

# Mid-Loddon Groundwater Management Area Local Management Rules

Annual Report

For year ending 30 June 2023

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Excellence



Honesty



Accountability

OFFICIAL



Courage



Caring

# Foreword

Goulburn-Murray Water (GMW) is pleased to present the annual report for the *Mid-Loddon Groundwater Management Area Local Management Rules* (the Rules) for the 2022/23 water year.

GMW is responsible for implementation and administration of the Rules which was endorsed by the Board of GMW in 2009.

This report provides an overview of the groundwater management activities administered under the Rules between 1 July 2022 and 30 June 2023. A copy of the report is available for inspection at GMW's Tatura office, or for download from the GMW website.



Matthew Pethybridge  
GROUNDWATER AND STREAMS MANAGER

Date: 28 September 2023

## Executive summary

The *Mid-Loddon Groundwater Management Area Local Management Rules* (the Rules) was endorsed by the Board of Goulburn Murray Water (GMW) in July 2009. The 2022/23 water year marks the fourteenth year of operation under the Rules.

A groundwater allocation of 100 per cent of licence entitlement volume was available for the Mid-Loddon Groundwater Management Area (the GMA) for the 2022/23 water year. Recorded use was 11,761.9 ML, or 35 per cent of the total licence entitlement volume; the lowest total since the 2011/12. A total of 10,090.9 ML of unused allocation was carried over for use in the 2023/24 water year.

Licence transfer activity during the 2022/23 water year was relatively subdued with just three temporary transfers (totalling 688.0 ML/yr) being completed by licence holders in the GMA.

A total of 652 millimetres (mm) of rain was recorded at Bridgewater, during the 2022/23 water year – 150 mm more than the 2021/22 total and the second highest total in the last fifty years. The combination of reduced groundwater extraction and increased rainfall during 2022/23 has resulted in increased seasonal recovery of groundwater levels, compared to the previous three to four seasons.

Groundwater monitoring and metering programs continue to support the objectives of the Rules.

GMW has commenced the initial stages for development of a new Local Groundwater Management Plan to replace the Rules. This management plan will cover an expanded area and include the area covered by the Rules as a zoned area within the larger management plan area. The Rules will continue to be in place until the new management plan is implemented by GMW.

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# 1 Introduction

## 1.1 Purpose

This report has been prepared to meet requirements of the *Mid-Loddon Groundwater Management Area Local Management Rules* (GMW, 2009) (the Rules). It provides an overview of groundwater resource status and summarises the groundwater management activities undertaken in accordance with the Rules during the 2022/23 water year (1 July 2022 to 30 June 2023).

## 1.2 Groundwater Management Area

The Mid-Loddon Groundwater Management Area (the GMA) extends from Tullaroop Reservoir in the south to Mitiamo in the north and includes the townships of Carisbrook, Bridgewater and Serpentine.

The GMA incorporates groundwater resources to all depths and contains three management zones – Moolort Zone (1011), Laanecoorie-Serpentine Zone (1012) and Jarklin Zone (1013) – as shown in Figure 1.

## 1.3 Local Management Rules

The Rules was endorsed for implementation by the Board of Goulburn-Murray Water (GMW) on 1 July 2009. It aims to ensure groundwater resources in the GMA are managed in an equitable and sustainable manner. More specifically, the Rules seeks to:

1. Provide all groundwater users with access to the resource, including domestic and stock users;
2. Enable development of the groundwater resources to realise the potential for its use in the region;
3. Provide environmental benefits through management of groundwater resources and maintain the integrity of the aquifer system, including its structure and groundwater quality;
4. Manage groundwater interference and intensively pumped areas to protect existing authorised users and the environment from unacceptable drawdown levels;
5. Establish transparent trigger levels and restrictions;
6. Provide mechanisms such as transfer of licence entitlement and carryover to allow flexible and adaptive management in response to changing demands, such as climatic conditions; and
7. Establish an effective monitoring program and provide periodic communications that will inform groundwater users of the status of the resource.

An assessment of GMW's activities against the Rules is presented in [Appendix A](#).

A copy of the Rules can be downloaded from the GMW website, at [www.gmwater.com.au/midloddongma](http://www.gmwater.com.au/midloddongma)

