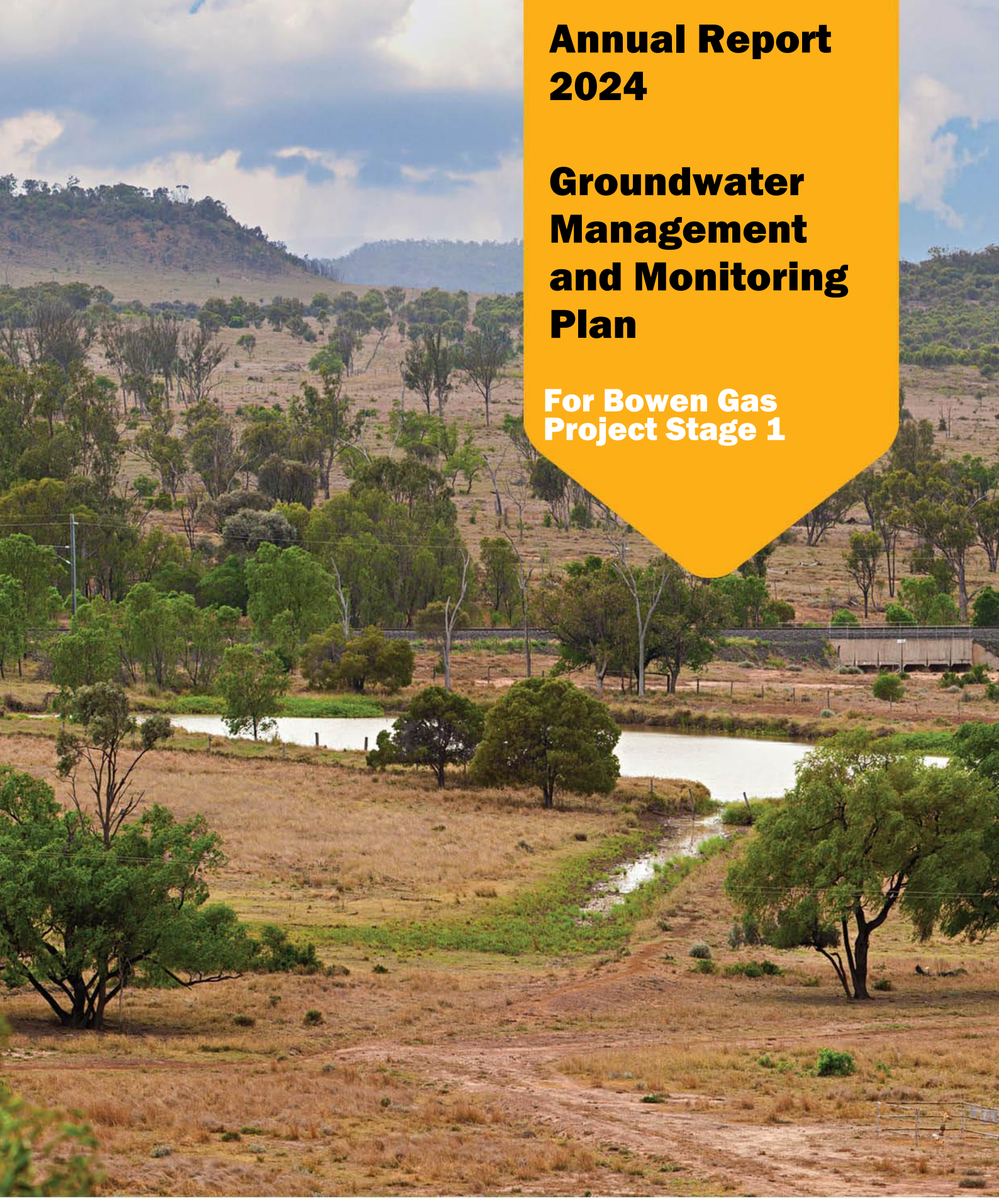
Annual Report 2024

Groundwater Management and Monitoring Plan

For Bowen Gas Project Stage 1



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REVISION HISTORY

Revision	Revision Date	Revision Summary
0	May 2024	Final report for release

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

EXECUTIVE SUMMARY

This report forms the fifth annual review of the Groundwater Monitoring and Management Plan (GMMP) for the Bowen Gas Project (BGP) Stage 1 and includes baseline data from Arrow's previous Moranbah Gas Project (MGP) operations.

MGP (tenures PL191, 196, 223 and 224) has been entirely acquired by QPM Energy (MPG Upstream) Pty Ltd (QPM) from Arrow CSG (ATP364) Pty Ltd, CH4 Pty Ltd and AGL Energy Limited effective 20 September 2023, becoming the holder of the resource tenure and the responsible tenure holder for reporting obligations for these tenures. Arrow Energy continues to operate the BGP project (tenures PL486 and ATP1103, 1031, 742 held variably by CH4 Pty Ltd, Arrow CSG (ATP 364) Pty Ltd, AGL Energy Limited and Bow CSG Pty Ltd).

The BGP GMMP was approved with conditions by the (then) Department of Environment and Energy (DoEE), now the Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 24 October 2019. This report is due annually, 3 months after the anniversary date of the commencement of the BGP. The BGP commenced on 14 February 2019[1] and on this basis, annual reports will be submitted to DCCEEW and uploaded to Arrow Energy's website by 14 May of each year. This report satisfies requirements for the annual report as outlined in Section 6.2.4 of the GMMP. A summary of the report is outlined as per below:

- Seven (7) production wells have been installed as heel intersects wells on multi-branch laterals, less than the 1408 authorised operational wells for Stage 1 of the BGP. The seven production wells were installed in 2019 in the Red Hill Central Petroleum Lease (within PL486).

- Production from Red Hill Central Petroleum Lease (within PL486) commenced in 2022.

- A total of nine (9) locations are now monitored in this reporting period as part of the BGP monitoring network, supplemented with the existing monitoring network established for MGP.

- There is no apparent influence of CSG production to the Tertiary Sediment, Fort Cooper Coal Measures (FCCM) and Rewan aquifers in the installed monitoring network for the BGP.

- A review of the groundwater quality data indicates that there are no notable trends for both the shallow and deep aquifers.

- No non-compliances were recorded for the BGP GMMP bores and therefore no remedial actions were undertaken.

- All monitoring obligations have been met and no exceedances under the GMMP early warning system (EWS) recorded across the monitoring network. However, for the MGP monitoring bores which supplement the BGP GMMP monitoring network, data loss due to hardware issues was experienced at some of these bores and sampling was not conducted due to equipment issues or access due to weather as follows:

    - M162V groundwater water level was monitored but was not sampled due to equipment issues;
    - M340W groundwater water level and groundwater quality were not monitored as the bore was dry;
    - M230W was not monitored as it has been decommissioned and replaced by the groundwater monitoring bore M300W; and
    - AN020F groundwater water level was not monitored and sampled as it was not accessible due to wet weather.

- 2024 Annual Review of 2022 Bowen UWIR was completed. The 2022 Bowen UWIR was submitted to the Department of Environment and Science (DES) and was approved with conditions on 2 August 2022. This report includes results from updated 2021 Bowen groundwater model and 2024 Annual Review of 2022 Bowen UWIR.
- No out of cycle Underground Water Impact Report (UWIR) was submitted. The 2024 Annual Review of the 2022 Bowen UWIR, submitted to DES on 17 April 2024, concluded that given the updated water production forecast for the BGP is less than what was modelled in the 2022 UWIR, the predicted impacts are expected to be less than originally modelled, and an update of the of the 2022 UWIR is not proposed.

[1] DCCEEW was notified by email of the commencement on 7 March 2019 (reference: 2012/6377).

1 INTRODUCTION

This report forms the fifth annual review of the Groundwater Monitoring and Management Plan (GMMP) for the Bowen Gas Project (BGP) Stage 1. The purpose of the GMMP is to address specific requirements for monitoring of groundwater and groundwater related impacts potentially resulting from the development of Stage 1 and contains details of:

- A groundwater monitoring network to provide early detection of any changes in groundwater regime and impacts on groundwater dependent ecosystems;
- A baseline monitoring data acquisition program;
- An Early Warning System (EWS) including:
    - early warning indicators, trigger thresholds and limits for detecting impacts on groundwater levels, and;
    - exceedance response actions and timeframes.
- The timeframe for a regular review of the GMMP aligned with the state of Queensland required Bowen UWIR; and
- Provisions to make monitoring results publicly available.

This report also includes data from Arrow's previous MGP operations (within Petroleum Leases (PLs) 191, 196, 223, and 224) which was previously described in the GMMP for baseline groundwater purposes and also supplements the GMMP monitoring network. Full analysis of the monitoring network, water production, groundwater levels and groundwater quality for the MGP is available in the 2022 Bowen UWIR, 2024 Annual Review of 2022 Bowen UWIR (Appendix A).

MGP (tenures PL191, 196, 223 and 224) has been entirely acquired by QPM Energy (MPG Upstream) Pty Ltd (QPM) from Arrow CSG (ATP364) Pty Ltd, CH4 Pty Ltd and AGL Energy Limited effective 20 September 2023, becoming the holder of the resource tenure and the responsible tenure holder for reporting obligations for these tenures. Arrow Energy continues to operate the BGP project (tenures PL486 and ATP1103, 1031, 742 held variably by CH4 Pty Ltd, Arrow CSG (ATP 364) Pty Ltd, AGL Energy Limited and Bow CSG Pty Ltd).

The location of Arrow Energy and QPM Energy tenures in the Bowen Basin is displayed in Figure 1, with the project area for Stage 1 of the BGP displayed in Figure 2.

The GMMP was approved with conditions by the then Department of Environment and Energy (DoEE), now the Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 24 October 2019. This report is due annually, 3 months after the anniversary date of the commencement of the BGP, which was triggered on 14 February 2019. DCCEEW was notified of the commencement on 7 March 2019 (reference: 2012/6377). On this basis, annual reports will be submitted to DCCEEW and uploaded to Arrow Energy's website by 14 May of each year. Periodic revisions of the GMMP are required to be submitted to the DCCEEW every three years if it is deemed that there are material changes to forecast production or groundwater modelling impacts.

For the purposes of reporting and alignment with the annual review of Arrow Energy's Bowen UWIR, the data collected and analysed will be for the calendar year (i.e. 1 Jan 2023 to 31 Dec 2023) and include groundwater data for both Arrow's BGP and QPM's MGP production areas.

As per Section 6.2.4 of the GMMP, the annual report requires the following to be addressed:

- Report on any relevant ongoing studies and research projects and include any supporting technical studies as appendices to the annual report (Section 5);
- Document the number of coal seam gas wells, including (Section 2):
    - Total number of wells installed, the number of operational wells, the number of non-operational wells, and the number of decommissioned or failed wells; and

- Confirmation that production is not from more than 1,408 operational wells.

- Provide an update on the implementation of the groundwater monitoring network and baseline monitoring, and summarise relevant monitoring results, including (Sections 3 and 4):
    - Groundwater levels and trends (Section 4.2);
    - Groundwater chemistry results and trends (Section 4.3);
    - Analysis and interpretation of data and identification whether drawdown predictions made have changed materially (Section 4.2); and
    - An assessment of factors contributing to observed groundwater level changes e.g. non-CSG versus CSG influences (Section 4.2).
- Provide any updates to the groundwater monitoring network if required (Section 3);
- Detail any confirmed non-compliances along with details of any remedial actions (Sections 3 and 4);
- Document compliance against the approval conditions over the preceding 12 months, including monitoring obligations and implementation of the EWS (Sections 3 and 4);
- Document corrective actions implemented to address any exceedances of trigger thresholds, limits, or non-compliance with approval conditions (Sections 3 and 4);
- Report against the performance measure criteria (Section 3); and
- Identify if an out of cycle UWIR was submitted (due to a material change or error in the information or predictions) and if practical consider a review of the GMMP outside of the 3-yearly review schedule. No out of cycle UWIR was submitted.

2 WATER PRODUCTION REVIEW

A review of water production and forecast water production for the MGP and BGP is presented in the 2024 Annual Review of the 2022 Bowen UWIR (refer to Appendix A). This was submitted to DES on 17 April 2024.

Table 1 below displays the current status of production wells within the BGP. Production does not exceed the 1,408 authorised operational wells.

Table 1: BGP well status

		Approximate number of anticipated production wells[1]	Wells installed	Operational wells	Non-operational wells	Decommissioned or failed wells
Project Stage 1 FDP	Red Hill Central	31	7	7	0	0
	Remainder of the Project Stage 1 area	1,377	0	0	0	0
	GMMP Total	1,408	7	0	0	0

[1] Well locations and numbers for Red Hill and the remainder of Project Stage 1 area are indicative only. Total well count, however, will not exceed 1,408 for Project Stage 1. The well counts are for vertical production wells only.

There have been no changes to the field development plan (FDP) since the 2023 Annual Review:

- Red Hill Central Petroleum Lease (within PL486) production commenced in 2022 and continues; and
- The remainder of the field development plan (FDP) area including Mavis Downs and Ellensfield, presented in the 2022 Bowen UWIR (ATP1103, ATP742 and ATP1031), is still forecast to commence in 2030.

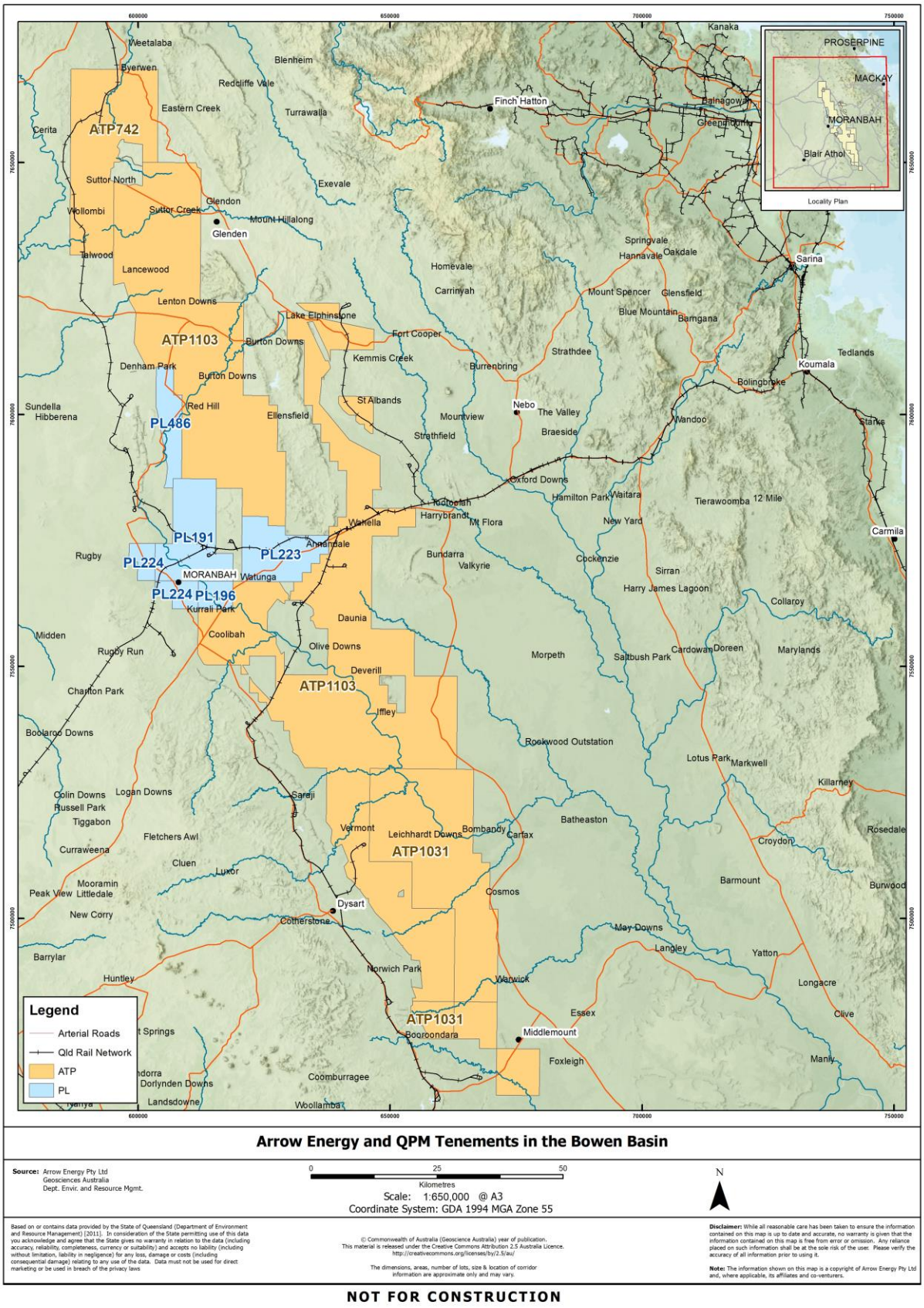


Figure 1: Arrow Energy and QPM Energy tenures for the BGP and MGP in the Bowen Basin. The location of ATP 1103, 1031, 742, 832 and PL 191, 196, 223, 224 and 486 are displayed on the map.

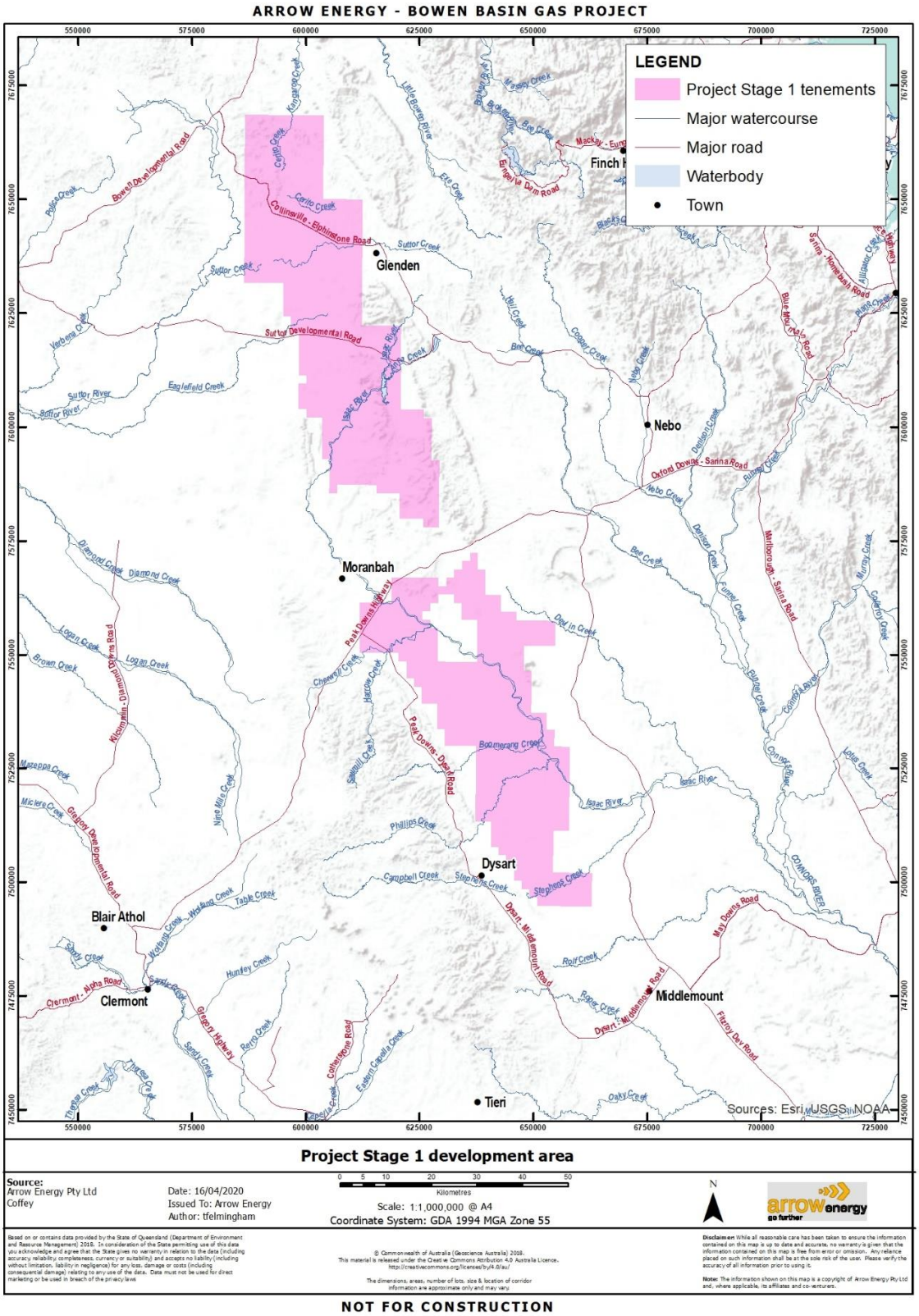


Figure 2: Stage 1 development area for the BGP

3 WATER MONITORING STRATEGY (WMS)

3.1 MGP Area Groundwater Monitoring Network

A total of 16 groundwater monitoring bores form the groundwater monitoring network for the MGP Area. Figure 3 provides an overview of the spatial distribution of the groundwater monitoring network. Groundwater monitoring is being undertaken in these bores in accordance with the WMS in the approved 2022 Bowen UWIR. The data collected from this monitoring network is being used to supplement baseline data from the BGP groundwater monitoring network. Full discussion of the MGP groundwater monitoring network is available in the 2024 Annual Review of the 2022 Bowen UWIR (refer to Appendix A), submitted to DES on 17 April 2024.

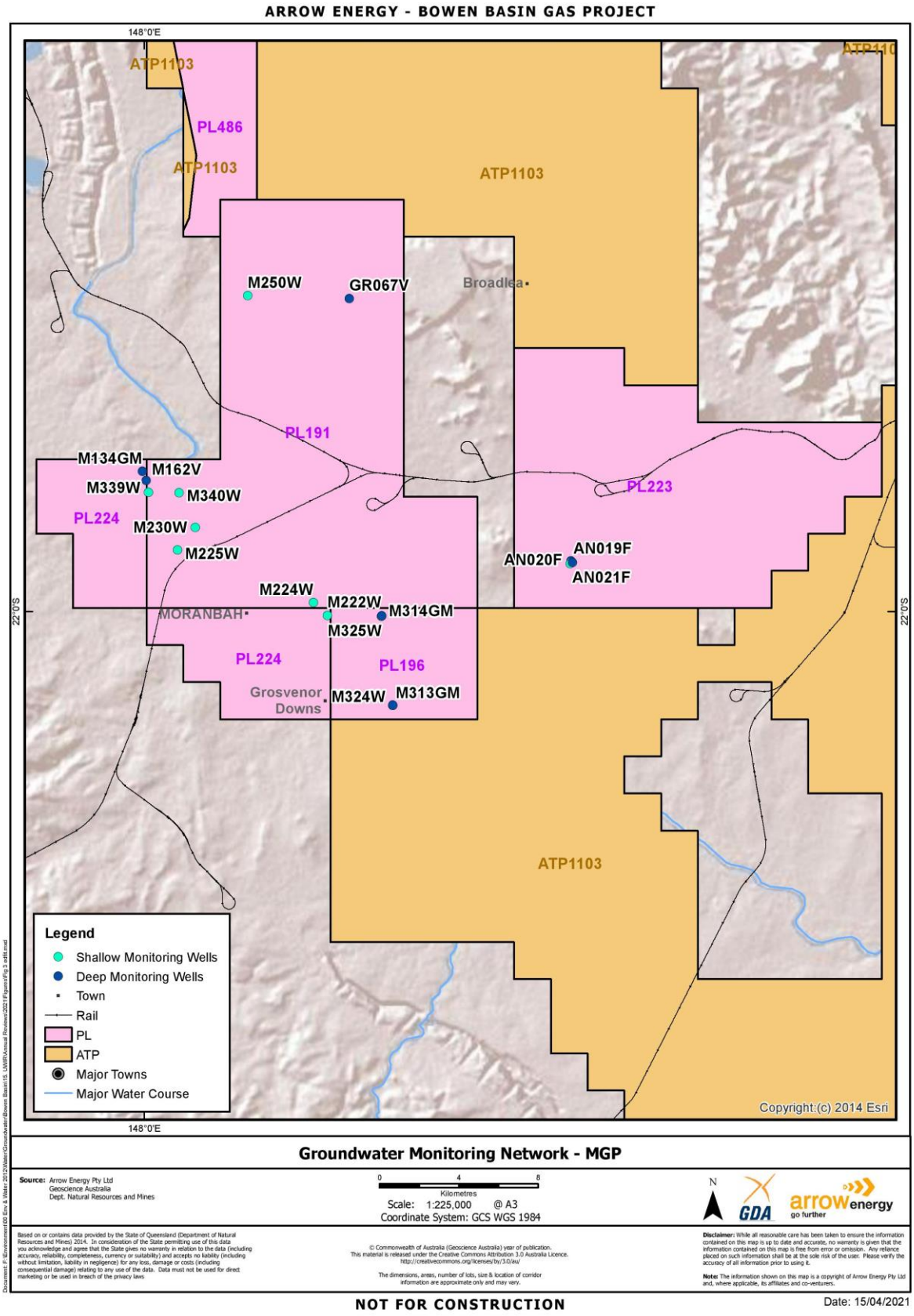


Figure 3: Groundwater Monitoring Network for MGP

3.2 BGP Area Groundwater Monitoring Network

The approved groundwater monitoring network for the BGP area is comprised of 35 monitoring intervals at 22 separate locations (comprising 12 single sites and 10 nested sites of 23 monitoring intervals). Figure 4 provides an overview of the spatial distribution of the groundwater monitoring network. Table 2 below displays the monitoring requirements of the BGP, along with the status of each location. Note that Table 2 displays the monitoring location name as per the 2019 Bowen Groundwater Monitoring and Management Plan (GMMP) which was approved by the then Department of the Environment and Energy (now DCCEEW) to comply with Arrow Energy's approval for the BGP. All subsequent reporting is based off this nomenclature.

At present, nine monitoring points have been installed at seven locations as a part of the monitoring network; MB1-S/I/D, MB2, MB3, MB12, GW004, GW007 and AEN1063 as detailed below. The groundwater levels and water quality of these bores are presented in Section 4.2 and 4.3. No non-compliances have been recorded to date.

MB1-S/I/D

MB1, located within 10 kilometres of the Red Hill Central development area, was installed as an appraisal (pilot) production well (originally named Red Hill-30) in January 2010. Groundwater level observations were made from the Moranbah Coal Measures (i.e. the deep interval) using the well from November 2011 to December 2011. Pumping from the well (for the pilot) was also undertaken during this time.

Pilot operation (and monitoring) ceased between December 2011 and November 2012.

The well was again monitored from 30 November 2012. The water level in Red Hill-30 had recovered to within 92% of its original baseline level prior to pumping for the pilot recommencing in December 2012.

From December 2012 the pilot was again operated (including production from Red Hill-30). Production from Red Hill-30 and the other pilot well in the pilot ceased in May and April 2013 respectively. Monitoring in Red Hill-30 continued until it was suspended in September 2013.

In October 2019, MB1 was modified by installation of a multi-level monitoring system to enable additional monitoring from the intermediate and shallow intervals to take place. Groundwater level data has been collected from all three intervals in MB1 since 11 November 2019. Drilling information for MB1 identified sufficient Quaternary / Tertiary Sediment or Rangal Coal Measures were not encountered at this location, and the shallow and intermediate monitoring points are therefore located within the Fort Cooper Coal Measures. During this Annual Review period, groundwater level data was recorded from 1 January 2023 to 31 December 2023.

Pressure spikes at the time of sampling from the lower zone from MB1-D are likely associated with spikes in temperature in the Fairhill pressure gauge. The calibration files in the skids use both the temperature and pressure data from the downhole gauge (digital gauges have both temperature and pressure sensors) to calculate the amount of pressure (i.e. water and gas) above the gauge. The temperature is an input to the calibration calculation and so changes in temperature directly affects the calculated pressure. As the temperature spikes are associated with the time of pumping from the lower zone (MCM), it is likely these data don't represent actual changes in pressure.

MB2

Located within 10 kilometres of the Red Hill Central development area, MB2 was originally installed as an appraisal (pilot) production well (originally named Red Hill-60) in January 2011. Pumping (intermittently) from the well for the pilot was undertaken between 2012 and 2018. Groundwater level observations were made from the Moranbah Coal Measures using the well from September to October 2015 (1.5 months), October 2017 to May 2018 (8 months). The well was converted to a permanent monitoring well using the existing downhole pressure gauge in February 2019 with twice daily groundwater level observations collected from February 2019 to October 2019 (7 months), followed by a period of data loss between October 2019 to January 2020. This data loss affected MB2 and MB3 due to the installed telemetry system not sending data to Arrow's server. An investigation on why this occurred identified that the route cause was human error. Following this, routine manual checking of the reporting status of the telemetry system was implemented. Additionally, an automatic alert system was then implemented in January 2021 that alerts Arrow personnel when telemetry data loss is found on monitoring locations and the telemetry system can be restarted to allow continuous logging.

Logged casing pressure between September 2019 and August 2020 displayed frozen values and is not likely real data. In this period, manually obtained pressure readings have been used.

Pumping (intermittently) from the well (for the pilot) was undertaken between 2012 and 2018. The well was converted to a monitoring well using the existing downhole pressure gauge in February 2019.

MB2 was worked over in February 2022 to install a digital downhole pressure. During the workover, it was identified that the existing analogue gauge depth was incorrect by 6.32m which has been used to correct the historical data.

Data loss due to hardware issues was observed between 14 July 2022 and 14 August 2022, but groundwater level monitoring was resumed afterwards and during this Annual Review period from 1 January 2023 to 31 December 2023.

MB3

MB3 was installed as an appraisal (pilot) production well (originally named Red Hill-51) in November 2011. The well was converted to a monitoring well using the existing downhole pressure gauge in February 2019. Similar to MB1-S/I/D and MB2, it is located within 10 kilometres of the Red Hill Central development area. Groundwater observations were made from the Moranbah Coal Measures using the well from September 2013 to May 2014 (9 months), October 2017 to May 2018 (7 months), and February 2019 to October 2019 (7 months, with data loss affecting this site until January 2020, as for MB2). Following reinstatement of the telemetry system, it was identified that the downhole pressure gauge failed during the period of data loss.

An adjacent appraisal (pilot) production well (originally named Red Hill-50) was converted to a monitoring well in September 2020 to continue to fulfil monitoring requirements for MB3.

The exact cause of the rise (and subsequent drop) in pressure from 4 November 2021 to 31 December 2021 in MB3 is not fully known. Data was collected during this period, however, given there was no change in wellhead pressure over the same time period, there is a chance the data is not reliable for this time period.

Additional data data loss was observed from 1 January 2022 to 13 February 2022 due to skid communication issues. During this Annual Review period, groundwater level data was recorded from 1 January 2023 to 31 December 2023.

MB12

MB12 was installed as a mine monitoring bore (originally named EFGW5D) by Fitzroy Mining in June 2008. This monitoring location is within 10 kilometres of the Red Hill Central development area. Groundwater level observations were made from the Rewan Formation through both manual water level measurements and hourly data logger measurements since January and July (respectively) 2018. A data logger was installed in the monitoring bore in July 2018 which is still in operation.

Supplementary monitoring bores

These monitoring locations comprise existing third-party monitoring bores and landholder bores and are included in the monitoring network.

GW004 (replacement for GW001) and GW007

GW001, GW004 and GW007 were installed as mine monitoring bores by BHP Mitsubishi Alliance (BMA) in 2011. These monitoring locations are within 10 kilometres of the Red Hill Central development area. Arrow commenced monitoring of GW001 and GW007 in November 2019.

GW004 was chosen as a replacement of GW001 from November 2020 due to poor data and logger reliabilities associated with the vibrating wire piezometers installed in GW001 which was failed in March 2020. A logger was deployed in GW004 during the November 2020 sampling round. During this Annual Review period, GW004 and GW007 groundwater level data has been recorded from 1 January 2023 to 31 December 2023.

AEN1063 (replacement for AEN1036)

A logger was deployed in a private water bore owned by a landholder, AEN1063, during the November 2020 sampling round after an access and monitoring agreement was completed with the landholder. The location of this bore is on the same property and same formation (Blackwater Group) as the monitoring point AEN1036, which was proposed in the GMMP. AEN1063 was chosen for monitoring after assessment of the bores on the property, with this bore being the most suitable for long term monitoring. Groundwater level has been monitored for this bore from 1 January 2023 to 31 December 2023 during this Annual Review period.

The following bore locations discussed below (AEN1214 and AEN1234), have been visited and assessed as suitable for long term monitoring and are awaiting execution of agreements with the landholders before logging equipment is installed. These bores are intended as part of the supplementary monitoring network and are currently visited for manual water level monitoring every six months.

AEN1214

AEN1214 is a private water bore owned by a landholder. With a total constructed depth of 37.3m, it was installed in Rangal Coal Measures and monitored since November 2020. Manual measurements are recorded every 6-months. No readings were recorded for Q2 2022 due to the landholder denying access to the property. Arrow is currently awaiting an access and monitoring agreement to be signed by the landholder for deployment of a logger.

AEN1234

Similar to AEN1214, AEN1234 is a private water bore owned by a landholder. AEN1234, with a total constructed depth of 102m, was installed in Blackwater Group and monitored since November 2020. Manual measurements are recorded every 6-months. Arrow is currently awaiting an access and monitoring agreement to be signed by the landholder for deployment of a logger.

Table 2: BGP Monitoring network

Monitoring location	Monitoring interval and target formation	Development area	Status/Indicative year of installation	Status
MB1	S – Quaternary / Tertiary I – RCM D – MCM	PL486	Current	Currently on monitoring. Groundwater level monitoring was required twice daily until 11/11/2020, which has been achieved. Going forward, a minimum of 6-monthly water level measurements are required for remainder of CSG production. Water quality sampling was required from MB1-D at biannual frequency for the first year, which has been achieved. Going forward annual monitoring is required.
MB2	MCM		Current	Currently on monitoring. Groundwater level monitoring was required twice daily until 31/10/2020, which has been achieved. Going forward, a minimum of 6-monthly water level measurements are required for remainder of CSG production. Online date is 16 February 2019 however data was lost between 30 October 2019 and 9 January 2020.
MB3	MCM		Current	Currently on monitoring. Groundwater level monitoring was required twice daily until 31/10/2020, which has been achieved. Going forward, a minimum of 6-monthly water level measurements are required for remainder of CSG production. Online date is 16 February 2019 however data was lost between 30 October 2019 and 9 January 2020, and 1 January 2022 to 13 February 2022.
MB4	Unconfined alluvium		Contingent	Not currently required as criteria not yet triggered. Requirement for installation is based on (modelled) increased risk of depressurisation resulting from changes in the FDP, or MB1 groundwater level monitoring data indicate interconnectivity of MCM with overlying units.
MB5	Tertiary / Triassic	ATP1103	2020	Not currently required due to no development scheduled within 10km.
MB6	Quaternary / Tertiary	ATP742	Contingent	Not currently required as criteria not yet triggered. Requirement for installation is based on (modelled) increased risk of depressurisation resulting from changes in the FDP, or monitoring of other sites in the northern development area indicate the potential or likelihood of preferential groundwater flow occurring across formations by way of geological faults
MB7	S – Tertiary D – RCM	ATP742	2029	Not currently required due to no development within 10km.
MB8	Quaternary / Tertiary	ATP742	2030	Not currently required due to no development within 10km.
MB9	S – Quaternary / Tertiary I – RCM D – MCM / FCCM	ATP1103	2029	Not currently required due to no development within 10km.
MB10	Tertiary	ATP1103	2030	Requires installation immediately prior to commencement of pumping from Wards Well pilot wells.
MB11	S – Quaternary / Tertiary or Rewan Formation D – RCM	ATP1103	2029	Not currently required due to no development within 10km.
MB12	Quaternary / Tertiary	ATP1103	Current	Existing Fitzroy Mining monitoring bore (EFGW5D) being utilised to obtain groundwater level monitoring data in place of MB12. EFGW5D is located approximately 345m from the proposed location for MB12. Monitoring commenced in July 2018. Groundwater level monitoring will include 6-monthly water level measurements for remainder of CSG production.
MB13	S – Quaternary / Tertiary (if present) D – Blackwater Group (RCM / FCCM / MCM)	ATP1103 ATP1103	Contingent - 2028	MB13S not currently required due to no development within 10km. Requirement for installation of MB13D is based on monitoring of MB13-S and/or other monitoring points in the southern development area indicates the potential or likelihood of preferential groundwater flow occurring across formations by way of geological faults, or ongoing modelling or revised development indicates a greater risk of depressurisation impact at this location.
MB14	S – Quaternary / Tertiary I – RCM D – MCM / RCCM	ATP1103 ATP1103 ATP1103	2029	Not currently required due to no development within 10km.
MB15	S – Unconfined alluvium I – Tertiary / Triassic	ATP1103 ATP1103	2029	Not currently required due to no development within 10km.
MB16	Tertiary	ATP1103	2029	Not currently required due to no development within 10km.
MB17	S – Unconfined alluvium I – Rewan Formation	ATP 1103 (in proximity to Lake Elphinstone)	Contingent	Not currently required as criteria not yet triggered. Requirement for installation is based on if revised modelling indicates a risk of depressurisation impacts to Lake Elphinstone, or if impacts are detected at MB11-S.
Supplementary monitoring bores				
AEN1214	Rangal Coal Measures	ATP742	Current	Manual measurements recorded every 6-months. Awaiting access and monitoring agreement for deployment of logger. No readings were recorded for Q2 2022 due to the landholder denying access to the property.
AEN1063	Blackwater Group	ATP1031	Current	On monitoring as of November 2020. Suitable replacement for proposed AEN1036 as on same property and drilled to the same formation.
AEN1234	Quaternary alluvium	ATP1234	Current	Manual measurements recorded every 6-months. Awaiting access and monitoring agreement for deployment of logger.
GW004	Alluvium Fort Cooper Coal Measures	ATP1103	Current	On monitoring as of November 2020. Replaced GW001 due to logger failure.
GW007	Alluvium Fort Cooper Coal Measures	PL486	Current	On monitoring as of November 2020.

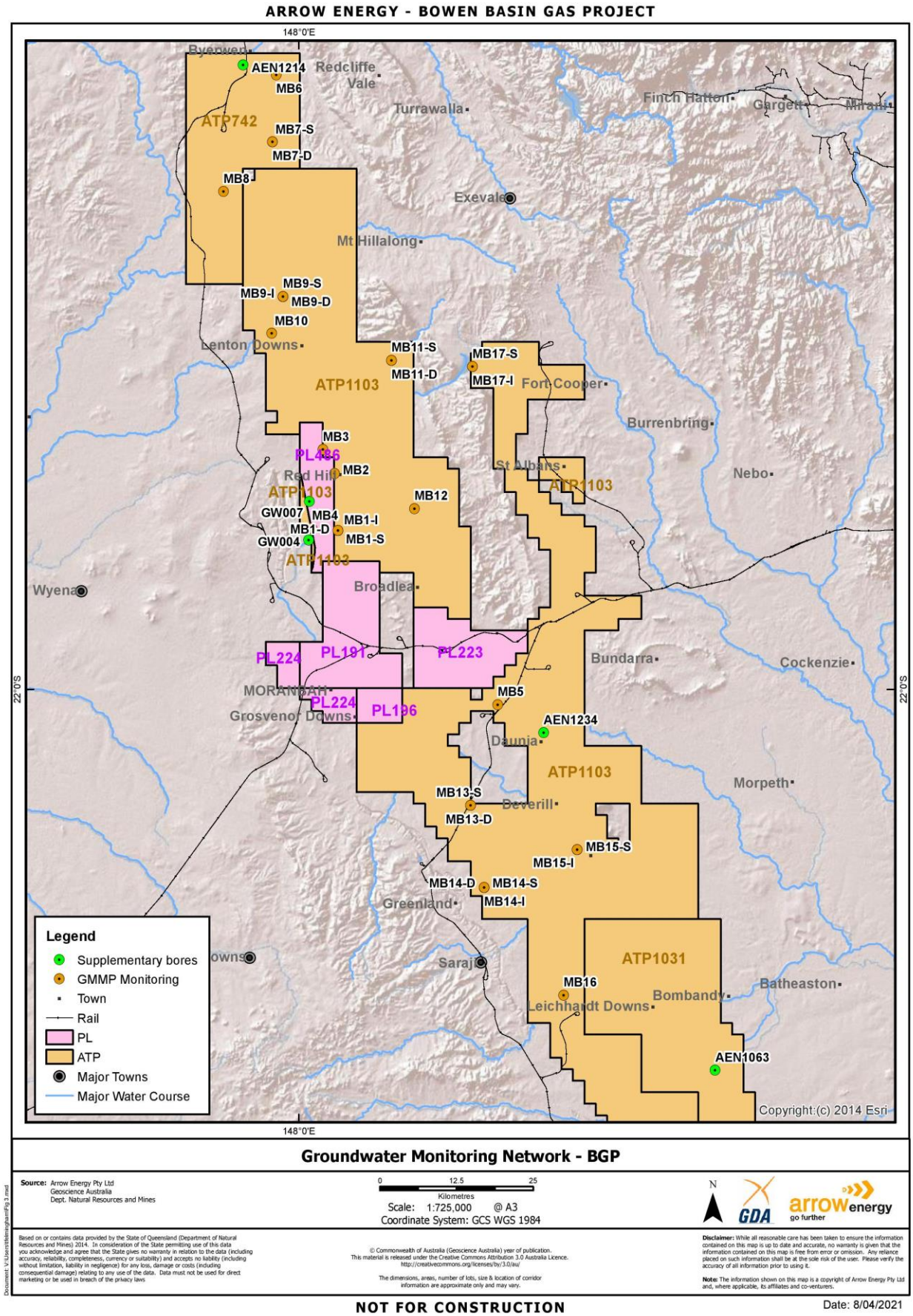


Figure 4: Groundwater Monitoring Network for BGP

4 GROUNDWATER ASSESSMENT UPDATE

4.1 Trigger Levels

Arrow's early warning system (EWS) is based on comparing modelled groundwater drawdowns derived from the GMMP groundwater model with early warning indicator levels (EWI), trigger threshold (TT), and drawdown limits, to inform escalating response actions.

