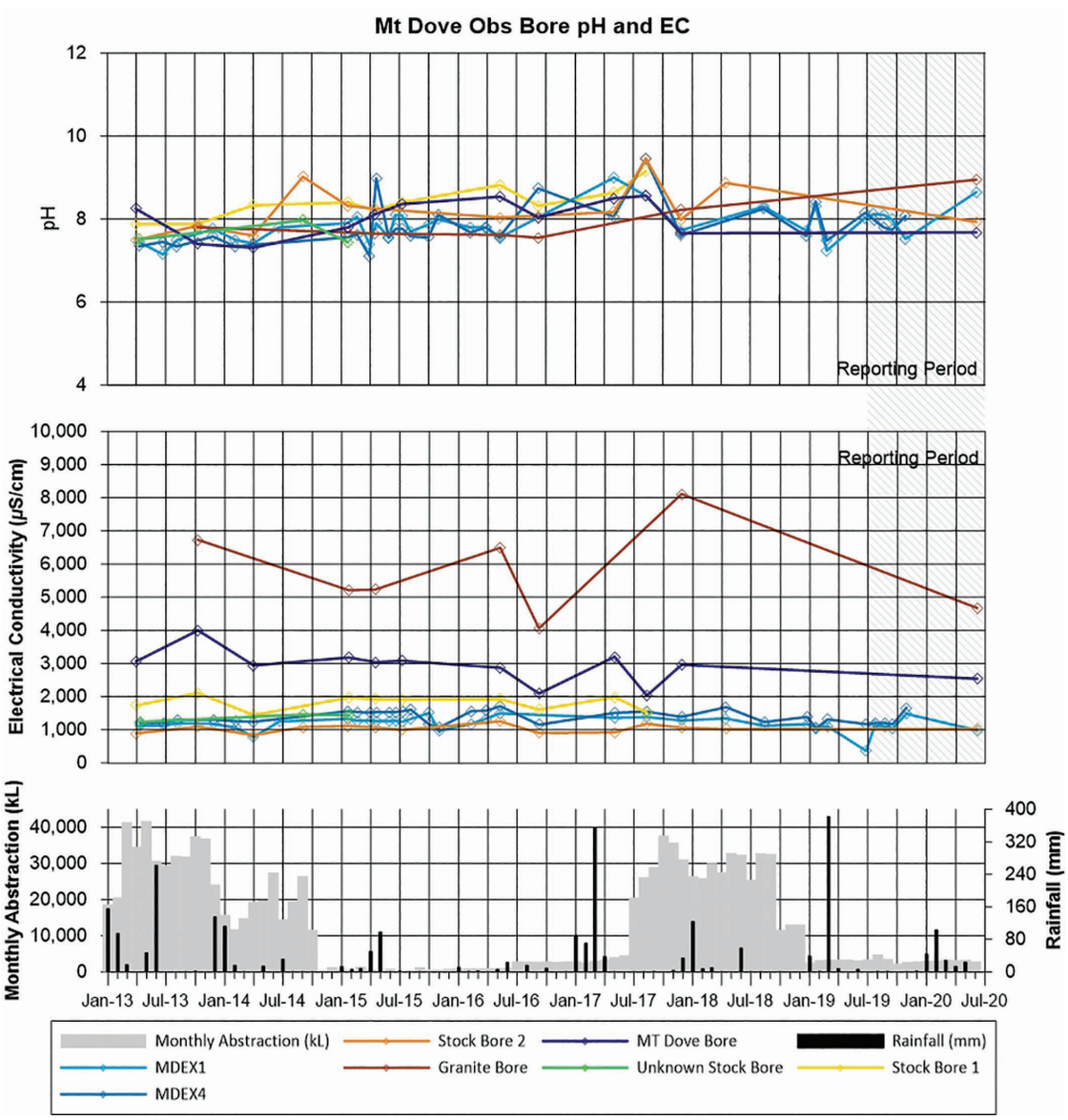

Figure 4.12: Mt Dove Observation Bores pH and EC

TDS and Na concentrations have been reported above the ADWG aesthetic guideline values at a number of bores, however these consistent with the historic water quality data and are largely considered to be low-level exceedances. The water quality results are therefore not of concern with respect to operational or environmental impacts.

Groundwater from the nominated potable bore (MDEX2) is treated to drinking water standards at the on-site treatment plant prior to consumption and tested monthly.

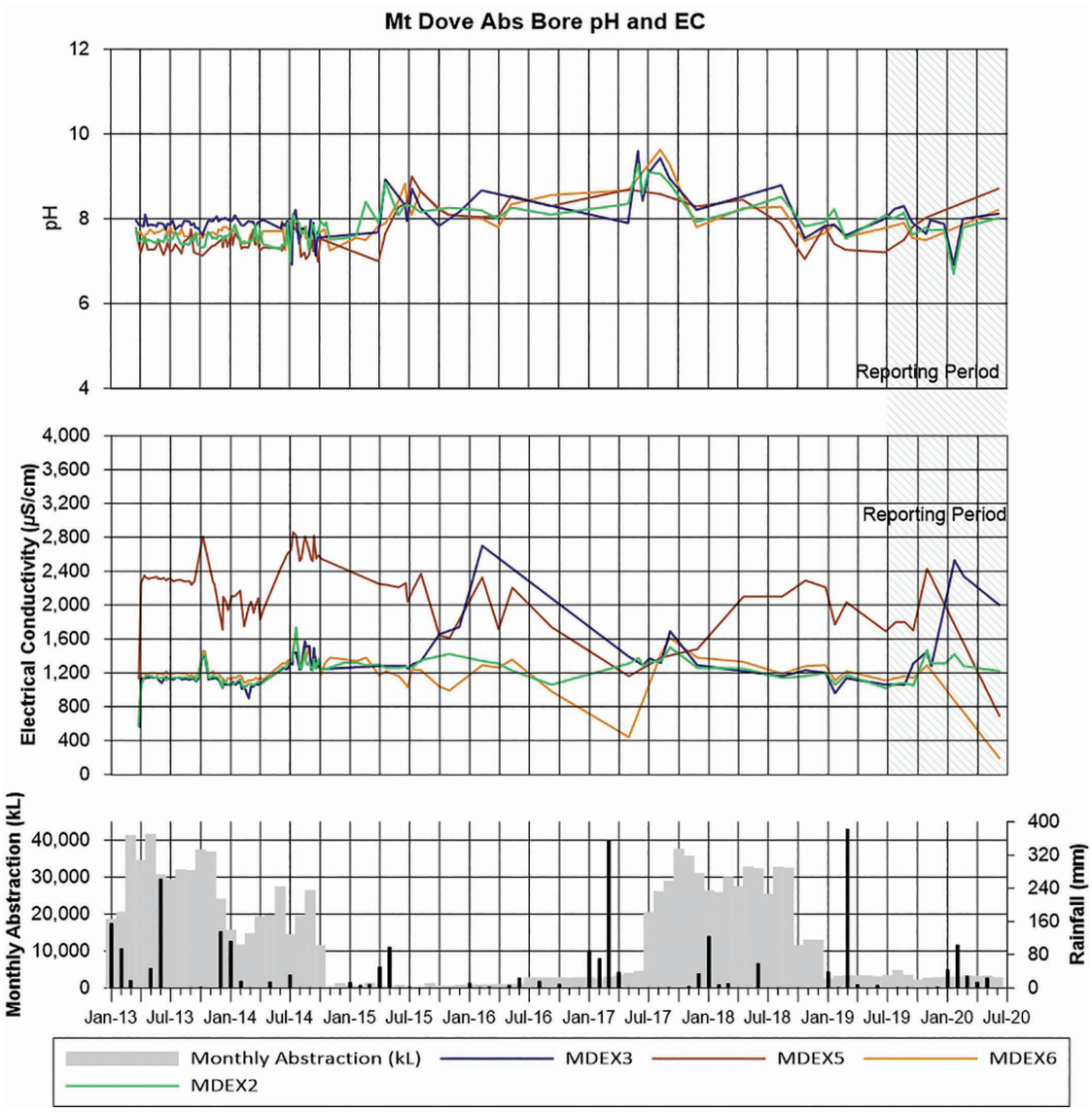

Figure 4.13: Mt Dove Abstraction Bores EC and pH

Table 4.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
MDEX1	11/04/2013				160	420	40	23	37	8.9	190		23
	23/06/2013				160	400	37	23	40	9.4	190		18
	1/04/2014				180	450	53	31	44	10	190		640
	21/01/2015	8.3	1,300	750		440		23	37	11	180	34	23
	20/04/2015	8.2	1,200	890	150	<5	37	22	38	9.4	190		
	9/05/2016	8	1,200	710		370	35	22	37	8.1	180		5
	1/05/2017	7.8	1,200	700	150	350	34	22	35	8.4	170	7.4	700
	20/04/2018	7.7		770	130	350	31	26	38	8.5	180	27	<5
	24/04/2018	7.7		830	130	350	30	25	38	8.4	180	28	<5
	29/10/2019	7.6	1.2	720	150	350	39	25	38	9.6	200	8.5	<5
MDEX2	14/02/2013				160	410	41	27	36	9.9	190		2.5
	23/06/2013				170	380	40	26	38	9.8	190		2.5
	19/08/2013				160	390	48	27	37	9.6	190		2.5
	26/11/2013				170	420	40	29	38	10	190		2.5
	13/02/2014				170	430	42	25	36	11	170		2.5
	26/05/2014				160	440	40	26	35	9.5	170		
	4/08/2014		1,200	740	170	400	39	25	34	9.5	160		2.5
	4/08/2014			740	170	400	39	25	34	9.5	160		
	21/01/2015	8.3	1,300	750		420		27	38	12	190	34	2.5
	25/06/2015	8.3	1,200	740	160		38	26		9.4	170	35	<5
	9/05/2016	8.2	1,200	690		350	37	27	37	8.7	170		2.5
	1/05/2017	8.1	1,200	690	150	350	35	26	34	8.4	170	7.8	<5
	22/03/2018	7.9	1,300	790	160	350	38	28	38	9.4	180	7.2	<5

Table 4.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	24/10/2018	8.1	1,300	820	160	350	35	26	38	8.9	180		<5
	29/10/2019	7.9	1	670	170	350	41	30	39	10	190	9.3	<5
MDEX3	29/07/2011	7.7	1,200	740		380						32	2.5
	14/02/2013				170	410	39	29	36	10	190		2.5
	23/06/2013				170	380	40	27	38	9.5	180		2.5
	19/08/2013				170	390	40	29	38	5.7	190		2.5
	26/11/2013				170	400	38	31	38	9.7	180		2.5
	13/02/2014				170	410	39	29	38	11	180		11
	26/05/2014				160	440	38	26	34	9.4	160		
	4/08/2014		1,200	730	170	400	37	27	34	9.8	160		2.5
	25/06/2015	8.3	1,200	740	170	<5	37	28	38	9.6	170	33	<5
	1/05/2017	8.2	1,200	680	150	340	34	27	35	8.4	170	7.1	<5
	22/03/2018	8.1	1,300	810	160	340	37	30	39	9.9	180	7.1	<5
	24/10/2018	7.9	1,300	790	170	330		30	38	9.2	180		47
	29/10/2019	7.8	1	650	170	270	38	31	38	10	190	8.6	<5
MDEX4	31/05/2012	8.5	1,300	790		370		32	42	11	170	36	
	11/04/2013				180	410	37	34	40	12	190		16
	23/06/2013				190	420	33	32	42	14	180		7
	1/04/2014				220	450	47	39	46	11	180		63
	21/01/2015	8.2	1,500	920		420		40	51	14	190	38	
	20/04/2015	8.1	1,500	890	240	<5	48	41	53	13	200		
	9/05/2016	7.9	1,400	820	230	350	44	40	50	11	180		2.5
	1/05/2017	7.7	1,500	790	210	340	42	39	47	11	170	8.3	<5
	23/03/2018	8.6	1,400	850	230	260	45	18	48	12	190	8.5	<5

Table 4.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	17/04/2018	7.7	1,400	850	210	350	42	38	49	10	180	7.4	<5
	29/10/2019	8	1	780	240	330	46	42	48	12	190	9.7	<5
MDEX5	14/02/2013				500	530	90	46	100	17	350		8
	23/06/2013				510	510	86	46	120	18	360		2.5
	19/08/2013				500	490	92	47	110	17	360		5
	26/11/2013				540	540	91	47	100	16	330		
	13/02/2014				520	410	88	44	110	19	330		2.5
	26/05/2014				460	580	90	38	91	15	290		
	4/08/2014		2,400	1,400	520	540	89	45	100	17	320		2.5
	4/08/2014			1,400	520	540	89	45	100	17	320		
	20/04/2015	8.1	2,200	1,300	390	<5	83	33	90	16	310		
	9/05/2016	8.4	2,200	1,200	420	450	74	25	89	14	300		2.5
	1/05/2017	8.3	1,100	310	100	300	26	13	20	14	70	2.3	5
	22/03/2018	7.9	1,100	550	160	230	38	18	32	19	110	2.4	14
	29/10/2019	8.2	2	1200	430	450	82	30	82	16	300	8.3	<5
MDEX6	27/07/2011	7.6	1,300	780		400		31	41	11	180	36	2.5
	17/11/2012				200	420	48	32	46	12	200		
	14/02/2013				190	410	43	35	42	11	190		2.5
	23/06/2013				190	400	43	32	45	11	180		2.5
	19/08/2013				190	380	45	34	45	11	180		2.5
	26/11/2013				190	420	42	36	44	11	180		2.5
	13/02/2014				190	440	43	34	45	13	170		2.5
	26/05/2014				180	440	43	33	42	11	160		
	4/08/2014		1,300	770	190	410	42	34	43	11	160		2.5

Table 4.6 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	4/08/2014			770	190	410	42	34	43	11	160		
	21/01/2015	8.2	1,200	740		400		28	35	14	170	45	11
	20/04/2015	8.2	1,200	720	160	<5	26	27	34	12	160		
	9/05/2016	8.5	1,100	660	150	310	25	28	35	11	160		2.5
	1/05/2017	7.7	790	470	50	220	8	14	11	11	58	3.6	<5
	22/03/2018	7.8	1300	810	180	340	40	35	45	10	170	7.1	<5
	29/10/2019	7.8	1.1	580	160	690	17	29	33	15	140	0.02	23
MDOBS4	21/01/2015	8.3	1,400	870		410		36	49	11	180	35	8
	9/05/2016	8.7	1,400	760	230	260	43	19	52	11	190		2.5
	23/03/2018	7.7	1,500	920	220	350	44	40	51	11	190	8.1	<5
Mt Dove Bore	30/03/2013				740	580	160	60	74	12	590		2.5
	1/04/2014				780	730	190	63	73	12	570		45
	21/01/2015	8.4	3,200	1,900		630		53	65	14	520	49	
	9/05/2016	8.3	2,800	1,600	570	490	130	51	61	10	460		2.5
	1/05/2017	7.8	3,100	1,800	610	500	150	52	63	9.9	470	9.9	<5
	29/10/2019	7.6	3	1,500	540	1000	130	55	62	12	480	9.4	13
Stock Bore 1	30/03/2013				300	590	43	30	68	16	280		2.5
	1/04/2014				280	550	44	26	58	15	240		44
	21/01/2015	8.5	2,000	1,200		570		30	68	22	290	26	
	9/05/2016	8.5	1,900	1,100	300	480	40	32	70	17	260		34
	1/05/2017	8.3	1,900	1,100	290	490	39	30	66	15	250	7	27
Stock Bore 2	30/03/2013				140	300	20	29	31	9	110		32
	1/04/2014				130	340	20	31	32	11	110		10
	9/05/2016	8.3	1,000	590	140	290	22	37	39	11	120		2.5
	10/05/2017	7.5	850	510	130	190	19	26	24	7	93	3.7	16
	29/10/2019	8.1	1	630	170	330	26	34	39	12	130	7.7	20
Unknown Stock Bore	11/04/2013				190	430	46	24	41	8.6	220		67
	20/06/2014		1,400	830	190	460	52	26	40	9.2	210		
	9/05/2016	8.1	1,300	780	190	380	44	26	43	7.8	200		2.5
	1/05/2017	7.8	1,400	790	180	380	44	23	38	7.5	190	5	<5
	22/03/2018	7.7	1,400	890	190	380	47	25	44	8.2	210	5.4	66

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).

Table 4.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
MDEX1	11/04/2013		0.6												0.01
	23/06/2013		0.5												0.01
	1/04/2014	0.05	0.5	<0.005	0.0125	0.65		<0.1	0.0125	<0.025		0.0125			0.11
	21/01/2015	0.007	0.54	<0.0001	0.002	<0.001	<0.005	<0.001	0.0005	<0.001		0.0005			0.01
	20/04/2015	0.006	0.56	<0.0001	0.002	<0.001	0.028	<0.001	0.002	<0.005		<0.001			<0.005
	9/05/2016	0.006	0.47	<0.0001	0.002	<0.001	<0.01	<0.001	0.0025	<0.001	0.002		0.45	0.0005	0.002
	1/05/2017	0.006	0.59	<0.0001	0.002	0.002	<0.01	<0.001	<0.005	<0.001	0.002		0.47	<0.001	0.005
	20/04/2018	0.006	0.54	<0.0001	0.002	0.014	<0.01	0.001	<0.005	0.005	0.002		0.5	<0.001	0.037
	24/04/2018	0.006	0.55	<0.0001	0.002	0.003	<0.01	<0.001	<0.005	<0.001	0.002		0.49	<0.001	0.006
	29/10/2019	0.007	0.59	<0.0001	0.002	<0.001	<0.01	<0.001	<0.01	<0.001	0.004	<0.001	0.45	<0.001	<0.005
MDEX2	14/02/2013														0.1
	23/06/2013		0.6												1.3
	19/08/2013		0.6												0.14
	26/11/2013	0.01	0.6	<0.001	0.0025	<0.005		<0.02	0.006	<0.005		0.0025			0.69
	13/02/2014		0.6												0.33
	26/05/2014	0.01	0.6	<0.001	0.0025	<0.005		<0.02	0.0025	<0.005		0.0025			<0.01
	4/08/2014	0.01	0.5	<0.001	0.0025	<0.005	<0.02	<0.02	0.005	<0.005		0.0025		0.025	0.01
	21/01/2015	0.006	0.54	<0.0001	0.002	0.002	<0.005	<0.001	0.0005	<0.001		0.0005			0.21
	25/06/2015	0.006	0.53	<0.0001	0.003	0.001	0.014	0.002	<0.001	0.002	0.002	<0.001			0.033
	9/05/2016	0.006	0.48	<0.0001	0.002	0.006	<0.01	0.001	0.0025	<0.001	0.002		0.44	0.0005	0.066
	1/05/2017	0.006	0.6	<0.0001	0.002	0.001	<0.01	<0.001	<0.005	<0.001	0.002		0.44	<0.001	0.009
	23/03/2018	0.006	0.51	<0.0001	0.003	<0.001	<0.01	<0.001	<0.005	<0.001	0.002		0.48	<0.001	0.011
	24/10/2018	0.006	0.52	<0.0001	0.002	<0.001	<0.01	<0.001	<0.005	<0.001	0.002		0.49	<0.001	0.013
	29/10/2019	0.007	0.6	<0.0001	0.002	<0.001	<0.01	<0.001	<0.01	<0.001	0.004	<0.001	0.44	<0.001	<0.005

Table 4.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	14/02/2013														0.01
	23/06/2013		0.6												0.03
	19/08/2013		0.6												0.03
	26/11/2013	0.01	0.6	<0.001	0.0025	<0.005		<0.02	0.005	<0.005		0.0025			0.02
	13/02/2014		0.6												0.02
	26/05/2014	0.01	0.6	<0.001	0.0025	<0.005		<0.02	0.0025	<0.005		0.0025			<0.01
	4/08/2014	0.01	0.6	<0.001	0.0025	<0.005	<0.02	<0.02	0.0025	<0.005		0.0025		0.025	<0.01
	25/06/2015	0.005	0.55	<0.0001	0.003	0.001	0.065	0.001	0.001	0.002	0.003	<0.001			0.14
	1/05/2017	0.005	0.6	<0.0001	0.003	0.001	<0.01	<0.001	<0.005	<0.001	0.002		0.44	<0.001	0.003
	23/03/2018	0.005	0.52	<0.0001	0.003	0.001	<0.01	<0.001	<0.005	<0.001	0.002		0.5	<0.001	0.008
	24/10/2018	0.0005	0.53	<0.0001	0.003	<0.001	<0.01	<0.001	<0.005	0.002	0.002		0.49	<0.001	0.008
	29/10/2019	0.005	0.6	<0.0001	<0.001	<0.001	0.09	<0.001	<0.01	0.001	0.004	<0.001	0.43	<0.001	0.014
MDEX4	31/05/2012						<0.02								
	11/04/2013														0.01
	23/06/2013		0.6												0.02
	1/04/2014	0.01	0.6	<0.001	0.0025	0.091		<0.02	0.007	<0.005		0.0025			0.02
	21/01/2015	0.005	0.55	<0.0001	0.003	<0.001	<0.005	<0.001	0.0005	<0.001		0.0005			0.024
	20/04/2015	0.004	0.58	<0.0001	0.003	<0.001	0.036	<0.001	0.002	<0.001		<0.001			<0.005
	9/05/2016	0.004	0.49	<0.0001	0.003	<0.001	<0.01	<0.001	0.0025	0.001	0.003		0.59	0.0005	0.001
	1/05/2017	0.004	0.62	<0.0001	0.003	0.002	<0.01	<0.001	<0.005	<0.001	0.003		0.6	<0.001	0.015
	22/03/2018	0.004	0.55	<0.0001	0.003	0.002	<0.01	<0.001	<0.005	<0.001	0.003		0.35	<0.001	0.009
	17/04/2018	0.004	0.58	<0.0001	0.003	<0.001	<0.01	<0.001	<0.005	<0.001	0.003		0.58	<0.001	0.003
	29/10/2019	0.005	0.64	<0.0001	0.003	<0.001	<0.01	<0.001	<0.01	<0.001	0.004	<0.001	0.56	<0.001	<0.005
MDEX5	14/02/2013														1
	23/06/2013														0.01

Table 4.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	19/08/2013														0.03
	26/11/2013	0.01	1	<0.001	0.008	<0.005		<0.02	0.016	0.039		0.0025			0.02
	13/02/2014														0.03
	26/05/2014	0.01	0.9	<0.001	0.0025	<0.005		<0.02	0.009			0.0025			<0.01
	4/08/2014	0.01	1	<0.001	0.0025	<0.005	<0.02	<0.02	0.01	<0.005		0.0025		0.025	<0.01
	20/04/2015	0.007	0.89	<0.0001	0.004	<0.001	0.018	<0.001	<0.001	<0.001		<0.001			<0.005
	9/05/2016	0.005	0.79	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.004		0.62	0.0005	0.008
	1/05/2017	0.002	0.26	<0.0001	<0.001	0.004	<0.01	<0.001	0.03	0.001	0.001		0.18	0.014	0.036
	23/03/2018	0.003	0.3	<0.0001	<0.001	0.002	<0.01	<0.001	0.074	0.002	<0.001		0.26	0.007	0.049
	29/10/2019	0.008	0.95	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.01	0.002	0.009	<0.001	0.67	<0.001	0.03
MDEX6	27/07/2011	0.01	0.5	<0.001	0.0025	0.038	<0.02	<0.005	0.0025	<0.005	0.01	0.0025		0.025	<0.01
	14/02/2013														0.02
	23/06/2013		0.6												0.82
	19/08/2013		0.6												0.04
	26/11/2013	0.01	0.6	<0.001	0.0025	<0.005		<0.02	0.006	<0.005		0.0025			0.01
	13/02/2014		0.6												1.4
	26/05/2014	0.01	0.6	<0.001	0.0025	<0.005		<0.02	0.005	<0.005		0.0025			<0.01
	4/08/2014	0.01	0.6	<0.001	0.0025	<0.005	<0.02	<0.02	0.0025	<0.005		0.0025		0.025	<0.01
	21/01/2015	0.004	0.56	0.0002	0.001	<0.001	0.008	<0.001	0.0005	<0.001		0.0005			0.028
	20/04/2015	0.005	0.58	<0.0001	0.002	<0.001	0.041	<0.001	0.003	<0.001		<0.001			0.011
	9/05/2016	0.005	0.52	<0.0001	0.002	<0.001	<0.01	<0.001	0.0025	<0.001	0.002		0.47	0.0005	0.002
	1/05/2017	0.001	0.2	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001		0.19	<0.001	0.002
	23/03/2018	0.007	0.53	<0.0001	0.003	<0.001	<0.01	<0.001	<0.005	<0.001	0.003		0.55	<0.001	0.004
	29/10/2019	<0.001	0.46	<0.0001	<0.001	<0.001	0.01	<0.001	0.02	<0.001	<0.001	<0.001	0.4	<0.001	0.007
MDOBS4	21/01/2015	0.004	0.57	<0.0001	0.003	0.006	<0.005	<0.001	0.0005	<0.001		0.0005			<0.005

Table 4.7 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Ag (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	9/05/2016	0.004	0.53	<0.0001	0.002	<0.001	<0.01	<0.001	0.0025	<0.001	0.003		0.42	0.0005	<0.001
	22/03/2018	0.004	0.54	<0.0001	0.003	<0.001	<0.01	<0.001	<0.005	<0.001	0.003		0.64	<0.001	0.005
Mt Dove Bore	30/03/2013														0.02
	1/04/2014	0.01	0.9	<0.001	0.0025	0.027		<0.02	0.05	0.007		0.0025			0.02
	21/01/2015	0.005	0.71	<0.0001	0.002	0.036	0.009	<0.001	0.0005	<0.001		0.0005			0.042
	9/05/2016	0.006	0.56	<0.0001	0.002	0.028	<0.01	<0.001	0.0025	<0.001	0.003		0.8	0.0005	0.029
	1/05/2017	0.005	0.74	<0.0001	0.002	0.002	<0.01	<0.001	<0.005	<0.001	0.004		0.89	<0.001	0.008
	29/10/2019	0.007	0.66	<0.0001	0.002	0.001	<0.01	<0.001	<0.01	<0.001	0.005	<0.001	0.77	<0.001	<0.005
Stock Bore 1	30/03/2013														0.03
	1/04/2014	0.01	0.9	<0.001	0.0025	<0.005		<0.02	0.014	0.006		0.0025			0.02
	21/01/2015	0.005	0.93	<0.0001	0.001	0.003	0.14	<0.001	0.009	0.001		0.0005			0.007
	9/05/2016	0.006	0.81	<0.0001	0.001	<0.001	<0.01	<0.001	0.0025	<0.001	0.004		0.87	0.0005	0.001
	1/05/2017	0.005	1	<0.0001	0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.004		0.91	<0.001	0.002
Stock Bore 2	1/04/2014	0.01	0.5	<0.001	0.0025	0.065		<0.02	0.0025	0.01		0.0025			0.02
	20/06/2014	0.01	0.6	<0.001	0.0025	<0.005	<0.02	<0.02	0.023	<0.005	0.025	0.0025		0.025	<0.01
	9/05/2016	0.004	0.42	<0.0001	0.002	0.012	<0.01	<0.001	0.0025	0.004	0.002		0.49	0.0005	0.006
	1/05/2017	0.001	0.28	<0.0001	<0.001	0.16	<0.01	0.018	<0.005	0.007	<0.001		0.35	<0.001	0.059
	29/10/2019	0.004	0.52	<0.0001	0.001	0.003	<0.01	<0.001	<0.01	0.002	0.003	<0.001	0.48	<0.001	<0.005
	20/06/2014	0.01	0.6	<0.001	0.0025	<0.005	<0.02	<0.02	0.023	<0.005	0.025	0.0025		0.025	<0.01
	9/05/2016	0.007	0.48	<0.0001	0.002	<0.001	<0.01	0.01	0.0025	<0.001	0.002		0.44	0.0005	<0.001
	1/05/2017	0.006	0.59	<0.0001	0.002	<0.001	<0.01	0.002	<0.005	<0.001	0.002		0.45	<0.001	0.002
	23/03/2018	0.006	0.52	<0.0001	0.003	<0.001	<0.01	<0.001	0.015	<0.001	0.002		0.47	<0.001	0.004

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).
Values highlighted orange exceed the Australian Drinking Water Guidelines for health impacts (NHMRC, 2012).

Table 4.8 - Hydrocarbons

Bore ID	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	o-xylene (mg/L)	Toluene (mg/L)	Total recoverable hydrocarbons (TRH)						
						C6-C9 (mg/L)	C10-C14 (mg/L)	C10-C36 (mg/L)	C15-C28 (mg/L)	C29-C36 (mg/L)	C29-C40 (mg/L)	C6-C36 (mg/L)
MDEX1	1/04/2014	0.00025				0.02	0.51		160	300		460
	21/01/2015	0.00025	<0.0005	<0.0005	<0.0005	0.02	0.025		0.1	0.1		0.25
	20/04/2015					<0.04	<0.05		<0.2	<0.2		<0.5
	9/05/2016	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1		
	20/04/2018	<0.001	<0.001	<0.001	0.038	0.052	<0.05		0.12	0.13		
	24/04/2018	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1		
	29/10/2019	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04		
MDEX2	4/08/2014	0.00025				0.02	0.025	0.225	0.1	0.1	0.2	
	21/01/2015	0.00025	<0.0005	<0.0005	<0.0005	0.02	0.025		0.1	0.1		0.25
	9/05/2016	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1		
	1/05/2017	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1		
MDEX3	4/08/2014	0.00025				0.02	0.025	0.225	0.1	0.1	0.2	
	1/05/2017	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1		
MDEX4	1/04/2014	0.00025				0.02	0.025		8.2	15		23
	21/01/2015	0.00025	<0.0005	<0.0005	<0.0005	0.02	0.025		0.1	0.1		0.25
	20/04/2015					<0.04	<0.05		<0.2	<0.2		<0.5
	9/05/2016	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1		
	17/04/2018	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		0.16	<0.1		
	29/10/2019	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04		
MDEX5	4/08/2014	0.00025				0.02	0.025	0.225	0.1	0.1	0.2	
	20/04/2015					<0.04	<0.05		0.3	<0.2		<0.5
MDEX6	4/08/2014	0.00025				0.02	0.025	0.225	0.1	0.1	0.2	
	21/01/2015	0.00025	<0.0005	<0.0005	<0.0005	0.02	0.025		0.1	0.2		0.25

Table 4.8 - Hydrocarbons

Bore ID	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	o-xylene (mg/L)	Toluene (mg/L)	Total recoverable hydrocarbons (TRH)						
						C6-C9 (mg/L)	C10-C14 (mg/L)	C10-C36 (mg/L)	C15-C28 (mg/L)	C29-C36 (mg/L)	C29-C40 (mg/L)	C6-C36 (mg/L)
	20/04/2015					<0.04	<0.05		<0.2	<0.2		<0.5
MDOBS1	23/03/2018	<0.001	<0.001	<0.001	<0.001	<0.01						
MDOBS4	21/01/2015	0.00025	<0.0005	<0.0005	<0.0005	0.02	0.14		4.9	9		14
Mt Dove Bore	1/04/2014	0.00025				0.02	0.025		3.8	6.8		11
	21/01/2015	0.00025	<0.0005	<0.0005	<0.0005	<0.04	0.025		0.1	0.2		<0.5
Granite Well	20/06/2014	0.00025				<0.04	0.14		0.1	0.1		<0.5
Stock Bore 1	1/04/2014	0.00025				<0.04	<0.05		0.1	0.1		<0.5
	21/01/2015	0.00025	<0.0005	<0.0005	<0.0005	<0.04	<0.05		0.1	0.1		<0.5
Stock Bore 2	1/04/2014	0.00025				<0.04	<0.05		0.1	0.1		<0.5
Unknown Stock Bore	20/06/2014	0.00025				<0.04	<0.05		0.1	0.1		<0.5

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).
Values highlighted orange exceed the Australian Drinking Water Guidelines for health impacts (NHMRC, 2012).

4.13 Compliance

No trigger values were exceeded during the reporting period. Table 4.9 summarises the compliance commitments at Mt Dove.

Monitoring over the reporting period was in accordance with the SWOP (Atlas, 2015c) except in August where a broken dipper prevented water levels being measured in production bores MDEX2 and MDEX3.

Table 4.9 - Summary of Commitments and Compliance

Activity	Action	Compliance	Comments
Administration	Submit an annual aquifer review to DWER on 30 September each year. Submit a final aquifer review within 3 months after completion of mining and crushing. The specific delivery date for the final aquifer review will be agreed with the DWER once the site closure date is determined. This report will contain: • Compliance with the monitoring schedule and assess results; • Aquifer performance against that predicted; and • Aquifer recovery predictions.	Compliant	Report submitted 30th September 2020.
	Review SWOP in conjunction with annual/final reporting.	Compliant	SWOP September 2020.
Monitoring	Implementation of monitoring schedule as per SWOP.	Compliant	Monitoring complete
Water use efficiency	Monthly infrastructure checks/maintenance.	Mostly compliant	Checks completed during SWOP review.
	Site water balance review as required.	Compliant	Review completed during SWOP review.
Contingency plans	Review triggers annually or as required.	Compliant	Review completed during SWOP review.

4.14 Recommendations

It is recommended that:

- Monitoring is continued as per the current SWOP (Atlas, 2015c)

5. MT WEBBER

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5.1 Introduction

This Annual Aquifer Review relates to instrument GWL177240(7) which allows Atlas Iron Pty Ltd (Atlas) to take water under section 5C of the RiWI Act 1914.

The duration of the licence is from 19 November 2019 to 30 October 2027. The reporting period is 1 July 2019 to 30 June 2020. The Mt Webber DSO Project AAR report is scheduled for submission to the Department of Water and Environmental Regulation (DWER) annually in September.

5.2 Background and Location

The Mt Webber DSO Project (the project) is located 170 km south east of Port Hedland in the Pilbara region of Western Australia (Figure 5.1). The project is located within mining leases M45/1209, M45/1197 and miscellaneous leases L45/280, L45/371, L45/372, L45/394 and L45/395.

Stage 1 mining at Mt Webber began in July 2014 at a rate of 3 Mtpa. In late 2014 mining increased to 6 Mtpa following completion of Stage 2 developments. Production increased to approximately 9 Mtpa beginning in August 2017. Mining was reduced back to 7.8 Mtpa between November 2017 to February 2018 before increasing again to approximately 9 Mtpa thereafter. As at August 2020 the Mt Webber mine life is estimated to be 2.5 years depending on future mine plans and ultimate production rates.

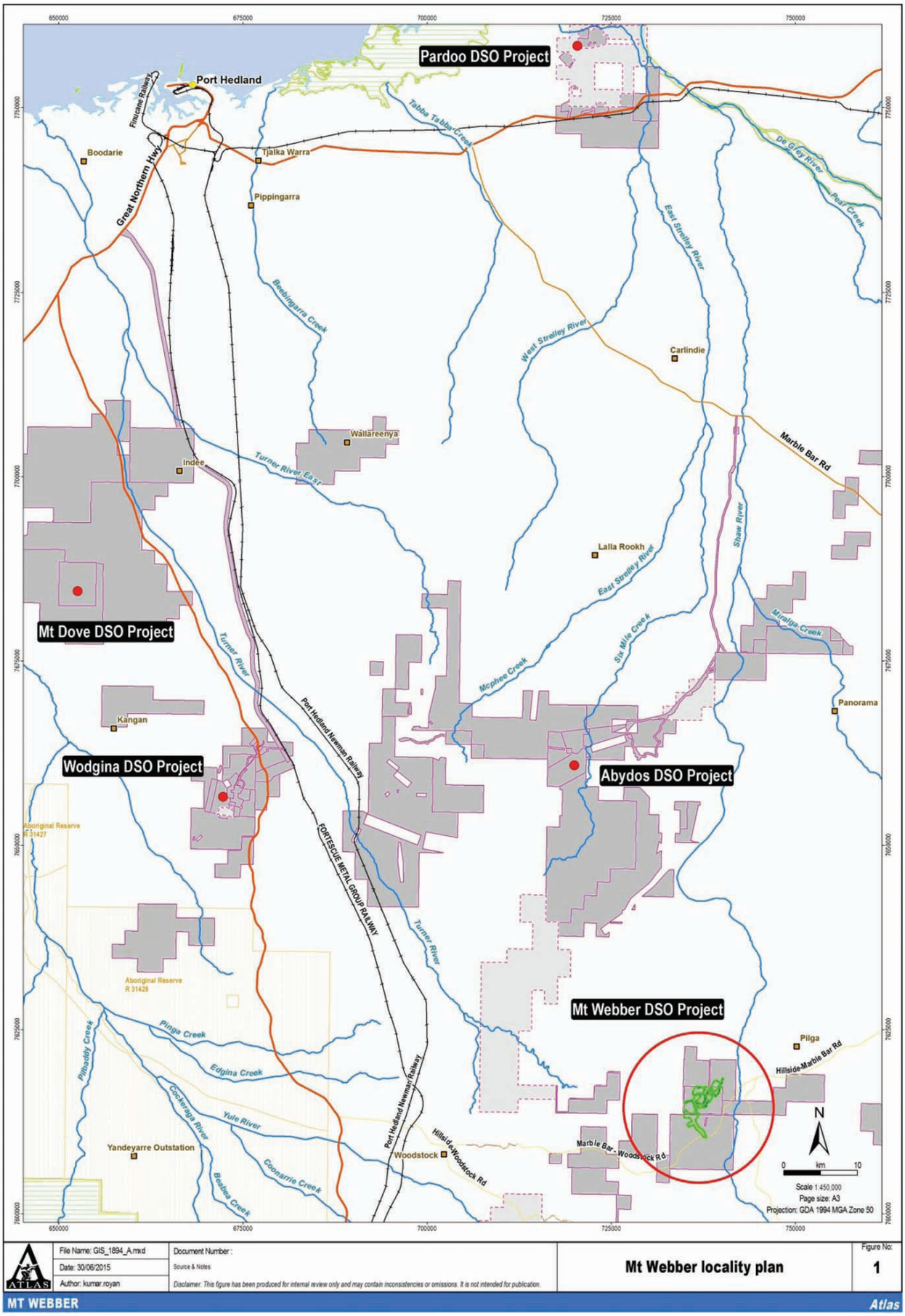

Figure 5.1 - Mt Webber DSO Project Location

5.3 Groundwater Management Areas

The project lies within the Pilbara Groundwater Management Area and the Pilbara Groundwater Province. It is not located within a public drinking water source area.

5.4 Water Usage

Water taken during the reporting period is authorised to be used for:

- Dust suppression, earthworks and construction purposes;
- Exploratory drilling operations;
- General campsite purposes;
- Mineral ore processing and other mining purposes; and
- Potable water supply purposes.

A total of 789,588 kL of groundwater was used during the reporting period. This amounts to 66% of the annual licensed allocation of 1,198,368 kL.

5.5 Licensing

Groundwater abstraction for the project is authorised by GWL177240(7) (Figure 5.2). This GWL authorises an abstraction of up to 1,198,368 kL/year from the Pilbara Fractured Rock aquifer. Under this licence the authorised activities listed above can be undertaken within leases M45/1209, M45/1197, L45/280, L45/371, L45/372, and L45/394. Table 5.1 lists the details of the historical GWL approvals.

Table 5.1 - License History

License	Allocation (kL)	Start Date	Expiry Date	Comments
GWL168543(2)	15,000	4/04/2012	3/04/2017	Exploration supply
GWL168543(3)	63,000	21/12/2012	20/12/2022	Construction and exploration
GWL168543(4)	95,000	26/03/2013	21/03/2023	Increase allocation for construction
GWL177960(1)	800,000	15/08/2013	14/08/2023	Haul road construction (Relinquished 16/06/2015)
GWL177240(1)	1,198,368	2/08/2013	1/08/2025	Mining operations supply
GWL177240(2)	1,198,368	16/06/2015	15/06/2025	Add bores from GWL177960(1) and update SWOP
GWL177240(3)	1,198,368	01/06/2016	30/06/2026	Added L45/371, L45/372 and L45/394
GWL177240(4)	1,198,368	07/04/2017	06/04/2027	Added M45/1197
GWL177240(5)	1,198,368	30/10/2017	30/10/2027	Added bores PB58E, PB99D, GWB3, GWB7, GWB12, WEB0089 and WEB0091
GWL177240(6)	1,198,368	19/06/2019	30/10/2027	Added bores WEB0108 and WEB0119
GWL177240(7)	1,198,368	19/11/2019	30/10/2027	Added bores WEB0121, WEB0122 and WEB0123

File No: RF3939~4

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Instrument No. GWL177240(7)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Atlas Iron Limited		
Description of Water Resource	Pilbara Pilbara - Fractured Rock	**Annual Water Entitlement**	1,198,368kL
Location of Water Source	L45/280 L45/371 L45/372 L45/394 M45/1197 M45/1209		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes	L45/280 L45/371 L45/372 L45/394 M45/1197 M45/1209
	Earthwork and construction purposes	L45/280 L45/371 L45/372 L45/394 M45/1197 M45/1209
	Exploratory drilling operations	L45/280 L45/371 L45/372 L45/394 M45/1197 M45/1209
	Mineral ore processing and other mining purposes	M45/1197 M45/1209
	Mining camp purposes	L45/280

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

Figure 5.2 - License to Take Water GWL177240(7) page 1 of 2

File No: RF3939~4

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Instrument No. GWL177240(7)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

		M45/1209
Duration of Licence	From 19 November 2019 to 30 October 2027	

This Licence is subject to the following terms, conditions and restrictions:

1. The annual water year for water taken under this licence is defined as 1 July to 30 June.
2. The licensee shall comply with the commitments of the operating strategy "Atlas Iron Limited Mount Webber DSO Project, Revision 5b, PRJ0007-132-461-TS-PLN-0001", as prepared by the licensee and approved by the Department of Water and Environmental Regulation on 19/06/2019 including any modifications to the commitments as approved during the term of the licence.
3. Every 12 Months the licensee shall provide to the Department of Water and Environmental Regulation a Groundwater Monitoring Summary for the preceding water year. The first report is due 30/09/2020.
4. Every 3 Years the licensee shall provide to the Department of Water and Environmental Regulation a Groundwater Monitoring Review. The first report is due 30/09/2021. A Groundwater Monitoring Summary need not be submitted in a year in which a Groundwater Monitoring Review is due.

End of terms, conditions and restrictions

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

Figure 5.3 - License to Take Water GWL177240(7) page 2 of 2

5.6 Climate

The semi-arid climate of the Pilbara Region has two distinct seasons (wet and dry). The wet season occurs from November to May with periodic light rains punctuated by thunderstorms or by cyclones which bring intense and heavy rainfall. Pilbara cyclones generally occur in about 7 out of 10 years. The dry season occurs from June to November is typically hot, dry and characterised by high evaporation rates (MWH, 2013 and BOM, 2018).

The two Bureau of Meteorology (BOM) climate stations with long term climatic records near the project area are Marble Bar BOM Station 4020/4106 and Hillside BOM Station 4015. These climate stations are located approximately 65 km northeast and 22 km southeast of the Mt Webber Minesite, respectively (MWH, 2013).

Rainfall and temperature data from the currently operational Marble Bar Station (4106) is presented below in Table 5.2.

Table 5.2: Marble Bar Climatic Summary

Month	Mean Daily Maximum Temperature (°C) (2000-2020)	Mean Daily Minimum Temperature (°C) (2000-2020)	Mean Monthly Rainfall (mm)
January	40.7	26.5	114.7
February	39.8	26.1	73.7
March	38.3	25.2	81.3
April	36.3	22.1	19.6
May	31.1	17.0	11.8
June	27.1	13.2	22.3
July	27.6	12.2	14.2
August	30.2	13.0	0.4
September	34.7	16.7	3.7
October	39.0	21.8	3.3
November	40.8	24.1	9.9
December	42.0	26.2	29.6

Source: Marble Bar Station 4106 (BoM, 2020)

5.7 Hydrogeology

The mine operation straddles a surface water divide, with water flowing away in all directions from the ore-bodies that form the high ground. Resting water levels from bores drilled in the northeast of the study area show a groundwater gradient decreasing towards the Shaw River. Groundwater occurrences in the project area are associated with fractured and weathered bedrock (RPS Aquaterra, 2013c).

The project area is structurally complex and the ore-bodies overlie large anticlinal structures with faulting parallel to the strike of the anticline and jointing normal to strike. Within such an environment there is a good chance of brittle deformation being preserved in highly siliceous lithologies such as cherts and banded iron formation (BIF). In addition, weathering in the transition zone (between completely and partially oxidised formations) also has potential to enhance permeability (RPS Aquaterra, 2013c).

Some alluvial, colluvial and eluvial deposits and calcrete are noted on the Tambourah and White Springs 1:100,000 geological maps. These are not anticipated to comprise significant aquifers in their own right, but where saturated, they could provide a source of storage and recharge to underlying hard rock aquifers, particularly where associated with current drainage in the east. This suggests that the groundwater flow direction broadly mimics the topographic gradient (RPS Aquaterra, 2013c).

Aquifer systems at Mt Webber DSO Project are associated with two primary aquifer types (RPS Aquaterra, 2013c):

- Fractured Rock Aquifers; predominantly in the valley floor and associated with fractured zones within the quartzites and along contact zones of the local geology between Archean ultramafic greenstone rock, structurally weaker schistose formations, quartzites and metasediment contact zones. Structurally induced secondary porosity through faulting and folding provides higher permeability conduits and preferentially channels groundwater flow through the surrounding rock mass. Recharge occurs by infiltration of rainfall along outcrops, which is enhanced where contact or fracture geological zones cross ephemeral water courses. These aquifers are generally heterogeneous and anisotropic.
- Alluvial aquifers; occur mainly in the valleys from drainage channels and the Shaw River depositional areas. These alluvial aquifers are recharged by the leakage of surface water flow within the drainage channels.

It is likely that the area is one of active recharge, with percolation of surface water into the various sub-catchment basin areas during rainfall and cyclonic events. Groundwater quality is fresh, indicating proximity to recharge. Groundwater recharge is episodic and affected by direct infiltration of rainfall on fractured rock areas (RPS Aquaterra, 2013c).

5.8 Mt Webber Borefield

The Mt Webber Minesite Borefields (Figure 5.4 and Figure 5.5) are grouped into five areas as follows:

- West Ibanez Area;
- East Fender Area;
- Camp Area;
- Contractor Area;
- South Haul Road Area.

The Mt Webber Minesite Borefields were initially established between 2012 and 2013 with the installation of 12 production bores and 15 monitoring bores. Additional installations over time include:

- Two production bores (WEB0089 and WEB0091) and four monitoring bores (WEB0078, WEB0079, WEB0085 and WEB0086) installed in July 2016 and equipped in September 2016;
- Three East Fender production bores (GWB3, GWB7 and GWB12) were added to the supply scheme in June 2017;
- Two North Fender production bores (WEB0108 and WEB0119) and three monitoring bores (WEB0111, WEB0118 and WEB0103) were drilled and constructed between November 2018 and February 2019;
- One new North Fender production bore (WEB0121) and two monitoring bores (WEB0122 and WEB0123) were drilled and constructed between August and October 2019.

The Mt Webber scheme now comprises 19 operational production bores, 4 unequipped production bores (treated as monitoring bores) and 23 monitoring bores.

Details of all existing production and monitoring bores are provided in Table 5.3.

5.8.1 Supply Scheme

Figure 5.6 illustrates the layout of the Mt Webber DSO Project water supply scheme.