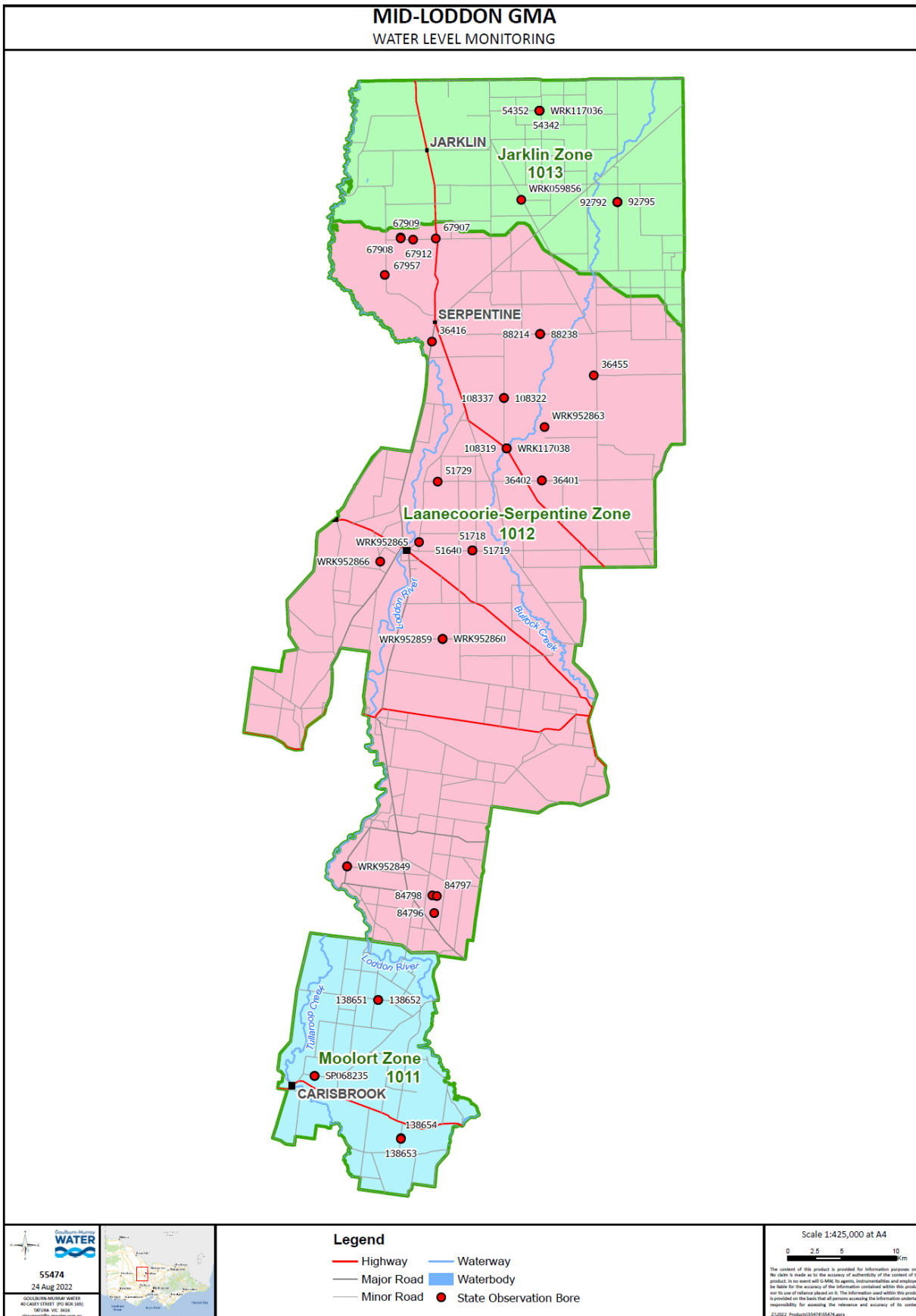


Figure 1 Mid-Loddon Groundwater Management Area

# 2 Groundwater Management

## 2.1 Licence entitlement volume

The Minister for Water declared a permissible consumptive volume of 34,037 megalitres per year (ML/yr) for the GMA in March 2013 (Victorian Government, 2013).

As of 30 June 2023, the total licence entitlement volume in the GMA was 33,927.1 ML/yr; unchanged from 30 June 2014. The number of licences in each management zone is summarised in Table 1, as well as the total number of licensed bores and the total licence entitlement volume.

**Table 1 Groundwater licences by management zone in 2022/23**

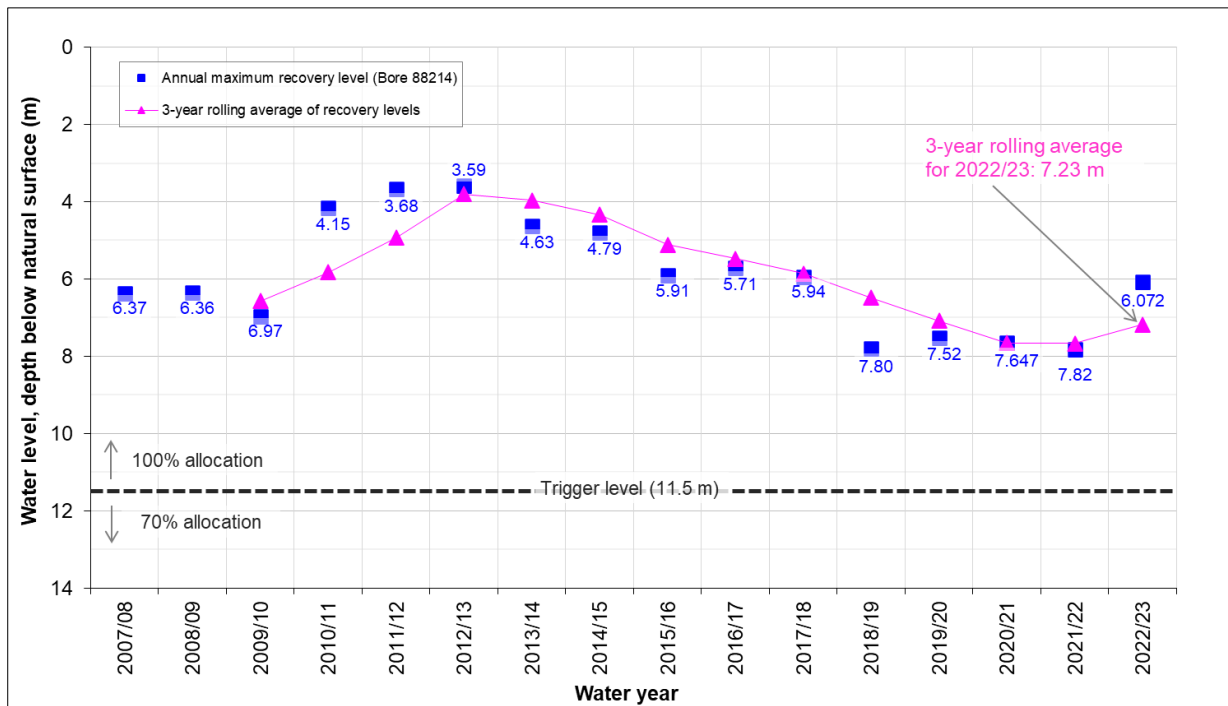
Management zone	Licences	Licensed bores	Licence entitlement volume (ML/yr)
Moolort Zone (1011)	23	31	3,875.4
Laanecoorie-Serpentine Zone (1012)	66	81	27,204.7
Jarklin Zone (1013)	14	17	2,847.0
<b>Total</b>	<b>103</b>	<b>129</b>	<b>33,927.1</b>

Note: Data extracted from the Victorian Water Register 1 July 2023.

## 2.2 Groundwater allocations

Annual groundwater allocations are determined by comparing the average of annual maximum groundwater recovery levels recorded in observation bore 88214 (referred to as the 'trigger bore') across three water years (the current and the two preceding), against a trigger level outlined in the Rules (11.5 metres below the natural ground surface).

On 10 August 2022, an allocation of 100 per cent was announced for all groundwater licence holders in the GMA for the 2022/23 water year (Figure 2).



**Figure 2 Allocations trigger graph, 2007/08 to 2022/23**

### 2.3 Rainfall

Rainfall data, recorded at a Bureau of Meteorology weather station at Bridgewater (BOM, 2023), is presented in Figure 3 as an indicator of climate trends across the GMA. The data indicate that annual rainfall totals have mostly been below the long-term average since the Rules was implemented. Notable exceptions include the 2010/11 and 2022/23 water years, when widespread flooding occurred as a result of significant rain events, as well as 2016/17.