The values of the EWI, TT and limits for the Quaternary age alluvium, Tertiary age sediments and basalts and Triassic age Clematis sandstone are presented below.

- EWI – Predicted drawdown by more than the applicable bore trigger threshold (BTT) (2 metres for unconsolidated aquifers and 5 metres for consolidated aquifers) for the Quaternary age alluvium, Tertiary age sediments and basalts and Triassic age Clematis sandstone;
- TT – Predicted drawdown by more than the BTT for the Quaternary age alluvium, Tertiary age sediments and basalts and Triassic age Clematis sandstone within three years;
- Limit – Predicted drawdown by more than double the applicable BTT for the Quaternary age alluvium, Tertiary age sediments and basalts and Triassic age Clematis sandstone within three years; and
- The EWS values are not assigned to the coal measures (Moranbah Coal Measures and Rangal Coal Measures) per the GMMP.

The 2022 Bowen UWIR indicated that drawdown is not predicted in the unconsolidated aquifers and the Clematis sandstone.

There have been no exceedances of EWS values to date.

4.2 Groundwater Level Monitoring

In-depth analysis of the groundwater levels for the MGP is available in the 2024 Annual Review of the Bowen UWIR (Appendix A). Findings for the MGP groundwater levels are summarised in the below sections.

4.2.1 Shallow Monitoring Bores

4.2.1.1 MGP

The groundwater levels in the MGP range from:

- 200.1 to 209.2 m Australian Height Datum (AHD) in the weathered Tertiary Basalt aquifer;
- 233.2 to 242.7 m AHD in the Tertiary Sediment aquifer;
- 207.8 to 211.7 m AHD in the Quaternary Alluvium aquifer;
- 202.4 to 206.3 m AHD in the Fort Cooper Coal Measures aquifer; and
- 236.6 to 238.6 m AHD in the Rewan Formation.

All bores located within close proximity to the Isaac River display similar depths to groundwater, as discussed in the 2022 Bowen UWIR. It should be noted that bore M250W, which was not monitored in Q4 2022, has been monitored and sampled during this Annual Review period (in Q2 2023 & Q4 2023).

The groundwater levels for bores M250W, AN021F and AN020F are higher due to the respective surface elevation in the areas being approximately 30 to 95 m above the other bores. M250W and AN021F are installed in the Tertiary Sediment and located approximately 10 km north and east respectively of the other groundwater monitoring sites along the Isaac River, while MB12 is constructed within the Rewan Formation and located approximately 26km northeast of the other groundwater monitoring sites along the Isaac River.

A comparison of modelled drawdown predictions made in the 2022 Bowen UWIR with monitoring data to date has been undertaken. There is no predicted IAA or LAA for unconsolidated aquifers for the MGP and BGP as modelled drawdown does not exceed the bore trigger threshold of 2 metres. The monitoring data to date supports this modelled prediction in the 2022 Bowen UWIR.

Groundwater level monitoring indicates:

- Actual groundwater levels monitored in bores M339W and M225W have remained generally stable over the monitoring period;
- The water levels in bore M222W have stabilised in recent years (2016 – 2023). It should be noted that water levels of this bore were subjected to a steady rise from beginning of monitoring in 2012 to 2016;
- Figure **7** displays cumulative rainfall departure and groundwater levels at groundwater monitoring bores M225W, M222W and M224W. Recharge to shallow aquifers due to above mean rainfall during the periods 2016 to 2017 and 2021 to 2022 has contributed to the trends in groundwater levels for these monitoring bores;
- There is no predicted IAA or LAA for any aquifer underlying PL 223; hence modelled drawdown greater than the bore trigger threshold at the end of 2022 was not predicted in the 2022 Bowen UWIR to occur at the location of bores AN020F and AN021F. AN021F is installed in the Tertiary Sediment and has increased in water level since monitoring began and has been relatively stabilise during this review period. AN020F is installed in the Rewan Formation which is considered to be a regional aquitard. Groundwater levels monitored at AN020F have had a slow decline since the end of 2019 which has continued during this review period, with a decline of approximately 2m over the last 4 years, which is less than the trigger threshold for a consolidated formation;
- A decline in groundwater level by greater than the bore trigger threshold was noted at bore M224W between November 2017 and May 2021. As discussed in the 2022 Bowen UWIR, the water levels in this bore indicate a possible hydraulic link to the river level fluctuations. The water levels have recovered approximately 2m since 2021 during the period of above average rainfall. This is in-line with the conceptual hydrogeological model report in the 2022 Bowen UWIR, where there is linkage between rainfall events and river level flow periods to groundwater level change. This decline is not considered to be due to the effects of CSG production; and
- A decline in groundwater level by greater than the bore trigger threshold was noted at bore M230W between November 2017 and November 2019.The water levels observed in this bore are considered to have been influenced by nearby mining operations; a review of mine plan schedules indicated that “drive Number-1” traversed the area in proximity to M230W between Q3 and Q4-2017 indicating that the SWL decline were expected to be a result of the Anglo underground mine development. This was similar to the decline seen in M340W (as discussed in the 2017 Annual Review of the 2016 Bowen UWIR) where a decline in groundwater level has made this monitoring borehole dry. Both monitoring bores are in the same area, as shown in Figure 3. Accordingly, the decline is not considered to be due to the effects of CSG production. Due to the impact of mining operations, this monitoring bore has been replaced by M300W but is included in this report for historical analysis.

Based on the graphically presented monitoring data in Figure 5, it is clear that there is no apparent influence of CSG production to the Quaternary alluvium, weathered Tertiary basalt, Tertiary sediment, weathered Fort Cooper coal measures and Rewan aquifers in which these bores are installed. This data supports the groundwater modelling predictions in the 2021 Bowen groundwater model.

4.2.1.2 BGP

Groundwater level monitoring has been undertaken in the following shallow groundwater monitoring bores which form part of the BGP monitoring network.

Table 3 provides a summary of these bores.

- Monitoring since January 2018 for bore MB12;
- Monitoring since November 2019 for bores MB1-S, GW004A, GW004B, and GW007A; and
- Monitoring since November 2020 for landholder bores AEN1214, AEN1234 and AEN1063.

Table 3: BGP Shallow Groundwater Monitoring Bores

Bore ID	Total Constructed Depth (m)	Screen Interval (mbgl)	Screened Formation	Tenure Holder
MB1-S	60	45 – 50	Fort Cooper Coal Measures – Girrah Seam	Arrow Energy
MB12	59.1	56 – 59	Rewan Formation	Arrow Energy
GW004A	13.5	7.5 – 13.5	Tertiary Sediment	Arrow Energy
GW007A	7.5	1.5 – 7.5	Tertiary Sediment	Arrow Energy
AEN1214	37.32	*	Rangal Coal Measures	Landholder (private bore)
AEN1234	102	48.2 – 102	Blackwater Group	Landholder (private bore)
AEN1063	52.6	39.6 – 45.7	Blackwater Group	Landholder (private bore)

* Screened interval could not be determined due to pumping infrastructure

The groundwater level monitoring results are shown in Appendix B. Groundwater levels, as is shown in Figure 6, range from:

- 234.03 to 235.16 m Australian Height Datum (AHD) in the Tertiary Sediment aquifer;
- 262.18 to 263.51 m AHD in the weathered Fort Cooper Coal Measures aquifer,
- 286.31 to 299.00 m AHD in the Rewan Formation;
- 2015.12 to 217.32 m AHD in the Rangal Coal Measures; and
- 142.53 to 185.64 m AHD in the Blackwater Group.

Groundwater level monitoring indicates:

- Groundwater levels are stable in the shallow bores;
- GW007A was recorded as dry. An alternate location may be required if GW007A is shown to be continually dry, however the Tertiary Sediment may not form an aquifer in this area; and
- Water level decline in MB12 from Q4 2018 to Q4 2020 is due to water quality sampling (pumping) being undertaken in the bore. The frequency of water quality sampling was decreased in Q2 2021 where subsequent water level data show water level recovery between monitoring events.

Based on the presented monitoring data in Figure 6, there is no apparent influence of CSG production to the Tertiary Sediment, Fort Cooper Coal Measures and Rewan aquifers in which these bores are installed and thus no thresholds have been exceeded as per the EWI. This is expected given the limited water production in the PL486 (Red Hill Central) area from the seven production wells, and no development has commenced in the remainder of the BGP area.

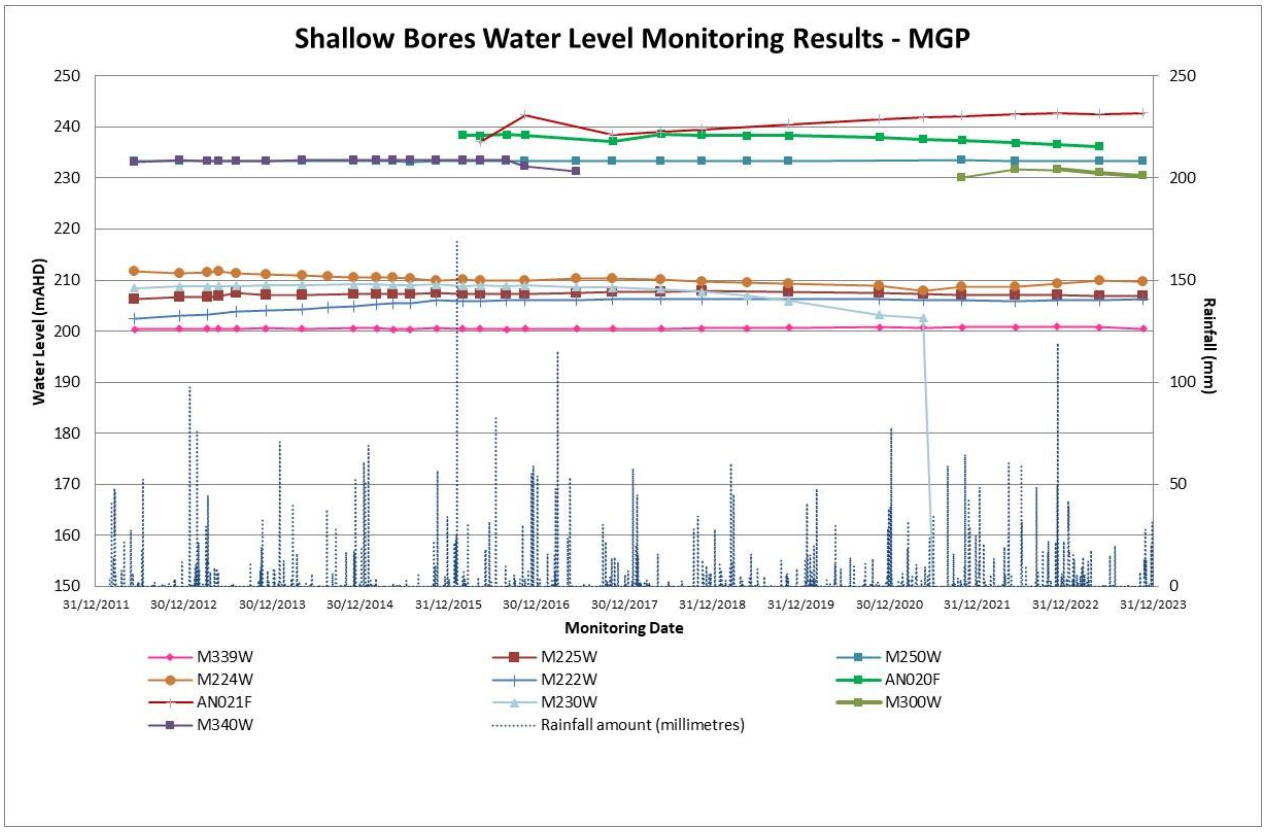


Figure 5: Shallow Bores Water Level Monitoring Results - MGP

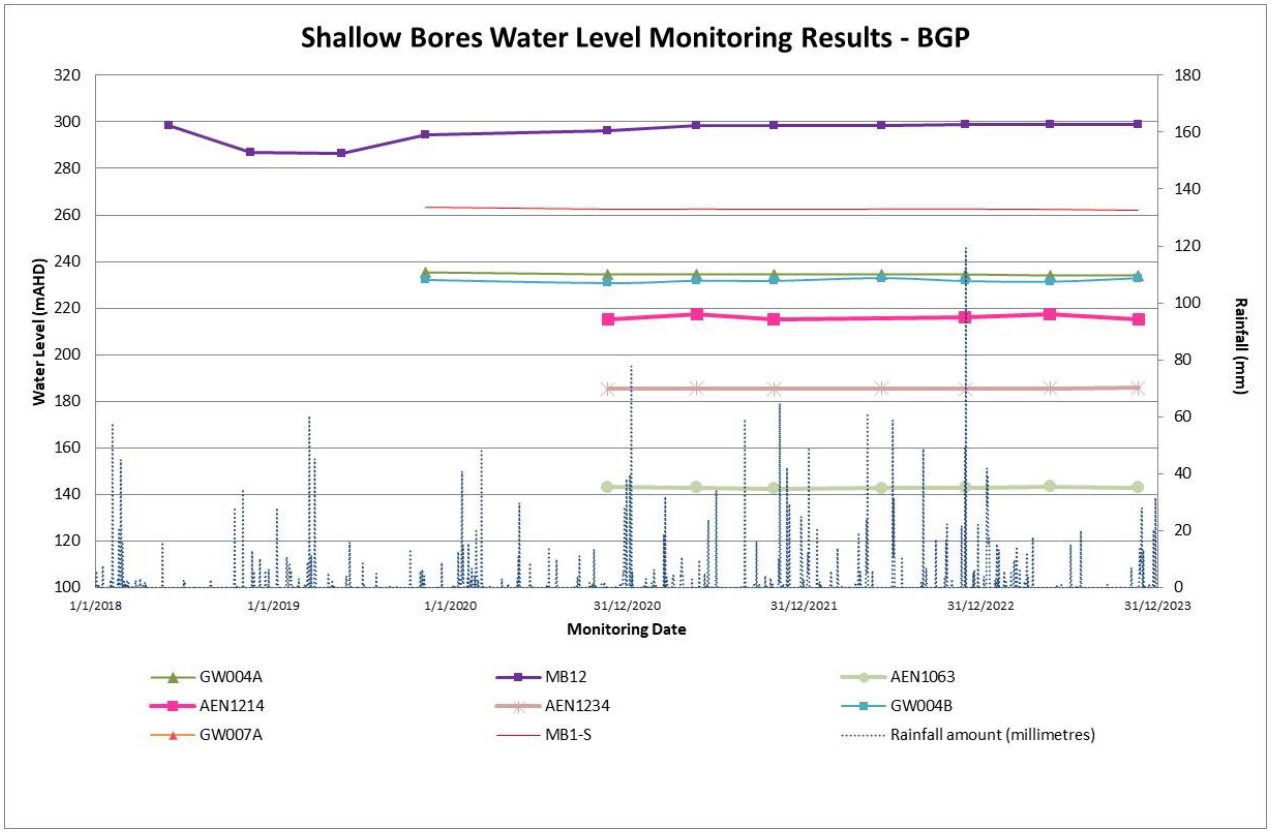


Figure 6: BGP Shallow Bores Water Level Monitoring Results

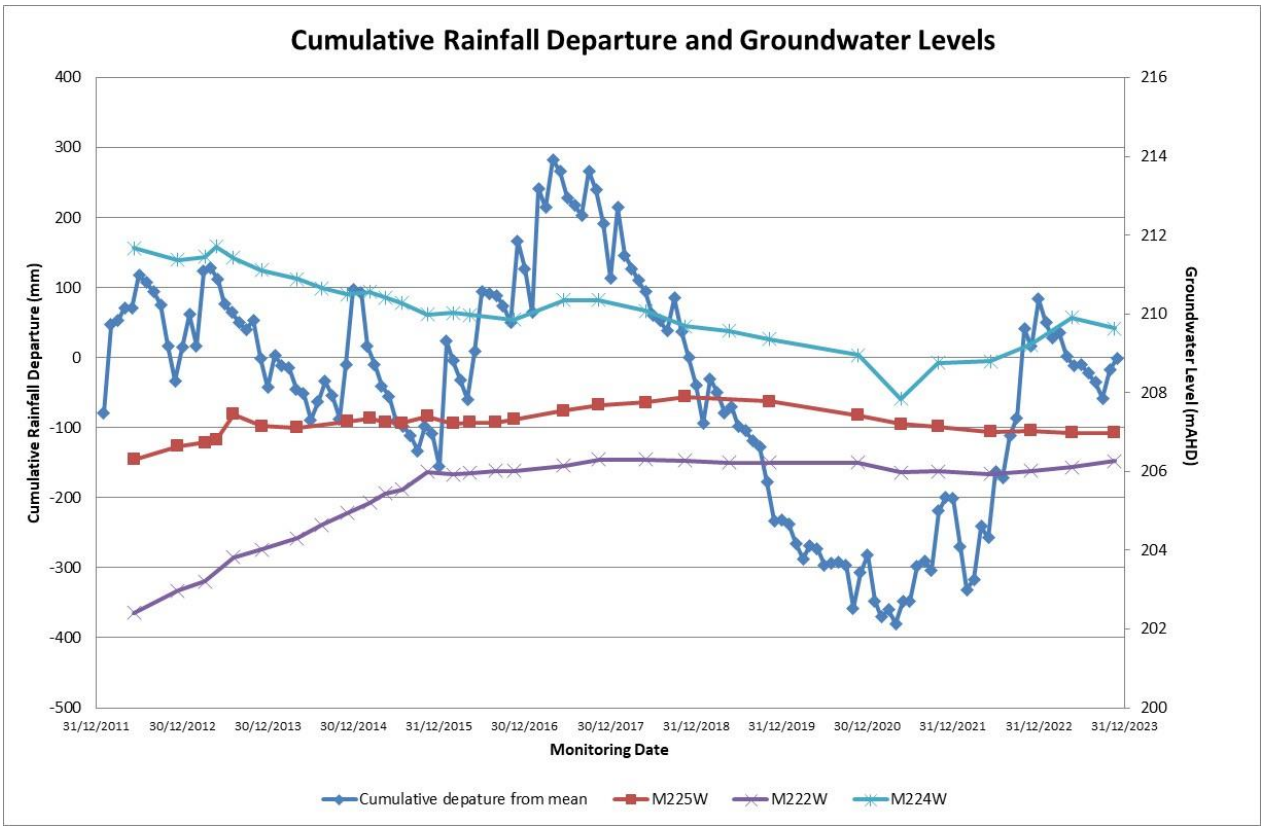


Figure 7: Cumulative Rainfall Departure and Groundwater Levels

4.2.2 Deep Monitoring Bores

4.2.2.1 MGP

The groundwater level monitoring results are shown in Figure 11. Observed groundwater levels or calculated potentiometric water levels ranged from:

- 206.3 to 215.9m AHD in the BCG;
- 49.6 to 204.8m AHD in the FCCM; and
- -129.1 to 204.5m AHD in the MCM.

Based on comparison of modelled drawdown predictions in the 2022 Bowen UWIR due to CSG activities with monitoring data, it is concluded that observations of drawdown are generally consistent with the drawdown predictions made in the 2022 Bowen UWIR. Further detail on MGP groundwater level monitoring results can be found in the 2024 Annual Review of the 2022 Bowen UWIR (refer to Appendix A), submitted to DES on 17 April 2024.

4.2.2.2 BGP

The groundwater level monitoring results are shown in Figure **12**. Observed groundwater levels or calculated potentiometric water level ranged from:

- 240.7 to 265.0m AHD in the FCCM; and
- -356.3 to 211.4m AHD in the MCM.

As displayed above, there is a large range in water levels in the MCM. This is due to recovery of water levels at the monitoring locations from historical production. Analysis of MB1-D, MB2 and MB3 water levels was conducted to determine the recovery time of the water levels to a static condition prior to modelled drawdown at these locations to fulfil the requirements of the GMMP. The Theis recovery method was used to analyse that data and concluded that MB1 has fully recovered, and MB2 and MB3 will recover fully prior to predicted drawdown. Appendix D displays the curve analysis and graphs, with

Figure **8** to Figure **10** showing the water level recovery of these wells compared to the calculated recovery. These figures show:

- MB1 water level has fully recovered;
- MB2 water level is recovering in-line with the calculated recovery; and
- MB3 water level recovery is less than calculated. Due to the limited amount of data since relocation of the monitoring point (from Red Hill-51 to Red Hill 50), analysis will be undertaken in future reports.

Table **4** displays the predicted recovery year for each bore. As discussed in Section 3.2, the location of MB3 was changed due to a failure in a pressure gauge.

Table 4: Recovery dates – MB1, MB2 & MB3

Bore ID	Recovery date	Predicted drawdown year
MB1	05/06/2014	2028
MB2	14/02/2027	2035
MB3	28/04/2027	2033

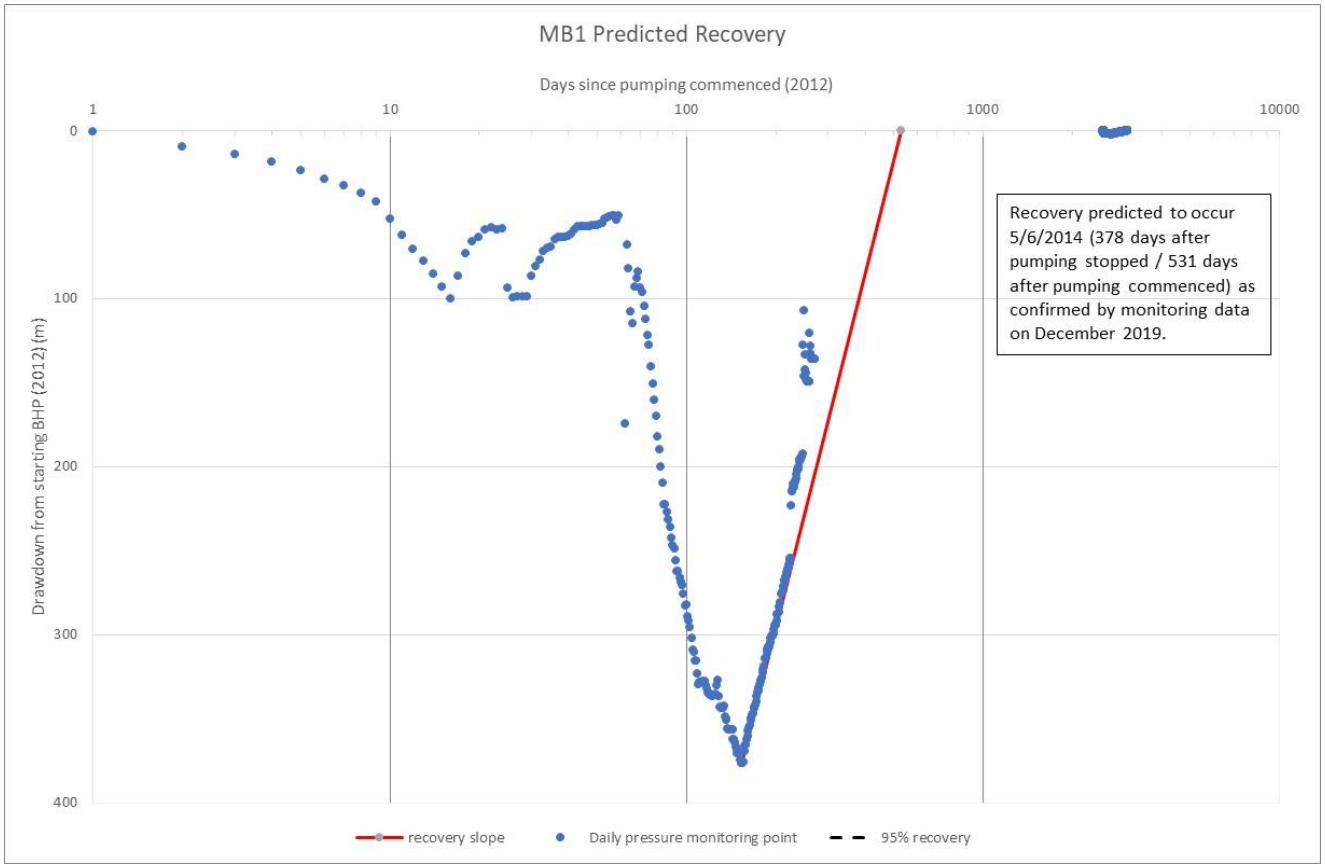


Figure 8: MB1-D recovery data

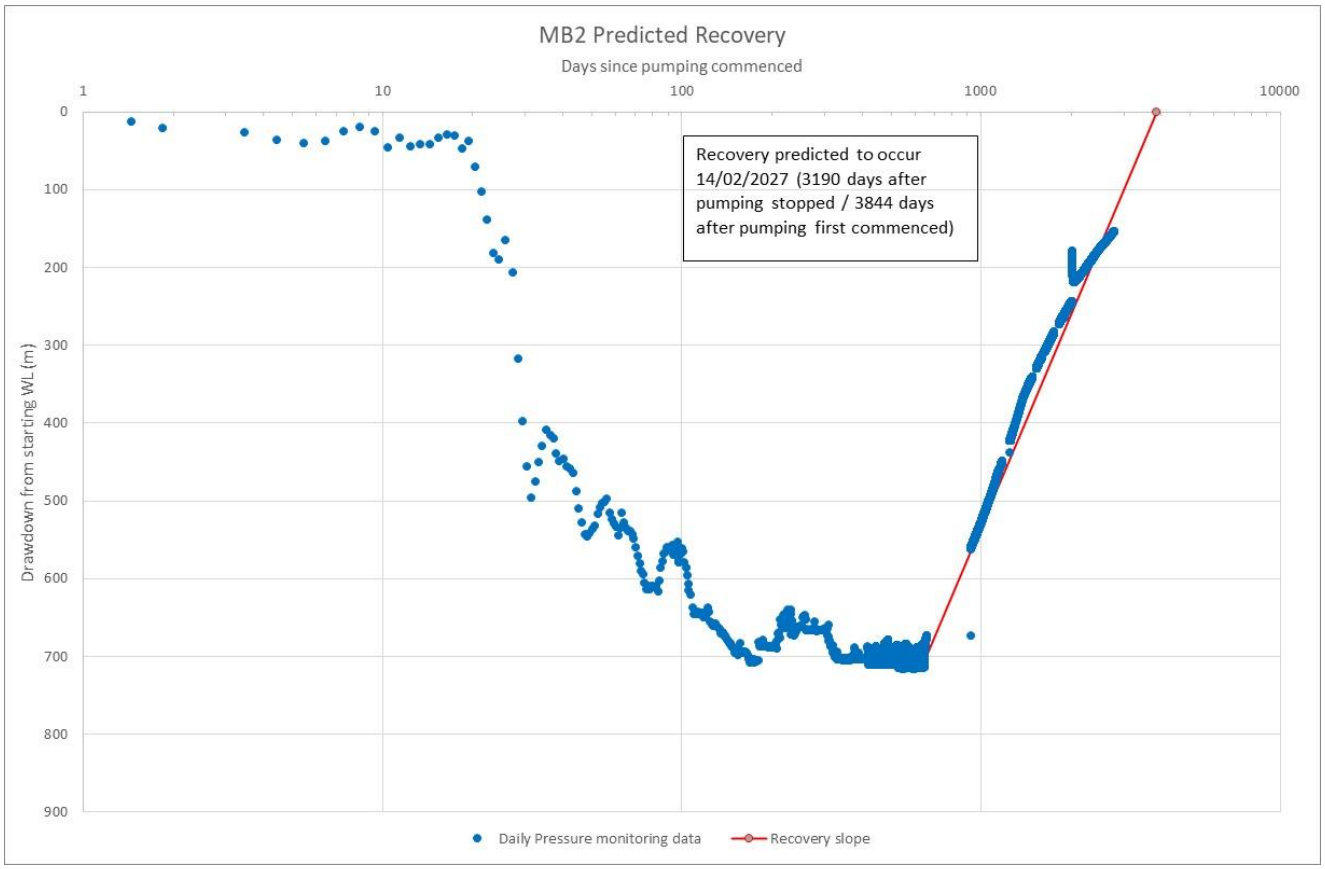


Figure 9: MB2 recovery data

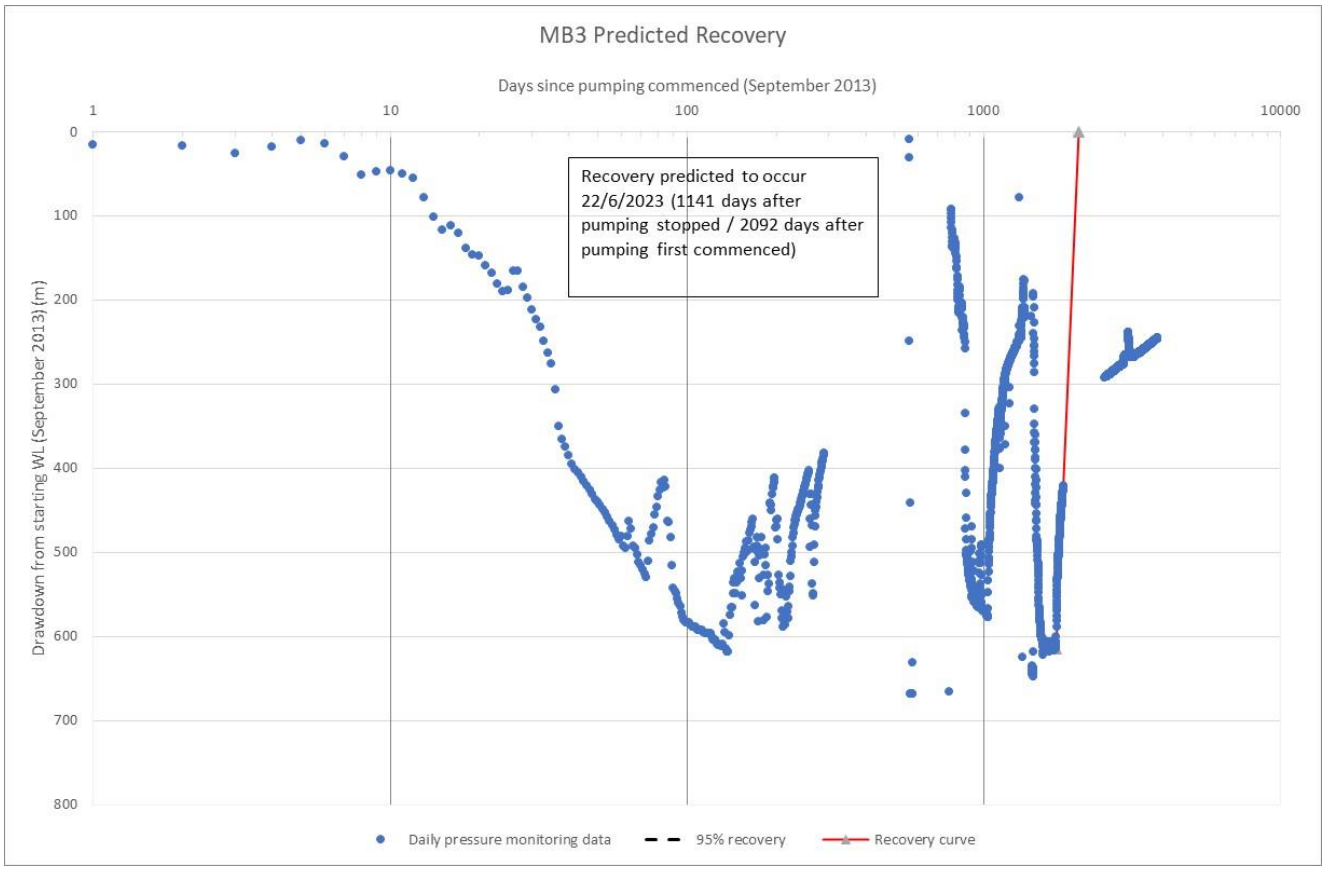


Figure 10: MB3 recovery data

A comparison of modelled drawdown predictions modelled in the 2022 Bowen UWIR with monitoring data to date has been undertaken and indicates:

- Drawdown in the MCM aquifer at the end of 2022 at the location of MB1 was not predicted to occur in the model. There was a decline in water levels in 2019 as a result of equilibration due to the workover of the well in late 2019 to equip the borehole with multiple pressure sensors and is not related to CSG activities. This is further discussed in Section 4.2.3. Actual groundwater levels monitored indicate a continuous recovery after decline in 2019;
- Drawdown in the MCM aquifer at the end of 2022 at the location of MB2 was not predicted to occur in the model. Actual groundwater levels monitored indicate an increase of 387.8 m. The water level in this bore is recovering from production during the pilot which ceased operation in 2018;
- Drawdown in the MCM aquifer at the end of 2022 at the location of MB3 was predicted to be 6.94 m. Actual groundwater levels monitored indicate an increase of 190.4 m from the recovery, started in June 2019 after cessation of pilot production in 2018;
- Drawdown in the FCCM aquifer at the end of 2022 at the location of MB1 and GW007B was predicted to be 0 m. Actual water level monitored indicates a decline of 8.5 in MB1 and 0.6 in GW007B. The observed decline, which appears to be flattening in MB1, is likely due to equilibration of pressure within the bore and the formation following the workover when the well was topped up with water; and
- MB2 and MB3 display recovering water levels. MB2 and MB3 are prior appraisal wells.

Based on the monitoring data, it is concluded that observations of drawdown were generally consistent with the drawdown predictions made in the 2022 Bowen UWIR.

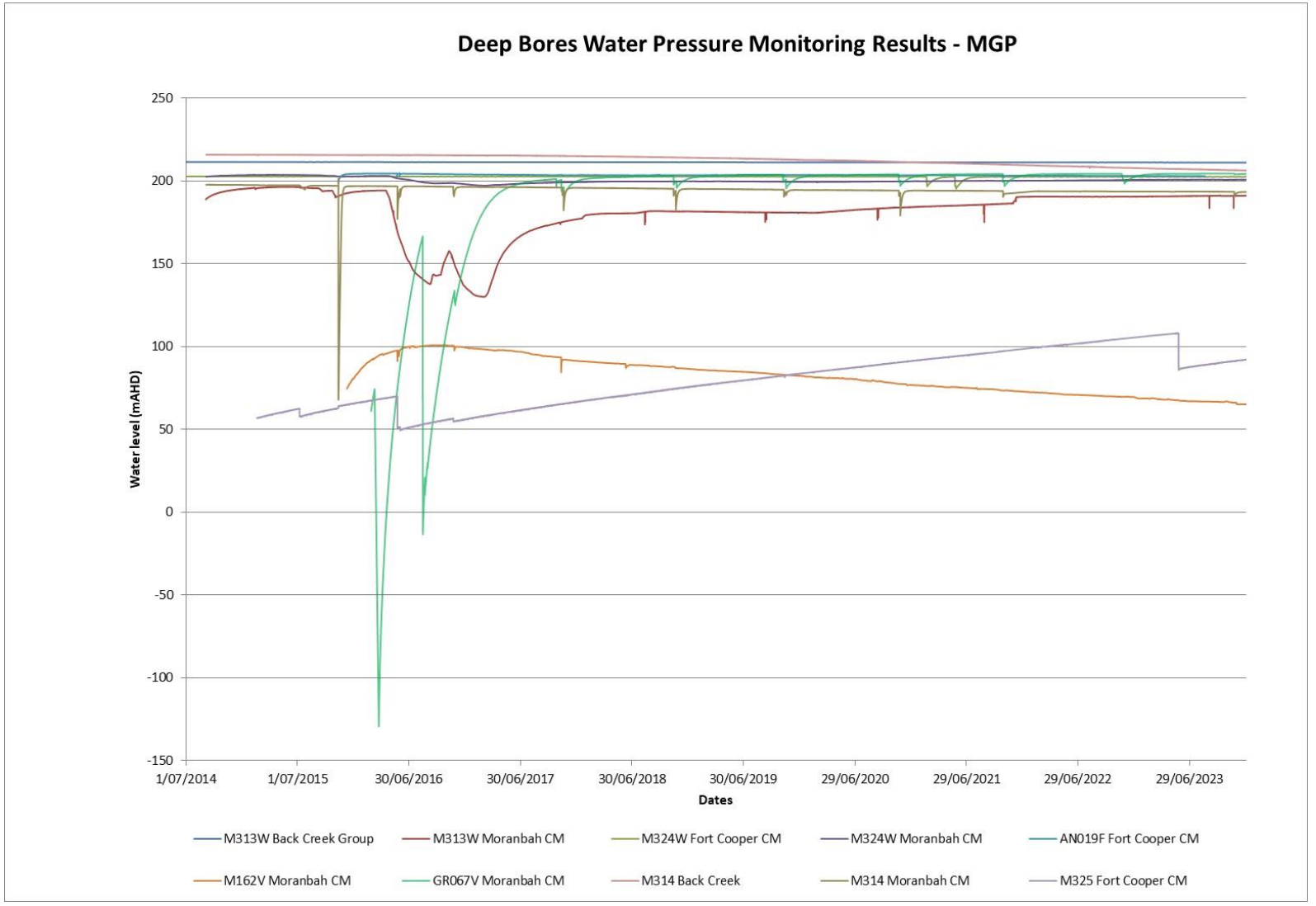


Figure 11: Deep Bores Water Level Monitoring Results - MGP

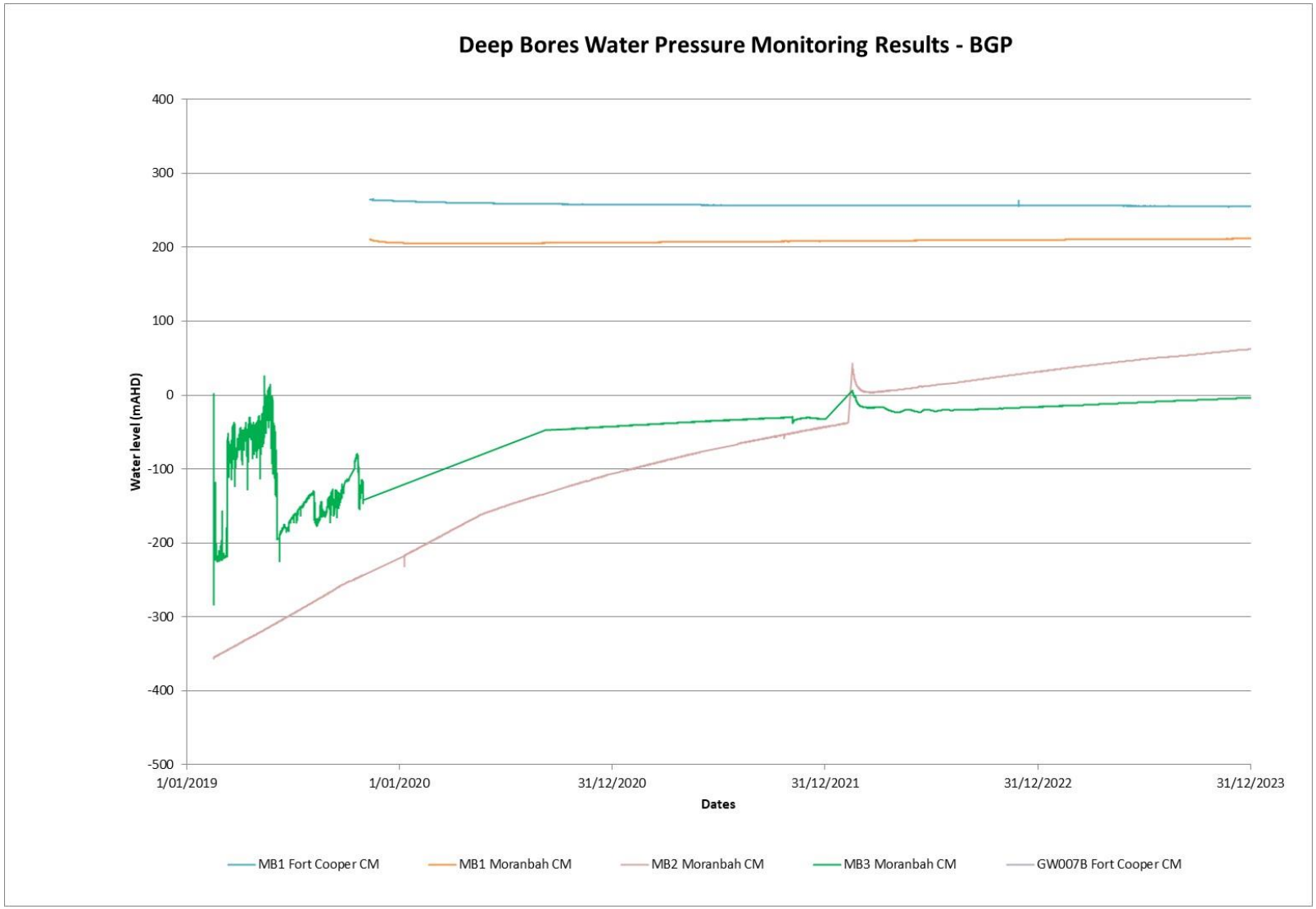


Figure 12: Deep Bores Water Level Monitoring Results - BGP

4.2.3 Groundwater Flow

A review of vertical gradients was undertaken for two monitoring locations in the MGP Area and one monitoring location in the BGP area. Monitoring at each site included:

- Site 1: From deepest to shallowest; Back Creek Group (M314W), Moranbah Coal Measures (M314W), Fort Cooper Coal Measures (M325W) as well as data from monitoring approximately 3 km north west in the weathered Fort Cooper Coal Measures (M222W) and Quaternary Alluvium (M224W);
- Site 2: From deepest to shallowest; Back Creek Group (M313W), Moranbah Coal Measures (M313W), Moranbah Coal Measures (M324W) and Fort Cooper Coal Measures (M324W); and
  Site 3. From deepest to shallowest, Moranbah Coal Measures, Fort Cooper Coal Measures and Fort Cooper Coal Measures (Girrah seam), in MB1.