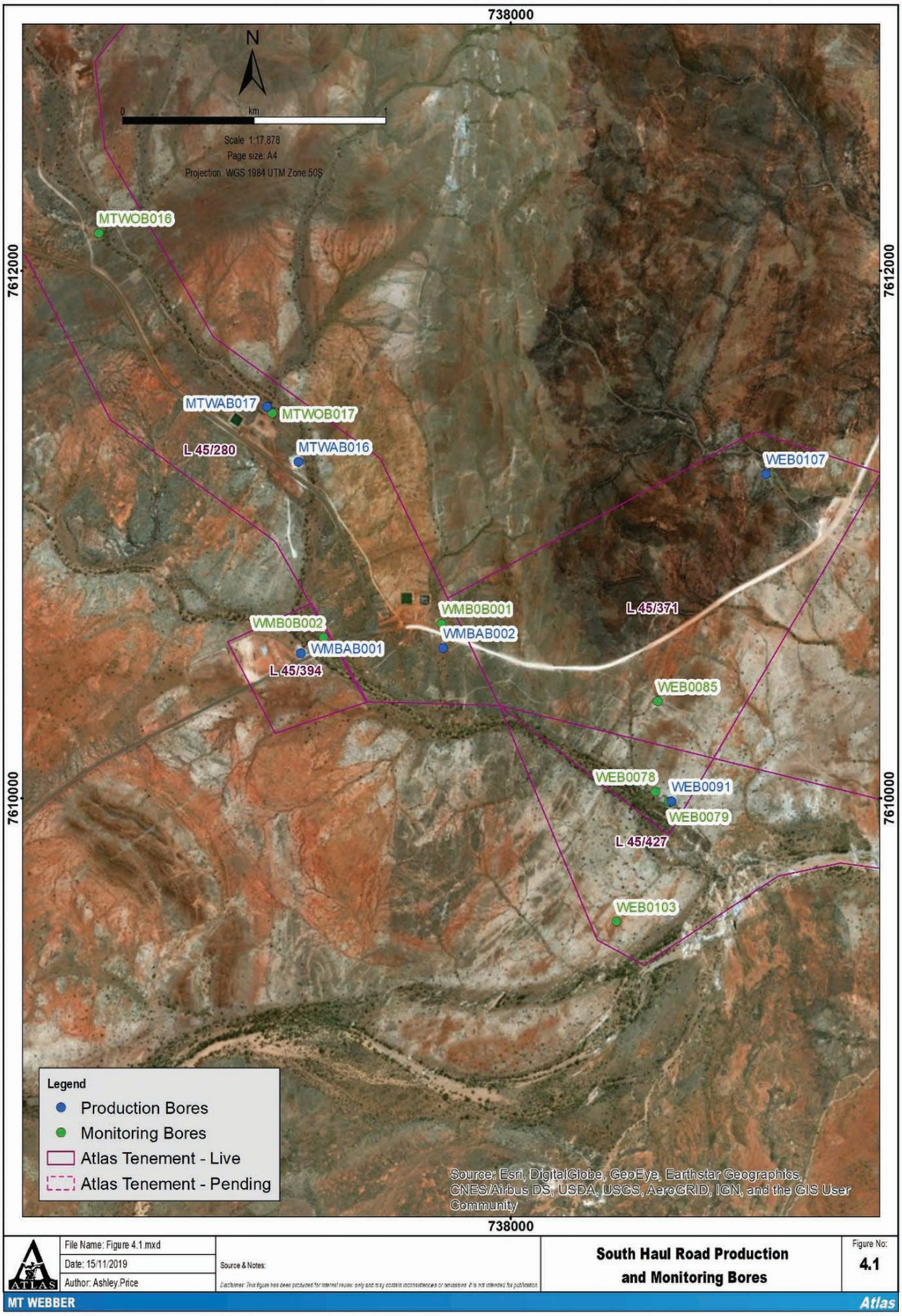

Figure 5.4 - South Haul Road Borefield

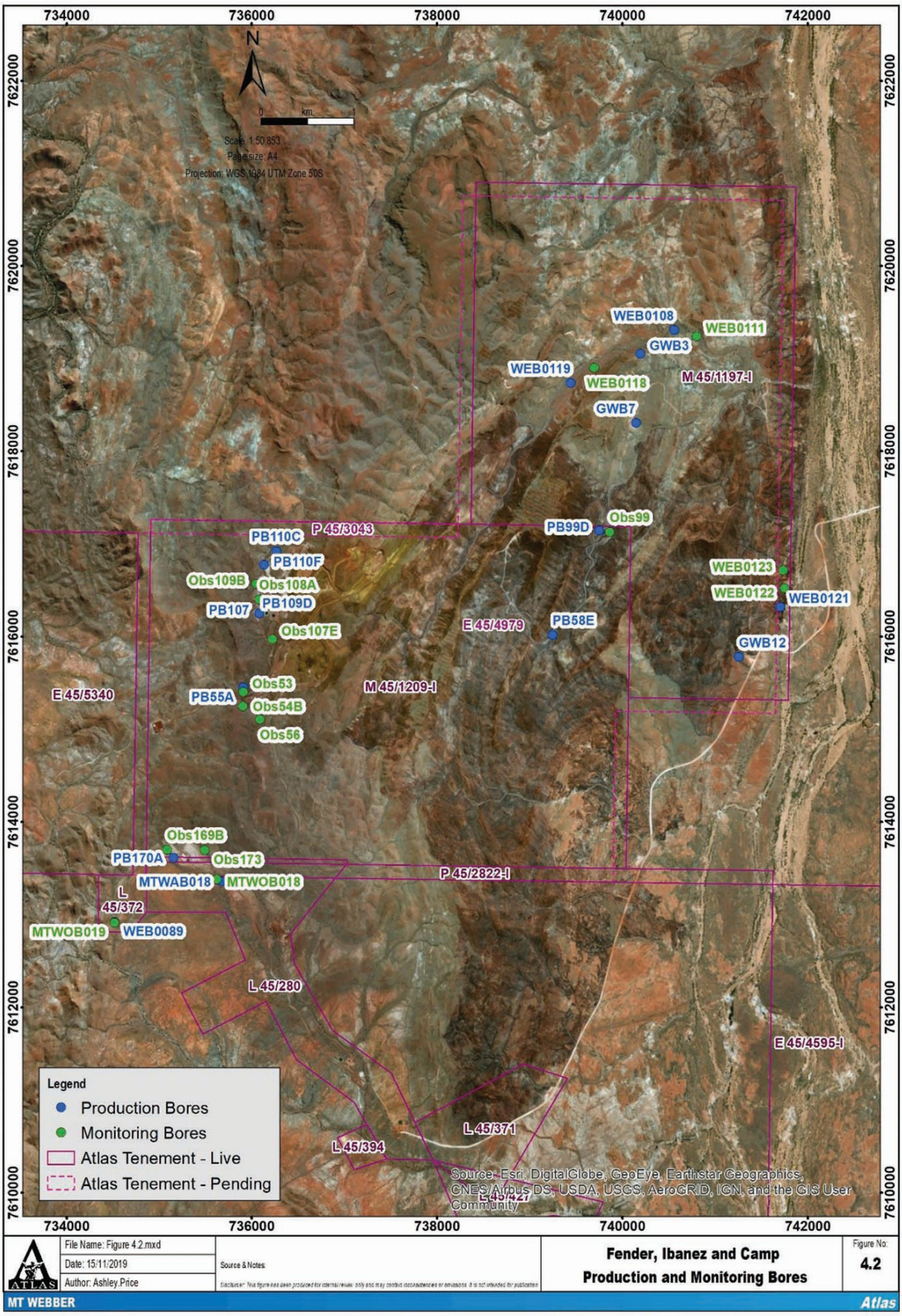

Figure 5.5 - Fender, Ibanez and Camp Borefields

Table 5.3 - Production and Observation Bore Details

Bore Name	Borefield	Coordinates (GDA94, Zone 50)		Total Depth (mbgl)	Nominal Casing Diameter (mm)	Screen Interval (mbgl)	Static Water Level (mbtoc)	Advised Rate (L/sec)	Advised Pump Inlet Depth (mbgl)
		Easting	Northing						
Non-Potable Production Bores									
PB107	Contractor	736080	7616250	120	205	30 - 120	24.03	5	50
PB55A	Contractor	735906	7615451	91	205	18 - 90	12.69	N/A	N/A
PB110C	W. Ibanez	736263	7616923	120	205	17 - 100	12.78	6	54
PB110F	W. Ibanez	736130	7616774	92	205	15 - 75	13.56	5	30
GWB3	E. Fender	740195	7619050	72	155	24 - 72	9.33	7	50
GWB7	E. Fender	740141	7618306	26	155	8 - 26	11.07	2	22
GWB12	E. Fender	741257	7615781	72	155	3.5 - 39.5	13.8	4	30
PB58E	E. Fender	739249	7616020	79	205	18 - 66	14.72	3	40
PB99D	E. Fender	739751	7617142	91	205	16 - 80	21.01	2	45
WEB0108	E. Fender	740557	7619310	84	205	5 - 84	8.39	5	60
WEB0119	E. Fender	739440	7618736	84	205	12 - 84	10.73	2	60
WEB0121	E. Fender	741703	7616333	84	203	6.0-84.0	5.29	15	80
WEB0091	S. Haul R.	738608	7609988	76	205	9 - 75.5	4.5	10	60
WMBAB001	S. Haul R.	737202	7610550	87.1	205	15.1 - 87.1	9.26	10	70
WMBAB002	S. Haul R.	737742	7610570	80.5	205	14.5 - 80.5	8.15	18	70
MTWAB017	S. Haul R.	737073	7611485	76.1	205	16.1 - 76.1	6.95	18	70
WEB0107	N/A	738965	7611233	77	203	11-71	8	N/A	N/A
MTWAB018	Camp	735666	7613359	99.2		21.2-99.2	15.98	N/A	N/A
WMBAB003	Woodstock Marble Bar Road East	722633	7608820	97.2		9.2-97.2	7.5	N/A	N/A
Potable Production Bores									
PB170A	Camp	735153	7613615	120	205	32 - 110	21.9	1.5	80
WEB0089	Camp	734516	7612920	64	205	11 - 63	14.2	2	50
PB109D	Contractor	736109	7616534	91	205	18 - 90	18.4	8	58
MTWAB016	S. Haul R.	737193	7611276	92.8	205	8.8 - 92.8	7.3	15	70
Monitoring Bores									
MTWOB018	Camp	735625	7613380	95.9	50	23.9 - 95.9	15.66	N/A	N/A
MTWOB019	Camp	734518	7612913	94.9	50	22.9 - 94.9	14.5	N/A	N/A
Obs169B	Camp	735085	7613700	100	50	24 - 80	21.87	N/A	N/A
Obs173	Camp	735491	7613697	120	50	24 - 78	21.04	N/A	N/A
Obs53	Contractor	735907	7615402	115	50	24 - 78	13.69	N/A	N/A
Obs54B	Contractor	735903	7615250	151	50	24 - 80	16.34	N/A	N/A
Obs56	Contractor	736086	7615107	151	50	18 - 90	14.4	N/A	N/A
Obs99	E. Fender	739859	7617129	104	50	18 - 66	16.92	N/A	N/A
WEB0118	E. Fender	739694	7618900	48	50	6 - 48	8.68	N/A	N/A
WEB0111	E. Fender	740799	7619241	96	50	6.0-35.0	6.97	N/A	N/A
WEB0122	E. Fender	741736	7616524	30	50	6.0-30.0		N/A	N/A
WEB0123	E. Fender	741732	7616715	30	50	6.0-30.0		N/A	N/A
WEB0078	S. Haul R.	738548	7610025	30	50	5 - 30	6.7	N/A	N/A
WEB0079	S. Haul R.	738599	7609987	65	50	5 - 65	4.72	N/A	N/A
WEB0085	S. Haul R.	738557	7610368	98	50	10 - 34	10.1	N/A	N/A
WEB0086	S. Haul R.	737455	7610472	100	50	11 - 83	19	N/A	N/A
MTWOB016	S. Haul R.	736435	7612143	77.1	50	11.1 - 77.1	7.5	N/A	N/A
MTWOB017	S. Haul R.	737093	7611461	73.5	50	15.5 - 73.5	6.81	N/A	N/A
WMBOB001	S. Haul R.	737736	7610662	95.4	50	5.4 - 95.4	8.46	N/A	N/A
WMBOB002	S. Haul R.	737288	7610610	95.8	50	17.8 - 95.8	8.45	N/A	N/A
WEB0103	S. Haul R.	738400	7609533	48	50	6 - 48	18.93	N/A	N/A
Obs107E	W. Ibanez	736223	7615970	97	50	18 - 84	19.85	N/A	N/A
Obs108A	W. Ibanez	736080	7616403	120	50	28 - 100	20.85	N/A	N/A
Obs109B	W. Ibanez	736047	7616569	86	50	24 - 84	19.83	N/A	N/A

Production bores PB55A, WEB0107, MTWAB018 and WMBAB003 were not equipped at any time during the review period.

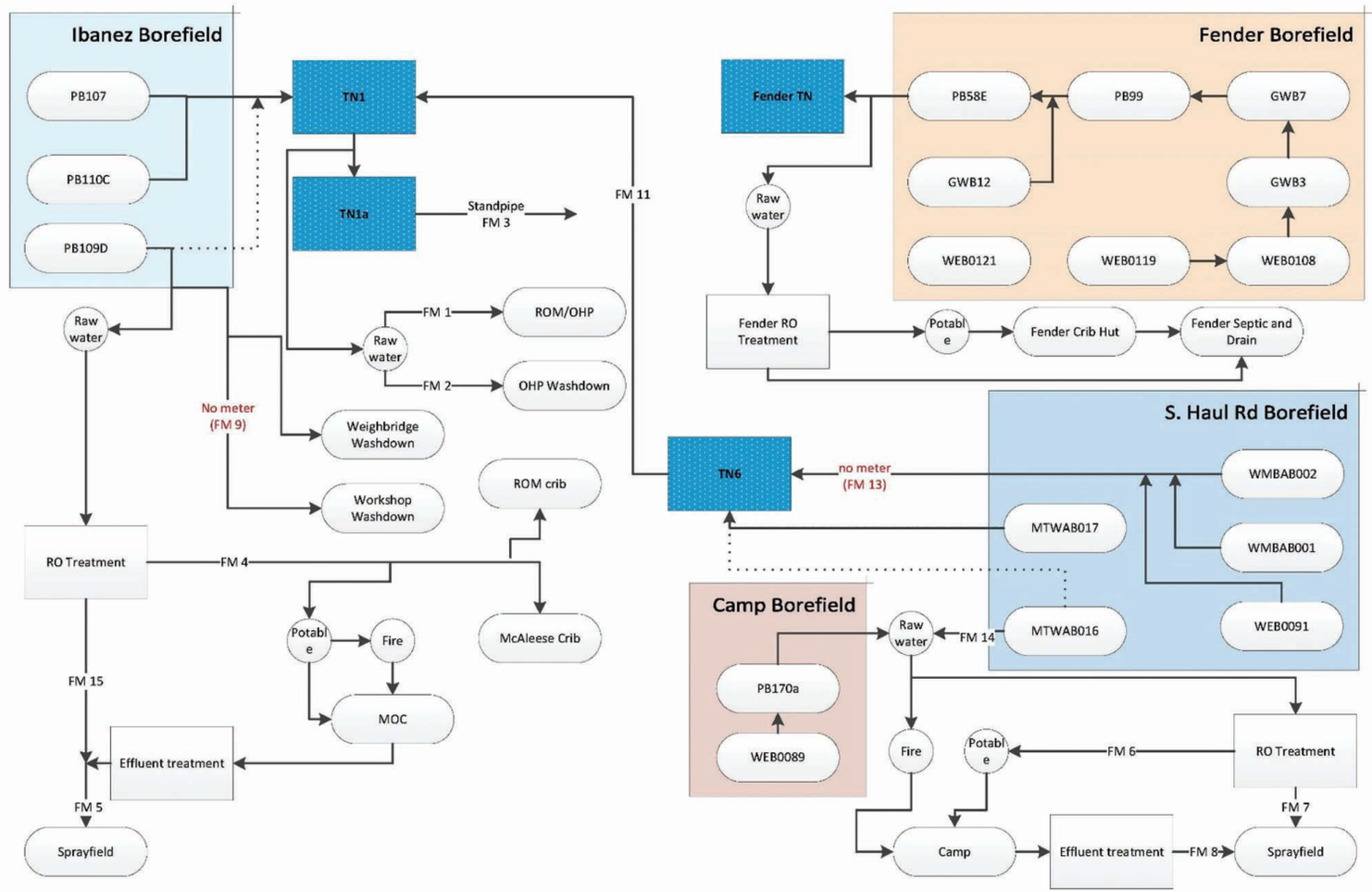

Figure 5.6 - Mt Webber DSO Project Water Supply Scheme

5.9 Abstraction

A total of 789,588kL of groundwater was abstracted across all production bores associated with the Project during the reporting period, representing approximately 66% of the annual water entitlement (1,198,368 kL).

The monthly breakdown of abstraction from each bore for the reporting period is provided in Table 5.4. Borefield totals are shown graphically in Figure 5.7 (including the previous years for comparison).

Table 5.4 - Monthly Groundwater Abstraction

Date	PB107	PB110C	PB109D	PB110F	PB170A	MTWAB016	MTWAB017	WMBAB001	WMBAB002	WEB0089
Jul 2019	0	0	1,233	0	0	3,365	589	8,111	5,814	0
Aug 2019	0	0	1,785	0	0	3,279	6,690	6,603	7,789	0
Sep 2019	0	0	1,329	0	0	2,685	8,410	8,116	12,034	0
Oct 2019	1,000	1,000	1,157	1,000	1,000	10,064	6,360	7,383	8,867	1,000
Nov 2019	1,000	1,000	2,199	1,000	0	8,900	9,398	7,309	4,632	1,000
Dec 2019	1,839	2,796	1,733	2,301	1,193	9,001	14,151	2,678	2,440	2,346
Jan 2020	1,759	1,553	2,072	1,398	1,123	4,170	3,488	0	4,841	1,263
Feb 2020	1,529	1,446	2,020	1,214	1,050	1,760	963	0	0	1,207
Mar 2020	1,899	1,739	1,315	1,466	1,612	3,309	524	0	0	1,659
Apr 2020	1,713	1,626	2,384	1,331	689	2,348	1,022	2,447	1,274	1,446
May 2020	1,690	1,681	2,207	1,258	1,487	2,164	178	5,642	2,738	1,519
Jun 2020	1,565	1,602	1,576	1,193	798	2,174	293	6,386	4,032	1,541
Total	**13,993**	**14,443**	**21,008**	**12,161**	**8,953**	**53,218**	**52,066**	**54,675**	**54,460**	**12,981**

Date	WEB0091	GWB3	GWB7	GWB12	PB58E	PB99D	WEB0108	WEB0119	WEB0121	Total
Jul 2019	0	10,512	330	539	0	0	0	8,872	0	**39,364**
Aug 2019	0	7,364	0	6,588	0	0	19,975	8,746	0	**68,819**
Sep 2019	0	7,737	0	7,034	0	0	9,960	9,159	0	**66,465**
Oct 2019	0	6,341	0	8,003	0	0	11,674	11,082	0	**75,929**
Nov 2019	0	9,443	0	4,971	884	0	9,468	11,131	0	**72,336**
Dec 2019	16,657	11,255	0	5,616	0	0	7,984	12,018	0	**94,007**
Jan 2020	12,017	3,918	0	1,278	0	0	5,494	6,525	2,918	**53,818**
Feb 2020	14,562	2,725	0	2,405	0	0	9,678	8,625	1,290	**50,474**
Mar 2020	27,519	6,677	0	6,892	0	0	10,539	9,134	2,571	**76,854**
Apr 2020	22,033	6,189	0	3,840	0	0	10,526	8,198	2,750	**69,815**
May 2020	23,334	3,977	0	2,466	0	0	7,359	5,436	1,402	**64,537**
Jun 2020	23,284	2,186	0	2,274	0	0	3,833	4,224	210	**57,171**
Total	**139,406**	**78,324**	**330**	**51,906**	**884**	**0**	**106,489**	**103,150**	**11,141**	**789,588**

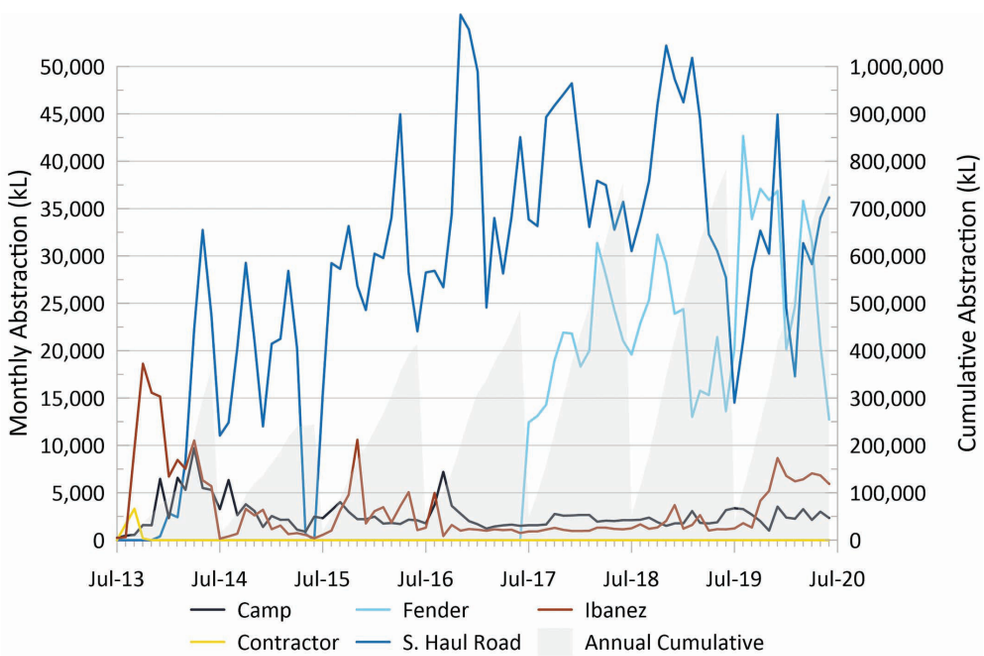

Figure 5.7 - Mt Webber Monthly and Cumulative Abstraction by Borefield

5.10 Water Balance

As no discharge took place the water balance is equivalent to groundwater abstraction.

Of the total 789,588 kL abstracted for the year, operations (processing/dust suppression) accounted for 693,429 kL while potable usage totalled 96,159 kL (Figure 5.8). Dust suppression and potable usage amounted to 88 and 12 percent, respectively, of the total usage.

A review of the water balance in August 2020 indicated the current license allocation is adequate. Water usage increased from an average monthly take of 65,280 kL in the 2018/19 water year to 65,799 kL in the 2019/20 water year. The mining rate increased in the second half of the review period likely accounting for the slight increase in water usage.

The annual abstraction volume averages approximately 0.1 kilolitre per wet metric tonne (Figure 5.9) and is related to tonnes mined/processed and rainfall received. Atlas anticipates no increases to the mining rate for the remainder of the mine life.

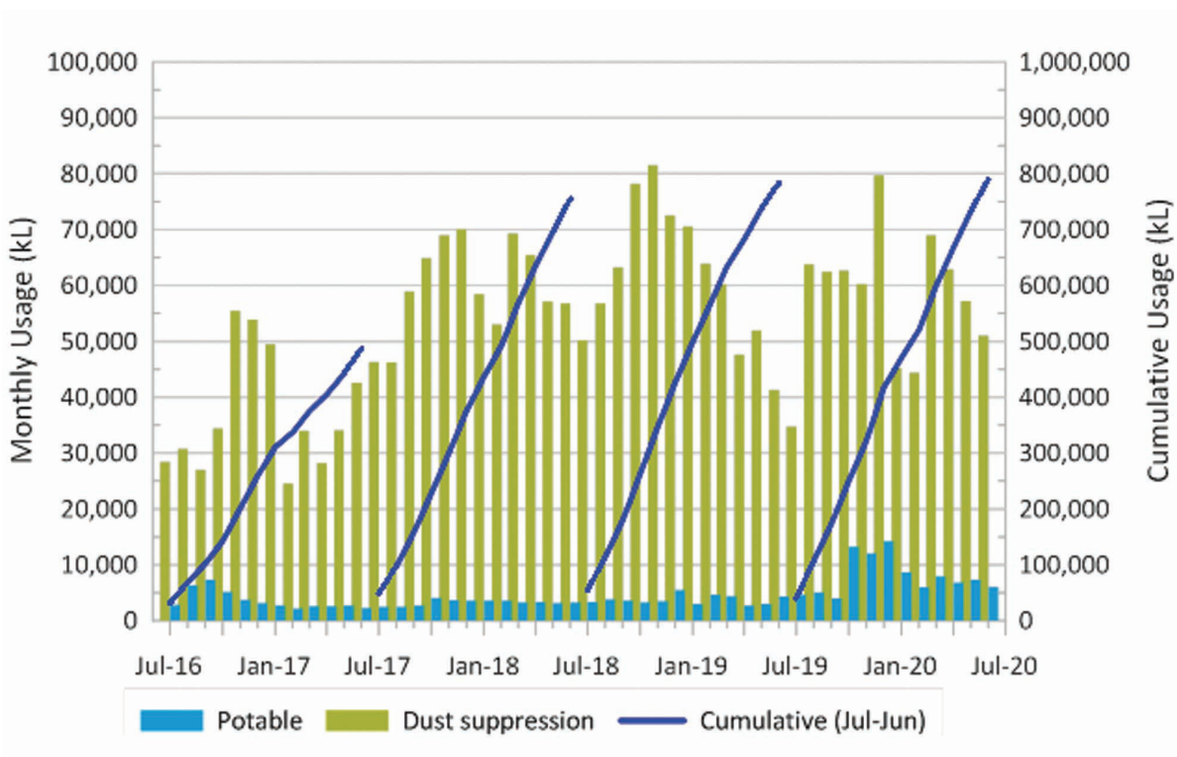

Figure 5.8 - Mt Webber Monthly Usage by Type

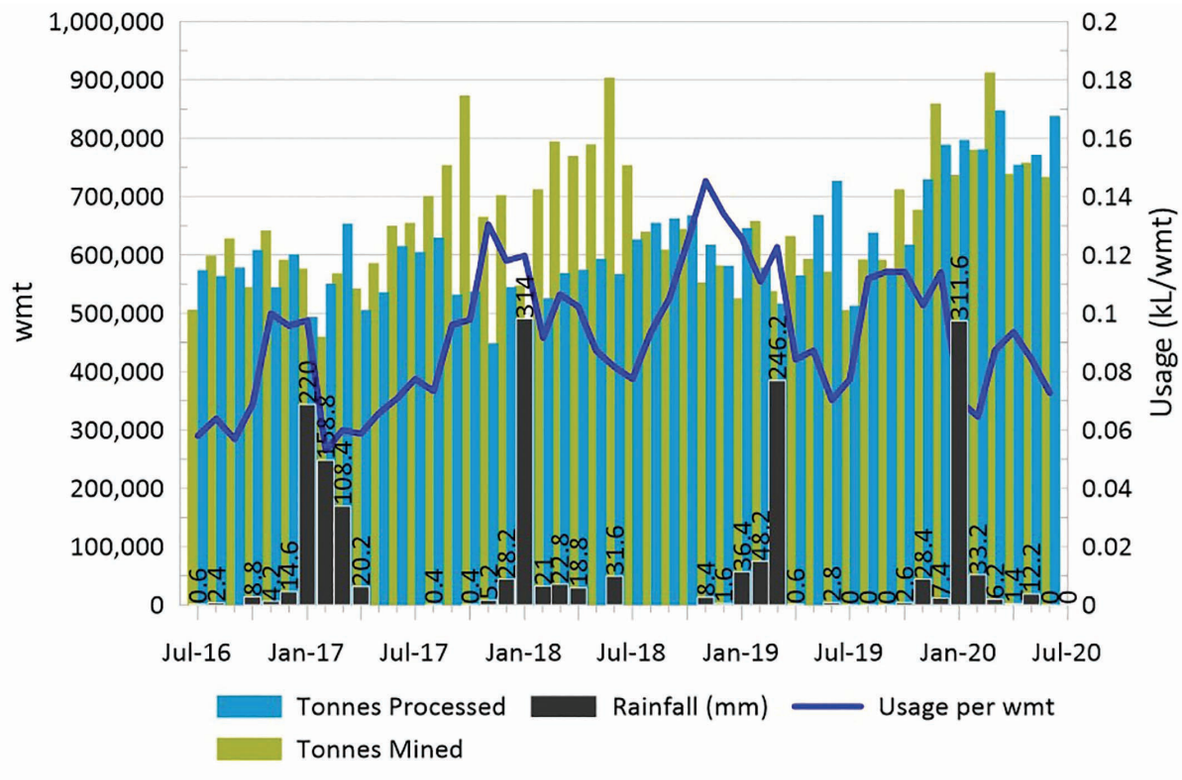

Figure 5.9 - Usage vs Wet Metric Tonnes Mined and Processed

5.11 Monitoring

5.11.1 Objectives

The objectives of the Mt Webber monitoring program, as described in the Mt Webber Site Water Operating Plan (SWOP) (Atlas, 2019), were developed in accordance with the Atlas Water Policy (Atlas, 2019b) to meet regulatory requirements/license conditions. The Project's groundwater monitoring requirements are outlined in Table 5.5.

Table 5.5 - Groundwater Monitoring Schedule

Location	Frequency	Type of monitoring	Parameters
Operational production bores	Monthly	Field measurement	Water Levels Salinity, pH, and Temperature Flow meter readings (instantaneous and cumulative volume) Visual vegetation monitoring in the vicinity of bores WMBAB001, WMBAB002, WEB0091, WEB0108, WEB0119 and WEB0121.
	Nov/April	Laboratory testing	Major ions Metals Total Petroleum Hydrocarbons (Nov only) Total Suspended Solids
	Nov/April	Dataloggers	Download dataloggers
Monitoring, regional bores and non-operational monitoring bores	Quarterly	Field measurement	Water Levels Salinity, pH and Temperature
	(Nov/April)	Dataloggers	Download dataloggers
	Annual	Laboratory testing	Major ions Metals Total Suspended Solids

5.11.2 Regulatory Conditions

There are no specific statutory conditions related to groundwater abstraction other than the standard conditions associated with the groundwater license. The license conditions are as follows:

1. The annual water year for water taken under this license is defined as 1 July to 30 June.
2. The licensee shall comply with the commitments of the operating strategy "Atlas Iron Limited Mount Webber DSO Project, Revision 5b, PRJ0007-132-461-TS-PLN-0001", as prepared by the licensee and approved by the Department of Water and Environmental Regulation on 19/06/2019 including any modifications to the commitments as approved during the term of the licence.
3. Every 12 months the licensee shall provide to the Department of Water a Groundwater Monitoring Summary for the preceding water year. The first report is due 30/09/2020.
4. Every 3 Years the licensee shall provide to the Department of Water and Environmental Regulation a Groundwater Monitoring Review. The first report is due 30/09/2021. A Groundwater Monitoring Summary need not be submitted in a year in which a Groundwater Monitoring Review is due.

5.11.3 Trigger Levels

Using standard methods and performance monitoring to minimise impacts on the community and environment are a key part of the Atlas Water Policy. Trigger values and contingency actions as set forth in the SWOP (Atlas, 2019) provide a framework for detecting and mitigating pumping-related impacts. The following triggers and contingency actions were developed with regulatory input during review of the SWOP in October 2019.

Water level trigger values were set to avoid the lowering of the resting water levels below each bore's main water bearing zones identified during drilling and test pumping. Trigger values are based on maximum anticipated pumping water levels (mbgl) (RPS Aquaterra, 2013c). Water level trigger values are calculated as the maximum long term pumping water levels (mbgl) plus 30% of the calculated drawdown while assuming no periodic recharge to the aquifer.

Baseline electrical conductivity concentrations in production bores range from 420 to 3,300 µS/cm and is considered to be fresh to slightly brackish. Groundwater salinity trigger values below are based on a 50% increase in salinity during operation.

The trigger values and associated contingency actions that have been adopted for the project are summarised in Table 5.6 and Table 5.7.

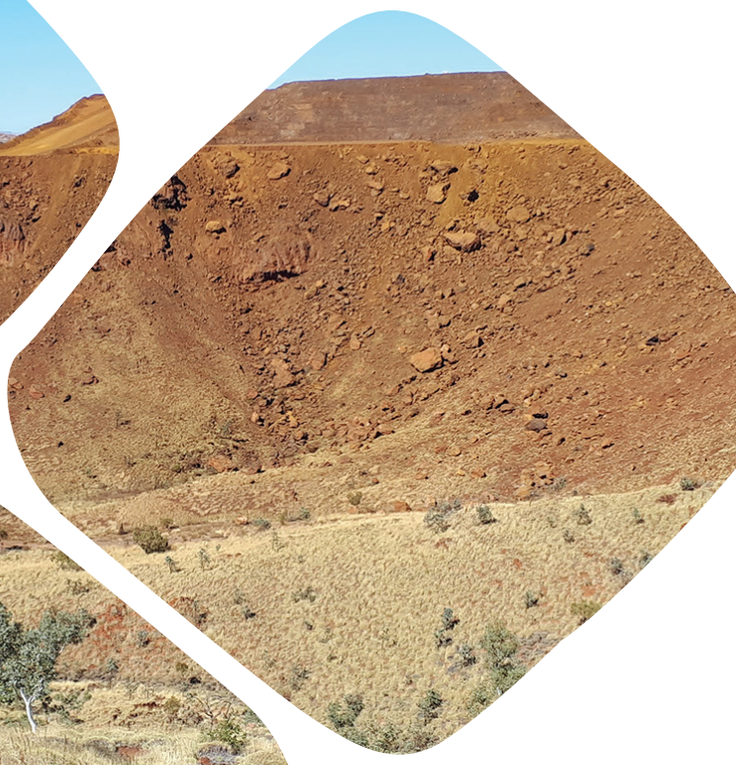

Table 5.6 - Key Contingency Water Management Actions

Bore ID	Triggers		Contingency Actions	
	Max Pumping WL (mbgl)	Water Quality (µS/cm)	Water Quality	Drawdown
PB109D	57	>5,000 (with the exception of bore WEB0108). Bore WEB0108, if electrical conductivity is >10,000 (due to bore having higher baseline salinity).	Repeat measurement; Notify DWER, review data; Identify source (if possible); Increase frequency of monitoring (if required); Agree on action in consultation with DWER (no action, reduce pumping, or take bore out of service; update SWOP)	1. Drawdown within 5 meters of max pumping water level: Increase monitoring frequency to fortnightly. 2. Drawdown at max pumping water level: Reduce pumping rate, or rest if possible; Increase monitoring frequency to fortnightly, and/or; Shutdown bore. 3. If vegetation stress is identified in the area of WMBAB001 and WMBAB002 the bores will be switched off and a rapid assessment completed to determine if the stress is due to groundwater drawdown. If it is determined that the impact is a result of abstraction the bores will either remain switched off, or be operated at a rate which limits drawdown to 10 m below standing water level
PB107	45			
PB110C	53			
PB110F	30			
PB55A	65			
PB99D	35			
PB58E	30			
PB170A	79			
WMBAB001	65			
WMBAB002	55			
MTWAB016	60			
MTWAB017	65			
MTWAB018	65			
WEB0089	50			
WEB0091	50			
GWB3	26			
GWB7	18			
GWB12	21			
WEB0108	35			Bores WEB0108 and WEB0119 will be operated such that drawdown in the area of a known GDE to the east will be less than 0.25 m/year and less than 1 m in total. If this level is reached the following actions will be implemented: Reduce pumping rate, or rest if possible; Increase monitoring frequency to fortnightly, and/or; Shutdown bore.
WEB0119	28			
WEB0121	60			Bore WEB0121 will be operated such that drawdown in a known area of GDV to the north-east will be less than 0.25 m/year and less than 1 m in total utilising monitoring bores WEB0122 and WEB0123. If this level is reached the following actions will be implemented: Reduce pumping rate, or rest if possible; Increase monitoring frequency to fortnightly, and/or; Shut down bore.

Table 5.7 - WEB0091 Abstraction Monitoring Bore Triggers

Monitoring Bore	Maximum Depth to Water (m below top of casing)
MTWOB016	7.5
MTWOB017	33.97
WMBOB002	44.96
WMBOB001	23.56
WEB0086	25.24
WEB0085	24.39
WEB0078	32.08
WEB0079	32.57
WEB0091	34.87
WEB0107	19.86
WEB0103	18.3

5.12 Monitoring Observations

5.12.1 Water Levels

Historical hydrographs for production bores are presented in Figure 5.10 to Figure 5.29. The hydrographs, plotted against trigger levels, illustrate the historical performance of each bore.

Water levels in the majority of production bores remained above trigger levels throughout the reporting period. However, in the first half of the review period water levels in some East Fender pumping bores temporarily exceeded the pumping water level trigger but recovered after reductions in pumping rate coupled with seasonal recharge.

Water levels in South Haul Road, Camp and Ibanez Borefields remained above water level triggers during the review period.