A total of 652 millimetres (mm) of precipitation was recorded at Bridgewater over the 2022/23 water year – that is 150 mm more than the 2021/22 total, and the second highest total in the last fifty years.

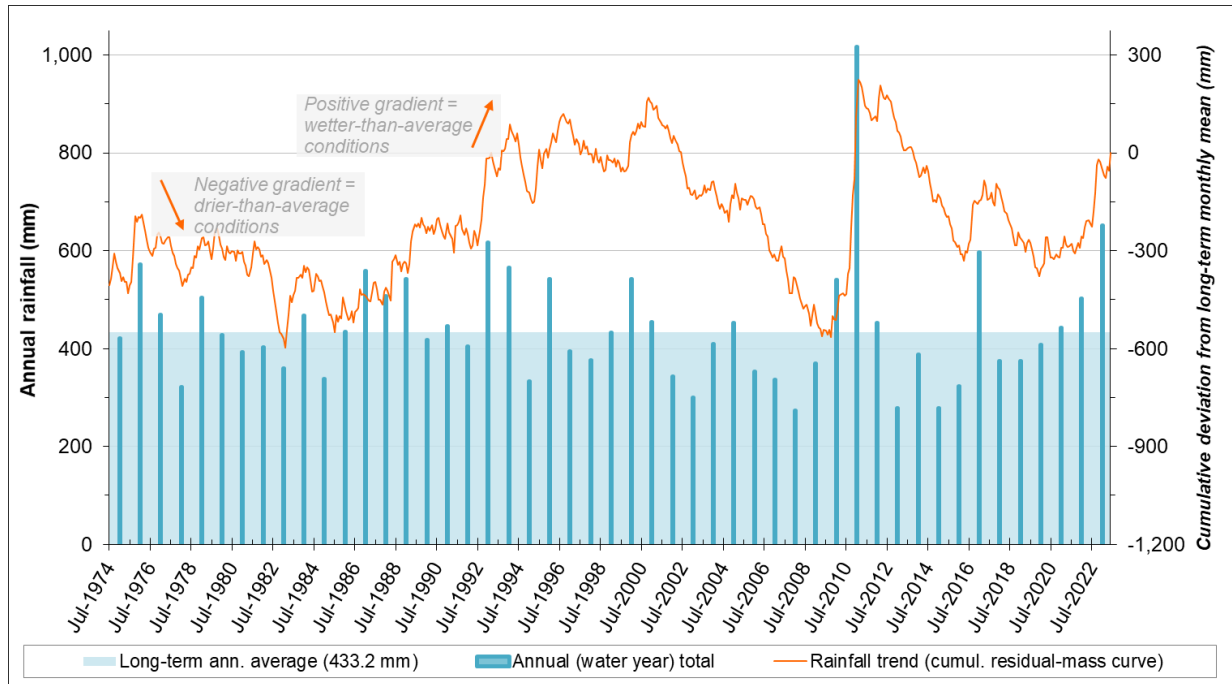


Figure 3 Rainfall recorded at Bridgewater, July 1974 to June 2023 (BOM, 2023)

### 2.4 Groundwater use

Recorded use in the GMA in 2022/23 was 11,761.9 ML, or 35 per cent of the licence entitlement volume. This is approximately 2,250 ML less than the 2021/22 figure and the lowest total since 2011/12 (Figure 4).

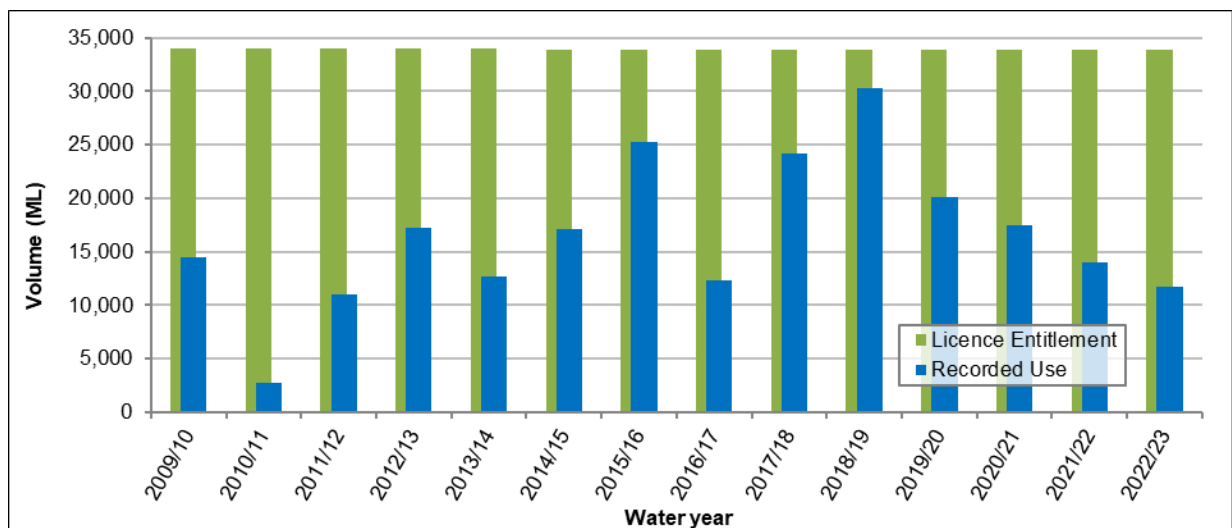


Figure 4 Annual recorded use compared to licence entitlement volume, since 2009/10



Note: 'recorded use' refers to metered and deemed use.

In 2022/23, the volume of recorded use was greatest in Laanecoorie-Serpentine Zone, where the majority of the licence entitlement volume was held. The highest recorded use, as a percentage of licence entitlement volume, occurred in Moolort Zone (Table 2).