Figure 13 below shows the vertical gradients for Site 1 and the latest data indicates the FCCM aquifer, at bore M325W, has the lowest water level. The collected and graphically displayed data indicate a very steady and continued recovery of approximately 59m. With the exception of M325W, there is an apparent gradient toward the MCM (the target coal seams for CSG production from the MGP) – i.e. upward from the BCG and downward from the Quaternary Alluvium, to the FCCM and then to the MCM.

As discussed in Section 4.2.1, water levels in monitoring bore M222W which is constructed into the FCCM show a rising trend in response to above average rainfall recharge. Water levels in M224W constructed in the Quaternary Alluvium show that trends in water levels are linked to flows in the nearby Isaac River.

As discussed in Section 4.2.2, A decline in water levels have been observed in M314W within the MCM and the BCG. The water level trends between the MCM and shallow aquifer seem to indicate no vertical hydraulic links exist at this location.

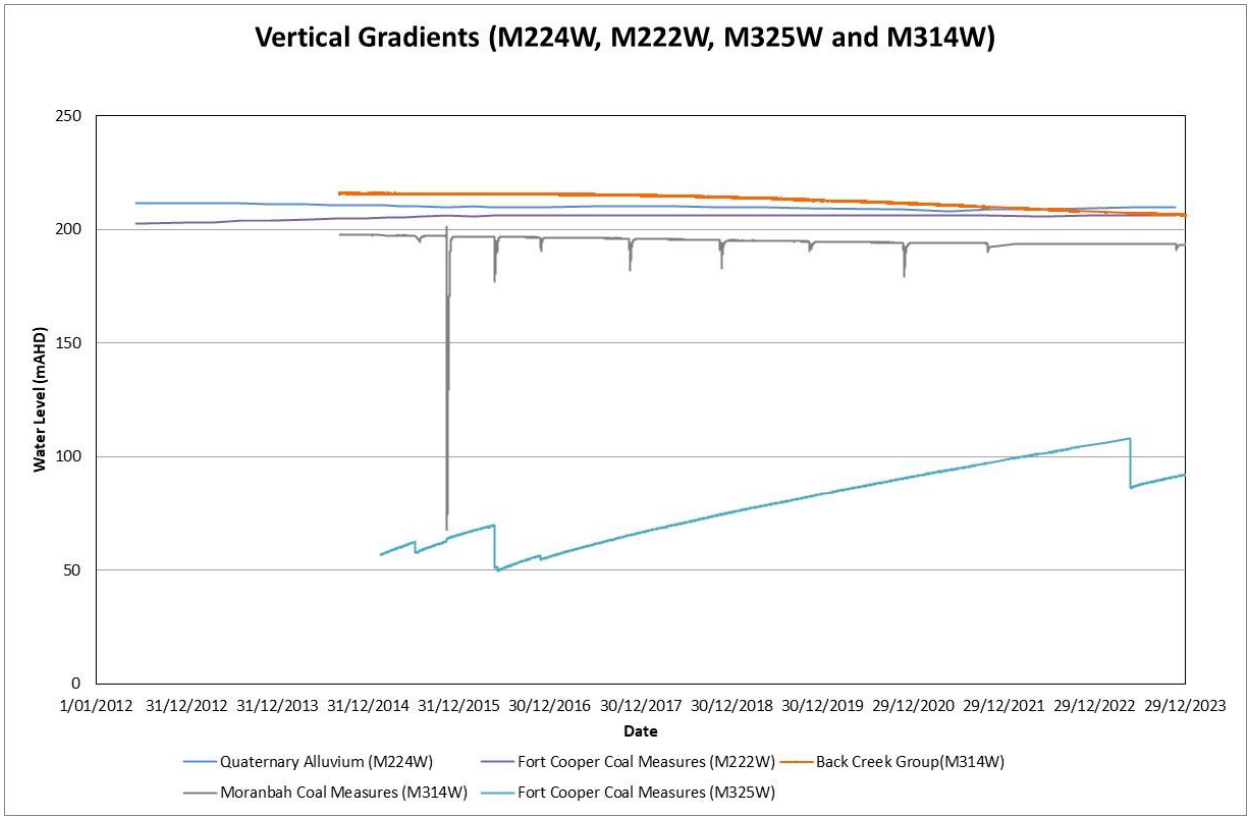


Figure 13: Site 1 - Review of Vertical Gradients (M224W, M222W, M325W and M314W)

Figure 14 shows the graphically displayed vertical gradients for Site 2 and based on the presented data, water levels in the MCM monitoring bores have continued to recover following cessation of production in nearby production well GM052V.

As discussed in 4.2.2, drawdown as a result of water production in CSG wells to the MCM aquifer is evident at site M313W and M324W but since the production ceased in April 2017, the water level recovery is evident in both monitoring boreholes. Monitoring data for the FCCM and BCG at this site indicates a slight decline in water levels. Decline in water levels noted

for the FCCM are observed to correlate to the water production in CSG wells and consequential drawdown in the underlying MCM. This suggests that there is some transmission of impacts from the MCM to the shallower FCCM. Whilst there is some decline in water levels in the deeper Back Creek Group aquifer, it does not clearly correlate to the water production in the CSG wells and ongoing monitoring will confirm this. Based on this, monitoring data suggests that impacts are contained within the MCM and FCCM.

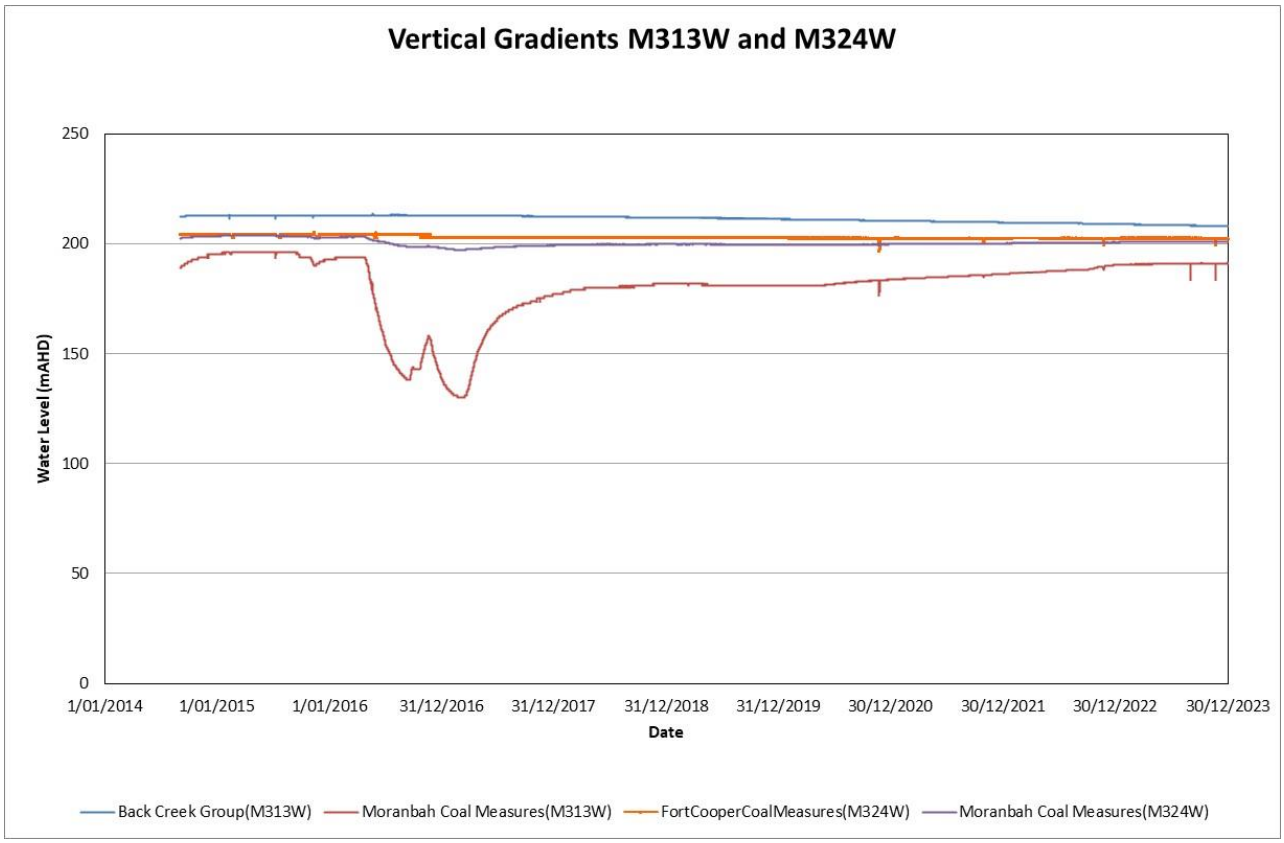


Figure 14: Site 2 - Review of Vertical Gradients (M324W and M313W)

A review of vertical gradients was undertaken for one monitoring location in the BGP (MB1 – denoted Site 3). Figure 15 shows the graphically displayed vertical gradients for Site 3 and based on the presented data, an initial decrease in water levels in the MCM is visible, with a smaller decrease seen in the FCCM. This decline in water levels can be attributed to the workover conducted on MB1 to equip the borehole for multi-zone monitoring. During the workover process, a slug of water was introduced to 'kill' the well and due to the low permeability of the FCCM and MCM, a decline in water level was seen. As of the end of 2023 the water levels in all three zones are stabilising, with the MCM zone displaying an increase in water levels.

The sharp pressure increases in the data can be attributed to sampling events of MB1, where the pressure is bled off the borehole during sampling.

Ongoing monitoring will provide further information on the interconnectivity of aquifers at these sites.

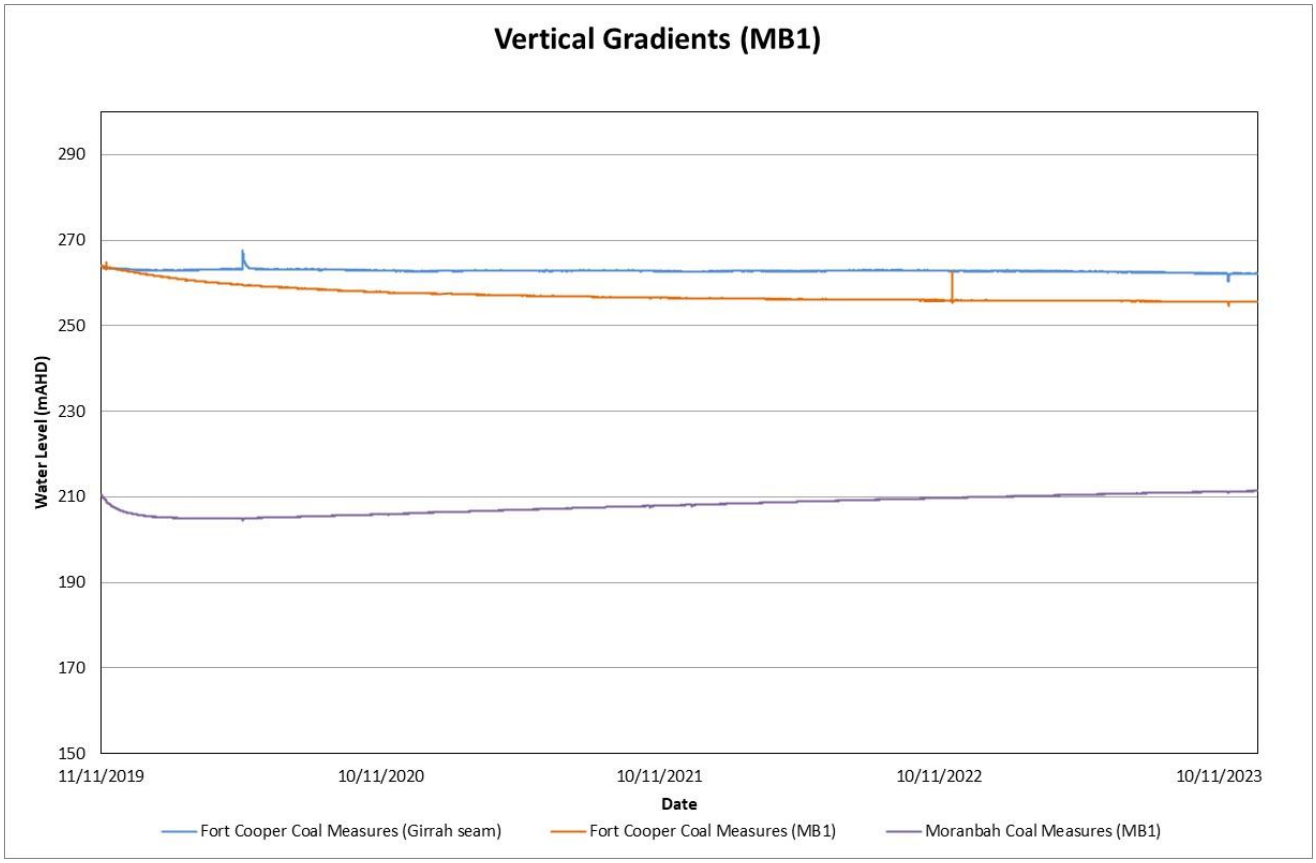


Figure 15: Site 3 - Review of Vertical Gradients (MB1)

4.3 Groundwater Quality Monitoring

The groundwater quality monitoring results are shown in Appendix C. A summary of these results is provided in the following sections.

4.3.1 Shallow aquifer water quality

4.3.1.1 MGP

The groundwater quality data indicated that there are no notable trends. In general, the salinity ranges[2] for the underlying units can be described as follows:

- Groundwater quality of the quaternary alluvium varies from brackish to saline;
- Groundwater quality of the tertiary basalt aquifer varies from brackish to saline;
- Groundwater quality of the tertiary sediment aquifer is fresh to brackish to brackish;
- Groundwater quality of the weathered coal measures is saline; and
- Groundwater quality of the Rewan Formation is saline.

4.3.1.2 BGP

No groundwater quality data was obtained for the shallow aquifer for the BGP. At present, no shallow groundwater quality data locations are required to be collected. As the project progresses, the following locations will require groundwater quality data to be collected:

- MB5;
- MB7-S;
- MB8;
- MB9-S;
- MB10;
- MB11-S;
- MB13-S (contingent);
- MB14-S;
- MB15-S & MB15-I (contingent);
- MB16; and
- MB17-S & MB17-I (contingent).

[2] Environmental Protection Agency (EPA) of South Australia

4.3.2 Deep aquifer background water quality

4.3.2.1 MGP

Table 5 provides a summary of water quality results obtained from bores targeting the deep aquifers (M313W, M314W, M324W, M325W, AN019F, GR067V, M162V, M134GMV and MB1-D). This provides an indication of water quality ranges for each parameter analysed based on aquifer type. Results for some parameters between different monitoring locations show high degree of variation which is likely to be attributable to the spatial heterogeneity and low permeability of the hydrogeological system. In addition, as displayed by the groundwater pressure data, groundwater recovery for some sites is slow and this is likely to result in variations in some parameters at the same monitoring location. Overall, a review of this data indicates that there are no notable trends. In general, this data shows that:

- Groundwater quality of the Fort Cooper Coal Measures aquifer is fresh to saline[3]; and
- Groundwater quality of the Moranbah Coal Measures is fresh to saline.

[3] Environmental Protection Agency (EPA) of South Australia

Table 5: Background Water Quality – Deep Monitoring Bores

Parameter	Unit	Fort Cooper Coal Measures		Moranbah Coal Measures	
		Min	Max	Min	Max
Field pH		6.79	11.8	7.27	9.42
Electrical Conductivity	µS/cm	1170	15700	1710	16000
Total Dissolved Solids	mg/L	707	9910	1160	9810
Hydroxide Alkalinity (OH-) as CaCO3	mg/L	<1	456	<1	<1
Carbonate Alkalinity as CaCO3	mg/L	<1	157	<1	456
Bicarbonate Alkalinity as CaCO3	mg/L	<1	1380	159	2380
Total Alkalinity as CaCO3	mg/L	222	1380	159	2420
Sulphate, SO4	mg/L	<1	68	<1	134
Chloride, Cl	mg/L	188	4920	198	5850
Calcium - Dissolved	mg/L	<1	276	2	209
Magnesium - Dissolved	mg/L	<1	256	<1	62
Sodium - Dissolved	mg/L	199	2590	212	3490
Potassium - Dissolved	mg/L	10	73	6	1450
Arsenic-Dissolved	mg/L	<0.001	0.005	<0.001	0.013
Beryllium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Barium-Dissolved	mg/L	0.005	12.2	0.236	23
Cadmium-Dissolved	mg/L	<0.001	<0.001	<0.001	0.001
Chromium-Dissolved	mg/L	<0.001	0.004	<0.001	0.018
Cobalt-Dissolved	mg/L	<0.001	0.004	<0.001	0.01
Copper-Dissolved	mg/L	<0.001	0.582	<0.001	7.08
Lead-Dissolved	mg/L	<0.001	0.459	<0.001	2.19
Manganese-Dissolved	mg/L	<0.001	0.304	0.007	0.446
Molybdenum	mg/L	0.006	0.114	0.001	0.091
Nickel-Dissolved	mg/L	<0.001	0.02	<0.001	0.05
Selenium	mg/L	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	0.406	8.18	1.18	10.8
Vanadium-Dissolved	mg/L	<0.01	<0.01	<0.01	0.02
Zinc-Dissolved	mg/L	<0.005	2.16	<0.005	0.568
Boron	mg/L	0.24	1.17	0.46	2.4
Iron	mg/L	<0.05	2.94	0.07	3
Mercury-Dissolved	mg/L	<0.0001	0.42	<0.0001	0.87
Fluoride, F	mg/L	0.2	4.5	0.4	2.6
Phosphate as P in water	mg/L	<0.01	0.62	<0.01	17.4

4.3.2.2 BGP

Table 6 provides a summary of water quality results obtained from bores targeting the deep aquifers (MB1-D and GW007B).

Overall, a review of this data indicates that there are no notable trends. In general, this data shows that:

- Groundwater quality of the Fort Cooper Coal Measures aquifer is brackish; and
- Groundwater quality of the Moranbah Coal Measures is brackish.

Currently, groundwater quality data is required to only be collected at MB1-D. Water quality sampling was required at MB1-D at biannual frequency for the first year, which was achieved, and sampling will continue annually going forward.

A sample was collected from GW0007B at the same visit (on 27/11/2019) as a water level logger download from GW007B was undertaken in November 2019. Although it is not required by the GMMP, it is included into Table 6: B for analysis.

For the BGP, deep groundwater quality data will be required to be collected at the following monitoring locations as the project progresses:

- MB7-D;
- MB9-I & MB9-D;
- MB11-D; and
- MB14-I & MB14-D.

Table 6: Background Water Quality – Deep Monitoring Bores

Parameter	Unit	Fort Cooper Coal Measures	Moranbah Coal Measures	
		GW007B	MB1-D	
			Min	Max
Field pH		6.79	7.86	8.26
Electrical Conductivity	µS/cm	15700	8600	9380
Total Dissolved Solids	mg/L	9910	5110	5460
Hydroxide Alkalinity (OH-) as CaCO3	mg/L	<1	<1	<1
Carbonate Alkalinity as CaCO3	mg/L	<1	<1	40
Bicarbonate Alkalinity as CaCO3	mg/L	1380	817	1870
Total Alkalinity as CaCO3	mg/L	1380	817	1870
Sulphate, SO4	mg/L	<1	<1	11
Chloride, Cl	mg/L	4920	1940	2560
Calcium - Dissolved	mg/L	276	6	14
Magnesium - Dissolved	mg/L	256	6	12
Sodium - Dissolved	mg/L	2330	1900	2410
Potassium - Dissolved	mg/L	64	16	24
Arsenic-Dissolved	mg/L	0.005	0.002	0.003
Beryllium-Dissolved	mg/L	<0.001	<0.001	<0.001
Barium-Dissolved	mg/L	12.2	2.72	4.29
Cobalt-Dissolved	mg/L	0.001	<0.001	0.001
Copper-Dissolved	mg/L	<0.001	<0.001	0.005
Lead-Dissolved	mg/L	<0.001	0.002	0.008
Manganese-Dissolved	mg/L	0.12	0.009	0.049
Molybdenum	mg/L	0.006	0.014	0.018
Nickel-Dissolved	mg/L	0.02	0.01	0.05
Vanadium-Dissolved	mg/L	<0.01	<0.01	<0.01
Zinc-Dissolved	mg/L	2.16	<0.005	0.045
Boron	mg/L	0.24	1.04	1.68
Iron	mg/L	2.94	0.56	1.53
Fluoride, F	mg/L	0.2	2	2.2
Phosphate as P in water	mg/L	0.02	1.31	1.31

5 RESEARCH

A list of research and reports produced in this reporting period are described below:

- 2024 Annual Review of 2022 Bowen UWIR was completed and submitted to DES on 17 April 2024. The 2022 Bowen UWIR was submitted to DES and was approved with conditions on 2 August 2022. This report includes results from updated 2021 Bowen groundwater model and 2024 Annual Review of 2022 Bowen UWIR.

A copy of the 2024 Annual Review of 2022 Bowen UWIR can be found on Arrow Energy's website at

https://www.arrowenergy.com.au/environment/groundwater/water-monitoring-management-plans.

6 CONCLUSION

- Seven (7) production wells have been installed as heel intersects wells on multi-branch laterals, less than the 1408 authorised operational wells for Stage 1 of the BGP. The seven production wells were installed in 2019 in the Red Hill Central Petroleum Lease (within PL486).

- There is no apparent influence of CSG production to the Tertiary Sediment, Fort Cooper Coal Measures (FCCM) and Rewan aquifers in the installed monitoring network for the BGP.

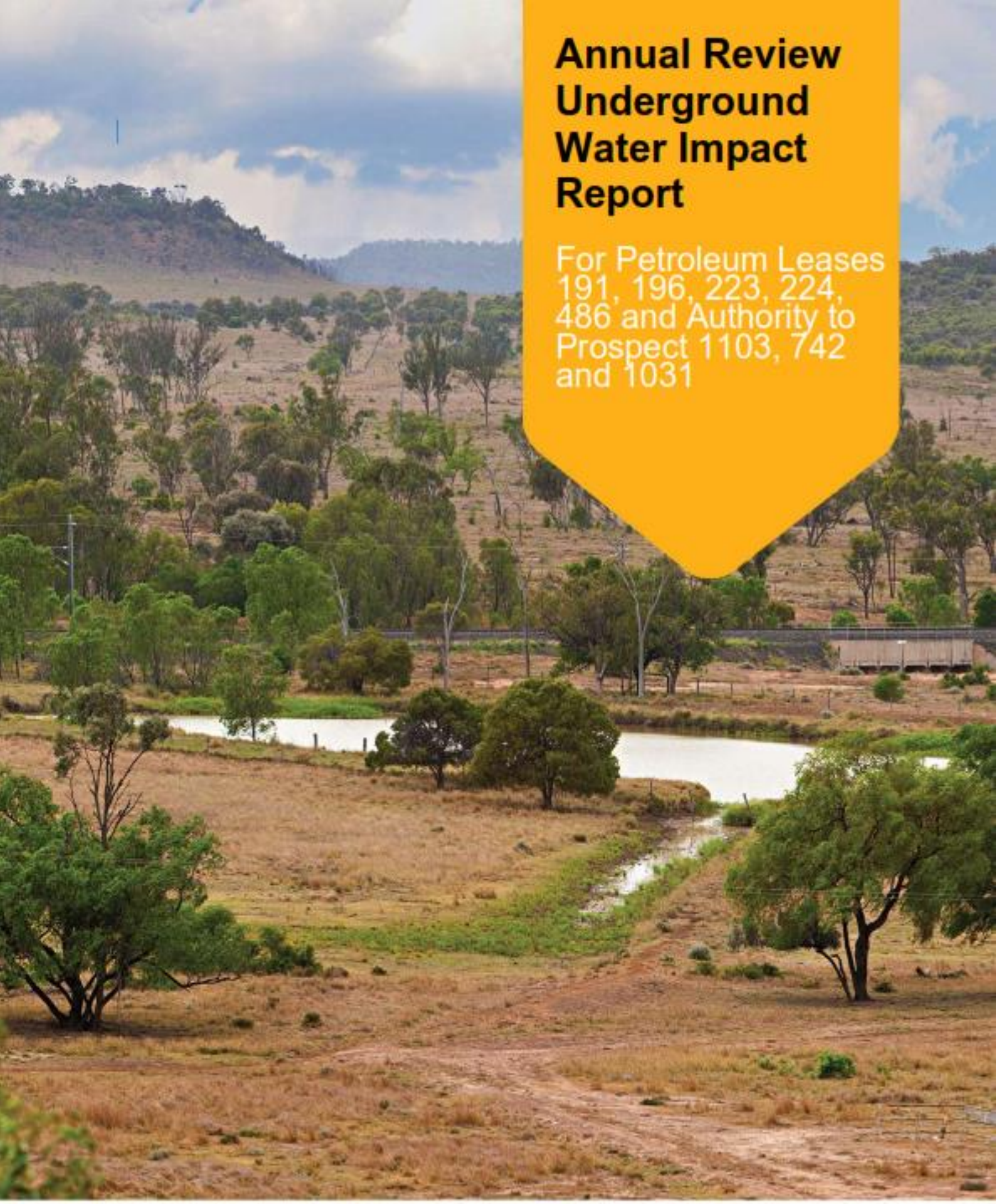
- A review of the groundwater quality data indicates that there are no notable trends for both the shallow and deep aquifers.

- Production from Red Hill Central Petroleum Lease (within PL486) commenced in 2022.

- No non-compliances were recorded for the BGP GMMP bores and therefore no remedial actions were undertaken.

- All monitoring obligations have been met and no exceedances under the GMMP early warning system (EWS) recorded across the monitoring network. However, for the MGP monitoring bores which supplement the BGP GMMP monitoring network, data loss due to hardware issues was experienced at some of these bores and sampling was not conducted due to equipment issues or access due to weather as follows:
    - M162V groundwater water level was monitored but was not sampled due to equipment issues;
    - M340W groundwater water level and groundwater quality were not monitored as the bore was dry;
    - M230W was not monitored as it has been decommissioned and replaced by the groundwater monitoring bore M300W; and
    - AN020F groundwater water level was not monitored and sampled as it was not accessible due to wet weather.
- 2024 Annual Review of 2022 Bowen UWIR was completed. The 2022 Bowen UWIR was submitted to the Department of Environment and Science (DES) and was approved with conditions on 2 August 2022. This report includes results from updated 2021 Bowen groundwater model and 2024 Annual Review of 2022 Bowen UWIR.
- No out of cycle Underground Water Impact Report (UWIR) was submitted. The 2024 Annual Review of the 2022 Bowen UWIR, submitted to DES on 17 April 2024, concluded that given the updated water production forecast for the BGP is less than what was modelled in the 2022 UWIR, the predicted impacts are expected to be less than originally modelled, and an update of the of the 2022 UWIR is not proposed.

APPENDIX A: 2024 Annual Review of the Bowen UWIR



Annual Review Underground Water Impact Report

For Petroleum Leases 191, 196, 223, 224, 486 and Authority to Prospect 1103, 742 and 1031

QPM ENERGY

arrow energy
go further

April 2024

REVISION HISTORY

Revision	Revision Date	Revision Summary
0	April 2024	Final report for release

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

EXECUTIVE SUMMARY

The 2022 Bowen Underground Water Impact Report (2022 Bowen UWIR) for Authority to Prospect (ATP) 1103, 1031, 742 and Petroleum Leases (PL) 191, 196, 223, 224 and 486 was approved with conditions by the Department of Environment and Science (DES) on 2 August 2022. The 2022 Bowen UWIR included tenures for Arrow Energy's then domestic gas project in the Bowen Basin, referred to as the Moranbah Gas Project (MGP), and an expansion project referred to as the Bowen Gas Project (BGP).

MGP (tenures PL191, 196, 223 and 224) has been entirely acquired by QPM Energy (MPG Upstream) Pty Ltd (QPM) from Arrow CSG (ATP364) Pty Ltd, CH4 Pty Ltd and AGL Energy Limited effective 20 September 2023, becoming the holder of the resource tenure and the responsible tenure holder for the 2022 Bowen UWIR make good and report obligations for these tenures. Arrow Energy continues to operate the BGP project (tenures PL486 and ATP1103, 1031, 742 held variably by CH4 Pty Ltd, Arrow CSG (ATP 364) Pty Ltd, AGL Energy Limited and Bow CSG Pty Ltd). However, for the sake of consistency this review report comprises both MGP and BGP projects. Where practical, the results and analysis of the data contained in this report has been separated into each project (MGP and BGP).

This review has been undertaken in line with the *Water Act (2000)* and conditions received for the 2022 Bowen UWIR approval in relation to the annual review.

This review includes:

- A review of the accuracy of the IAA and LAA maps;
- A description of how the Water Monitoring Strategy (WMS) has been implemented within the period of the annual review and that this update will be provided to the Office of Groundwater Impact Assessment (OGIA);
- Any new hydrogeological data that significantly alters the conceptual model;
- Whether new production testing or production has been undertaken or is planned; and
- Whether the predictions made in Section 8 have materially changed.

Key findings of the 2024 annual review for the MGP tenures consisting of PLs 191, 196, 223 and 224 are:

- Based on the observed water produced since the 2022 Bowen UWIR, there has been 38.8 ML less water produced than was forecasted in the 2022 UWIR;
- The updated water production forecast is 1% less than the modelled water production to the end of 2023;
- Given the updated water production forecast is less than what was modelled in the 2022 UWIR, the predicted impacts are expected to be less than originally modelled, an update of the of the 2022 UWIR is not proposed. Accordingly, a material change to the Immediately Impacted Area (IAA) or the Long-Term Affected Area (LAA) is not expected.
- The maps prepared under s.376(1)(b)(iv) and (v) do not require updating as there has not been a material change in the information or predictions used to prepare the maps.

Key findings of the 2024 annual review for the BGP tenures consisting of ATPs 1103, 1031, 742 and PL486 are:

- For PL486, a combined water production of 42.5 ML was produced over 2022 and 2023 compared to a modelled 75.6 ML for the same period in the 2022 Bowen UWIR. The updated water production is forecasted to be 56.7% less than modelled water production for 2024. As a result, there is no material change in the information or predictions made in the 2022 Bowen UWIR. Based on this, no change is proposed to the modelling undertaken for the 2022 Bowen UWIR;
- Three production testing wells in ATP 1103 were active in 2020 (RH098A, RH099A and RH100A), with a combined water production of 5.3 ML since the 2022 Bowen UWIR, with no further production occurring during this reporting period. This amount of water produced is below the Peak Downs reference pilot site, therefore, any IAA or LAA arising from production testing wells prior to this reporting period will be smaller than that associated with the reference pilot site.
- No landholder bores are located within the 1-kilometre IAA radius from any production testing wells. Given the updated water production forecast is less than what was modelled in the 2022 UWIR, the predicted impacts are expected to be less than originally modelled, and an update of the of the 2022 UWIR is not proposed.
- The maps prepared under s.376(1)(b)(iv) and (v) do not require updating as there has not been a material change in the information or predictions used to prepare the maps.[1]

[1] For Authority to Prospect tenures (ATP), the LAA is taken to be the same as the IAA until such time as a PL is granted and production commences.

Based on the above, the predictions made in the 2022 UWIR have not materially changed. The next UWIR is due to be provided to DES on 4 April 2025, unless agreed otherwise with the regulator.

1 INTRODUCTION

The 2022 Bowen Underground Water Impact Report (2022 Bowen UWIR) for Authority to Prospect (ATP) 1103, 1031, 742 and Petroleum Leases (PL) 191, 196, 223, 224 and 486 was approved with conditions by the Department of Environment and Science (DES) on 2 August 2022. The 2022 Bowen UWIR included tenures for Arrow Energy's operation of the then domestic gas project in the Bowen Basin, referred to as the Moranbah Gas Project (MGP), and an expansion project referred to as the Bowen Gas Project (BGP).

MGP (tenures PL191, 196, 223 and 224) has been entirely acquired by QPM Energy (MPG Upstream) Pty Ltd (QPM) from Arrow CSG (ATP364) Pty Ltd, CH4 Pty Ltd and AGL Energy Limited effective 20 September 2023, becoming the holder of the resource tenure and the responsible tenure holder for the 2022 Bowen UWIR make good and report obligations for these tenures. Arrow Energy continues to operate the BGP project (tenures PL486 and ATP1103, 1031, 742 held variably by CH4 Pty Ltd, Arrow CSG (ATP 364) Pty Ltd, AGL Energy Limited and Bow CSG Pty Ltd). However, for the sake of consistency this review report comprises both MGP and BGP projects.

This report forms the second annual review (2024 annual review) of the 2022 Bowen UWIR. Where practical, the results and analysis of the data contained in this review report has been separated into each project (MGP and BGP). The spatial distribution of these projects is shown in Figure 1.

As is required in Chapter 3, s376 (e) of the *Water Act (Qld) 2000*, the 2022 Bowen UWIR includes a program for:

i. Conducting an annual review of the accuracy of each map prepared under paragraph (b)(iv) and (v); and
ii. Giving the chief executive a summary of the outcome of each review, including a statement of whether there has been a material change in the information or predictions used to prepare the maps.

This report satisfies the requirements for the annual review outlined in the:

- *Water Act 2000* (Water Act),
- 2022 Bowen UWIR annual review commitments, and
- 2022 Bowen UWIR approval conditions.

In addressing the annual review requirements, Arrow Energy and QPM have considered the following:

- A review of the accuracy of the IAA and LAA maps,
- A description of how the Water Monitoring Strategy (WMS) has been implemented within the period of the annual review and that this update will be provided to the OGIA,
- Any new hydrogeological data that significantly alters the conceptual model,
- Whether new production testing or production has been undertaken or is planned, and
- Whether the predictions made in Section 8 have materially changed.

A copy of this report will be provided to the Office of Groundwater Impact Assessment (OGIA).

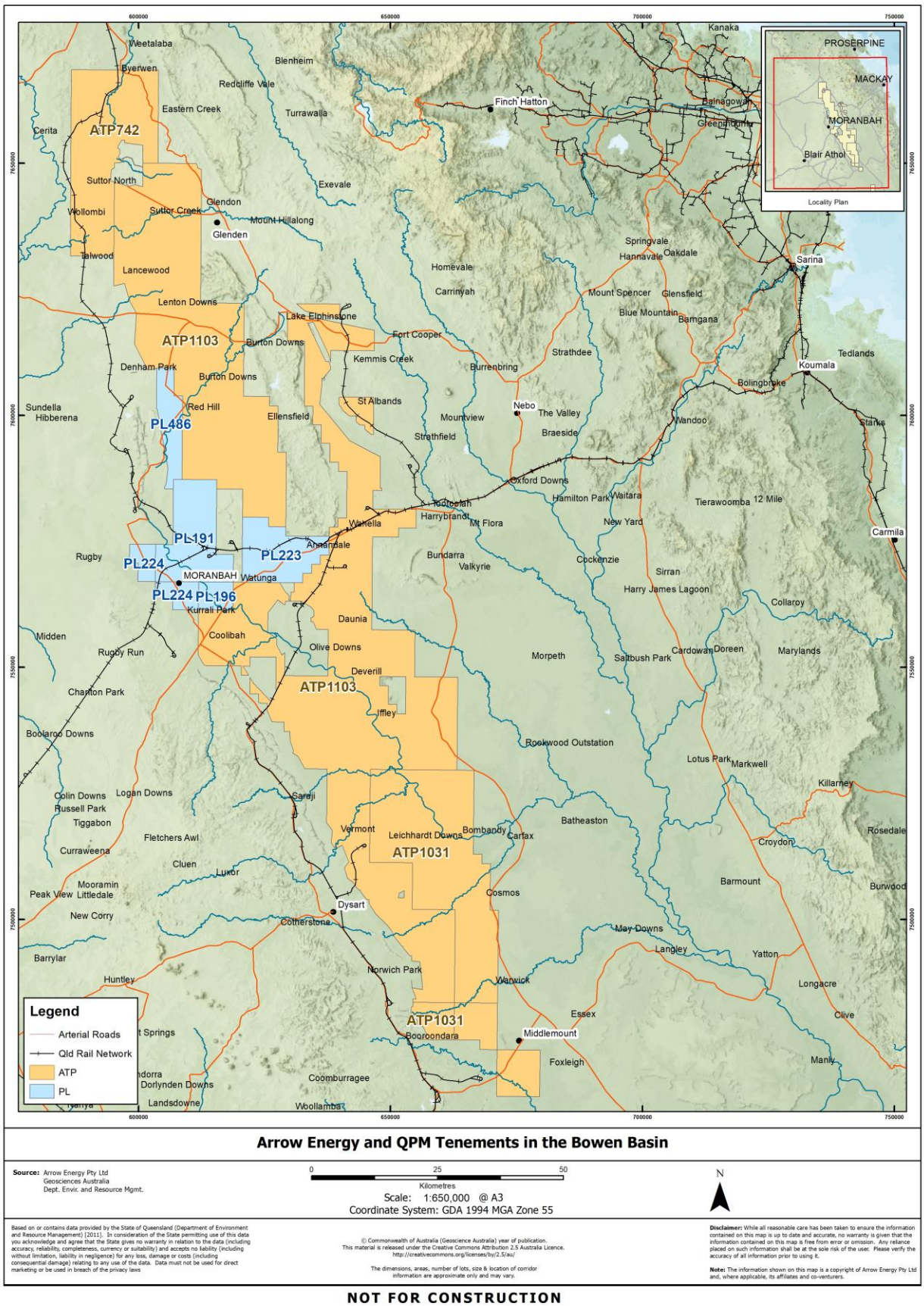


Figure 1: Location of ATP 1103, 1031, 742, 832 and PL 191, 196, 223, 224 and 486

2 WATER PRODUCTION REVIEW

A review of actual water production and forecast water production is presented in this section of this report for the MGP and BGP projects.

Review of water production from the ATP's and PL's is based on the following:

- 2022 Bowen UWIR data capture period from 1 January 2003 to 31 December 2021;
- 2022 Bowen UWIR water production forecast period from 1 January 2022 to 31 December 2026;
- 2024 Annual review data capture period from 1 January 2023 to 31 December 2023; and
- 2024 Annual review water production forecast period from 1 Jan 2024 to 31 December 2026.