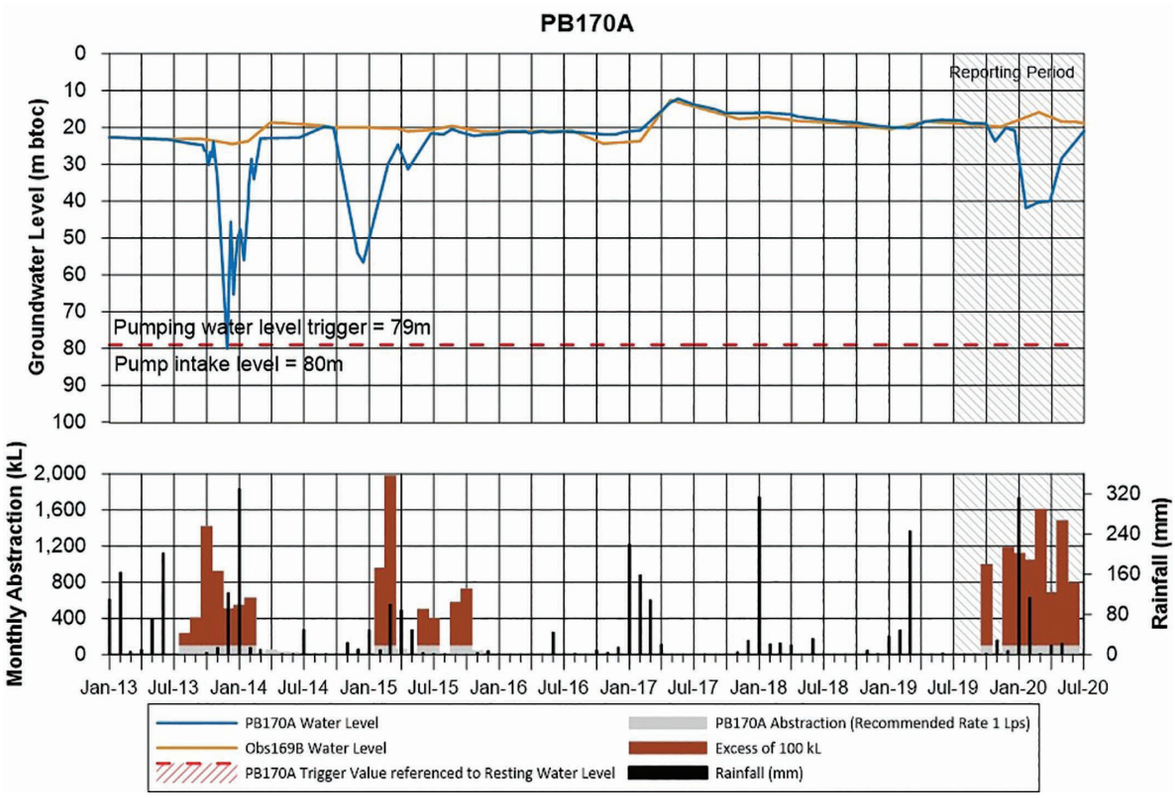

Figure 5.10 - PB170A Water Levels vs. Abstraction and Rainfall

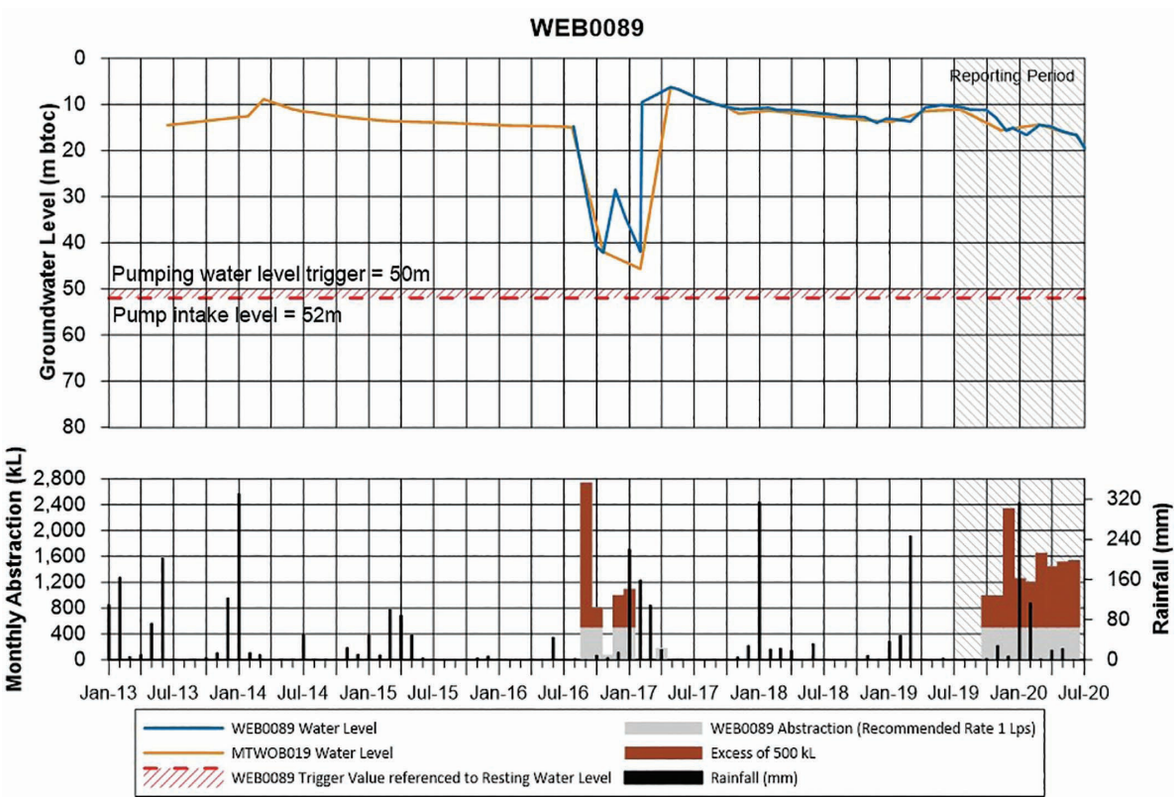

Figure 5.11 - WEB0089 Water Levels vs. Abstraction and Rainfall

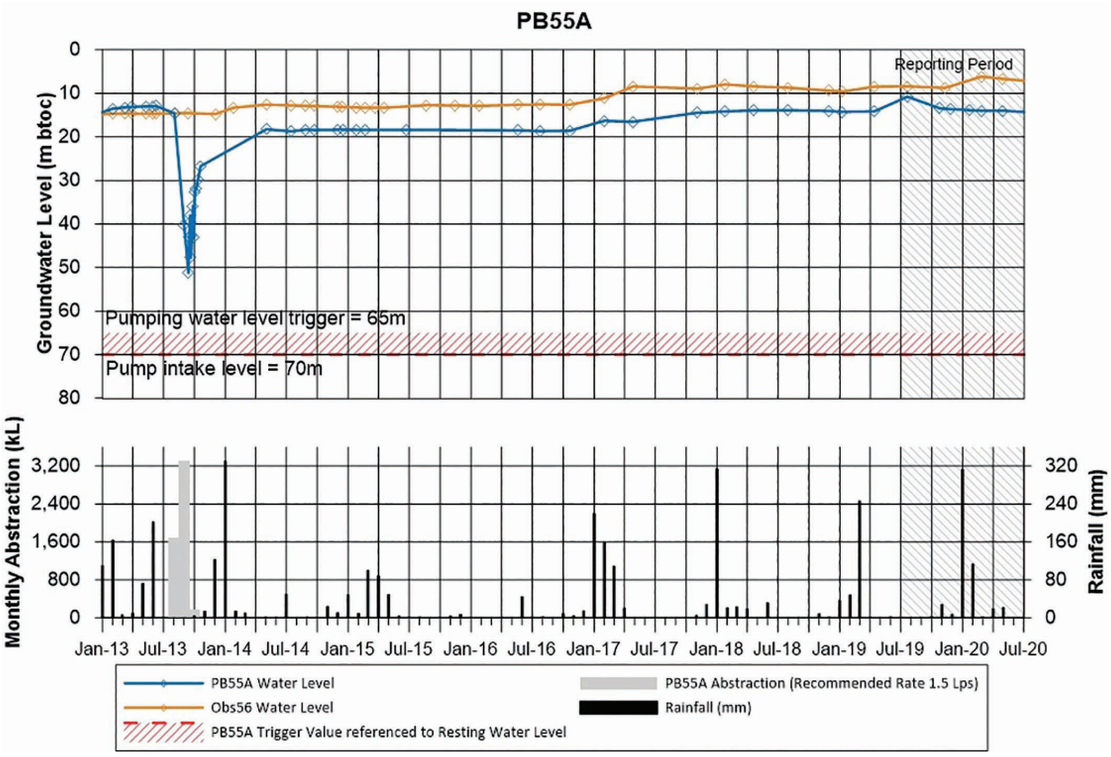

Figure 5.12 - PB55A Water Levels vs. Abstraction and Rainfall

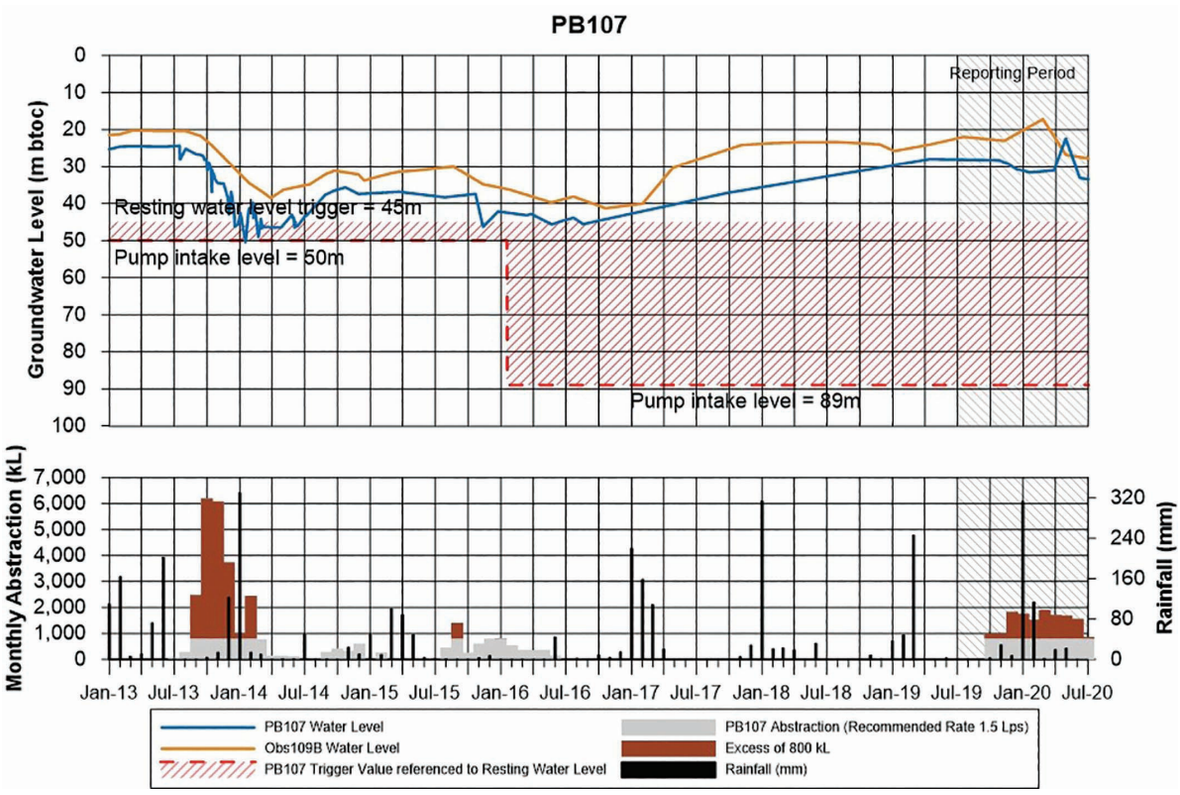

Figure 5.13 - PB107 Water Levels vs. Abstraction and Rainfall

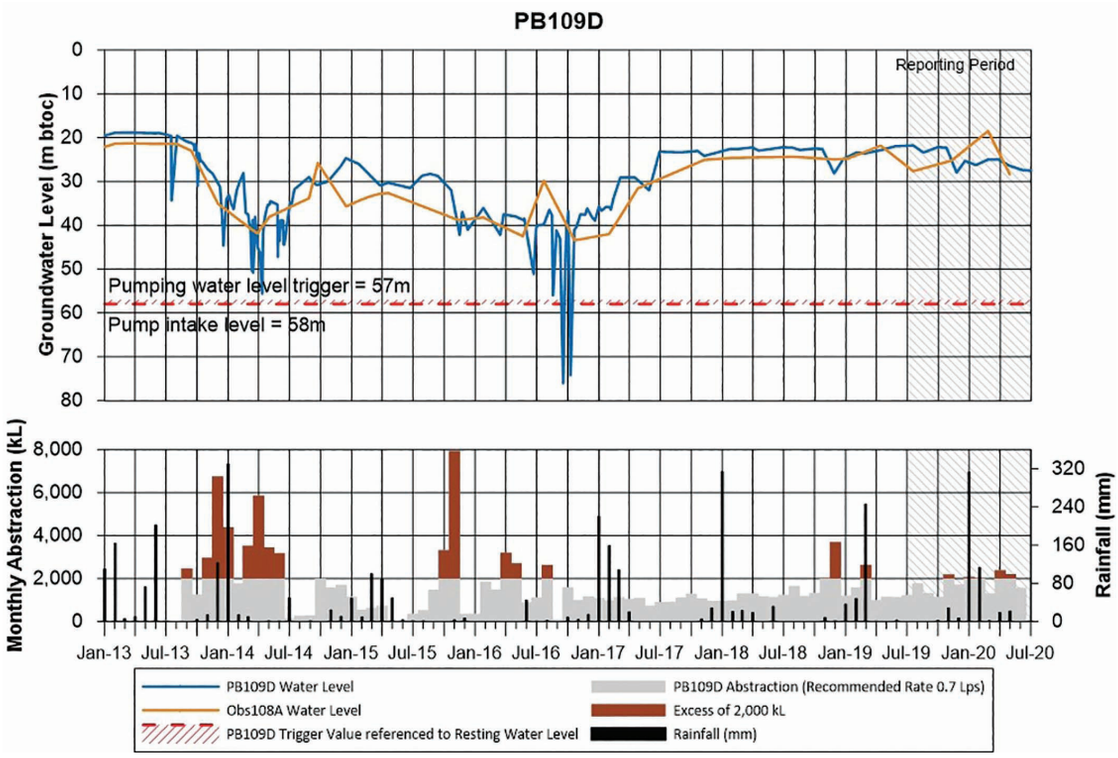

Figure 5.14 - PB109D Water Levels vs. Abstraction and Rainfall

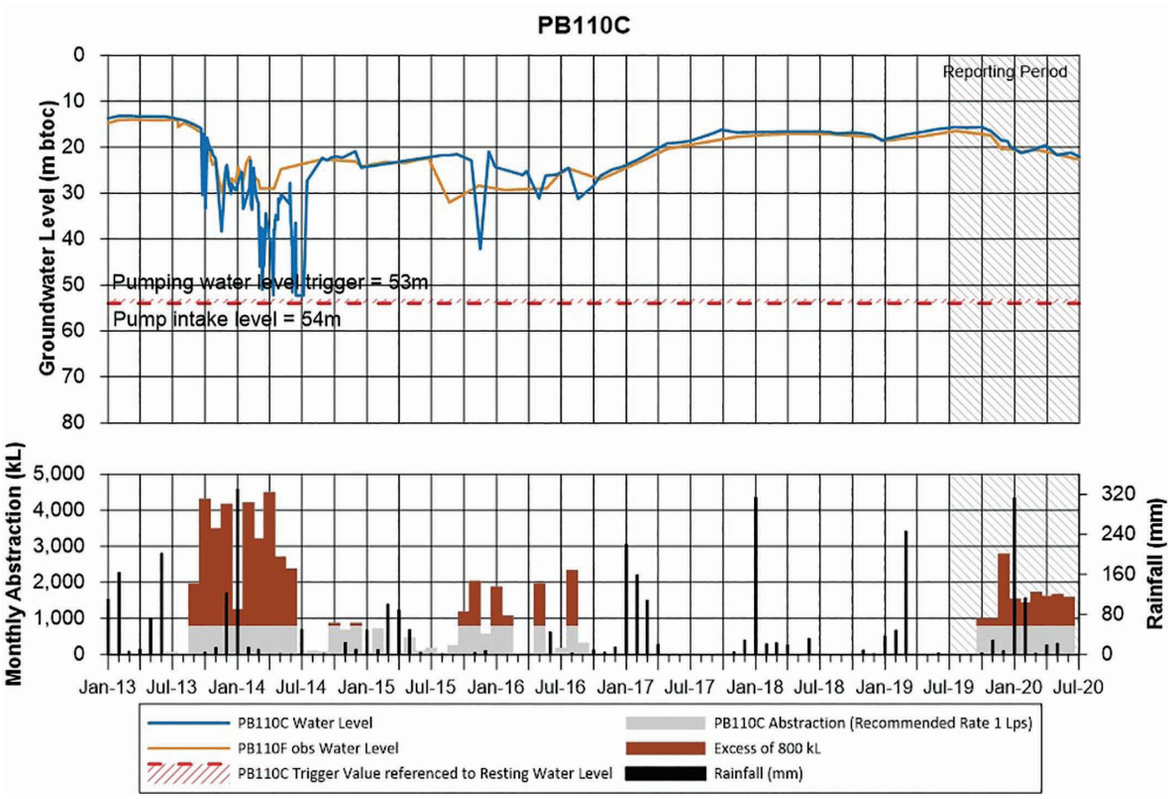

Figure 5.15 - PB110C Water Levels vs. Abstraction and Rainfall

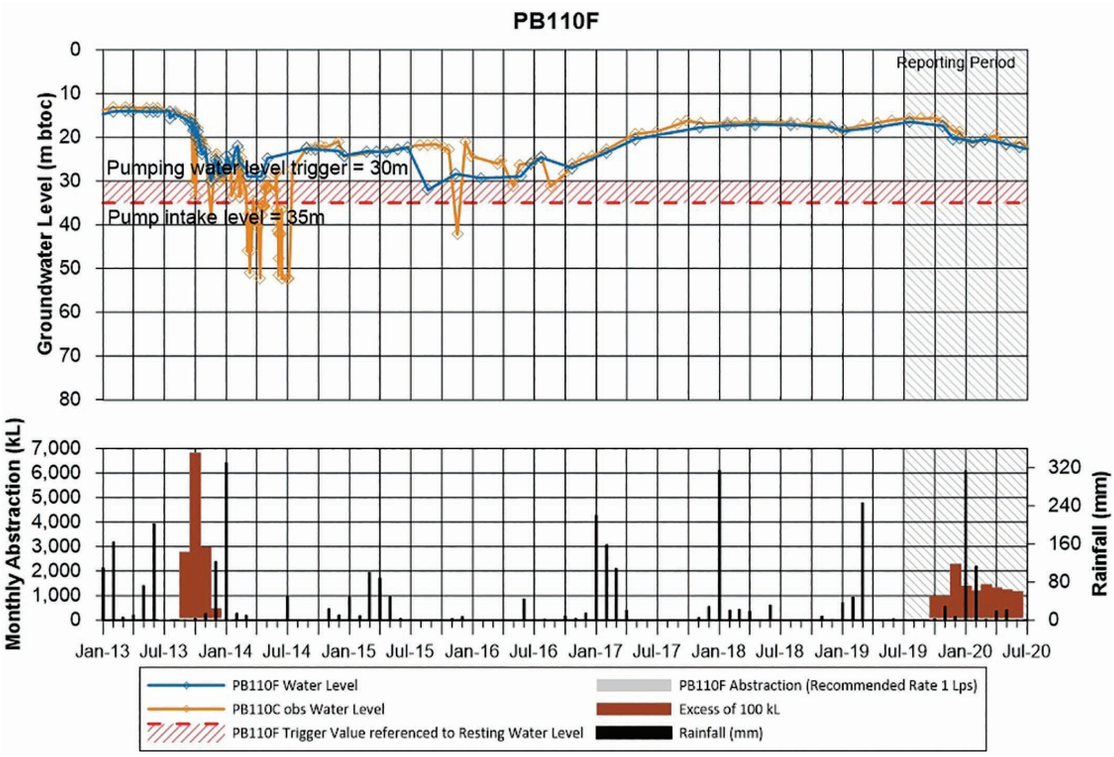

Figure 5.16 - PB110F Water Levels vs. Abstraction and Rainfall

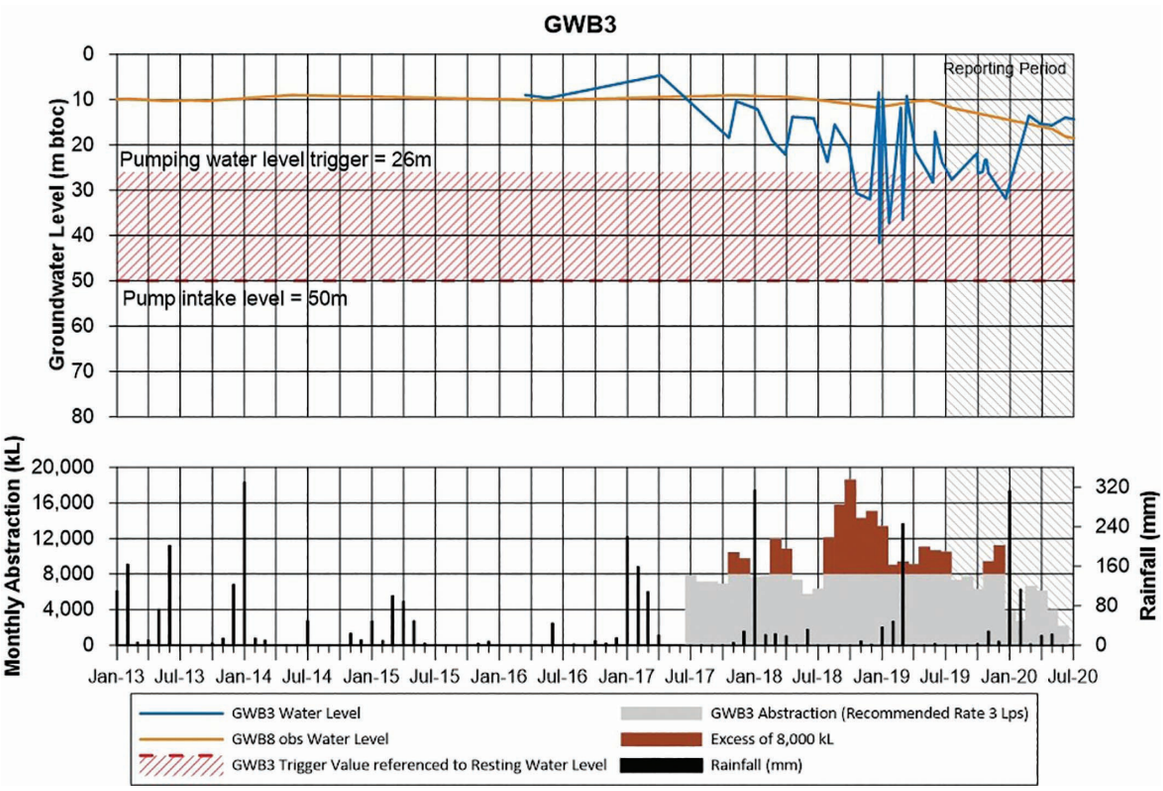

Figure 5.17 - GWB3 Water Levels vs. Abstraction and Rainfall

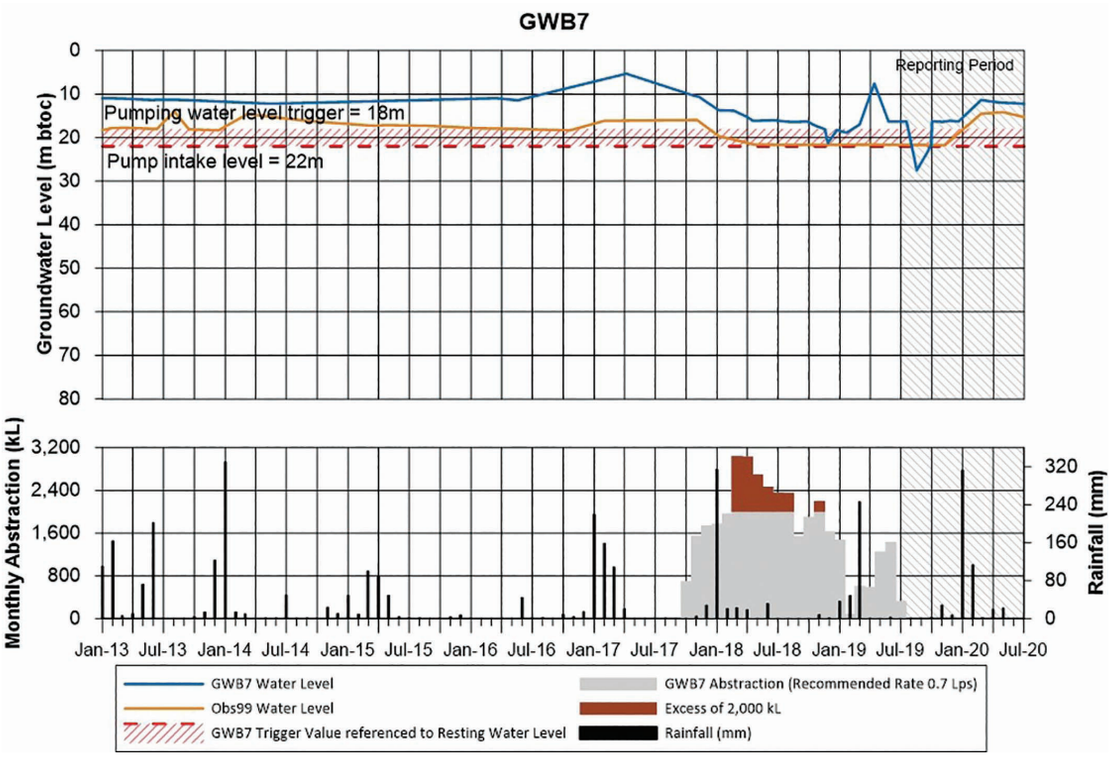

Figure 5.18 - GWB7 Water Levels vs. Abstraction and Rainfall

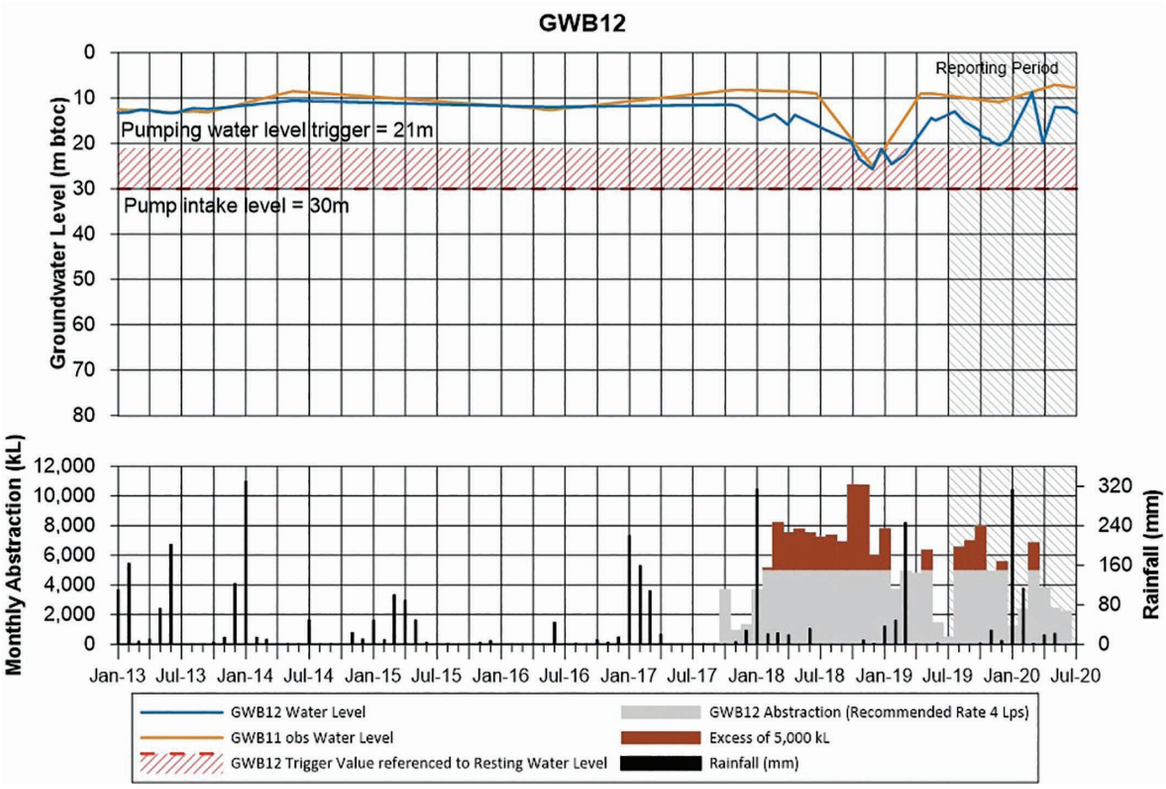

Figure 5.19 - GWB12 Water Levels vs. Abstraction and Rainfall

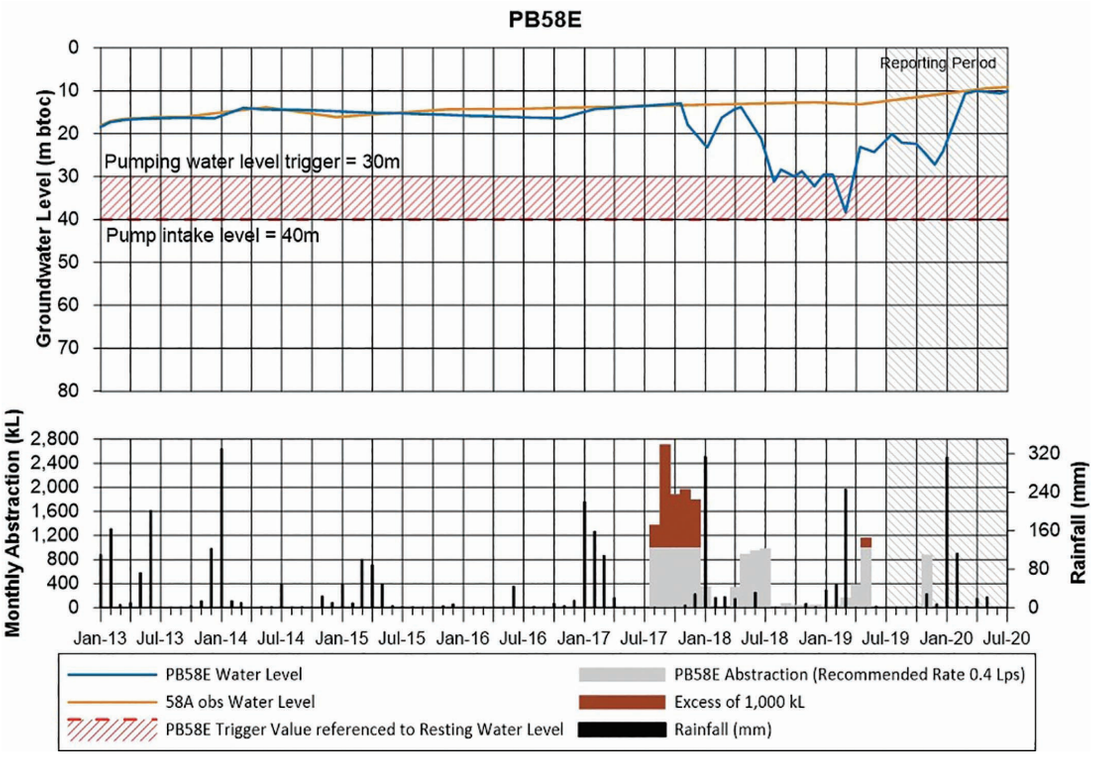

Figure 5.20 - PB58E Water Levels vs. Abstraction and Rainfall

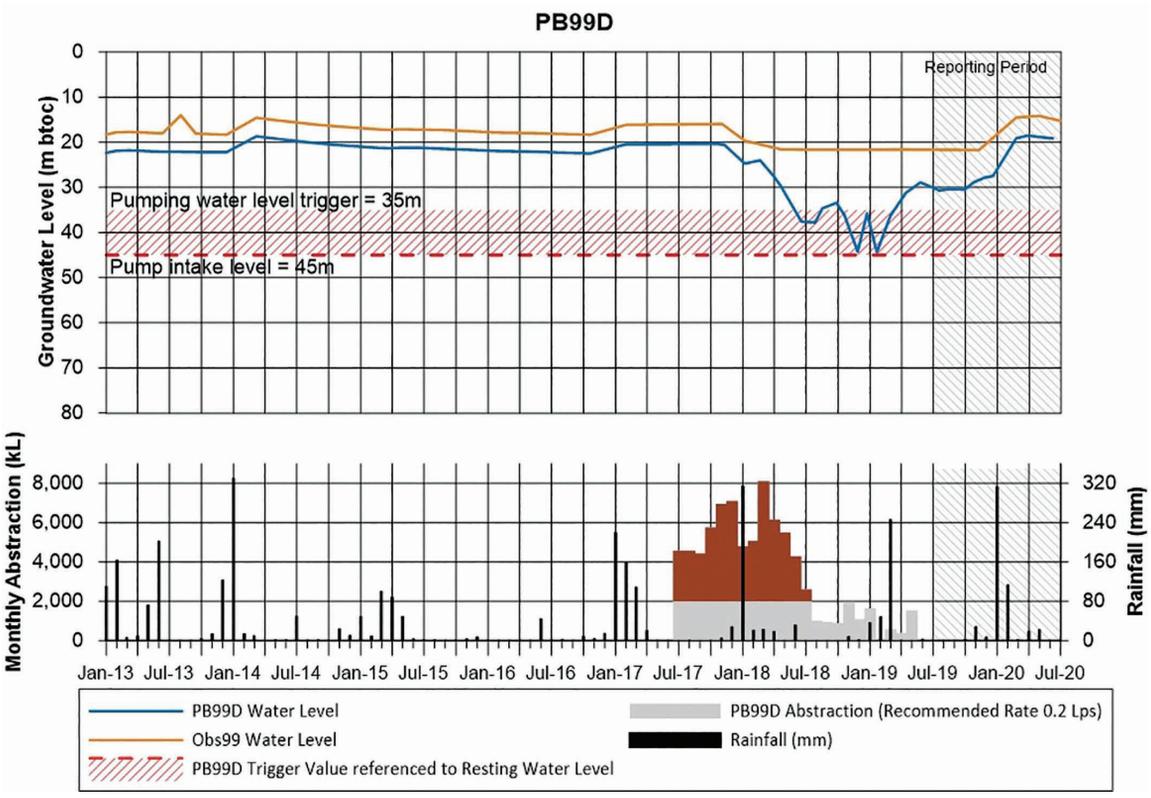

Figure 5.21 - PB99D Water Levels vs. Abstraction and Rainfall

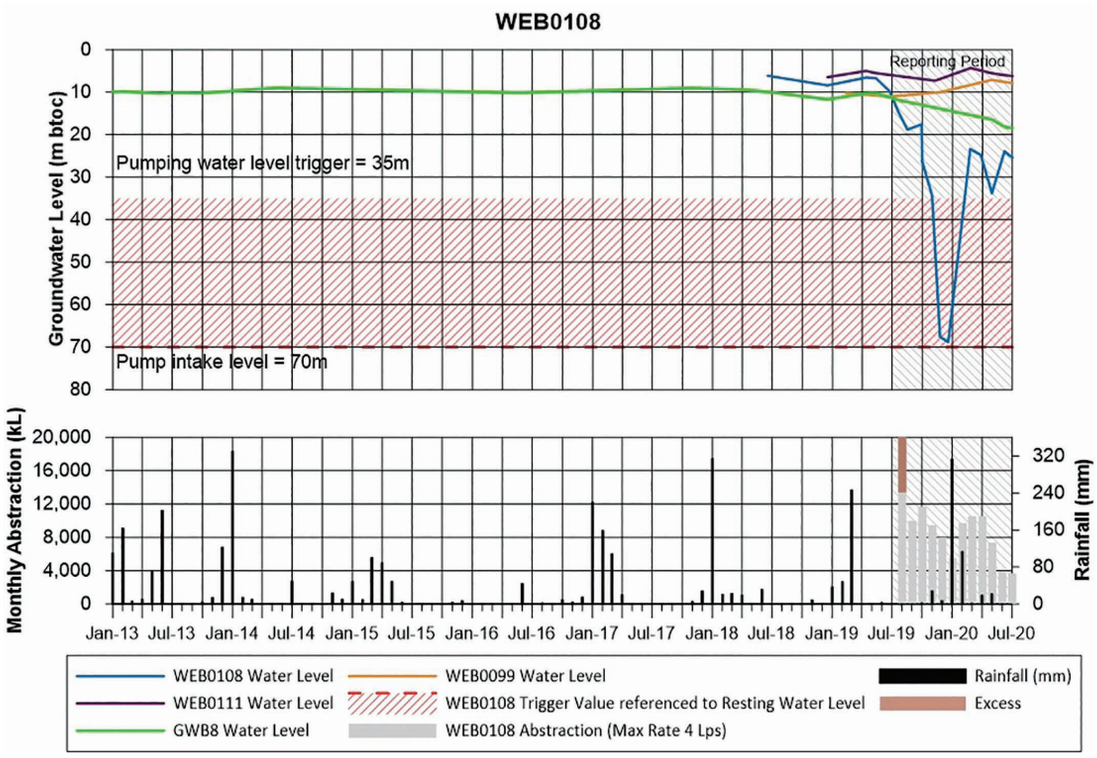

Figure 5.22 - WEB0108 Water Levels vs. Abstraction and Rainfall

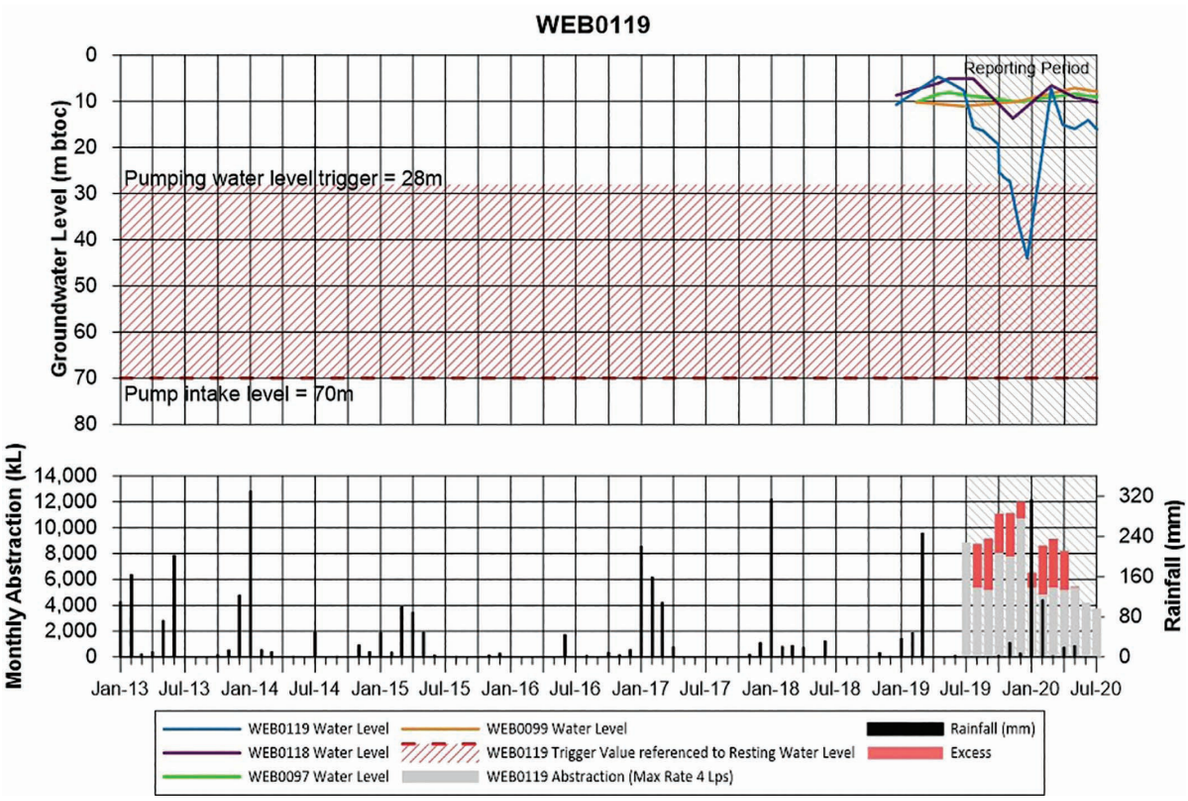

Figure 5.23 - WEB0119 Water Levels vs. Abstraction and Rainfall

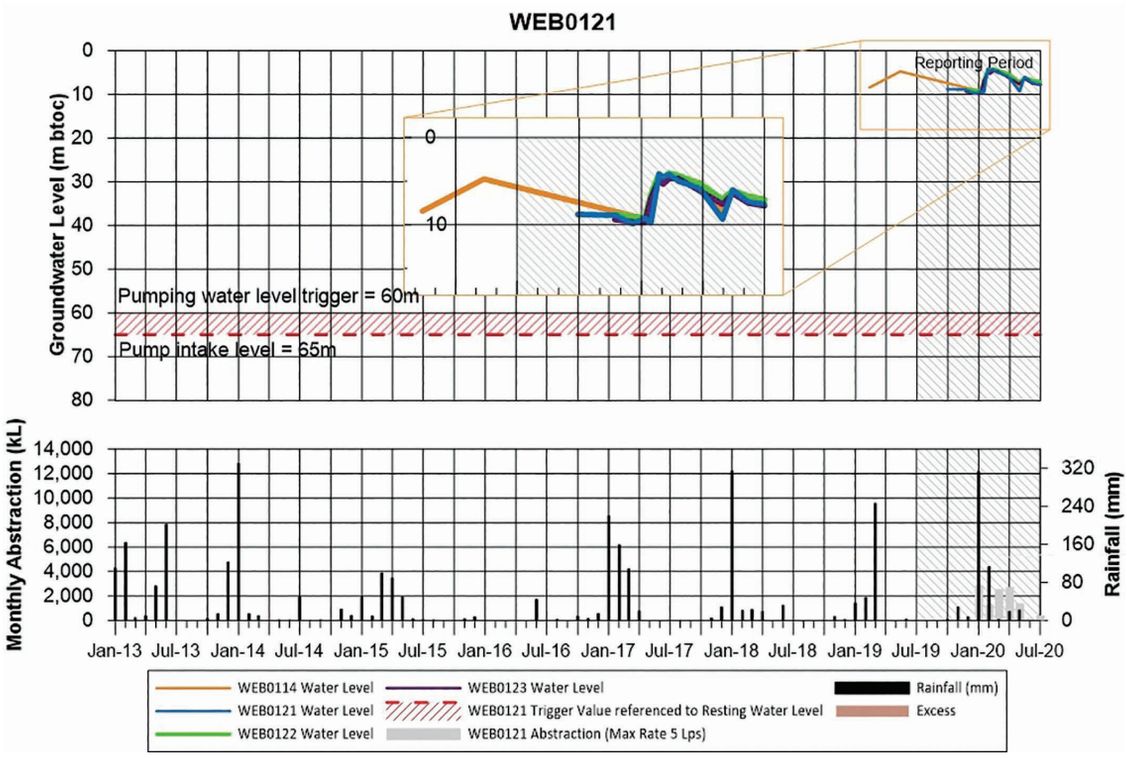

Figure 5.24 - WEB0121 Water Levels vs. Abstraction and Rainfall

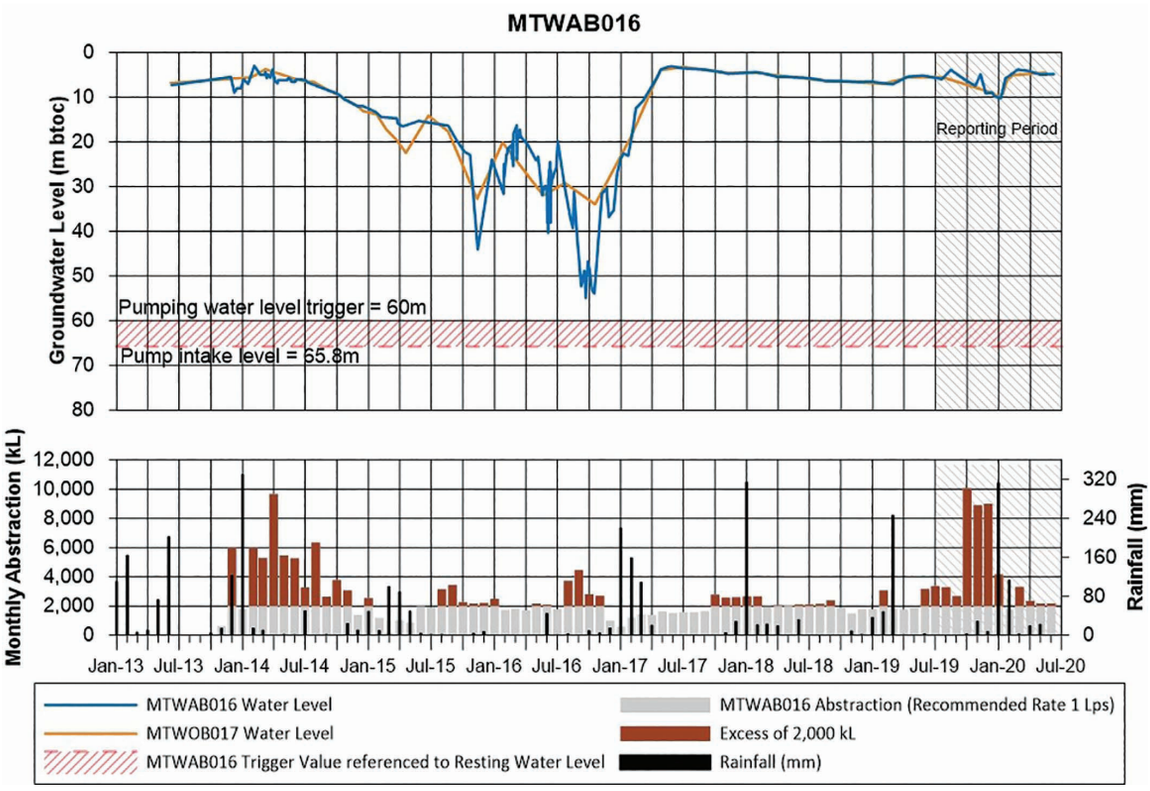

Figure 5.25 - MTWAB016 Water Levels vs. Abstraction and Rainfall

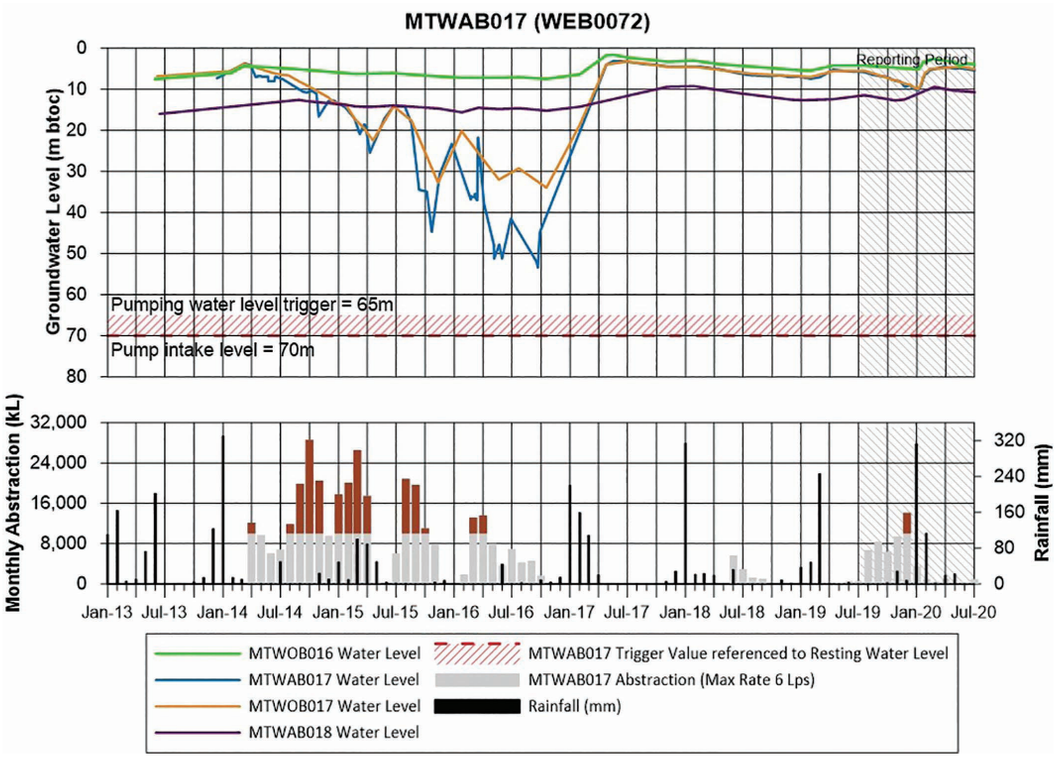

Figure 5.26 - MTWAB017 Water Levels vs. Abstraction and Rainfall

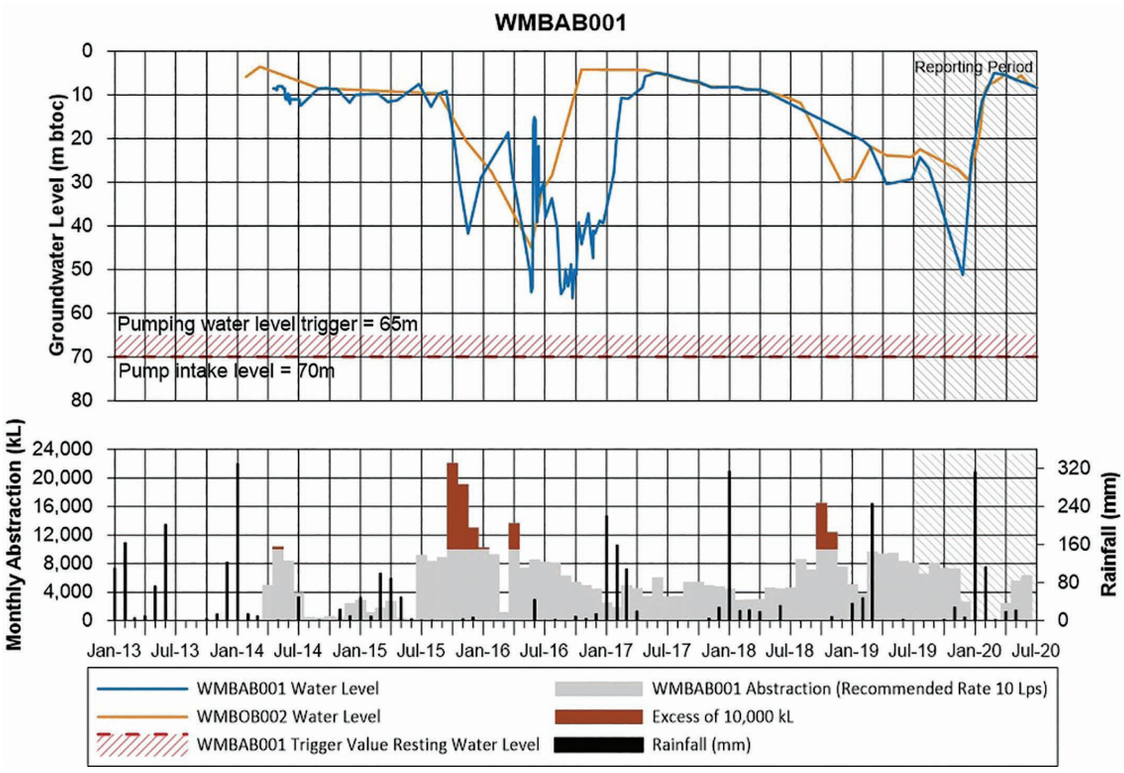

Figure 5.27 - WMBAB001 Water Levels vs. Abstraction and Rainfall

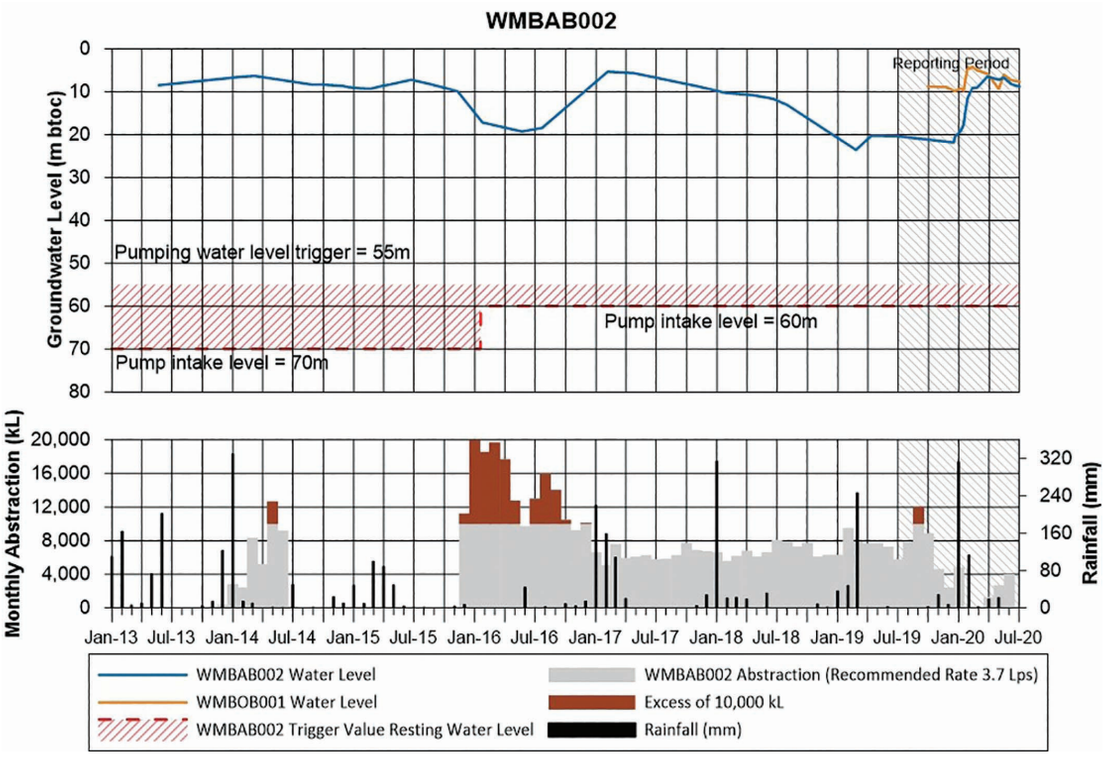

Figure 5.28 - WMBAB002 Water Levels vs. Abstraction and Rainfall

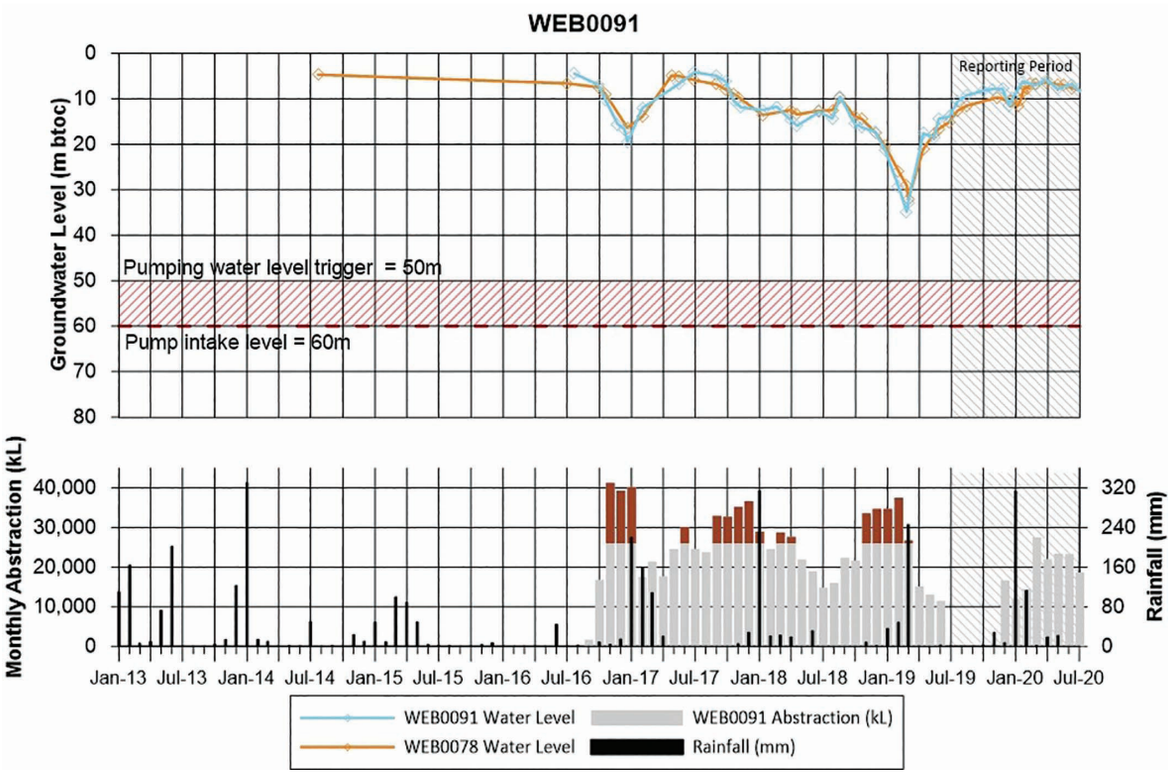

Figure 5.29 - WEB0091 Water Levels vs. Abstraction and Rainfall

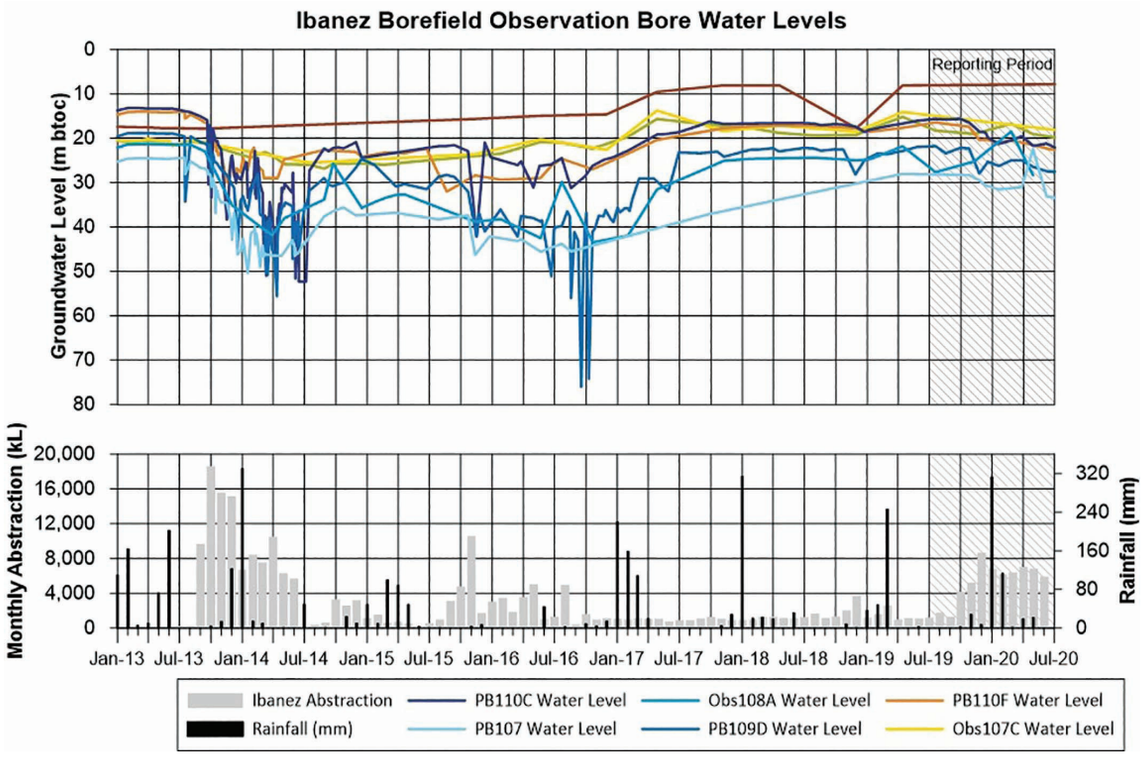

Figure 5.30 - Ibanez Borefield Observation Water Levels

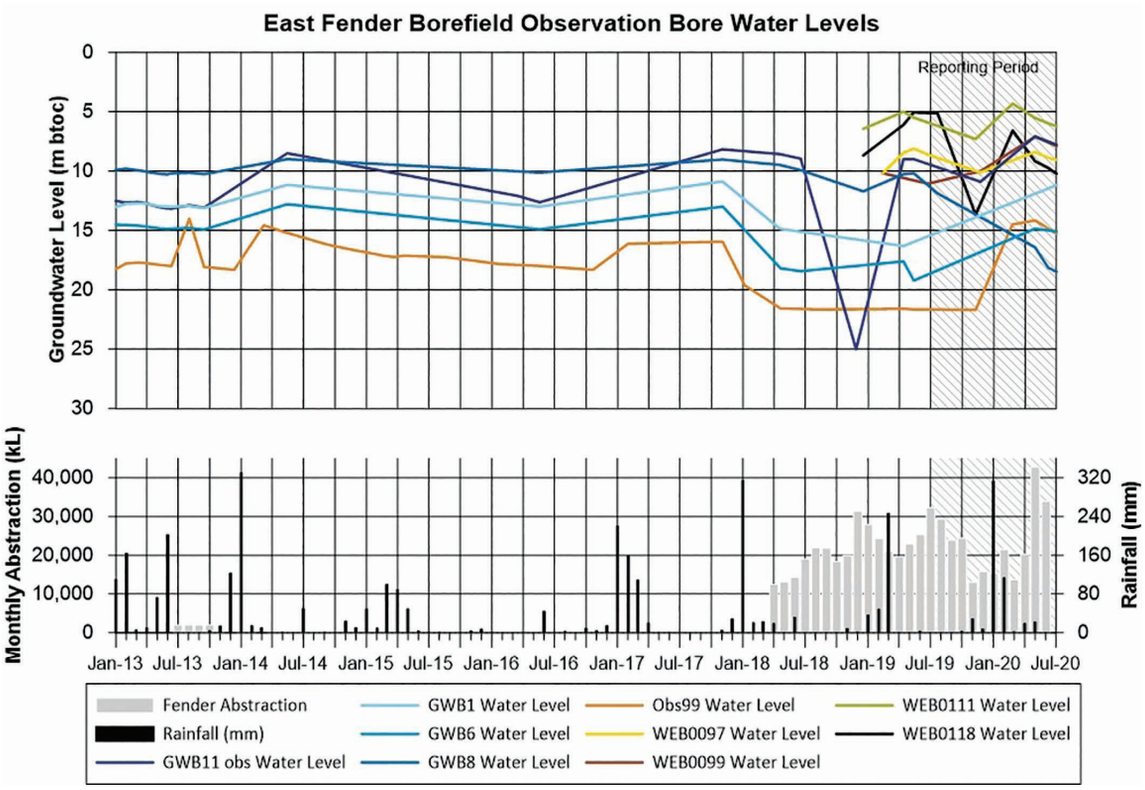

Figure 5.31 - East Fender Borefield Observation Water Levels

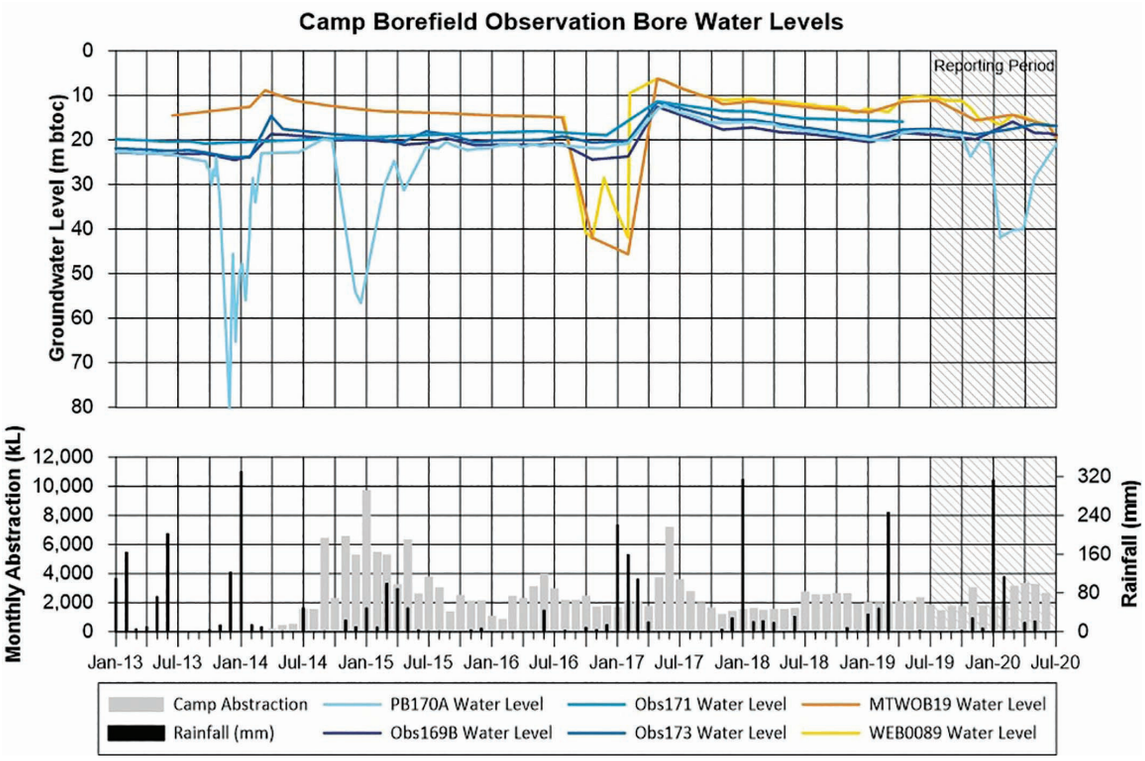

Figure 5.32 - Camp Borefield Observation Water Levels

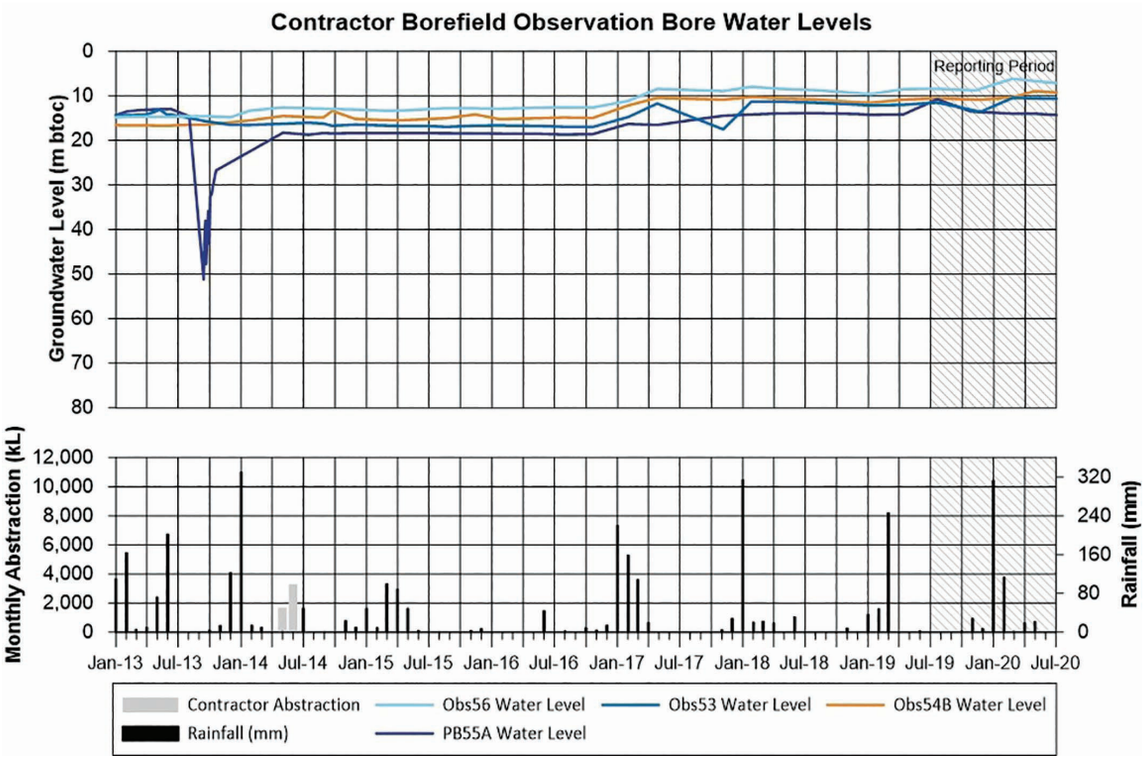

Figure 5.33 - Contractor Borefield Observation Water Levels

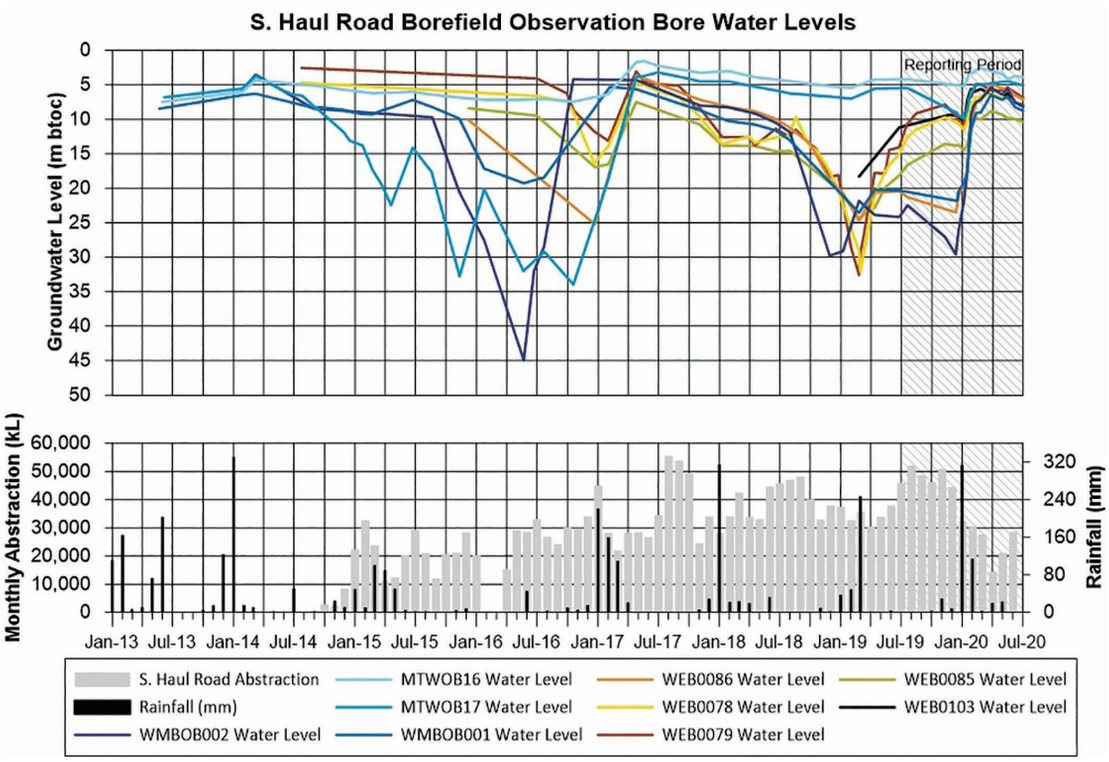

Figure 5.34 - South Haul Road Borefield Observation Water Levels

5.12.2 Water Quality

Groundwater in the Mt Webber project area ranges from fresh (<1,000 mg/L Total Dissolved Solids [TDS]) in recharge areas to slightly brackish (<2,500 mg/L TDS) in areas further along the groundwater flow path (valleys and lower lying areas).

No water quality trigger values were exceeded during the reporting period.

Conductivity and pH measurements in abstraction and monitoring bores (Figure 5.35 and Figure 5.36) remained relatively constant throughout the reporting period. Overall historical trends in conductivity and pH suggest negligible pumping impacts (no mixing of water types) since pumping began. Minor seasonal fluctuations in pH and EC occur in all bores suggesting the influence of rainfall recharge.

Exceedances of some metals (highlighted in red in Table 5.9) are typical for groundwaters of the Pilbara. Groundwater from the nominated potable bores (WEB0089, MTWAB016, PB170A, and PB109D) are treated to drinking water standards at the on-site treatment plant prior to consumption. Monthly potability testing of the treated water confirms water is fit for consumption.

Table 5.8 to Table 5.10 present a summary of the analytical data for abstraction and monitoring bores.