**Table 2 Recorded use by management zone in 2022/23**

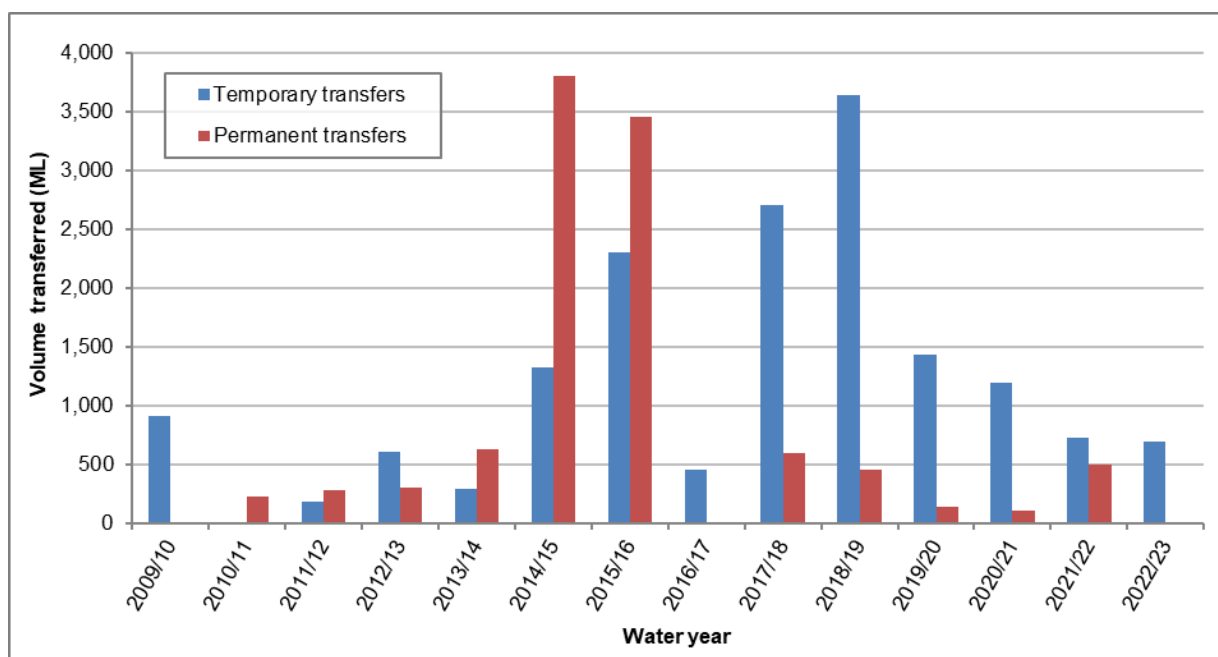
Management zone	Licence entitlement volume (ML/yr)	Recorded use (ML)	Proportion of licence entitlement volume used
Moolort Zone (1011)	3,875.4	1,583.3	41%
Laanecoorie-Serpentine Zone (1012)	27,204.7	9,569.9	35%
Jarklin Zone (1013)	2,847.0	608.7	21%
<b>Total</b>	<b>33,927.1</b>	<b>11,761.9</b>	<b>35%</b>

Note: Data extracted from the Victorian Water Register on 1 July 2023.

## 2.5 Licence transfers

The Rules allows groundwater licence holders to temporarily or permanently transfer (sell or purchase) licence entitlement. During the 2022/23 water year there were three temporary transfer transactions, for a total of 688.0 ML; no permanent transfer transactions were completed (Figure 5).

Of the three transfers completed, two were between licence holders within the same management zone; there was one temporary transfer of 288.0 ML/yr from Laanecoorie-Serpentine Zone to Moolort Zone (Table 3).



**Figure 5 Volume of licence transfers completed each water year since 2009/10**

**Table 3 Licence transfers by management zone, completed in 2022/23**

Management zone	Permanent				Temporary			
	Transfer from		Transfer to		Transfer from		Transfer to	
	No. of transfers	Volume (ML/yr)	No. of transfers	Volume (ML/yr)	No. of transfers	Volume (ML/yr)	No. of transfers	Volume (ML/yr)
Moolort Zone (1011)	-	-	-	-	-	-	1	288.0
Laanecoorie-Serpentine Zone (1012)	-	-	-	-	3	688.0	2	400.0
Jarklin Zone (1013)	-	-	-	-	-	-	-	-
<b>Total</b>	<b>0</b>	<b>0.0</b>	<b>0</b>	<b>0.0</b>	<b>3</b>	<b>688.0</b>	<b>3</b>	<b>688.0</b>

## 2.6 Carryover

Under the Rules, licence holders in the GMA are permitted to carryover up to a maximum of 30 per cent of their unused licence entitlement from one water year to the next.

A total of 9,742.3 ML was carried over to the 2022/23 water year by licence holders in the GMA. At the conclusion of 2022/23, 10,090.9 ML was able to be carried over for use in the 2023/24 water year.

## 2.7 Metering

As of 30 June 2023, there were 130 active service points associated with the 129 licensed bores in the GMA. These comprised 126 metered service points, three deemed service points and one unmetered service point. All meters were read at least twice (where possible) during the 2022/23 water year.

Three meter-maintenance events were recorded in GMW's asset management system during the 2022/23 water year.

## 2.8 Licence compliance

The Victorian Government and GMW have a zero-tolerance approach to unauthorised take of non-urban water. GMW is responsible for ensuring water users in northern Victoria comply with their licence conditions. All incidents of non-compliance are investigated by GMW, and action is taken in accordance with GMW's Risk-Based Compliance and Enforcement Framework.

More information can be found on the GMW website, at [www.gmwater.com.au/water-resources/water-use-compliance](http://www.gmwater.com.au/water-resources/water-use-compliance).

No prosecutions or convictions relating to groundwater matters in the GMA occurred during the 2022/23 water year.

## 2.9 Domestic and stock bore licences

The volume of groundwater taken for domestic and stock (D&S) use is not required to be licensed as it is a private right under section 8 of the Act, provided that water is used in accordance with the constraints imposed by the Act and is not regulated by the Rules.

The installation of a bore for D&S use requires a bore construction licence, in accordance with section 67 of the Act. Upon completion of a bore, a 'bore completion report' is required to be submitted to GMW and details are recorded in the Victorian state groundwater database, currently referred to as the *Water Measurement Information System* (WMIS).

According to the Victorian Water Register, six D&S bore construction licences, for locations within the GMA, were issued during the 2022/23 water year.