Historical data from the Peak Downs (PD) production testing site on ATP 1103 (comprising production testing wells PD120V, PD122V, PD130V, and PD131V) was used as a reference pilot site to estimate the IAA for future production testing sites, specifically any new sites which commenced during the annual review period. Arrow Energy has done this because the BGP is a phased expansion of production; therefore, only limited production testing has previously occurred and as a result only limited hydrogeological data exists for predicting impacts.

The annual review uses the following assessment approach outlined in the 2022 Bowen UWIR:

- Water produced at Peak Downs (part of ATP 1103 production testing site between 2013 and 2015) was 26.7 ML which resulted in an Immediately Affected Area (PD IAA) in the 2022 Bowen UWIR which extended approximately 1 km from the wells. This is termed the reference pilot site;
- Actual water production from any subsequent production testing site in the annual review data capture period was compared to that produced at the reference pilot site;
- If water produced at the production testing sites in the annual review data capture period was equal to or less than the reference pilot site, then it was concluded that any resultant Immediately Affected Area (IAA) would be equal to or less than the reference pilot site; and
- If water production in the production testing well in the annual review data capture period was greater than PD IAA site, then a review of the 1m drawdown contour was undertaken to identify any existing or abandoned but useable landholder water supply bores.

2.1 Moranbah Gas Project

Table 1 and Table 2 below provide a comparison of observed and forecasted water production in the 2022 Bowen UWIR, and the updated observed water production for the 2024 annual review data capture period. It should be noted that whilst PLs 191, 196, 223 and 224 make up the Moranbah Gas Project (MGP), production has only been undertaken on PLs 191, 196 and 224. Table 1 shows the observed water production for 1 January 2003 to 31 December 2023 and the comparison of observed to forecasted production for the 2022 annual review data capture period.

Based on the observed water produced since the 2022 Bowen UWIR, there has been 38.8 ML less water produced than was forecasted in the 2022 Bowen UWIR.

Table 1: MGP Water Production

Report	Water Production (ML) 1 Jan 2003 - 31 Dec 2018	Water Production (ML) 1 Jan 2019 - 31 Dec 2021	Water Production (ML) 1 Jan 2022 - 31 Dec 2022	Water Production (ML) 1 Jan 2023 - 31 Dec 2023	Total Water Production (ML) 1 Jan 2003 - 31 Dec 2023	Difference
2022 Bowen UWIR	5334.7	563.9	181.1*	179.3*	6259.0*	N/A -
2024 Annual Review	5334.7	563.9	161.7	159.9	6220.2	38.8 ML less (<1%)

* denotes forecast production in the 2022 Bowen UWIR

Table 2 below shows the updated water production forecast for 2024 to 2026. The forecast has been updated based on new data and a better understanding of the reservoir (obtained through drilling, testing and water production analysis). The updated forecast is less than that what was outlined in the 2022 Bowen UWIR.

Table 2: Forecast Water Production PL 191, 196, and 224

Year	2022 Bowen UWIR	2024 Annual Review	Difference
	Forecast Water Production (ML)	Forecast Water Production (ML)	
2024	161.5	159.9	1.6 ML less than the 2022 Bowen UWIR (1% less)
2025	154.0	154.0	N/A
2026	148.6	148.6	N/A
Total	464.1	462.5	1.6 ML less than the 2022 Bowen UWIR (0.3% less)

2.1.1 Predicted Impacts

The impacts predicted in the 2022 Bowen UWIR define the IAA as occurring in the Moranbah Coal Measures and Rangal Coal Measures as shown in Figure 2 and Figure 3 for the MGP area. The IAA is a prediction of water level decline where the drawdown is expected to exceed the bore trigger threshold of 5 metres drawdown for a 3-year period which commenced in January 2019. The LAA is a prediction of water level decline where the drawdown is expected to exceed the bore trigger threshold at any time (i.e. greater than the 3-year period).

Based on this, the prediction of the IAA is influenced by the water production from 2003 to 2022. As indicated in Table 1, the actual water production for the 2024 annual review data capture period is 38.8 ML less than the modelled water production in the 2022 Bowen UWIR. The updated water production forecast presented in Table 2 is 1% less than the modelled water production to the end of 2024. This reduction in water production is due to updated reservoir information (obtained through drilling, testing and water production analysis) and changes in the field development plan (FDP) of the MGP.

It is expected that the modelled IAA and LAA in the 2022 Bowen UWIR overestimate impacts likely to occur. This is due to the actual water production and updated water production forecast in this annual review being less than the forecast in the 2022 Bowen UWIR (i.e. less water has been and is now forecasted to be produced and therefore impacts are expected to be less).

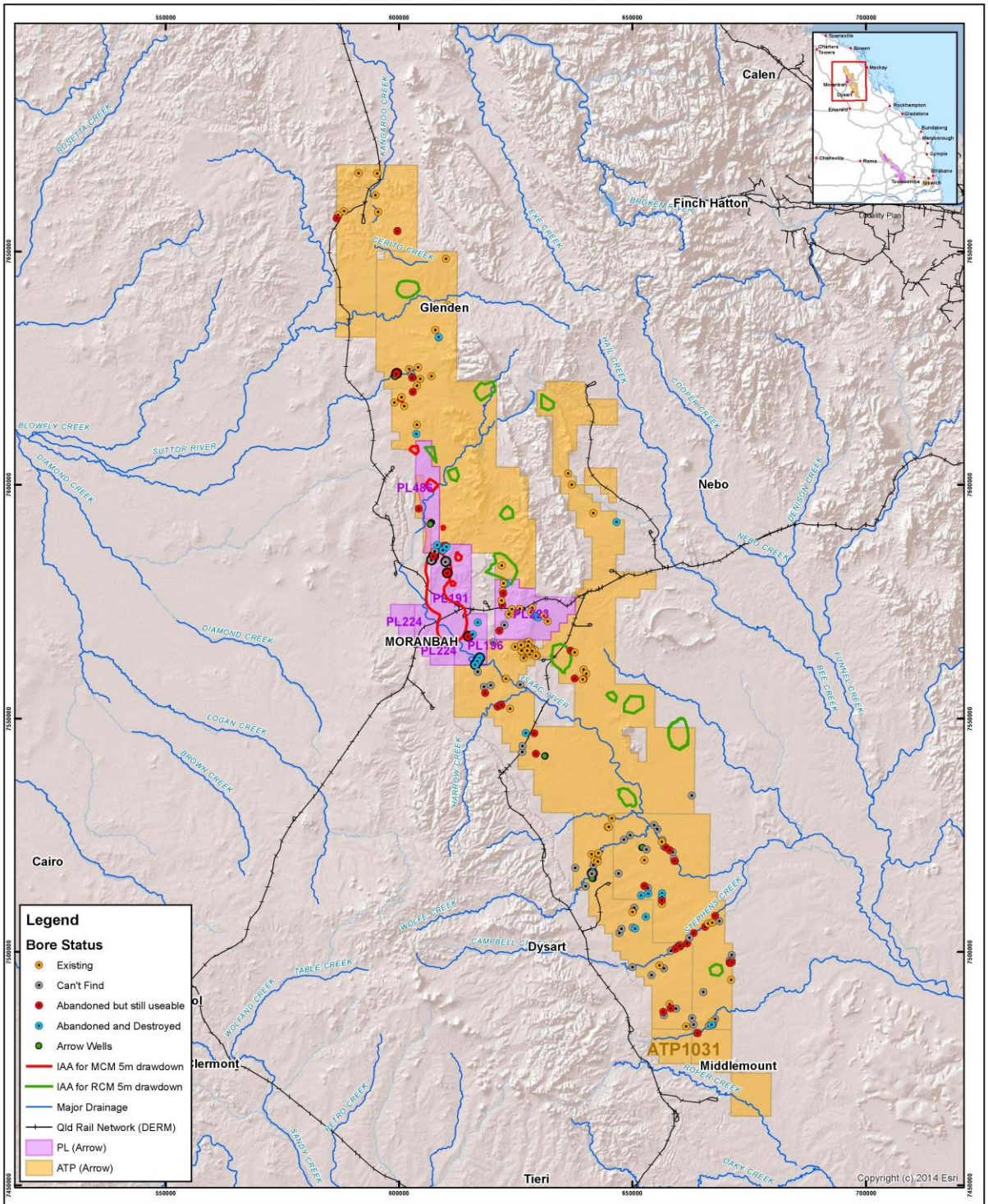


Figure 2: Extent of the IAA as per the 2022 UWIR

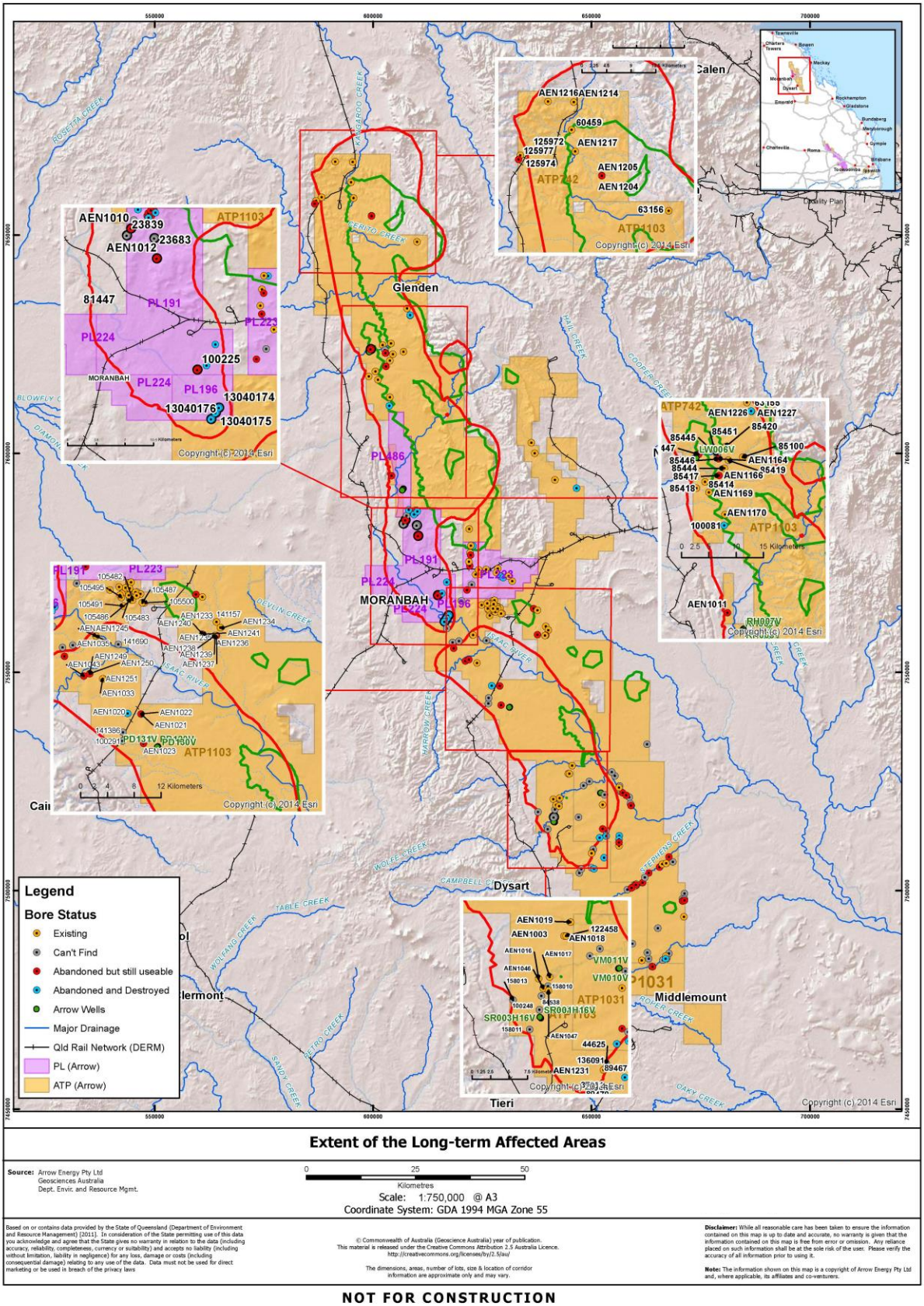


Figure 3: Extent of the LAA as per the 2022 UWIR

2.2 Bowen Gas Project

The Arrow Energy Bowen Gas Project (BGP) was approved by the Queensland Government on 8 September 2014 and the Commonwealth on 27 October 2014. Arrow Energy's BGP involves a phased expansion of Arrow Energy's Bowen Basin tenures. It comprises an update of development plans in the same general areas (i.e. within tenements ATP742, ATP1103, and ATP1031) from those presented in the Supplementary Report to the Environmental Impact Statement (SREIS) with the addition of development in Mavis Downs (also located within ATP1103).

The Field Development Plan (FDP) as outlined in the 2022 Bowen UWIR was as follows:

- Red Hill Central (within PL486) to commence in 2022;
- The remainder of the field development plan (FDP) area presented in the 2016 Bowen UWIR (ATP1103, ATP742 and ATP1031) commencing 2030.

Figure 2 and Figure 3 display the IAA and LAA for the MGP and BGP projects.

2.2.1 ATP 1103

ATP 1103 is a large exploration tenure located in the North, East and South of the BGP. A total of 5.3 ML of water was produced as part of production testing on ATP 1103 since the 2022 Bowen UWIR. This water volume is from production testing wells (RH098A, RH099A and RH100A) on what was ATP 1103, which has now been converted to PL486 (Red Hill Central). Production from these wells occurred from 2018 through to August 2022, with no further production test since that time.

2.2.1.1 Predicted Impacts

A total of 18.27 ML of water has been produced from production testing pilots from ATP1103 as described in the 2023 annual report, with no further production occurring during this reporting period. This amount of produced water is below the volume produced from the reference pilot site in 2013 to 2015. A 1-kilometre IAA radius consistent with the methodology outlined in the 2022 Bowen UWIR showed that no landholder bores are located in proximity to the testing.

Based on the limited production, no change is proposed to the modelling undertaken for the 2022 Bowen UWIR. Therefore, the maps in Figure 2 and Figure 3 do not require updating.

2.2.2 PL 486

PL 486, which incorporates the Red Hill Central (RHC) development, is located approximately 30 km north of the township of Moranbah and borders the MGP area to the South. Water production from PL 486 is currently forecast to occur from 2022 to 2026. The water production profile used in the 2022 Bowen UWIR indicated a total of 13.1 ML of water to be produced from 2024 to 2026, with 11.8 ML of water to be produced in 2023 (refer to Table 3).

Production from PL 486 commenced in June 2022, with the delay in commencement of production extending the peak water production. A total of 6 ML has been forecasted to be produced in 2024. As noted in Section 2.2.1, production testing commenced in ATP 1103 prior to PL486 being granted. Therefore, the water volumes for the production testing (from wells RH098A, RH099A and RH100A) are included in ATP 1103 water volumes. That production testing does not form part of PL 486.

Table 3 below shows the current water production forecast for 2024 to 2026. Based on the observed water produced since the 2022 Bowen UWIR and the updated forecast used for the 2024 Annual Review, 9 ML less water is now forecasted to be produced for the period from 2024 to 2026. This reduction in forecasted water production is due to updated reservoir information (e.g. water production analysis) and an improved forecast for PL 486.

Table 3: Actual and Forecast Water Production PL486

Year	2022 Bowen UWIR Forecast Water Production (ML)	2024 Annual Review Actual and Forecast Water Production (ML)	Difference
2022	63.8	18.4	45.4ML less than forecast (71.2% less)
2023	11.8	24.1	12.3ML more than forecast (104% more)
2024	6	2.6	3.4 ML less than current forecast (56.7% less)
2025	4	1.3	2.7 ML less than current forecast
2026	3.1	0.2	2.9 ML less than current forecast
Total	88.7	46.6	42.1 ML less than the 2022 Bowen UWIR (47.5% less)

2.2.2.1 Predicted Impacts

Water production for the 2024 annual review data capture period was 24.1 ML, with 9 ML less water now forecasted to be produced for the period from 2024 to 2026 cumulatively, and a total of 42.1 ML less water expected to be produced over the period of 2022 to 2026. As a result, there is no material change2 in the information or predictions made in the 2022 Bowen UWIR. Based on this, no change is proposed to the modelling undertaken for the 2022 Bowen UWIR. Therefore, the maps in Figure 2 and Figure 3 do not require updating.

2.2.3 ATP 1031

ATP 1031 lies approximately 100 km to the south of Moranbah. A total of 0 ML of water has been produced as part of production testing on ATP 1031 for the annual review data capture period.

2.2.3.1 Predicted Impacts

No further production testing has been undertaken in any wells on ATP 1031 since the UWIR and therefore there is no material change in the information or predictions made in the 2022 Bowen UWIR. Based on this, no change is proposed to the modelling undertaken for the 2022 Bowen UWIR. Therefore, the maps in Figure 2 and Figure 3 do not require updating.

2.2.4 ATP 742

ATP 742 is located approximately 50 kilometres north of Moranbah. A total of 0 ML of water has been produced as part of production testing on ATP 742 for the 2024 annual review data capture period.

2.2.4.1 Predicted Impacts

No further production testing has been undertaken in any wells on ATP 742 since the UWIR and therefore there is no material change in the information or predictions made in the 2022 Bowen UWIR. Based on this, no change is proposed to the modelling undertaken for the 2022 Bowen UWIR. Therefore, the maps in Figure 2 and Figure 3 do not require updating.

[2] Arrow defines a material change as only occurring if water production increases above the original forecast used in the 2022 UWIR.

3 WATER MONITORING STRATEGY (WMS)

A water monitoring strategy was prepared as part of the 2022 Bowen UWIR. The strategy proposed the installation and monitoring of a total of 43 groundwater monitoring bores. The installation of 16 of these groundwater monitoring bores, located on PLs 191, 196, 223 and 224, has been completed and groundwater monitoring has been ongoing within the bores. Monitoring bores as a part of the larger BGP have been installed, with remaining monitoring bores to be added as the project increases in area.

3.1 MGP Area Groundwater Monitoring Network

A total of 16 groundwater monitoring bores forms the groundwater monitoring network for the MGP Area. Figure 4 provides an overview of the spatial distribution of the groundwater monitoring network. Groundwater monitoring is being undertaken in these bores in accordance with the WMS in the approved 2022 Bowen UWIR.

As discussed in Section 4.3 and the 2022 UWIR, drawdown observed in monitoring bore M162V has resulted in water level dropping below the pump intake and as a result water sampling could not be undertaken. In spite of this, groundwater water level of this bore has been monitored since December 2015. Sampling has been undertaken at production well M134GMV, located approximately 480 m north of M162V, from 2018 to 2020 but the water level has dropped below the pump intake in November 2021 and therefore has not been sampled since then. The well has been completed to approximately the same depth as M162V and intersects the MCM seam. A replacement production well, GM031V, located 1.4 km south of M162V was therefore selected to be used for sampling until water levels recover in M162V.

Data loss due to hardware issues was experienced at some of these bores and sampling was not conducted due to equipment issues or access due to weather. More specifically, during this Annual Review period (from 1 January 2023 to 31 December 2023), M162V groundwater water level was monitored but was not sampled due to equipment issues. M340W groundwater water level and groundwater quality were not monitored as the bore was dry. M230W was not monitored as it has been decommissioned and replaced by the groundwater monitoring bore M300W. Finally, AN020F groundwater water level was not monitored and sampled as it was not accessible due to wet weather.

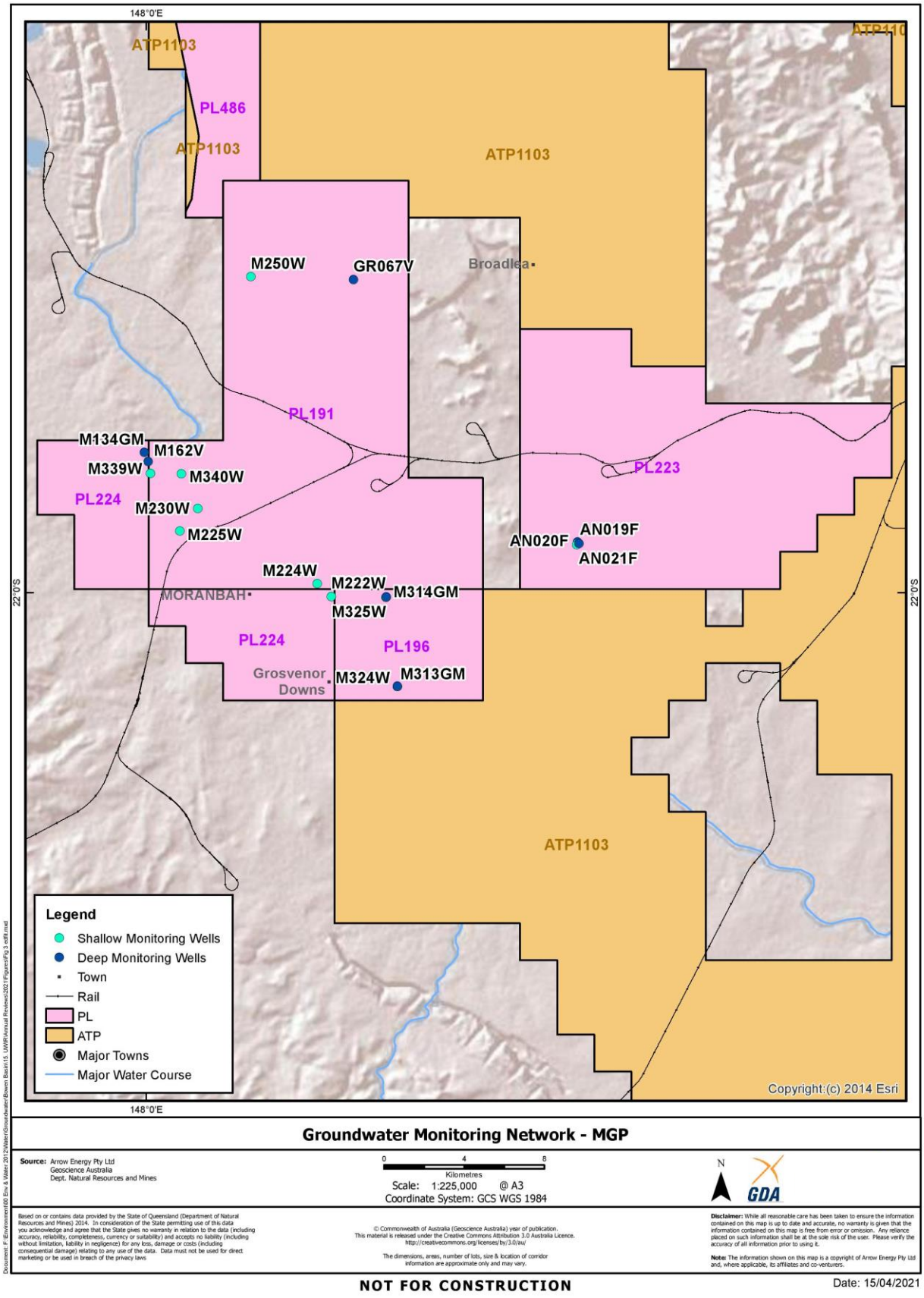


Figure 4: Groundwater Monitoring Network for MGP

3.2 BGP Area Groundwater Monitoring Network

The network is comprised of 35 monitoring intervals at 22 separate locations (comprising 12 single sites and 10 nested sites of 23 monitoring intervals) from the approved groundwater monitoring network for the BGP area. Figure 5 provides an overview of the spatial distribution of the groundwater monitoring network. Table 4 below displays the monitoring requirements of the BGP, along with the status of each location. Note that Table 4 displays the monitoring location name as per the 2019 Bowen Groundwater Monitoring and Management Plan (GMMP) which was approved by the Commonwealth Department of the Environment and Energy on 24 October 2019. All subsequent reporting is based on this nomenclature.

The network includes phased installation of the monitoring bores in advance of CSG development in the vicinity of the bores as detailed in Section 4.1.1.2 of the 2022 UWIR. At present, 9 monitoring points have been installed at seven locations as part of the monitoring network; MB1-S/I/D, MB2, MB3, MB12, GW004, GW007 and AEN1063 as detailed below. Bore locations for the remaining supplementary monitoring bores have been visited and assessed as suitable for long term monitoring and are awaiting execution of agreements with the landholders before logging equipment is installed. These bores are currently visited for manual water level monitoring every six months.

MB1-S/I/D

MB1 was originally installed as an appraisal (pilot) production well (originally named Red Hill-30) in January 2010. Groundwater level observations were made from the Moranbah Coal Measures (i.e. the deep interval) using the well from November 2011 to December 2011. Pumping from the well (for the pilot) was also undertaken during this time.

Pilot operation (and monitoring) ceased between December 2011 and November 2012.

The well was again monitored from 30 November 2012. The water level in Red Hill-30 had recovered to within 92% of its original baseline level prior to pumping for the pilot recommencing in December 2012.

From December 2012, the pilot was again operated (including production from Red Hill-30). Production from Red Hill-30 and the other pilot well in the pilot ceased in May and April 2013 respectively. Monitoring in Red Hill-30 continued until it was suspended in September 2013.

In October 2019, MB1 was modified by installation of a multi-level monitoring system to enable additional monitoring from the intermediate and shallow intervals to take place. Drilling information for MB1 identified sufficient Quaternary / Tertiary Sediment or Rangal Coal Measures were not encountered at this location, and the shallow and intermediate monitoring points are therefore located within the Fort Cooper Coal Measures. Groundwater level data has been collected from all three intervals in MB1 since 11 November 2019. During this Annual Review period, groundwater level data was recorded from 1 January 2023 to 31 December 2023.

MB2

MB2 was originally installed as an appraisal (pilot) production well (originally named Red Hill-60) in January 2011. Pumping (intermittently) from the well for the pilot was undertaken between 2012 and 2018. Groundwater level observations were made from the Moranbah Coal Measures using the well from September to October 2015 (1.5 months) and October 2017 to May 2018 (8 months). The well was converted to a permanent monitoring well using the existing downhole pressure gauge in February 2019 with twice daily groundwater level observations collected from February 2019 to October 2019 (7 months) followed by a period of data loss between October 2019 to January 2020. This data loss affected MB2 and MB3 due to the installed telemetry system not sending data to Arrow Energy's server. An investigation on why this occurred identified that the route cause was human error. Following this, routine manual checking of the reporting status of the telemetry system was implemented. Additionally, an automatic alert system was then implemented in January 2021 that alerts Arrow Energy personnel when telemetry data loss is found on monitoring locations and the telemetry system can be restarted to allow continuous logging.

Additional data loss due to hardware issues was observed between 14 July 2022 and 14 August 2022, but groundwater level monitoring was resumed afterwards and during this Annual Review period, from 1 January 2023 to 31 December 2023.

MB3

MB3 was originally installed as an appraisal (pilot) production well (originally named Red Hill-51) in November 2011. Groundwater observations were made from the Moranbah Coal Measures using the well from September 2013 to May 2014 (9 months), October 2017 to May 2018 (7 months), and February 2019 to October 2019 (7 months, with data loss affecting this site until January 2020, as for MB2). Following reinstatement of the telemetry system, it was identified that the downhole pressure gauge failed during the period of data loss. An adjacent appraisal (pilot) production well (originally named Red Hill-

50) was then converted to a monitoring well in September 2020 to fulfil monitoring requirements for MB3. Additional data loss was observed from 1 January 2022 to 13 February 2022 due to skid communication issues. During this Annual Review period, groundwater level data was recorded from 1 January 2023 to 31 December 2023.

MB12

MB12 was installed as a mine monitoring bore (originally named EFGW5D) by Fitzroy Mining in June 2008. Groundwater level observations were made from the Rewan Formation through both manual water level measurements and hourly data logger measurements since January and July (respectively) 2018. A data logger was installed in the monitoring bore in July 2018 which is still in operation.

Supplementary monitoring bores

These monitoring locations comprise existing third-party monitoring bores and landholder bores and are included in the monitoring network.

GW004 and GW007

GW001, GW004 and GW007 were installed as mine monitoring bores by BHP Mitsubishi Alliance (BMA) in 2011. Arrow Energy commenced monitoring of GW001 and GW007 in November 2019.

GW004 was chosen as a replacement for GW001 from November 2020 due to poor data and logger reliabilities associated with the vibrating wire piezometers installed in GW001 which failed in March 2020. A logger was deployed in GW004 during the November 2020 sampling round. During this Annual Review period, GW004 and GW007 groundwater level data has been recorded from 1 January 2023 to 31 December 2023.

AEN1063

A logger was deployed in AEN1063 during the November 2020 sampling round after an access and monitoring agreement was completed with the landholder. The location of this bore is on the same property and same formation (Blackwater Group) as the monitoring point AEN1036, proposed in the GMMP. AEN1063 was chosen for monitoring after assessment of the bores on the property, with this bore being the most suitable for long term monitoring. Groundwater level has been monitored for this bore from 1 January 2023 to 31 December 2023 during this Annual Review period.

AEN1214

AEN1214 is a private water bore owned by a landholder. With a total constructed depth of 37.3m, it was installed in Rangal Coal Measures and monitored since November 2020. Manual measurements recorded every 6-months. No readings were recorded for Q2 2022 due to the landholder denying access to the property. Arrow is currently awaiting an access and monitoring agreement to be signed by the landholder for deployment of a logger.

AEN1234

Similar to AEN 1214, AEN1234 is a private water bore owned by a landholder. AEN 1234, with a total constructed depth of 102m, was installed in Blackwater Group and monitored since November 2020. Manual measurements recorded every 6-months. Arrow is currently awaiting an access and monitoring agreement to be signed by the landholder for deployment of a logger.

Table 4: BGP monitoring network

Monitoring location	Monitoring interval and target formation	Development area	Status/Indicative year of installation	Status
MB1	S – Quaternary / Tertiary I – RCM D – MCM	PL486	Current	Currently on monitoring. Groundwater level monitoring was required twice daily until 11/11/2020, which has been achieved. Going forward, a minimum of 6-monthly water level measurements are required for remainder of CSG production. Water quality sampling was required from MB1-D at biannual frequency for the first year, which has been achieved. Going forward annual monitoring is required.
MB2	MCM		Current	Currently on monitoring. Groundwater level monitoring was required twice daily until 31/10/2020, which has been achieved. Going forward, a minimum of 6-monthly water level measurements are required for remainder of CSG production. Online date is 16 February 2019 however data was lost between 30 October 2019 and 9 January 2020.
MB3	MCM		Current	Currently on monitoring. Groundwater level monitoring was required twice daily until 31/10/2020, which has been achieved. Going forward, a minimum of 6-monthly water level measurements are required for remainder of CSG production. Online date is 16 February 2019 however data was lost between 30 October 2019 and 9 January 2020, and 1 January 2022 to 13 February 2022.
MB4	Unconfined alluvium		Contingent	Not currently required as criteria not yet triggered. Requirement for installation is based on (modelled) increased risk of depressurisation resulting from changes in the FDP, or MB1 groundwater level monitoring data indicate interconnectivity of MCM with overlying units.
MB5	Tertiary / Triassic	ATP1103	2020	Not currently required due to no development within 10km.
MB6	Quaternary / Tertiary	ATP742	Contingent	Not currently required as criteria not yet triggered. Requirement for installation is based on (modelled) increased risk of depressurisation resulting from changes in the FDP, or monitoring of other sites in the northern development area indicate the potential or likelihood of preferential groundwater flow occurring across formations by way of geological faults.
MB7	S – Tertiary D – RCM	ATP742	2029	Not currently required due to no development within 10km.
MB8	Quaternary / Tertiary	ATP742	2030	Not currently required due to no development within 10km.
MB9	S – Quaternary / Tertiary I – RCM D – MCM / FCCM	ATP1103	2029	Not currently required due to no development within 10km.
MB10	Tertiary	ATP1103	2030	Requires installation immediately prior to commencement of pumping from Wards Well pilot wells.
MB11	S – Quaternary / Tertiary or Rewan Formation D – RCM	ATP1103	2029	Not currently required due to no development within 10km.
MB12	Quaternary / Tertiary	ATP1103	Current	Existing Fitzroy Mining monitoring bore (EFGW5D) being utilised to obtain groundwater level monitoring data in place of MB12. EFGW5D is located approximately 345m from the proposed location for MB12. Monitoring commenced in July 2018. Groundwater level monitoring will include 6-monthly water level measurements for remainder of CSG production.
MB13	S – Quaternary / Tertiary (if present) D – Blackwater Group (RCM / FCCM / MCM)	ATP1103 ATP1103	Contingent - 2028	MB13S not currently required due to no development within 10km. Requirement for installation of MB13D is based on monitoring of MB13-S and/or other monitoring points in the southern development area indicates the potential or likelihood of preferential groundwater flow occurring across formations by way of geological faults, or ongoing modelling or revised development indicates a greater risk of depressurisation impact at this location.
MB14	S – Quaternary / Tertiary I – RCM D – MCM / RCCM	ATP1103 ATP1103 ATP1103	2029	Not currently required due to no development within 10km.
MB15	S – Unconfined alluvium I – Tertiary / Triassic	ATP1103 ATP1103	2029	Not currently required due to no development within 10km.
MB16	Tertiary	ATP1103	2029	Not currently required due to no development within 10km.
MB17	S – Unconfined alluvium I – Rewan Formation	ATP 1103 (in proximity to Lake Elphinstone)	Contingent	Not currently required as criteria not yet triggered. Requirement for installation is based on if revised modelling indicates a risk of depressurisation impacts to Lake Elphinstone, or if impacts are detected at MB11-S.
Supplementary monitoring bores				
AEN1214	Rangal Coal Measures	ATP742	Current	Manual measurements recorded every 6-months. Awaiting access and monitoring agreement for deployment of logger. No readings were recorded for Q2 2022 due to the landholder denying access to the property.
AEN1063	Blackwater Group	ATP1031	Current	On monitoring as of November 2020. Suitable replacement for proposed AEN1036 as on same property and drilled to the same formation.
AEN1234	Blackwater Group	ATP1234	Current	Manual measurements recorded every 6-months. Awaiting access and monitoring agreement for deployment of logger.
GW004	Alluvium Fort Cooper Coal Measures	ATP1103	Current	On monitoring as of November 2020. Replaced GW001 due to logger failure.
GW007	Alluvium Fort Cooper Coal Measures	PL486	Current	On monitoring as of November 2020.

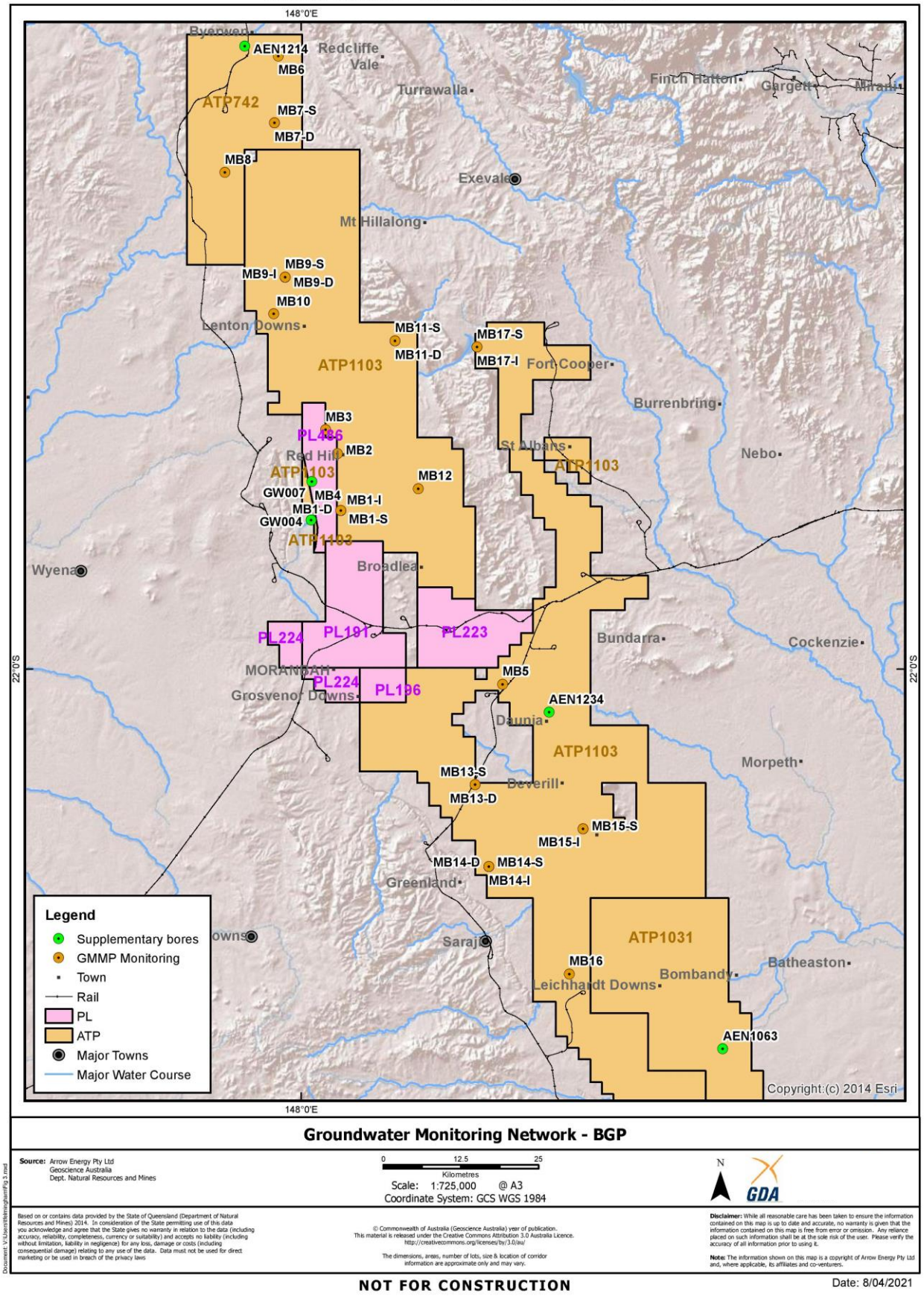


Figure 5: Groundwater Monitoring Network for BGP

4 GROUNDWATER ASSESSMENT UPDATE

4.1 Trigger Levels

The trigger levels associated with the 2022 Bowen UWIR are the bore trigger threshold as defined in the *Water Act (2000)*. Bore trigger threshold, for an aquifer, means a decline in the water level in the aquifer that is –

a) If a regulation prescribes the bore trigger threshold for an area in which the aquifer is situated – the prescribed threshold for the area; or
b) Otherwise –
    i. For a consolidated aquifer – 5m; or
    ii. For an unconsolidated aquifer – 2m.

Based on this, the applicable bore trigger threshold for the MGP and BGP is 5 m for a consolidated aquifer and 2 m for an unconsolidated aquifer. Consistent with the *Water Act (2000)*, no trigger thresholds are proposed for water quality.

4.2 Groundwater Level Monitoring

4.2.1 Shallow Monitoring Bores

Groundwater level monitoring has been undertaken in the following shallow groundwater monitoring bores which form part of the 2022 Bowen UWIR groundwater monitoring network for the MGP and BGP Area (Table 5 provides a summary of these bores).

- Monitoring since June 2012 for bores M339W, M225W, M340W, M230W, M250W, M224W, M222W;
- Monitoring since March 2016 for bores AN020F and AN021F;
- Monitoring since January 2018 for bore MB12;
- Monitoring since November 2019 for bores MB1-S and GW007A;
- Monitoring since November 2020 for bores GW004A, GW004B, AEN1214, AEN1234 and AEN1063; and
- Monitoring since November 2021 for bore M300W.

Table 5: Shallow Groundwater Monitoring Bores

Bore ID	Network	Total Constructed Depth (m)	Screen Interval (mbgl)	Screened Formation	Tenure Holder
M339W	MGP	41.0	35.0 – 41.0	Weathered Tertiary Basalt	QPM
M225W	MGP	34.0	23.0 – 34.0	Weathered Tertiary Basalt	QPM
M340W	MGP	27.3	19.3 – 27.3	Weathered Tertiary Basalt	QPM
M230W[1]	MGP	32.0	29.0 – 32.0	Weathered Tertiary Basalt	QPM
M300W	MGP	30.0	24.0 – 30.0	Weathered Tertiary Basalt	QPM
M250W	MGP	56.5	44.5 – 56.5	Tertiary Sediment	QPM
AN021F	MGP	27.0	20.0 – 22.0	Tertiary Sediment	QPM
M224W	MGP	32.5	26.5 – 32.5	Quaternary Alluvium	QPM
M222W	MGP	30.2	20.0 – 26.0	Weathered Fort Cooper Coal Measures	QPM
AN020F	MGP	77.0	70.0 – 72.0	Rewan Formation	QPM
GW004A	BGP	13.5	7.5 – 13.5	Tertiary Sediment	Arrow Energy
GW007A	BGP	7.5	1.5 – 7.5	Tertiary Sediment	Arrow Energy
GW004B	BGP	59	53.0 – 59.0	Fort Cooper Coal Measures	Arrow Energy
MB1-S	BGP	60	45.0 – 50.0	Fort Cooper Coal Measures – Girrah Seam	Arrow Energy
MB12	BGP	59.1	56.0 – 59.0	Rewan Formation	Arrow Energy
AEN1214	BGP	37.32	-[2]	Rangal Coal Measures	Landholder (private bore)
AEN1234	BGP	102	48.2 – 102.0	Blackwater Group	Landholder (private bore)
AEN1063	BGP	52.6	39.6 – 45.7	Blackwater Group	Landholder (private bore)

[1]M230W was replaced by M300W due to underground coal mining impact impacting the water level.
[2]Screened interval could not be determined due to pumping infrastructure.