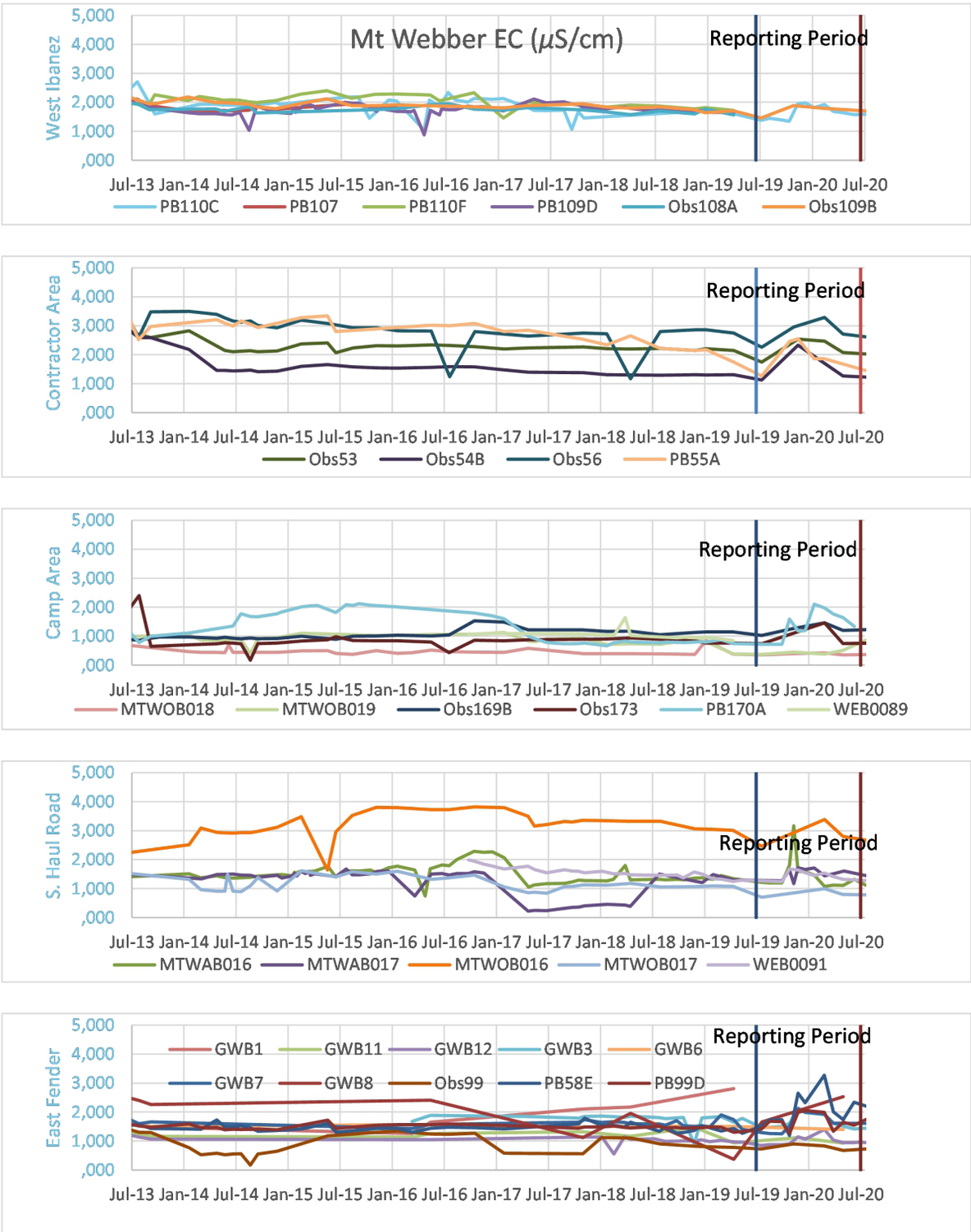

Figure 5.35 - All Bores EC

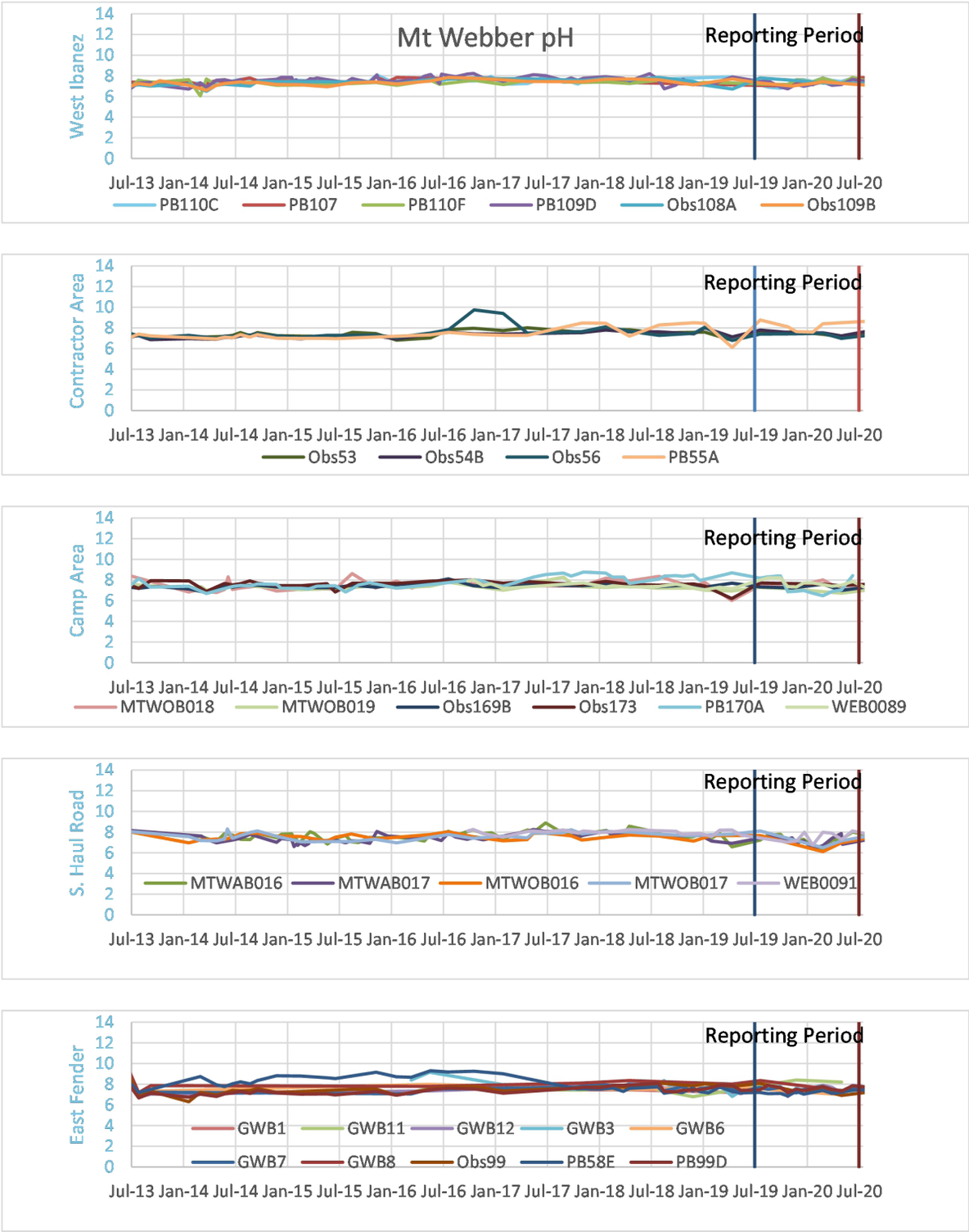

Figure 5.36 - All Bores pH

Table 5.8 - Major Ions and Physical Parameters

Bore ID	Date	pH (pH units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
GWB12	8-Oct-10	8.2	1,100	650	120	520	51	59	56	3.2	100		
	7-Apr-17	8.0	1,000	500	100	330	44	62	48	3	83	1	<5
	8-Nov-17	7.6	1,100	700	78	450	38	70	48	3.1	97	<0.5	<5
	17-Apr-18	7.5	1,100	640	73	410	32	64	47	2.7	97	1.4	<5
	13-Apr-19	7.9	1,000	610	85	360	35	60	45	2.1	93	8.3	<5
	24-Nov-19	7.6	1,000	540	120	360	37	57	42	2.3	95	2.4	<5
	30-Apr-20	7.7	1,000	950	74	400	37	57	43	2.7	81	8.3	8
GWB3	26-Sep-10	8.0	1,900	1,000	300	620	160	80	120	6.3	170		
	6-Apr-17	8.0	2,000	1,100	240	440	180	65	110	6	170	3	160
	8-Nov-17	7.7	1,900	1,100	240	490	150	73	110	6.1	160	7.8	<5
	17/04/2018	7.7	1,900	1,100	190	480	160	68	110	6.3	160	1.2	6
	13/04/2019	7.6	1,900	1,200	220	440	250	68	110	6.4	160	7.8	<5
	24/11/2019	7.7	2,000	1,200	260	440	280	71	100	7.3	170	2	5
	30/04/2020	7.6	1,600	1,100	150	460	160	58	100	7.4	120	11	26
GWB7	2/10/2010	8.1	1,500	1,000	240	540	68	48	100	4.8	130		
	6/04/2017	8.0	1,500	680	180	430	51	57	88	4	120	3	<5
	8/11/2017	7.6	1,800	1,100	230	510	100	78	110	5.5	140	8.9	<5
	17/04/2018	7.7	1,700	970	190	490	59	74	94	4.5	120	2.1	<5
	13/04/2019	7.8	1,900	1,200	220	430	270	69	110	6.4	160	3.3	<5
	24/11/2019	7.8	2,000	1,200	280	430	200	71	110	7.4	170	1.5	<5
MTWAB017	11/03/2014	8.0	1,300	790	160	560	67	68	66	2.1	120	18	<5
	29/11/2014	8.2	1,500	800	180	580	75	82	66	2.2	150	4.5	
	26/05/2015	7.9	1,500	890	180	590	91	76	65	2.4	150	8.1	
	22/05/2016	7.2	1,400	660	160	460	72	75	62	2.4	130		2.5
	22/11/2016	7.5	1,300	820	150	470	82	71	60	2.5	140	1.4	<5
	25/04/2017	7.5	170	100	7	78	2	18	3.8	2.2	9.1	<0.005	36
	8/11/2017	7.1	330	200	20	130	3	26	8.7	3.4	20	<0.5	31
	17/04/2018	7.3	390	230	21	97	6	28	9.8	6.4	25	10	
	12/04/2019	7.9	1,400	840	160	490	69	78	67	3.1	130	<0.5	10
	24/11/2019	7.2	1,600	840	190	470	98	82	67	2.4	150	1.3	<5

Table 5.8 - Major Ions and Physical Parameters

	3/05/2020	7.2	1,700	1,100	180	510	190	92	74	2.8	140	14	20
PB107	2/12/2013	8.0	1,500	900	180	700	76	36	100	6.3	150	7.9	<5
	8/03/2014	8.0	1,600	980	190	730	79	43	110	7.6	150	6.9	<5
	31/05/2014	7.9	1,700	970	210	760	87	43	120	8	160	6.6	
	28/08/2014	8.2	1,700	1,000	210	720	91	40	100	7	140	5.9	
	29/11/2014	8.1	1,800	990	230	720	91	46	120	8.3	160	6	
	24/11/2019	7.5	2,100	1,100	290	570	120	52	130	8.3	180	1.6	<5
	29/04/2020	7.8	2,100	1,200	280	610	140	51	140	9.1	150	8.3	26
PB110C	2/12/2013	8.1	1,900	1,100	250	770	110	56	110	4.8	230	5.2	<5
	8/03/2014	8.2	1,800	1,100	220	780	120	58	110	4.8	190	4.5	<5
	31/05/2014	8.0	1,900	1,100	230	820	120	57	110	5	190	5.1	
	28/08/2014	8.2	1,900	1,200	240	780	140	60	110	4.9	180	3.9	
	29/11/2014	8.1	2,000	1,100	250	760	140	61	120	4.9	220	2.3	
	22/05/2016	7.9	1,800	940	220	640	130	65	120	5	200		2.5
	22/11/2016	7.6	1,700	1,100	280	590	120	62	100	4.4	220	0.056	<5
	27/04/2017	7.6	1,700	980	150	660	95	50	99	5.1	200	1	<5
	8/11/2017	7.2	1,700	1,100	140	660	96	49	98	5.4	190	3.3	<5
	14/04/2019	7.2	1,800	1,000	150	610	120	53	110	4.8	180	3.1	11
	24/11/2019	7.5	1,800	990	170	610	110	57	94	4.9	170	1.7	<5
	29/04/2020	7.7	1,700	990	180	680	110	50	98	5.1	160	6.6	8
PB110F	2/12/2013	8.1	1,800	1,100	230	790	110	46	120	4.5	190	6.5	7
	8/03/2014	8.2	2,100	1,200	280	860	130	45	140	3.6	230	3.7	<5
	31/05/2014	7.8	2,100	1,200	270	860	130	47	140	4.4	240	5.7	
	28/08/2014	8.0	2,000	1,200	260	830	140	45	120	4.4	230	4.6	
	29/11/2014	8.0	2,100	1,200	270	810	140	46	130	4.2	230	4.9	
	21/05/2016	7.6	2,000	1,100	280	680	140	47	130	3.8	250		2.5
	26/04/2017	7.7	1,900	1,100	210	670	120	49	120	4.7	210	1.1	<5

Table 5.8 - Major Ions and Physical Parameters

	20/04/2018	7.4	2,000	1,200	170	660	110	48	110	5	200	0.92	<5
	14/04/2019	7.5	1,800	1,100	190	620	120	49	110	4.4	200	3.7	<5
	24/11/2019	7.6	1,900	1,100	210	650	120	49	110	5.2	200	1.1	<5
	29/04/2020	7.7	1,900	1,100	240	620	130	48	120	4.7	180	6.1	16
PB58E	1/12/2013	8.7	1,300	780	180	490	53	14	91	5.4	140	23	6
	8/03/2014	8.7	1,300	800	170	490	57	23	95	5.5	140	27	<5
	31/05/2014	8.2	1,500	830	170	660	54	38	68	4.1	110	17	
	28/08/2014	8.3	1,400	850	170	610	54	32	84	4.4	130	12	
	29/11/2014	8.7	1,300	730	170	440	55	4.6	90	4.6	140	12	
	21/05/2016	8.9	1,300	610	170	380	54	8.9	95	5.3	160		2.5
	7/04/2017	8.0	1,400	670	130	510	45	52	83	4	130	2	6
	8/11/2017	7.3	1,900	1,100	240	500	150	73	110	6.2	160	9.1	<5
	20/04/2018	7.3	1,700	990	170	500	95	70	96	5.4	130	2	<5
	13/04/2019	7.4	1,500	940	180	470	100	74	94	4.1	120	11	<5
	24/11/2019	7.4	2,500	1,600	340	400	340	72	150	11	220	1.5	11
	30/04/2020	7.5	1,900	1,300	220	490	310	55	120	10	160	9.7	22
PB99D	1/12/2013	7.9	1,400	840	190	620	51	70	85	6	110	9.3	<5
	8/03/2014	7.9	1,400	810	160	630	46	70	83	4.5	110	15	<5
	31/05/2014	7.7	1,400	790	160	650	41	66	73	4.7	98	12	
	28/08/2014	8.0	1,400	830	160	630	45	71	78	5.3	100	10	
	29/11/2014	8.1	1,400	770	160	620	45	71	81	5.4	110	9.6	
	21/05/2016	7.4	1,400	710	170	520	45	78	90	5.5	120		2.5
	6/04/2017	8.0	1,200	560	110	470	32	60	75	4	110	4.7	<5
	8/11/2017	7.5	1,500	850	160	540	43	73	84	4.7	110	8.1	<5
	20/04/2018	7.5	1,500	810	140	520	36	72	84	4.5	120	1.9	<5
	13/04/2019	7.8	1,400	840	150	490	44	72	83	4.3	110	13	<5
	24/11/2019	7.8	1,800	1,000	240	480	170	73	97	6.9	150	1.9	<5

Table 5.8 - Major Ions and Physical Parameters

	30/04/2020	7.8	1,800	1,300	210	490	210	58	110	9	150	1.2	16
WEB0091	22/11/2016	8.1	1,600	900	230	520	65	57	71	2	200	1.2	<5
	24/04/2017	8.2	1,700	1,000	240	530	70	60	77	1.9	220	1.7	<5
	8/11/2017	7.9	1,600	940	180	500	54	52	64	2	190	4.8	<5
	20/04/2018	7.9	1,500	870	150	500	44	47	59	2.1	180	1.3	<5
	12/04/2019	7.9	1,400	800	150	430	53	44	54	1.8	170	11	<5
	24/11/2019	7.3	1,500	800	230	410	64	46	53	2.1	180	2.1	<5
	30/04/2020	7.9	1,400	980	140	480	50	44	59	2.2	160	9.2	14
WEB0108	13/04/2019	7.7	3,000	2,100	470	300	860	49	260	16	320	2.2	<5
	24/11/2019	7.5	5,700	4,200	880	440	1,400	100	340	26	640	1.4	13
	30/04/2020	7.6	3,500	1,900	520	470	750	52	210	23	390	7.8	52
WEB0119	13/04/2019	7.4	330	220	17	72	22	25	16	5.4	10	30	<5
	24/11/2019	7.1	1,400	870	110	380	180	57	93	8.9	78	1.3	<5
	30/04/2020	7.2	1,400	870	140	380	220	59	110	9.5	70	7	130
WEB0121	24/11/2019	7.1	1,000	550	110	330	52	59	41	2.2	90	2.7	11
	30/04/2020	7.7	930	690	70	350	36	52	41	2.5	70	13	<5
WMBAB001	11/03/2014	8.1	870	520	76	420	36	38	34	1.9	100	10	<5
	31/05/2014	7.9	1,500	890	180	630	68	62	59	1.9	140	7.1	
	28-Aug-14	8.2	1,400	910	180	610	69	67	63	1.9	160	5.9	
	29-Nov-14	8.3	1,600	900	200	610	75	73	68	2	170	6.3	
	23-Jun-15	7.9	1,300	750	140	540	59	58	58	1.8	130	6.6	
	22-May-16	8.1	1,200	620	130	490	48	67	64	2.1	150		2.5
	22-Nov-16	7.8	1,200	670	120	480	44	58	54	1.8	130	1.5	<5
	25-Apr-17	8.1	790	470	42	350	23	36	33	1.3	96	1.5	<5
	8-Nov-17	7.6	1,400	880	140	490	60	63	59	1.9	160	4.7	5
	20-Apr-18	7.8	1,500	900	120	490	56	63	60	1.9	160	1	<5
	12-Apr-19	7.7	1,200	720	110	430	48	55	52	1.7	130	9.6	<5
	24-Nov-19	7.6	1,300	720	140	460	51	59	53	2.1	130	1.7	<5

Table 5.8 - Major Ions and Physical Parameters

	30-Apr-20	7.6	1,100	690	72	420	46	44	45	1.8	110	11	14
WMBAB002	8-Mar-14	8.0	1,400	830	160	600	64	65	66	1.5	150	9.6	<5
	31-May-14	7.8	1,400	830	150	620	54	62	59	1.6	140	7.9	
	28-Aug-14	8.1	1,300	830	150	610	56	65	61	1.7	150	0.67	
	29-Nov-14	8.1	1,400	770	160	570	57	64	60	1.5	140	4.9	
	22-May-16	7.8	1,300	630	160	500	49	73	71	1.9	160		2.5
	22-Nov-16	7.8	1,300	780	170	500	54	66	63	1.8	150	1.3	<5
	25-Apr-17	8.0	1,200	650	87	480	33	52	52	1.4	140	1.5	<5
	8-Nov-17	7.6	1,200	740	96	480	37	55	52	1.6	140	5.6	<5
	20-Apr-18	7.4	1,300	760	90	460	33	53	51	1.5	140	1.4	<5
	12-Apr-19	7.7	1,300	740	110	440	38	54	52	1.4	140	14	<5
	24-Nov-19	7.8	1,400	770	140	470	51	59	57	1.7	150	2.3	<5
	30-Apr-20	7.7	1,100	910	85	530	37	51	50	1.7	110	14	14
MTWAB018	11-Mar-14	7.7	420	280	7	260	3	39	13	0.6	36	6.7	<5
	31-May-14	7.8	420	290	8	270	4	36	12	0.7	35	6.5	
	29-Nov-14	8.3	380	240	8	220	4	25	12	0.7	36	6.1	
	21-May-16	8.2	330	200	9	160	4	21	12	3	35		2.5
	25-Apr-17	8.2	360	220	9	180	3	22	10	2.3	33	1.6	<5
	17-Apr-18	8.3	400	240	8	190	2	35	11	1.7	34	0.71	<5
	11-Apr-19	8.2	300	180	10	140	3	34	12	2	34	2.4	6
	24-Nov-19	7.8	380	230	11	170	4	28	10	1.8	29	0.52	13
PB55A	31-May-14	7.6	3,200	2,000	580	770	350	80	200	21	300	2.5	
	28-Aug-14	7.9	2,900	2,000	550	740	340	85	200	19	260	2.9	
	29-Nov-14	8.0	3,200	1,900	970	710	350	88	220	23	320	2.9	
	21-May-16	7.4	2,900	1,500	500	620	300	86	200	19	250		2.5
	26-Apr-17	7.6	2,900	1,800	500	540	260	88	200	15	220	0.31	<5
	17-Apr-18	7.5	2,600	1,600	410	480	240	68	180	17	250	0.19	<5
	13-Apr-19	8.4	2,300	1,400	360	350	210	12	140	14	180	1.1	<5
	24-Nov-19	8.7	1,800	1,100	330	250	190	44	160	19	210	0.41	17

Table 5.8 - Major Ions and Physical Parameters

	29-Apr-20	8.2	1,700	980	240	300	150	12	94	16	130	2.1	16
WEB0107	12-Apr-19	7.3	1,000	660	53	440	26	56	51	3.3	90	13	11
	24-Nov-19	7.0	1,200	630	74	500	27	64	56	3.9	97	1.4	7
WMBAB003	31-May-14	7.8	1,100	650	100	590	27	57	54	1	54	4.7	
	28-Aug-14	8.1	1,100	650	100	560	26	69	69	1.1	63	3.6	
	24-Jun-15	8.0	990	590	84	440	29	55	64	2	57	41	
	24-Nov-19	7.0	1,000	510	60	440	17	64	61	1.1	56	1.6	6
MTWOB016	29-Nov-14	8.3	3,300	1,900	840	530	390	140	190	15	270	0.05	
	21-May-16	7.4	3,600	2,100	820	440	430	150	230	16	300		2.5
	25-Apr-17	7.9	1,000	600	55	430	32	55	43	1.3	110	1.9	<5
	20-Apr-18	7.3	3,600	2,300	640	430	350	150	200	16	280	0.044	11
	11-Apr-19	7.4	3,400	2,400	700	380	390	140	190	14	270	<1	16
MTWOB017	29-Nov-14	8.4	910	540	73	380	42	51	42	1.5	78	19	
	21-May-16	7.3	1,200	620	110	430	54	68	57	2.5	110		2.5
	25-Apr-17	7.8	810	480	37	350	25	47	35	1.5	81	4.7	<5
	17-Apr-18	7.8	1,100	700	78	360	53	58	50	3.4	110	8.4	6
	12-Apr-19	7.8	1,200	740	96	390	60	60	51	2.8	110	34	<5
MTWOB018	29-Nov-14	8.1	430	260	6	260	3	44	12	0.7	29	7.1	
	21-May-16	7.3	430	260	10	230	4	46	13	2.1	33		22
	25-Apr-17	7.5	360	220	6	190	2	38	10	0.6	25	0.71	<5
	20-Apr-18	7.7	370	220	5	180	2	37	9.7	1	26	0.67	<5
	11-Apr-19	7.6	380	240	5	180	2	38	11	0.7	27	3.3	43
MTWOB019	29-Nov-14	8.2	930	530	40	540	17	74	44	2	74	2.9	
	21-May-16	7.3	910	540	41	480	19	78	45	1.9	77		2.5
	26-Apr-17	7.5	760	460	20	360	10	47	18	1.5	38	2	<5
	17-Apr-18	7.1	700	420	21	330	10	72	23	3.9	39	1.8	<5
	12-Apr-19	7.1	500	270	12	220	6	43	13	4	20	3	12
Obs107E	2-Dec-13	7.6	2,500	1,500	450	760	230	100	210	15	120	2.1	8
	29-Nov-14	8.0	1,900	1,000	230	790	110	67	150	12	100	<0.05	

Table 5.8 - Major Ions and Physical Parameters

	21-May-16	7.3	1,400	690	130	630	33	68	120	4.5	61		2.5
	26-Apr-17	7.5	740	440	6	420	5	82	44	0.8	16	1.7	<5
	20-Apr-18	7.1	1,300	760	65	620	<1	83	100	4.7	44	0.014	12
	14-Apr-19	7.2	820	490	18	430	9	79	56	1.4	24	15	<5
Obs108A	2-Dec-13	7.8	1,400	840	150	710	64	37	96	6.3	140	7	200
Obs109B	2-Dec-13	7.9	1,900	1,100	250	740	130	28	120	4.5	240	5.4	1000
	29-Nov-14	8.1	1,800	1,000	230	700	100	21	110	3.6	200	4.7	
Obs169B	3-Dec-13	7.9	890	530	46	520	32	59	39	4.1	78	3.1	280
	29-Nov-14	8.2	920	530	46	500	33	61	38	4.1	80	1.4	
	21-May-16	7.5	940	570	49	430	38	60	41	5.3	89		2.5
	26-Apr-17	7.7	1,200	600	110	430	43	79	53	3.4	100	1.7	<5
	20-Apr-18	7.7	1,100	650	96	410	39	71	50	4.4	95	1.6	120
	12-Apr-19	7.5	1,200	730	120	430	51	78	51	5.6	100	2.5	15
Obs173	3-Dec-13	8.1	670	400	52	320	27	30	15	1.8	88	0.14	90
	29-Nov-14	8.3	750	430	57	350	27	40	20	4.1	85	0.06	
	26-Apr-17	7.9	790	480	56	310	26	48	22	4.5	97	0.039	<5
	17-Apr-18	7.5	890	540	66	330	25	54	26	7.9	93	0.47	<5
	11-Apr-19	7.8	770	500	65	290	30	42	24	3.2	95	1.6	7
Obs53	30-Nov-13	7.8	2,600	1,600	450	730	300	68	170	24	270	2.9	7
	29-Nov-14	8.2	2,200	1,200	340	650	200	79	160	12	140	0.52	
Obs54B	3-Dec-13	7.8	2,500	1,500	260	690	670	120	170	5.8	200	0.06	18
	29-Nov-14	8.0	1,500	860	120	540	220	65	88	5.5	110	0.11	
Obs56	3-Dec-13	7.8	3,300	2,000	410	610	950	110	210	26	380	0.16	25
	29-Nov-14	8.1	3,100	2,100	370	580	870	100	190	25	360	<0.05	
	21-May-16	7.5	2,600		320	460	590	100	160	19	290		6
	26-Apr-17	7.7	2,700	1,700	330	450	530	95	140	17	300	0.041	<5
	17-Apr-18	7.8	3,000	2,000	340	440	540	90	160	21	310	0.14	<5
	13-Apr-19	7.5	3,100	2,100	400	470	650	96	170	20	320	<1	<5
Obs99	1-Dec-13	7.7	1,200	740	150	570	47	92	65	2.9	87	4.6	33

Table 5.8 - Major Ions and Physical Parameters

	29-Nov-14	8.1	590	350	25	320	19	56	26	1.5	27	2.1	
WEB0078	25-Apr-17	7.6	2,000	1,000	260	580	76	60	85	2.2	240	0.84	<5
	20-Apr-18	7.4	1,800	1,100	190	570	64	50	71	2.1	230	1.3	<5
	12-Apr-19	7.8	1,600	980	190	510	67	36	64	2	210	4.7	9
WEB0085	25-Apr-17	7.7	850	510	36	400	16	40	40	2.3	91	3	<5
	12-Apr-19	7.4	1,100	720	73	460	31	54	54	2.3	110	7	10
WEB0106	15-Dec-18	8.0	2,300	1,500	460	420	150	84	94	4.2	270	1.7	12000
WEB0113	13-Dec-18	7.9	980	590	110	290	46	67	43	2.7	95	2.5	1200
WMBOB001	29-Nov-14	8.1	1,300	740	160	540	56	62	57	1.3	130	3.6	
	25-Apr-17	8.0	1,000	600	49	490	28	35	34	1.1	160	0.86	<5
	20-Apr-18	7.3	1,200	740	92	440	35	53	52	1.7	140	1.1	<5
WMBOB002	29-Nov-14	8.3	1,400	810	190	520	73	72	69	2.2	140	11	
	21-May-16	7.6	1,300	650	130	490	51	68	70	1.7	140		150
	25-Apr-17	8.1	720	430	34	330	19	33	31	1.1	85	1.3	<5
	20-Apr-18	7.8	920	550	61	390	26	42	44	1.4	100	1.3	<5
	12-Apr-19	7.5	1,100	700	92	400	42	49	50	1.4	120	12	<5
Potable Bores													
MTWAB016	8-Mar-14	8.2	1,300	780	160	550	63	77	65	1.7	120	11	<5
	31-May-14	8.1	1,400	840	160	600	68	63	35	1.1	63	7.6	
	28-Aug-14	8.4	1,300	840	170	570	68	75	59	1.8	120	6.1	
	29-Nov-14	8.3	1,500	870	190	570	73	84	67	1.9	140	4.7	
	26-May-15	8.2	1,500	880	190	570	78	83	69	2.1	130	6.4	
	22-May-16	7.6	1,600	780	220	450	87	87	72	2.3	150		2.5
	22-Nov-16	8.1	2,000	1,200	390	440	120	110	87	2.7	200	1.4	<5
	27-Apr-17	7.6	3,500	2,400	700	480	380	150	210	14	290	0.043	<5
	8-Nov-17	7.8	1,300	770	100	450	63	71	55	1.7	120	6	<5
	17-Apr-18	7.8	1,300	770	110	460	61	73	58	1.9	120	1.5	<5
	12-Apr-19	7.6	1,400	900	160	420	86	79	62	1.6	130	11	<5
	24-Nov-19	7.5	1,400	770	160	470	77	78	62	2	130	1.5	<5

Table 5.8 - Major Ions and Physical Parameters

	30-Apr-20	7.8	1,200	730	83	480	58	63	53	1.9	97	12	6
PB109D	2-Dec-13	8.1	1,400	850	150	730	63	38	92	5.9	140	6.2	<5
	8-Mar-14	8.1	1,500	900	160	730	79	41	100	6.1	160	6.5	<5
	31-May-14	8.0	1,600	920	170	750	85	42	95	6.4	150	6	
	28-Aug-14	8.3	1,800	1,100	220	770	110	50	110	6.3	170	4.6	
	29-Nov-14	8.3	1,700	920	190	720	90	44	100	6	170	5.2	
	23-Jun-15	8.2	1,900	1,100	230	770	120	51	120	6.2	190	4.8	
	22-May-16	8.1	1,500	740	160	580	86	44	100	6.2	170		2.5
	22-Nov-16	8.1	1,600	860	180	570	110	46	110	6.2	150	1.2	<5
	27-Apr-17	8.1	1,900	1,100	310	610	170	54	120	5.5	190	1.1	<5
	8-Nov-17	7.6	1,900	1,100	190	640	110	49	120	6.2	190	4.2	<5
	20-Apr-18	7.6	1,800	1,000	160	590	88	45	110	5.7	170	1.4	<5
	14-Apr-19	7.3	1,800	900	200	600	98	49	110	5.9	160	6.7	<5
	24-Nov-19	7.2	1,800	960	190	570	91	45	97	6.5	160	2.1	<5
	29-Apr-20	7.5	1,600	930	160	560	86	48	110	7.3	130	12	14
PB170A	29-Nov-14	8.2	1,800	1,000	270	540	69	140	70	5.8	120	96	
	23-Jun-15	8.1	1,900	1,100	310	560	83	120	83	5.9	150	44	
	22-Nov-16	8.0	1,500	900	300	320	65	79	66	6.9	140	0.026	<5
	27-Apr-17	7.8	880	530	60	370	20	63	31	4	85	2.5	<5
	8-Nov-17	8.3	730	440	57	250	20	21	31	4.9	84	20	5
	20-Apr-18	7.6	770	460	48	230	21	28	30	8.4	82	2.8	7
	12-Apr-19	8.0	850	510	51	260	25	41	31	8.7	84	80	<5
	24-Nov-19	7.1	1,000	570	34	470	18	70	43	2	77	1.7	<5
	29-Apr-20	7.5	1,700	960	240	480	76	100	65	6	140	25	20
WEB0089	22-Nov-16	7.8	830	500	48	470	27	75	45	1.9	77	1.1	<5
	8-Nov-17	7.7	1,000	640	61	440	31	74	47	2.2	82	<0.5	<5
	20-Apr-18	7.2	1,000	570	36	460	18	74	46	2.3	76	0.94	<5
	12-Apr-19	7.2	870	520	26	390	14	65	39	1.6	69	20	<5
	24-Nov-19	7.5	1,000	550	35	470	19	70	42	1.9	80	2	<5
	29-Apr-20	7.5	1,000	920	34	490	23	72	46	2.1	70	8.7	24

Table 5.9 - Trace Elements and Metals

Bore ID	Date	pH (pH units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	29-Nov-14	8.3	1,700	920	190	720	90	44	100	6	170	5.2	
	23-Jun-15	8.2	1,900	1,100	230	770	120	51	120	6.2	190	4.8	
	22-May-16	8.1	1,500	740	160	580	86	44	100	6.2	170		2.5
	22-Nov-16	8.1	1,600	860	180	570	110	46	110	6.2	150	1.2	<5
	27-Apr-17	8.1	1,900	1,100	310	610	170	54	120	5.5	190	1.1	<5
	8-Nov-17	7.6	1,900	1,100	190	640	110	49	120	6.2	190	4.2	<5
	20-Apr-18	7.6	1,800	1,000	160	590	88	45	110	5.7	170	1.4	<5
	14-Apr-19	7.3	1,800	900	200	600	98	49	110	5.9	160	6.7	<5
	24-Nov-19	7.2	1,800	960	190	570	91	45	97	6.5	160	2.1	<5
	29-Apr-20	7.5	1,600	930	160	560	86	48	110	7.3	130	12	14
PB170A	29-Nov-14	8.2	1,800	1,000	270	540	69	140	70	5.8	120	96	
	23-Jun-15	8.1	1,900	1,100	310	560	83	120	83	5.9	150	44	
	22-Nov-16	8.0	1,500	900	300	320	65	79	66	6.9	140	0.026	<5
	27-Apr-17	7.8	880	530	60	370	20	63	31	4	85	2.5	<5
	8-Nov-17	8.3	730	440	57	250	20	21	31	4.9	84	20	5
	20-Apr-18	7.6	770	460	48	230	21	28	30	8.4	82	2.8	7
	12-Apr-19	8.0	850	510	51	260	25	41	31	8.7	84	80	<5
	24-Nov-19	7.1	1,000	570	34	470	18	70	43	2	77	1.7	<5
	29-Apr-20	7.5	1,700	960	240	480	76	100	65	6	140	25	20
WEB0089	22-Nov-16	7.8	830	500	48	470	27	75	45	1.9	77	1.1	<5
	8-Nov-17	7.7	1,000	640	61	440	31	74	47	2.2	82	<0.5	<5
	20-Apr-18	7.2	1,000	570	36	460	18	74	46	2.3	76	0.94	<5
	12-Apr-19	7.2	870	520	26	390	14	65	39	1.6	69	20	<5
	24-Nov-19	7.5	1,000	550	35	470	19	70	42	1.9	80	2	<5
	29-Apr-20	7.5	1,000	920	34	490	23	72	46	2.1	70	8.7	24

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).
Values highlighted orange exceed the Australian Drinking Water Guidelines for health impacts (NHMRC, 2012).

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
GWB12	8/10/2010						<0.02		<0.005					
	7/04/2017	0.003	0.29	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	<0.001	0.003	0.33	<0.001	<0.001
	8/11/2017	0.003	0.22	<0.0001	<0.001	<0.001	0.02	<0.001	<0.005	0.001	0.002	0.4	<0.001	2.1
	17/04/2018	0.003	0.24	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.002	0.36	<0.001	0.083
	13/04/2019	0.003	0.22	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.002	0.34	<0.001	0.003
	24/11/2019	0.003	0.18	<0.0001	<0.001	0.002	<0.01	<0.001	<0.01	<0.001	0.002	0.27	<0.001	<0.005
	30/04/2020	0.003	0.21	<0.0001	<0.001	0.005	<0.01	<0.001	<0.01	<0.001	0.001	0.32	<0.010	0.006
GWB3	26/09/2010						<0.02		<0.005					
	6/04/2017	0.005	0.6	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.004	0.47	<0.001	<0.001
	8/11/2017	0.003	0.32	<0.0001	<0.001	<0.001	<0.01	0.002	<0.005	0.009	0.005	0.53	<0.001	4.5
	17/04/2018	0.003	0.39	<0.0001	<0.001	<0.001	0.04	0.002	<0.005	0.007	0.005	0.48	<0.001	2.9
	13/04/2019	0.004	0.39	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.003	0.47	<0.001	0.003
	24/11/2019	0.005	0.34	<0.0001	<0.001	0.002	<0.01	<0.001	<0.01	<0.001	0.004	0.38	<0.001	<0.005
	30/04/2020	0.004	0.33	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	0.003	0.42	<0.010	<0.005
GWB7	2/10/2010						<0.02		<0.005					
	6/04/2017	0.007	0.47	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.004	0.34	<0.001	<0.001
	8/11/2017	0.005	0.31	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.001	0.005	0.53	<0.001	3.5
	17/04/2018	0.005	0.35	<0.0001	<0.001	0.002	<0.01	0.001	<0.005	0.007	0.007	0.5	<0.001	2.6
	13/04/2019	0.001	0.41	<0.0001	<0.001	0.001	0.03	<0.001	0.013	0.011	0.003	0.48	<0.001	3.8
	24/11/2019	0.004	0.34	<0.0001	<0.001	0.005	<0.01	<0.001	<0.01	0.002	0.004	0.38	<0.001	0.8
MTWAB017	11/03/2014	0.024		<0.0001	<0.001	<0.001	<0.005	<0.001		0.001				1
	29/11/2014	0.015		<0.0001	<0.001	0.001	0.007	<0.001		<0.001				0.046
	26/05/2015	0.015		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				0.034

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	22/05/2016	0.011	0.3	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.002	0.52	0.0005	0.003
	22/11/2016	0.013	0.29	<0.0001	<0.001	0.001	<0.01	<0.001	<0.005	0.003	0.002	0.56	<0.001	0.21
	25/04/2017	0.004	<0.02	<0.0001	<0.001	<0.001	0.39	<0.001	0.12	0.001	<0.001	0.052	<0.001	0.001
	8/11/2017	0.004	0.04	<0.0001	<0.001	0.001	0.27	<0.001	0.08	<0.001	<0.001	0.089	0.001	0.004
	17/04/2018	0.005	0.05	<0.0001	<0.001	0.001	0.03	<0.001	0.018	<0.001	<0.001	0.1	<0.001	0.007
	12/04/2019	0.005	0.31	<0.0001	<0.001	<0.001	0.03	<0.001	0.054	0.001	<0.001	0.51	<0.001	0.003
	24/11/2019	0.015	0.27	<0.0001	<0.001	0.003	<0.01	<0.001	<0.01	<0.001	0.002	0.45	<0.001	<0.005
	3/05/2020	0.013	0.35	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.01	0.019	0.002	0.65	<0.010	0.033
PB107	2/12/2013	0.005		<0.0001		0.003	0.007	<0.001	<0.001					0.045
	8/03/2014	0.004		<0.0001	0.002	0.003	<0.005	<0.001		0.003				0.16
	31/05/2014	0.004		<0.0001	0.002	0.006	0.013	<0.001		0.008				2.9
	28/08/2014	0.004		<0.0001	0.002	0.004	<0.005	<0.001		0.004				0.17
	29/11/2014	0.003		<0.0001	0.002	0.004	0.045	<0.001		0.05				0.18
	24/11/2019	0.004	0.46	<0.0001	0.002	0.013	<0.01	<0.001	<0.01	0.003	0.005	0.31	<0.001	0.016
	29/04/2020	0.005	0.53	<0.0001	0.003	<0.001	<0.01	<0.001	<0.01	0.003	0.004	0.4	<0.010	0.005
PB110C	2/12/2013	0.003		<0.0001		0.009	0.097	<0.001	0.012					0.034
	8/03/2014	0.003		<0.0001	<0.001	0.009	<0.005	<0.001		0.004				0.09
	31/05/2014	0.003		<0.0001	0.001	0.008	<0.005	<0.001		0.004				0.026
	28/08/2014	0.002		<0.0001	<0.001	0.011	<0.005	<0.001		0.011				2.8
	29/11/2014	0.003		<0.0001	<0.001	0.005	0.032	<0.001		0.007				0.059
	22/05/2016	0.003	0.54	<0.0001	0.0005	0.01	<0.01	<0.001	0.0025	0.005	0.005	0.34	0.0005	0.086
	22/11/2016	0.002	0.59	<0.0001	<0.001	0.004	<0.01	<0.001	0.009	0.004	0.002	0.36	<0.001	0.005
	27/04/2017	0.003	0.56	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	0.002	0.004	0.29	<0.001	0.004
	8/11/2017	0.003	0.42	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	0.002	0.003	0.33	<0.001	0.007

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	14/04/2019	0.003	0.54	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	0.002	0.003	0.32	<0.001	0.004
	24/11/2019	0.003	0.43	<0.0001	0.001	0.012	<0.01	<0.001	<0.01	0.004	0.004	0.24	<0.001	0.016
	29/04/2020	0.003	0.51	<0.0001	0.001	0.005	0.02	<0.001	<0.01	0.004	0.003	0.28	0.02	0.01
PB110F	2/12/2013	0.004		<0.0001		0.014	<0.005	<0.001	<0.001					0.03
	8/03/2014	0.002		<0.0001	<0.001	0.006	0.03	0.001		0.026				2.2
	31/05/2014	0.004		<0.0001	0.001	0.008	0.013	<0.001		0.007				0.024
	28/08/2014	0.004		<0.0001	0.001	0.013	<0.005	<0.001		0.007				0.017
	29/11/2014	0.004		<0.0001	0.001	0.013	<0.005	<0.001		0.006				0.03
	21/05/2016	0.003	0.59	<0.0001	0.0005	0.005	<0.01	<0.001	0.0025	0.011	0.003	0.31	0.001	0.003
	26/04/2017	0.003	0.6	<0.0001	<0.001	0.012	<0.01	<0.001	<0.005	0.005	0.005	0.3	<0.001	0.008
	20/04/2018	0.003	0.51	<0.0001	<0.001	0.012	<0.01	<0.001	<0.005	0.006	0.006	0.34	<0.001	0.01
	14/04/2019	0.003	0.62	<0.0001	<0.001	0.011	<0.01	<0.001	<0.005	0.005	0.004	0.32	<0.001	0.008
	24/11/2019	0.003	0.47	<0.0001	0.001	0.023	<0.01	<0.001	<0.01	0.006	0.005	0.24	<0.001	0.019
	29/04/2020	0.004	0.54	<0.0001	0.002	0.006	<0.01	<0.001	<0.01	0.005	0.004	0.29	<0.010	0.006
PB58E	1/12/2013	0.003		<0.0001		0.003	0.01	<0.001	0.005					0.018
	8/03/2014	0.003		<0.0001	<0.001	0.003	<0.005	<0.001		0.001				0.039
	31/05/2014	0.002		<0.0001	<0.001	0.001	<0.005	<0.001		<0.001				0.045
	28/08/2014	0.003		<0.0001	<0.001	0.001	<0.005	<0.001		<0.001				0.035
	29/11/2014	0.004		<0.0001	<0.001	0.001	<0.005	<0.001		<0.001				<0.005
	21/05/2016	0.003	0.42	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.004	0.032	0.0005	<0.001
	7/04/2017	0.003	0.44	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.003	0.35	<0.001	<0.001
	8/11/2017	0.004	0.32	<0.0001	<0.001	<0.001	<0.01	0.001	<0.005	0.001	0.005	0.55	<0.001	1.6
	20/04/2018	0.005	0.35	<0.0001	<0.001	<0.001	<0.01	0.001	<0.005	0.001	0.005	0.45	<0.001	2.3
	13/04/2019	0.003	0.36	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.005	0.47	<0.001	0.015

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	24/11/2019	0.006	0.43	<0.0001	<0.001	0.002	<0.01	<0.001	<0.01	0.002	0.004	0.46	<0.001	0.1
	30/04/2020	0.005	0.42	<0.0001	<0.001	0.003	<0.01	<0.001	<0.01	0.002	0.003	0.47	<0.010	1.7
PB99D	1/12/2013	0.004		<0.0001		0.012	0.015	<0.001	0.004					0.016
	8/03/2014	0.006		<0.0001	<0.001	0.002	<0.005	<0.001		<0.001				0.041
	31/05/2014	0.006		<0.0001	<0.001	0.001	0.008	<0.001		<0.001				0.016
	28/08/2014	0.005		<0.0001	<0.001	0.002	0.019	<0.001		<0.001				0.024
	29/11/2014	0.004		<0.0001	<0.001	0.003	<0.005	<0.001		<0.001				0.056
	21/05/2016	0.005	0.36	<0.0001	0.0005	0.001	<0.01	<0.001	0.0025	<0.001	0.005	0.4	0.0005	0.003
	6/04/2017	0.006	0.46	<0.0001	<0.001	0.001	<0.01	<0.001	<0.005	<0.001	0.003	0.32	<0.001	<0.001
	8/11/2017	0.004	0.3	<0.0001	<0.001	0.002	<0.01	0.002	<0.005	0.01	0.004	0.43	<0.001	5.4
	20/04/2018	0.004	0.35	<0.0001	<0.001	<0.001	0.04	<0.001	<0.005	0.01	0.005	0.42	<0.001	4.1
	13/04/2019	0.005	0.39	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.004	0.4	<0.001	0.13
	24/11/2019	0.004	0.35	<0.0001	<0.001	0.002	0.01	<0.001	<0.01	0.004	0.005	0.35	<0.001	0.89
	30/04/2020	0.003	0.42	<0.0001	<0.001	0.002	<0.01	<0.001	0.01	0.007	0.003	0.43	<0.010	4.4
WEB0091	22/11/2016	0.01	0.32	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.004	0.003	0.64	<0.001	0.005
	24/04/2017	0.01	0.39	<0.0001	<0.001	0.003	0.01	<0.001	<0.005	0.004	0.006	0.62	<0.001	0.015
	8/11/2017	0.011	0.28	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	0.003	0.003	0.63	<0.001	0.015
	20/04/2018	0.01	0.35	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	0.003	0.003	0.54	<0.001	0.022
	12/04/2019	0.009	0.31	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	0.003	0.004	0.48	<0.001	0.028
	24/11/2019	0.009	0.28	<0.0001	<0.001	0.001	<0.01	<0.001	<0.01	0.002	0.004	0.4	<0.001	<0.005
	30/04/2020	0.011	0.32	<0.0001	<0.001	0.009	<0.01	0.001	<0.01	0.005	0.004	0.51	<0.010	0.055
WEB0108	13/04/2019	0.005	0.78	<0.0001	0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.007	0.89	<0.001	0.011
	24/11/2019	0.014	1	0.0001	0.002	0.003	<0.01	<0.001	<0.01	0.006	0.009	0.95	<0.001	0.009
	30/04/2020	0.011	0.91	<0.0001	0.002	0.001	<0.01	<0.001	<0.01	0.003	0.007	0.79	<0.010	0.035

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
WEB0119	13/04/2019	<0.001	0.1	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	<0.001	<0.001	0.11	<0.001	0.002
	24/11/2019	0.004	0.23	<0.0001	<0.001	0.001	<0.01	<0.001	0.01	<0.001	0.002	0.24	<0.001	0.01
	30/04/2020	0.004	0.23	<0.0001	<0.001	0.003	<0.01	<0.001	<0.01	0.001	0.001	0.32	<0.010	0.077
WEB0121	24/11/2019	0.003	0.18	<0.0001	<0.001	0.003	<0.01	<0.001	<0.01	<0.001	0.003	0.31	<0.001	<0.005
	30-Apr-20	0.003	0.18	<0.0001	<0.001	0.003	<0.01	<0.001	<0.01	<0.001	0.002	0.34	<0.010	0.026
WMBAB001	11-Mar-14	0.012		<0.0001	<0.001	<0.001	0.006	<0.001		<0.001				0.056
	31-May-14	0.013		<0.0001	<0.001	0.002	0.022	0.003		0.006				2.9
	28-Aug-14	0.017		<0.0001	<0.001	<0.001	<0.005	<0.001		0.002				0.044
	29-Nov-14	0.015		<0.0001	0.001	0.006	0.016	<0.001		0.008				0.047
	23-Jun-15	0.013		<0.0001	<0.001	<0.001	0.006	0.003		0.005				4.6
	22-May-16	0.013	0.28	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.002	0.5	0.0005	0.009
	22-Nov-16	0.014	0.25	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.002	0.51	<0.001	0.011
	25-Apr-17	0.014	0.2	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	<0.001	<0.001	0.27	<0.001	0.012
	8-Nov-17	0.018	0.25	<0.0001	<0.001	0.001	<0.01	<0.001	<0.005	<0.001	0.002	0.58	<0.001	0.025
	20-Apr-18	0.017	0.31	<0.0001	<0.001	0.004	<0.01	<0.001	<0.005	0.001	0.002	0.56	<0.001	0.19
	12-Apr-19	0.013	0.27	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	0.002	0.002	0.46	<0.001	0.047
	24-Nov-19	0.014	0.24	<0.0001	<0.001	0.002	<0.01	<0.001	<0.01	<0.001	0.003	0.39	<0.001	0.006
	30-Apr-20	0.016	0.22	<0.0001	<0.001	0.002	<0.01	<0.001	<0.01	<0.001	0.002	0.38	<0.010	0.051
WMBAB002	8-Mar-14	0.014		<0.0001	<0.001	0.001	0.007	<0.001		0.022				0.057
	31-May-14	0.013		<0.0001	<0.001	0.025	0.024	0.001		0.004				0.82
	28-Aug-14	0.004		<0.0001	<0.001	0.002	0.68	<0.001		0.014				9.2
	29-Nov-14	0.012		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				0.009
	22-May-16	0.012	0.31	<0.0001	0.0005	0.001	<0.01	<0.001	0.0025	<0.001	0.002	0.56	0.0005	0.005
	22-Nov-16	0.014	0.3	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.002	0.6	<0.001	0.027

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	25-Apr-17	0.013	0.27	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	<0.001	0.002	0.44	<0.001	0.018
	8-Nov-17	0.009	0.23	<0.0001	<0.001	0.003	<0.01	<0.001	0.01	<0.001	0.002	0.51	<0.001	0.24
	20-Apr-18	0.014	0.27	<0.0001	<0.001	0.007	<0.01	0.001	<0.005	0.011	0.002	0.49	<0.001	0.18
	12-Apr-19	0.013	0.27	<0.0001	<0.001	0.004	<0.01	0.002	<0.005	<0.001	0.002	0.49	<0.001	0.045
	24-Nov-19	0.013	0.27	<0.0001	<0.001	0.003	0.02	<0.001	<0.01	<0.001	0.006	0.42	<0.001	0.006
	30-Apr-20	0.012	0.23	<0.0001	<0.001	0.009	<0.01	0.001	<0.01	0.004	0.001	0.44	<0.010	0.11
MTWAB018	11-Mar-14	<0.001		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				0.026
	31-May-14	<0.001		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				0.021
	29-Nov-14	<0.001		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				<0.005
	21-May-16	0.0005	0.063	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.0005	0.18	0.0005	0.003
	25-Apr-17	<0.001	0.04	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	<0.001	0.16	<0.001	0.004
	17-Apr-18	<0.001	0.05	<0.0001	<0.001	0.001	<0.01	<0.001	<0.005	<0.001	<0.001	0.21	<0.001	0.005
	11-Apr-19	<0.001	0.06	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001	0.2	<0.001	0.003
	24-Nov-19	<0.001	<0.05	<0.0001	<0.001	0.003	<0.01	<0.001	<0.01	<0.001	<0.001	0.13	<0.001	<0.005
PB55A	31-May-14	0.075		<0.0001	0.002	<0.001	<0.005	<0.001		0.001				0.031
	28-Aug-14	0.068		<0.0001	0.002	<0.001	<0.005	<0.001		0.002				0.071
	29-Nov-14	0.071		<0.0001	0.002	<0.001	<0.005	<0.001		0.002				0.036
	21-May-16	0.061	0.79	<0.0001	0.001	<0.001	<0.01	<0.001	0.0025	<0.001	0.009	0.59	0.0005	0.004
	26-Apr-17	0.06	0.62	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.007	0.58	<0.001	0.008
	17-Apr-18	0.076	0.63	<0.0001	<0.001	0.001	<0.01	<0.001	<0.005	<0.001	0.006	0.57	<0.001	0.005
	13-Apr-19	0.062	0.55	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	0.002	0.005	0.055	<0.001	0.004
	24-Nov-19	0.073	0.55	<0.0001	<0.001	0.001	<0.01	<0.001	<0.01	<0.001	0.007	0.26	<0.001	0.005
	29-Apr-20	0.051	0.31	<0.0001	0.001	<0.001	<0.01	<0.001	<0.01	0.002	0.003	0.06	<0.010	0.012
WEB0107	12-Apr-19	<0.001	0.23	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.003	0.31	<0.001	0.003

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	24-Nov-19	<0.001	0.21	<0.0001	<0.001	0.002	<0.01	<0.001	<0.01	<0.001	0.002	0.28	<0.001	0.009
WMBAB003	31-May-14	0.007		<0.0001	<0.001	0.089	3	0.033		0.014				1.9
	28-Aug-14	0.004		<0.0001	<0.001	0.002	0.25	<0.001		0.011				2.8
	24-Jun-15	0.006		<0.0001	0.012	<0.001	0.006	<0.001		<0.001				<0.005
	24-Nov-19	0.006	0.19	<0.0001	<0.001	0.002	<0.01	<0.001	<0.01	<0.001	0.001	0.2	<0.001	<0.005
MTWOB016	29-Nov-14	0.002		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				<0.005
	21-May-16	0.002	0.7	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.001	0.95	0.0005	0.001
	25-Apr-17	0.013	0.29	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	<0.001	0.003	0.33	<0.001	0.1
	20-Apr-18	0.001	0.6	<0.0001	<0.001	0.002	0.01	<0.001	1.4	0.002	<0.001	0.89	<0.001	0.013
	11-Apr-19	<0.001	0.66	<0.0001	<0.001	<0.001	<0.01	<0.001	0.14	<0.001	<0.001	0.85	<0.001	0.021
MTWOB017	29-Nov-14	0.014		<0.0001	<0.001	0.002	<0.005	<0.001		<0.001				0.007
	21-May-16	0.01	0.23	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.003	0.48	0.0005	0.002
	25-Apr-17	0.013	0.2	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.002	0.29	<0.001	0.005
	17-Apr-18	0.016	0.23	<0.0001	<0.001	0.002	<0.01	<0.001	0.007	<0.001	0.002	0.43	<0.001	0.013
	12-Apr-19	0.014	0.28	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.002	0.002	0.42	<0.001	0.005
MTWOB018	29-Nov-14	<0.001		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				0.01
	21-May-16	0.0005	0.055	<0.0001	0.002	0.007	<0.01	<0.001	0.012	0.003	0.0005	0.23	0.001	0.039
	25-Apr-17	<0.001	0.03	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001	0.19	<0.001	0.003
	20-Apr-18	<0.001	0.04	<0.0001	<0.001	<0.001	<0.01	<0.001	0.008	<0.001	<0.001	0.2	<0.001	0.005
	11-Apr-19	<0.001	0.05	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001	0.2	<0.001	0.006
MTWOB019	29-Nov-14	0.005		<0.0001	<0.001	0.001	0.01	<0.001		0.001				0.008
	21-May-16	0.005	0.18	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.001	0.41	0.0005	0.002
	26-Apr-17	0.002	0.09	<0.0001	<0.001	0.004	<0.01	<0.001	<0.005	0.001	<0.001	0.18	<0.001	0.033
	17-Apr-18	0.002	0.1	<0.0001	<0.001	0.002	<0.01	<0.001	0.19	0.003	<0.001	0.28	<0.001	0.007