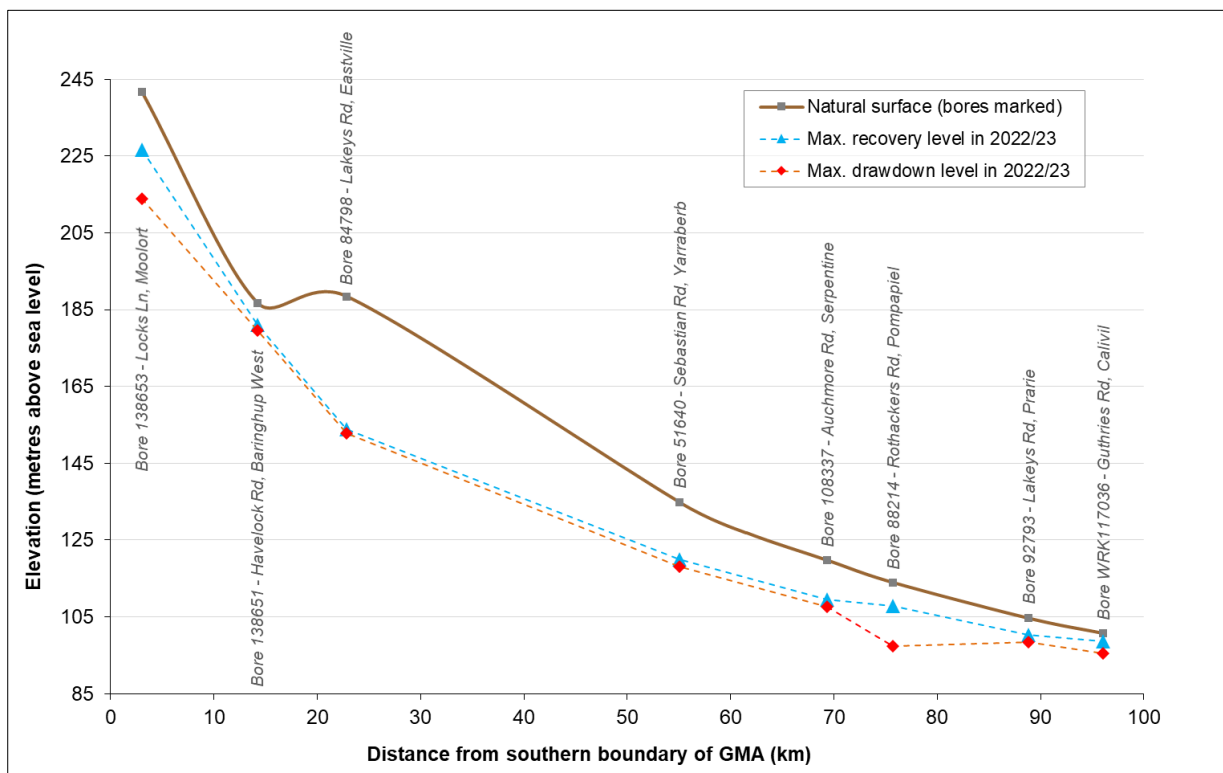
# 3 Monitoring Program

## 3.1 Groundwater levels

During the 2022/23 water year a total of 48 State observation bores, located within the GMA, were monitored by GMW and the Department of Energy, Environment and Climate Action (DEECA) – refer Figure 1 for locations. This total includes the 25 key bores specified in the Rules, where practicable. Of the 48 bores, 34 were monitored remotely using telemetry equipment, with measurements recorded hourly, and 14 were monitored manually, with measurements recorded at either one-month or three-month intervals. Water level data for these bores are presented as hydrographs in Appendix B.

Monitoring data, obtained from the State groundwater database, indicate that the groundwater resource position across the GMA improved in 2022/23, compared to recent years. Recovery levels<sup>1</sup> in most observation bores were considerably higher in 2022/23, compared to 2021/22. Furthermore, the combination of increased rainfall and reduced groundwater extraction during 2022/23 (Figure 4, Figure 3), resulted in drawdown levels<sup>2</sup> that were equal to or elevated compared to 2021/22.

The magnitude of drawdown<sup>3</sup> in the Deep Lead aquifer, during 2022/23, was between 10 and 13 metres in areas of intensive groundwater extraction, such as Moolort and Pompapiel, and typically less than 2 m in areas with less-intensive groundwater development, such as Eastville and Prairie (Figure 6).



**Figure 6 Groundwater levels in the Deep Lead aquifer along a south-to-north transect of the Mid-Loddon GMA**

<sup>1</sup> 'Recovery level' refers to the highest water level (i.e., closest to the ground surface) recorded during a water year – this typically occurs between August and November, when rainfall is higher and groundwater extraction is lower.

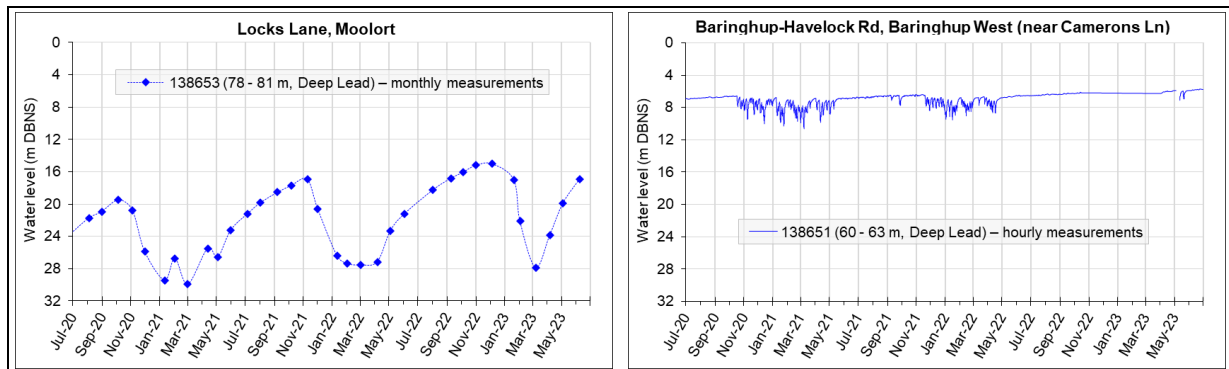
<sup>2</sup> 'Drawdown level' refers to the lowest water level (i.e., furthest from the ground surface) recorded during a water year – this typically occurs between December and March, when extraction is higher and there is less rainfall.

<sup>3</sup> The 'magnitude of drawdown' is the difference in depth between the maximum and minimum water levels recorded during the same water year.

### Moolort Zone

At Moolort, the groundwater level in Deep Lead observation bore 138653 recovered to a level 1.9 m higher (*i.e., closer to the surface*) in 2022/23, compared to 2021/22 – 15.0 m depth below natural surface (DBNS), up from 16.9 m. The level of maximum drawdown in 2022/23 was 27.9 m DBNS, occurring in March 2023; this was marginally lower than the 2022/21 level (27.5 m DBNS) which also occurred in month of March (Figure 7).