The groundwater level monitoring results are shown in Appendix A. Groundwater levels, are shown in Figure 6 to Figure 8 and are discussed below for the MGP and BGP areas.

MGP:

The groundwater levels in the MGP range from:

- 200.1 to 209.2 m Australian Height Datum (AHD) in the weathered Tertiary Basalt aquifer;
- 233.2 to 242.7 m AHD in the Tertiary Sediment aquifer;
- 207.8 to 211.7 m AHD in the Quaternary Alluvium aquifer;
- 202.4 to 206.3 m AHD in the Fort Cooper Coal Measures aquifer; and
- 236.6 to 238.6 m AHD in the Rewan Formation.

All bores located within close proximity to the Isaac River display similar depths to groundwater, as discussed in the 2022 Bowen UWIR. It should be noted that bore M250W, which was not monitored in Q4 2022, has been monitored and sampled during this Annual Review period (in Q2 2023 & Q4 2023).

The groundwater levels for bores M250W, AN021F and AN020F are higher due to the respective surface elevation in the areas being approximately 30 to 95 m above the other bores. As indicated in Table 5, M250W and AN021F are installed in the Tertiary Sediment and located approximately 10 km north and east respectively of the other groundwater monitoring sites along the Isaac River, while MB12 is constructed within the Rewan Formation and located approximately 26km northeast of the other groundwater monitoring sites along the Isaac River.

A comparison of modelled drawdown predictions made in the 2022 Bowen UWIR with monitoring data to date has been undertaken. There is no predicted IAA or LAA for unconsolidated aquifers for the MGP and BGP as modelled drawdown does not exceed the bore trigger threshold of 2 metres. The monitoring data to date supports this modelled prediction in the 2022 Bowen UWIR.

Groundwater monitoring further indicates:

- Actual groundwater levels monitored in bores M339W and M225W have remained generally stable over the monitoring period;
- The water levels in bore M222W have stabilised in recent years (2016 – 2023). It should be noted that water levels of this bore were subjected to a steady rise from beginning of monitoring in 2012 to 2016;
- Figure 8 displays cumulative rainfall departure and groundwater levels at groundwater monitoring bores M225W, M222W and M224W. Recharge to shallow aquifers due to above mean rainfall during the periods 2016 to 2017 and 2021 to 2022 has contributed to the trends in groundwater levels for these monitoring bores;
- There is no predicted IAA or LAA for any aquifer underlying PL 223; hence modelled drawdown greater than the bore trigger threshold at the end of 2022 was not predicted in the 2022 Bowen UWIR to occur at the location of bores AN020F and AN021F. AN021F is installed in the Tertiary Sediment and has increased in water level since monitoring began and has been relatively stabilise during this review period. AN020F is installed in the Rewan Formation which is considered to be a regional aquitard. Groundwater levels monitored at AN020F have had a slow decline since the end of 2019 which has continued during this review period, with a decline of approximately 2m over the last 4 years, which is less than the trigger threshold for a consolidated formation;
- A decline in groundwater level by greater than the bore trigger threshold was noted at bore M224W between November 2017 and May 2021. As discussed in the 2022 Bowen UWIR, the water levels in this bore indicate a possible hydraulic link to the river level fluctuations. The water levels have recovered approximately 2m since 2021 during the period of above average rainfall. This is in-line with the conceptual hydrogeological model report in the 2022 Bowen UWIR, where there is linkage between rainfall events and river level flow periods to groundwater level change. This decline is not considered to be due to the effects of CSG production; and
- A decline in groundwater level by greater than the bore trigger threshold was noted at bore M230W between November 2017 and November 2019. The water levels observed in this bore are considered to have been influenced by nearby underground coal mining operations; a review of mine plan schedules indicated that “drive Number-1” traversed the area in proximity to M230W between Q3 and Q4-2017 indicating that the SWL decline were expected to be a result of the Anglo underground mine development. This was similar to the decline seen in M340W (as discussed in the 2017 Annual Review of the 2016 Bowen UWIR) where a decline in groundwater level has made this monitoring borehole dry. Both monitoring bores are in the same area, as shown in Figure 4. Accordingly, the decline is not considered to be due to the effects of CSG production. Due to the impact of mining operations, this monitoring bore has been replaced by M300W but is included in this report for historical analysis.

Based on the graphically presented monitoring data in Figure 6, it is clear that there is no apparent influence of CSG production to the Quaternary alluvium, weathered Tertiary basalt, Tertiary sediment, weathered Fort Cooper coal measures and Rewan aquifers in which these bores are installed. This data supports the groundwater modelling predictions in the 2022 Bowen UWIR groundwater model.

BGP:

Groundwater level monitoring has been undertaken in the following shallow groundwater monitoring bores which form part of the BGP monitoring network. Table 6 provides a summary of these bores.

- Monitoring since January 2018 for bore MB12; and
- Monitoring since November 2019 for bores MB1-S, GW004A and GW007A.
- Monitoring since November 2020 for landholder bores AEN1214, AEN1234, and AEN1063

Table 6: BGP Shallow Groundwater Monitoring Bores

Bore ID	Total Constructed Depth (m)	Screen Interval (mbgl)	Screened Formation	Tenure Holder
MB1-S	60	45 – 50	Fort Cooper Coal Measures – Girrah Seam	Arrow Energy
MB12	59.1	56 – 59	Rewan Formation	Arrow Energy
GW004A	13.5	7.5 – 13.5	Tertiary Sediment	Arrow Energy
GW007A	7.5	1.5 – 7.5	Tertiary Sediment	Arrow Energy
AEN1214	37.32	*	Rangal Coal Measures	Landholder (private bore)
AEN1234	102	48.2 – 102	Blackwater Group	Landholder (private bore)
AEN1063	52.6	39.6 – 45.7	Blackwater Group	Landholder (private bore)

* Screened interval could not be determined due to pumping infrastructure

The groundwater level monitoring results are shown in Appendix A. Groundwater levels, as is shown in Figure 7 range from:

- 234.03 to 235.16 m Australian Height Datum (AHD) in the Tertiary Sediment aquifer;
- 262.18 to 263.51 m AHD in the weathered Fort Cooper Coal Measures aquifer;
- 286.31 to 299.00 m AHD in the Rewan Formation;
- 2015.12 to 217.32 m AHD in the Rangal Coal Measures; and
- 142.53 to 185.64 m AHD in the Blackwater Group.

Groundwater level monitoring indicates:

- Groundwater levels are stable in the shallow bores;
- GW007A was recorded as dry. An alternate location may be required if GW007A is shown to be continually dry, however the Tertiary Sediment may not form an aquifer in this area; and
- Water level decline in MB12 from Q4 2018 to Q4 2020 is due to water quality sampling (pumping) being undertaken in the bore. The frequency of water quality sampling was decreased in Q2 2021 where subsequent water level data show water level recovery between monitoring events.

Based on the presented monitoring data in Figure 6, there is no apparent influence of CSG production to the Tertiary Sediment, Fort Cooper Coal Measures and Rewan aquifers in which these bores are installed. This is expected given little water production has occurred in the BGP.

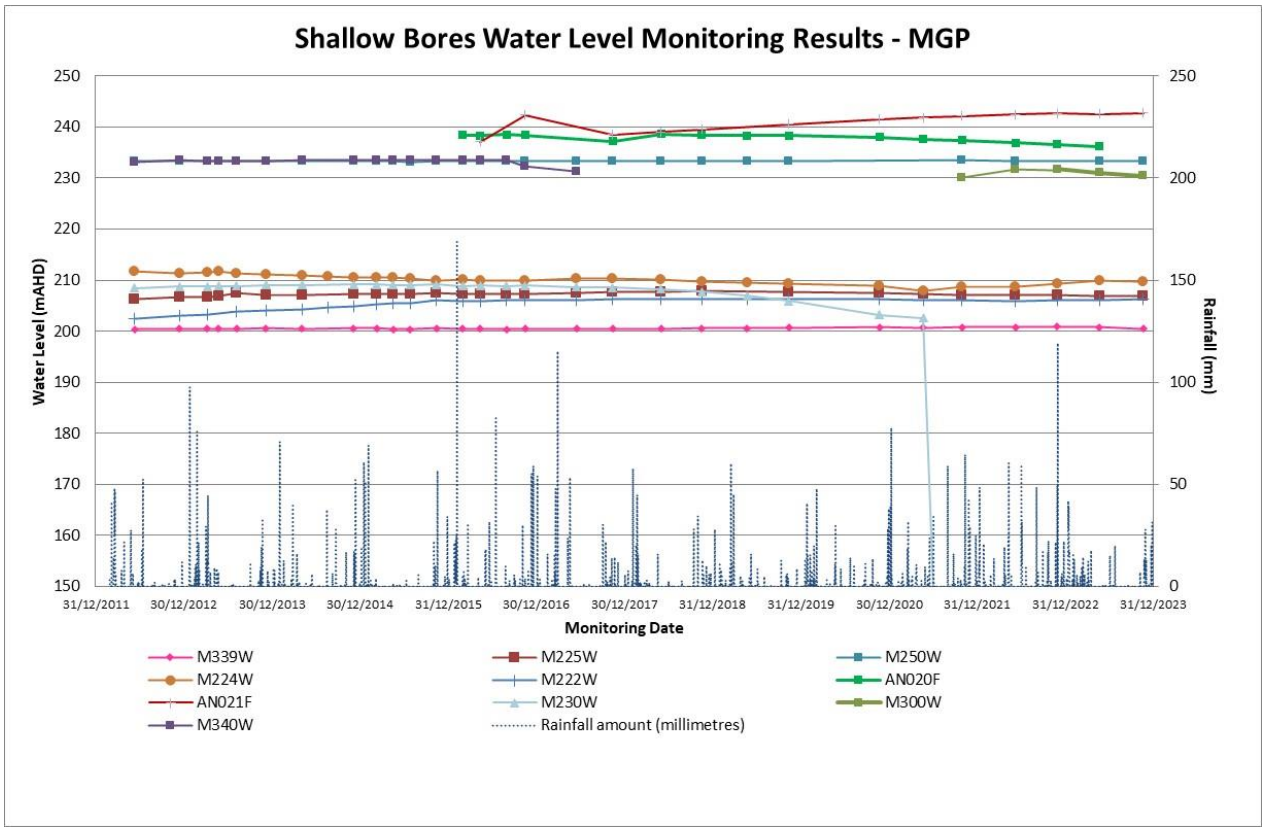


Figure 6: Shallow Bores Water Level Monitoring Results – MGP

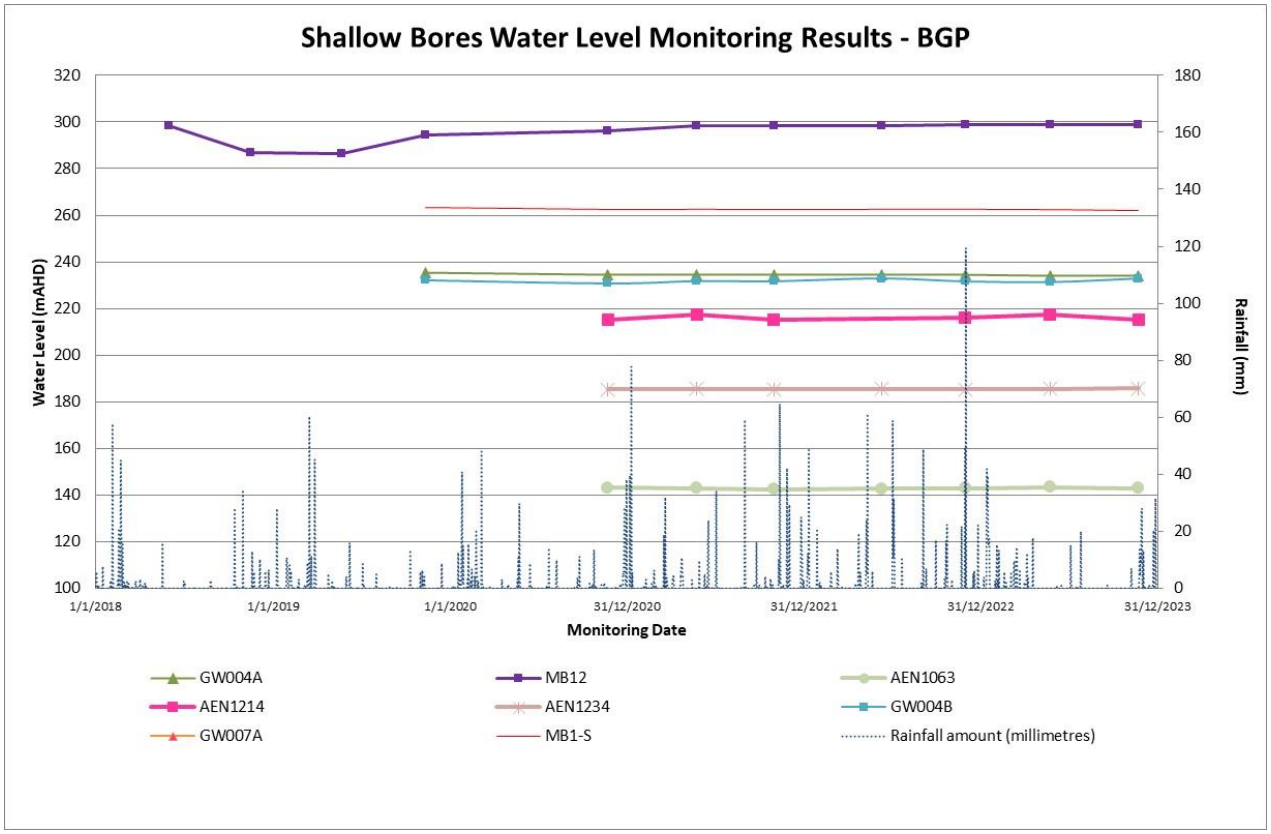


Figure 7: Shallow Bores Water Level Monitoring Results - BGP

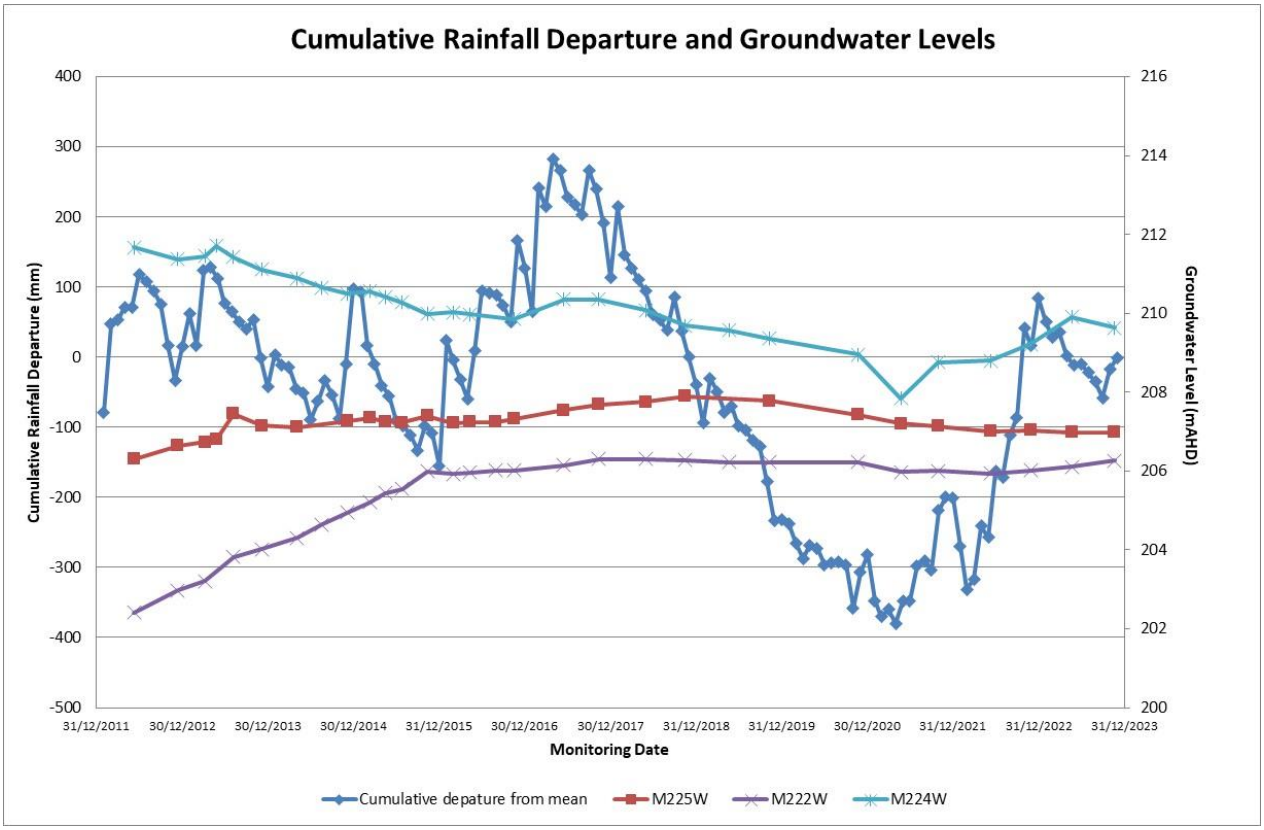


Figure 8: Cumulative Rainfall Departure and Groundwater Levels

4.2.2 Deep Monitoring Bores

Groundwater level monitoring has been undertaken in the following deep groundwater monitoring bores which form part of the 2022 Bowen UWIR groundwater monitoring network.

- Monitoring since November 2011 for MB1-D and since November 2019 for MB1-I (as detailed in Section 3.2);
- Monitoring since September 2015 for bore MB2 (as detailed in Section 3.2);
- Monitoring since September 2013 for bore MB3 (as detailed in Section 3.2);
- Monitoring since September 2014 for bores M313W, M314W, M324W;
- Monitoring since February 2015 for bore M325W;
- Monitoring since November 2015 for bores AN019F;
- Monitoring since December 2015 for bore M162V;
- Monitoring since February 2016 for bore GR067V; and
- Monitoring since November 2019 for bore GW007B (as detailed in Section 3.2).

Table 7 provides details for these bores. As previously indicated in the 2018 Annual Review for the 2016 Bowen UWIR, available data suggested that the permeability of the formation that M325W is installed into is so low that recovery of groundwater levels in the Fort Cooper Coal Measures would take a very long time. The updated water level data supports the previous statement and recovery of the bore continued during the Annual Review period. The following observations has been made:

- A groundwater level decline of 6.6m has been observed at bore M324W (MCM) from 15/04/2015 to 3/03/2017. However, this bore has been experiencing a long-term recovery since 3/03/2017 and its current groundwater level is 2.9m below the historical groundwater level high (maximum groundwater level) implying that its current decline is less than the bore trigger threshold, which is consistent with this bore being within the IAA as per the 2022 Bowen UWIR (Section 7.4.1).

- A groundwater level decline of 66.5m has been observed at bore M313W (MCM) from 7/06/2015 to 3/03/2017. Similar to M324W, this bore has been experiencing a long-term recovery since 3/03/2017, which is consistent with the bore being inside the IAA.
- A continuous decline in groundwater levels, greater than the bore trigger threshold, have been observed at bore M314W (MCM) which is consistent with this bore being in the IAA. Continuous decline in groundwater levels, greater than the bore trigger threshold at bore M314W (BCG) and M313W (BCG), are unlikely to be associated with CSG production as these monitoring points are below and separated from the productive coals by low permeability materials.
- Groundwater levels in bore M162V (MCM) have been subjected to a continuous decline (9.6m) since 16/10/2016, which is greater than the bore trigger threshold and can be attributed to impact of CSG production to the MCM, and is consistent with this bore being in the IAA.
- No decline in groundwater levels greater than the bore trigger threshold is observed at bores M325W (FCCM), M324W (FCCM), AN019F (FCCM), and GR067V (MCM).

Table 7: Deep Groundwater Monitoring Bores

Bore ID	Total Constructed Depth (m)	Screen Interval (mbgl)	Screened Formation	Tenure Holder
M313W	532.4	313.0 – 316.5 507.0 – 510.0	Moranbah Coal Measures (QA Seam) Back Creek Group	QPM
M314W	560.5	210.5 – 213.5 551.5 – 553.5	Moranbah Coal Measures (QA Seam) Back Creek Group	QPM
M324W	240.0	163.0 – 166.0 187.0 – 190.0	Fort Cooper Coal Measures Moranbah Coal Measures (QA Seam)	QPM
M325W	202.3	180.5 – 182.0	Fort Cooper Coal Measures	QPM
AN019F	290.0	269.0 – 271.0	Fort Cooper Coal Measures	QPM
M162V	276.0	252.0 – 256.0	Moranbah Coal Measures	QPM
GR067V	610.9	543.2 – 610.9	Moranbah Coal Measures	QPM
MB1	550	336 -340 423.9-506.6	Fort Cooper Coal Measures Moranbah Coal Measures	Arrow Energy
MB2	834	701.1-814.7	Moranbah Coal Measures	Arrow Energy
MB3	796.3	712.3 – 717.9	Moranbah Coal Measures	Arrow Energy
GW007B	181.5	175.5 – 181.5	Fort Cooper Coal Measures	Arrow Energy

Data loss due to hardware issues was experienced at some of the bores including bores M314W and M325W between 01 January 2022 to 10 February 2022, 24 May 2022 to 24 June 2022 and 26 October 2022 to 31 December 2022, bores M313W and M324W between 30 January 2022 and 29 April 2022 and bore AN019F between 16 August 2022 and 28 February 2023.

MGP:

The groundwater level monitoring results are shown in Figure 12. Observed groundwater levels or calculated potentiometric water levels ranged from:

- 206.3 to 215.9m AHD in the BCG;
- 49.6 to 204.8m AHD in the FCCM; and
- -129.0 to 204.5m AHD in the MCM.

A comparison of modelled drawdown predictions in the 2022 Bowen UWIR due to CSG activities with monitoring data to date indicates:

- Modelled drawdown in the MCM aquifer at the end of 2022 at the location of M314W was predicted in the model to be approximately 196.35 m. Actual groundwater levels monitored for the MCM at M314W indicates decline in levels of approximately 7.9 m measured on 30 December 2023;
- Modelled drawdown in the MCM aquifer at the end of 2022 at the location of M313W was predicted in the model to be approximately 31.30 m. Actual groundwater levels monitored for the MCM at M313W shows the maximum decline in the water level of 66.52 m, as measured on 3 March 2017. Since 3 March 2017 the water level has recovered by 61.22 m which represents approximately 92% recovery of the original water level prior to the drawdown as indicated in Figure **12**. The graphically displayed water level curve indicates the recovery will continue;
- Modelled drawdown in the MCM aquifer at the end of 2022 at the location of M324W was predicted in the model to be approximately 31.38 m. Actual groundwater levels monitored at M324W show a maximum decline in levels by 6.63 m on 3 March 2017. Since 3 March 2017, the water level has recovered by 3.75 m which represents a 56.6% recovery of the water level prior to the drawdown as indicated in Figure **12**. This groundwater monitoring bore is located in the southern part of PL 196 and approximately 350 m from production well GM052V. The total amount of water actually produced from GM052V during this annual review data capture period was 0 ML. Since production ceased, the water level has continued to recover;
- Modelled drawdown in the MCM aquifer at the end of 2022 at the location of M162V was predicted to be approximately 26.06 m. Actual groundwater levels monitored at this site show a steady groundwater level decrease of approximately 35.8 m;
- Modelled drawdown in the MCM aquifer at the end of 2022 at the location of GR067V was predicted to be approximately 1.64 m. Decreases in water levels of up to 150 metres, noted in April and August 2016, are due to depressurisation activities in this bore associated with monitoring events. The recovery curve has subsequently stabilised, and a standing water level of 204 m AHD is evident;
- Modelled drawdown in the FCCM aquifer at the end of 2022 at the location of M324W was predicted to be 0.3 m. Actual groundwater levels monitored for the FCCM at M324W shows a decline of approximately 2 m;
- Modelled drawdown in the FCCM aquifer at the end of 2022 at the location of AN019F was predicted to be 0.04 m. Actual groundwater levels monitored indicates a decline of approximately 1.8 m; and
- Modelled drawdown in the BCG aquifer at the end of 2022 at the location of M313W and M314W was not predicted to occur in the model. Actual groundwater levels monitored for the BCG at M313W and M314W indicate a decline of approximately 5.1 m and 9.6 m respectively.

Based on the monitoring data, which detect the impact of all influences on the groundwater system not just CSG impact, it is concluded that observations of drawdown were generally consistent with respect to predicted exceedances of the bore trigger threshold as follows:

- Modelled drawdown greater than the bore trigger threshold was not predicted to occur at bores AN019F (FCCM), M324W (FCCM), and GR067V (MCM) which is confirmed by the monitoring data;
- Modelled drawdown greater than the bore trigger threshold was predicted to occur at bore M314W (MCM), M313W (MCM), M324W (MCM) and M162V (MCM), which is confirmed by the monitoring data. There are no existing or useable landholder bores within a 2 km radius of these locations in the IAA aquifer;
- Monitoring data shows that drawdown greater than the bore trigger threshold was observed at monitoring bores M313W (BCG) and M314W (BCG). These drawdowns were not predicted in the model and are unlikely to be associated with CSG production as these monitoring points are below and separated from the productive coals by low permeability materials. There are no existing or useable landholder bores within a 2 km radius of these locations in the aquifer.

BGP:

The groundwater level monitoring results are shown in Figure 13. Observed groundwater levels or calculated potentiometric water levels ranged from:

- 240.7 to 265.0 m AHD in the FCCM; and
- -356.3 to 211.4 m AHD in the MCM.

A comparison of modelled drawdown predictions modelled in the 2022 Bowen UWIR with monitoring data to date has been undertaken and indicates:

- Drawdown in the MCM aquifer at the end of 2022 at the location of MB1 was not predicted to occur in the model. There was a decline in water levels in 2019 as a result of equilibration due to the workover of the well in late 2019

to equip the borehole with multiple pressure sensors and is not related to CSG activities. This is further discussed in Section 4.2.3.3. Actual groundwater levels monitored indicate a continuous recovery after decline in 2019.

- Drawdown in the MCM aquifer at the end of 2022 at the location of MB2 was not predicted to occur in the model. Actual groundwater levels monitored indicate an increase of 387.8 m. The water level in this bore is recovering from production during the pilot which ceased operation in 2018;
- Drawdown in the MCM aquifer at the end of 2022 at the location of MB3 was predicted to be 6.94 m. Actual groundwater levels monitored indicate an increase of 190.4 m from the recovery started in June 2019 after cessation of pilot production in 2018;
- Drawdown in the FCCM aquifer at the end of 2022 at the location of MB1 and GW007B was predicted to be 0 m. Actual water level monitored indicates a decline of 8.5 in MB1 and 0.6 in GW007B. The observed decline, which appears to be flattening in MB1, is likely due to equilibration of pressure within the bore and the formation following the workover when the well was topped up with water.

Analysis of MB1, MB2 and MB3 water levels was conducted to determine the recovery time of the water levels to a static condition prior to modelled drawdown at these locations to fulfil the requirements of the GMMP. The Theis recovery method was used to analyse that data and concluded that MB1 has fully recovered, and MB2 and MB3 will recover fully prior to predicted drawdown. Appendix C displays the curve analysis and graphs, with Figure 9 to Figure 11 showing the water level recovery of these wells compared to the calculated recovery. These figures show:

- MB1 water level has fully recovered;
- MB2 water level is recovering in-line with the calculated recovery; and
- MB3 water level recovery is less than calculated. Due to the limited amount of data since relocation of the monitoring point, analysis will be undertaken in future reports.

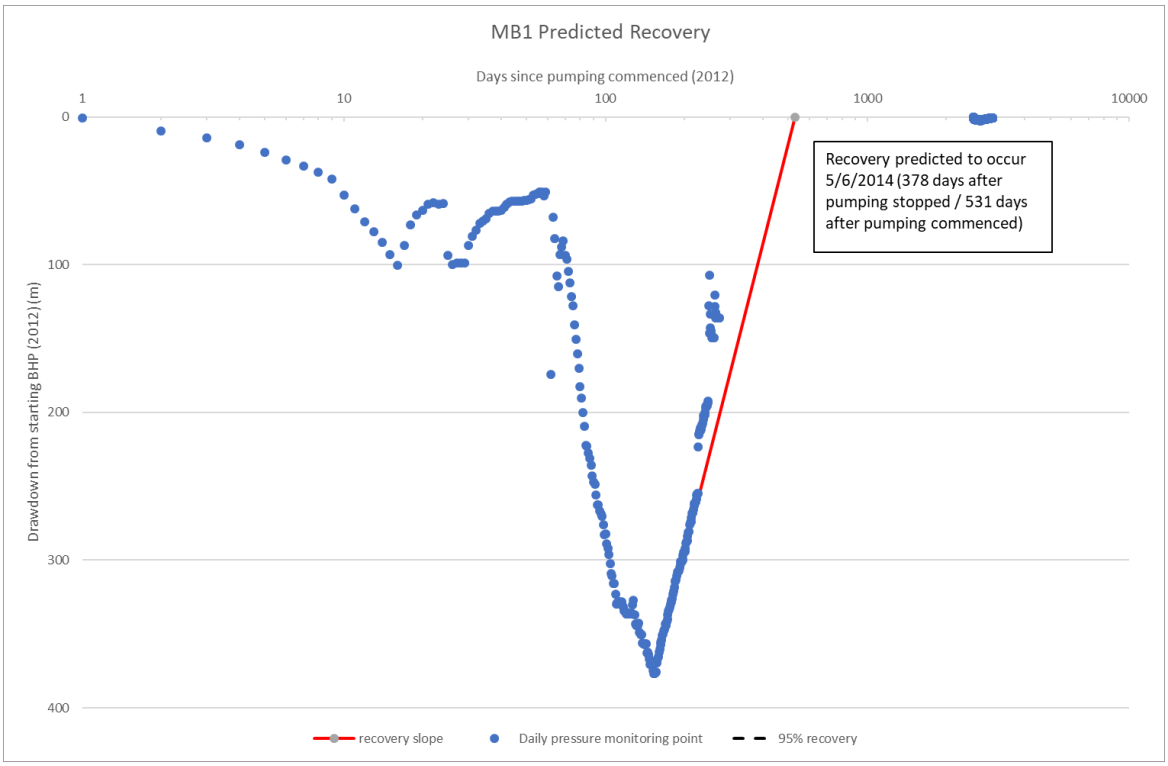


Figure 9: MB1 recovery data

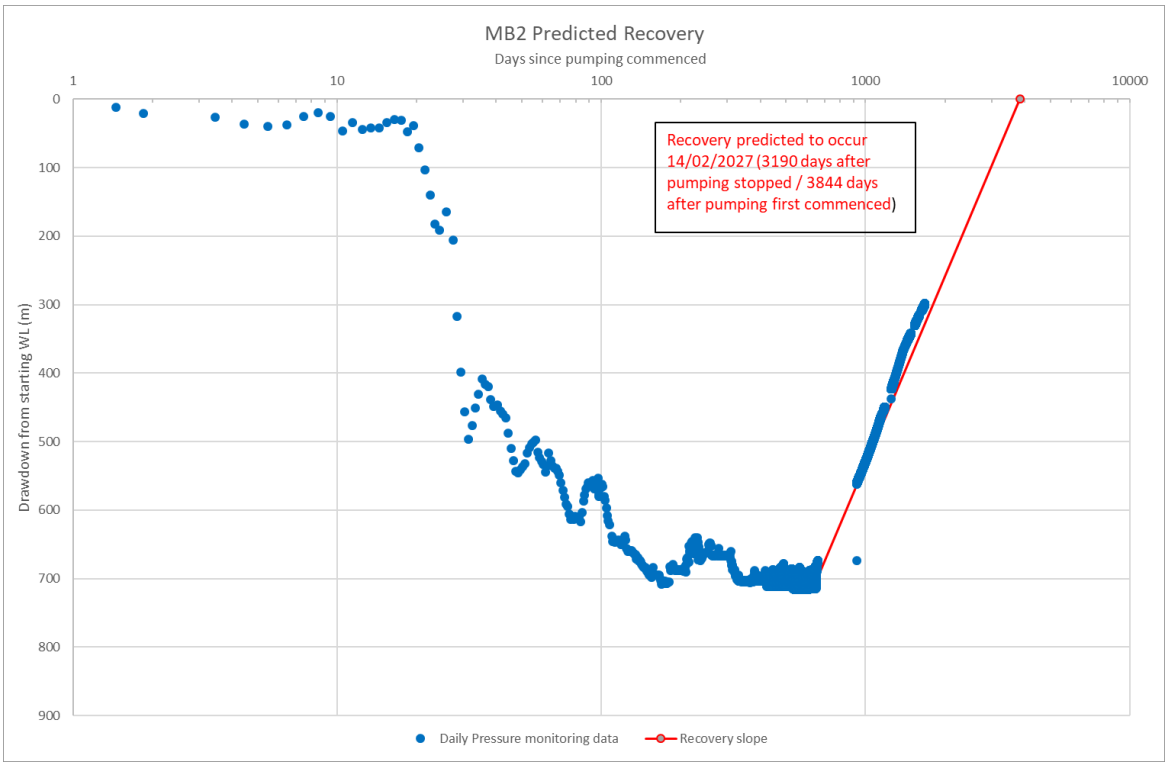


Figure 10: MB2 recovery data

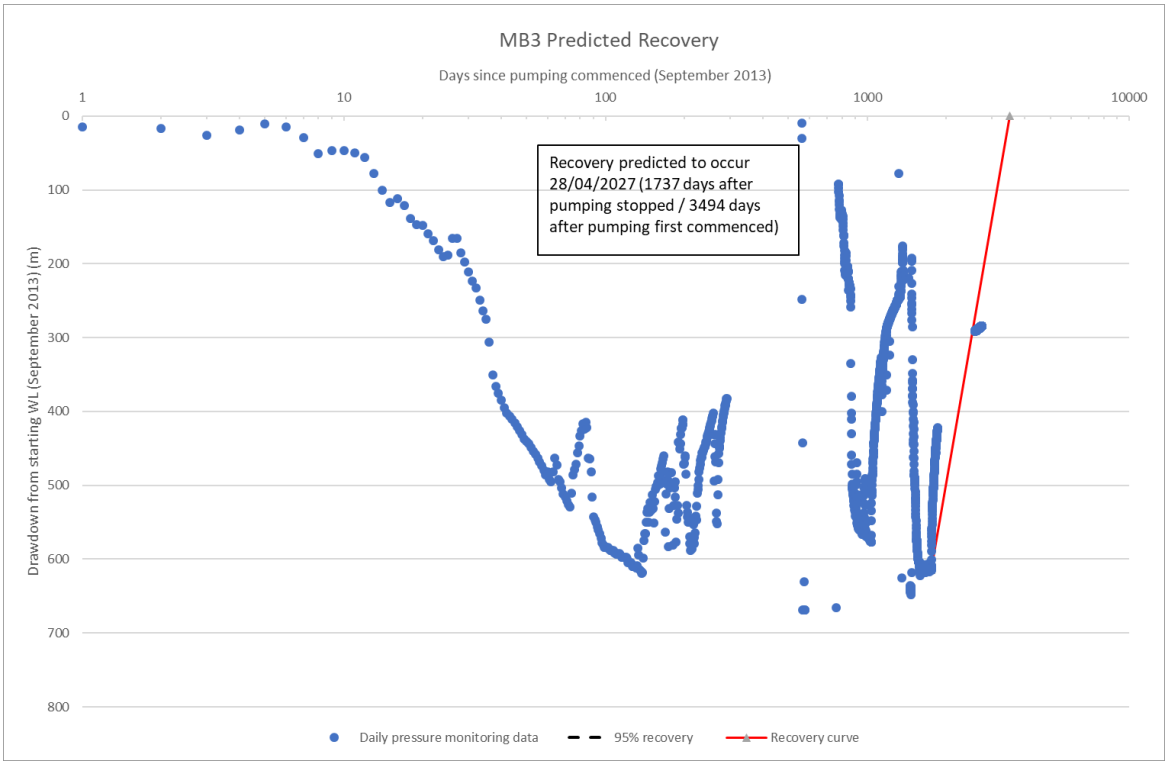


Figure 11: MB3 recovery data

Table 8 displays the predicted recovery year for each bore. As discussed in Section 3.2, the location of MB3 was changed due to a failure in a pressure gauge.

Table 8: Recovery dates – MB1, MB2 & MB3

Bore ID	Recovery date	Predicted drawdown year
MB1	05/06/2014	2028
MB2	14/02/2027	2035
MB3	28/04/2027	2033

Based on the monitoring data, it is concluded that observations of drawdown were generally consistent with respect to predicted exceedances of the bore trigger threshold as follows:

- Monitoring data shows that drawdown greater than the bore trigger threshold was detected at monitoring bore MB1. This was due to equilibration due to the workover of the well in late 2019 to equip the borehole with multiple pressure sensors and is not related to CSG activities. There are no existing or useable landholder bores within a 2 km radius at this location in the IAA aquifer; and
- MB2 and MB3 display recovering water levels.