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	12-Apr-19	0.004	0.06	<0.0001	<0.001	0.001	0.01	<0.001	0.073	0.002	<0.001	0.13	<0.001	0.011
Obs107E	2-Dec-13	0.002		<0.0001		0.001	0.017	<0.001	0.25					0.018
	29-Nov-14	0.002		<0.0001	<0.001	0.001	0.009	<0.001		0.001				0.013
	21-May-16	<0.001	0.14	<0.0001	0.0005	<0.001	<0.01	<0.001	0.026	0.002	0.0005	0.47	0.0005	0.002
	26-Apr-17	<0.001	0.04	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	<0.001	0.27	<0.001	0.004
	20-Apr-18	0.002	0.1	<0.0001	<0.001	<0.001	0.32	<0.001	0.25	0.001	<0.001	0.52	<0.001	0.006
	14-Apr-19	0.001	0.08	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.007	<0.001	0.32	<0.001	0.028
Obs108A	2-Dec-13	0.004		<0.0001		0.004	0.038	<0.001	0.01					0.013
Obs109B	2-Dec-13	0.001		<0.0001		0.002	<0.005	<0.001	<0.001					0.007
	29-Nov-14	0.002		<0.0001	0.004	0.016	<0.005	<0.001		0.006				0.026
Obs169B	3-Dec-13	0.002		<0.0001		<0.001	0.02	<0.001	0.11					0.015
	29-Nov-14	0.002		<0.0001	<0.001	0.001	<0.005	<0.001		<0.001				0.056
	21-May-16	0.002	0.2	<0.0001	0.0005	<0.001	<0.01	<0.001	0.13	0.001	0.0005	0.33	0.0005	0.003
	26-Apr-17	0.002	0.2	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.001	0.4	<0.001	0.002
	20-Apr-18	0.002	0.2	<0.0001	<0.001	0.001	<0.01	<0.001	0.09	0.001	0.001	0.42	<0.001	0.004
	12-Apr-19	0.002	0.23	<0.0001	<0.001	0.001	<0.01	<0.001	0.01	0.002	<0.001	0.43	<0.001	0.003
Obs173	3-Dec-13	0.005		<0.0001		<0.001	<0.005	<0.001	0.035					0.02
	29-Nov-14	0.002		<0.0001	0.004	<0.001	<0.005	<0.001		<0.001				0.013
	26-Apr-17	0.002	0.33	<0.0001	0.001	0.003	<0.01	<0.001	<0.005	0.002	<0.001	0.19	<0.001	0.003
	17-Apr-18	0.003	0.27	<0.0001	0.001	0.001	0.01	<0.001	0.4	0.015	<0.001	0.24	<0.001	0.004
	11-Apr-19	0.003	0.35	<0.0001	0.003	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001	0.18	<0.001	0.003
Obs53	30-Nov-13	0.063		<0.0001		0.002	0.097	<0.001	0.064					0.013
	29-Nov-14	0.003		<0.0001	0.005	<0.001	0.018	<0.001		0.31				0.032
Obs54B	3-Dec-13	0.11		<0.0001		0.003	0.16	<0.001	0.035					0.015

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	29-Nov-14	0.25		<0.0001	<0.001	<0.001	0.68	<0.001		0.007				0.016
Obs56	3-Dec-13	0.11		<0.0001		0.002	1.9	<0.001	0.32					0.005
	29-Nov-14	0.029		<0.0001	<0.001	<0.001	<0.005	<0.001		0.001				0.006
	21-May-16	0.027	0.84	<0.0001	0.0005	<0.001	<0.01	<0.001	0.17	<0.001	0.0005	0.35	0.0005	<0.001
	26-Apr-17	0.037	0.86	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	<0.001	0.34	<0.001	0.003
	17-Apr-18	0.068	0.81	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001	0.39	<0.001	0.004
	13-Apr-19	0.024	1	<0.0001	0.001	<0.001	<0.01	<0.001	0.097	0.001	<0.001	0.4	<0.001	0.002
Obs99	1-Dec-13	0.001		<0.0001		0.003	0.11	<0.001	0.1					0.032
	29-Nov-14	<0.001		<0.0001	<0.001	0.001	<0.005	<0.001		0.001				0.011
WEB0078	25-Apr-17	0.012	0.42	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	0.005	0.006	0.68	<0.001	0.04
	20-Apr-18	0.014	0.44	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.005	0.008	0.62	<0.001	0.002
	12-Apr-19	0.011	0.41	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.002	0.003	0.51	<0.001	0.002
WEB0085	25-Apr-17	0.005	0.21	<0.0001	<0.001	0.001	<0.01	<0.001	<0.005	<0.001	0.001	0.31	<0.001	0.014
	12-Apr-19	0.006	0.27	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.001	0.42	<0.001	0.003
WEB0106	15-Dec-18	0.003	0.47	<0.0001	<0.001	<0.001	<0.01	<0.001	0.073	0.002	0.002	0.78	<0.001	<0.001
WEB0113	13-Dec-18	0.002	0.22	<0.0001	<0.001	<0.001	<0.01	<0.001	0.045	<0.001	0.001	0.45	<0.001	<0.001
WMBOB001	29-Nov-14	0.009		<0.0001	<0.001	0.001	0.23	<0.001		<0.001				0.023
	25-Apr-17	0.007	0.26	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.001	0.29	<0.001	<0.001
	20-Apr-18	0.013	0.24	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.002	0.49	<0.001	0.043
WMBOB002	29-Nov-14	0.011		<0.0001	<0.001	<0.001	<0.005	<0.001		0.001				0.01
	21-May-16	0.01	0.29	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.002	0.49	0.0005	0.002
	25-Apr-17	0.014	0.1	<0.0001	<0.001	0.001	<0.01	<0.001	<0.005	<0.001	<0.001	0.23	<0.001	0.004
	20-Apr-18	0.014	0.2	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.001	0.36	<0.001	0.005
	12-Apr-19	0.012	0.26	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.002	0.39	<0.001	0.002

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
Potable Bores														
MTWAB016	8-Mar-14	0.013		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				0.024
	31-May-14	0.007		<0.0001	<0.001	<0.001	<0.005	<0.001		<0.001				0.01
	28-Aug-14	0.012		<0.0001	<0.001	<0.001	0.007	<0.001		0.002				0.58
	29-Nov-14	0.01		<0.0001	<0.001	0.001	0.014	<0.001		0.002				0.89
	26-May-15	0.01		<0.0001	0.001	0.001	0.025	<0.001		0.002				2.3
	22-May-16	0.01	0.32	<0.0001	0.0005	0.002	<0.01	<0.001	0.0025	<0.001	0.009	0.57	0.0005	0.42
	22-Nov-16	0.008	0.31	<0.0001	<0.001	<0.001	0.07	<0.001	<0.005	<0.001	0.004	0.79	<0.001	0.39
	27-Apr-17	0.002	0.7	<0.0001	<0.001	0.001	<0.01	<0.001	0.67	0.002	<0.001	0.86	<0.001	0.003
	8-Nov-17	0.011	0.22	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	0.002	0.49	<0.001	0.003
	17-Apr-18	0.011	0.27	<0.0001	<0.001	<0.001	0.01	<0.001	<0.005	<0.001	0.002	0.48	<0.001	0.017
	12-Apr-19	0.009	0.31	<0.0001	<0.001	0.005	<0.01	<0.001	0.006	<0.001	0.003	0.51	<0.001	0.09
	24-Nov-19	0.012	0.25	<0.0001	<0.001	0.001	<0.01	<0.001	<0.01	<0.001	0.002	0.4	<0.001	<0.005
	30-Apr-20	0.012	0.22	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.01	0.002	0.001	0.41	<0.010	<0.005
PB109D	2-Dec-13	0.003		<0.0001		0.003	0.035	<0.001	0.003					0.053
	8-Mar-14	0.003		<0.0001	0.003	0.003	<0.005	<0.001		0.003				0.026
	31-May-14	0.002		<0.0001	0.003	0.004	0.008	<0.001		0.006				1.8
	26-Aug-14	0.003	0.46								0.008		<0.001	
	28-Aug-14	0.003		<0.0001	0.004	0.003	<0.005	<0.001		0.005				0.018
	29-Nov-14	0.003		<0.0001	0.003	0.004	<0.005	<0.001		0.004				0.029
	23-Mar-15	0.003	0.56								0.007			
	23-Jun-15	0.003		<0.0001	0.002	0.003	<0.005	<0.001		0.006				0.019
	22-May-16	0.003	0.49	<0.0001	0.003	0.003	<0.01	<0.001	0.0025	0.003	0.005	0.28	0.0005	0.005
	22-Nov-16	0.003	0.51	<0.0001	0.003	0.003	<0.01	<0.001	<0.005	0.004	0.005	0.32	<0.001	0.015

Table 5.9 - Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	27-Apr-17	0.003	0.53	<0.0001	<0.001	0.006	<0.01	<0.001	<0.005	0.004	0.004	0.33	<0.001	0.007
	8-Nov-17	0.003	0.42	<0.0001	0.001	0.003	<0.01	<0.001	<0.005	0.004	0.005	0.36	<0.001	0.008
	20-Apr-18	0.003	0.5	<0.0001	0.001	0.003	0.02	<0.001	<0.005	0.004	0.005	0.32	<0.001	0.068
	14-Apr-19	0.002	0.52	<0.0001	<0.001	0.006	<0.01	<0.001	<0.005	0.005	0.004	0.33	<0.001	0.15
	24-Nov-19	0.003	0.41	<0.0001	0.002	0.004	<0.01	<0.001	<0.01	0.004	0.005	0.24	<0.001	<0.005
	29-Apr-20	0.003	0.44	<0.0001	0.002	0.004	<0.01	<0.001	<0.01	0.004	0.003	0.32	<0.010	0.051
PB170A	29-Nov-14	<0.001		<0.0001	<0.001	0.002	0.009	<0.001		0.003				1.6
	23-Mar-15	0.001	0.3								0.002			
	23-Jun-15	<0.001		<0.0001	<0.001	0.001	0.016	0.004		0.014				3.2
	22-Nov-16	<0.001	0.24	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.04	<0.001	0.75	<0.001	0.003
	27-Apr-17	<0.001	0.1	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	0.001	<0.001	0.35	<0.001	0.008
	8-Nov-17	<0.001	0.1	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	<0.001	0.33	<0.001	0.01
	20-Apr-18	<0.001	0.2	<0.0001	<0.001	0.003	0.01	<0.001	0.017	0.001	<0.001	0.31	<0.001	0.008
	12-Apr-19	<0.001	0.2	<0.0001	<0.001	0.002	<0.01	<0.001	<0.005	<0.001	<0.001	0.34	<0.001	0.004
	24-Nov-19	0.005	0.15	<0.0001	<0.001	0.007	<0.01	<0.001	<0.01	<0.001	0.001	0.33	<0.001	0.007
	29-Apr-20	0.001	0.3	<0.0001	<0.001	0.001	<0.01	<0.001	<0.01	<0.001	0.001	0.72	<0.010	<0.005
WEB0089	22-Nov-16	0.004	0.2	<0.0001	<0.001	0.003	<0.01	<0.001	<0.005	0.004	0.001	0.42	<0.001	1
	8-Nov-17	0.002	0.2	<0.0001	<0.001	<0.001	0.03	<0.001	0.024	0.003	<0.001	0.45	<0.001	1.6
	20-Apr-18	0.005	0.2	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.001	0.43	<0.001	0.007
	12-Apr-19	0.004	0.2	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	0.001	0.001	0.36	<0.001	0.008
	24-Nov-19	0.005	0.15	<0.0001	<0.001	0.002	<0.01	<0.001	<0.01	<0.001	0.001	0.33	<0.001	<0.005
	29-Apr-20	0.005	0.15	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.01	<0.001	<0.001	0.41	<0.010	0.023

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).
Values highlighted orange exceed the Australian Drinking Water Guidelines for health impacts (NHMRC, 2012).

Table 5.10 - Hydrocarbons

Bore ID	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	o-xylene (mg/L)	Toluene (mg/L)	Total recoverable hydrocarbons (TRH)					
						C6-C9 (mg/L)	C10-C14 (mg/L)	C10-C36 (mg/L)	C15-C28 (mg/L)	C29-C36 (mg/L)	C6-C36 Total (mg/L)
GWB12	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	13-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
GWB3	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	13-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
GWB7	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	13-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
MTWAB017	11-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	26-May-15					<0.04	<0.05		<0.2	<0.2	<0.5
	22-May-16	<0.001	<0.001	<0.001	<0.001	0.005	0.025		0.05	0.05	
	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	12-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	0.11		0.51	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
PB107	12-Dec-13						<0.04	<0.44	<0.2	<0.2	
	8-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
PB110C	12-Dec-13						<0.04	<0.44	<0.2	<0.2	

Table 5.10 - Hydrocarbons

Bore ID	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	o-xylene (mg/L)	Toluene (mg/L)	Total recoverable hydrocarbons (TRH)					
						C6-C9 (mg/L)	C10-C14 (mg/L)	C10-C36 (mg/L)	C15-C28 (mg/L)	C29-C36 (mg/L)	C6-C36 Total (mg/L)
	8-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	22-May-16	<0.001	<0.001	<0.001	<0.001	0.005	0.025		0.05	0.05	0.005
	22-Nov-16	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1	<0.5
	14-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
PB110F	12-Dec-13						<0.04	<0.44	<0.2	<0.2	
	8-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	0.06	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
PB58E	8-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	13-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
PB99D	8-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5

Table 5.10 - Hydrocarbons

Bore ID	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	o-xylene (mg/L)	Toluene (mg/L)	Total recoverable hydrocarbons (TRH)					
						C6-C9 (mg/L)	C10-C14 (mg/L)	C10-C36 (mg/L)	C15-C28 (mg/L)	C29-C36 (mg/L)	C6-C36 Total (mg/L)
	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	13-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
WEB0091	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	12-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
WEB0108	13-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
WEB0119	13-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
WEB0121	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
WMBAB001	11-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	22-May-16	<0.001	<0.001	<0.001	<0.001		0.05		0.05	0.005	
	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	12-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
WMBAB002	8-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	12-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	

Table 5.10 - Hydrocarbons

Bore ID	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	o-xylene (mg/L)	Toluene (mg/L)	Total recoverable hydrocarbons (TRH)					
						C6-C9 (mg/L)	C10-C14 (mg/L)	C10-C36 (mg/L)	C15-C28 (mg/L)	C29-C36 (mg/L)	C6-C36 Total (mg/L)
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
MTWAB018	11-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
PB55A	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
WMBAB003	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
MTWOB016	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
MTWOB017	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
MTWOB018	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
MTWOB019	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
OBS107E	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
OBS109B	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
OBS169B	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
OBS173	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
OBS53	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
OBS54B	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
OBS56	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
OBS99	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
WMBOB001	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
WMBOB002	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5

Table 5.10 - Hydrocarbons

Bore ID	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	o-xylene (mg/L)	Toluene (mg/L)	Total recoverable hydrocarbons (TRH)					
						C6-C9 (mg/L)	C10-C14 (mg/L)	C10-C36 (mg/L)	C15-C28 (mg/L)	C29-C36 (mg/L)	C6-C36 Total (mg/L)
Potable Bores											
MTWAB016	12-Dec-13						<0.04	<0.44	<0.2	<0.2	
	8-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	26-May-15					<0.04	<0.05		<0.2	<0.2	<0.5
	22-May-16	<0.001	<0.001	<0.001	<0.001	0.005	0.025		0.05	0.05	
	22-Nov-16	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1	<0.5
	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	12-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
PB109D	12-Dec-13						<0.04	<0.44	<0.2	<0.2	
	8-Mar-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05	<0.05	<0.2	<0.2	
	31-May-14					<0.04	<0.05		<0.2	<0.2	
	26-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	28-Aug-14	<0.0005	<0.0005	<0.0005	<0.0005	<0.04	<0.05		<0.2	<0.2	
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	23-Jun-15					<0.04	<0.05		<0.2	<0.2	<0.5
	22-May-16	<0.001	<0.001	<0.001	<0.001		0.025		0.05	0.05	
	22-Nov-16	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1	<0.5
	14-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
PB170A	12-Dec-13						<0.04	<0.44	<0.2	<0.2	

Table 5.10 - Hydrocarbons

Bore ID	Date	Benzene (mg/L)	Ethylbenzene (mg/L)	o-xylene (mg/L)	Toluene (mg/L)	Total recoverable hydrocarbons (TRH)					
						C6-C9 (mg/L)	C10-C14 (mg/L)	C10-C36 (mg/L)	C15-C28 (mg/L)	C29-C36 (mg/L)	C6-C36 Total (mg/L)
	29-Nov-14					<0.04	<0.05		<0.2	<0.2	<0.5
	23-Jun-15					<0.04	<0.05		<0.2	<0.2	<0.5
	22-Nov-16	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1	<0.5
	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	12-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	
WEB0089	22-Nov-16	<0.001	<0.001	<0.001	<0.001	<0.01	<0.05		<0.1	<0.1	<0.5
	17-Apr-18	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	12-Apr-19	<0.001	<0.001	<0.001	<0.001	<0.010	<0.050		<0.100	<0.100	
	24-Nov-19	<0.001	<0.001	<0.003	<0.001	<0.02	<0.02		<0.04	<0.04	

5.13 Compliance

Water levels in some East Fender production bores (GWB3, GWB7, WEB0108, and WEB0119) temporarily declined below pumping water level triggers but recovered quickly due to a combination of pumping rate modifications and seasonal recharge. No water quality trigger values were exceeded during the reporting period. Table 5.11 summarises the compliance commitments at Mt Webber.

Table 5.11 - Summary of Commitments and Compliance

Activity	Action	Compliance	Comments
Administration	Submit the aquifer review to DoW annually on 30 September. This report will contain: Compliance with the monitoring schedule and assess results. Aquifer performance against that predicted.	Compliant	Report submitted 30th September.
	Review SWOP in conjunction with annual/triennial reporting.	Compliant	SWOP reviewed November 2019.
Monitoring	Implementation of monitoring schedule as per SWOP.	Mostly compliant	Gaps in record due to access issues and staffing.
Water use efficiency	Monthly infrastructure checks/maintenance.	Compliant	Checks completed monthly and during SWOP review.
	Site water balance review as required.	Compliant	Review completed during SWOP review.
Contingency plans	Review triggers annually or as required.	Compliant	Review completed during SWOP review.

In general, the monitoring requirements were met during the reporting period. However, some gaps appear in the record as a result of access issues and staffing shortages. Table 5.12 provides details for non-compliances.

Table 5.12 - Non-Compliances

Frequency	Requirement	Monitoring Period	Non-compliances
Production Bores			
Monthly	Water level	January	GWB12, WEB0108 and WEB0119
		March	PB110F
		May	GWB3, PB110F, GWB12, WEB0108, MTWAB016, PB109D, PB110C, PB170A, WEB0089, WEB0091 and WEB0119
		June	MTWAB017
		September	WMBAB001
		October	WMBAB001
	Field chemistry (pH, EC, temperature)	January	GWB3, GWB12, WEB0108 and WEB0119
		March	PB110F
		April	MTWAB017, PB55A , GWB3 and GWB7
		May	GWB3, GWB7, GWB12, WEB0108, WEB0119, MTWAB016, PB55A , PB109D, PB110C, PB110F, PB170A, WEB0089, PB107, WEB0091, WMBAB001, and WMBAB002
		June	GWB7, PB55A and MTWAB017
		July	MTWAB017
		December	PB110F
Monitoring and Regional Bores			
Quarterly	Water level	Q1	WEB0122, WEB0123 and WMBOB001
	Field chemistry (pH, EC, temperature)	Q1	WMBOB001
		Q2	Obs173, WMBOB001, MTWOB016 and MTWOB017
		Q3	WEB0122 and WEB0123
		Q4	Obs107E, Obs108A and Obs109B
Annual	Laboratory analysis	Annual (Nov)	All monitoring bores

5.14 Assessment of Impacts

5.14.1 Water Levels

Bores in the South Haul Road borefield show gradual water level declines, which is exacerbated in production bores and their associated monitoring bores. Conversely, all bores showed rapid recovery during the seasonal rainfall event in January to approximately the same level as historical maximums, although this is indicative of a limited storage capacity.

Water levels in the East Fender Borefield showed declines in the first half of the reporting period during higher than anticipated utilisation. However, seasonal rainfall and reduced abstraction promoted recovery of water levels in the second half of the reporting period in most bores.

The West Ibanez Borefield, along with PB107 (Contractor Area) and WEB0089 (Camp Area), showed gradually declining water levels over the reporting period. This is believed to be due to each production bore being fully utilised at or above its modelled capacity. It is noted that none of these bores are in the vicinity of GDEs. Further, the West Ibanez and Contractor Area Borefields are also not within or adjacent to areas disturbed by mining activity.

In the short term, aquifer levels can be managed within the current operational requirements. However, there is some reliance on regular seasonal rainfall for groundwater recovery with limited storage capacity available.

5.14.2 Water Quality

Water quality has remained relatively consistent over the project area since monitoring began. This suggests that abstraction of groundwater has not resulted in deterioration of water quality thus far over the life of the project. Potable water at Mt Webber is fresh with moderate to low concentrations of major ions. However, water quality in the Mt Webber bores is typical of BIF and granite, most notably the naturally occurring metals which are reported to be above the Australian Drinking Water Guidelines (NHMRC, 2012).

There are no water quality implications on Mt Webber DSO Project operations as all potable water sources are treated to maintain compliance with the ADWG, which is verified by monthly testing. All other water is used for dust suppression or mining activities. Prior to treatment, raw water samples occasionally return sporadic detections of metals slightly above the guidelines which is consistent with background sampling results and typical of groundwater in the Pilbara.

5.14.3 Vegetation Impacts

No vegetation impacts have been observed in the vicinity of bores WMBAB001, WMBAB002, WEB0091, WEB0108, WEB0119 and WEB0121 since the implementation of the monthly vegetation monitoring required under SWOP 5b in conjunction with GWL177240(7) issued in November 2019.

5.15 Recommendations

Considering the monitoring results obtained to date, the following recommendations are made:

- Continue Monitoring as per Table 7.1 of the approved SWOP.
- Improve tracking of water usage by installing flowmeters at remaining standpipes.
- Identify and investigate water conservation opportunities.
- Develop supplies as required according to the Mt Webber Life of Mine Water Supply Plan (Atlas, 2015e).

Recommended Changes to the SWOP
Following review of the Annual Report and agreement by the DWER to the recommendations these changes are to be implemented as a modification to the commitments as per condition 2 of GWL177240(7)

1. Change the text in Table 7.1 of the approved SWOP from “Monitoring, regional bores and non-operational monitoring bores” to “Monitoring, regional bores and non-operational production bores”

6. PARDOO

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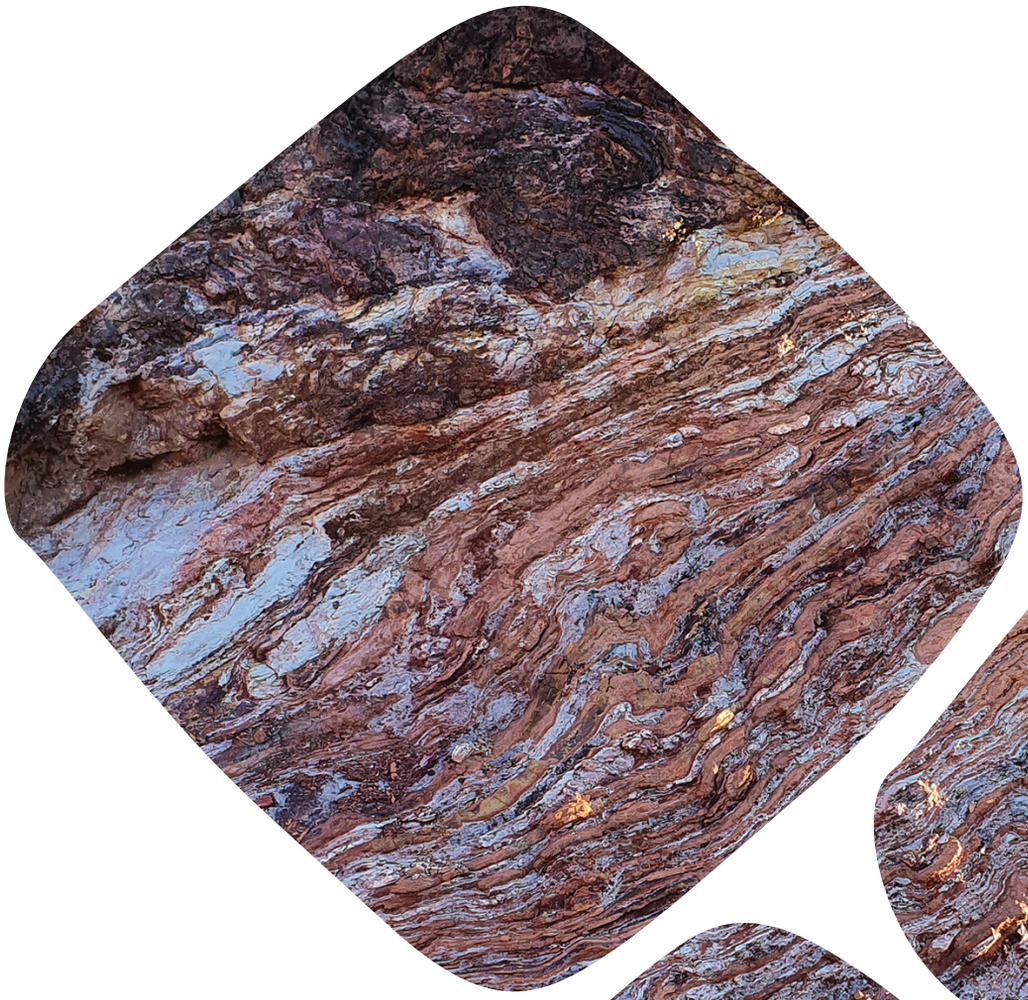

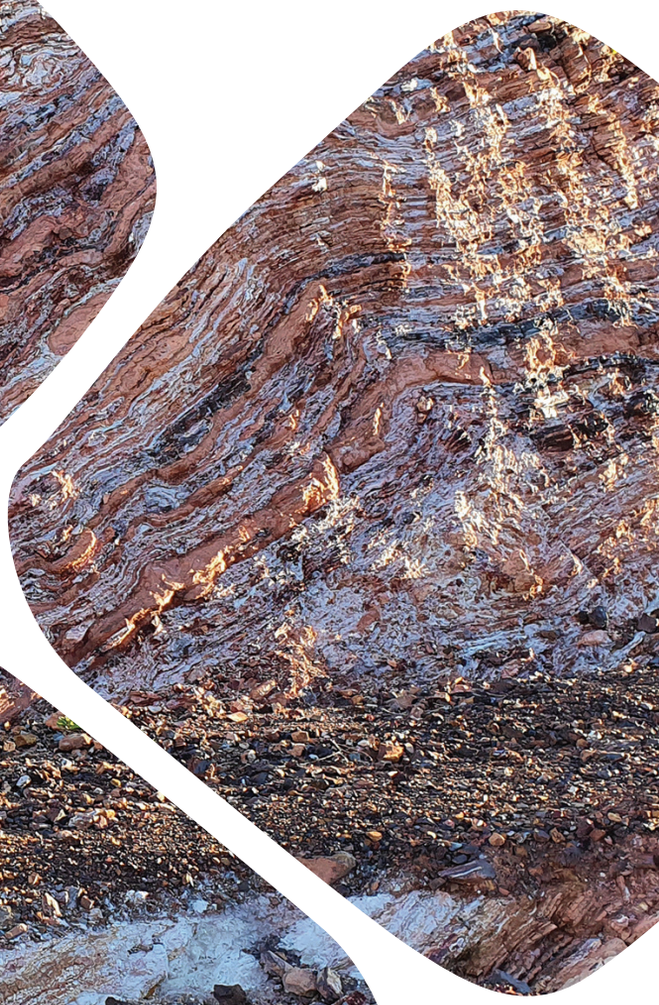

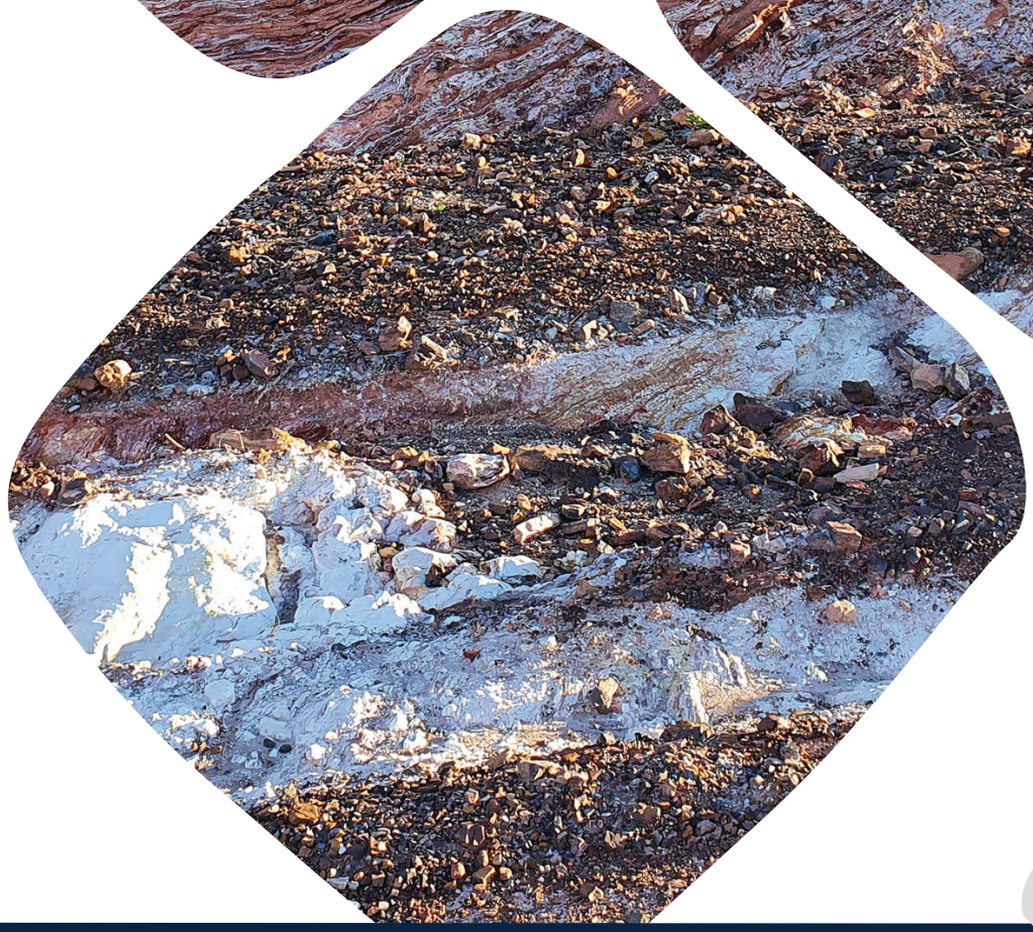

6.1 Introduction

This Groundwater Monitoring Report relates to instrument GWL166951(5), which allows Atlas Iron Limited (Atlas) to take water under section 5C of the Rights in Water and Irrigation Act 1914 (RIWI Act).

This report is intended to satisfy the annual monitoring reporting requirements for GWL166951(5) in accordance with the Pardoo DSO Project - Closure Monitoring Program (Atlas, 2014a). Please refer to the 2013/2014 Atlas Water Report (Atlas, 2014b) for details on the life of mine aquifer impact assessment.

6.2 Background and Location

The Pardoo DSO Project (the project) is located within the De Grey pastoral station, approximately 70 km east of Port Hedland in the Pilbara region of Western Australia (Figure 6.1).

From April 2009 to November 2013 the project involved mining in small open cut pits. Ore was crushed, screened and stockpiled onsite and then loaded into road trains for haulage to an export berth at Port Hedland. Active dewatering from a network of production bores occurred over this period in support of mining operations.

Mining and associated dewatering at Pardoo ceased in November 2013. Low volume pumping continued until April 2014 to support decommissioning and rehabilitation activities and to provide discharge water to Ridley Creek to support ongoing environmental impact studies.

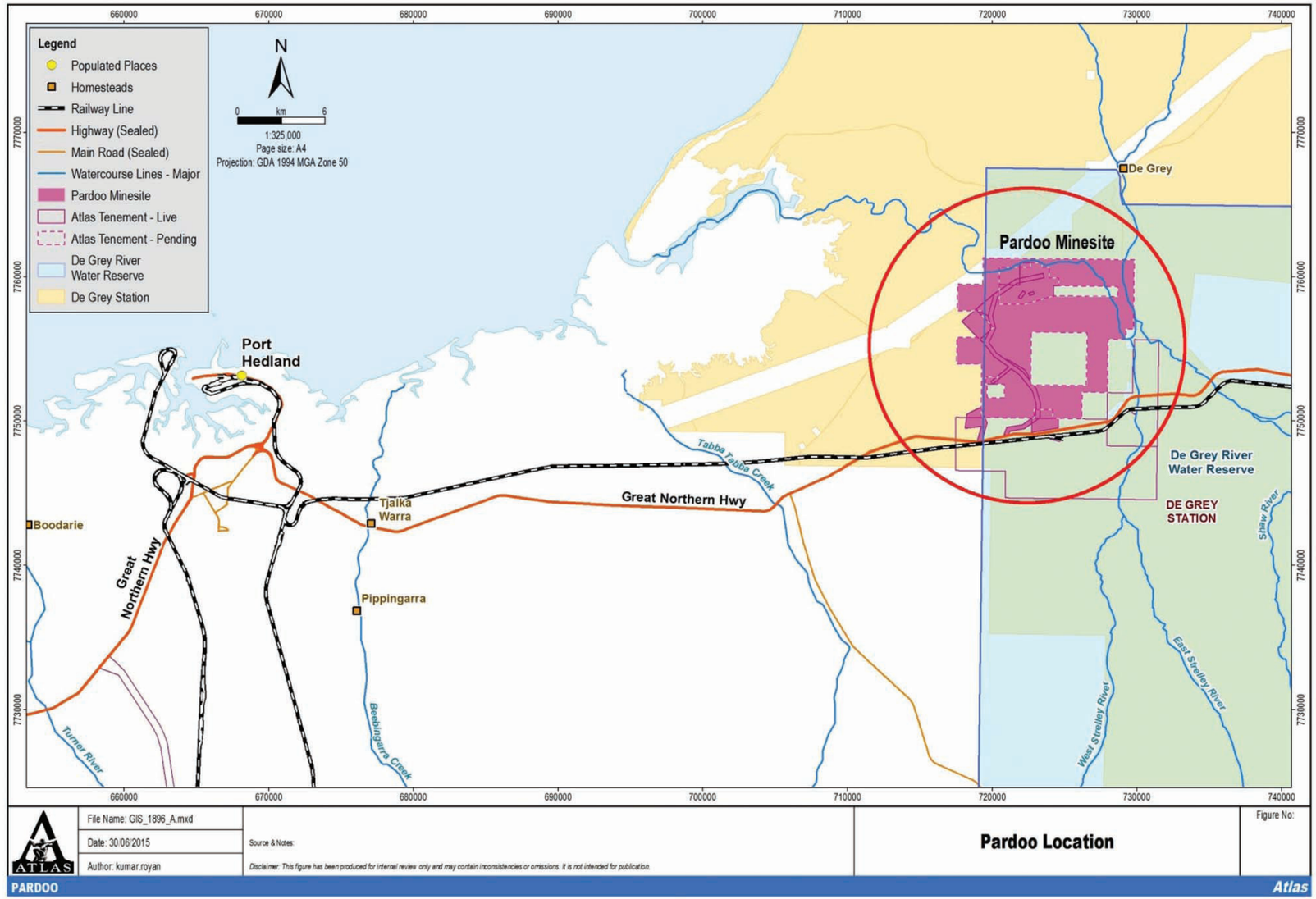

Figure 6.1 - Pardoo DSO Project Location

6.3 Groundwater Management Areas

The De Grey River Water Reserve is the groundwater supply reserve for potable water to Port Hedland. This reserve was gazetted in 1977 under the *Country Areas Water Supply Act 1947* and is designated as a Priority 1 (P1) under the Priority Source Classification System.

6.4 Water Usage

Any water taken under the GWL is authorised to be used for:

- Dust suppression, earthworks and construction purposes,
- Exploratory drilling operations,
- Mining care and maintenance purposes, and
- Mining camp purposes.

No water was abstracted during the 2019/2020 reporting period.

6.5 Licensing

Groundwater abstraction for the project is authorised by GWL166951(5) (Figure 6.2). This Groundwater License (GWL) authorises an abstraction of up to 100,000 kL/year from the Pilbara Fractured Rock aquifer for the purposes noted above. Table 6.1 lists the details of the historical GWL approvals.

Under this licence the authorised activities listed above can be undertaken within leases E45/2380, L45/210, E45/2330, M45/1158, M45/1194, M45/1170, M45/1157, G45/273, M45/1159, M45/1190, G45/315, L45/154, L45/175, L45/176, L45/202, and L45/209.

The reporting period is 1 July 2019 to 30 June 2020. The project annual monitoring report is scheduled for submission to the Department of Water and Environmental Regulation (DWER) annually in September.

Table 6.1 - License History

License	Allocation (kl)	Start Date	Expiry Date	Comments
GWL166951(1)	2,007,000	23/01/2009	22/01/2011	Original license.
GWL166951(2)	4,000,000	12/06/2012	11/06/2013	Increase allocation, update SWOP.
GWL166951(3)	10,000,000	24/08/2012	31/08/2014	Increase allocation, update SWOP.
GWL166951(4)	10,000,000	09/12/2013	31/08/2014	Update SWOP.
GWL166951(5)	100,000	24/07/2014	23/07/2024	Reduced allocation.

File No: RF693-05

Government of Western Australia
Department of Water

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Instrument No. GWL166951(5)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Atlas Iron Limited		
Description of Water Resource	Pilbara Pilbara - Fractured Rock	**Annual Water Entitlement**	100000 kL
Location of Water Source	E45/2380, L45/210, E45/2330, M45/1158, M45/1194, M45/1170, M45/1157, G45/273, M45/1159, M45/1190, G45/315, L45/154, L45/175, L45/176, L45/202, L45/209		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes Earthwork and construction purposes Exploratory drilling operations Mining Care and maintenance purposes Mining camp purposes	E45/2380, L45/210, E45/2330, M45/1158, M45/1194, M45/1170, M45/1157, G45/273, M45/1159, M45/1190, G45/315, L45/154, L45/175, L45/176, L45/202, L45/209
Duration of Licence	From 24 July 2014 to 23 July 2024	

This Licence is subject to the following terms, conditions and restrictions:

1 The licensee must install an approved meter to each water draw-point through which water is taken under this licence.

2 The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this licence.

3 The licensee is to comply with the monitoring program as submitted with the amendment application and any amendments made by or with the approval of the Department.

End of terms, conditions and restrictions

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000

Figure 6.2 - License to Take Water GWL166951(5)

6.6 Climate

The project is located within a zone of arid tropical climate subject to monsoonal influence. The region experiences a climate of extremes, where severe droughts and major floods can occur at close intervals.

The longest rainfall records for the region are located at the Pardoo Station (Bureau of Meteorology (BoM) Climate Station 004028), which is operated by the station owners and reported to the BoM. Rainfall data is available from 1904 to present. The annual rainfall in the region is highly variable ranging from 18 to over 1,000 mm with a long term average of 316 mm/year.

6.7 Hydrogeological Setting

There are a number of discrete groundwater units within the project area. These groundwater units interact with groundwater in the De Grey Priority 1 public drinbking water source protection area. This water reserve provides scheme water from the Namagoorie borefield, 12 km east of the project. The Bulgarene borefield is also located within the water reserve and 5 km northeast of the project area, to provide scheme water.

The hydrogeological setting at Pardoo is detailed in the 2013/2014 Atlas Water Report (Atlas, 2014b). Local aquifers in the Pardoo Project area include:

- Tertiary and recent alluvial aquifers
- CID aquifers
- Canning Basin Sequence
- Secondary permeability and fractured rock aquifers within the Archaean BIF

6.8 Borefield Description

The Pardoo borefield was decommissioned in June 2014. As no bores were equipped or in operation during the reporting period, the borefield consists entirely of monitoring points as some production locations are now included in the monitoring program. These monitoring locations are depicted in Figure 6.3 and described further in Section 6.9.

Please refer to the 2013/2014 Atlas Annual Water Report (Atlas, 2014b) for a full description of the previous borefield extent.

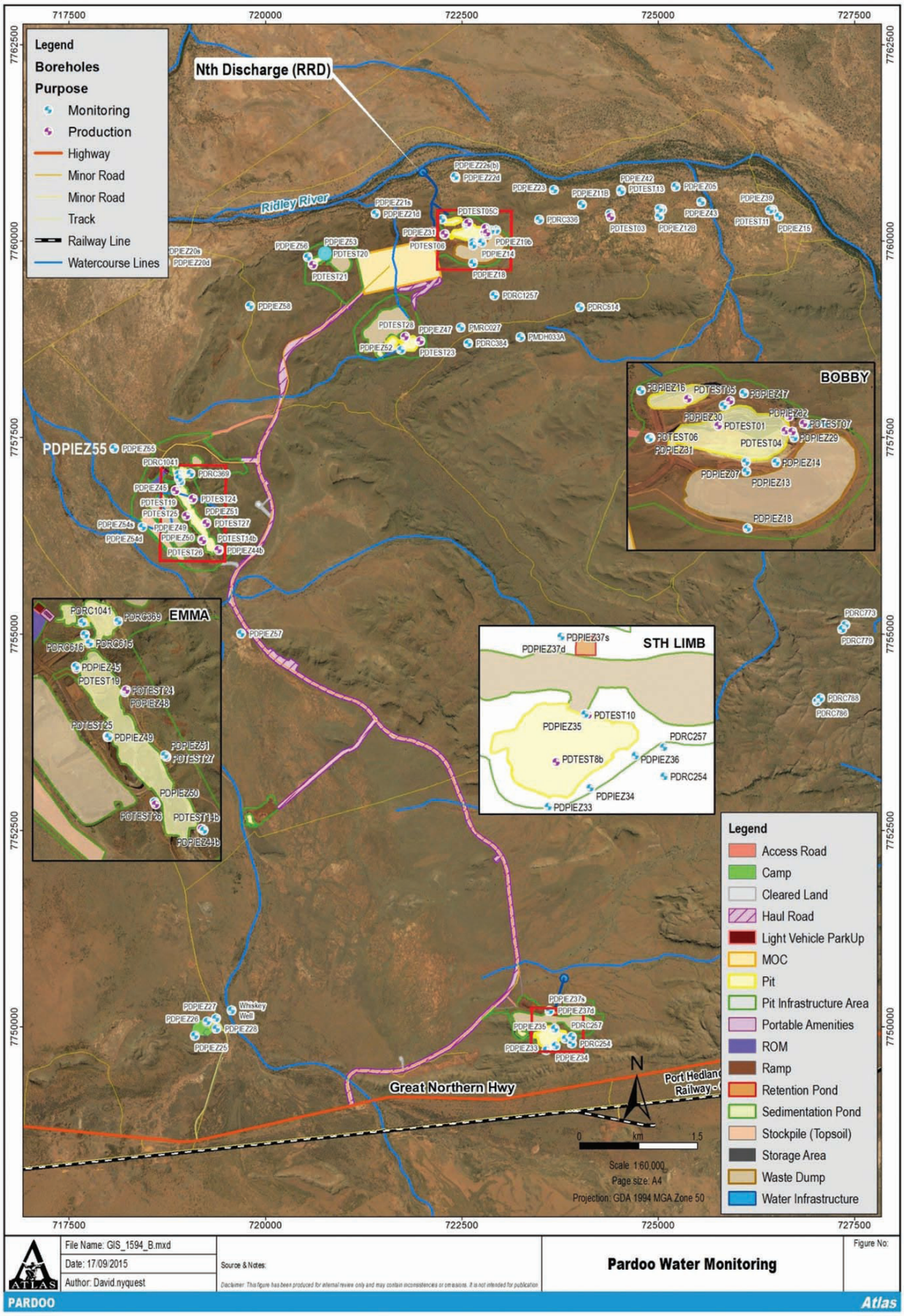

Figure 6.3 - Pardoo Bore Locations

6.9 Monitoring Requirements

6.9.1 Objectives

The current monitoring program is designed to track the recovery of water levels and detect changes in groundwater chemistry over time in support of the closure of the mine. Groundwater monitoring requirements for the project are described in the Pardoo Mine Closure Plan (Mine Earth, 2013) and the Pardoo Interim Care and Maintenance Monitoring Program (Atlas, 2014a).

In accordance with the Mine Closure Plan, water monitoring is only required on a biennial basis only (sample round completed during 2018/19, with a final sampling round to be completed in 2020/21). As such, water quality monitoring was not performed during the current reporting period.

Monitoring requirements described in the Mine Closure Plan are summarised in Table 6.2.

Table 6.2 - Post closure pit water and groundwater monitoring requirements

Area	Water levels	Water quality
Bobby	Bobby pit, PDPIEZ29, PDPIEZ30b, PDPIEZ31, PDPIEZ32 PDPIEZ07 PDPIEZ13, PDPIEZ17, PDPIEZ18, PDPIEZ19 PDPIEZ19b PDPIEZ14, PDPIEZ38, PDPIEZ39, PDPIEZ40, PDPIEZ41, PDPIEZ42, PDPIEZ43, PDPIEZ22 (s/b), PDPIEZ30	Bobby pit, PDPIEZ29, PDPIEZ18, PDPIEZ30b, PDPIEZ22 (s/b), PDPIEZ38
Alice extension	Alice extension pit, PDPIEZ47, PDPIEZ52	Alice extension pit, PDPIEZ47
Chloe	Chloe Pit, PDPIEZ46, PDPIEZ53, PDPIEZ56	Chloe Pit, PDPIEZ53
Emma	Emma pit, PDPIEZ54s, PDPIEZ54d, PDPIEZ55, PDPIEZ48, PDPIEZ49, PDPIEZ50, PDPIEZ51, PDPIEZ45, PDPIEZ44b	Emma pit, PDPIEZ45, PDPIEZ44b
South Limb	South Limb Pit, PDPIEZ35, PDPIEZ37s, PDPIEZ36, PDPIEZ37d, PDPIEZ34	South Limb Pit, PDPIEZ35

The Mine Closure Plan notes that monitoring will only be undertaken where pits and bores can be safely accessed. Locations which are no longer in use are summarised in Table 6.3.

Table 6.3 - Monitoring locations no longer in use

Area	Monitoring Point	Status
Bobby pit	PDPIEZ40	No longer accessible
	PDPIEZ41	No longer accessible
	PDPIEZ42	No longer accessible
Alice Extension	Alice Pit	No longer accessible
	PDPIEZ47	No longer accessible, nearby bore PDTEST23 sampled instead.
Chloe	PDPIEZ46	Collapsed

6.9.2 Regulatory Conditions

While in Care and Maintenance the project has no specific statutory conditions related to groundwater abstraction other than the standard conditions associated with the groundwater licence. The licence conditions are as follows:

- The licensee must install an approved meter to each water draw-point through which water is taken under this licence.
- The meter(s) must be installed in accordance with the provisions of the document entitled "Guidelines for Water Meter Installation 2009" before any water is taken under this licence.
- The licensee is to comply with the monitoring program as submitted with the amendment application and any amendments made by or with the approval of the Department.

6.10 Monitoring Observations

6.10.1 Water Levels

Historical hydrographs for monitoring locations are presented in Figure 6.4 through Figure 6.6. These hydrographs include data from some monitoring locations which are additional to the minimum requirements.

Water levels in the Bobby Pit area continued to recover during the reporting period. The local aquifer is approximately 1.7 m below the model prediction and approximately 1.43 m below pre-mining water levels, most likely as a result of evaporative effects.

In the alluvial aquifer east of Bobby Pit (PDPIEZ18) water levels increased marginally over the reporting period, though remained within the range of historical variation. Water levels in these areas showed minimal influence from pumping during mining.

In the Chloe and Emma Pit areas water levels have recovered to near pre-pumping levels suggesting negligible long-term drawdown impacts.

At Alice Extension and South Limb Pits water levels continued to recover slowly due to the relatively higher elevation and lower recharge rates in these areas.