At Baringhup West, the groundwater level in Deep Lead observation bore 138651 recovered to a level 0.67 m higher in 2022/23, compared to 2021/22 – 5.72 m DBNS, up from 6.39 m. Drawdown of the observed water level in 2022/23 was minimal (1.0 m decline) and occurred late in the year, over a short period (one week, in May), compared to most other years on record (Figure 7, [Appendix B](#)).



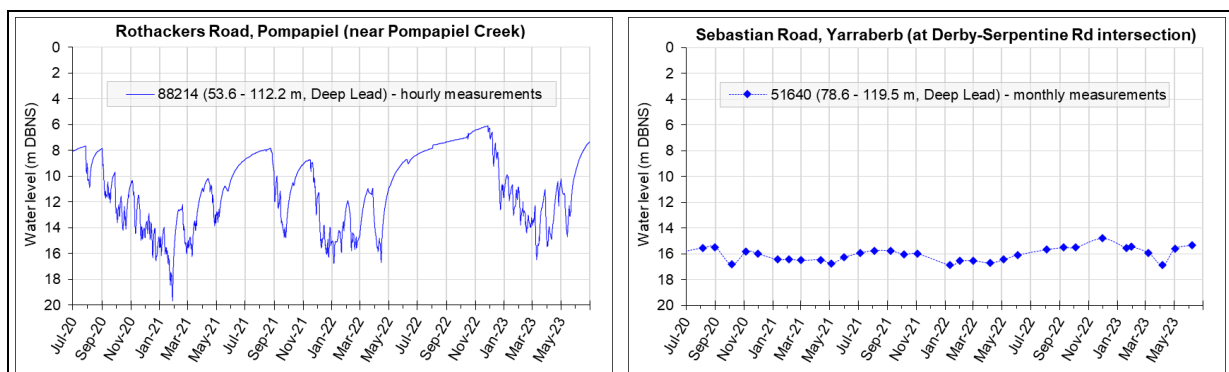
**Figure 7 Groundwater level monitoring in the Moolort Zone – all records between 1 July 2020 and 30 June 2023 (DEECA, 2023)**

### Laanecoorie-Serpentine Zone

In 2022/23, the maximum groundwater recovery level recorded in the allocations trigger bore (*ID 88214*), located in Pompapiel, was 1.75 m higher than the maximum of 2021/22 (6.08 m DBNS, compared to 7.83 m). As a result of the observed water level in 2022/23 reaching a maximum drawdown level similar to that of 2021/22 (16.49 m DBNS, versus 16.71 m), the magnitude of drawdown was greater – 10.41 m, compared to 8.88 m (Figure 8).

At Yarraberb, the maximum groundwater recovery level in Deep Lead observation bore 138653 was 0.94 m higher in 2022/23, compared to 2021/22 (Figure 8), and was the highest level in more than four years – *refer longer-term hydrograph in Appendix B*.

As with bore 88214, the lowest water level recorded in this observation bore in 2022/23 was comparable to that of 2021/22 (16.88 m DBNS, versus 16.87 m) and therefore, correspondingly, the magnitude of drawdown in 2022/23 was greater – 2.08 m, compared to 1.13 m (Figure 8).



**Figure 8 Groundwater level monitoring in the Laanecoorie-Serpentine Zone – all records between 1 July 2020 and 30 June 2023 (DEECA, 2023)**

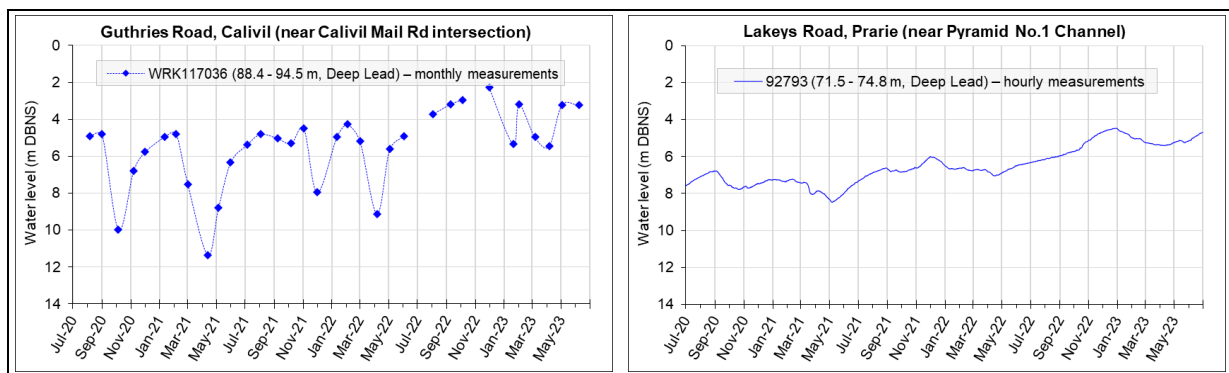
### Jarklin Zone

At Calivil, the highest water level recorded in Deep Lead observation bore WRK117036<sup>4</sup> during 2022/23 (i.e., the maximum recovery level) was 2.27 m DBNS; 2.00 m higher than the 2021/22 level and the highest since 2017/18.

The lowest recorded level was 5.45 m DBNS, up from 9.12 m recorded in 2021/22 (Figure 9). When comparing this to previous maximum drawdown levels (by water year), this is the highest since 2013/14 when the lowest recorded level was 5.12 m DBNS – refer longer-term hydrograph in Appendix B.

At Prairie, the highest groundwater level recorded in Deep Lead observation bore 92793 during 2022/23 was 4.46 m DBNS, 1.53 m higher than the highest level recorded in 2021/22; the magnitude of drawdown was 1.87 m (Figure 9).

Lower groundwater levels can provide improved drainage and reduced waterlogging and land-salinity problems in this area.



**Figure 9 Groundwater level monitoring in the Jarklin Zone – all records between 1 July 2020 and 30 June 2023 (DEECA, 2023)**

### 3.2 Groundwater quality

#### Sampling of State observation bores

During the 2022/23 water year two State observation bores, located within the GMA, were sampled by GMW and DEECA. These comprised bore 88214, in the Laanecoorie-Serpentine Zone, and bore WRK059856 (an alternative for bore 54343) in the Jarklin Zone. Both bores are screened in the Deep Lead aquifer.

Groundwater samples collected from these bores were sent to an accredited laboratory for analysis. The full suite of results is presented in Appendix C.

Groundwater salinity results, presented in Figure 10, indicate that groundwater salinity levels have been relatively stable since 2009; and were at similar levels in the 1970s. Continued annual sampling of these key bores will enable variations in groundwater quality to be observed.