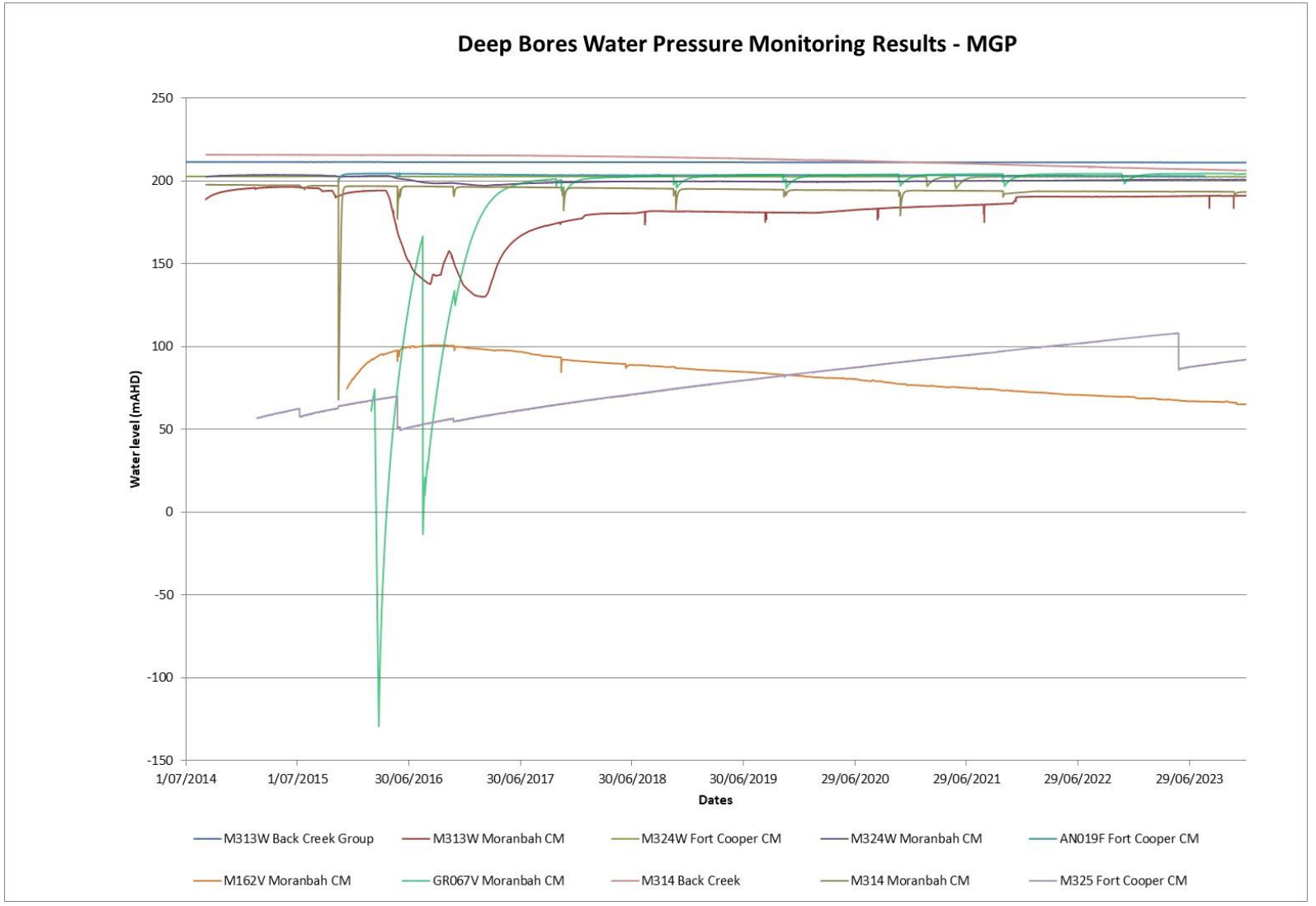


Figure 12: Deep Bores Water Level Monitoring Results – MGP

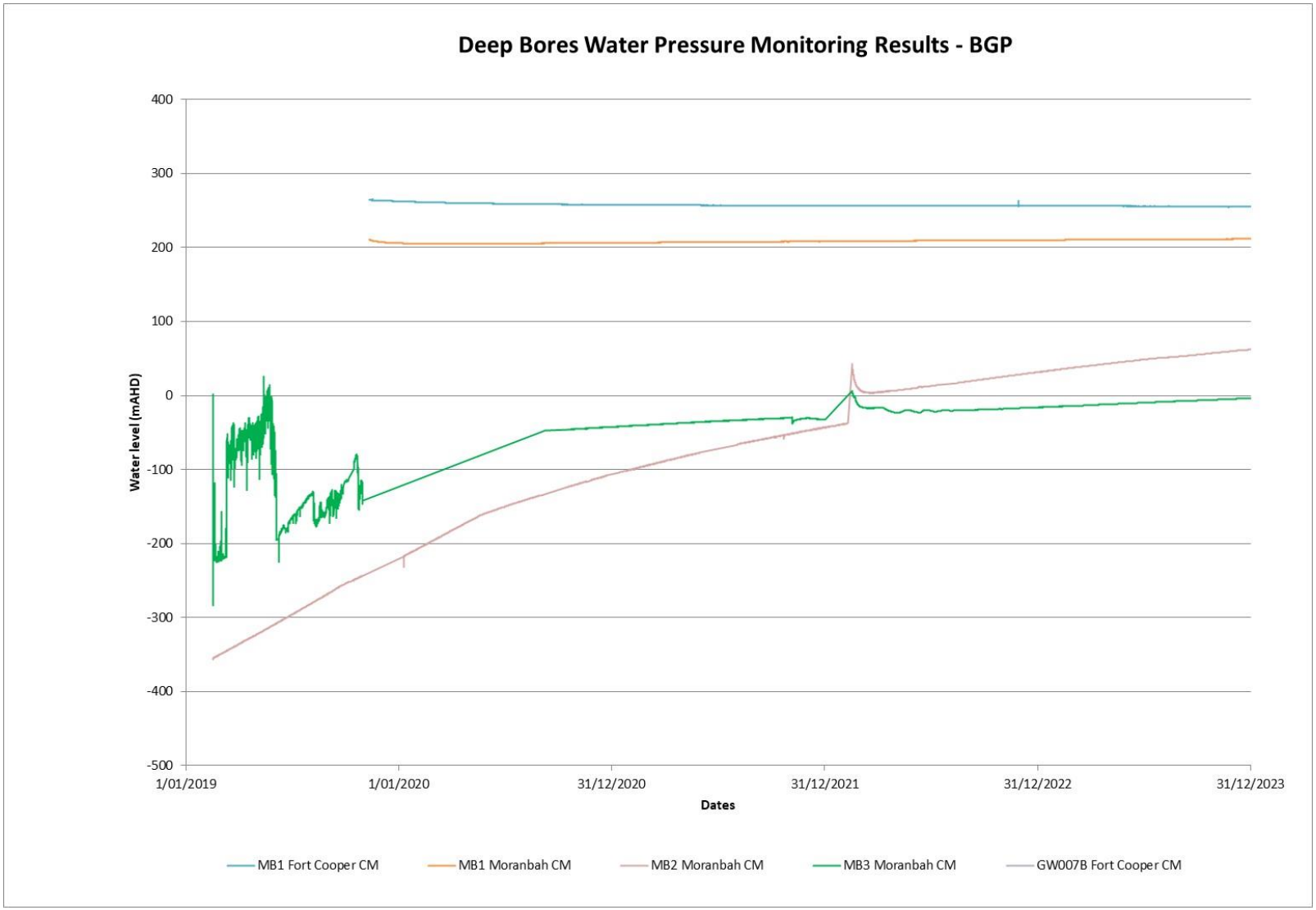


Figure 13: Deep Bores Water Level Monitoring Results - BGP

4.2.3 Groundwater Flow

A review of vertical gradients was undertaken for two monitoring locations in the MGP area and one monitoring location in the BGP area. Monitoring at each site included:

- Site 1: From deepest to shallowest; Back Creek Group (M314W), Moranbah Coal Measures (M314W), Fort Cooper Coal Measures (M325W) as well as data from monitoring approximately 3 km northwest in the weathered Fort Cooper Coal Measures (M222W) and Quaternary Alluvium (M224W);
- Site 2: From deepest to shallowest; Back Creek Group (M313W), Moranbah Coal Measures (M313W), Moranbah Coal Measures (M324W) and Fort Cooper Coal Measures (M324W); and
- Site 3. From deepest to shallowest, Moranbah Coal Measures, Fort Cooper Coal Measures and Fort Cooper Coal Measures (Girrah seam), in MB1.

4.2.3.1 Site 1

Figure 14 below shows the vertical gradients for Site 1 and the latest data indicates the FCCM aquifer, at bore M325W, has the lowest water level. The collected and graphically displayed data indicate a very steady and continued recovery of approximately 59m. With the exception of M325W there is an apparent gradient toward the MCM (the target coal seams for CSG production from the MGP) i.e. upward from the BCG and downward from the Quaternary Alluvium, to the FCCM and then to the MCM.

As discussed in Section 4.2.1, water levels in monitoring bore M222W which is constructed into the FCCM show a rising trend in response to above average rainfall recharge. Water levels in M224W constructed in the Quaternary Alluvium show that trends in water levels are linked to flows in the nearby Isaac River.

As discussed in Section 4.2.2, a decline in water levels have been observed in M314W within MCM and the BCG. The water level trends between the MCM and shallow aquifer seem to indicate no vertical hydraulic links exist at this location.

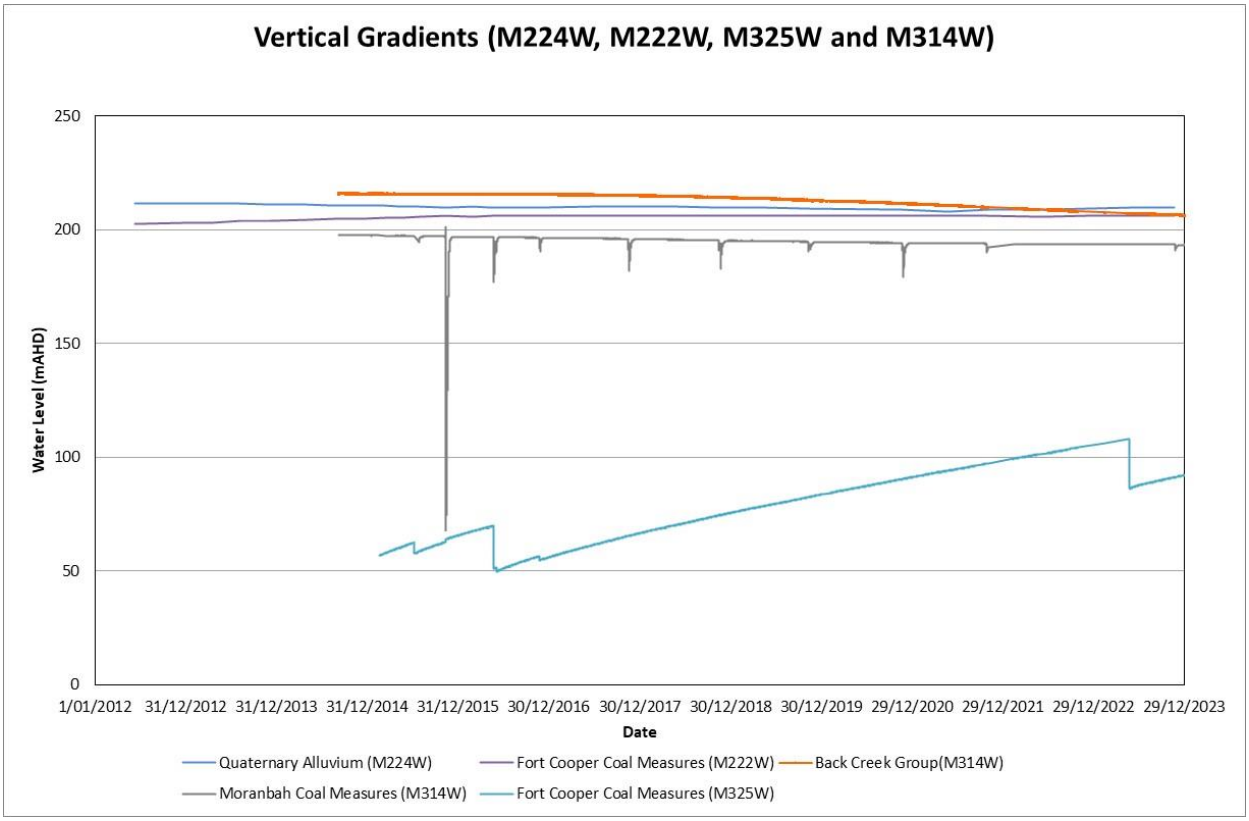


Figure 14: Site 1 - Review of Vertical Gradients (M224W, M222W, M325W and M314W)

4.2.3.2 Site 2

Figure 15 shows the graphically displayed vertical gradients for Site 2 and based on the presented data, water levels in the MCM monitoring bores have continued to recover following cessation of production in GM052V.

As discussed in Section 4.2.2, drawdown as a result of water production in CSG wells to the MCM aquifer is evident at site M313W and M324W but since the production ceased in April 2017, the water level recovery is evident in both monitoring boreholes. Monitoring data for the FCCM and BCG at this site indicates a slight decline in water levels. Decline in water levels noted for the FCCM are observed to correlate to the water production in CSG wells and consequential drawdown in the underlying MCM. This suggests that there is some transmission of impacts from the MCM to the shallower FCCM. Whilst there is some decline in water levels in the deeper Back Creek Group aquifer, it does not clearly correlate to the water production in the CSG wells and ongoing monitoring will confirm this. Based on this, monitoring data suggests that impacts are contained within the MCM and FCCM.

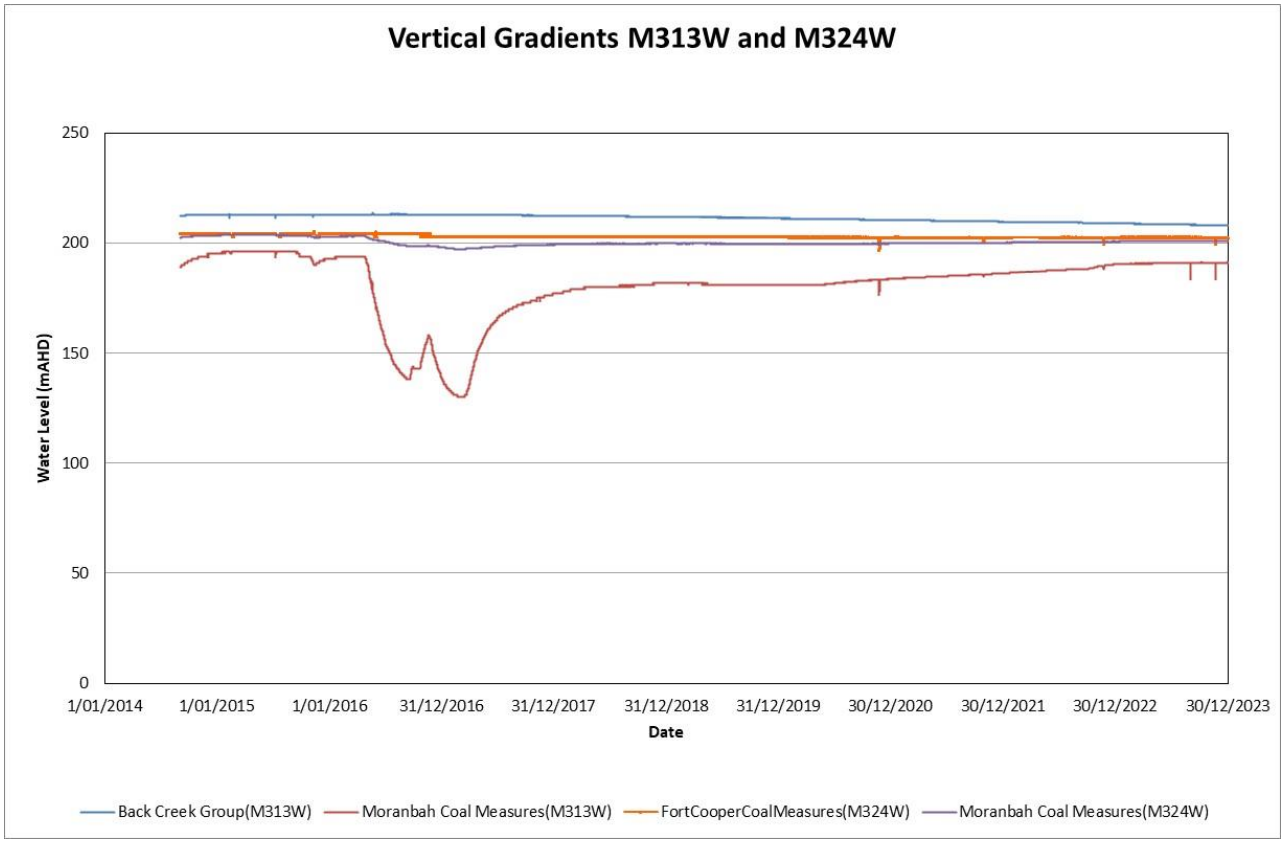


Figure 15: Site 2 - Review of Vertical Gradients (M324W and M313W)

4.2.3.3 Site 3

Figure 16 shows the graphically displayed vertical gradients for Site 3 (MB1) and based on the presented data, an initial decrease in water levels in the Moranbah Coal Measures is visible, with a smaller decrease seen in the Fort Cooper Coal Measures. This decline in water levels can be attributed to the workover conducted on MB1 to equip the borehole for multi-zone monitoring. During the workover process, a slug of water was introduced to 'kill' the well and due to the low permeability of the FCCM and MCM, a decline in water level was seen. As of the end of 2022, the water levels in all three zones are stabilising, with the MCM zone displaying an increase in water levels.

The sharp pressure increases in the data can be attributed to sampling events of MB1, where the pressure is bled off the borehole during sampling.

Ongoing monitoring at this site will provide further information on the interconnectivity of aquifers at these sites.

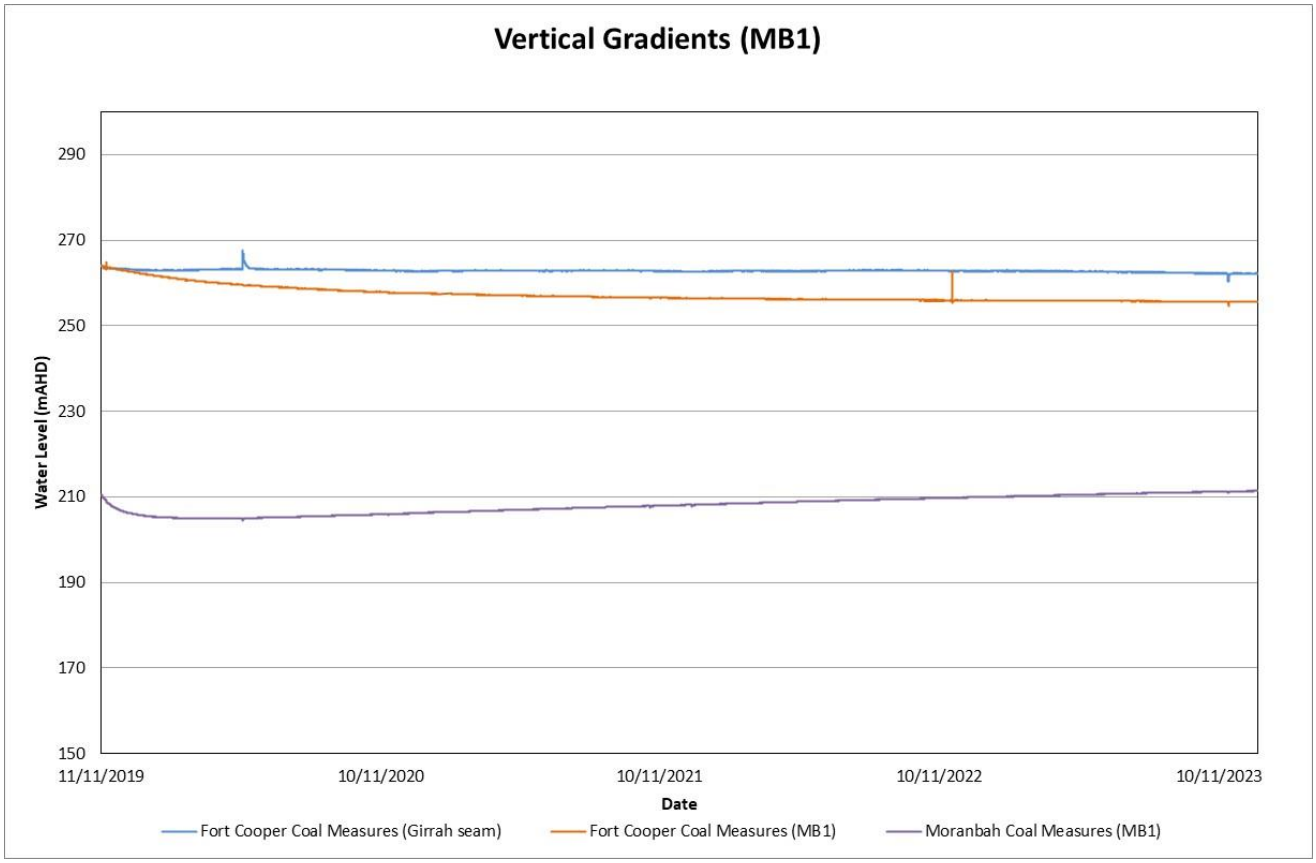


Figure 16: Site 3 - Review of Vertical Gradients (MB1)

5 GROUNDWATER QUALITY MONITORING

Groundwater quality is monitored in eight shallow groundwater monitoring bores. Monitoring has been undertaken since June 2012 in seven of the shallow groundwater monitoring bores and since May 2016 from the other remaining monitoring bore. It should be noted that one additional shallow groundwater monitoring bore (AN021F) exists and was sampled in Q4 2022. However, it has not been monitored for water quality during this review period as it was not required, as outlined in the 2022 Bowen UWIR. An adjacent bore, AN020F, drilled and completed into the Rewan Formation, has been sampled since 13 May 2016. However, this bore has not been sampled during this review period as it was not accessible due to wet weather.

Groundwater quality monitoring was also undertaken in four deep groundwater monitoring bores that were completed in July 2014, two additional deep groundwater monitoring bores that were completed in November 2015 and one more recent deep groundwater monitoring bore that was completed in August 2016.

As part of the commencement of the BGP, MB1 was an additional monitoring site that was incorporated into the monitoring network. MB1 is located in PL486 and has been added to the MGP network for analysis.

As outlined in the 2022 Bowen UWIR, GM031V replaced M162V to allow water levels in M162V to recover, and M300W replaced M230W as nearby mining operations were impacting water levels.

The groundwater quality monitoring results are shown in Appendix B. The primary purpose of groundwater quality monitoring is to identify changes in background water quality. A summary of these results (2012 to 2023) are provided in the following sections.

5.1 Shallow aquifer water quality

Table 9 provides a summary of water quality results obtained from bores targeting the shallow aquifers (M339W, M225W, M340W, M230W (replaced with M300W in Q4 2021), M250W, M224W, M222W, AN020F and AN021F). This provides an indication of water quality ranges for each parameter analysed based on aquifer type. Results for some parameters between different monitoring locations in the Tertiary Basalt show a high degree of variation which is likely to be attributable to the spatial heterogeneity of the hydrogeological system. Additionally, a high degree of variation is also shown in the Tertiary Sediment as no sampling was able to be conducted prior to 2022 from bore AN021F due to low water volume in the bore casing.

Review of this data indicates that there are no notable trends. As displayed by the groundwater level data in Section 4.2.1, recharge by rainfall or streams occurs to shallow aquifers and is likely to result in variations in some parameters at the same monitoring location as shown in the table below.

In general, the salinity ranges[3] for the underlying units can be described as follows:

- Groundwater quality of the Quaternary alluvium varies from brackish to saline;
- Groundwater quality of the Tertiary basalt aquifer varies from brackish to saline;
- Groundwater quality of the Tertiary sediment aquifer is fresh to brackish to brackish;
- Groundwater quality of the weathered coal measures is saline; and
- Groundwater quality of the Rewan Formation is saline.

[3] Environmental Protection Agency (EPA) of South Australia

Table 9: Background Water Quality - Shallow Monitoring Bores

Parameter	Units	Quaternary Alluvium		Tertiary Basalt		Tertiary Sediment		Weathered Coal Measures		Rewan Formation	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Field pH		5.73	7.48	6.28	8.49	5.42	12.6	5.92	8.16	6.02	7.58
Electrical Conductivity	µS/cm	4240	31600	5300	42769	2170	13800	9090	11700	9590	11200
Total Dissolved Solids	mg/L	2360	27000	3000	29000	1300	5470	5190	9990	6210	9070
Hydroxide Alkalinity (OH-) as CaCO3	mg/L	<1	<5	<1	<5	<1	2420	<1	<5	<1	<1
Carbonate Alkalinity as CaCO3	mg/L	<1	<5	<1	94	<1	80	<1	<5	<1	<1
Bicarbonate Alkalinity as CaCO3	mg/L	101	360	380	827	53	116	243	457	3	126
Total Alkalinity as CaCO3	mg/L	101	360	380	827	53	2500	243	457	5	126
Sulphate, SO4	mg/L	541	6200	60	1140	28	106	78	196	<1	1
Chloride, Cl	mg/L	1020	14000	1490	17000	660	1280	3140	4140	3750	4030
Calcium - Dissolved	mg/L	172	1000	55	362	12	312	290	452	51	460
Magnesium - Dissolved	mg/L	107	1400	85	808	<1	52	340	529	147	203
Sodium - Dissolved	mg/L	543	6200	891	13000	344	1330	932	1400	1450	2160
Potassium - Dissolved	mg/L	5	17	12	150	9	580	9	14	21	29
Arsenic-Dissolved	mg/L	<0.001	0.008	<0.001	0.003	<0.001	<0.001	<0.001	0.011	<0.001	<0.001
Beryllium-Dissolved	mg/L	<0.0005	0.193	<0.0005	<0.005	<0.0005	<0.001	<0.0005	<0.001	<0.001	<0.001
Barium-Dissolved	mg/L	0.045	0.2	0	0.283	0.047	1.06	0.184	3.9	3.42	5.34
Cadmium-Dissolved	mg/L	<0.0001	0.0002	<0.0001	0.7	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium-Dissolved	mg/L	<0.001	0.015	<0.001	0.014	<0.001	0.076	<0.001	0.002	<0.001	<0.001
Cobalt-Dissolved	mg/L	<0.001	0.027	<0.001	0.005	<0.001	0.005	<0.001	0.002	<0.001	0.001
Copper-Dissolved	mg/L	<0.001	0.063	<0.001	0.094	<0.001	0.145	<0.001	0.036	<0.001	0.005
Lead-Dissolved	mg/L	<0.001	<0.01	<0.001	<0.005	<0.001	0.112	<0.001	<0.001	<0.001	<0.001
Manganese-Dissolved	mg/L	0.313	8.1	<0.005	0.611	0.003	0.095	1.1	2.03	1.17	2.28
Molybdenum	mg/L	<0.001	0.004	0.002	0.008	<0.001	0.152	0.002	0.004	<0.001	0.007
Nickel-Dissolved	mg/L	<0.05	0.17	0.005	0.361	0.006	0.088	<0.001	0.125	<0.001	0.006
Selenium	mg/L	<0.01	<0.05	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	<0.01	14	1.52	11.1	0.69	0.91	6.67	10.4	11	11.3
Vanadium-Dissolved	mg/L	<0.001	0.002	<0.001	0.042	<0.001	<0.01	<0.001	<0.01	<0.01	<0.01
Zinc-Dissolved	mg/L	0.008	0.302	<0.005	2.27	<0.005	0.131	<0.005	0.719	<0.005	0.014
Boron	mg/L	0.13	0.55	0.42	2.96	0.13	0.78	0.3	0.38	0.09	0.2
Iron	mg/L	0.2	14.2	<0.05	0.59	<0.05	0.43	0.05	22.2	1.68	14.3
Mercury-Dissolved	mg/L	<0.00005	<0.0001	<0.00005	0.001	<0.00005	<0.0001	<0.00005	<0.0001	<0.0001	<0.0001
Fluoride, F	mg/L	0.2	0.9	0.09	2	0.04	0.6	0.4	1	<0.1	0.1
Phosphate as P in water	mg/L	<0.005	0.79	0.026	12.6	<0.005	1.3	<0.005	2.09	<0.01	0.11

5.2 Deep aquifer water quality

Table 10 provides a summary of water quality results obtained from bores targeting the deep aquifers (M313W, M314W, M324W, M325W, AN019F, GR067V, M162V, M134GMV and MB1-D). This provides an indication of water quality ranges for each parameter analysed based on aquifer type. Results for some parameters between different monitoring locations show a high degree of variation which is likely to be attributable to the spatial heterogeneity and low permeability of the hydrogeological system. In addition, as displayed by the groundwater pressure data, groundwater recovery for some sites is slow and this is likely to result in variations in some parameters at the same monitoring location. Overall, a review of this data indicates that there are no notable trends. In general, this data shows that:

- Groundwater quality of the Fort Cooper Coal Measures aquifer is fresh to saline[4]; and
- Groundwater quality of the Moranbah Coal Measures is fresh to saline.

Table 10: Background Water Quality – Deep Monitoring Bores

Parameters	Units	Fort Cooper Coal Measures		Moranbah Coal Measures	
		Min	Max	Min	Max
Field pH		6.79	11.8	7.27	9.42
Electrical Conductivity	µS/cm	1170	15700	1710	16000
Total Dissolved Solids	mg/L	707	9910	1160	9810
Hydroxide Alkalinity (OH-) as CaCO3	mg/L	<1	456	<1	<1
Carbonate Alkalinity as CaCO3	mg/L	<1	157	<1	456
Bicarbonate Alkalinity as CaCO3	mg/L	<1	1380	159	2380
Total Alkalinity as CaCO3	mg/L	222	1380	159	2420
Sulphate, SO4	mg/L	<1	68	<1	134
Chloride, Cl	mg/L	188	4920	198	5850
Calcium - Dissolved	mg/L	<1	276	2	209
Magnesium - Dissolved	mg/L	<1	256	<1	62
Sodium - Dissolved	mg/L	199	2590	212	3490
Potassium - Dissolved	mg/L	10	73	6	1450
Arsenic-Dissolved	mg/L	<0.001	0.005	<0.001	0.013
Beryllium-Dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Barium-Dissolved	mg/L	0.005	12.2	0.236	23
Cadmium-Dissolved	mg/L	<0.001	<0.001	<0.001	0.001
Chromium-Dissolved	mg/L	<0.001	0.004	<0.001	0.018
Cobalt-Dissolved	mg/L	<0.001	0.004	<0.001	0.01
Copper-Dissolved	mg/L	<0.001	0.582	<0.001	7.08
Lead-Dissolved	mg/L	<0.001	0.459	<0.001	2.19
Manganese-Dissolved	mg/L	<0.001	0.304	0.007	0.446
Molybdenum	mg/L	0.006	0.114	0.001	0.091
Nickel-Dissolved	mg/L	<0.001	0.02	<0.001	0.05
Selenium	mg/L	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	0.406	8.18	1.18	10.8
Vanadium-Dissolved	mg/L	<0.01	<0.01	<0.01	0.02
Zinc-Dissolved	mg/L	<0.005	2.16	<0.005	0.568
Boron	mg/L	0.24	1.17	0.46	2.4
Iron	mg/L	<0.05	2.94	0.07	3
Mercury-Dissolved	mg/L	<0.0001	0.42	<0.0001	0.87
Fluoride, F	mg/L	0.2	4.5	0.4	2.6
Phosphate as P in water	mg/L	<0.01	0.62	<0.01	17.4

[4] Environmental Protection Agency (EPA) of South Australia

6 SPRINGS AND GROUNDWATER DEPENDANT ECOSYSTEMS

As outlined in the 2022 Bowen UWIR, no relevant springs or Groundwater Dependent Ecosystems (GDE's) have been identified in the MGP or BGP areas.

7 CONCLUSION

Key findings of the 2024 UWIR annual review for the water production are:

MGP:

- Based on the observed water produced since the 2022 Bowen UWIR, there has been 38.8 ML less water produced than was forecasted in the 2022 UWIR;
- The updated water production forecast is 1% less than the modelled water production to the end of 2023. Given the updated water production forecast is less than what was modelled in the 2022 UWIR, the predicted impacts are expected to be less than originally modelled, an update of the of the 2022 UWIR is not proposed. Accordingly, a material change to the Immediately Impacted Area (IAA) or the Long-Term Affected Area (LAA) is not expected; and
- The maps prepared under s.376(1)(b)(iv and v) do not require updating as there has not been a material change in the information or predictions used to prepare the maps.

BGP:

- For PL486, a combined water production of 42.5 ML was produced over 2022 and 2023 compared to a modelled 75.6 ML for the same period in the 2022 Bowen UWIR. The updated water production is forecasted to be 56.7% less than modelled water production for 2024. As a result, there is no material change in the information or predictions made in the 2022 Bowen UWIR. Based on this, no change is proposed to the modelling undertaken for the 2022 Bowen UWIR;
- Three production testing wells in ATP 1103 were active in 2020 (RH098A, RH099A and RH100A), with a combined water production of 5.3 ML since the 2022 Bowen UWIR, with no further production occurring during this reporting period. This amount of water produced is below the Peak Downs reference pilot site. Therefore, any IAA or LAA arising from production testing wells prior to this reporting period will be smaller than that associated with the reference pilot site;
- No landholder bores are located within the 1-kilometre IAA radius from any production testing wells. Given the updated water production forecast is less than what was modelled in the 2022 UWIR, the predicted impacts are expected to be less than originally modelled, an update of the of the 2022 UWIR is not proposed; and
- The maps prepared under s.376(1)(b)(iv and v) do not require updating as there has not been a material change in the information or predictions used to prepare the maps.

As identified above, there is no material increase in observed and predicted water production for the MGP or BGP, therefore the modelling conducted in the 2022 UWIR overestimates groundwater impacts and an update of the 2022 UWIR is not proposed.

Key findings of the 2024 annual review for water levels monitoring are:

- There is no apparent influence of CSG production to the Quaternary alluvium, weathered Tertiary basalt, Tertiary sediment and Rewan aquifers in which these bores are installed. Decline in water levels noted for the FCCM are observed to correlate to the water production in CSG wells and consequential drawdown in the underlying MCM. This suggests that there is some transmission of impacts from the MCM to the shallower FCCM. This relationship will continue to be monitored.

Key findings of the 2024 annual review for water quality monitoring are:

- A review of this data indicates that there are no notable trends for both the shallow and deep aquifers.

APPENDIX B: Water Level Results

Shallow Monitoring Bores

Bore Name	SWL (mAHD)																												
	9/06/2012	13/12/2012	8/04/2013	25/05/2013	6/08/2013	6/12/2013	5/05/2014	19/08/2014	5/12/2014	11/03/2015	17/05/2015	27/07/2015	13/11/2015	2/03/2016	13/05/2016	29/08/2016	15/11/2016	15/06/2017	12/11/2017	1/06/2018	17/11/2018	24/05/2019	12/11/2019	22/11/2020	24/05/2021	30/10/2021	9/06/2022	29/11/2022	23/05/2023	21/11/2023
M339W	200.426	200.456	200.43	200.451	200.462	200.546	200.49		200.56	200.533	200.416	200.398	200.556	200.466	200.456	200.426	200.500	200.507	200.498	200.520	200.600	200.620	200.660	200.750	200.680	200.820	200.780	200.870	200.769	200.439
M225W	206.298	206.641	206.737	206.8	207.455	207.152	207.11		207.27	207.349	207.257	207.23	207.402	207.215	207.245	207.248	207.316	207.54	207.685	207.75	207.9		207.78	207.43	207.2	207.14	207.01	207.03	206.987	206.987
M340W	207.621	208.973	208.118	208.216	208.261	208.507	208.6		208.7	208.771	208.753	208.805	208.918	208.869	208.9	208.761	205.946	203.032	dry											
M230W	208.495	208.705	208.715	208.837	208.865	209.062	209.07		209.2	209.204	209.106	209.058	209.145	208.884	208.922	208.863	208.992	208.629	208.591	208.214	207.7	206.94	205.95	203.17	202.6	Decomissioned and replaced with M300W				
M300W																										200.1	204.496	204.437	202.64	201.06
GW004A																							235.162	234.692	234.542	234.442	234.542	234.437	234.202	234.027
GW007A																										dry				
M250W	233.288	233.248	233.238	233.232	233.248	233.308	233.26		233.33	233.289	233.25	233.221	233.25	233.243	233.258	233.328	233.237	233.283	233.273	233.29	233.32	233.34	233.34			233.55	233.39		233.394	233.384
AN021F															237.06		242.34		238.47	239.06	239.52		240.52	241.52	241.83	242.11	242.44	242.7	242.54	242.75
M224W	211.675	211.365	211.45	211.705	211.42	211.11	210.89	210.65	210.49	210.561	210.419	210.277	209.982	210.02	209.969		209.852	210.354	210.355	210.08	209.69	209.57	209.36	208.96	207.84	208.76	208.8	209.22	209.905	209.63
M222W	202.414	202.974	203.209		203.819	204.014	204.3	204.65	204.95	205.21	205.44	205.54	205.994	205.929	205.969	206.014	206.014	206.149	206.301	206.3	206.28	206.22	206.22	206.22	205.98	206	205.94	206.02	206.11	206.26
MB1S																							263.51	262.72	262.75	262.7	262.745	262.7875	262.62	262.18
GW004B																							232.09	230.95	231.80	231.74	232.74	231.67	231.45	232.74
AEN1214																								215.12	217.32	215.32		216.18	217.32	215.32
AEN1234																								185.34	185.44	185.35	185.45	185.35	185.602	185.644
AEN1063																								143.12	142.845	142.53	142.64	142.965	143.36	142.892
MB12																				298.54	286.88	286.31	294.26	296.01	298.28	298.51	298.62	298.65	299	298.87
AN020F														238.37	238.366	238.48	238.44		237.18	238.61	238.39	238.36	238.36	237.99	237.62	237.37	236.86	236.61	236.23	no access