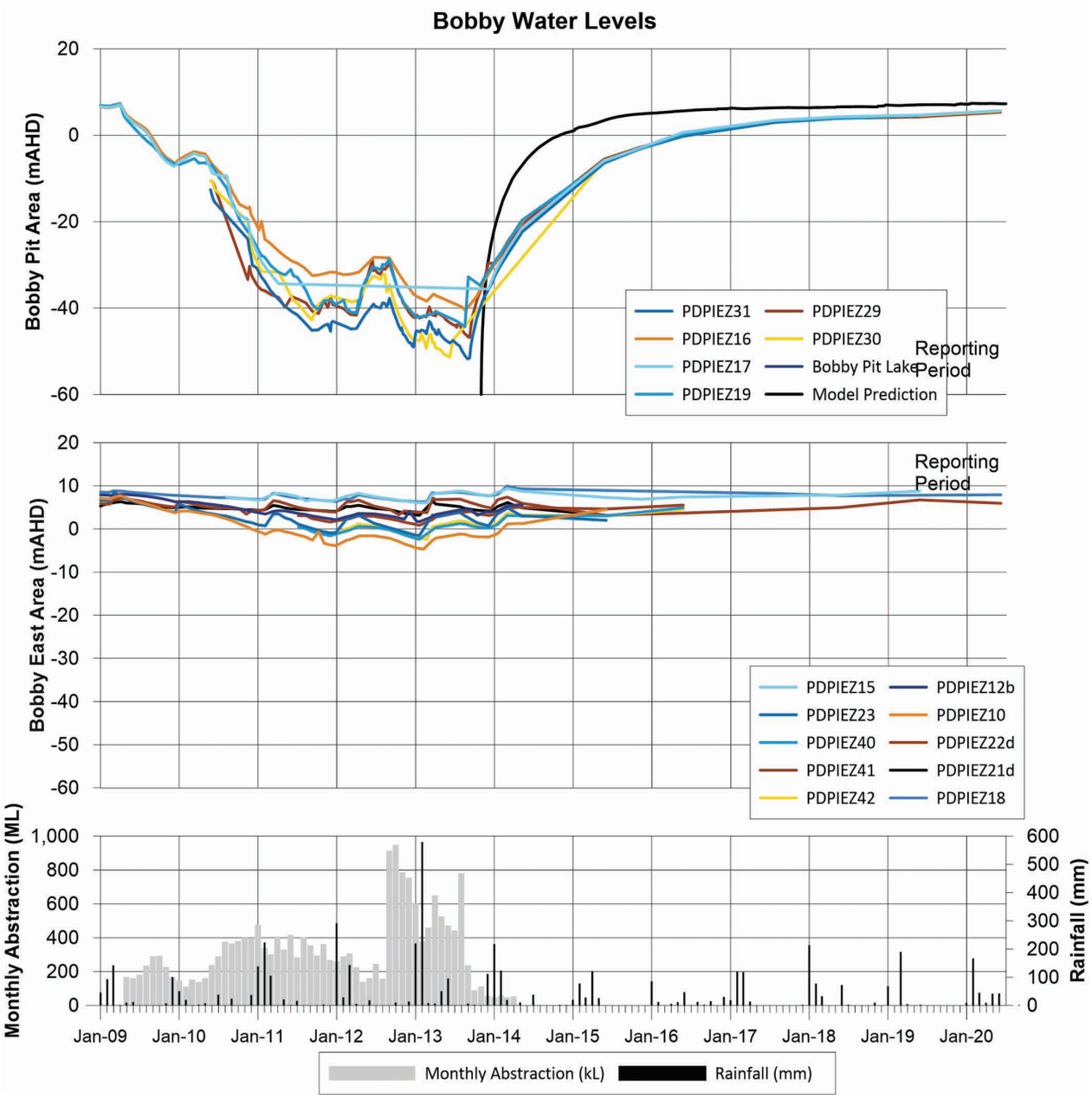

Figure 6.4 - Bobby Area Water Levels vs. Abstraction and Rainfall

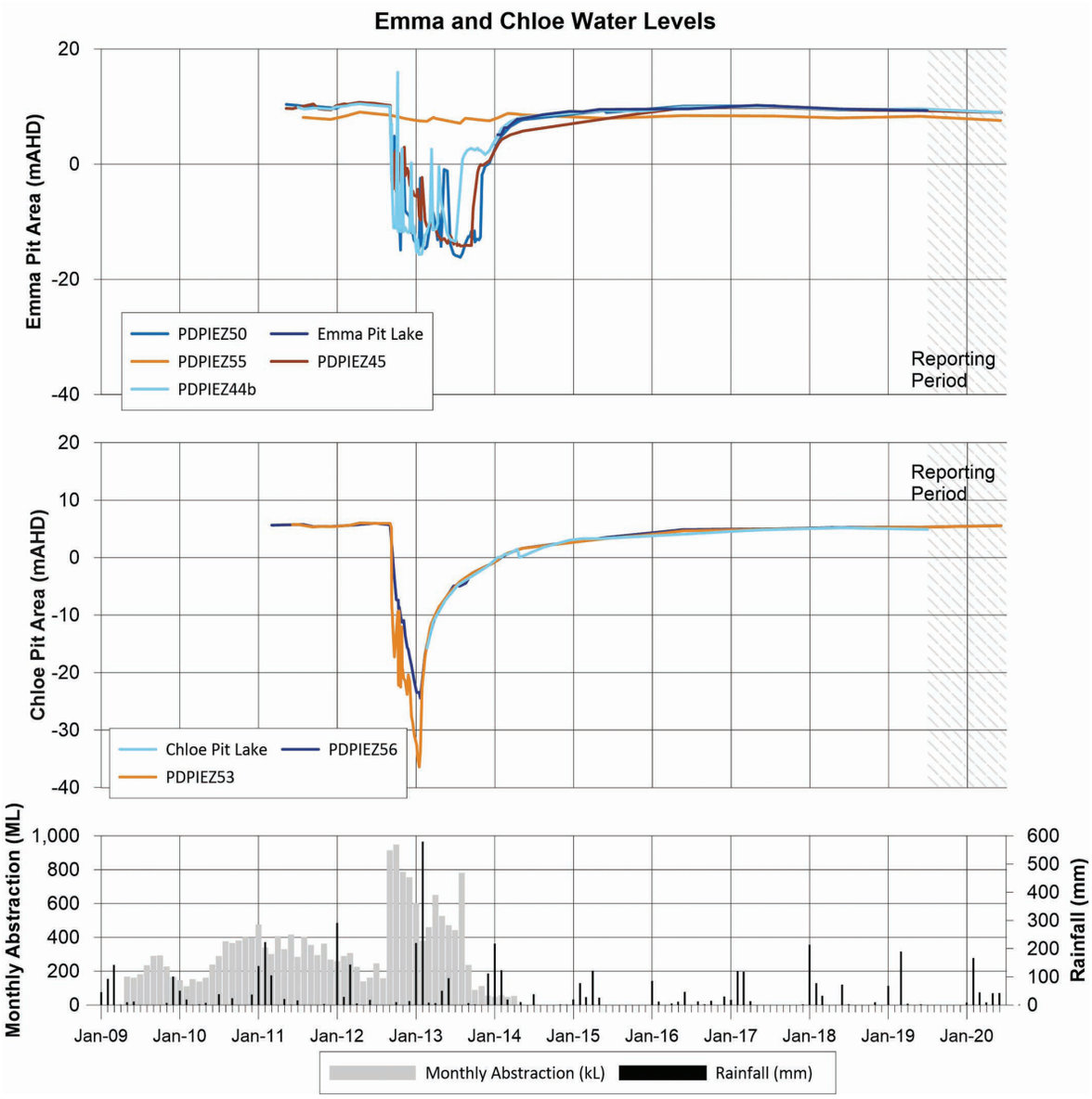

Figure 6.5 - Emma and Chloe Area Water Levels vs Abstraction and Rainfall

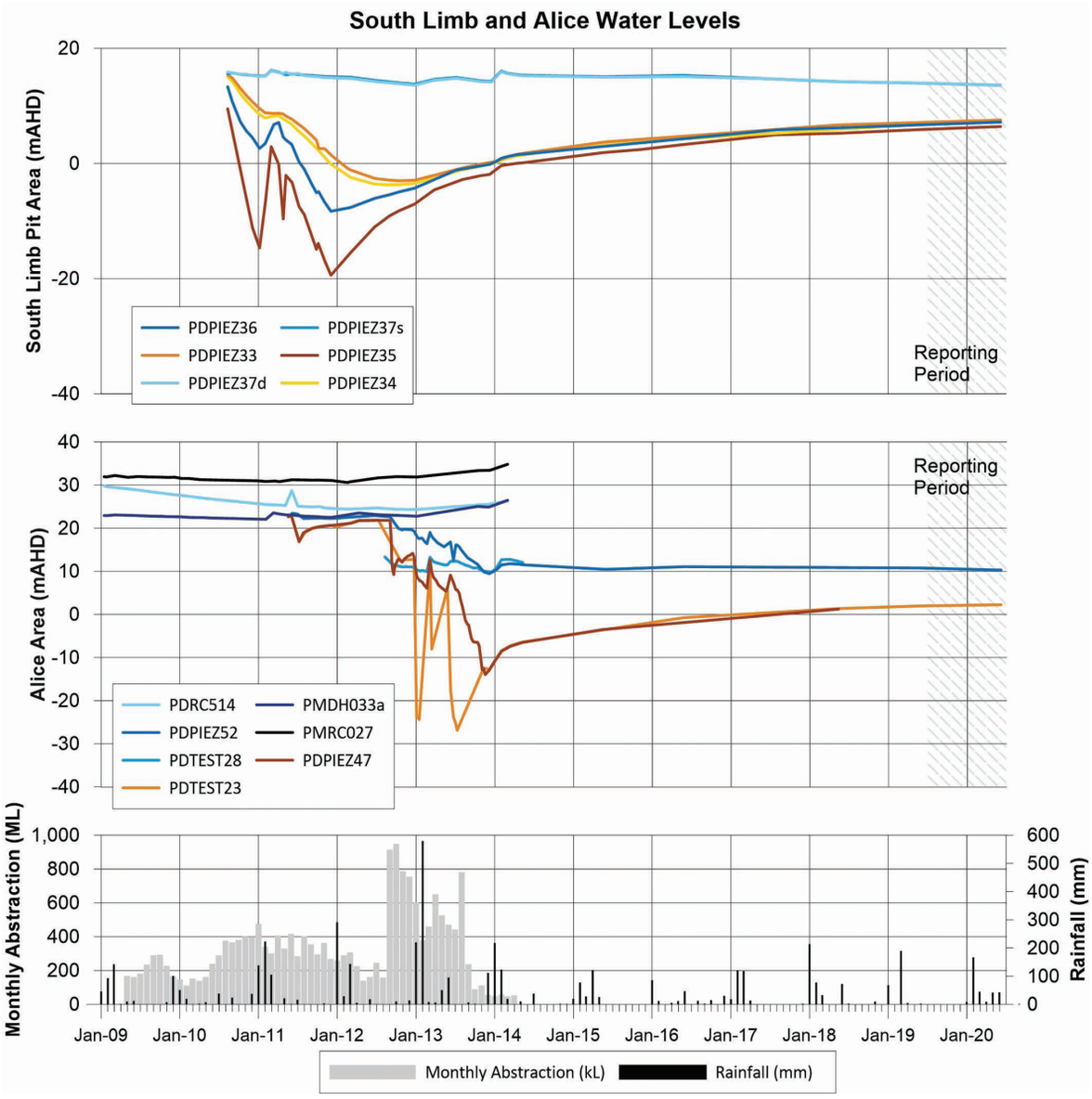

Figure 6.6 - South Limb and Alice Area Water Levels vs Abstraction and Rainfall

6.10.2 Water Quality

Groundwater in the project area ranges from fresh (<1,000 mg/L Total Dissolved Solids [TDS]) in recharge areas to saline (<13,000 mg/L TDS) in areas further along the groundwater flow path (valleys and lower lying areas).

In general, salinity (EC) and pH measurements (Figure 6.7 and Figure 6.8) remained relatively constant throughout the monitoring period. EC concentrations in PDPIEZ45 (Emma Pit) and PDPIEZ37s (South Limb) showed an increase from the previous reporting period, however values remained within the historical range. pH values also remained constant over the reporting period, and no significant variation in major ions and metals was identified

Table 6.4 to Table 6.6 present a summary of the analytical data for all monitoring points in the Pardoo DSO Project Interim Care and Maintenance Monitoring Program (Atlas, 2014a). Groundwater laboratory testing was conducted as per the monitoring program requirements. Due to safety restrictions and access issues water samples can no longer be collected at the bores east of Bobby Pit and Alice Extension Pit.

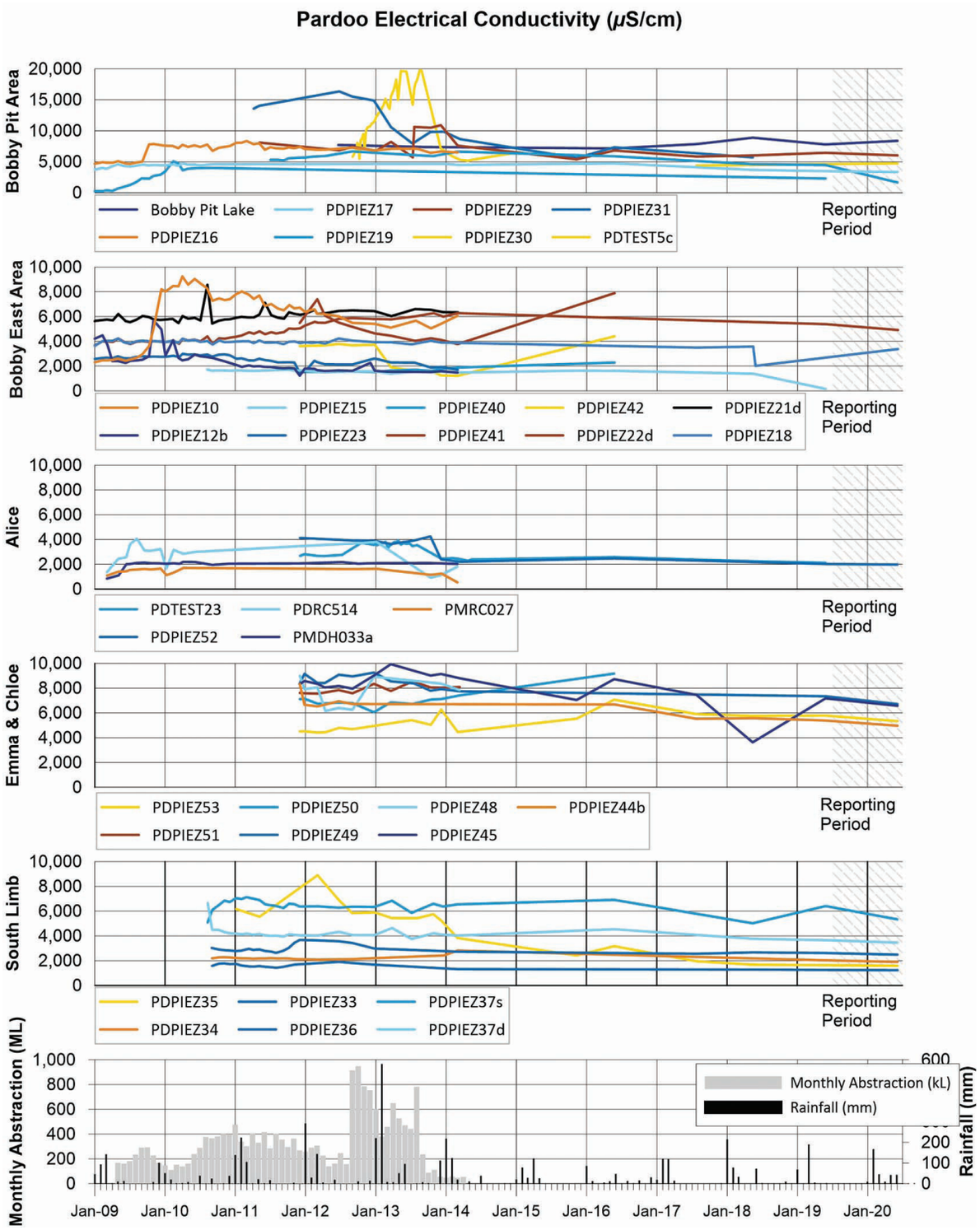

Figure 6.7 - Pardoo Electrical Conductivity vs. Abstraction and Rainfall

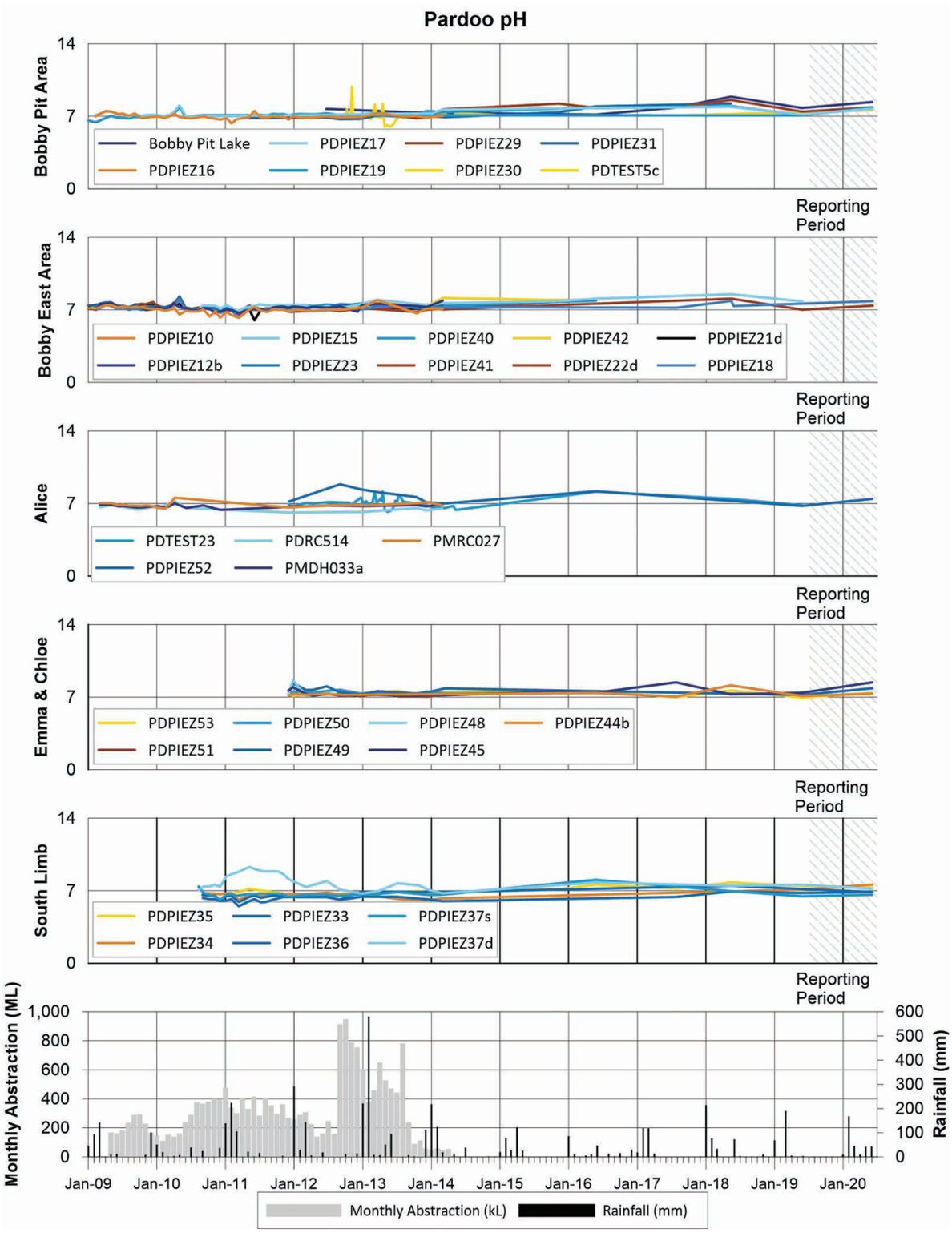

Figure 6.8 - Pardoo pH vs. Abstraction and Rainfall

Table 6.4 - Major Ions and Physical Parameters

Sampling point	Date	pH (pH units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
Bobby Pit	3/09/2013	7.4	9,700	5,800	2,800	350	290	240	300	29	1,500	0.52	
	17/12/2013	7.9	9,400	5,600	3,000	310	290	240	290	32	1,300	0.74	30
	26/05/2015	8.2	9,400	5,200		300		210	290	30	1,300	0.11	2.5
	25/05/2016	8.0						200	290	25	1,500		
	26/07/2017	8.2	9,900	5,800	3,100	220	300	220	300	27	1,600	<0.005	<5
	15/05/2018	8.3	11,000	6,600	3,200	200	310	200	310	27	1,600	0.017	6
	27/05/2019	8.2	10,000	6,500	2,700	200	240	190	290	28	1,600	<5	<5
Chloe Pit	26/07/2017	8.4	7,200	4,300	2,100	280	340	73	230	24	1,100	0.26	<5
	14/05/2018	8.5	8,700	4,900	2,200	270	370	70	260	26	1,300	0.06	<5
	28/05/2019	8.4	8,000	4,500	2,200	290	350	66	250	27	1,300	<2.5	<5
PDPIEZ18	26/07/2017	7.5	3,800	2,100	940	370	150	82	96	15	540	0.85	<5
	15/05/2018	7.4	4,200	2,200	940	390	150	78	99	15	560	0.83	<5
	27/05/2019	7.4	3,700	1,900	930	390	150	72	90	15	550	<1	29
PDPIEZ22s(b)	11/09/2011	7.5	5,100		1,600	400	210	130	120	14	760	0.49	35
	4/12/2011	7.5	5,100		1,500	57	170	150	130	15	800	1.7	34
	5/03/2012	7.4	5,900	3,500	1,800	490	230	160	160	23	1,200	0.26	71
	22/06/2012		5,700		1,800	360	210	150	130	15	840	0.48	130
	24/07/2013		8,400		2,400	570	290	130	170	32	1,200	0.39	
	17/12/2013	7.1	6,000		1,800	390	210	170	140	16	920	0.37	45
	26/05/2015	7.9	3,600	2,000		430		83	74	17	560	0.9	48
	25/05/2016	7.5	2,900	1,900	740	390	190	73	64	10	510		61
	26/07/2017	7.4	5,200	2,900	1,400	470	210	140	120	15	780	0.05	25
	15/05/2018	7.3	4,700	2,600	1,100	330	120	100	96	12	650	0.2	14
	27/05/2019	7.4	6,700	3,800	1,800	410	230	140	160	21	1,200	<2.5	<5
PDPIEZ29	24/06/2012		7,200		2,300	330	260	170	200	22	1,000	0.85	59
	20/07/2013		8,900		3,200	300	250	270	300	28	1,400	0.03	
	26/05/2015	8.2	6,000	3,300		430		120	180	22	900	4.4	14
	25/05/2016	8.1	5,900	3,500	1,800		270	57	180	19	930		7

Table 6.4 - Major Ions and Physical Parameters

Sampling point	Date	pH (pH units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	26/07/2017	8.3	6,300	3,800	1,800	300	260	83	200	22	1,000	2	<5
	15/05/2018	8.2	7,300	4,000	1,900	310	260	55	200	22	1,100	2.6	20
	28/05/2019	8.2	6,900	4,000		320		100	210	21	1,100	2.9	<5
PDPIEZ30b	26/05/2015	7.9	5,000	2,800		410		120	140	20	740	0.67	13
	25/05/2016	7.5	4,600	2,800	1,300		190	100	120	16	670		2.5
	26/07/2017	7.4	4,700	2,700	1,300	340	180	110	130	17	670	0.16	<5
	15/05/2018	7.3	5,200	2,900	1,300	350	180	110	130	16	690	0.17	6
	28/05/2019	7.4	4,600	2,900	1,200	330	170	98	110	15	670	<2.5	27
PDPIEZ31	25/06/2012		15,000		5,400	380	680	420	570	47	2,300	0.22	170
	11/07/2013		7,800		2,300	490	360	150	210	28	1,100	1.4	
	26/05/2015	7.8	6,900	4,000		480		130	190	28	1,100	7.1	92
	25/05/2016	7.5	6,200	3,800	1,800		280	120	170	21	1,000		32
PDPIEZ37	26/07/2017	6.7	2,700	1,600	670	220	130	110	76	8.3	340	0.35	53
PDPIEZ38	4/12/2011	7.9	1,700		310	340	78	86	48	5.3	240	0.82	97
	3/03/2012	7.6	1,600	970	380	340	67	87	47	6.7	280	0.61	50
	21/06/2012		1,700		380	280	56	77	43	5	210	0.21	120
	26/12/2012	8.1	1,800		380	310	73	67	37	3.9	180	1.1	
	24/07/2013		1,800	1,100	370	310	53	78	46	5	220	0.61	13
	5/12/2013	7.6	1,800	1,100	370	320	63	77	44	5.2	200	0.63	60
	26/05/2016	7.9	1,600	970	370		66	66	42	5.8	200		13
	15/05/2018	7.7	1,900	980	350	240	64	69	46	5.5	200	0.13	27
PDPIEZ53	3/12/2011	7.7	4,400		2,100	520	150	65	130	20	740	5.7	92
	3/03/2012	8.0	4,000	2,400	1,200	550	220	71	120	18	680	5.6	50
	25/06/2012		4,400		1,200	510	200	61	120	19	710	6.3	86
	6/07/2013	7.6	5,400		1,500	450	260	67	150	24	810	10	
	26/05/2015	8.0	6,300	3,600		520		87	180	30	1,000	0.11	18
	26/05/2016	7.9	1,600	970	370		66	66	42	5.8	200		13
	26/07/2017	7.4	6,400	3,700	1,800	440	350	95	180	24	990	0.01	51
	14/05/2018	7.3	6,900	3,900	1,600	440	350	80	170	24	1000	0.013	15

Table 6.4 - Major Ions and Physical Parameters

Sampling point	Date	pH (pH units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	28/05/2019	7.2	6,300	3,600	1,600	450	320	88	180	24	1,000	<2.5	7
Emma Pit North	14/03/2014	8.2	6,900	4,100	1,900	520	430	39	88	16	1,500	28	
Emma Pit South	14/03/2014		6,900	4,200	1,900	640	410	32	72	19	1,500	18	
	28/05/2015	8.8	8,900			600		22	86	26	1,800	10	2.5
	24/05/2016	8.6						24	130	21	2,100		
	26/07/2017	8.8	10,000	6,300	2,900	570	570	20	100	27	2,300	0.82	<5
	28/05/2019	8.9	11,000	6,300	2,800	600	540	22	100	27	2,500	<5	<5
PDPIEZ44b	3/12/2011	7.9	6,300	3,800	1,700	690	330	55	92	19	1,300	11	190
	4/03/2012	7.6	6,000	3,600	1,800	740	450	56	96	19	1,400	2.3	42
	22/06/2012		6,400		1,800	590	390	50	88	19	1,400	11	65
	26/05/2015	8.1	6,000	3,400		550		50	84	20	1,200	15	2.5
	24/05/2016	7.7	5,500	3,500	1,600		310	48	81	16	1,100		5
	26/07/2017	7.5	6,000	3,500	1,500	470	290	51	85	18	1,200	3.6	<5
	14/05/2018	7.4	6,700	3,700	1,600	480	310	49	84	16	1,200	3.8	<5
	28/05/2019	7.5	5,900	3,200	1,500	470	300	45	75	15	1,100	9.8	<5
PDPIEZ45	2/12/2011	8.2	7,900		2,200	750	430	89	130	23	1,600	29	150
	4/03/2012	7.8	7,800	4,700	2,100	620	500	58	110	15	1,400	26	110
	23/06/2012		7,500		2,200	540	430	62	110	20	1,400	27	46
	6/12/2013	7.2	9,100	5,500	2,400	920	420	69	130	23	1,800	8.2	450
	26/05/2015	8.2	8,600	4,900		880		56	120	23	1,700	7.2	2.5
	24/05/2016	7.8	7,700	4,700	2,100		420	57	110	17	1,500		5
	26/07/2017	8.8	8,100	4,600	2,300	370	290	7	52	21	1,800	0.01	11
	14/05/2018	7.7	8,900	4,900	2,100	640	420	52	110	17	1,600	3.7	<5
	28/05/2019	7.8	7,800	4,300	2,000	610	390	50	99	17	1,600	13	<5
PDTEST23	4/12/2011	7.6	2,500		700	240	95	87	78	4.4	360	6.8	15
	5/03/2012	7.6	2,500	1,500	710	240	110	91	78	5.2	400	19	8
	9/07/2012	7.1	2,700	1,600	650	210	90	87	72	4.2	340	3.1	
	14/10/2012	7.6	3,200		960	290	130	99	97	4.8	460	11	
	22/12/2012	8.0	3,500		920	310	140	90	91	3.9	440	11	

Table 6.4 - Major Ions and Physical Parameters

Sampling point	Date	pH (pH units)	EC (µS/cm)	TDS (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)	TSS (mg/L)
	21/03/2013	7.7	3,300		930	270	120	100	100	5.3	470	11	
	4/07/2013		3,300		910	290	120	99	98	6.1	450	8.8	
	13/03/2014		2,300		600	280	78	88	100	9.5	190	0.08	
	26/05/2015	7.7	2,200	1,200		260		79	100	18	180	0.1	7
	14/05/2018	6.7	2,500	1,400	560	230	64	84	98	9.7	210	0.033	13
	28/05/2019	6.8	2,300	1,200	460	220	52	79	90	9	200	<0.5	<5
South Limb Pit Lake	2/04/2012	7.9	8,700	5,200	2,800	200	210	400	240	20	910	7.2	20
	23/06/2012		9,200	5,500	3,200	170	86	520	290	27	1,100	3.1	50
	26/09/2012	7.7	9,600	5,800	3,700	190	220	540	300	28	1,200	5.7	
	4/08/2013	7.8	9,700	5,800	3,100	150	200	490	290	27	1,100	1.6	15
	15/03/2014	7.8	8,000	4,800	2,900	110	220	430	270	24	1,000	1.1	
	14/05/2018	7.9	12,000	7,500	3,500	95	220	480	320	26	1,300	<0.005	<5
	28/05/2019	7.9	10,000	6,700	2,800	97	160	450	300	26	1,300	<0.5	<5
PDPIEZ35	4/03/2012	6.8	8,100	4,900	2,900	280	210	560	290	28	1,200	0.58	99
	23/06/2012		6,500		2,200	240	170	280	170	15	700	1.7	75
	25/12/2012	7.5	5,700		1,800	280	160	230	140	9.9	590	1.6	
	4/08/2013	6.9	5,200		1,600	280	170	250	150	14	690	2.3	
	26/05/2015	7.7	3,100	1,700		270		120	87	9	340	5.8	52
	24/05/2016	7.4	2,500	1,700	750		97	100	78	7.4	330		26
	26/07/2017	7.8	1,900	960	460	250	83	54	51	13	280	3.5	<5
	28/05/2019	7.0	2,700	1,400	270	210	41	48	44	8	210	13	13

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).

Table 6.5 - Trace Elements and Metals

Sampling point	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
Bobby Pit	3/09/2013	0.010	0.93	<0.0010	0.0025	<0.005	<0.02	<0.02	0.077	0.013	0.025		0.025	0.03
	17/12/2013	0.010	1.30	<0.0010	0.0025	<0.005	<0.02	<0.02	0.019	0.009	0.025		0.025	0.02
	26/05/2015	0.003	1.10	<0.0005	0.0025	<0.005	<0.025	<0.005	0.0025	<0.005	0.0025	4.9	0.0025	<0.025
	25/05/2016	0.001	0.83	<0.0001	0.0005	<0.001	<0.01	<0.001	0.0025	<0.001	0.0005		0.0005	0.003
	26/07/2017	<0.001	1.10	<0.0001	<0.0010	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001	5.3	0.002	<0.001
	15/05/2018	<0.001	1.30	<0.0001	<0.0010	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001	5	<0.001	0.002
	27/05/2019	<0.001	1.40	<0.0001	<0.0010	<0.001	<0.01	<0.001	<0.005	<0.001	<0.001	5.3	<0.001	0.004
Chloe Pit	26/07/2017	<0.001	1.70	<0.0001	<0.0010	<0.001	<0.01	<0.001	0.009	<0.001	0.01	2.3	<0.001	0.002
	14/05/2018	<0.001	2.00	<0.0001	<0.0010	<0.001	<0.01	<0.001	0.025	<0.001	0.009	2.3	<0.001	0.002
	28/05/2019	<0.001	2.20	<0.0001	<0.0010	<0.001	0.02	<0.001	<0.005	<0.001	0.008	2.2	<0.001	0.002
PDPIEZ18	26/07/2017	<0.001	0.92	<0.0001	<0.0010	<0.001	<0.01	0.009	<0.005	<0.001	0.003	1.6	<0.001	0.004
	15/05/2018	<0.001	1.10	<0.0001	<0.0010	<0.001	<0.01	0.01	<0.005	<0.001	0.002	1.5	<0.001	0.005
	27/05/2019	<0.001	1.00	<0.0001	<0.0010	<0.001	0.39	<0.001	0.048	0.002	<0.001	1.4	<0.001	0.003
PDPIEZ22s(b)	11/09/2011	0.010	1.20	<0.0010	0.0025	<0.005	0.37	0.005	0.24	0.007	0.01		0.025	0.11
	4/12/2011	0.010	1.20	<0.0010	0.0025	<0.005	0.1	<0.005	0.053	0.005	0.005		0.025	0.04
	5/03/2012	<0.020	1.70	<0.0010	<0.0050	<0.005	<0.02	<0.005	0.027	0.009	<0.01		<0.05	0.03
	22/06/2012	0.010	1.10	<0.0010	0.0025	<0.005	<0.02	<0.005	0.053	0.007	0.01		0.025	0.01
	24/07/2013	0.010	2.60	<0.0010	0.0025	<0.005	<0.02	<0.02	0.0025	0.007	0.025		0.025	0.02
	17/12/2013	0.010	1.20	<0.0010	0.0025	<0.005	<0.02	<0.02	0.014	0.006	0.025		0.025	0.04
	26/05/2015	0.001	0.95	<0.0001	0.0005	<0.001	<0.005	<0.001	0.085	<0.001	0.001	1.4	0.0005	0.008
	26/07/2017	<0.001	1.30	<0.0001	<0.0010	<0.001	<0.01	<0.001	0.006	0.002	0.002	2.5	<0.001	0.008
	15/05/2018	<0.001	1.10	<0.0001	<0.0010	0.001	<0.01	<0.001	0.006	<0.001	<0.001	2	<0.001	0.013
	27/05/2018	0.001	1.90	<0.0001	0.0020	<0.001	0.01	<0.001	<0.005	0.002	0.006	3.6	<0.001	0.006
PDPIEZ29	24/06/2012	0.010	1.20	<0.0010	0.0025	<0.005	<0.02	<0.005	0.007	0.007	0.01		0.025	0.01
	20/07/2013	0.010	0.90	<0.0010	0.0025	<0.005	<0.02	<0.02	0.27	0.009	0.025		0.025	0.02
	26/05/2015	0.001	1.10	0.0010	0.0005	0.001	<0.005	<0.001	0.0005	0.001	0.0005	2.6	0.0005	0.01
	25/05/2016	0.001	0.85	<0.0001	0.0020	0.001	<0.01	<0.001	0.0025	0.025	0.0005	1.6	0.0005	0.005
	26/07/2017	<0.001	1.00	0.0003	0.0030	0.002	<0.01	<0.001	0.005	0.018	0.001	2.3	<0.001	0.006

Table 6.5 - Trace Elements and Metals

Sampling point	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	15/05/2018	<0.001	1.20	<0.0001	<0.0010	0.002	<0.01	<0.001	0.009	0.009	<0.001	1.6	<0.001	0.008
	28/05/2019	<0.001	1.20	<0.0001	0.0010	0.002	0.47	<0.001	0.049	0.052	<0.001	3	<0.001	0.004
PDPIEZ30b	26/05/2015	0.001	1.10	<0.0001	0.0005	<0.001	<0.005	<0.001	0.003	0.001	0.025	2.5	0.0005	0.016
	25/05/2016	0.001	0.81	<0.0001	0.0005	0.002	<0.01	<0.001	0.0025	0.002	0.016	2.1	0.0005	0.009
	26/07/2017	<0.001	0.97	<0.0001	0.0010	<0.001	<0.01	<0.001	<0.005	0.002	0.017	2.4	<0.001	0.007
	15/05/2018	<0.001	1.10	<0.0001	<0.0010	<0.001	<0.01	<0.001	<0.005	0.001	0.017	2.5	<0.001	0.012
	28/05/2019	<0.001	1.10	<0.0001	0.0020	<0.001	0.01	<0.001	<0.005	0.002	0.018	2.3	<0.001	0.008
PDPIEZ31	25/06/2012	0.010	1.50	<0.0010	0.0025	<0.005	<0.02	<0.005	0.007	0.033	0.01		0.025	0.12
	11/07/2013	0.010	1.20	<0.0010	0.0025	<0.005	<0.02	<0.02	0.0025	0.009	0.025		0.025	0.01
	26/05/2015	0.003	1.30	<0.0005	0.0025	<0.005	<0.025	<0.005	0.0025	<0.005	0.0025	3.2	0.0025	<0.025
	25/05/2016	0.001	1.00	<0.0001	0.0020	0.003	<0.01	<0.001	0.0025	0.001	0.003	2.8	0.0005	0.01
PDPIEZ36	26/07/2017	<0.001	0.56	<0.0001	<0.0010	<0.001	<0.01	<0.001	<0.005	<0.001	0.002	1.3	<0.001	0.005
PDPIEZ38	4/12/2011	0.010	0.40	<0.0010	0.013	<0.005	0.5	<0.005	0.081	0.007	0.005		0.025	0.15
	3/03/2012	<0.020	0.40	<0.0010	<0.0050	<0.005	<0.02	<0.005	<0.005	0.006	<0.01		<0.05	0.05
	21/06/2012	0.010	0.30	<0.0010	0.0025	<0.005	<0.02	<0.005	0.007	0.005	0.01		0.025	0.03
	26/12/2012	0.010	0.40	<0.0010	0.0025	<0.005	0.26	<0.02	0.028	0.005	0.025		0.025	0.02
	24/07/2013	<0.020	0.40	<0.0010	<0.0050	<0.005	<0.02	<0.02	<0.005	0.007	<0.05		<0.05	0.05
	5/12/2013	<0.020	0.70	<0.0010	<0.0050	<0.005	<0.02	<0.02	0.014	<0.005	<0.05		<0.05	0.04
	26/05/2016	0.001	0.28	<0.0001	0.0005	0.002	<0.01	<0.001	0.006	0.003	0.0005	0.73	0.0005	0.018
	15/05/2018	<0.001	0.35	<0.0001	<0.0010	<0.001	0.48	<0.001	0.27	0.003	<0.001	0.84	<0.001	0.007
PDPIEZ53	3/12/2011	0.010	1.80	<0.0010	0.0025	0.005	0.48	<0.005	0.18	0.006	0.029		0.025	0.16
	3/03/2012	<0.2	2.30	<0.0100	<0.0500	<0.05	<0.2	<0.05	<0.05	<0.05	<0.2		<0.5	<0.1
	25/06/2012	0.010	1.70	<0.0010	0.0025	<0.005	<0.02	<0.005	0.025	<0.005	0.036		0.025	0.13
	6/07/2013	0.010	1.60	<0.0010	0.0025	<0.005	<0.02	<0.02	0.0025	0.007	0.025		0.025	0.03
	26/05/2015	0.001	1.40	<0.0001	0.0005	0.006	<0.005	<0.001	0.36	0.002	0.13	3.1	0.0005	<0.005
	24/05/2016	0.001	1.10	<0.0010	0.0005	0.01	<0.01	<0.001	0.016	0.001	0.12	2.7	0.0005	0.009
	26/07/2017	<0.001	1.40	<0.0001	0.003	0.01	<0.01	<0.001	0.53	0.003	0.062	3.1	<0.001	0.005
	14/05/2018	<0.001	1.40	<0.0001	<0.0010	0.006	<0.01	<0.001	0.22	0.001	0.091	3.1	<0.001	0.006
	28/05/2019	<0.001	1.50	<0.0001	<0.0010	0.005	<0.01	<0.001	0.44	0.002	0.038	3.2	<0.001	0.004

Table 6.5 - Trace Elements and Metals

Sampling point	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
Emma Pit North	14/03/2014	0.010	2.20	<0.0010	0.0025	<0.005	<0.02	<0.02	0.009		0.025		0.025	<0.01
Emma Pit South	14/03/2014	0.010	2.40	<0.0010	0.0025	<0.005	<0.02	<0.02	0.008	<0.005	0.025		0.025	<0.01
	28/05/2015	0.003	2.90	<0.0005	0.0025	<0.005	<0.025	<0.005	0.0025	<0.005	0.019		0.0025	<0.025
	26/07/2017	0.002	3.10	<0.0001	0.0020	<0.001	<0.01	<0.001	<0.005	<0.001	0.01	0.89	<0.001	<0.001
	28/05/2019	0.003	4.30	<0.0001	0.0010	<0.001	0.01	<0.001	<0.005	<0.001	0.008	0.66	<0.001	<0.001
PDPIEZ44b	3/12/2011	<0.020	2.70	<0.0010	0.0080	0.013	1.1	0.008	0.13	0.016	0.014		<0.05	0.27
	4/03/2012	<0.2	3.00	<0.0100	<0.0500	<0.05	<0.2	<0.05	<0.05	<0.05	<0.2		<0.5	<0.1
	22/06/2012	0.010	2.60	<0.0010	0.0025	<0.005	<0.02	<0.005	0.0025	0.006	0.01		0.025	0.04
	26/05/2015	0.003	2.10	<0.0005	0.0025	<0.005	<0.025	<0.005	0.0025	<0.005	0.009	1.7	0.0025	<0.025
	24/05/2016	0.002	1.90	<0.0001	0.002	0.006	<0.01	<0.001	0.0025	<0.001	0.008	1.6	0.0005	0.033
	26/07/2017	0.001	1.90	<0.0001	0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.009	1.8	0.003	0.003
	14/05/2018	0.001	2.30	<0.0001	0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.008	1.8	<0.001	0.003
	28/05/2019	0.001	2.40	<0.0001	<0.0010	<0.001	<0.01	<0.001	<0.005	0.001	0.009	1.7	<0.001	0.002
PDPIEZ45	2/12/2011	0.010	2.80	<0.0010	0.017	0.014	0.94	0.028	0.13	0.054	0.02		0.025	0.24
	4/03/2012	<0.20	2.50	<0.0100	<0.0500	<0.05	<0.2	<0.05	<0.05	<0.05	<0.2		<0.5	<0.1
	23/06/2012	0.010	2.40	<0.0010	0.0025	<0.005	<0.02	<0.005	0.0025	0.006	0.01		0.025	<0.01
	6/12/2013	<0.020	2.80	<0.0010	<0.0050	<0.005	<0.02	<0.02	0.017	0.01	<0.05		<0.05	0.05
	26/05/2015	0.003	2.70	<0.0005	0.0025	<0.005	<0.025	<0.005	0.0025	<0.005	0.011	2.1	0.0025	<0.025
	24/05/2016	0.001	2.10	<0.0001	0.002	<0.001	<0.01	0.017	0.0025	0.001	0.009	2.1	0.0005	0.007
	26/07/2017	<0.001	2.00	<0.0001	<0.0010	<0.001	<0.01	<0.001	0.035	<0.001	<0.001	0.25	<0.001	<0.001
	14/05/2018	<0.001	2.80	<0.0001	0.0030	<0.001	<0.01	<0.001	<0.005	0.001	0.01	2.1	<0.001	0.005
	28/05/2019	<0.001	2.90	<0.0001	0.0020	<0.001	0.02	<0.001	0.009	0.002	0.01	2	<0.001	0.003
PDTEST23	4/12/2011	0.010	0.40	<0.0010	0.0025	<0.005	<0.02	<0.005	0.21	0.007	0.005		0.025	0.09
	5/03/2012	<0.020	0.40	<0.0010	<0.0050	<0.005	<0.02	<0.005	<0.005	0.01	<0.01		<0.05	0.03
	9/07/2012	<0.020	0.33	<0.0010	<0.0050	<0.005	<0.02	<0.005	0.029	<0.005	<0.02		<0.05	0.24
	14/10/2012	0.010	0.60	<0.0010	0.0025	<0.005	<0.02	<0.005	0.03	0.008	0.01		0.025	0.12
	22/12/2012	0.010	0.60	<0.0010	0.0025	<0.005	<0.02	<0.02	0.025	0.007	0.025		0.025	0.04
	21/03/2013	0.010	0.60	<0.0010	0.0025	0.008	<0.02	<0.02	0.16	0.012	0.025		0.025	0.08
	4/07/2013	0.010	0.60	<0.0010	0.0025	<0.005	<0.02	<0.02	0.07	0.007	0.025		0.025	0.06

Table 6.5 - Trace Elements and Metals

Sampling point	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
	13/03/2014	0.010	0.43	<0.0010	0.0025	<0.005		<0.02	5.5		0.025		0.025	
	26/05/2015	0.001	0.34	<0.0001	0.0005	<0.001	0.46	<0.001	5.1	0.002	0.0005	0.52	0.0005	<0.005
	14/05/2018	<0.001	0.43	<0.0001	<0.0010	<0.001	0.58	<0.001	4	0.001	<0.001	0.75	<0.001	0.009
	28/05/2019	<0.001	0.40	<0.0001	<0.0010	<0.001	0.24	<0.001	3.6	0.001	<0.001	0.65	<0.001	0.005
South Limb Pit Lake	2/04/2012	0.010	0.50	<0.0010	0.0025	<0.005	<0.02	<0.005	0.044	0.007	0.01		0.025	<0.01
	23/06/2012	0.010	0.60	<0.0010	0.0025	<0.005	<0.02	<0.005	0.0025	0.01	0.01		0.025	<0.01
	26/09/2012	0.010	0.60	<0.0010	0.0025	<0.005	<0.02	<0.005	0.0025	0.013	0.01		0.025	0.01
	4/08/2013	<0.020	0.60	<0.0010	<0.0050	<0.005	<0.02	<0.02	0.013	0.009	<0.05		<0.05	0.02
	15/03/2014	0.010	0.60	<0.0010	0.0025	<0.005	<0.02	<0.02	0.018		0.025		0.025	
	14/05/2018	0.001	0.78	<0.0001	<0.0010	<0.001	<0.01	<0.001	0.025	<0.001	0.001	6.4	<0.001	0.003
	28/05/2019	0.001	0.91	<0.0001	<0.0010	<0.001	0.01	<0.001	0.049	<0.001	0.001	6.8	<0.001	0.002
PDPIEZ35	25/12/2012	0.010	0.60	<0.0010	0.0025	0.043	0.12	<0.02	0.073	0.009	0.025		0.025	0.01
	4/08/2013	0.010	0.70	0.0010	0.0025	0.008	<0.02	<0.02	0.0025	0.009	0.025		0.025	0.02
	26/05/2015	0.001	0.55	<0.0001	0.0005	0.004	<0.005	<0.001	0.0005	0.004	0.003	1.6	0.0005	0.02
	24/05/2016	0.001	0.38	<0.0001	0.0005	0.003	<0.01	<0.001	0.011	0.008	0.003	1.5	0.0005	0.004
	26/07/2017	0.001	0.48	<0.0001	0.0010	0.005	<0.01	<0.001	<0.005	0.034	0.006	0.74	<0.001	0.001
	28/05/2019	<0.001	0.55	<0.0001	<0.0010	0.005	<0.01	<0.001	<0.005	0.024	0.005	0.66	<0.001	0.003

Values highlighted blue exceed the Australian Drinking Water Guidelines for aesthetic impacts (NHMRC, 2012).
Values highlighted orange exceed the Australian Drinking Water Guidelines for health impacts (NHMRC, 2012).

Table 6.6 - Hydrocarbons

Sampling Point	Date	TRH C10-C14 (mg/L)	TRH C15-C28 (mg/L)	TRH C29-C36 (mg/L)	TRH C6-C9 (mg/L)
Bobby Pit	15/05/2018	<0.05	<0.100	<0.100	<0.010
	26/07/2017	<0.05	<0.1	<0.1	<0.01
	25/05/2016				<0.01
	26/05/2015	0.06	<0.2	<0.2	<0.04
	17/12/2013	0.1	<0.2	<0.2	<0.04
	3/09/2013	<0.05	<0.2	<0.2	<0.04
PDPIEZ22s(b)	17/12/2013	0.13	<0.2	<0.2	<0.04
	24/07/2013	<0.05	<0.2	<0.2	<0.04
	22/06/2012	<0.05	<0.2	<0.2	<0.04
	5/03/2012	0.08	<0.2	<0.2	<0.04
	4/12/2011	<0.05	<0.2	<0.2	<0.04
	11/09/2011	0.08	<0.2	<0.2	0.09
PDPIEZ29	20/07/2013	<0.05	<0.2	<0.2	<0.04
	24/06/2012	<0.05	<0.2	<0.2	<0.04
PDPIEZ31	11/07/2013	<0.05	<0.2	<0.2	<0.04
	25/06/2012	<0.05	<0.2	<0.2	<0.04
PDPIEZ38	5/12/2013	<0.05	<0.2	<0.2	<0.04
	24/07/2013	<0.05	<0.2	<0.2	<0.04
	26/12/2012	0.035	0.22	<0.23	0.03
	21/06/2012	<0.05	0.36	<0.2	<0.04
	3/03/2012	<0.05	<0.2	<0.2	<0.04
	4/12/2011	<0.05	<0.2	<0.2	<0.04
PDPIEZ53	26/05/2015	<0.05	<0.2	<0.2	<0.04
	6/07/2013	0.17	0.69	<0.2	<0.04

Table 6.6 - Hydrocarbons

Sampling Point	Date	TRH C10-C14 (mg/L)	TRH C15-C28 (mg/L)	TRH C29-C36 (mg/L)	TRH C6-C9 (mg/L)
	25/06/2012	<0.05	<0.2	<0.2	<0.04
	3/03/2012	<0.05	<0.2	<0.2	<0.04
Emma Pit North	14/03/2014	0.14	<0.2	<0.2	<0.04
Emma Pit South	26/07/2017	<0.05	<0.1	<0.1	<0.01
	24/05/2016				<0.01
	14/03/2014	0.1	<0.2	<0.2	<0.04
PDPIEZ44b	22/06/2012	<0.05	<0.2	<0.2	<0.04
	4/03/2012	0.12	<0.2	<0.2	0.08
	3/12/2011	<0.05	<0.2	<0.2	<0.04
PDPIEZ45	6/12/2013	<0.05	<0.2	<0.2	<0.04
	23/06/2012	<0.05	<0.2	<0.2	<0.04
	4/03/2012	<0.05	<0.2	<0.2	<0.04
	2/12/2011	<0.05	<0.2	<0.2	<0.04
PDTEST23	13/03/2014	<0.05	<0.2	<0.2	<0.04
	5/12/2013	<0.05	<0.2	<0.2	<0.04
	4/07/2013	<0.05	<0.2	<0.2	<0.04
	21/03/2013	<0.05	<0.2	<0.2	<0.04
	22/12/2012	<0.05	<0.2	<0.2	<0.04
	14/10/2012	<0.05	<0.2	<0.2	<0.04
	9/07/2012	<0.05	<0.2	<0.2	<0.04
	5/03/2012	<0.05	<0.2	<0.2	<0.04
	4/12/2011	<0.05	<0.2	<0.2	<0.04
South Limb Pit Lake	14/05/2018	<0.05	<0.100	<0.100	<0.010
	15/03/2014	<0.05	<0.2	<0.2	<0.04
	4/08/2013	<0.05	<0.2	<0.2	<0.04

Table 6.6 - Hydrocarbons

Sampling Point	Date	TRH C10-C14 (mg/L)	TRH C15-C28 (mg/L)	TRH C29-C36 (mg/L)	TRH C6-C9 (mg/L)
	26/09/2012	<0.05	<0.2	<0.2	<0.04
	23/06/2012	<0.05	<0.2	<0.2	<0.04
	2/04/2012	<0.05	<0.2	<0.2	<0.04
PDPIEZ35	4/08/2013	<0.05	<0.2	<0.2	<0.04
	25/12/2012	<0.05	<0.2	<0.2	<0.04
	23/06/2012	<0.05	<0.2	<0.2	<0.04
	4/03/2012	<0.05	<0.2	<0.2	<0.04
Chloe Pit Lake	14/05/2018	<0.05	<0.100	<0.100	<0.010

6.11 Pardoo Groundwater Model Update

Please refer to the Atlas 2018 Annual Water Report (Atlas, 2018) for a detailed description of the model update. In July 2017 Atlas engaged Jacobs Engineering to complete an update of the Pardoo Groundwater Model (Jacobs, 2017) using the 2017 monitoring and climate observation data to compare recorded groundwater recovery to model predictions. The report describes the changes made to the model in 2017 and results of scenarios. Overall the modelling indicated that water level recovery was proceeding as expected with a dramatic decrease in impacted area.

No further updates to the model are planned.

6.12 Compliance

Table 6.7 summarises the compliance commitments at Pardoo. In general, the monitoring requirements were met during the reporting period. Some locations could not be accessed due to poor track conditions and/or pit wall safety concerns and hence could not be monitored. This is provided for in the closure plan which notes that samples will be collected from monitoring points where accessible.

Table 6.7 - Summary of Commitments and Compliance

Activity	Action	Compliance	Comments
Administration	Submit the aquifer review to DoW annually on 30 September. This report will contain: • Compliance with the monitoring schedule and assess results. • Aquifer performance against that predicted.	Compliant	Submitted 30th September 2020.
Monitoring	• Implementation of monitoring schedule as per Pardoo Mine Closure Plan and Interim Care and Maintenance Monitoring Program.	Compliant	Monitoring not required for this reporting period.

7. CORUNNA DOWNS

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7.1 Introduction

This groundwater monitoring summary report relates to instrument GWL176960(5), which entitles Atlas Iron Ltd to take water under section 5C of the RiWI Act (1914). The duration of this licence is from 03 April 2020 to 02 April 2030.

Project activity undertaken during the reporting period includes commencement of the construction works in support of upgrading the existing HilsideHillside-Marble Bar Road and construction of the mine access road (MAR).

During the next reporting period (2020/2021) it is anticipated that the project will also include the development of five open pits and the commencement of mining. It is expected that a total of 23.3 Mt of iron ore will be produced over approximately 6 years.

To support the project, groundwater is proposed to be used for construction, dust suppression, ore processing and potable requirements. Dewatering is not expected to be required, as the proposed mining activities are above the observed groundwater table.

7.2 Background and Location

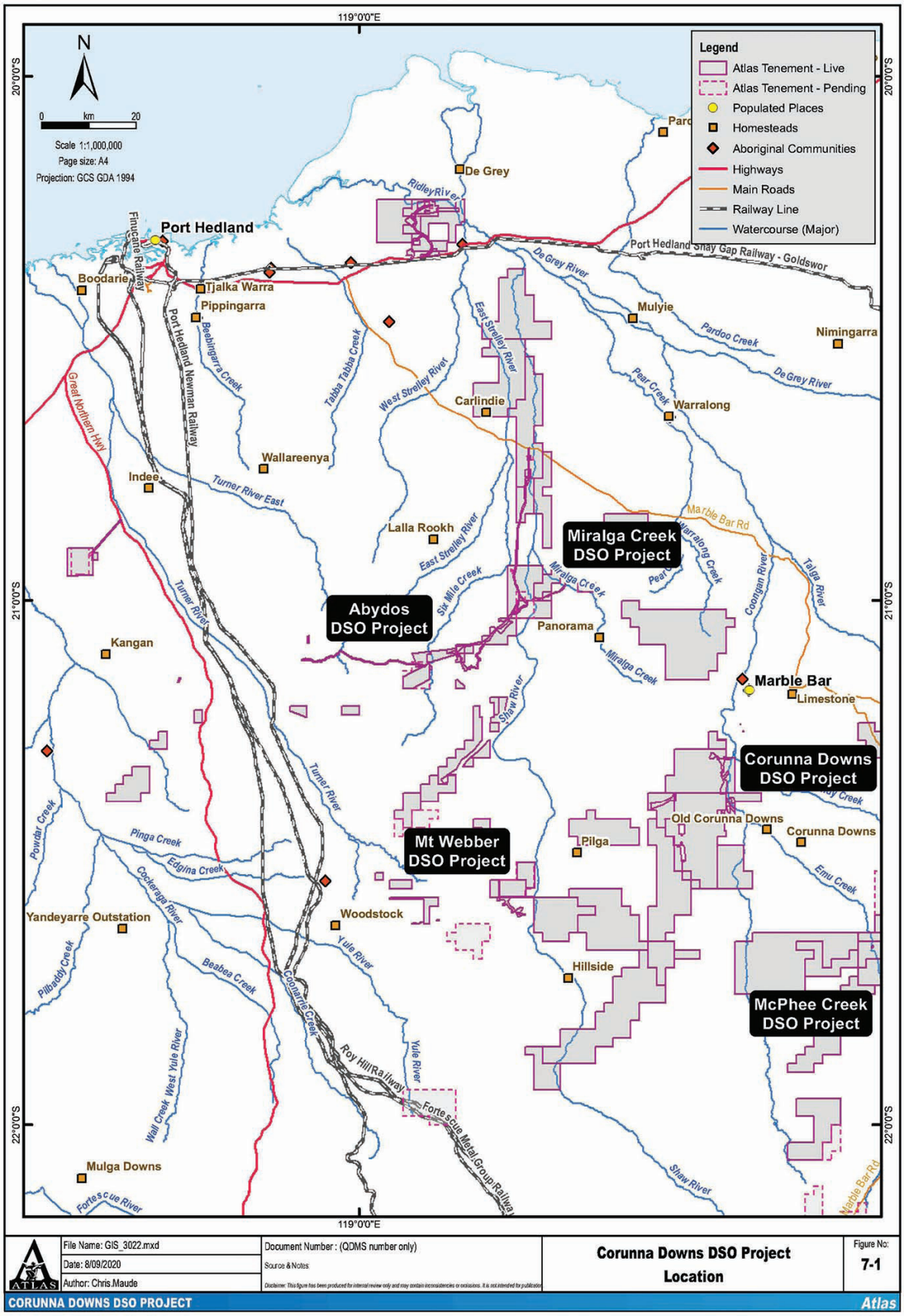
The Corunna Downs DSO Project is located in the Pilbara region of Western Australia, approximately 33 km south of Marble Bar (Figure 7.1). The project consists of the Corunna Downs mine site and the 30 km MAR to enable access to Hillside-Marble Bar Road.