<sup>4</sup> In August 2020, observation bore 54343 was replaced and has since been known as WRK117036.



## 4 Administration and Engagement

### 4.1 Proposed expansion of the GMA

GMW has commenced a process to expand groundwater management in the Loddon groundwater catchment. This process aims to incorporate the area currently managed under the Rules (the GMA) into a local management plan covering a broader region, including the parts of the Loddon groundwater catchment which are currently unincorporated<sup>5</sup>. This broader area is currently being referred to, by GMW, as the Loddon Plains Groundwater Management Area.

GMW has sent a letter to all licence holders in the GMA asking them to participate in a survey about the performance of the existing management arrangements. GMW has also developed a webpage where relevant information, timelines and opportunities for input to the process is being published. People wanting to engage in the process to develop the new management plan are encouraged to regularly visit the webpage, found at: <https://yoursay.gmwater.com.au/loddon-plains-groundwater-management-area-local-management>

Groundwater resources in the Mid-Loddon GMA will continue to be management under the Rules until the new management plan is implemented by GMW.

### 4.2 Groundwater Reference Committee

GMW has met with the Mid-Loddon Groundwater Reference Committee on fourteen occasions since its establishment.

GMW did not meet with the committee during the 2022/23 water year however intends to hold a meeting in the second quarter of the 2023/24 water year so that technical information currently being developed by the Department of Environment, Energy and Climate Change can be presented to the committee.

GMW intends to communicate the proposed plan-development process and relevant technical information to the committee, as well as other stakeholders and the broader community, as soon as practicable.

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<sup>5</sup> 'Unincorporated' refers to areas where a groundwater management unit has not been declared – this could be a groundwater management area (GMA) or a water supply protection area (WSPA).

## 5 References

Australian Laboratory Services Pty Ltd (ALS), 2022. *Certificate of Analysis – Batch No. 22-72913 – Final Report 57061*. Laboratory report completed for Department of Environment and Primary Industries (currently known as Department of Energy, Environment and Climate Action), dated 29 December 2022. ALS Environmental Laboratory, Scoresby, Victoria.

Bureau of Meteorology (BOM), 2023. *Climate Data Online – Bridgewater (Post Office) station number 81058*. Retrieved in September 2023 from: [http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p\\_nccObsCode=139&p\\_display\\_type=dataFile&p\\_startYear=&p\\_c=&p\\_stn\\_num=081058](http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=081058)

Victorian Department of Energy, Environment and Climate Action (DEECA), 2023. *Water Measurement Information System*. Data retrieved in September 2023 from: <https://data.water.vic.gov.au>

Goulburn-Murray Water (GMW), 2009. *Mid-Loddon Groundwater Management Area Local Management Rules*. Goulburn-Murray Water, Tatura, Victoria.

Victorian Government, 2013. *Victorian Government Gazette No. G10 Thursday 7 March 2013*. Victorian Government, Melbourne, Victoria.

*Water Act 1989 (Vic)*, viewed 30 June 2023 at:  
[http://classic.austlii.edu.au/au/legis/vic/consol\\_act/wa198983/](http://classic.austlii.edu.au/au/legis/vic/consol_act/wa198983/)



## Appendix A – Assessment of activities against the Rules

Rule	Activity	Compliant?
1. Cap on licence entitlement	The Minister for Water declared a Permissible Consumptive Volume of 34,037 ML/yr for the Mid-Loddon GMA in March 2013.	Yes
2. Managing groundwater interference	GMW processed all groundwater licence applications in accordance with section 40 of the Act.	Yes
3. Managing intensity of groundwater extraction	GMW processed all groundwater licence applications in accordance with the conditions outlined in Rule 3.	Yes
4. Managing groundwater levels	On 10 August 2022, GMW announced an allocation of 100% of licence entitlement volume for all management zones for the 2022/23 water year.  GMW announced the allocation by listing it on the GMW website, sending letters to all licence holders and placing public notices in local newspapers.	Yes
5. Transfer of groundwater licence entitlement	GMW processed three temporary transfer transactions in 2022/23. All transfers were carried out in accordance with conditions outlined in Rule 5.	Yes
6. Carryover	Carryover up to 30% of licence volume was available to all licence holders in the Mid-Loddon GMA.	Yes
7. Monitoring groundwater levels	Of the 25 key bores identified for monthly monitoring in Schedule 1 of the Rules: <ul style="list-style-type: none"> <li>• six bores were monitored remotely, with hourly measurements recorded;</li> <li>• ten bores were monitored manually, on a monthly basis;</li> <li>• four bores were monitored manually, on a quarterly basis; and</li> <li>• four bores were not monitored at all.</li> </ul>	No
8. Monitor groundwater salinity	State observation bores 88214 and WRK059856 were sampled on 11 October 2022 and analysed for salinity at a NATA-accredited laboratory, run by <i>Australian Laboratory Services Pty Ltd</i> . All water quality data from these samples was entered into the State groundwater database within 60 days.  <i>Note: bore WRK059856 has been used as an alternative to bore 54343 since 2011/12. Bore 54343 was replaced in April 2010 (now called WRK117036), however GMW intends to continue sampling bore WRK059856 for data-continuity purposes.</i>  GMW sent sample bottles and reply-paid envelopes to all licensed groundwater users (one per licensed bore) in February 2023. GMW measured the salinity of returned samples, advised licence holders of their result/s and recorded the results in a database.	Yes