APPENDIX C: Water Quality Results

Shallow Monitoring Bores

Monitoring Bore ID	Sample Date	Field pH	Electrical Conductivity (µS/cm)	Total Dissolved Solids (mg/L)	Hydroxide Alkalinity (OH-) as CaCO3 (mg/L)	Carbonate Alkalinity as CaCO3 (mg/L)	Bicarbonate Alkalinity as CaCO3 (mg/L)	Total Alkalinity as CaCO3 (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Aluminium - Dissolved (mg/L)	Arsenic- Dissolved (mg/L)	Beryllium- Dissolved (mg/L)	Barium- Dissolved (mg/L)	Cadmium- Dissolved (mg/L)	Chromium- Dissolved (mg/L)	Cobalt- Dissolved (mg/L)
M339W	11/12/2012	6.46	38000	26000	<5	<5	680	680	980	15000	150	670	10000	110		<0.001	<0.0005	0.056	0.0004	0.006	<0.001
M339W	4/04/2013	6.28	36000	22000	<5	<5	690	690	830	14000	160	700	9700	120		<0.001	<0.0005	0.057	0.0003	0.007	<0.001
M339W	21/05/2013	8.09	37000	29000	<5	<5	680	680	1100	17000	150	710	10000	120		<0.001	<0.0005	0.067	0.0005	0.004	<0.001
M339W	7/08/2013	6.42	37000	25000	<5	<5	660	660	990	15000	190	670	13000	150		<0.002	<0.0005	0.061	0.0004	0.003	<0.001
M339W	5/12/2013	6.60	39000	28000	<5	<5	660	660	1100	16000	160	740	11000	110		<0.001	<0.0005	0.055	0.0005	0.006	<0.001
M339W	11/05/2014	6.60	37900	24600	<1	<1	698	698	1020	13800	150	722	7740	100	<0.5						
M339W	9/12/2014	6.46	39300	25400	<1	<1	706	706	893	13700	158	780	8220	138	<0.05						
M339W	10/03/2015	6.53	39000	27100	<1	<1	644	644	932	13900	183	682	8360	98		<0.005	<0.005	0.058		<0.005	<0.005
M339W	16/05/2015	6.67	37500	24200	<1	<1	647	647	1140	12200	167	668	7770	82	<0.01	<0.001	<0.001	0.124	0.0007	0.002	<0.001
M339W	27/07/2015	6.53	38200	25400	<1	<1	658	658	1020	13500	180	676	7600	90	<0.01	<0.001	<0.001	0.051	0.0004	<0.001	<0.001
M339W	16/11/2015	6.43	32300	21200	<1	<1	714	714	987	12700	147	669	7170	81	<0.05	<0.005	<0.005	0.053	<0.0005	<0.005	<0.005
M339W	2/03/2016	7.56	39800	21200	<1	<1	712	712	1000	13400	160	747	8710	104		<0.001	<0.001	0.050		0.007	<0.001
M339W	13/05/2016		39000	24400	<1	<1	681	681	1020	13000	178	712	7850	89	<0.01	0.001	<0.001	0.055		0.010	<0.001
M339W	29/08/2016	8.37	41300	28200	<1	43	714	757	993	12600	170	688	7790	93		<0.005	<0.005	0.058		0.010	<0.005
M339W	15/11/2016	7.13	37100	22900	<1	<1	652	652	1050	12600	171	743	8440	92	<0.01	<0.001	<0.001	0.055	0.0001	0.002	<0.001
M339W	13/06/2017		38600	25100	<1	<1	726	726	964	13500	186	780	9040	105	<0.05						
M339W	12/11/2017	6.99	39800	27100	<1	<1	708	708	923	13700	204	792	9570	102		<0.005	<0.005	0.062		0.008	<0.005
M339W	1/06/2018	6.58	39300		<1	<1	644	644	974	12900	181	772	8990	97	<0.05						
M339W	17/11/2018	6.51	42769	26800	<1	<1	661	661	916	11600	174	750	7800	96	<0.05	<0.005	<0.005	0.057		0.010	<0.005
M339W	27/05/2019	6.47	37398	26200	<1	<1	632	632	958	13600	174	769	8370	95	<0.05						
M339W	12/11/2019	6.69	38760	23400	<1	<1	669	669	936	13800	142	680	7860	88	<0.05	<0.005	<0.005	0.052		0.009	<0.005
M339W	22/11/2020	6.73	38200	26800	<1	<1	677	677	941	14000	154	708	8150	91		<0.005	<0.005	0.058		0.010	<0.005
M339W	30/10/2021	6.43	40600	28600	<1	<1	617	617	925	12900	168	729	8570	99	<0.05						
M339W	28/11/2022	7.50	33700	26600	<1	<1	621	621	976	13600	166	700	8610	94		<0.005	<0.005	0.066		0.014	<0.005
M339W	22/11/2023	6.72	41800	26800	<1	<1	659	659	934	13400	156	725	8380	91	<0.05	<0.005		0.062	<0.0005	<0.005	<0.005
M225W	3/04/2013	7.54	28000	17000	<5	<5	810	810	710	11000	150	510	7200	84		<0.001	<0.0005	0.063	0.0006	0.003	<0.001
M225W	21/05/2013	6.53	28000	21000	<5	<5	790	790	660	10000	150	520	7500	82		0.001	<0.0005	0.140	0.0006	0.002	0.001
M225W	8/08/2013	6.59	29000	20000	<5	<5	780	780	700	11000	160	480	7500	75		<0.001	<0.0005	0.120	0.0010	0.002	0.001
M225W	5/12/2013	6.84	30000	21000	<5	<5	780	780	780	11000	180	490	9500	95	<0.05	<0.001	<0.0005	0.120	0.0007	0.002	0.002
M225W	6/05/2014	6.98	29900	19400	<1	<1	745	745	369	9940	142	495	5440	72	<0.01						
M225W	5/12/2014	6.73	30500	20100	<1	<1	808	808	617	9880	151	523	6450	76							
M225W	11/03/2015	6.82	30100	20000	<1	<1	716	716	827	10200	163	508	6600	75	<0.01	<0.005	<0.005	0.075		<0.005	<0.005
M225W	17/05/2015	6.89	30200	19800	<1	<1	780	780	884	9850	161	518	6430	64	<0.01	0.001	<0.001	0.112	0.0012	0.001	<0.001
M225W	28/07/2015	6.96	28700	19300	<1	<1	790	790	735	9660	157	478	5670	65	<0.05	0.001	<0.001	0.089	0.0006	<0.001	<0.001
M225W	16/11/2015	6.38	23700	17400	<1	<1	826	826	738	9870	134	485	5460	59		<0.005	<0.005	0.055	0.0006	<0.005	<0.005
M225W	2/03/2016	7.71	30500	19400	<1	<1	817	817	721	10300	153	541	6530	76	<0.01	<0.001	<0.001	0.053		0.002	<0.001
M225W	13/05/2016	7.57	29600	18400	<1	<1	779	779	752	9390	158	532	6570	66		<0.001	<0.001	0.062	0.0005	0.002	<0.001
M225W	29/08/2016	7.45	29600	17900	<1	<1	799	799	727	9750	158	532	6220	68	<0.01	<0.001	<0.001	0.065		0.002	<0.001
M225W	15/11/2016	7.31	30200	19800	<1	<1	778	778	711	9620	169	567	6560	72	<0.01	<0.001	<0.001	0.068	0.0006	0.002	<0.001
M225W	13/06/2017		29900	18300	<1	<1	827	827	786	10800	150	492	6780	66							
M225W	12/11/2017	7.15	30700	20100	<1	<1	814	814	691	10400	144	507	5930	64		<0.001	<0.001	0.060		0.003	<0.001
M225W	31/05/2018	7.16	30100	19200	<1	<1	701	701	701	9900	169	578	6960	70	<0.05						
M225W	21/11/2018	6.74	29700	19000	<1	<1	748	748	723	10200	159	566	6470	68	<0.05	<0.005	<0.005	0.103		<0.005	<0.005
M225W	25/05/2019	6.59	29500	19500	<1	<1	738	738	745	10700	159	541	6250	70							
M225W	7/11/2019	6.91	30400	21800	<1	<1	733	733	715	10200	149	566	6670	71	<0.05	<0.005	<0.005	0.067		<0.005	<0.005
M225W	19/11/2020	6.81	29700	20000	<1	<1	758	758	746	10600	179	518	6130	68	<0.05	<0.005	<0.005	0.000		<0.005	<0.005
M225W	25/10/2021	7.99	25600	21100	<1	<1	749	749	725	9950	168	567	6640	73	<0.05	<0.005	<0.005	0.062		<0.005	<0.005
M225W	23/11/2022	6.61	26600	19700	<1	<1	681	681	712	10400	169	523	6780	68	<0.05	<0.005	<0.005	0.080		0.008	<0.005
M225W	20/11/2023	6.64	31200	20900	<1	<1	718	718	722	10400	164	600	6990	74	<0.05			0.067	0.7	<0.005	<0.005
M340W	11/12/2012	6.60	8600	5200	<5	<5	620	620	240	2900	57	110	2100	25		<0.001	<0.0005	0.056	0.0002	<0.001	0.000
M340W	4/04/2013	6.30	8300	5200	<5	<5	620	620	230	2600	62	120	1900	32		<0.001	<0.0005	0.056	<0.0001	<0.001	0.002
M340W	22/05/2013	6.81	8400	5000	<5	<5	610	610	240	2700	59	120	1900	25		<0.001	<0.0005	0.057	<0.0001	<0.001	0.002
M340W	7/08/2013	6.63	8600	5000	<5	<5	620	620	230	2700	55	110	2000	26		<0.001	<0.0005	0.061	<0.0001	<0.001	0.002
M340W	5/12/2013	6.63	9100	5700	<5	<5	610	610	260	2800	56	110	2200	27		<0.001	<0.0005	0.058	<0.0001	<0.001	0.002
M340W	10/05/2014	6.74	10000	6500	<1	<1	661	661	246	3150	71	141	1920	25	<0.01						
M340W	8/12/2014	6.69	11100	6390	<1	<1	708	708	257	3400	85	172	2050	33	<0.01						
M340W	12/03/2015	6.81	11400	6500	<1	<1	689	689	269	3760	102	174	2240	32		<0.001	<0.001	0.068		<0.001	0.002
M340W	17/05/2015	6.82	11700	6900	<1	<1	679	679	383	3740	96	179	2060	27	<0.01	<0.001	<0.001	0.194	<0.0001	<0.001	0.001
M340W	28/07/2015	6.68	11400	6280	<1	<1	668	668	319	3670	100	177	2120	29	<0.01	<0.001	<0.001	0.113	<0.0001	<0.001	<0.001
M340W	16/11/2015	6.38	10700	7320	<1	<1	727	727	322	3850	89	193	2180	28	<0.01	<0.001	<0.001	0.057	<0.0001	0.001	0.001
M340W	2/03/2016	8.43	12600	6400	<1	43	681	725	320	4060	101	203	2480	33		<0.001	<0.001	0.060		<0.001	0.002
M340W	13/05/2016	7.67	12400	7140	<1	<1	693	693	342	3790	100	200	2310	30	<0.01	<0.001	<0.001	0.070	<0.0001	<0.001	0.001
M340W	29/08/2016	8.49	13000	7250	<1	94	636	730	345	3780	107	198	2340	30		<0.001	<0.001	0.073		0.001	0.003
M340W	15/11/2016	7.44	13100	7430	<1	<1	668	668	371	4310	109	216	2420	31		<0.001	<0.001	0.075	<0.0001	0.002	0.002
M340W	13/06/2017	Dry	11300	6590	<1	<1	651	651	353	3690	90	180	2180	27	<0.01						
M230W	11/12/2012	7.15	5600	3300	<5	<5	420	420	64	1600	55	93	1200	18		0.002	<0.0005	0.150	<0.0001	<0.001	<0.001
M230W	3/04/2013	6.66	5400	3200	<5	<5	420	420	66	1600	60	96	1000	19		0.002	<0.0005	0.170	<0.0001	<0.001	0.002
M230W	21/05/2013	7.01	5300	3300	<5	<5	410	410	60	1700	60	96	1100	18		0.002	<0.0005	0.180	<0.0001	<0.001	0.002
M230W	7/08/2013	7.05	5600	3000	<5	<5	400	400	77	1700	58	93	1100	16		0.002	<0.0005	0.180	<0.0001	<0.001	<0.001
M230W	7/12/2013	6.96	5900	3700	<5	<5	390	390	83	1700	56	85	1200	15		0.002	<0.0005	0.180	<0.0001	<0.001	0.002
M230W	11/05/2014	6.99	6010	3910	<1	<1	426	426	82	1660	67	100	1040	14	<0.01						
M230W	5/12/2014	7.05	6100	3120	<1	<1	418	418	73	1490	70	103	970	17	<0.01						
M230W	12/03/2015	7.00	6080	3360	<1	<1	410	410	69	1730	74	100	1030	16		0.002	<0.001	0.195		<0.001	0.003
M230W	17/05/2015	7.00	6180	3580	<1	<1	407	407	97	1550	75	106	985	14	<0.01	0.002	<0.001	0.283	<0.0001	<0.001	0.003
M230W	28/07/2015	7.05	6000	3210	<1	<1	404	404	87	1500	74	107	1050	16	<0.01	0.002	<0.001	0.237	<0.0001	<0.001	0.001
M230W	15/11/2015	6.62	6260	3440	<1	<1	419	419	82	1840	69	101	891	12	<0.01	0.002	<0.001	0.175	<0.0001	0.002	<0.001
M230W	2/03/2016	7.82	6350	3350	<1	<1	431	431	84	1760	68	104	995	17		0.001	<0.001	0.164		<0.001	0.001
M230W	13/05/2016	7.78	6120	3500	<1	<1	419	419	80	1760	72	110	1050	16	<0.01	0.001	<0.001	0.184	<0.0001	<0.001	<0.001
M230W	29/08/2016	7.48	6130	3450	<1	<1	417	417	79	1680	76	111	1050	18		0.001	<0.001	0.186		<0.001	<0.001
M230W	15/11/2016	7.51	6220	3500	<1	<1	414	414	83	1750	68	117	1100	15		0.002	<0.001	0.186	<0.0001	<0.001	<0.001
M230W	13/06/2017		6270	3470	<1	<1	442	442	78	1870	65	110	1100	15	<0.01						
M230W	12/11/2017	7.50	6400	3710	<1	<1	420	420	79	1820	70	114	1070	15		0.002	<0.001	0.206		<0.001	0.005
M230W	1/06/2018	6.95	6860	3960	<1	<1	380	380	99	1920	78	121	1170	17							
M230W	21/11/2018	6.83	7260	4140	<1	<1	401	401	104	2140	98	158	1300	17		0.002	<0.001	0.207		<0.001	0.003
M230W	25/05/2019	6.74	7450	4410	<1	<1	397	397	117	2480	101	163	1350	18							
M230W	10/11/2019	6.88	7420	4770	<1	<1	403	403	110	2330	93	150	1260	18		0.002	<0.001	0.206		<0.001	0.004
M230W	1/11/2020	6.90	7670	4630	<1	<1	416	416	110	2520	109	159	1280	18							
M230W	19/11/2021	7.21	7620	4390	<1	<1	415	415	113	2540	128	208	1580	22		0.003	<0.001	0.283		<0.001	0.005
M300W	26/10/2021	7.61	32600	22400	<1	<1	531	531	550	10700	297	687	6430	79	<0.05						
M300W	7/06/2022	6.30	31800	23300	<1	<1	558	558	603	11400	312	805	7140	87	<0.05						
M300W	22/11/2022	6.56	33300	24000	<1	<1	598	598	633	11900	362	808	7110	88	<0.05						
M300W	19/11/2023	6.66	33000	27300	<1	<1	540	540	602	11500	297	799	7010	82	<0.05	<0.005		0.128	0.5	<0.005	<0.005
M250W	13/12/2012	5.42	2400	1400	<5	<5	61	61	54	700	14	39	380	11		<0.001	<0.0005	0.100	<0.0001	0.002	<0.001
M250W	6/04/2013	5.77	2400	1600	<5	<5	69	69	69	660	17	45	490	13		<0.001	<0.0005	0.110	<0.0001	0.001	<0.001
M250W	25/05/2013	5.86	2500	1600	<5	<5	67	67	83	730	18	46	510	13		<0.001	<0.0005	0.100	<0.0001	0.003	<0.001
M250W	6/08/2013	5.82	2300	1300	<5	<5	72	72	81	730	19	43	450	11		<0.001	<0.0005	0.100	<0.0001	0.002	<0.001
M250W	5/12/2013	5.92	2500	1600	<5	<5	60	60	84	710	14	39	480	12		<0.001	<0.0005	0.083	<0.0001	0.002	<0.001
M250W	9/05/2014	5.64	2440	1590	<1	<1	76	76	76	682	13	43	393	12	<0.01						
M250W	7/12/2014	5.65	2530	1380	<1	<1	58	58	76	717	13	45	432	11	<0.01						
M250W	10/03/2015	5.50	2540	1580	<1	<1	58	58	92	768	19	42	420	10		<0.001	<0.001	0.070		0.003	<0.001
M250W	18/05/2015	5.75	2560	1420	<1	<1	55	55	92	763	17	44	398	10	<001	<0.001	<0.001	0.070	<0.0001	0.002	0.001
M250W	29/07/2015	5.48	2430	1430	<1	<1	59	59	89	729	15	44	387	11	<0.01	<0.001	<0.001	0.078	<0.0001	0.003	0.001
M250W	16/11/2015	5.72	2170	1300	<1	<1	72	72	76	664	12	38	344	9	<0.01	<0.001	<0.001	0.061	<0.0001	0.001	0.004
M250W	2/03/2016	6.54	2650	1490	<1	<1	53	53	92	787	15	45	408	12		<0.001	<0.001	0.047		0.002	<0.001
M250W	13/05/2016	6.74	2620	1530	<1	<1	116	116	95	774	18	52	461	11	<0.01	<0.01	<0.001	<0.001		0.076	<0.0001
M250W	29/08/2016	7.76	2600	1440	<1	<1	64	64	81	678	14	44	396	10		<0.001	<0.001	0.055		0.002	0.001
M250W	15/11/2016	6.36	2460	1400	<1	<1	60	60	86	715	12	46	411	10	<0.01	<0.001	<0.001	0.050	<0.0001	0.002	0.001
M250W	18/06/2017		2450	1360			63	63	80	708	12	42	402	10	<0.01						
M250W	13/11/2017	7.23	2650	1620			55	55	106	794	20	50	465	11		<0.001	<0.001	0.072		0.002	0.005
M250W	2/06/2018	5.80	2530					55	77	708	15	48	440	10	<0.01						
M250W	22/11/2018	5.66	2510	1520	<1	<1	62	62	89	746	15	48	420	11	<0.01	<0.001	<0.001	0.057		0.002	0.001
M250W	26/05/2019	5.45	2480	1400	<1	<1	58	58	88	790	16	48	407	11	<0.01						
M250W	7/11/2019	5.93	2510	1560	<1	<1	59	59	87	744	20	46	414	11	<0.01	<0.001	<0.001	0.059		0.002	0.004
M250W	21/12/2021	5.65	2420	1550	<1	<1	60	60	80	767	20	46	438	12		<0.001		0.063		0.002	0.003
M250W	25/05/2023	5.80	2560	1530	<1	<1	60	60	77	764	17	45	390	10		<0.001	<0.001	0.056		<0.001	0.005
M250W	23/11/2023	5.96	2590	2200	<1	<1	60	60	77	764	17	45	390	10	<0.01	<0.001		0.057	<0.0001	<0.001	0.002
AN021F	10/12/2022	12.60	13800	5470	2420	80	<1	2500	28	1280	312	<1	1330	580		<0.001	<0.001	1.060		0.002	<0.001
M222W	16/06/2012	6.43	9520	6690	<1	<1	457	457	85	3140	326	355	1120	14		0.003	<0.001	3.900	<0.0001	0.002	0.002
M222W	14/12/2012	6.52	9300	6500	<5	<5	420	420	78	3500	290	340	1000	14		<0.001	<0.0005	1.200	<0.0001	<0.001	0.002
M222W	5/04/2013	6.22	9100	6500	<5	<5	300	300	140	4100	320	440	1100	14		<0.001	<0.0005	0.260	<0.0001	<0.001	<0.001
M222W	26/05/2013	6.67	9400	7500	<5	<5	290	290	100	3200	350	450	1100	14		0.001	<0.0005	0.240	<0.0001	<0.001	<0.001
M222W	9/08/2013	6.17	9200	6200	<5	<5	310	310	110	3400	340	400	1100	11		0.003	<0.0005	0.230	<0.0001	<0.001	<0.001
M222W	6/12/2013	6.26	9700	9600	<5	<5	300	300	130	3300	440	380	1400	12		0.006	<0.0005	0.240	<0.0001	<0.001	<0.001
M222W	10/05/2014	6.16	9480	6160	<1	<1	316	316	129	3420	363	428	1010	10	<0.01						
M222W	19/08/2014	6.81	9090	8950	<1	<1	275	275	128	3450	365	448	1020	12	<0.01						
M222W	4/12/2014	6.25	10200	7520	<1	<1	303	303	116	3330	361	451	1080	12	<0.01						
M222W	11/03/2015	6.55	10000	6810	<1	<1	295	295	122	3450	395	395	999	10		0.003	<0.001	0.248		<0.001	<0.001
M222W	17/05/2015	6.32	9890	7160	<1	<1	304	304	165	3480	374	426	943	9	<0.01	0.011	<0.001	0.202	<0.0001	<0.001	<0.001
M222W	27/07/2015	6.23	9670	6150	<1	<1	290	290	129	3420	385	434	956	10	<0.01	0.004	<0.001	0.226	<0.0001	<0.001	<0.001
M222W	17/11/2015	6.10	10200	6820	<1	<1	296	296	124	3560	352	376	932	10	0.36	0.004	<0.001	0.220	<0.0001	<0.001	<0.001
M222W	2/03/2016	7.19	10700	5190	<1	<1	318	318	118	3560	342	434	1040	12		0.003	<0.001	0.219		0.002	<0.001
M222W	13/05/2016	7.22	9890	5740	<1	<1	282	282	177	3340	376	456	1040	10	<0.01	0.009	<0.001	0.201	<0.0001	<0.001	<0.001
M222W	29/08/2016	8.16	10400	7370	<1	<1	280	280	155	3170	414	474	1080	10		0.010	<0.001	0.184		<0.001	<0.001
M222W	15/11/2016	6.62	10300	6300	<1	<1	292	292	140	3660	407	492	1170	11	<0.01	0.005	<0.001	0.252	<0.0001	<0.001	<0.001
M222W	13/06/2017		10600	6320			310	310	145	3920	379	448	1140	11	<0.01						
M222W	7/11/2017	6.82	10600	6800			271	271	126	3670	399	466	1080	10		0.005	<0.001	0.288		<0.001	<0.001
M222W	29/05/2018	6.29	11000					286	131	4020	417	478	1170	12	<0.01						
M222W	18/11/2018	6.19	11000	6970	<1	<1	282	282	130	3630	406	494	1080	11	<0.01	0.004	<0.001	0.268		<0.001	<0.001
M222W	24/05/2019	6.09	10700	7230	<1	<1	261	261	159	4000	432	506	1180	10							
M222W	10/11/2019	6.09	10700	8400	<1	<1	275	275	161	3780	404	470	1110	11	<0.01	0.007	<0.001	0.248		<0.001	<0.001
M222W	20/11/2020	6.30	11100	8600	<1	<1	292	292	155	4090	448	513	1200	11	<0.01						
M222W	28/10/2021	5.92	11400	9990	<1	<1	243	243	163	3800	438	481	1110	10	<0.01						
M222W	25/11/2022	6.06	10800	8830	<1	<1	249	249	178	4140	422	518	1180	11	<0.01	0.005	<0.001	0.287		<0.001	<0.001
M222W	21/11/2023	6.14	11700	7850	<1	<1	252	252	196	3940	452	529	1160	11	<0.01	0.006		0.277	<0.0001	<0.001	<0.001
M224W	16/06/2012	6.22	29500	22300	<1	<1	355	355	1600	9560	831	1260	4170	11		<0.050	0.010	0.078	<0.0001	<0.001	0.011
M224W	15/12/2012	6.24	28000	22000	<5	<5	340	340	1500	14000	780	1100	4500	13		0.003	<0.0005	0.110	<0.0001	<0.001	0.012
M224W	7/04/2013	5.73	25000	20000	<5	<5	360	360	1300	11000	740	1000	4300	16		0.002	<0.0005	0.200	0.0002	<0.001	0.015
M224W	25/05/2013	6.11	18000	14000	<5	<5	220	220	880	6200	610	680	2600	17		0.004	<0.0005	0.140	<0.0001	<0.001	0.007
M224W	6/08/2013	6.07	23000	17000	<5	<5	240	240	1200	9100	840	980	4500	12		0.005	<0.0005	0.130	<0.0001	<0.001	0.010
M224W	6/12/2013	6.15	28000	27000	<5	<5	280	280	6200	11000	1000	1400	6200	13	<0.05	0.007	<0.0005	0.130	<0.0001	<0.001	0.012
M224W	10/05/2014	6.24	27200	17700	<1	<1	253	253	1250	10200	779	1080	3690	11	<0.01						
M224W	19/08/2014	6.34	27600	21000	<1	<1	192	192	1060	10800	822	1300	4590	13	<0.01						
M224W	4/12/2014	6.14	31600	22900	<1	<1	186	186	842	9710	764	1320	4080	13							
M224W	12/03/2015	6.46	22900	16500	<1	<1	174	174	710	8850	661	842	3240	10	<0.01	0.004	<0.001	0.157		<0.001	0.016
M224W	17/05/2015	6.36	21000	16800	<1	<1	184	184	978	7200	640	768	2760	8	<0.01	0.006	<0.001	0.164	<0.0001	<0.001	0.021
M224W	27/07/2015	6.13	24700	17100	<1	<1	188	188	948	8670	712	984	3390	9	<0.01	0.008	<0.001	0.157	0.0001	<0.001	0.019
M224W	17/11/2015	6.13	27700	17500	<1	<1	158	158	890	9930	613	870	3320	7		0.008	<0.001	0.163	<0.0001	<0.001	0.027
M224W	2/03/2016	7.38	10800	5950	<1	<1	128	128	656	3350	316	360	1600	6	<0.01	0.005	<0.001	0.065		<0.001	0.009
M224W	13/05/2016	7.48	17900	11100	<1	<1	202	202	799	5860	512	664	2680	9		0.008	<0.001	0.159	<0.0001	<0.001	0.011
M224W	29/08/2016	7.21	4240	2360	<1	<1	101	101	541	1020	172	107	543	5		0.003	<0.001	0.060		<0.001	0.005
M224W	15/11/2016	6.77	17700	11700	<1	<1	192	192	802	6210	570	696	2650	8	<0.01	0.008	<0.001	0.182	<0.0001	<0.001	0.017
M224W	13/06/2017		17600	11000	<1	<1	238	238	1070	6490	676	630	2400	9							
M224W	07/11/2017	6.97	20400	14100	<1	<1	232	232	1000	7120	774	778	2650	10		<0.001	0.193	<0.001		0.015	<0.001
M224W	29/05/2018	6.28	27200					304	1240	10100	870	1090	4100	10							
M224W	18/11/2018	6.33	5490	3630	<1	<1	141	141	574	1270	264	137	669	5	<0.01	<0.001	<0.001	0.045		<0.001	0.003
M224W	24/05/2019	6.53	12800	8730	<1	<1	152	152	907	4490	448	440	1960	6	<0.01						
M224W	10/11/2019	6.12	18400	15200	<1	<1	141	141	644	6430	426	628	2760	6	<0.01	0.006	<0.001	0.126		<0.001	0.026
M224W	20/11/2020	6.13	20100	15600	<1	<1	137	137	575	7590	413	670	2980	5	<0.01						
M224W	28/10/2021	6.22	22600	18800	<1	<1	209	209	718	7490	582	767	3150	7	<0.01						
M224W	25/11/2022	6.03	25600	22600	<1	<1	336	336	1210	10700	758	1170	5030	8	<0.01	<0.005	<0.005	0.169		<0.001	0.017
M224W	21/11/2023	6.38	11600	7650	<1	<1	168	168	706	3650	389	361	1620	5	<0.01	0.001		0.069	<0.0001	<0.001	0.008
AN020F	13/05/2016	6.20	10800	6210	<1	<1	22	22	<1	3750	429	178	1550	29	<0.01	<0.001	<0.001	3.720	<0.0001	<0.001	0.001
AN020F	15/11/2016	6.32	10600	7210	<1	<1	21	21	1	4030	439	174	1450	26		<0.001	<0.001	3.620		<0.001	<0.001
AN020F	15/11/2017	7.39	10900	7010	<1	<1	47	47	<1	3790	456	182	1650	29		<0.001	<0.001	3.420		<0.001	<0.001
AN020F	15/11/2018	7.05	11200	7280	<1	<1	126	126	<1	3800	460	203	1460	24		<0.001	<0.001	3.880		<0.001	<0.001
AN020F	11/11/2019	7.58	10400	7310	<1	<1	20	20	<1	3830	457	174	1580	29		<0.001	<0.001	3.660		<0.001	<0.001
AN020F	21/11/2020	7.03	10300	8090	<1	<1	5	5	<1	3990	51	<1	2160	21		0.000	0.000	5.340			
AN020F	30/10/2021	7.10	9590	9070	<1	<1	27	27	<1	3760	420	169	1540	28		<0.001	<0.001	3.700		<0.001	<0.001
AN020F	10/12/2022	6.02	10800	7610	<1	<1	3	3	<1	3800	380	147	1500	27		<0.001	<0.001	3.840		<0.001	<0.001

Monitoring Bore ID	Sample Date	Copper- Dissolved (mg/L)	Lead- Dissolved (mg/L)	Manganese- Dissolved (mg/L)	Molybdenum (mg/L)	Nickel- Dissolved (mg/L)	Selenium - Dissolved (mg/L)	Strontium (mg/L)	Vanadium- Dissolved (mg/L)	Zinc- Dissolved (mg/L)	Boron - Dissolved (mg/L)	Iron - Dissolved (mg/L)	Mercury- Dissolved (mg/L)	Fluoride, F (mg/L)	Phosphate as P in water (mg/L)	Ammonia as N (mg/L)	Nitrite as N (mg/L)	Nitrate as N (mg/L)	Dissolved Organic Carbon (mg/L)	Total Organic Carbon (mg/L)	Methane (µg/L)
M339W	11/12/2012	0.007	<0.001	0.016		0.018			0.003	0.050			0.0001	0.45	0.100						
M339W	4/04/2013	0.005	<0.001	0.013		0.027			0.003	0.039			<0.00005	0.44	0.110						
M339W	21/05/2013	0.059	<0.001	0.012		0.014			0.003	0.068			0.0001	0.33	0.026						
M339W	7/08/2013	0.004	<0.001	0.007		0.014			0.003	0.078			<0.00005	0.29	0.190						
M339W	5/12/2013	0.007	<0.001	0.007		0.015			0.003	0.060			<0.00005	0.37	0.085						
M339W	11/05/2014	<0.05		<0.01						<0.05			<0.0001		0.260						
M339W	9/12/2014	<0.005		<0.005						0.040			<0.0001	0.40	0.080						
M339W	10/03/2015	<0.005	<0.005	0.009		0.026			<0.05	0.053				0.80		0.08	<0.01	0.10	3	3	
M339W	16/05/2015	0.009	<0.001	0.009		0.012			<0.01	0.128			0.0008	0.40		0.04	0.01	0.06	10	9	
M339W	27/07/2015	0.001	<0.001	0.003		0.012			<0.01	0.016			0.0010	0.50		0.02	<0.01	0.03	2	6	
M339W	16/11/2015	0.010	<0.005	<0.005		0.014			<0.05	0.149			0.0006	0.40	0.100	0.04	<0.01	0.08	11	8	
M339W	2/03/2016	0.002	<0.001	0.002		0.014			<0.01	0.046				0.40	0.240	0.03	<0.01	0.15	3	5	
M339W	13/05/2016	0.008	<0.001	0.005	0.003	0.014	0.01	8.48	<0.01	0.051	2.58	<0.05	<0.0001	0.40	0.620	0.02	<0.01	0.16	6	12	<10
M339W	29/08/2016	0.005	<0.005	<0.005	<0.005	0.014	<0.05	8.98	<0.05	0.027	2.66	<0.05		0.50	0.070	<0.01	<0.01	0.20	6	5	<10
M339W	15/11/2016	<0.001	<0.001	0.006	0.003	0.014	<0.01	8.36	<0.01	0.021	2.42	<0.05	<0.0001	0.50	0.150	<0.01	<0.01	<0.01	<1	8	<10
M339W	13/06/2017	0.006		<0.005						<0.025	2.74	<0.05	<0.0001	0.50							
M339W	12/11/2017		<0.005	<0.005	<0.005	0.015	<0.05		<0.05	<0.025	2.96	0.06		0.40	0.070						
M339W	1/06/2018	<0.005		<0.005						<0.025	2.66	<0.05	0.0010	0.40	0.090						
M339W	17/11/2018	<0.005	<0.005	<0.005	<0.005	0.013	<0.05		<0.05	<0.025	2.36	<0.05		0.09		0.03	<0.01	0.17	12	10	<10
M339W	27/05/2019	<0.005		<0.005						0.029	2.91	<0.05	0.0009	<0.05							
M339W	12/11/2019	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05		<0.05	0.047	2.81	<0.05		0.11		0.03	<0.01	0.21	2	14	<10
M339W	22/11/2020	0.008	<0.005	<0.005	<0.005	0.013	<0.05		<0.05	0.026	2.64	<0.05		0.40	0.130	0.06	<0.01	0.18	2	4	<10
M339W	30/10/2021	<0.005		<0.005						0.028	2.39	<0.05	0.0002	0.40	0.140						
M339W	28/11/2022	<0.005	<0.005	0.030	<0.005	0.042	<0.05		<0.05	0.047	2.81	<0.05		0.40	0.220	0.03	<0.01	0.32	<1	7	<10
M339W	22/11/2023	0.008	<0.005	0.010	<0.005	<0.005		10.20		0.033	2.43	<0.05	<0.0001	0.40	0.140	0.08				5	<10
M225W	3/04/2013	0.010	<0.001	0.011		0.025			0.015	0.042			<0.00005	0.48	0.200						
M225W	21/05/2013	0.010	<0.001	0.210		0.034			0.009	0.053			<0.00005	0.37	0.110						
M225W	8/08/2013	0.030	<0.001	0.180		0.068			0.013	0.036			<0.00005	0.32	0.190						
M225W	5/12/2013	0.009	<0.001	0.350		0.056			0.009	0.031			<0.00005	0.37	0.110						
M225W	6/05/2014	<0.05		<0.01						0.059			<0.0001		0.100						
M225W	5/12/2014	0.028		0.004						0.058			0.0001	0.50	0.270						
M225W	11/03/2015	<0.005	<0.005	0.009		0.026			<0.05	0.096				0.80		0.07	<0.01	0.25	4	2	
M225W	17/05/2015	0.022	<0.001	0.161		0.048			0.010	0.029			<0.0001	0.40		0.03	<0.01	0.21	6	5	
M225W	28/07/2015	0.011	<0.001	0.033		0.016			0.010	0.018			<0.0001	0.60		<0.01	<0.01	0.25	<5	<5	
M225W	16/11/2015	0.012	<0.005	<0.005		0.022			<0.05	0.099			0.0001	0.60	0.180	0.01	<0.01	0.25	9	10	
M225W	2/03/2016	0.020	<0.001	0.001		0.012			0.010	0.035				0.50	0.250	0.03	<0.01	0.27	6	5	
M225W	13/05/2016	0.006	<0.001	0.010	0.004	0.028	<0.01	4.25	0.010	0.036	2.48	<0.05	<0.0001	0.50	0.130	<0.01	<0.01	0.24	4	2	<10
M225W	29/08/2016	0.012	<0.001	0.006	0.004	0.022	<0.01	4.58	0.010	0.038	2.10	<0.05		0.60	0.220	<0.01	<0.01	0.26	<5	<5	<10
M225W	15/11/2016	0.006	<0.001	0.008	0.006	0.058	<0.01	4.93	0.010	0.062	2.32	<0.05	0.0002	0.70	0.120	0.02	<0.01	0.27	4	4	<10
M225W	13/06/2017	0.013		0.005						0.018	1.92	<0.05	<0.0001	0.40	0.430						
M225W	12/11/2017		<0.001	0.008	0.004	0.253	<0.01		0.010	0.015	1.95	<0.05		0.50	0.170						
M225W	31/05/2018	0.012		0.027						<0.025	2.07	<0.05	<0.0001	0.60	0.100						
M225W	21/11/2018	0.070	<0.005	<0.005	<0.005	0.016	<0.05		<0.05	0.046	2.02	<0.05	0.0001	0.50	0.140	0.05	<0.01	0.28	4	10	<10
M225W	25/05/2019	0.041		0.022						0.031	1.98	0.08	0.0001	0.50	0.090						
M225W	7/11/2019	<0.005	<0.005	0.008	<0.005	0.011	<0.05		<0.05	0.110	2.24	<0.05		0.50	0.090	0.02	<0.01	0.29	<1	9	<10
M225W	19/11/2020	0.022	<0.005	0.062	<0.005	0.361	<0.05		<0.05	0.045	1.81	<0.05	<0.0001	0.50	0.180						
M225W	25/10/2021	0.014	<0.005	<0.005	<0.005	0.026	<0.05		<0.05	0.032	2.07	<0.05		0.50	0.180	0.02	<0.01	0.30	7	9	<10
M225W	23/11/2022	0.094	<0.005	<0.005	<0.005	0.127	<0.05		<0.05	0.115	2.23	<0.05	<0.0001	0.50	0.170	0.01	<0.01	0.30	7	4	<10
M225W	20/11/2023	<0.005	<0.005	0.011	<0.005	0.013		4.32		<0.025	2.40	<0.05	<0.0001	0.40	0.160	0.07				3	<10
M340W	11/12/2012	0.005	<0.001	0.100		0.012			0.003	0.035			<0.00005	0.45	0.100						
M340W	4/04/2013	0.004	<0.001	0.085		0.014			0.002	0.028			<0.00005	1.60	0.077						
M340W	22/05/2013	0.005	<0.001	0.086		0.007			0.002	0.036			<0.00005	1.40	0.055						
M340W	7/08/2013	0.002	<0.001	0.095		0.006			0.001	0.037			<0.00005	1.30	0.100						
M340W	5/12/2013	<0.001	<0.001	0.100		0.013			0.001	0.021			<0.00005	1.50	0.063						
M340W	10/05/2014	0.007		0.075						0.041			<0.0001		0.120						
M340W	8/12/2014	0.008		0.081						0.076			<0.0001	1.80	0.080						
M340W	12/03/2015	0.003	<0.001	0.058		0.022			<0.01	0.013				1.70		0.02	<0.01	0.01	2	3	
M340W	17/05/2015	0.024	<0.001	0.051		0.009			<0.01	0.185			<0.0001	1.60		0.02	<0.01	<0.01	<1	4	
M340W	28/07/2015	0.011	<0.001	0.049		0.038			<0.01	0.060			<0.0001	1.90		<0.01	<0.01	0.04	<5	<5	
M340W	16/11/2015	0.018	<0.001	0.047		0.010			<0.01	0.098			<0.0001	1.60	0.040	<0.01	<0.01	0.01	8	10	
M340W	2/03/2016	0.002	<0.001	0.044		0.010				0.018				2.00	0.080	0.02	<0.01	0.02	2	6	
M340W	13/05/2016	0.012	<0.001	0.034	0.004	0.005	<0.01	2.95	<0.01	0.132	2.26	<0.05	<0.0001	1.80	0.050	<0.01	<0.01	<0.01	5	2	<10
M340W	29/08/2016	0.002	<0.001	0.060	0.004	0.008	<0.01	3.32	<0.01	0.005	1.83	<0.05		2.00	0.050	<0.01	<0.01	<0.01	5	2	<10
M340W	15/11/2016	<0.001	<0.001	0.056		0.006	<0.01		<0.01	0.014	2.14		<0.0001	1.60	0.080	0.04	<0.01	<0.01	4	31	<10
M340W	13/06/2017	<0.001		0.611						<0.005	1.75	<0.05	<0.0001	1.90	12.600						
M230W	11/12/2012	0.001	<0.001	0.097		0.005			<0.001	0.014			<0.00005	0.79	0.670						
M230W	3/04/2013	0.002	<0.001	0.260		0.010			<0.001	0.027			<0.00005	0.76	0.160						
M230W	21/05/2013	0.004	<0.001	0.180		0.014			<0.001	0.021			<0.00005	0.54	0.094						
M230W	7/08/2013	0.003	<0.001	0.091		0.010			<0.001	0.033			<0.00005	0.46	0.270						
M230W	7/12/2013	0.003	<0.001	0.160		0.008			<0.001	0.017			<0.00005	0.63	0.110						
M230W	11/05/2014	0.003		0.212						0.037			<0.0001		0.170						
M230W	5/12/2014	0.001		0.317						0.060			<0.0001	0.70	0.300						
M230W	12/03/2015	0.001	<0.001	0.251		0.131			<0.01	0.013				0.80		0.02	<0.01	0.02	2	<1	
M230W	17/05/2015	0.002	<0.001	0.243		0.010			<0.01	0.024			<0.0001	0.60		0.02	<0.01	0.01	<1	<1	
M230W	28/07/2015	0.004	<0.001	0.146		0.012			<0.01	0.049			<0.0001	0.70		<0.01	<0.01	0.02	<1	1	
M230W	15/11/2015	0.002	<0.001	0.046		0.060			<0.01	0.068			<0.0001	0.80	0.170	0.07	<0.01	<0.01	5	3	
M230W	2/03/2016	0.002	<0.001	0.035		0.006			0.042	<0.01				0.70	0.190	0.02	<0.01	0.02	4	1	
M230W	13/05/2016	0.001	<0.001	0.040	0.006	0.021	<0.01	1.52	<0.01	0.024	0.60	<0.05	<0.0001	0.70	0.100	<0.01	<0.01	<0.01	5	2	<10
M230W	29/08/2016	0.007	<0.001	0.027	0.008	0.039	<0.01	1.68	<0.01	0.026	0.42	<0.05		0.70	0.100	<0.01	<0.01	<0.01	6	<5	<10
M230W	15/11/2016	0.002	<0.001	0.097	0.008	0.026	<0.01	1.71	<0.01	0.036	0.47	<0.05	<0.0001	0.60	0.080	0.02	<0.01	<0.01	7	<1	<10
M230W	13/06/2017	0.001		0.451						0.014	0.45	0.36	<0.0001	0.80	0.180						
M230W	12/11/2017		<0.001	0.203	0.005	0.014	<0.01		<0.01	0.065	0.47	<0.05		0.7	0.230						
M230W	1/06/2018	0.001		0.188						0.012	0.44	0.43	<0.0001	0.70	0.170						
M230W	21/11/2018	<0.001	<0.001	0.186	0.003	0.009	<0.01		<0.01	0.047	0.48	<0.05	<0.0001	0.70	0.120	0.09	<0.01	<0.01	10	8	<10
M230W	25/05/2019	0.001		0.213						0.012	0.56	0.39	<0.0001	0.70	0.140						
M230W	10/11/2019	<0.001	<0.001	0.186	0.002	0.015	<0.01		<0.01	0.016	0.52	0.29		0.70	0.130	0.06	<0.01	<0.01	<1	<1	<10
M230W	1/11/2020	<0.001		0.204						0.017	0.44	<0.05	<0.0001	0.60	0.140						
M230W	19/11/2021	0.001	<0.001	0.286	0.004	0.262	<0.01		<0.01	0.025	0.71	0.59		0.70	0.130						
M300W	26/10/2021	0.015		0.016						2.270	1.45	<0.05	<0.0001	0.70	0.130	0.14	<0.01	0.30	7	5	<10
M300W	7/06/2022	0.044		0.005						0.060	1.61	<0.05	0.0006	0.70	0.160						
M300W	22/11/2022	0.058		0.011						0.146	1.65	0.09	0.0006	0.70	0.110						
M300W	19/11/2023	<0.005	<0.005	0.012	0.005	0.010		11.10		<0.025	1.75	<0.05	<0.0001	0.60	1.000	0.16				2	<10
M250W	13/12/2012	0.002	<0.001	0.027		0.008			<0.001	0.023			<0.00005	0.18	0.012						
M250W	6/04/2013	0.002	<0.001	0.054		0.014			<0.001	0.020			<0.00005	0.14	0.010						
M250W	25/05/2013	0.004	<0.001	0.015		0.007			<0.001	0.018			<0.00005	0.14	0.012						
M250W	6/08/2013	0.002	<0.001	0.007		0.006			<0.001	0.016			<0.00005	0.13	0.079						
M250W	5/12/2013	0.001	<0.001	0.019		0.010			<0.001	0.014			<0.00005	0.14	<0.005						
M250W	9/05/2014	0.004		0.018						0.019			<0.0001		1.300						
M250W	7/12/2014	<0.001		0.017						<0.005			<0.0001	0.20	0.080						
M250W	10/03/2015	<0.001	<0.001	0.013		0.010			<0.01	0.018				0.60		0.04	<0.01	1.39	<1	<1	
M250W	18/05/2015	<0.001	<0.001	0.015		0.011			<0.01	0.019				0.20		0.03	<0.01	1.46	14	7	
M250W	29/07/2015	<0.001	<0.001	0.028		0.010			<0.01	0.106			<0.0001	0.20		0.01	<0.01	1.42	3	2	
M250W	16/11/2015	0.005	<0.001	0.076		0.048			<0.01	0.131			<0.0001	0.20	0.400	0.01	<0.01	1.38	<5	5	
M250W	2/03/2016	0.001	<0.001	0.014		0.010			<0.01	0.048				0.20	0.160	0.02	<0.01	1.53	62	1	
M250W	13/05/2016	0.002	<0.001	0.011	<0.001	0.009	<0.01	0.73	<0.01	0.016	0.76	0.05	<0.0001	0.20	0.910	0.02	<0.01	1.45	4	2	<10
M250W	29/08/2016	0.001	<0.001	0.012	<0.001	0.010	<0.01	0.69	<0.01	0.008	0.61	<0.05		0.20	0.510	<0.01	<0.01	1.32	2	2	<10
M250W	15/11/2016	<0.001	<0.001	0.012	<0.001	0.008	<0.01	0.70	<0.01	0.032	0.73	<0.05	<0.0001	0.20	0.470	0.03	<0.01	1.51	3	1	<10
M250W	18/06/2017	0.001		0.014						0.021	0.67	<0.05	<0.0001	0.20	0.440						
M250W	13/11/2017	0.002	<0.001	0.095	0.002	0.043	<0.01		<0.01	0.111	0.70	<0.05		0.30	0.620						
M250W	2/06/2018	<0.001		0.014						0.006	0.73	0.43	<0.0001	0.20	0.630						
M250W	22/11/2018	0.001	<0.001	0.016	<0.001	0.010	<0.01		<0.01	0.072	0.68	<0.05	<0.0001	0.20	0.770	0.07	<0.01	1.43	<1	<1	<10
M250W	26/05/2019	0.001		0.021						0.031	0.74	<0.05	<0.0001	0.20	0.230						
M250W	7/11/2019	<0.001	<0.001	0.043	0.001	0.088	<0.01		<0.01	0.035	0.74	<0.05		0.20	0.030	<0.01	<0.01	1.42	1	1	<10
M250W	21/12/2021	<0.001	<0.001	0.050	0.003	0.056			<0.01	0.054	0.59	<0.05		0.10		<0.01	<0.01	1.40	3	4	<10
M250W	25/05/2023	0.002	<0.001	0.054	0.001	0.037	<0.01		<0.01	0.092	0.68	0.06		0.04	0.430	0.06	<0.01	1.46	2	2	<10
M250W	23/11/2023	0.008	<0.001	0.024	<0.001	0.020		0.91		0.115	0.78	<0.05	<0.0001	0.20	0.700	0.19				4	<10
AN021F	10/12/2022	0.145	0.112	0.003	0.152	0.042	<0.01		<0.01	0.064	0.13	0.14		0.20	0.030	5.02	<0.01	0.01	36	30	278
M222W	16/06/2012	0.002	<0.001	1.170		0.125			<0.01	0.041			<0.0001	0.60							
M222W	14/12/2012	0.003	<0.001	1.300		0.005			<0.001	0.043			<0.00005	0.48	<0.005						
M222W	5/04/2013	0.002	<0.001	1.100		0.019			<0.001	0.037			<0.00005	0.68	<0.005						
M222W	26/05/2013	0.002	<0.001	1.300		0.004			<0.001	0.007			<0.00005	0.47	<0.005						
M222W	9/08/2013	0.001	<0.001	1.200		<0.001			<0.001	0.011			<0.00005	0.44	<0.005						
M222W	6/12/2013	0.002	<0.001	1.700		0.001			<0.001	0.018			<0.00005	0.59	<0.005						
M222W	10/05/2014	0.004		1.350						0.019			<0.0001		2.090						
M222W	19/08/2014	0.001		1.540						0.036			<0.0001	0.40	0.180						
M222W	4/12/2014	<0.001		1.450						0.115			<0.0001	0.80	0.740						
M222W	11/03/2015	<0.001	<0.001	1.270		<0.001			<0.01	0.020				1.00		1.05	<0.01	0.02	4	4	
M222W	17/05/2015	<0.001	<0.001	1.570		0.002			<0.01	0.021			<0.0001	0.70		0.87	<0.01	0.03	2	<1	
M222W	27/07/2015	<0.001	<0.001	1.280		0.007			<0.01	<0.005			<0.0001	0.80		1.06	<0.01	0.02	3	1	
M222W	17/11/2015	0.001	<0.001	1.370		<0.001			<0.01	0.074			<0.0001	0.90	0.530	1.04	<0.01	<0.01	7	6	
M222W	2/03/2016	<0.001	<0.001	1.270		0.017			<0.01	0.043				0.80	0.110	1.09	<0.01	0.02	17	3	
M222W	13/05/2016	<0.001	<0.001	1.590	0.004	<0.001	<0.01	6.67	<0.01	<0.005	0.33	17.60	<0.0001	0.70	0.430	1.03	<0.01	<0.01	8	4	<10
M222W	29/08/2016	<0.001	<0.001	1.860	0.004	0.003	<0.01	8.96	<0.01	<0.005	0.32	21.10		0.80	0.550	1.08	<0.1	<0.1	6	2	<10
M222W	15/11/2016	<0.001	<0.001	1.590	0.003	0.002	<0.01	8.73	<0.01	0.015	0.34	13.60	<0.0001	0.80	0.190	0.97	<0.01	<0.01	7	<5	<10
M222W	13/06/2017	<0.001		1.550						<0.005	0.33	11.40	<0.0001	0.70	0.320						
M222W	7/11/2017	<0.001	<0.001	1.630	0.002	0.001	<0.01		<0.01	<0.005	0.30	14.50		0.80	0.430						
M222W	29/05/2018	0.002		1.630						<0.005	0.32	15.50	<0.0001	0.70	0.460						
M222W	18/11/2018	<0.001	<0.001	1.480	0.002	<0.001	<0.01		<0.01	<0.005	0.34	11.00		0.60	0.120	1.05	<0.01	<0.01	7	7	<10
M222W	24/05/2019	0.036		1.650						0.069	0.32	18.60	<0.0001	0.70	0.390						
M222W	10/11/2019	0.014	<0.001	1.560	0.003	0.028	<0.01		<0.01	0.059	0.32	17.10		0.70	0.410	1.07	<0.01	<0.01	6	4	<10
M222W	20/11/2020	<0.001		1.720						0.013	0.33	0.05	<0.0001	0.70	0.670	1.06	<0.01	0.02	4	6	<10
M222W	28/10/2021	0.007		1.780						0.719	0.33	19.50	<0.0001	0.70	0.390	1.20	<0.05	<0.05	6	4	<10
M222W	25/11/2022	0.006	<0.001	1.870	0.003	0.016	<0.01		<0.01	0.066	0.33	22.20	<0.0001	0.60	0.540	0.83	<0.01	<0.01	3	3	<10
M222W	21/11/2023	<0.001	<0.001	2.030	0.004	0.003		10.40		0.057	0.38	20.20	<0.0001	0.60	0.410	1.07				4	<10
M224W	16/06/2012	<0.05	<0.010	7.750		<0.05			<0.10	0.060			<0.0001	0.90							
M224W	15/12/2012	<0.001	<0.001	7.800		0.023			0.001	0.009			<0.00005	0.74	0.030						
M224W	7/04/2013	<0.001	<0.001	8.100		0.040			<0.001	0.024			<0.00005	0.45	<0.005						
M224W	25/05/2013	<0.001	<0.001	4.800		0.083			0.002	0.008			<0.00005	0.23	<0.005						
M224W	6/08/2013	<0.001	<0.001	6.800		0.018			<0.001	0.027			<0.00005	0.37	0.052						
M224W	6/12/2013	<0.001	<0.001	8.000		0.015			<0.001	0.021			<0.00005	0.51	0.007						
M224W	10/05/2014	<0.05		7.570						0.056			<0.0001		0.300						
M224W	19/08/2014	<0.001		7.980						0.302			<0.0001	0.40	0.790						
M224W	4/12/2014	<0.001		6.830						0.067			<0.0001	0.40	0.170						
M224W	12/03/2015	0.006	<0.001	4.400		0.119			<0.01	0.044				0.60		0.66	<0.01	0.01	2	1	
M224W	17/05/2015	0.001	<0.001	4.590		0.025			<0.01	0.050			<0.0001	0.30		0.46	<0.01	<0.01	5	3	
M224W	27/07/2015	0.003	<0.001	4.510		0.170			<0.01	0.059			<0.0001	0.50		0.66	<0.01	0.01	<1	<1	
M224W	17/11/2015	<0.001	<0.001	3.780		0.014			<0.01	0.101			<0.0001	0.40	0.110	0.51	<0.01	<0.01	4	5	
M224W	2/03/2016	0.002	<0.001	1.360		0.021			<0.01	0.037				0.40	0.060	0.26	<0.01	0.02	2	3	
M224W	13/05/2016	0.005	<0.001	3.420	0.001	0.007	<0.01	11.40	<0.01	0.176	0.34	4.80	<0.0001	0.40	<0.05	0.34	<0.01	<0.01	7	3	78
M224W	29/08/2016	<0.001	<0.001	0.834	0.001	0.004	<0.01	3.19	<0.01	0.037	0.13	0.20		0.20	0.090	0.09	<0.01	0.03	5	2	12
M224W	15/11/2016	<0.001	<0.001	3.750	0.002	0.020	<0.01	14.00	<0.01	0.210	0.24	5.39	<0.0001	0.40	0.070	0.47	<0.01	<0.01	4	2	79
M224W	13/06/2017	<0.001		4.040						0.052	0.22	7.91	<0.0001	0.30	0.080						
M224W	07/11/2017		<0.001	4.940	0.003	0.042	<0.01	<0.01	<0.01	0.044	0.22	10.10		0.40	0.300						
M224W	29/05/2018	0.002		6.720						0.062	0.34	7.20	<0.0001	0.50	0.220						
M224W	18/11/2018	0.017	<0.001	0.313	<0.001	0.014	<0.01		<0.01	0.103	0.16	0.52		0.20	0.030	0.05	<0.01	<0.01	8	4	<10
M224W	24/05/2019	0.001		1.680						0.032	0.29	1.12	<0.0001	0.40	0.130						
M224W	10/11/2019	0.002	<0.001	1.580	0.001	0.045	<0.01		<0.01	0.059	0.39	4.43		0.30	<0.05	0.20	<0.01	<0.01	2	4	41
M224W	20/11/2020	<0.001		1.640						0.042	0.39	0.20	<0.0001	0.30	0.090	0.17	<0.01	<0.01	2	2	38
M224W	28/10/2021	<0.001		5.230						0.038	0.38	14.20	<0.0001	0.50	0.080	0.20	<0.01	0.03	4	3	26
M224W	25/11/2022	0.063	<0.001	6.030	<0.005	0.120	<0.05		<0.05	0.180	0.55	3.82	<0.0001	0.70	0.400	0.53	<0.01	<0.01	4	5	<10
M224W	21/11/2023	<0.001	<0.001	2.110	0.004	0.028		8.44		0.014	0.36	1.33	<0.0001	0.40	0.070	0.27				5	26
AN020F	13/05/2016	<0.001	<0.001	1.920	<0.001	<0.001	<0.01	11.30	<0.01	<0.005	0.14	14.30	<0.0001	<0.1	<0.01	4.14	<0.01	<0.01	11	8	18600
AN020F	15/11/2016	<0.001	<0.001	1.850	0.001	0.001	<0.01	11.00	<0.01	<0.005	0.19	8.25		<0.1	<0.05	8.32	<0.01	<0.01	6	13	19800
AN020F	15/11/2017	<0.001	<0.001	1.170	0.005	0.006	<0.01		<0.01	<0.005	0.14	5.01		<0.1	0.110						
AN020F	15/11/2018	0.001	<0.001	1.190	0.007	0.001	<0.01		<0.01	<0.005	0.20	5.36		<0.1	<0.01	2.73	<0.01	<0.01	6	12	18600
AN020F	11/11/2019	0.005	<0.001	1.420	0.002	0.002	<0.01		<0.01	<0.005	0.13	1.68		<0.1	<0.01	6.71	<0.01	0.03	4	7	12100
AN020F	21/11/2020	<0.001		2.280	0.002					0.006	0.16	2.99	<0.0001	<0.1	0.010	5.76	<0.01	<0.01	4	4	10300
AN020F	30/10/2021	0.001	<0.001	1.510	0.003	0.003	<0.01		<0.01	0.014	0.09	1.87		0.10	<0.01	5.48	<0.01	<0.01	3	3	2770
AN020F	10/12/2022	<0.001	<0.001	1.480	0.001	0.001	<0.01		<0.01	0.012	0.11	3.65		<0.1	<0.01	5.73	<0.01	<0.01	4	4	3830