The Corunna Downs DSO Project area lies within an existing pastoral lease. The lease area is predominantly savannah scrubland and is grazed with cattle. Several mining and exploration tenements exist in the vicinity of Corunna Downs, with exploration activity focussed on gold and base metals.

The landforms surrounding the project are dominated by steep-sided ridges and hills associated with outcrops of banded iron formation (BIF), greenstone, chert, and minor sandstone, dolomite and Basalt. The proposed mining activities are generally centred on an elongated and elevated ridge. The Coongan River runs along the eastern boundary of the project area.

7.3 Groundwater Management Areas

The project lies within the Pilbara groundwater management area and the Pilbara groundwater management subarea. It is not located within a public drinking water source area.



File Name: GIS_3022.mxd	Document Number : (QDMS number only)	Corunna Downs DSO Project Location	Figure No: 7-1
Date: 8/09/2020	Source & Notes:		
Author: Chris.Maude	Disclaimer: This figure has been produced for internal review only and may contain inconsistencies or exclusions. It is not intended for publication		

CORUNNA DOWNS DSO PROJECT Atlas

Figure 7.1 - Corunna Downs DSO Project Location

7.4 Water Usage

Water taken under GWL179690(5) is authorised to be used for:

- Dust suppression for earthworks and construction purposes
- Dust suppression for mining purposes
- Exploratory drilling operations
- Mineral ore processing and other mining purposes
- Mining camp purposes
- Road construction purposes
- Road maintenance purposes.

The activities listed above are approved within leases E45/4639-I, G45/339, L45/407, L45/408, L45/410, L45/418, M45/1257 and the parcel of land described under Section 91 of the Land Administration Act (1997) LIC 00869/2016_A10394337.

7.5 Licencing

Groundwater abstraction for the project is granted under GWL176960(5). This entitles Atlas to take a volume of 1,100,000 kL per annum from the Pilbara Fractured Rock aquifer for the purposes described in Section 7.4. Prior to this, a separate licence (GWL184565(3)) was granted to support the commencement of the upgrade of the Hillside-Marble Bar Road. GWL184565 has since been amalgamated with GWL176960, and has therefore been relinquished. All groundwater abstraction is therefore performed under GWL176960(5). The historic section 5C licence approvals associated with the Corunna Downs DSO Project are summarised in Table 7.1, and the current groundwater licence GWL179690(5) is illustrated in Figure 7.2.

Table 7.1 - Licence History, Corunna Downs

License	Allocation (kL)	Issued date	Expiry date	Comments
GWL184565(2)	100,000	22/03/2019	21/03/2029	
GWL184565(3)	300,000	28/11/2019	27/11/2029	Allocation increased according to demand. Licence relinquished following consolidation with GWL176960(5).
GWL179086	50,000	28/03/2014	27/03/2024	Camp supply & exploration drilling
GWL179690	50,000	15/02/2013	31/01/2018	Dust suppression & construction
GWL176960(4)	100,000	29/05/2017	28/05/2027	
GWL176960(5)	1,100,000	03/04/2020	02/04/2030	Allocation increased to consolidate all water usage onto one licence.

The reporting period for GWL176960(5) is from 1 July to 30 June each year. A groundwater monitoring report (this report) is required to be provided to DWER annually. A groundwater monitoring review is required to be provided to DWER every three years, with the first being due on 30/09/2023.

File No: RF10954-5

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Instrument No. GWL176960(5)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Atlas Iron Pty Ltd		
Description of Water Resource	Pilbara Pilbara - Fractured Rock	**Annual Water Entitlement**	1,100,000kL
Location of Water Source	L45/410 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Dust suppression for earthworks and construction purposes	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Dust Suppression for mining purposes	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Exploratory drilling operations	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

Figure 7.2a - License to Take Water GWL176960(5) page 1 of 3

File No: RF10954~5

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Instrument No. GWL176960(5)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

		M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Mineral ore processing and other mining purposes	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Mining camp purposes	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Road construction purposes	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Road maintenance purposes	E45/4639-I G45/339 L45/407

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

Figure 7.2b - License to Take Water GWL176960(5) page 2 of 3

File No: RF10954~5

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Page 2 of 3

Instrument No. GWL176960(5)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

		M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Mineral ore processing and other mining purposes	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Mining camp purposes	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Road construction purposes	E45/4639-I G45/339 L45/407 L45/408 L45/410 L45/418 M45/1257 SECTION 91 OF LAND ADMINISTRATION ACT 1997 - LIC 00869/2016_A10394337
	Road maintenance purposes	E45/4639-I G45/339 L45/407

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

Figure 7.2c - License to Take Water GWL176960(5) page 3 of 3

7.6 Climate

The climate of the Corunna Downs DSO Project area is classified as semi-arid to arid and is characterised by hot summers and warm winters. The project area typically experiences a climate of extremes, where severe droughts and major floods can occur at close intervals.

The closest weather station to the project which is monitored by the Bureau of Meteorology (BoM) is sited in Marble Bar. The average monthly temperature and rainfall statistics at the Marble Bar weather station (#4106) are summarised in Table 7.2.

Table 7.2 - Marble Bar climatic data summary (BoM station #4106)

Month	Mean daily temperature (°C) (2000 - 2020)		Mean monthly rainfall (mm) (2000 - 2020)
	Maximum	Minimum	
January	40.7	26.5	114.7
February	39.8	26.2	73.7
March	38.3	25.2	81.3
April	36.3	22.1	19.6
May	31.1	17.0	11.8
June	27.1	13.2	22.3
July	27.5	12.2	14.9
August	30.2	13.0	0.4
September	34.7	16.7	3.7
October	39.0	21.8	3.3
November	40.8	24.1	9.9
December	42.0	26.2	29.6
Annual Average	35.6	20.3	392.7

Source: Marble Bar Station 4106 (BoM, 2020b)

7.7 Hydrogeology

The geology surrounding the Corunna Downs DSO project area is typically dominated by faulted granitoid rocks and folded greenstone rocks, with permeability being controlled by the structure of the faults (SRK 2019). The occurrence and movement of groundwater in this region is therefore controlled by secondary permeability and porosity in fractures, weathered zones and along bedding planes.

Two aquifer systems have been identified within the vicinity of the project; the fractured bedrock aquifer (FBA), and an ephemeral alluvial groundwater system associated with surface water drainage lines (SRK 2019).

7.7.1 Alluvial groundwater system

The alluvial aquifers occur mainly in the valleys and drainage channels incised into the ridge, and in the lower lying landforms, including the Coongan River depositional areas. These aquifers are recharged by the downward infiltration of surface water flows within the drainage channels. Groundwater elevations within the alluvial sediments are therefore highly variable and generally indicative of short term rainfall patterns.

While alluvial groundwater systems are not present within the proposed mining areas, they are present in areas associated with the Coongan River (SRK, 2019). This major arterial water body runs parallel and adjacent to the north-south oriented ridge that hosts the proposed mining.

The alluvial groundwater system is ephemeral and not considered to be a feasible source of water for the project (SRK, 2019). Rather, this system provides a source of recharge to the underlying FBA when saturated and in periods of low evaporation.

These unconfined alluvial deposits are typically thin and of limited extent, discontinuously overlying the FBA. The hydraulic connectivity between the alluvial aquifer and FBA is highly variable due to limited extent and composition of alluvial and colluvial sediments, and the extent of weathering and fracturing at the contact (SRK, 2019).

7.7.2 Fractured Bedrock Aquifer System

The fractured bedrock aquifer (FBA) system is hosted within the banded iron formation (BIF), Mt Roe Basalt, Hardy Formation, Dalton Suite, Wyman Formation and the Euro Basalt (SRK, 2019). Within the FBA, groundwater flows are controlled by structural features. The development of fractures within the bedrock provides storage and permeability via preferential flow pathways (secondary porosity). Diffuse flows through competent rock mass is considered to be low.

The FBA system is highly anisotropic, with higher hydraulic conductivities existing parallel to the primary BIF, chert and shale bedding planes. Hydrogeological investigations have suggested that the FBA is considerably compartmentalised, with variable hydraulic conductivity and degrees of connectivity between compartments (SRK, 2019). This results in variable responses to seasonal patterns.

Recharge to the FBA occurs via direct rainfall on exposed outcrop, and is enhanced where the exposed bedrock is characterised by well-developed weathered zones, shallow fracture zones, or lithological contacts. To a lesser extent, recharge also occurs via infiltration from the alluvial sediments, although these are thin and discontinuous. Recharge from alluvial sediments are enhanced where lithological contacts or fracture zones intersect ephemeral water courses.

7.8 Corunna Downs Borefield

The Corunna Downs borefields are grouped into two areas as follows:

- Mine water supply
- Road construction and maintenance

The Corunna Downs borefields were established during 2017, with the installation of 17 production bores and 34 monitoring bores. Details of the existing production and monitoring bores for these borefields are summarised in Table 7.3 and Table 7.4, and the locations of these bores are illustrated on Figure 7.3.

Table 7.3 - Production and Monitoring Bore Details, Road Construction and Maintenance

Bore ID	Coordinates (GDA94, Zone 50)		Total depth (mbgl)	Casing diameter (mm)	Screen interval (mbgl)	Static water level (mbtoc)	Advised flow rate (L/s)	Advised pump inlet depth (mbgl)
	Easting	Northing						
Production Bores								
CRD0084	778981	7641952	64	200	6 - 60	4.31	4	45
CRD0085	780809	7642040	64	200	6 - 64	8.16	4	55
CRD0086	782443	7644390	70	200	4 - 70	3.50	3	60
CRD0087	781895	7645717	64	200	4 - 64	4.86	5	50
CRD0088	782300	7652343	102	200	9 - 99	6.79	4	90
CRD0089	782645	7652340	100	200	12 - 96	11.47	4	90
Monitoring Bores								
CRD0039	782300	7652343	102	Not cased		5.73	-	-
CRD0043	782300	7652890	84	Not cased		5.50	-	-
CRD0044	782273	7645380	66	Not cased		2.91	-	-
CRD0056(1)	782645	7652340	102	Not cased		10.8	-	-
CRD0058	782443	7644390	66	Not cased		2.97	-	-
CRD0062	778987	7641946	60	Not cased		4.25	-	-
CRD0064	780812	7642047	60	Not cased		7.83	-	-

CRD0056 was destroyed in 2016 and is no longer available for use in this monitoring program.

Table 7.4 - Production Bore Details, Mine Water Supply

Bore ID	Coordinates (GDA94, Zone 50)		Total depth (mbgl)	Casing diameter (mm)	Screen interval (mbgl)	Static water level (mbtoc)	Advised flow rate (L/s)	Advised pump inlet depth (mbgl)
	Easting	Northing						
CRD0005[1]	775963	7623421	65	125	24 - 36, 48 - 54	22.41	2.5	50
CRD0007[1]	776305	7625361	84	150	42 - 84	32.71	2	70
CRD0014	777310	7628166	162	150	60 - 162	63.14	7	100
CRD0024	776622	7625594	72	100	30 - 72	31.26	1	60
CRD0071	778429	7633394	96	200	10 - 96	5.34	2	55
CRD0074[1]	766242	7623887	132	150	72 - 132	54.11	Nil	N/A
CRD0082	778961	7631290	88	200	10 - 88	6.04	4	65
CRD0083	778575	7632987	78	200	6 - 78	4.14	4	45
CRD0100	776191	7623165	114	150	60 - 114	57.41	7	105
CRD0101	777794	7628783	104	150	48 - 104	34.78	14	95
CRD0102[1]	775844	7624756	72	150	36 - 72	10.1	5	60

(1) CRD0005, CRD0007, CRD0074 and CRD0102 do not form part of the project approvals, but are available for use

Table 7.5 - Monitoring Bore Details, Mine Water Supply

Bore ID	Coordinates (GDA94, Zone 50)		Total depth (mbgl)	Casing diameter (mm)	Screen interval (mbgl)	Static water level (mbtoc)
	Easting	Northing				
CRD0001	776154	7623040	74	50	48 - 74	53.39
CRD0002	776237	7623041	74	50	48 - 74	56.21
CRD0003	776209	7623204	74	50	48 - 74	57.49
CRD0006	777629	7629198	84	50	6 - 84	30.20
CRD0010	776453	7624035	114	50	72 - 114	50.40
CRD0011	776501	7623104	84	50	12 - 84	79.49
CRD0012	775943	7623417	54	50	30 - 54	22.41
CRD0013	775844	7624756	54	50	6 - 54	9.91
CRD0015	777787	7628792	75	50	30 - 75	35.12
CRD0027	779018	7634054	100	50	28 - 100	11.61
CRD0033	776182	7623126	74	50	48 - 74	61.52
CRD0048	779844	7631676	90	100	6 - 90	3.30
CRD0073	779603	7631387	60	100	6 - 60	3.68
CRD0075	778427	7633388	48	50	12 - 48	6.00
CRD0090	776305	7625349	87	50	9 - 87	33.35
CRD0091	776547	7623515	90	50	6 - 90	71.13
CRD0092	777461	7628875	30	50	6 - 30	40.29
CRD0093	777010	7625741	30	50	6 - 77	30.87
CRD0094	777082	7627227	102	50	6 - 102	41.58
CRD0095	777310	7628185	119	50	53 - 119	62.72
CRD0096	777644	7628471	108	50	6 - 108	67.2
CRD0097	778886	7630420	72	50	6 - 72	23.8
CRD0098	776235	7623878	108	50	6 - 108	54.25
CRD0099	776448	7623375	102	50	5 - 102	57.49
CRD0103	*778628*	*7630233*	TBC	50	TBC	TBC
CRD0104	*778523*	*7630068*	TBC	50	TBC	TBC
CRD0105	*777466*	*7629125*	TBC	50	TBC	TBC

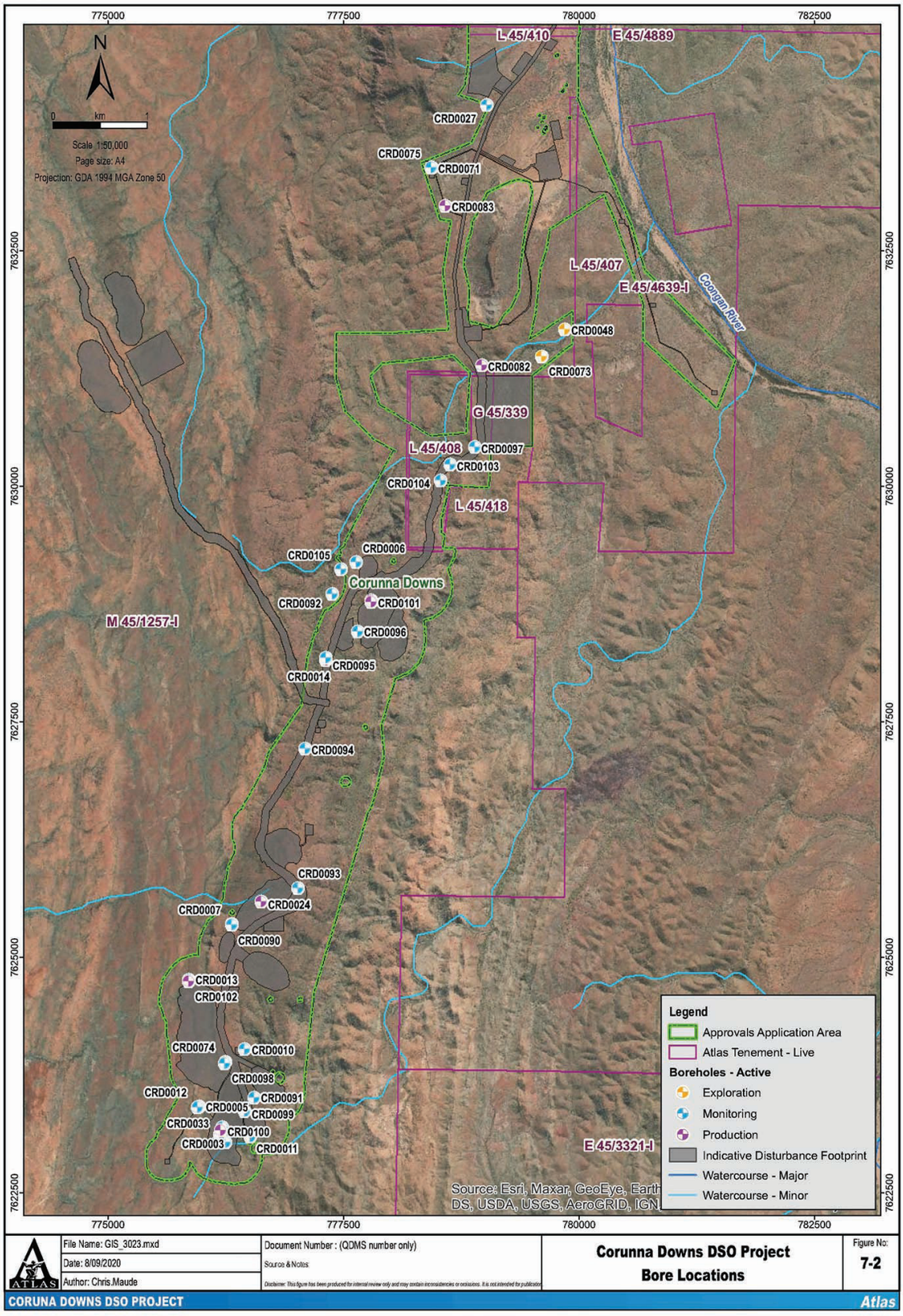

Figure 7.3 - Corunna Downs DSO Project Bore Locations

7.8.1 Supply Scheme

The existing water supply scheme for road construction and maintenance purposes is illustrated in Figure 7.4, and the proposed water supply scheme for the mine water supply is illustrated in Figure 7.5.

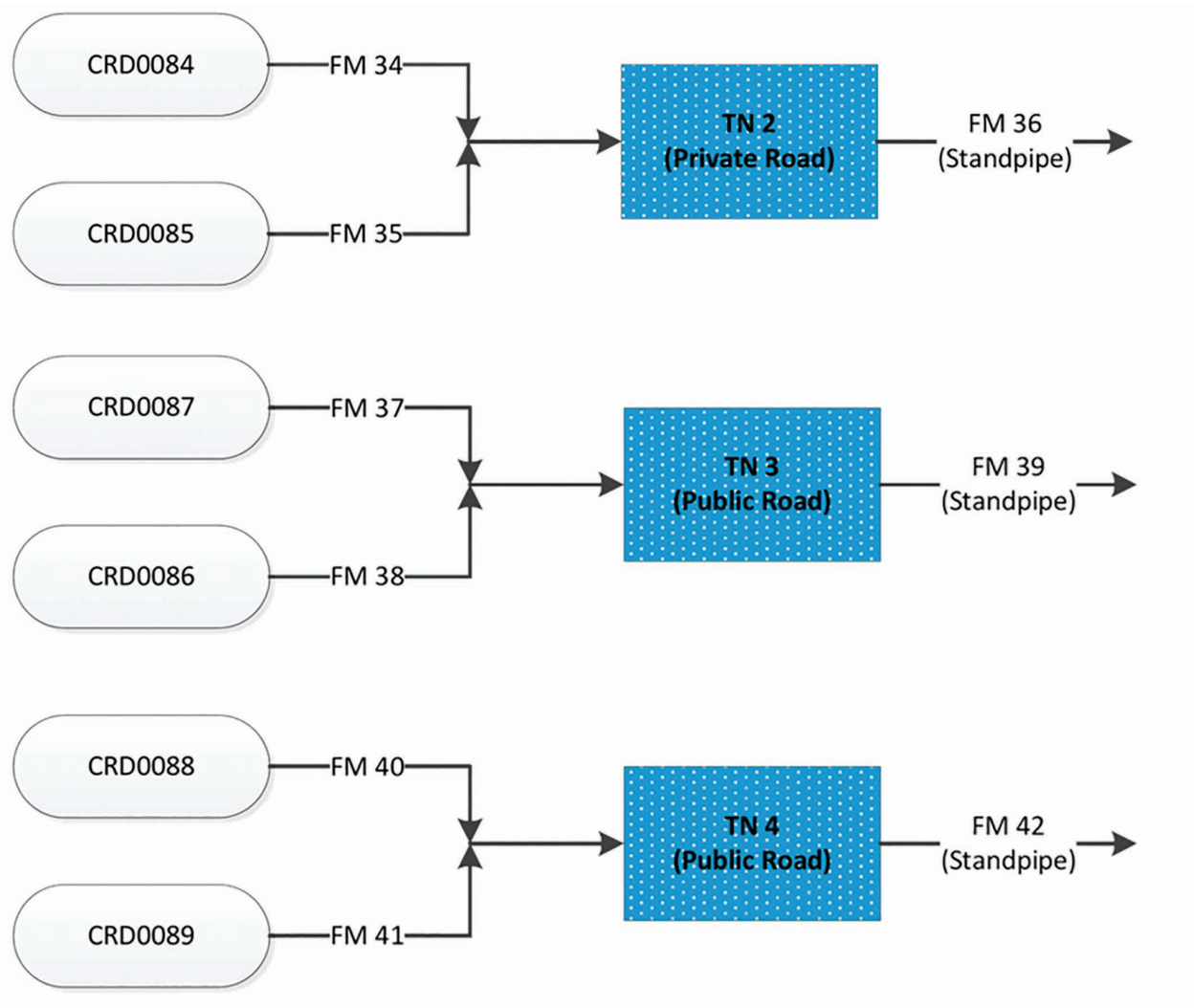

Figure 7.4 - Corunna Downs Water Supply Scheme - Haul Road Construction and Maintenance

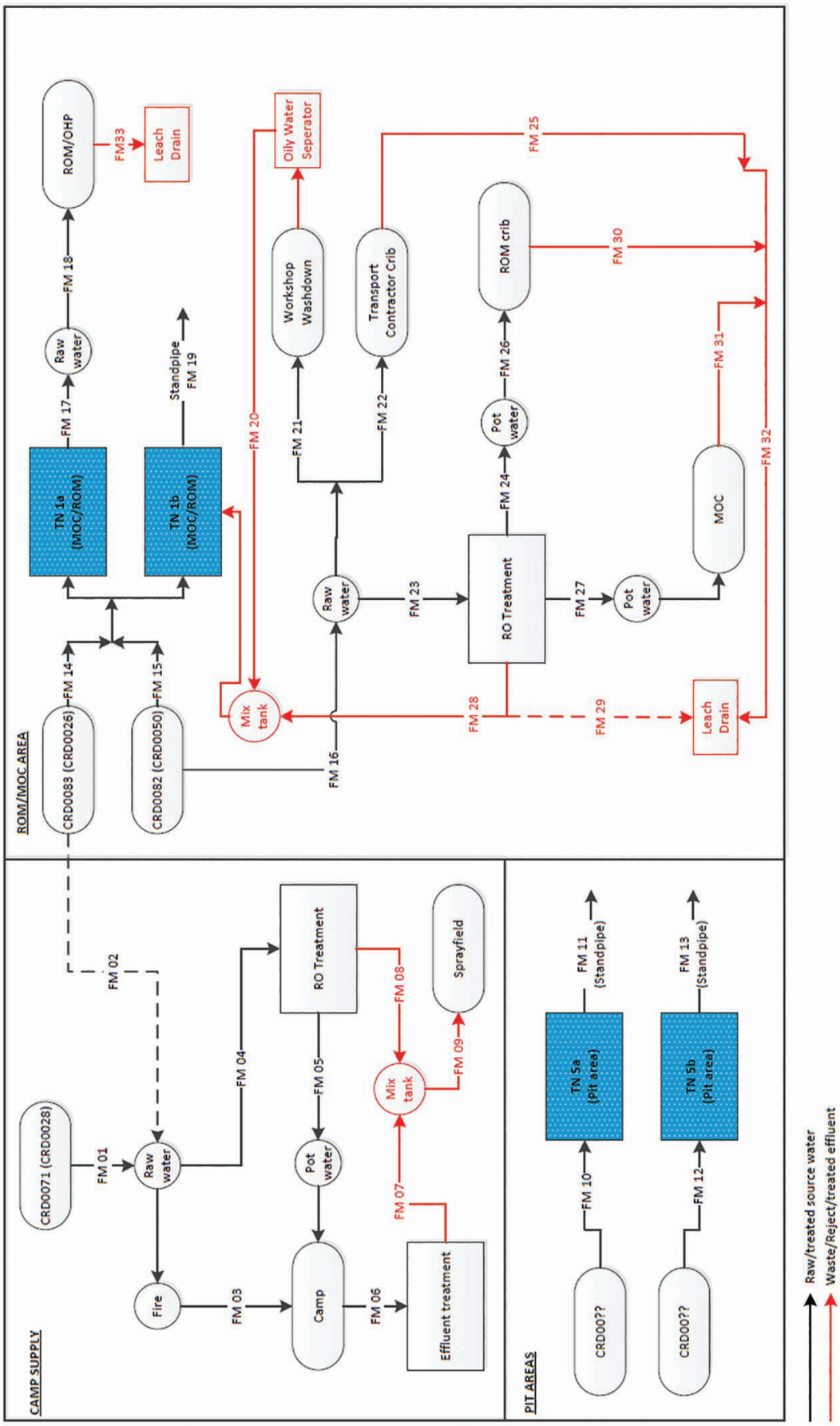

Figure 7.5 - Corunna Downs Water Supply Scheme - Mine Water Supply

7.9 Abstraction

A total of 80,293 kL of groundwater was abstracted during the reporting period. This represents approximately 7% of the annual water entitlement (1,100,000 kL). The use of groundwater during the 2019/2020 reporting period was limited to those production bores which support the public road upgrade and construction of the MAR.

The monthly breakdown of abstraction from each bore for the reporting period is summarised in Table 7.6. Bores not listed here were not used during the reporting period.

Table 7.6 - Monthly Groundwater Abstraction

Bore ID	May 2020	June 2020	Total
CRD0014	0	283	**283**
CRD0071	15,886	5,908	**21,794**
CRD0082	3,221	0	**3,221**
CRD0083	0	5,734	**5,734**
CRD0084	13,023	26,917	**39,940**
CRD0087	2,767	4,534	**7,301**
CRD0089	1,582	439	**2,021**
Total	**36,479**	**43,815**	**80,293**

7.10 Water Balance

As no discharge took place the water balance is equivalent to groundwater abstraction. The project is also in the construction phase, with 100% of groundwater abstracted being used for dust suppression purposes.

There have been no amendments to the construction schedule or proposed mining and processing rates. The existing licence allocation therefore remains appropriate for existing and expected future operations.

7.11 Monitoring

7.11.1 Objectives

The objectives of the Corunna Downs monitoring program, as described in the Corunna Downs Site Water Operating Plan (SWOP) (Atlas, 2020), were developed in accordance with the Atlas Water Policy (Atlas, 2019) to meet regulatory requirements/license conditions.

The groundwater monitoring requirements for the Corunna Downs DSO project have been designed to provide suitable coverage for both the MAR construction program and the long term mining operations. The monitoring requirements for these are summarised in Table 7.7 and Table 7.8, respectively.

Table 7.7 - Groundwater Monitoring Schedule, Road Construction and Maintenance

Location	Frequency	Type of Monitoring	Parameters
Production bores	Weekly	Field measurement	Water levels; Flow meter readings.
	Monthly	Field measurement	Salinity, pH and temperature;
	Nov/Apr	Laboratory testing	Major ions; Metals; Total petroleum hydrocarbons (Nov only); Total suspended solids.
Monitoring bores	Weekly	Field measurement	Water levels;
	Monthly	Field measurement	Salinity, pH and temperature.

Table 7.8 - Long Term Groundwater Monitoring Schedule

Location	Frequency	Type of Monitoring	Parameters
Operating Production and monitoring bores, including pool, soak and GDV monitoring bores (CRD0027, CRD0048, CRD0064, CRD0073, CRD0075, CRD0091, CRD0092, CRD0097, CRD0099, CRD0103, CRD0104, and CRD0105).	Monthly	Field measurement	Water levels; Salinity, pH and temperature; Flow meter readings.
	Nov/Apr	Laboratory testing	Major ions; Metals; Total petroleum hydrocarbons (Nov); Total suspended solids.
		Dataloggers	Download dataloggers
Other monitoring and regional bores	Quarterly	Field measurement	Water levels; Salinity, pH and temperature.
	Nov/Apr	Dataloggers	Download dataloggers
	Annual	Laboratory testing	Major ions; Metals; Total suspended solids.
Surface water pools (CO-WS-01, CO-WS-10, and CO-WS-14)	Monthly (CO-WS-01 and CO-WS-14) Quarterly (CO-WS-10)	Field measurement	Water levels; Salinity, pH and temperature.
		Dataloggers	Download dataloggers
		Laboratory testing	Major ions; Metals; Total petroleum hydrocarbons; Total suspended solids.

The monitoring program currently underway is the initial 'road construction and maintenance' program, as described in Table 7.7. Once construction is complete and the mine is operational, the long term monitoring program will commence.

7.11.2 Regulatory Conditions

There are no specific statutory conditions related to groundwater abstraction other than the standard conditions associated with the groundwater license. The license conditions are as follows:

1. The annual water year for water taken under this licence is defined as 1 July to 30 June.
2. The licensee shall comply with the commitments of the operating strategy Atlas Iron Pty Ltd Corunna Downs DSO Project - Site Water Operating Plan 179-DEV-DY-PLN-0011 Revision 1, as prepared by Atlas Iron Pty Ltd and approved by the Department of Water and Environmental Regulation on 30/03/2020 including any modifications to the commitments as approved during the term of the licence.
3. Every 1 year the licensee shall provide to the Department of Water and Environmental Regulation a Groundwater Monitoring Summary for the preceding water year. The first report is due 30/09/2019.
4. Every 3 Years the licensee shall provide to the Department of Water and Environmental Regulation a Groundwater Monitoring Review. The first report is due 30/09/2023. A Groundwater Monitoring Summary need not be submitted in a year in which a Groundwater Monitoring Review is due.

7.11.3 Trigger levels

Using standard methods and performance monitoring to minimise impacts on the community and environment are a key part of the Atlas Water Policy. Trigger values and contingency actions as described in the SWOP (Atlas, 2020) provide a framework for detecting and mitigating those impacts which may be related to groundwater abstraction.

Water level trigger values have been adopted for each production bore to limit the drawdown of water levels, mitigating the risk of dewatering important water bearing fractures. The trigger values were therefore based on the maximum anticipated pumping water levels (mbgl), assuming no periodic recharge to the aquifer, and limited by the depth of the water bearing zone observed in each bore.

Baseline (pre-construction) electrical conductivity (EC) measurements in production bores ranged from 30 to 2,280 µS/cm, which is considered to be fresh to slightly brackish. The trigger values adopted for EC are based on a 50% increase in salinity during operation.

Trigger values have also been adopted for surface water monitoring locations. The trigger values at most surface water monitoring locations were based on the modelled drawdown for the maximum pumping scenario, with trigger values at other locations being based on 32% of the maximum modelled drawdown to provide an early warning. The monitoring of surface water pools is also supported by the measurement of groundwater levels at nearby groundwater monitoring locations.

The adopted groundwater level and quality trigger values for the production bores are summarised in Table 7.9. The adopted triggers for surface water monitoring are summarised in Table 7.10.

Table 7.9 - Adopted Trigger Levels, Groundwater Monitoring

Bore ID	Trigger Values		Contingency Actions	
	Max Pumping Water Level (mbgl)	Water Quality (µS/cm)	Water Levels / Drawdown	Water Quality
Mine Water Supply Bores			Stage 1 (90% of predicted) Increase monitoring frequency to twice weekly. Stage 2 (100% of predicted) Reduce pumping rate, or rest if possible; Increase monitoring frequency to twice weekly. Stage 3 (110% of predicted) Shutdown bore and notify DWER.	Repeat measurement; Identify source (if possible); Increase frequency of monitoring (if required); Develop action plan (no action, reduce pumping, or take bore out of service; update SWOP) and consult with DWER.
CRD0014	90	1,000		
CRD0024	90	1,000		
CRD0071	15	1,600		
CRD0082	54	1,700		
CRD0083	17	1,700		
CRD0100	100	1,500		
CRD0101	90	1,000		
Road Construction and Maintenance				
CRD0084	40	2,250		
CRD0085	40	2,100		
CRD0086	55	4,500		
CRD0087	40	1,650		
CRD0088	85	1,450		
CRD0089	85	1,500		

Table 7.10 - Adopted Trigger Levels, Surface Water Monitoring

Feature ID	Monitoring Point	Baseline Water Level[2]	Trigger value (m) [3]	Water level trigger
CO-WS-01	CO-WS-01	255.627 (mAHD)	Flow ceases	Flow ceases
	CRD0097	23.8 (mbtc)	1.50[4]	25.3 (mbtc)
	CRD0103	TBD	0.5[4]	TBD
	CRD0104	TBD	0.5[4]	TBD
CO-WS-10	CO-WS-10	296.97 (mAHD)	0.10	296.87 (mAHD)
	CRD0092	40.29 (mbtc)	0.50	40.79 (mbtc)
	CRD0105	TBD	0.50[4]	TBD
CO-WS-14	CO-WS-14	320.975 (mAHD)	0.1	320.875 (mAHD)
	CRD0091	71.34 (mbtc)	0.3	71.34 (mbtc)
"Soak"	CRD0075	7.12 (mbtc)	8.00	15.12 (mbtc)
	CRD0027	13.7 (mbtc)	2.90	16.6 (mbtc)
Area of Moderate risk of GDV impact [1]	CRD0048	3.30 (mbtc)	1.64	4.94 (mbtc)
	CRD0073	3.68 (mbtc)	2.32	6.00 (mbtc)
Area of High risk of GDV impact [1]	CRD0064	10.29 (mbtc)	1.00[4]	11.29 (mbtc)

(1) Monitoring also includes vegetation health inspections along designated transects, described under separate approvals such as the Environmental Monitoring Plan (EMP).

(2) Baseline water levels may be updated prior to abstraction according to ongoing baseline monitoring. Baseline for proposed bores (CRD0103, CRD0104, and CRD0105) to be determined (TBD) on installation.

The contingency actions which have been adopted for the surface water monitoring triggers include the following:

- Conduct and assessment of monitoring data, including comparison with the results of the numerical model to determine cause (e.g. water abstraction or regional trend) and review accuracy of model predictions.
- Consult with DWER and develop an action plan (no action, reduce pumping, or take bore/s out of service). For example, manage the rate and duration of abstraction from bore CRD0082 to maintain the water level within monitoring bores CRD0103 and CRD0104 to within the baseline seasonal variation (and mitigate potential impact to pool).

7.12 Monitoring Observations

7.12.1 Water Levels

Hydrographs for production bores are presented in Figure 7.6 to Figure 7.22 . The hydrographs, plotted against trigger levels (where adopted), illustrate the performance of each bore. Some of the data presented in these figures are from monitoring bores which are additional to the minimum requirements described in Section 7.11.

Water levels in the production bores remained above trigger levels throughout the reporting period, with the exception of one bore associated with the road construction and maintenance works. Water levels at CRD0084 temporarily exceeded the water level trigger by 1.77 m on 25 May 2020, however this was due to the bore inadvertently being pumped at a higher than recommended rate. Once the pump was shut off, the water level quickly recovered. Water levels at this location will continue to be monitored, and corrective action will be taken in the event of any further trigger exceedances. The hydrograph for CRD0084 is illustrated in Figure 7.14.