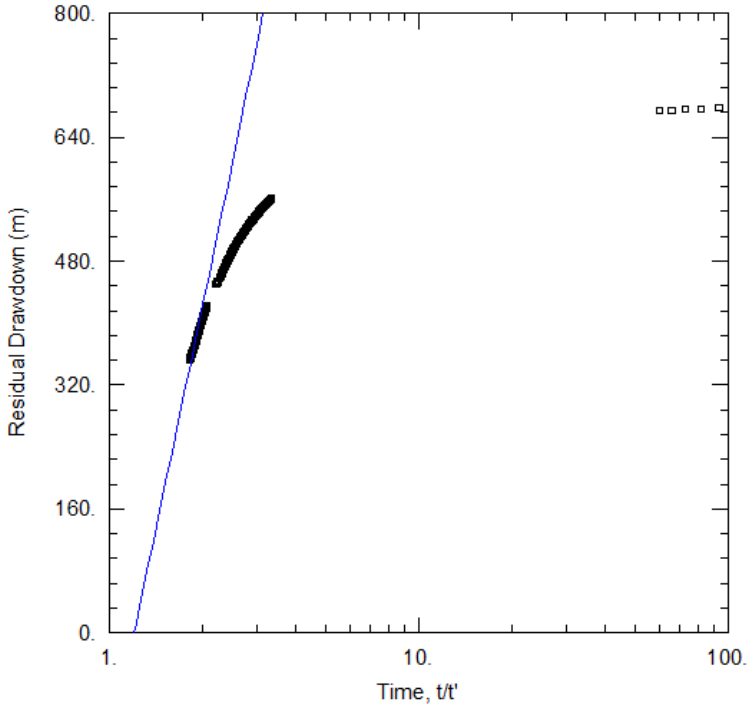
Deep Monitoring Bores

Monitoring Bore ID	Sample Date	Field pH	Electrical Conductivity	Total Dissolved Solids	Hydroxide Alkalinity (OH-)	Carbonate Alkalinity as	Bicarbonate Alkalinity as	Total Alkalinity as	Sulphate, SO4	Chloride, Cl	Calcium - Dissolved	Magnesium - Dissolved	Sodium - Dissolved	Potassium - Dissolved	Aluminium - Dissolved	Arsenic - Dissolved	Beryllium - Dissolved	Barium - Dissolved	Cadmium - Dissolved	Chromium - Dissolved	Cobalt-Dissolved	Copper - Dissolved	Lead-Dissolved	Manganese - Dissolved	Molybdenum	Nickel - Dissolved	Selenium	Strontium	Vanadium - Dissolved	Zinc-Dissolved	Boron	Iron	Mercury - Dissolved	Fluoride, F	Phosphate as P in water	Ammonia as N	Nitrite as N	Nitrate as N	Dissolved Organic Carbon	Total Organic Carbon	Methane
			µS/cm	(grav)	as CaCO3	as CaCO3	as CaCO3	as CaCO3																																		
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L
M313W	25/07/2014	9.42	1710	1160	<1	51	283	334	12	252	7	<1	319	98		0.004	<0.001	0.843		0.018	0.01	2.12	2.19	0.429		0.032			0.02	0.568				0.6									
M313W	13/02/2015	8.12	6940	4110	<1	<1	781	781	4	1810	26	5	1420	126		<0.001	<0.001	4.88		<0.001	<0.001	0.055	<0.001	0.139		0.004			<0.01	<0.005				2.4									
M313W	11/12/2015	8.3	6890	3870	<1	<1	666	667	2	1910	22	4	1250	56	<0.01	<0.001	<0.001	2.8		<0.001	<0.001	0.002	<0.001	0.099		0.002			<0.01	<0.005				2.4	0.87	2.68	<0.01	0.04	58	56	
M313W	30/05/2016	8.48	4570	2420	<1	41	443	484	2	1130	10	1	1000	60		<0.001	<0.001	1.23	<0.001	<0.001	<0.001	<0.001	0.04	0.017	<0.001	<0.01	1.39	<0.01	0.008	0.5	0.28			0.6	1.12	<0.01	0.03	32	32	32900
M313W	15/11/2016	7.8	5620	2950	<1	<1	634	634	<1	1420	20	3	1170	62		0.002	<0.001	2.63	<0.001	<0.001	<0.001	0.002	<0.001	0.077	0.035	0.003	<0.01	3.02	<0.01	0.018	0.95	1.08		2.3	0.89	1.39	<0.01	<0.01	28	25	13500
M313W	19/11/2017	8.59	6020	3320	<1	48	587	636	<1	1720	24	4	1370	60		0.003	<0.001	2.54		<0.001	<0.001	<0.001	<0.001	0.071	0.035	0.002	<0.01		<0.01	<0.005	0.92	0.57		2								
M313W	16/11/2018	8.05	5840	3210	<1	4	621	625	<1	1350	24	4	1200	61		0.003	<0.001	2.25		<0.001	<0.001	0.002	<0.001	0.106	0.039	0.002	<0.01		<0.01	<0.005	0.81	1.07		1.9	0.77	2.28	<0.01	<0.01	21	22	12700
M313W	14/11/2019	7.99	6030	3360	<1	<1	621	621	2	1600	20	4	1260	55		0.003	<0.001	2.42		<0.001	<0.001	<0.001	<0.001	0.088	0.041	0.002	<0.01		<0.01	<0.005	0.88	0.45		2.1	0.68	2.33	<0.01	0.04	19	20	14800
M313W	21/11/2020	8.23	6020	3390	<1	<1	648	648	1	1700	26	5	1520	67		0.003	<0.001	2.85		<0.001	<0.001	<0.001	<0.001	0.082	0.055	0.003	<0.01		<0.01	<0.005	1.31	1.4		2.2	0.65	2.36	<0.01	<0.01	22	20	12600
M313W	29/10/2021	8.18	5740	3510	<1	19	624	643	<1	1530	21	5	1320	62		0.003	<0.001	2.18		<0.001	<0.001	<0.001	0.074	0.044	0.002	<0.01			<0.01	<0.005	0.95	0.76		2	0.69	2.34	<0.01	0.01	30	28	11200
M313W	14/12/2022	8.49	5780	3380	<1	32	572	604	<1	1560	20	4	1280	54		0.002	<0.001	2.27		<0.001	<0.001	0.001	<0.001	0.071	0.042	0.002	<0.01		<0.01	0.019	1.03	0.91		2	0.67	2.46	<0.01	<0.01	23	23	10000
M313W	20/11/2023	7.99	6040	3,320	<1	<1	637	637	<1	1,510	23	5	1300	64	<0.01	0.002		1.99	<0.001	<0.001	<0.001	<0.001	<0.001	0.118	0.053	0.002		2.28		<0.005	1.02	0.15	<0.0001	1.8	0.77	2.64				26	10200
M314W	24/07/2014	8.57	5090	4790	<1	9	1210	1220	134	198	46	1	212	1450		0.013	<0.001	0.575		0.015	0.005	7.08	0.562	0.446		0.018			<0.01	0.472				0.4								
M314W	13/02/2015	8.04	7150	5470	<1	<1	1180	1180	69	1370	29	6	1040	795		0.004	<0.001	1.37		<0.001	<0.001	0.002	0.995	<0.001	0.141		0.01			<0.01	<0.005				0.9								
M314W	13/11/2015	8.01	8210	5280	<1	<1	836	836	2	2190	17	5	1420	335		0.003	<0.001	1.31		<0.001	<0.001	0.031	<0.001	0.14		0.013			<0.01	0.011				1.1	17.4	6.92	<0.01	0.17	352	372	
M314W	30/05/2016	8.6	8500	4880	<1	49	767	817	<1	2370	22	6	1640	326		0.003	<0.001	5.21	<0.001		<0.001	0.022	<0.001	0.028	0.053	0.001	<0.01	5.5	<0.01	0.01	0.87	0.1	0.87		9.67	2.97	<0.01	<0.01	224	238	26900
M314W	15/11/2016	8.88	8180	4810	<1	108	827	934	<1	2290	19	6	1500	404		0.004	<0.001	3.88	<0.001	<0.001	<0.001	0.03	<0.001	0.036	0.062	0.002	<0.01	3.67	<0.01	0.009	0.9	0.21		1.3	12.1	1.83	<0.01	<0.01	213	241	19100
M314W	18/11/2017	8.9	8300	4860	<1	169	908	1080	<1	2190	17	5	1880	543		0.004	<0.001	2.91		<0.001	<0.001	0.024	<0.001	0.053	0.068	0.002	<0.01		<0.01	<0.005	0.76	0.18		1.2								
M314W	20/11/2018	8.72	8010	4910	<1	142	892	1030	<1	2010	15	5	1530	459		0.005	<0.001	2.86		<0.001	<0.001	0.024	<0.001	0.057	0.078	0.002	<0.01		<0.01	<0.005	0.81	0.29		1.2	13.1	1.63	<0.01	<0.01	80	78	15500
M314W	16/11/2019	8.59	7910	4900	<1	86	991	1080	2	1860	8	4	1460	465		0.005	<0.001	2.43		<0.001	<0.001	0.024	<0.001	0.068	0.082	0.003	<0.01		<0.01	<0.005	0.77	0.33		1.3	13.8	1.94	<0.01	<0.01	70	76	15300
M314W	24/11/2020	8.64	7880	4510	<1	37	1010	1050	5	2130	10	4	1610	506		0.006	<0.001	2.82		<0.001	<0.001	0.021	<0.001	0.073	0.089	0.003	<0.01		<0.01	<0.005	0.91	0.59		1.3	14.5	1.8	<0.01	0.01	68	66	9260
M314W	31/10/2021	8.36	7620	5020	<1	73	992	1060	<1	1910	6	4	1500	468		0.006	<0.001	2.44		<0.001	<0.001	0.017	<0.001	0.025	0.078	0.002	<0.01		<0.01	<0.005	0.79	0.7		1.2	15.3	1.99	<0.01	<0.01	60	63	9650
M314W	27/11/2022	8.29	7870	4980	<1	86	885	971	<1	1960	7	4	1580	499		0.006	<0.001	2.52		<0.001	<0.001	0.016	<0.001	0.017	0.091	0.004	<0.01		<0.01	0.02	0.94	0.64		1.2	15.4	0.9	<0.01	<0.01	48	49	9000
M314W	22/11/2023	8.38	7990	4570	<1	22	999	1020	<1	1910	2	4	1510	470		0.005		2.33	<0.001	<0.001	<0.001	0.014	<0.001	0.011	0.086	0.001		2.99		<0.005	0.81	0.51	<0.0001	1.2	13.1	2.08	1.8			61	7590
GR067V	30/08/2016	9.05	7020	4000	<1	407	1550	1960	19	1180	7	1	1580	14		0.003	<0.001	1.48	0.001	0.001	<0.001	0.002	<0.001	0.11	0.032	0.006	<0.01	1.18	<0.01	0.011	0.81	1.56				11.8	<0.01	<0.01	13	42	31400
GR067V	15/11/2016	8.12	7850	4640	<1	<1	2310	2310	3	1260	15	3	1850	13		0.003	<0.001	4.94	0.001	0.001	<0.001	<0.001	<0.001	0.024	0.024	0.001	<0.01	3.72	<0.01	0.018	1.17	0.68		1.8		11.7	<0.01	<0.01	31	20	5470
GR067V	19/11/2017	8.72	8210	4910	<1	238	2120	2360	4	1440	19	3	2190	12		0.003	<0.001	3.83		<0.001	<0.001	<0.001	<0.001	0.008	0.019	<0.001	<0.01		<0.01	0.008	1.03	0.16		1.7								
GR067V	23/11/2018	8.46	8340	6020	<1	456	1950	2410	7	1460	18	3	2050	12		0.002	<0.001	4.44		<0.001	<0.001	<0.001	<0.001	0.008	0.023	<0.001	<0.01		<0.01	0.008	1.18	0.22		2		12.1	<0.01	<0.01	16	23	19900
GR067V	16/11/2019	8.19	7950	4950	<1	47	2380	2420	7	1350	7	3	2040	9		0.002	<0.001	3.23		<0.001	<0.001	<0.001	<0.001	0.009	0.019	<0.001	<0.01		<0.01	0.005	1.28	0.29		2		11.6	<0.01	<0.01	31	31	22800
GR067V	24/11/2020	8.73	7980	5040	<1	111	2240	2350	12	1520	7	3	1860	10		0.003	<0.001	5.28		<0.001	<0.001	<0.001	<0.001	0.014	0.03	<0.001	<0.01		<0.01	<0.005	1.56	0.54		2.2		11	<0.01	<0.01	38	36	8860
GR067V	31/10/2021	8.44	7700	5240	<1	223	2070	2300	22	1410	6	3	1980	10		0.002	<0.001	4.06		<0.001	<0.001	<0.001	<0.001	0.012	0.017	<0.001	<0.01		<0.01	<0.005	1.39	0.32		1.9	0.44	10.6	<0.01	<0.01	36	34	16500
GR067V	27/11/2022	8.37	8120	4920	<1	221	2000	2220	29	1490	10	4	2120	11		0.002	<0.001	4.62		<0.001	<0.001	<0.001	<0.001	0.016	0.024	<0.001	<0.01		<0.01	0.01	1.3	0.42		2	0.51	10.6	<0.01	<0.01	23	26	10800
M162V	14/11/2015	8.44	11500	6970	<1	38	1060	1090	3	3640	10	6	2370	12		<0.001	<0.001	0.236		<0.001	<0.001	<0.001	<0.001	0.092		<0.001			<0.01	<0.005				1.9		3.5	<0.01	0.02	78	71	
M162V	30/05/2016	7.91	12700	7250	<1	<1	1050	1050	2	4040	56	19	2590	12		<0.001	<0.001	11	<0.001	<0.001	<0.001	0.01	<0.001	0.063	0.002	0.001	<0.01	10.8	<0.01	0.16	2.4	3				1.86	<0.01	0.03	9	8	1840
M162V	15/11/2016	7.7	12300	6660	<1	<1	1060	1060	<1	3870	69	18	2670	12		<0.001	<0.001	9.93	<0.001	<0.001	<0.001	<0.001	<0.001	0.034	0.001	<0.001	<0.01	9.77	<0.01	0.032	2.02	2.19		2.6		4.04	<0.01	<0.01	7	6	17300
M134W	14/11/2017	8.1	15600	9810	<1	<1	168	168	<1	5770	209	62	3490	12		<0.001	<0.001	23		<0.001	<0.001	<0.001	<0.001	0.064	0.001	<0.001	<0.01		<0.01	0.009	0.46	0.4		0.5								
M134W	21/11/2018	7.3	16000	9710	<1	<1	159	159	<1	5310	182	61	2990	12		<0.001	<0.001	20.3		<0.001	<0.001	0.002	<0.001	0.063	0.001	<0.001	<0.01		<0.01	0.011	0.48	0.3		0.5		5.3	<0.01	<0.01	3	4	9050
M134W	14/11/2019	7.27	15500	9670	<1	<1	162	162	1	5460	134	58	3200	12		0.002	<0.001	20.2		<0.001	<0.001	0.005	<0.001	0.098	0.007	0.02	<0.01		<0.01	0.02	0.47	1.18		0.5		4.92	<0.01	<0.01	9	11	10500
M134W	24/11/2020	7.73	15500	9430	<1	<1	166	166	<1	5850	114	55	3100	11	<0.01					<0.001				0.068						0.011	0.49	0.45	<0.0001	0.6		5.97	<0.01	<0.01	3	3	6420
GM081V	21/12/2021	8.06	10170	5750	<1	<1	694	694	<1	3300	20	11	2240	6		<0.001	<0.001			<0.001	<0.001	0.006	<0.001	0.011	0.002	<0.001	<0.01		<0.01	0.007	1.11	0.07		1.5		4.22	<0.01	<0.01	8	9	13400
GM081V	14/12/2022	8.44	9940	5890	<1	31	610	641	<1	3180	19	10	2220	6		<0.001	<0.001	7.35		<0.001	<0.001	<0.001	<0.001	0.012	0.002	<0.001	<0.01		<0.01	0.006	1.47	0.07		1.6	<0.01	5.03	<0.01	0.01	4	7	12100
MB1-D	17/11/2019	7.95	8790	5110	<1	<1	817	817	<1	2250	14	12	1900	16		0.002	<0.001	4.29		<0.001	<0.001	0.005	0.008	0.049	0.018	0.036	<0.01		<0.01	0.045	1.04	1.53		2.2		1.92	<0.01	<0.01	37	38	13700
MB1-D	20/11/2020	8.26	9380	5460	<1	<1	1600	1600	<1	2560	14	10	2410	24		0.003	<0.001	4.12		<0.001	<0.001	0.002	0.006	0.015	0.017	0.032	<0.01		<0.01	0.024	1.68	1.14	<0.0001	2		2.45	<0.01	<0.01	24	23	8050
MB1-D	27/10/2021	8.15	8600	5320	<1	<1	1870	1870	<1	1970	12	6	2010	21		0.002	<0.001	2.72		<0.001	<0.001	<0.001	0.004	0.007	0.014	0.01	<0.01		<0.01	<0.005	1.19	0.56		2								
MB1-D	27/11/2022	7.86	8670	5230	<1	40	1550	1590	11	1940	6	6	2020	21		0.002	<0.001	2.97		0.002	<0.001	<0.001	0.002	0.009	0.015	0.05	<0.01		<0.01	0.008	1.39	0.68		2.1	1.31	2.82	<0.01	<0.01	16	15	5030
GW007B	15/11/2019	6.79	15700	9910	<1	<1	1380	1380	<1	4920	276	256	2330	64		0.005	<0.001	12.2		<0.001	<0.001	<0.001	<0.001	0.12	0.006	0.02	<0.01		<0.01	2.16	0.24	2.94		0.2		8.88	<0.01	<0.01	6	11	2580
M324W	26/07/2014	9.17	1170	707	<1	48	177	225	24	188	26	5	199	31		0.005	<0.001	0.31		0.004	0.004	0.582	0.459	0.304		0.008			<0.01	0.427				1								
M324W	13/02/2015	8.83	2660	1540	<1	105	615	720	1	505	7	2	627	29		<0.001	<0.001	0.482		<0.001	<0.001	<0.001	<0.001	0.018		0.002			<0.01	0.093				3.7								
M324W	30/05/2016	8.57	2750	1390	<1	64	624	688	6	522	6	1	599	12		<0.001	<0.001	0.921	<0.001	<0.001	<0.001	<0.001	<0.001	0.025	0.02	<0.001	<0.01	0.889	<0.01	0.006	0.76	0.22			0.46	1.05	<0.01	<0.01	22	22	21000
M324W	15/11/2016	8.58	2650	1540	<1	59	635	694	<1	503	5	1	612	12		0.001	<0.001	0.738	<0.001	<0.001	<0.001	<0.001	<0.001	0.009	0.024	<0.001	<0.01	0.807	<0.01	0.01	0.78	0.13		4.5	0.44	0.93	<0.01	<0.01	16	14	13200
M324W	19/11/2017	8.86	2740	1300	<1	104	568	672	<1	536	4	1	666	13		0.001	<0.001	0.572		<0.001	<0.001	<0.001	<0.001	0.006	0.027	<0.001	<0.01		<0.01	<0.005	0.72	<0.05		3.9								
M324W	16/11/2018	8.66	2740	1520	<1	86	565	651	<1	507	3	1	579	13		0.001	<0.001	0.555		<0.001	<0.001	0.006	0.031	0.031	<0.001	<0.001	<0.01		<0.01	<0.005	0.74	0.12		3.8	0.49	0.97	<0.01	<0.01	22	21	13300
M324W	14/11/2019	8.7	2690	1530	<1	74	571	645	1	524	2	<1	595	12		0.001	<0.001	0.56		<0.001	<0.001	<0.001	0.001	0.005	0.03	<0.001	<0.01		<0.01	<0.005	0.72	0.2		4.3	0.49	1.02	<0.01	<0.01	15	15	13100
M324W	23/11/2020	8.99	2590	1480	<1	92	556	648	<1	566	1	1	748	15		0.001	<0.001	0.584		<0.001	<0.001	0.002	0.002	0.005	0.044	<0.001	<0.01		<0.01	0.005	0.99	0.22		4.3	0.57	0.99	<0.01	<0.01	16	17	11900
M324W	29/10/2021	8.89	2650	1570	<1	87	552	639	<1	529	<1	<1	612	13		0.001	<0.001	0.433		<0.001	<0.001	<0.001	0.002	0.004	0.036	<0.001	<0.01		<0.01	<0.005	0.77	0.18		3.8	0.59	0.96	<0.01	<0.01	12	14	12100
M324W	20/11/2023	8.78	2720	1500	<1	81	532	612	<1	526	<1	<1	549	10		0.001		0.306	<0.001	<0.001	<0.001	<0.001	0.001	0.004	0.039	<0.001		0.406	<0.01	<0.005	0.52	0.15	<0.0001	3.9	0.62	1				18	12100
M325W	13/02/2015	8.55	3410	2260	<1	14	252	297	68	906	2	<1	709	73		0.002	<0.001	0.005		<0.001	<0.001	0.003	0.016	<0.001	0.009		0.009			<0.01	0.024				0.7								
M325W	13/11/2015	8.13	5000	2730	<1	<1	450	450	4	1400	8	1	919	40		<0.001	<0.001	0.252		<0.001	<0.001	0.002	<0.001	<0.001	0.086		<0.001			<0.01	<0.005				1.1		0.18	0.02	0.02	108	85	
M325W	30/05/2016	8.74	6150	3310	<1	75	370	446	1	1600	6	<1	1250	39		0.002	<0.001	0.384	<0.001	<0.001	<0.001	0.008	<0.001	0.057	0.114	0.002	<0.01	0.639	<0.01	0.009	1.17	0.24			0.54	0.01	<0.01	<0.01	75	84	9640
M325W	24/05/2023	9.17	7810	4370	<1	109	277	387	14	2450	6	<1	1660	25		0.002	<0.001	0.772		<0.001	<0.001	0.002	<0.001	0.011	0.079	0.002	<0.01	1.660	<0.01	<0.005	1.09	0.11		1.5	0.21	2.36	0.02	<0.01	52	52	5450
AN018F	10/11/2015	11.8	10200	5430	456	82	<1	539	33	2920	154	<1	1620	19		0.002	<0.001	2.79		<0.001	<0.001	0.006	<0.001	<0.001		0.007			<0.01	0.01				0.8	0.04	1.51	<0.01	<0.01	40	22	
AN018F	30/05/2016	11.6	10800	5970	410	100	<1	510	38	3180	168	<1	1840	29		0.004	<0.001	3.25	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.056	0.008	<0.01	8.18	<0.01	<0.005	0.42	<0.05	0.42		0.05	6.29	<0.01	<0.01	0.02	14	17	12900
AN018F	15/11/2016	11.8	11100	6140	428	125	<1	553	37	3400	162	<1	1970	28		0.004	<0.001	2.65	<0.001	<0.001	<0.001	<0.001	0.036	0.006	<0.01	5.92	<0.01		0.014	0.46	<0.05		0.7	<0.05	7.26	<0.01	<0.01	17	14	12600
AN018F	15/11/2017	11.1	10700	5890	123	135	<1	258	35	3340	104	<1	2330	27		0.004	<0.001	2.4		<0.001	<0.001	<0.001	<0.001	<0.001	0.027	0.003	<0.01		<0.01	0.006	0.45	<0.05		0.7								
AN018F	11/11/2019	11.41	10700	6550	195	125	<1	319	32	3540	82	<1	2280	23		0.004	<0.001	2.34		<0.001	<0.001	<0.001	<0.001	<0.001	0.024	0.002	<0.01		<0.01	<0.005	0.57	<0.05		0.8	<0.01	4.56	<0.01	<0.01	16	17	13800
AN018F	21/11/2020	11.37	10800	5750	230	61	<1	291	29	3670	63	<1	2590	24		0.004	<0.001	2.86		<0.001	<0.001	<0.001	0.01	0.01	0.002	<0.01	<0.01		<0.01	<0.005	0.75	<0.05		0.8	<0.01	3.64	<0.01	<0.01	15	15	12500
AN018F	30/11/2021	11.43	10000	6040	66	157	<1	223	26	3410	41	<1	2120	20		0.004	<0.001	2.41		<0.001	<0.001	<0.001	<0.001	<0.001	0.019	0.002	<0.01		<0.01	<0.005	0.47	<0.05		0.7	0.08	3.76	<0.01	<0.01	14	11	10900
AN018F	14/12/2022	11.2	9930	6030	129	100	<1	228	27	3440	40	<1	2220	20		0.003	<0.001	2.44		<0.001	<0.001	0.011	<0.001	0.004	0.021	0.003	<0.01		<0.01	0.082	0.62	<0.05		0.7	0.01	3.67	<0.01	<0.01	4	4	1130
AN019F	16/11/2023	11.34	10400	7550	167	54	<1	202	29	3610	36	<1	2300	19	0.8	0.003		2.61	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.022	<0.001		6.40		0.012	0.62	<0.05	<0.0001	0.7	<0.01	3.65				7	7190

APPENDIX D: Theis Recovery Analysis

MB2

Aqtesolv Output using BHP data (gas and water).



WELL TEST ANALYSIS

Data Set:
Date: 07/23/20 Time: 09:44:17

PROJECT INFORMATION

Test Well: RH60

AQUIFER DATA

Saturated Thickness: 775. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells			Observation Wells		
Well Name	X (m)	Y (m)	Well Name	X (m)	Y (m)
RH60	0	0	▫ RH60	0	0

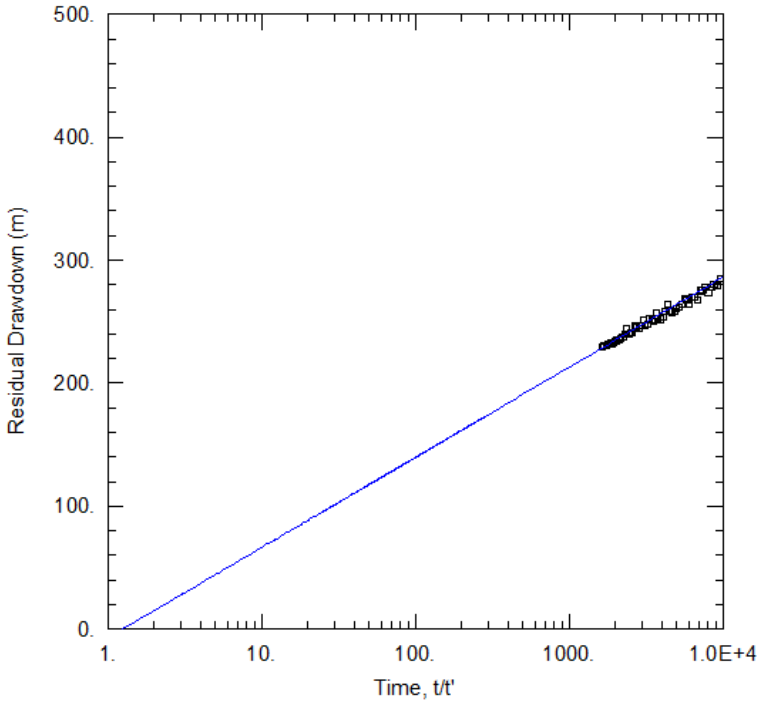
SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)
T = 0.000366 m^2/day S/S' = 1.205

Time axis intercept (t/t') =			1.205	
Pumping start day =		1 days		6/08/2016
Pumping stop day =		649 days		16/05/2018
extrapolating out t/t' in the Water Level Data tab until t/t' = 1.205				
	t'	t	t/t'	
	789	1443	1.828897	2401
	3190	3844	1.2050	
t' (time since pumping stopped) =		3190 days		8/02/2027
t (total time since pumping started) =		3844 days		14/02/2027
100% recovery =		14/02/2027		
		x	y	
recovery curve		649	704.6038	BHP monitoring point at start of recovery
		3844	0	100% recovery as determined above

MB3

Using latest monitoring period (29/9/17 to 17/10/18) - Aqtesolv Output - using measured bottom hole pressure (gas and water)



WELL TEST ANALYSIS

Data Set:
Date: 07/23/20 Time: 07:43:33

PROJECT INFORMATION

Test Well: RH50

AQUIFER DATA

Saturated Thickness: 665. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells			Observation Wells		
Well Name	X (m)	Y (m)	Well Name	X (m)	Y (m)
RH50	0	0	▫ RH50	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)
T = 0.001962 m^2/day S/S' = 1.247

Time axis intercept (t/t') =	1.247		
Pumping start day =	1 days	29/09/2017	
Pumping stop day =	283 days	8/07/2018	
extrapolating out t/t' in the RH30_all_data tab until t/t' = 1.247			
t' (time since pumping stopped) =	1141 days	22/08/2021	
t (total time since pumping started - analysis period) =	1423 days	22/08/2021	
t (total time since pumping started - all mon data) =	2092		
100% recovery =	22/06/2023		
	x	y	
recovery curve	1757.5	614.4019	BHP monitoring point at start of recovery
	2092	0	100% recovery as determined above

t'	t	t/t'
1141	1423	1.247152