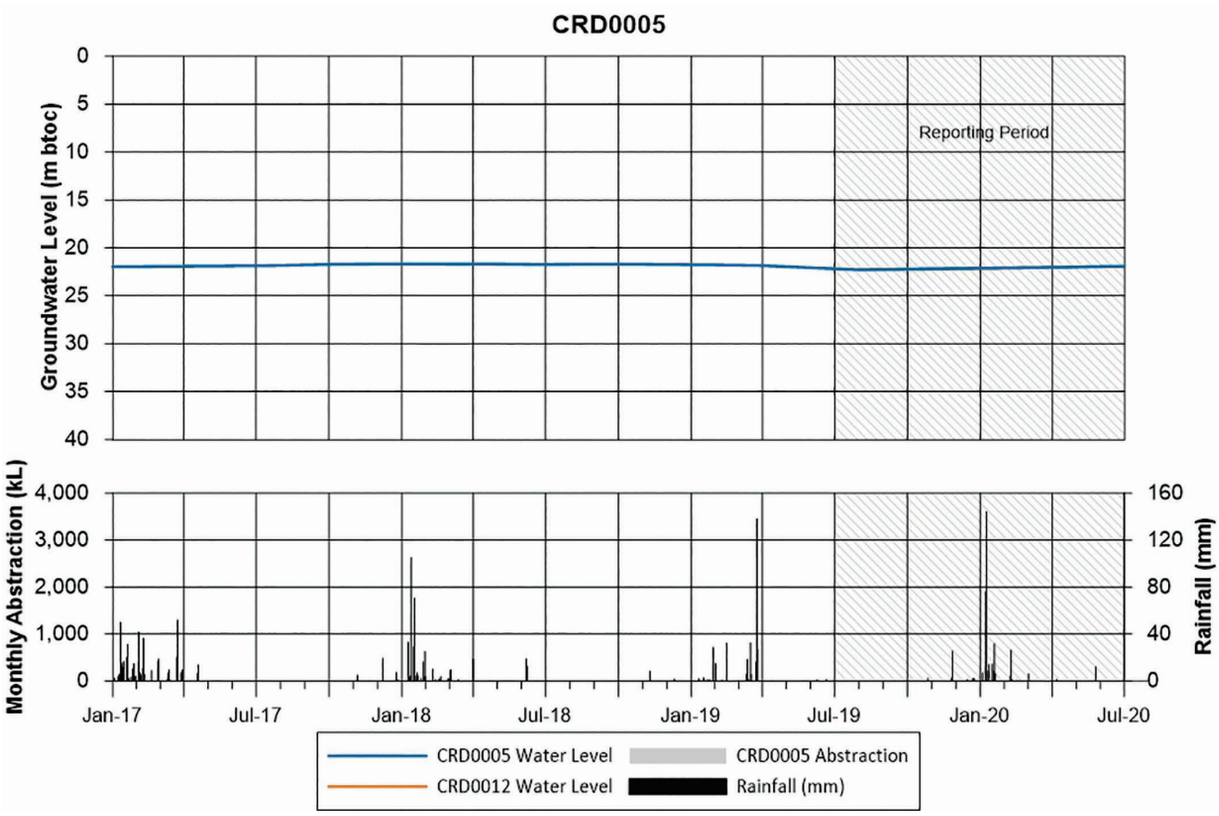

Figure 7.6 - CRD0005 Water levels vs abstraction and rainfall

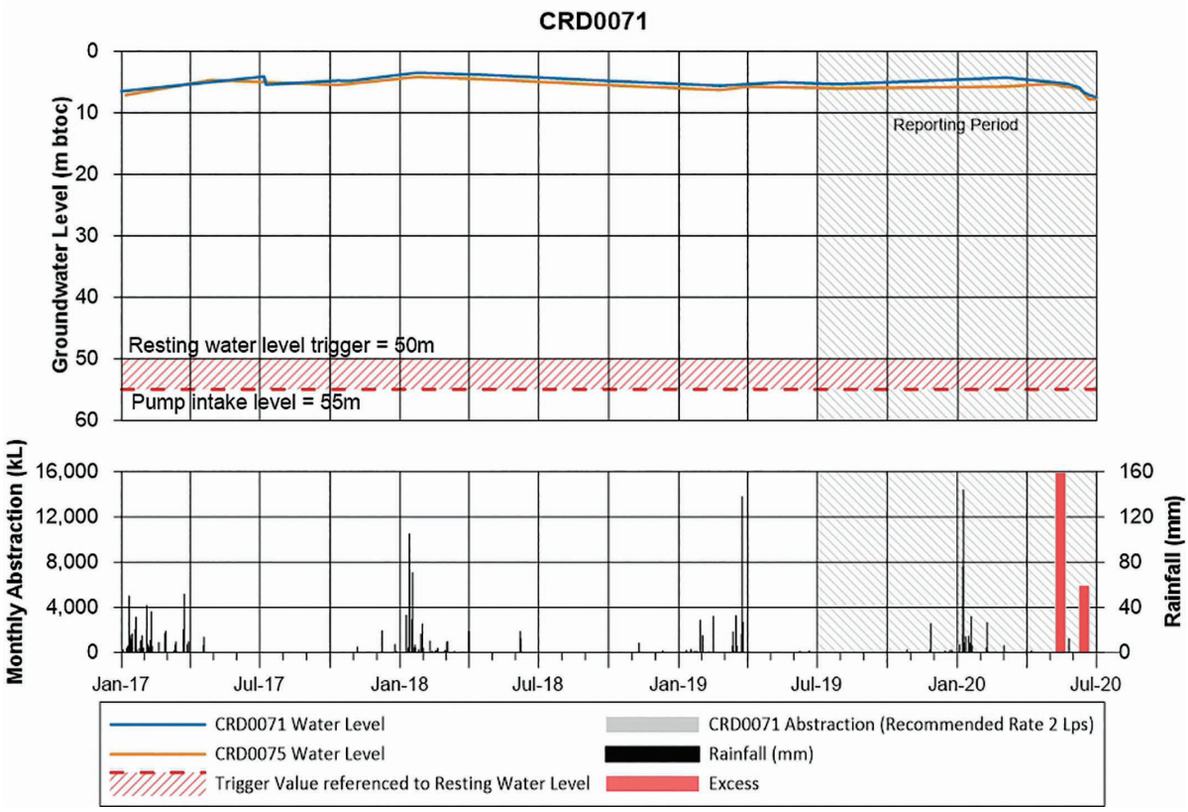

Figure 7.7 - CRD0007 Water levels vs abstraction and rainfall

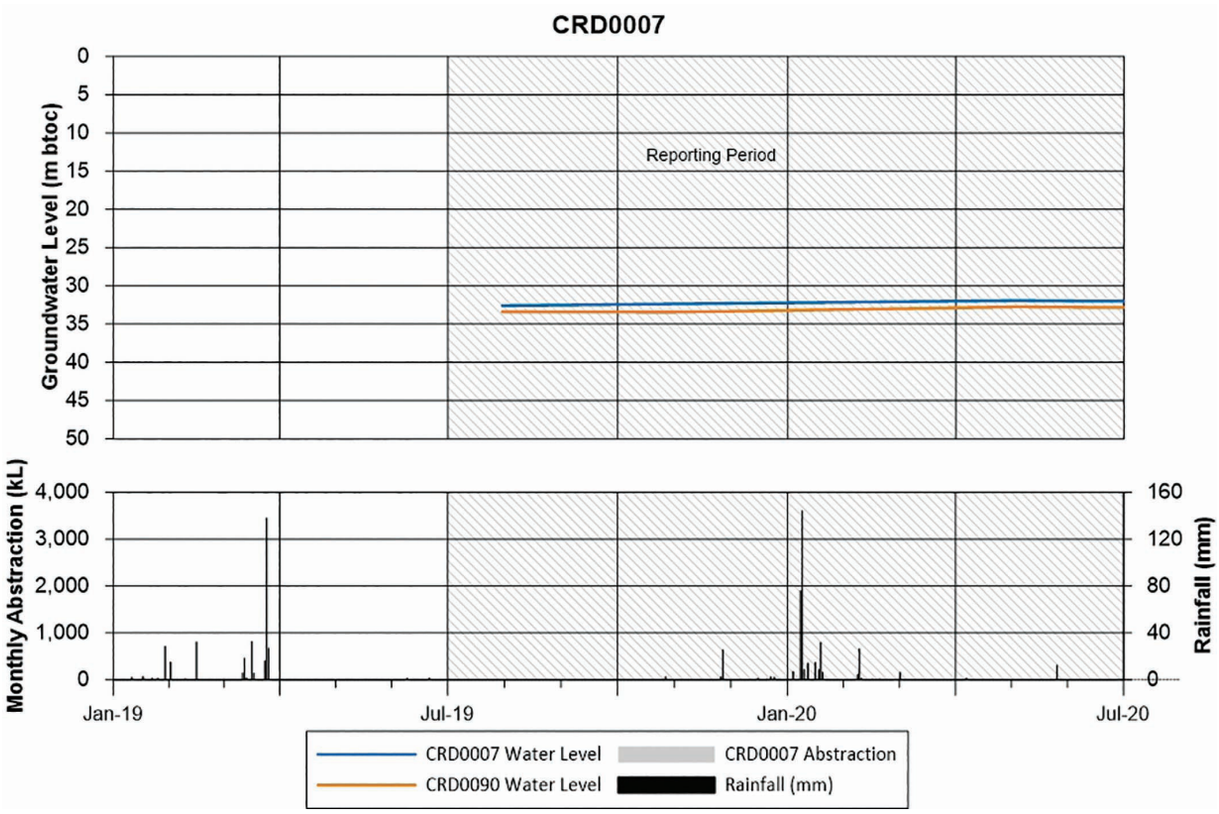

Figure 7.8 - CRD0014 Water levels vs abstraction and rainfall

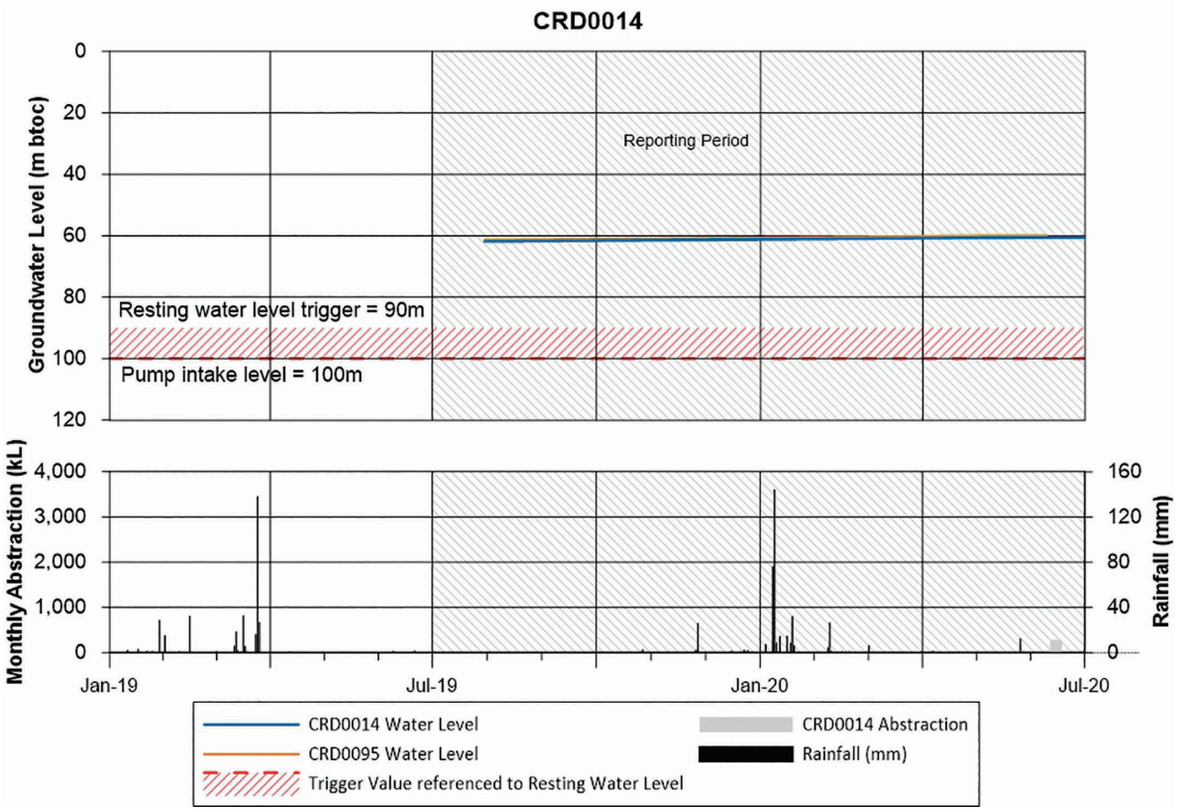

Figure 7.9 - CRD0024 Water levels vs abstraction and rainfall

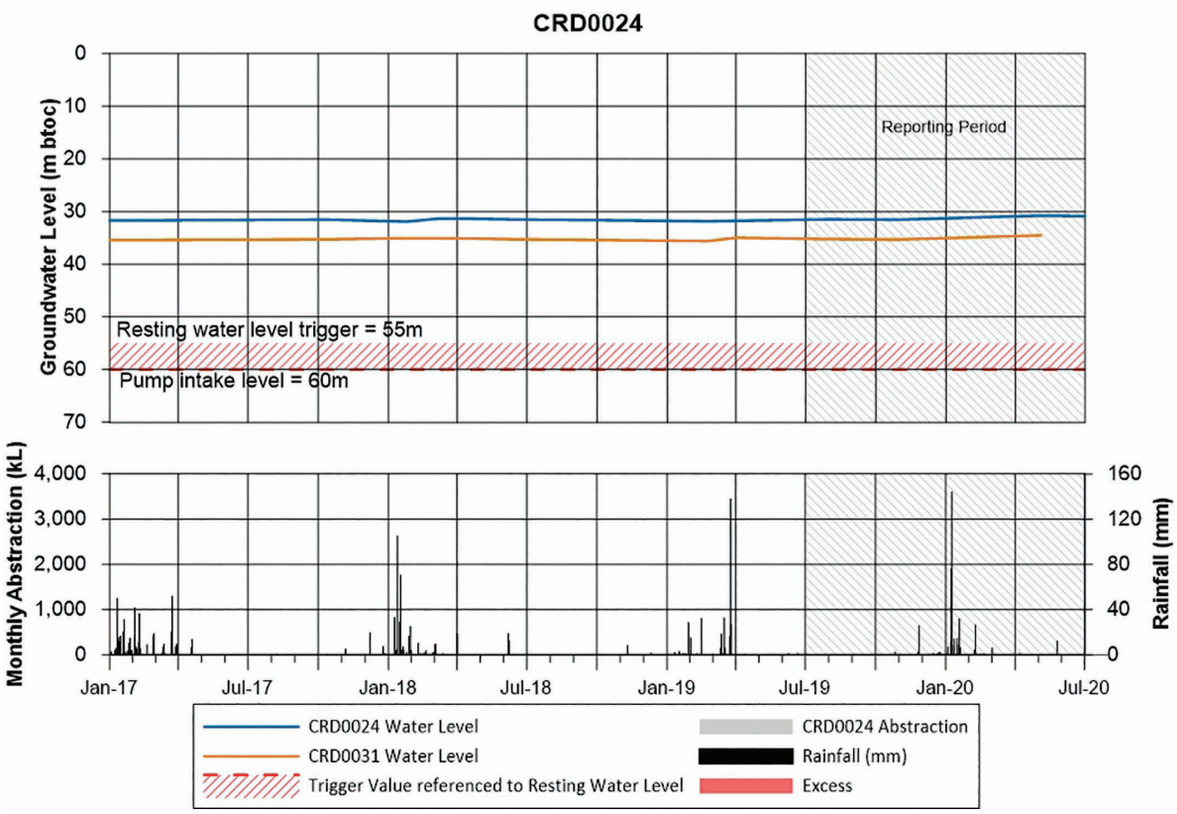

Figure 7.10 - CRD0071 Water levels vs abstraction and rainfall

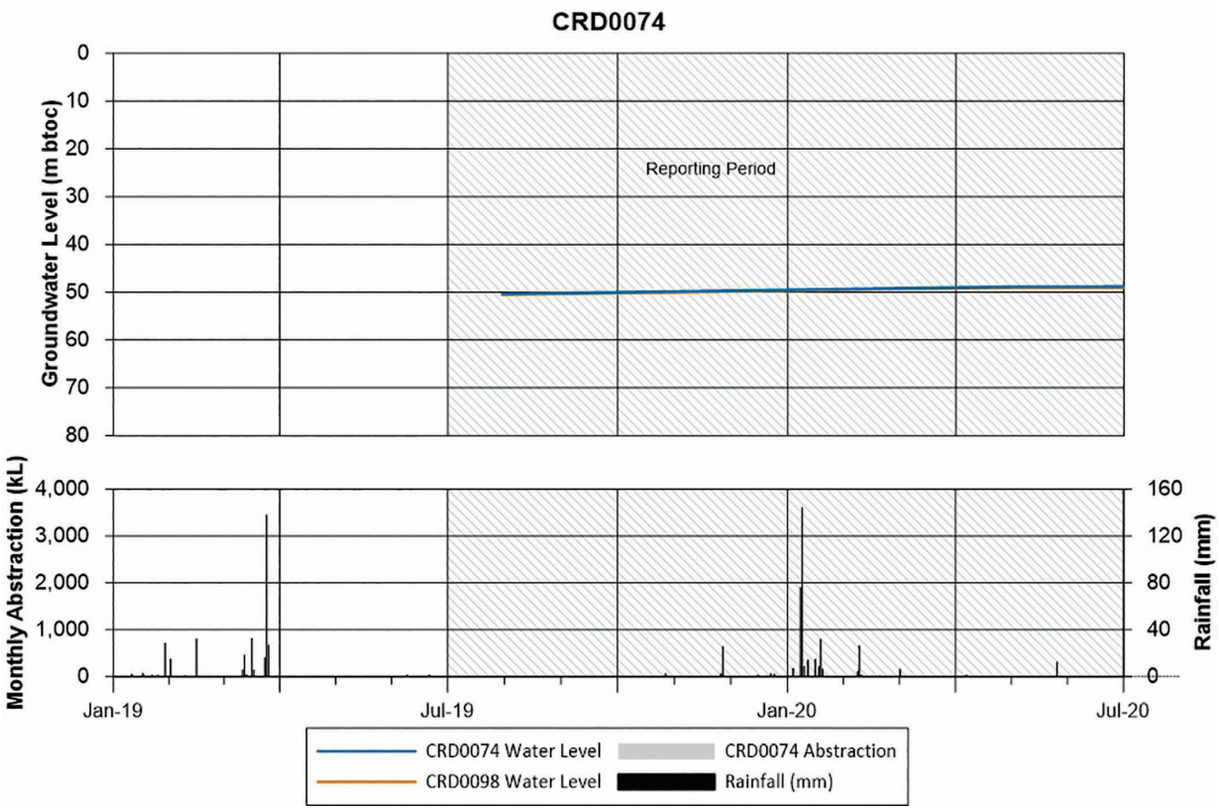

Figure 7.11 - CRD0074 Water levels vs abstraction and rainfall

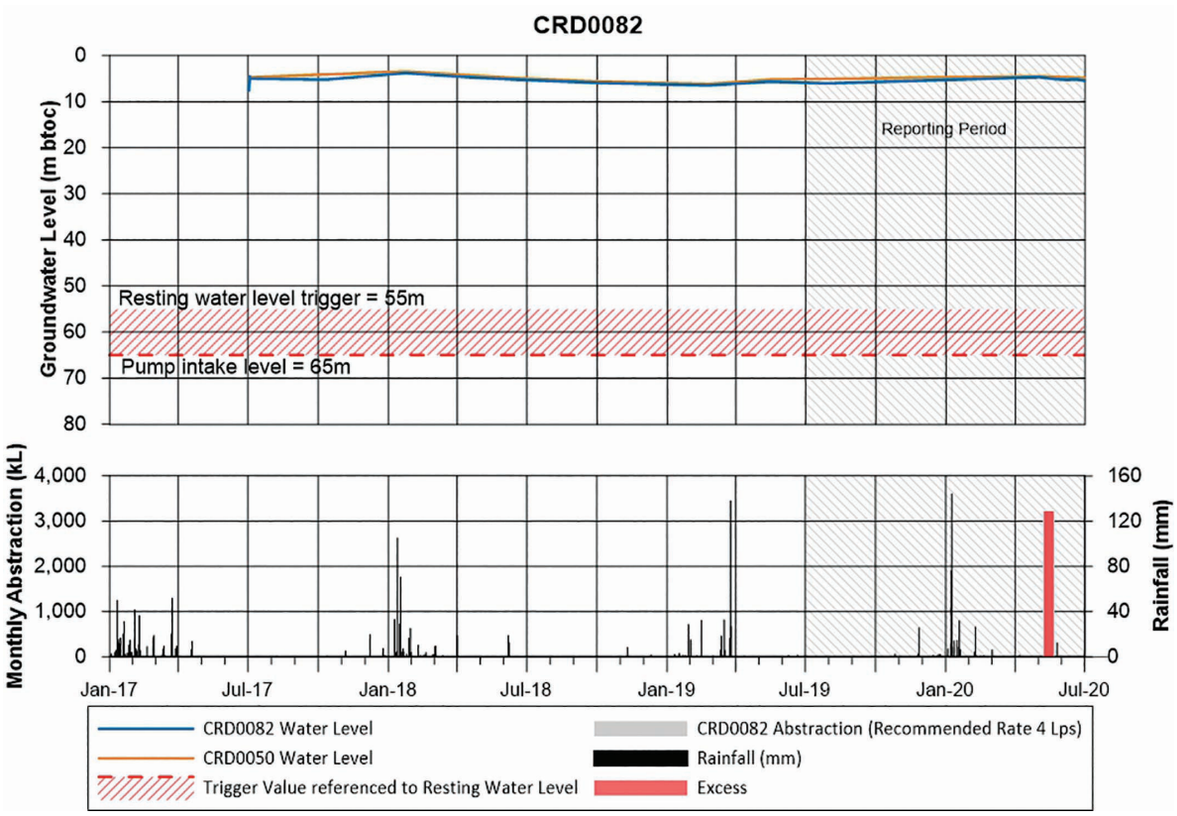

Figure 7.12 - CRD0082 Water levels vs abstraction and rainfall

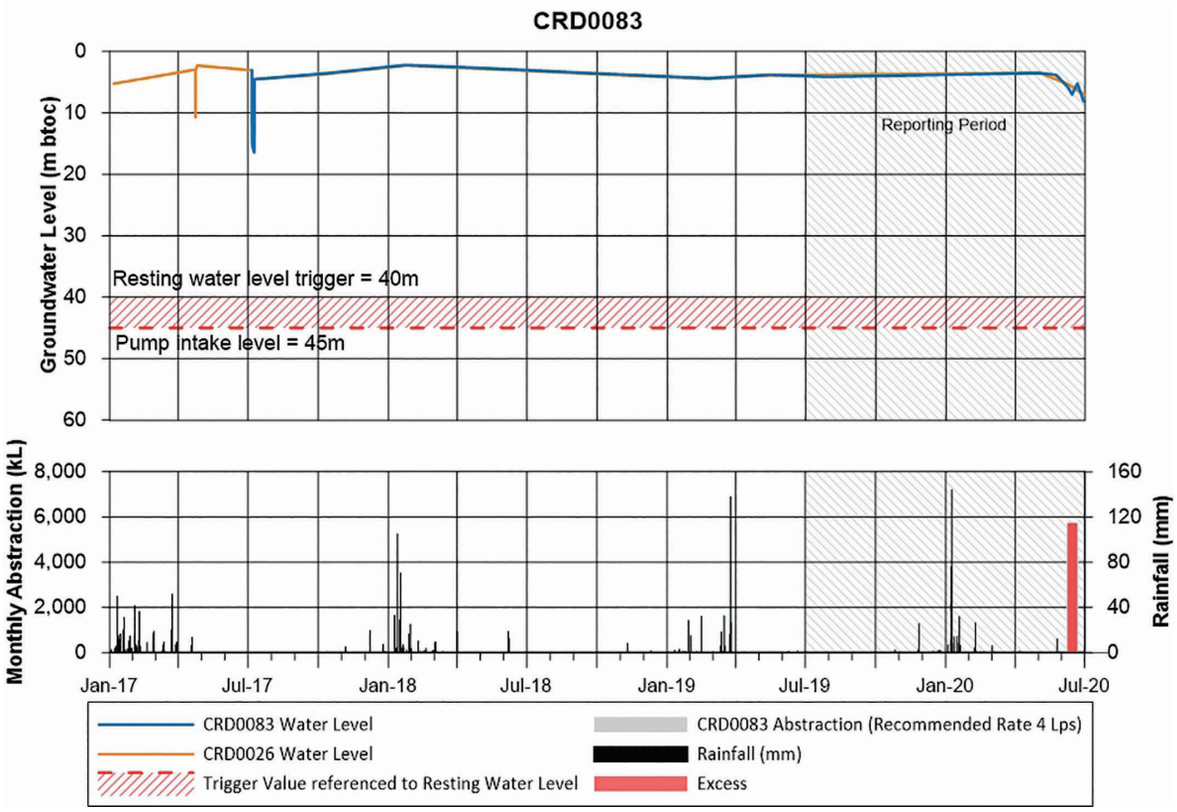

Figure 7.13 - CRD0083 Water levels vs abstraction and rainfall

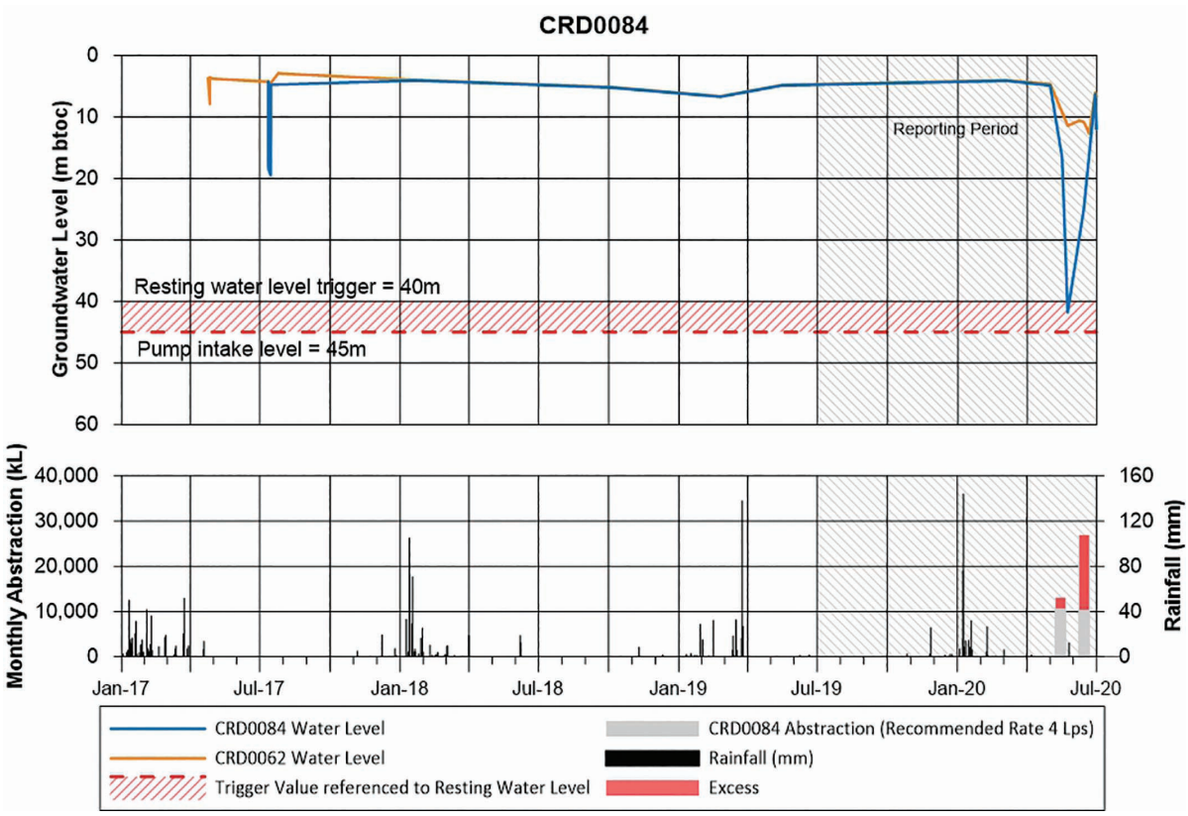

Figure 7.14 - CRD0084 Water levels vs abstraction and rainfall

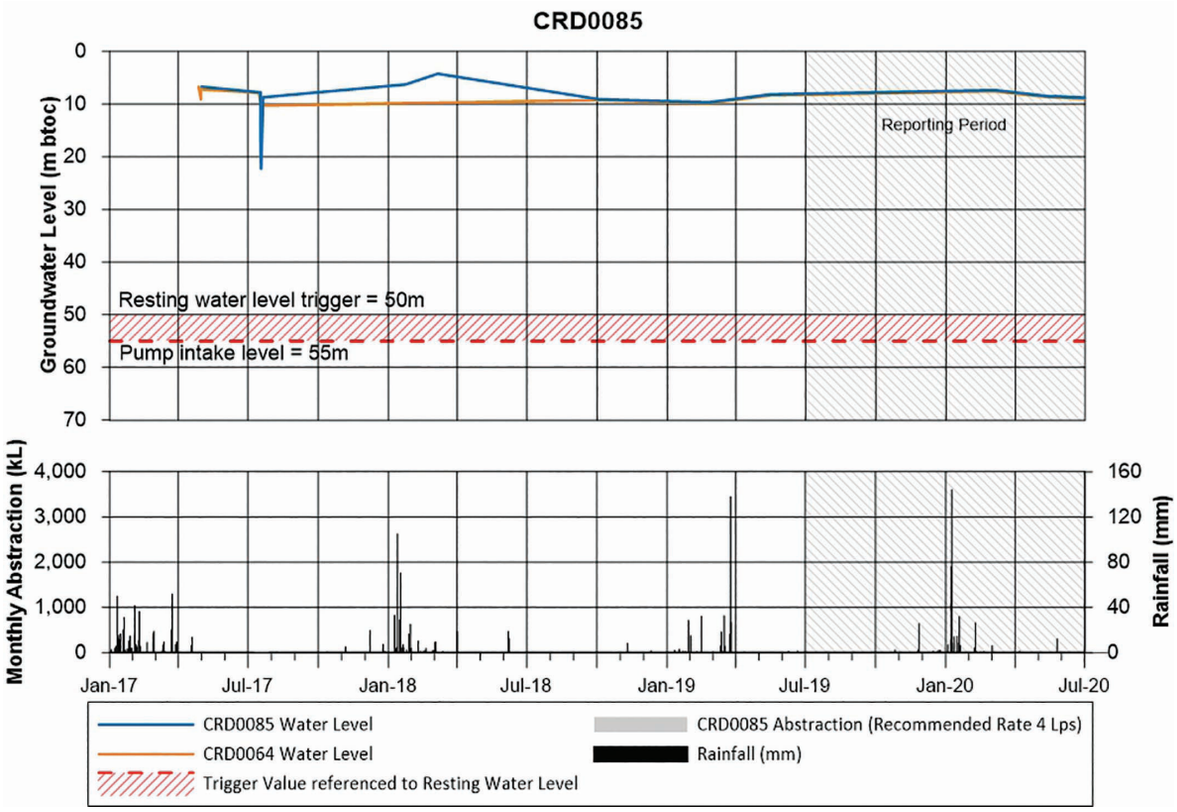

Figure 7.15 - CRD0085 Water levels vs abstraction and rainfall

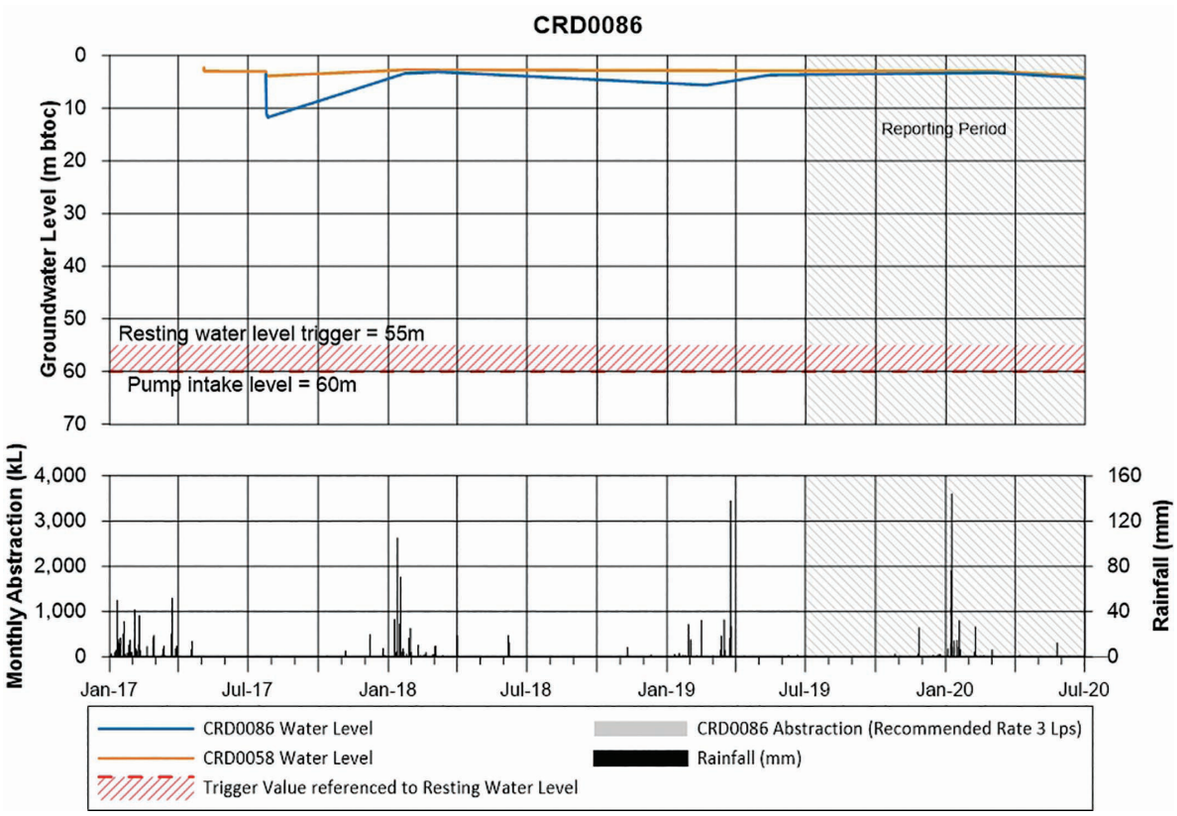

Figure 7.16 - CRD0086 Water levels vs abstraction and rainfall

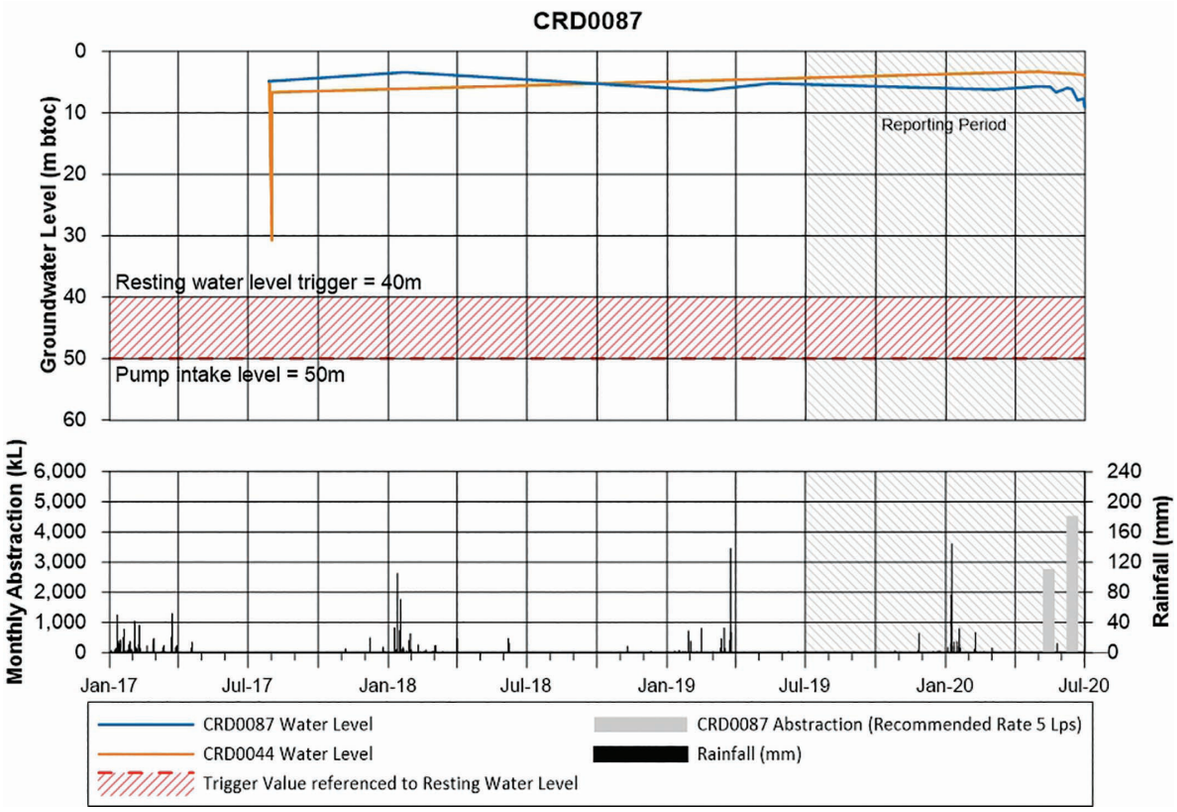

Figure 7.17 - CRD0087 Water levels vs abstraction and rainfall

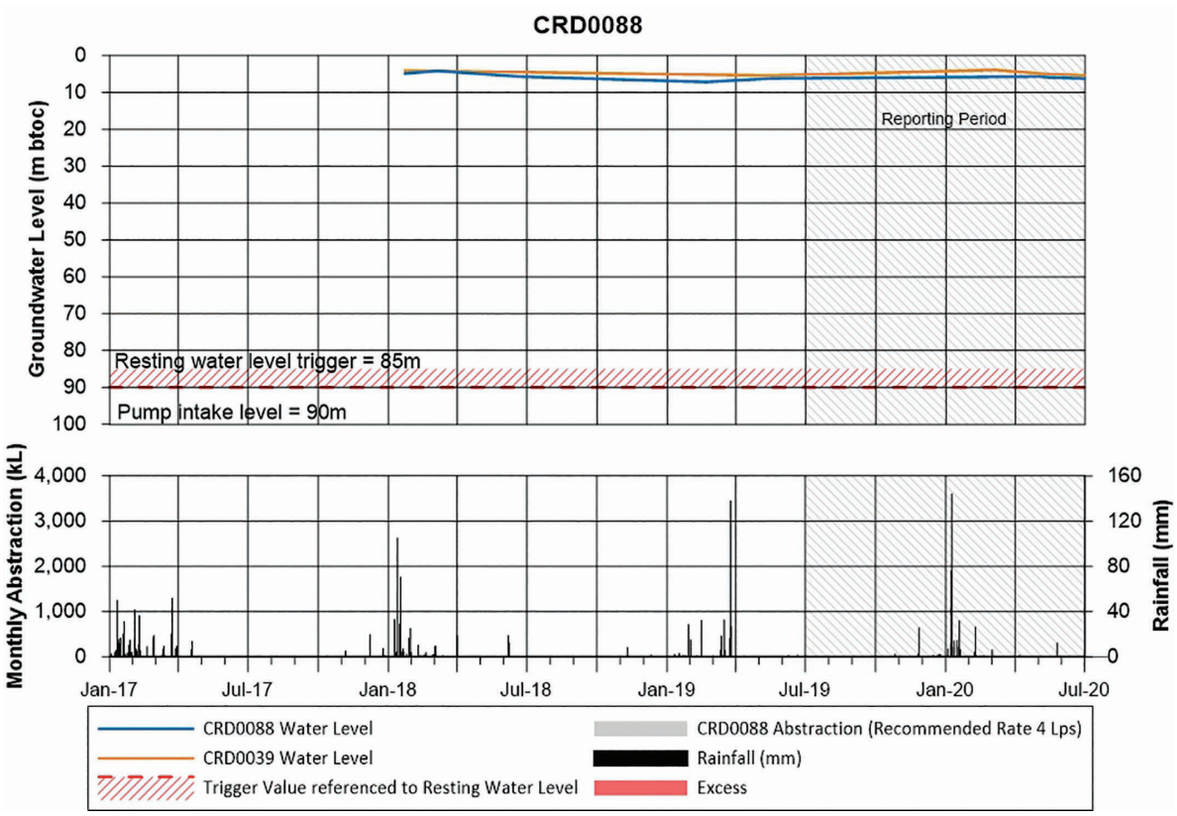

Figure 7.18 - CRD0088 Water levels vs abstraction and rainfall

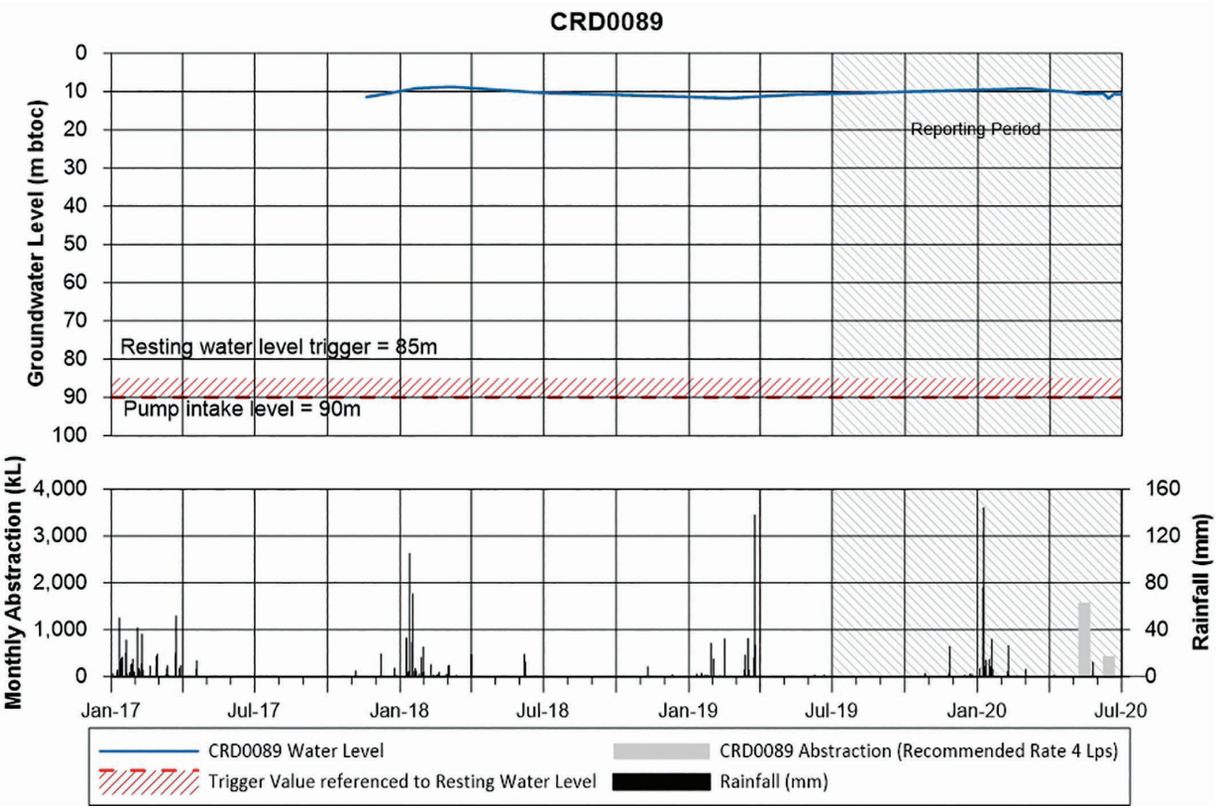

Figure 7.19 - CRD0089 Water levels vs abstraction and rainfall

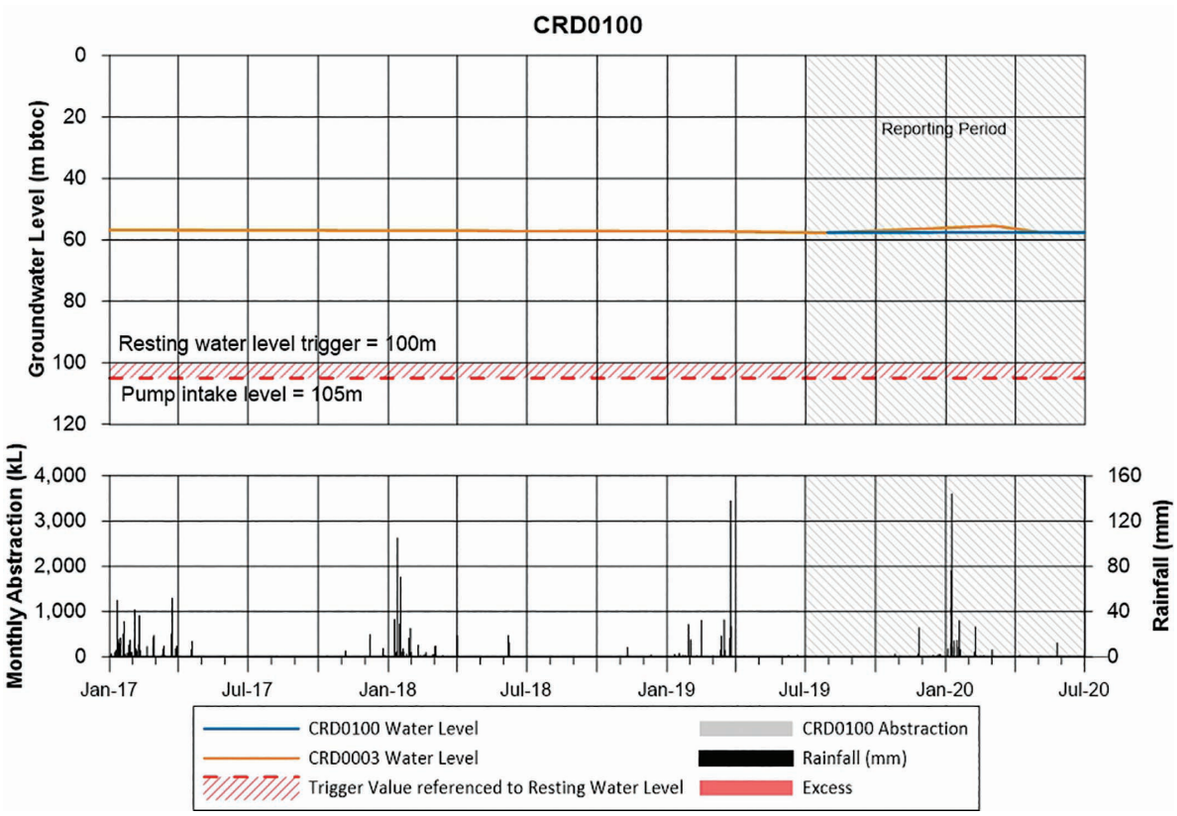

Figure 7.20 - CRD0100 Water levels vs abstraction and rainfall

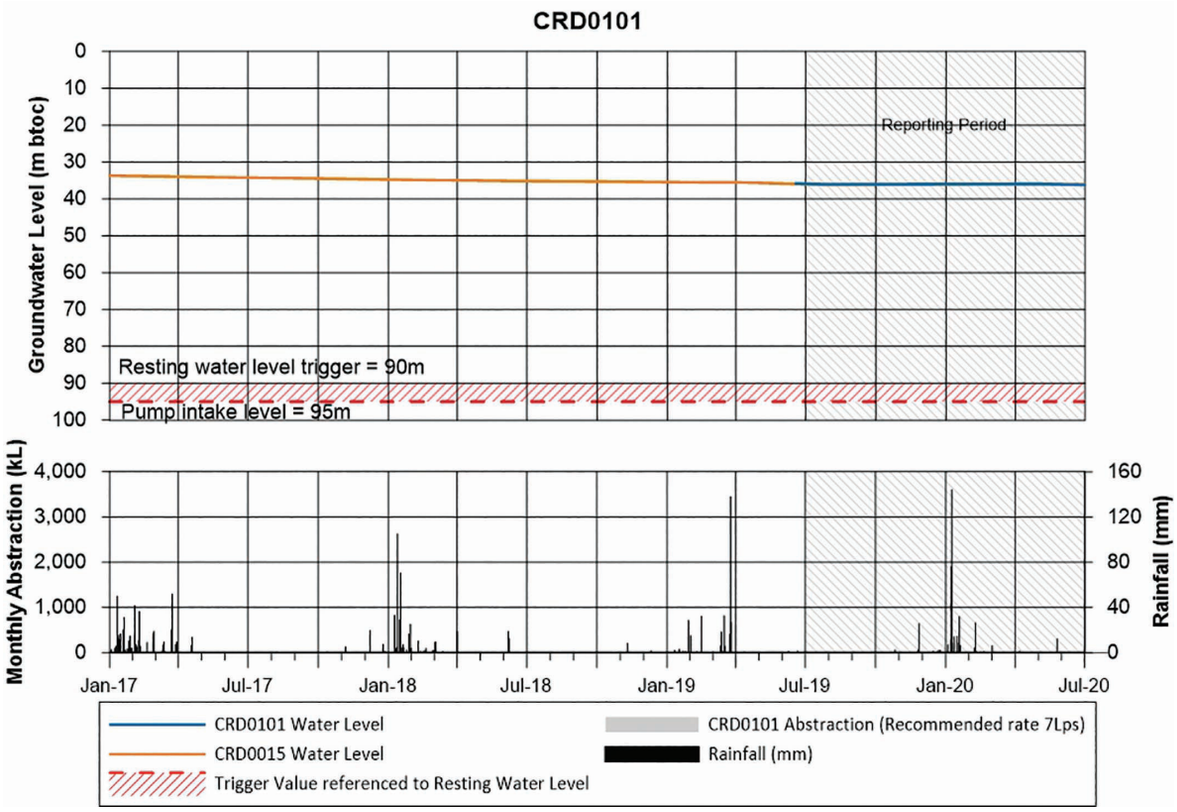

Figure 7.21 - CRD0101 Water levels vs abstraction and rainfall

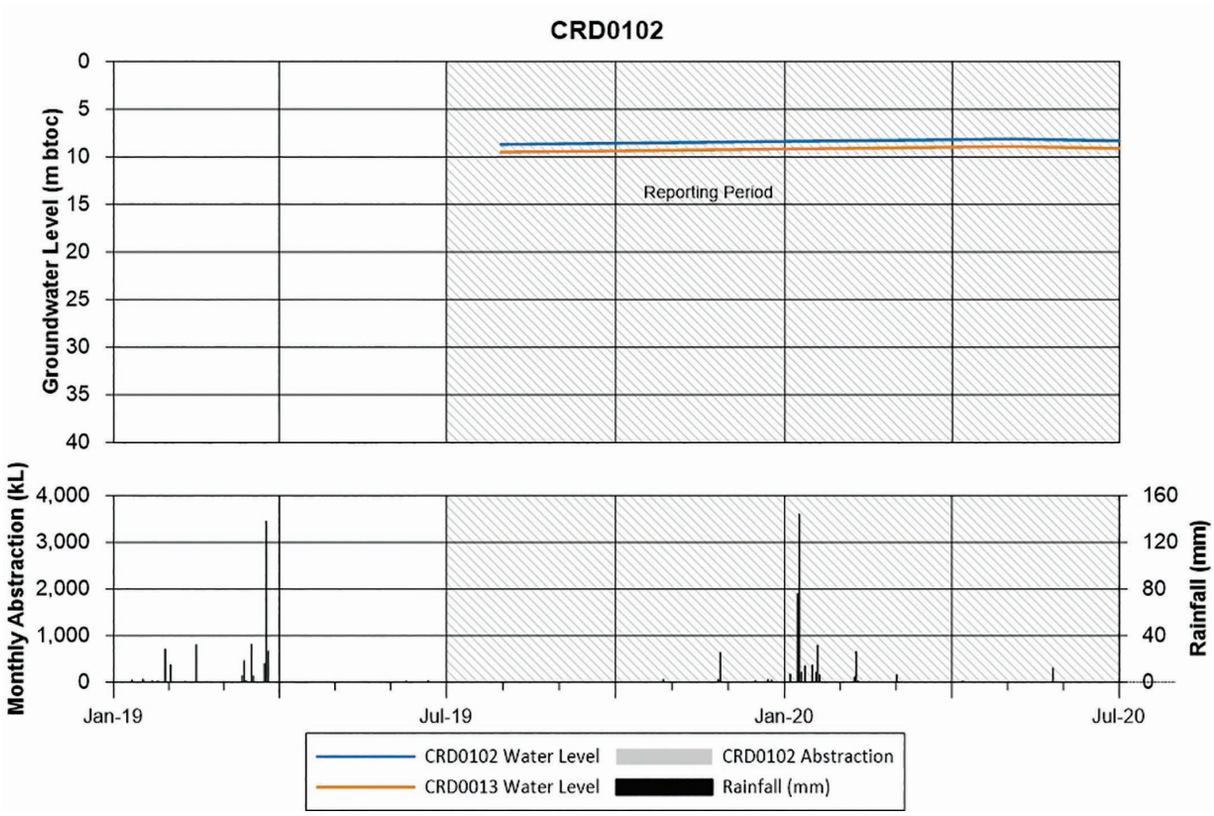

Figure 7.22 - CRD0102 Water levels vs abstraction and rainfall

7.12.2 Water Quality

Groundwater in the Corunna Downs project area ranges between 180 -1,700 mg/L TDS, and is considered fresh to brackish. No water quality trigger values were exceeded during the reporting period.

Historically, conductivity and pH measurements in production and monitoring bores have remained relatively constant (Figure 7.23 and Figure 7.24). The exception to this is conductivity at CRD0086, which has varied between 490 µS/cm and 2,280 µS/cm. Monitoring of in situ physical parameters during the reporting period indicate that there have been no impacts to conductivity and pH since pumping commenced. Minor seasonal fluctuations in pH and EC occur in all bores suggesting the influence of rainfall recharge.

The analytical groundwater quality data is summarised in Table 7.11 and Table 7.12. These results have been compared to the Australian Drinking Water Guideline values for aesthetic and human health impacts (NHMRC 2012). Any instance of the groundwater quality being above these guideline values has been highlighted.

The exceedances which have been highlighted are not uncommon for groundwaters of the Pilbara region. Groundwater taken for potable purposes will be treated to drinking water standards at the proposed on-site treatment plant prior to consumption. Monthly potability testing of the treated water will ensure that the water remains fit for consumption for the duration of the project.

Table 7.11 to Table 7.12 present a summary of the analytical data for the production and monitoring bores nominated in Table 7.3 and Table 7.4. It is noted that there are no analytical results for the reporting period, due to the timing of the commencement of construction. Results of groundwater quality analysis will be included in future annual reports.

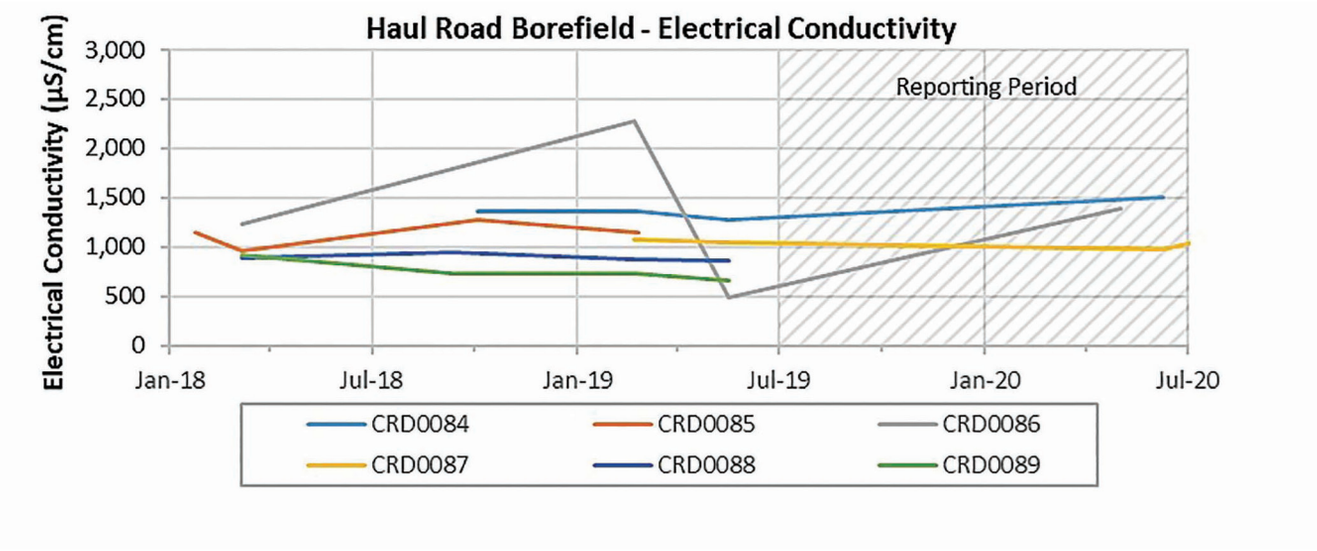

Figure 7.23 - Electrical Conductivity, Road Construction and Maintenance Bore Field

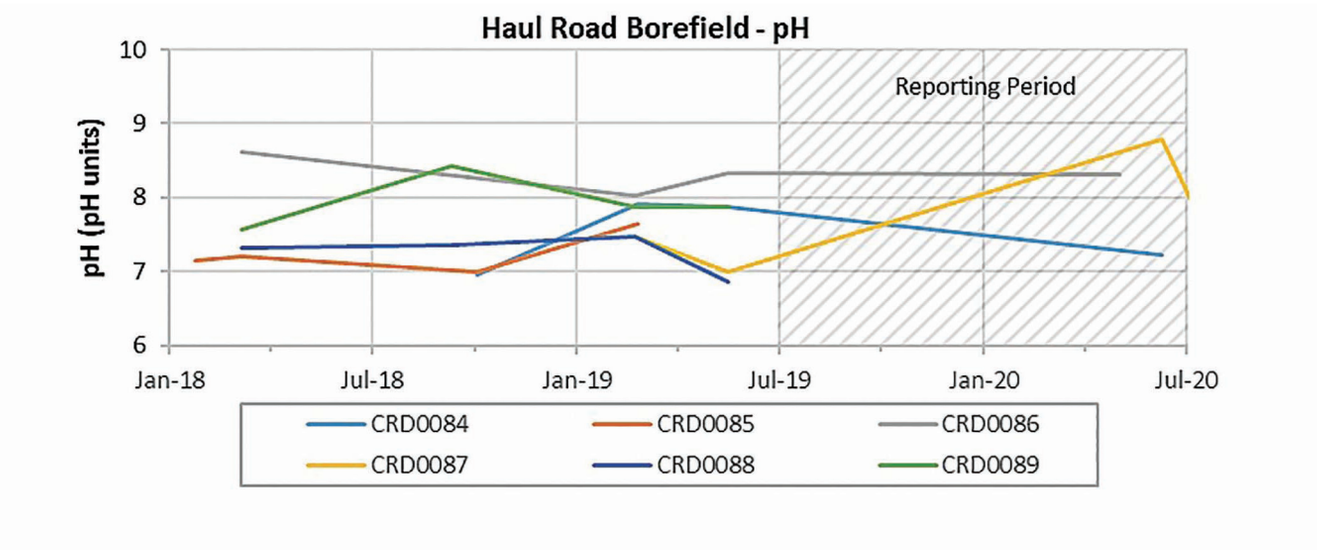

Figure 7.24 - pH, Road Construction and Maintenance Bore Field

Table 7.11 - Groundwater Quality, Major Ions and Physical Parameters

Bore ID	Date	pH (pH Units)	EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	NO_3 (mg/L)
CRD0003	29/04/2014	7.1	560	-	360	63	70	150	23	30	4.1	34	-
CRD0005	29/04/2014	7.5	800	-	470	46	15	430	56	30	1.8	33	-
CRD0027	30/11/2015	8.2	950	31,000	550	98	48	420	58	33	15.0	93	0.90
CRD0033	31/10/2015	7.8	400	37,000	280	34	89	78	30	30	4.2	39	<0.05
CRD0044	11/04/2017	8.4	2,700	780	1,500	400	99	650	18	23	1.0	570	1.20
CRD0048	9/12/2016	8.0	1,600	180	800	200	77	480	63	97	5.4	140	0.26
CRD0058	12/04/2017	8.3	3,000	950	1,600	460	130	690	23	32	1.9	610	1.50
	4/05/2017	8.1	2,900	200	1,700	480	140	700	21	27	1.5	480	<0.05
CRD0062	23/11/2016	7.8	1,200	350	630	170	83	300	65	48	1.5	110	0.88
	26/04/2017	7.9	1,300	0	660	180	91	310	63	44	1.0	110	1.40
	12/07/2017	7.2	1,300	0	800	190	91	350	89	52	1.2	130	1.40
	15/07/2017	7.2	1,500	0	930	220	120	360	97	57	1.1	160	1.70
CRD0064	23/11/2016	7.9	1,200	1,100	620	170	50	340	41	38	2.7	150	0.66
	30/04/2017	8.0	1,400	21	720	200	56	390	58	43	2.5	160	0.81
CRD0071	6/08/2016	8.0	560	<5	330	47	39	320	69	33	1.3	63	0.18
	2/09/2016	7.0	690	<5	420	45	40	320	62	26	1.2	52	0.02
	5/09/2016	7.0	760	<5	460	46	32	350	70	25	0.7	55	0.75
	6/07/2017	7.0	790	<5	480	40	22	360	79	19	0.0	56	4.60
CRD0073	11/12/2016	8.0	1,400	19	750	170	61	470	64	93	5.3	110	0.74
CRD0082	2/07/2017	7.0	950	<5	570	95	49	340	66	32	1.3	72	<0.50

Table 7.12 - Groundwater Quality, Trace Elements and Metals

Bore ID	Date	As (mg/L)	B (mg/L)	Cd (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Pb (mg/L)	Mn (mg/L)	Ni (mg/L)	Se (mg/L)	Sr (mg/L)	Sn (mg/L)	Zn (mg/L)
CRD0003	29/04/2014	<0.02	0.200	<0.0001	<0.001	0.006	<0.02	<0.001	0.670	<0.001	<0.001	0.094	<0.05	0.040
CRD0005	29/04/2014	<0.02	0.200	<0.0001	<0.001	<0.001	<0.02	<0.001	0.150	0.008	<0.001	0.120	<0.05	0.060
CRD0027	30/11/2015	<0.001	0.230	<0.0001	<0.001	<0.001	<0.005	<0.001	1.400	0.001	<0.001	0.490	<0.001	<0.005
CRD0033	31/10/2015	<0.001	0.092	<0.0001	<0.001	0.004	0.011	<0.001	0.960	0.010	0.001	0.220	-	0.007
CRD0044	11/04/2017	0.008	0.800	<0.0001	<0.001	<0.001	0.010	<0.001	0.067	0.001	0.003	0.250	<0.001	<0.001
CRD0048	9/12/2016	0.005	0.350	<0.0001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.001	0.001	0.380	<0.001	<0.001
CRD0058	12/04/2017	0.012	0.910	<0.0001	<0.001	<0.001	<0.01	<0.001	0.018	<0.001	0.003	0.300	<0.001	<0.001
	4/05/2017	0.038	<0.005	<0.0001	<0.001	0.020	<0.001	0.013	<0.00005	0.003	<0.001	<0.001	0.31	0.003
CRD0062	23/11/2016	0.200	<0.005	<0.0001	<0.001	<0.001	0.050	<0.001	0.051	<0.001	<0.001	0.001	<0.001	<0.001
	26/04/2017	0.046	<0.005	<0.0001	<0.001	<0.001	<0.001	0.016	<0.00005	0.001	<0.001	<0.001	0.57	<0.001
	12/07/2017	0.002	0.069	<0.0001	<0.001	<0.001	0.030	0.002	0.190	0.410	0.002	0.620	<0.001	0.130
	15/07/2017	0.001	0.054	<0.0001	<0.001	<0.001	<0.01	0.001	0.110	0.006	0.002	0.690	<0.001	0.012
CRD0064	23/11/2016	0.250	<0.005	<0.0001	<0.001	<0.001	0.020	<0.001	0.013	<0.001	<0.001	<0.001	<0.001	<0.001
	30/04/2017	0.013	<0.005	<0.0001	<0.001	0.020	<0.001	0.007	<0.00005	<0.001	<0.001	<0.001	0.46	<0.001
CRD0071	6/08/2016	<0.001	0.170	<0.0001	<0.001	<0.001	0.020	<0.001	0.190	<0.001	<0.001	0.300	<0.001	<0.001
	2/09/2016	<0.001	0.160	<0.0001	<0.001	0.001	0.020	<0.001	0.240	0.001	<0.001	0.280	<0.001	0.180
	5/09/2016	<0.001	0.170	<0.0001	<0.001	<0.001	0.050	0.001	0.170	<0.001	<0.001	0.340	<0.001	0.049
	6/07/2017	<0.001	0.100	<0.0001	<0.001	0.002	<0.01	<0.001	0.013	0.022	<0.001	0.430	<0.001	0.021
CRD0073	11/12/2016	0.010	0.320	<0.0001	<0.001	<0.001	<0.01	<0.001	0.020	<0.001	0.003	0.300	<0.001	<0.001
CRD0082	2/07/2017	0.002	0.230	<0.0001	<0.001	0.001	<0.01	<0.001	0.210	0.014	<0.001	0.380	<0.001	0.003

7.13 Compliance

Water levels in one of the road construction and maintenance production bores, CRD0084, temporarily declined below the water level trigger on 24/05/2019 but recovered quickly after the pump was turned off. Pumping rates at this location are under review to ensure water levels remain within triggers. An update on this will be provided in the 2021 Annual Report. No other water level or quality trigger values were exceeded during the reporting period.

A summary of the compliance commitments for Corunna Downs is provided in Table 7.13.

Table 7.13 - Summary of Commitments and Compliance

Activity	Action	Compliance	Comments
Administration	Submit a Groundwater Monitoring Summary to DWER annually on 30 September. This report will summarise: Compliance with the monitoring schedule and assessment of results. Actual aquifer performance against modelled predictions.	Compliant	Report submitted 30th September.
	Submit a Groundwater Monitoring Review to DWER on 30 September 2022 and 2025, and three months after operations are completed.	Compliant	Not yet required.
	Review SWOP in conjunction with annual/final reporting as required.	Compliant	Not yet required.
Monitoring	Implementation of monitoring schedule as described in the SWOP.	Mostly compliant	Minor gaps in record due to access issues and staffing (see Table 7.14).
Water use efficiency	Monthly infrastructure checks/maintenance.	Compliant	Checks completed monthly and during SWOP review.
	Site water balance review as required.	Compliant	Not yet required.
Contingency plans	Review triggers annually or as required.	Compliant	Review completed during SWOP review.

In general, the monitoring requirements were met during the reporting period. However, there were three instances of non-compliance with the monitoring requirements, due to access and resourcing issues which have since been rectified.. These are summarised in Table 7.14.

Table 7.14 - Non-Compliances

Monitoring Area or Topic	Source Document	Requirement	Frequency	Non-compliances
Production bores	SWOP	Water levels and meter readings	Weekly	1 June 2020: CRD0084
Monitoring bores	SWOP	Water Level, field pH, EC, and Temperature	Monthly	June 2020: CRD0091 CRD0099

7.14 Assessment of Impacts

7.14.1 Aquifer Levels

With the project still in early stages of construction, water levels have remained generally consistent with pre-construction levels. The only exception to this is the single water level trigger exceedance observed at CRD0084 (see Section 7.13 and Figure 7.14).

7.14.2 Water Quality

Water quality has remained relatively consistent over the project area since monitoring began. This suggests that abstraction in the Corunna Downs DSO Project area has not resulted in deterioration of water quality thus far over the life of the project.

7.15 Recommendations

As described in the preceding sections, water level and quality impacts that are attributable to the abstraction of groundwater for the Corunna Downs DSO Project have been negligible. Notwithstanding this, to improve the management of groundwater use at the project, the following recommendations are made:

- Confirm pump settings (depth and flow rate) in production bores to mitigate future water level trigger exceedances.
- Continuation of water level and quality monitoring as described in SWOP (Atlas, 2020).
- Hold a formal groundwater abstraction license handover with the Operations managers and site based personnel to ensure that compliance and monitoring requirements are understood prior to the operational phase commencing..

8. GENERAL EXPLORATION LICENCES

Atlas Iron has ongoing exploration projects across the Pilbara region which require water for exploration drilling and camp purposes. Water usage at these sites is typically low and of short duration. Over the reporting period for 2019/20, a volume of 9,396 kL was used at McPhee Creek. Groundwater was not used at the other exploration sites.

The exploration licenses and associated annual usages for the 2019/20 reporting period are summarised in Table 8.1.

Table 8.1 - Summary of groundwater usage across the Atlas Iron Exploration Licenses

Project	License Number	License Allocation (kL/yr)	2019/20 Usage (kL)	Start Date	Expiry Date	Authorised Activities		
						Potable and camp supply	Earthworks and dust suppression	Exploratory drilling
Copper Range	GWL200171	20,000	0	26/08/2019	25/08/2029	●		●
Hales Grave	GWL179423(1)	50,000	0	28/07/2014	27/07/2024	●		●
McPhee Creek	GWL175352(2)	95,000	9,396	14/02/2017	13/02/2027	●	●	●
Miralga Creek	GWL177500(1)	50,000	0	12/06/2013	03/06/2023	●	●	●

9. UTAH POINT

The Utah Point shipping facility at the port of Port Hedland consists of the joint-operated Stockyard 1 (SY1) and Atlas-operated Stockyard 2 (SY2). During the 2019/2020 reporting period ore throughput at SY1 averaged 501,387 tonnes per month while SY2 averaged 269,968 tonnes per month. Total ore throughput for 2019/2020 averaged 771,355 tonnes per month.

Dust suppression at the stackers and loadout bins makes up the bulk of water usage at Utah Point.

Water Corporation's existing potable supply system provides water for dust suppression and is routinely metered by the Pilbara Port Authority (PPA) contractor (Qube). Atlas has a water meter in place for SY2, but SY1 is fed from the main supply tanks under PPA control and meter readings are not provided.

A breakdown of the monthly usage volume for SY2 is shown in Table 9.1. The 2019/2020 total water usage for SY2 is 5,440 kL with an average usage of 453 kL/month or 15 kL/day. This represents an annual decrease of 32% from the 2018/2019 reporting period of 8,047 kL. This decrease resulted from reduced dust suppression activities at SY2.

Table 9.1 - Monthly Water Usage

Month	Stockyard 2 Product Throughput (tonnes)	Stockyard 2 Water Usage (kL)
Jul-19	245,120	317.7
Aug-19	275,184	465.8
Sep-19	249,046	291.3
Oct-19	232,770	584.4
Nov-19	284,878	589.2
Dec-19	306,102	575.9
Jan-20	206,992	464.6
Feb-20	262,812	437.5
Mar-20	295,595	537.1
Apr-20	349,890	421.7
May-20	290,892	376.0
Jun-20	240,330	379.2
Total	**3,239,610**	**5,440.40**

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