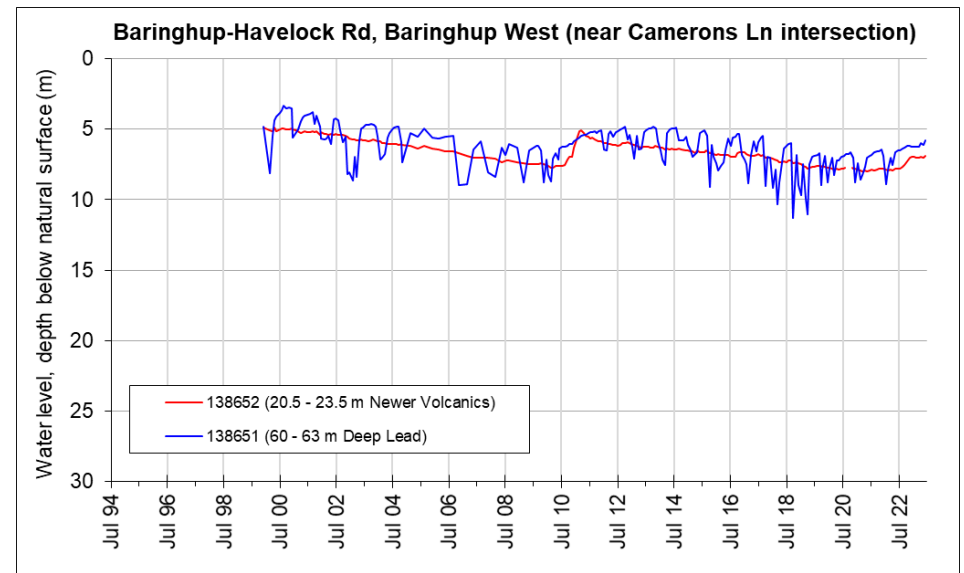
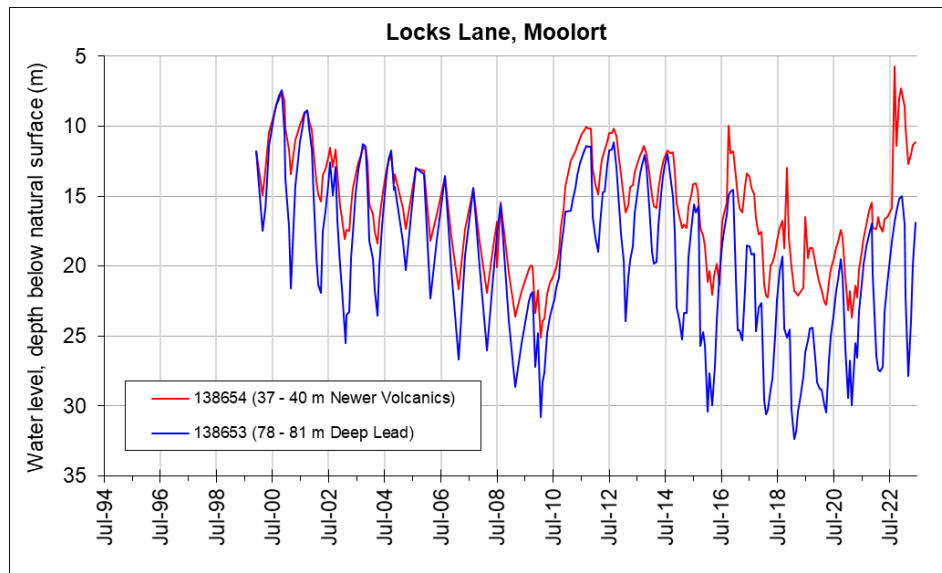
Rule	Activity	Compliant?
9. Record meter readings	<p>As at 30 June 2022, meters were fitted to 126 of 129 licensed bores in the Mid-Loddon GMA. GMW ensured that groundwater use was accounted for each operational licensed bore and read each meter at least twice (where practicable) during 2022/23.</p> <p>All meter reads were entered into GMW's metering database, known as <i>Irrigation Planning Module</i>.</p> <p><i>Note: the Rules states that GMW will "read each meter at least three times each season on average"; nevertheless GMW has maintained the flexibility to vary the frequency depending on seasonal climatic conditions since gaining support on this from the Mid-Loddon Groundwater Reference Committee on 31 August 2011.</i></p>	Yes
10. Annual reporting	<p>In September 2022, GMW prepared an annual report summarising the groundwater management activities under the Rules for the year ending 30 June 2022. The report was published on the GMW website on 6 December 2022.</p>	Yes
11. Provide effective communication	<p>GMW's communication activities during 2022/23 included:</p> <ul style="list-style-type: none"> <li>• prepared an annual newsletter in September 2022, and mailed a copy to all licence holders in the GMA;</li> <li>• published on the GMW website: the 2021/22 annual report, the 2022 annual newsletter and hydrographs for key bores (including the allocations trigger bore).</li> </ul> <p><i>Note, GMW did not meet with the Groundwater Reference Committee in 2022/23. The Loddon Campaspe Regional Water Service Committee has been updated on the Loddon Planning and management of the Mid Loddon GMA.</i></p> <p>A copy of the Rules, and other supporting documents, have been available on the GMW website since approval.</p>	No
12. Review of local management rules	<p>A formal review of the Rules was undertaken by GMW in 2018.</p> <p>At the last meeting of the Groundwater Reference Committee (February 2022), GMW discussed its intentions to expand the Mid-Loddon GMA (to include unincorporated areas to the west, east and north of the existing boundary) and to amend the Rules accordingly. GMW has and will continue to consult with all relevant stakeholders, including the Groundwater Reference Committee, as part of this process.</p>	Yes

# Appendix B – Groundwater level data

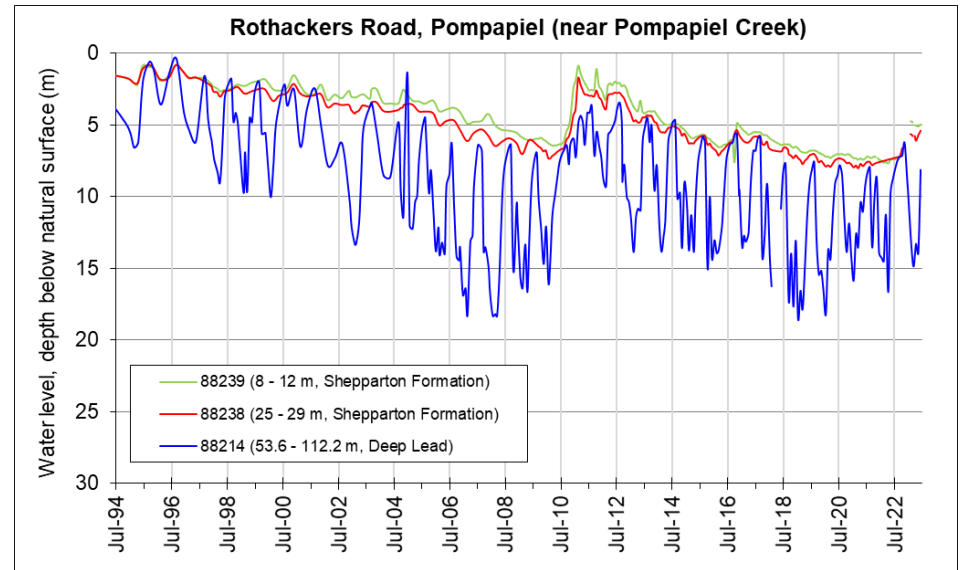
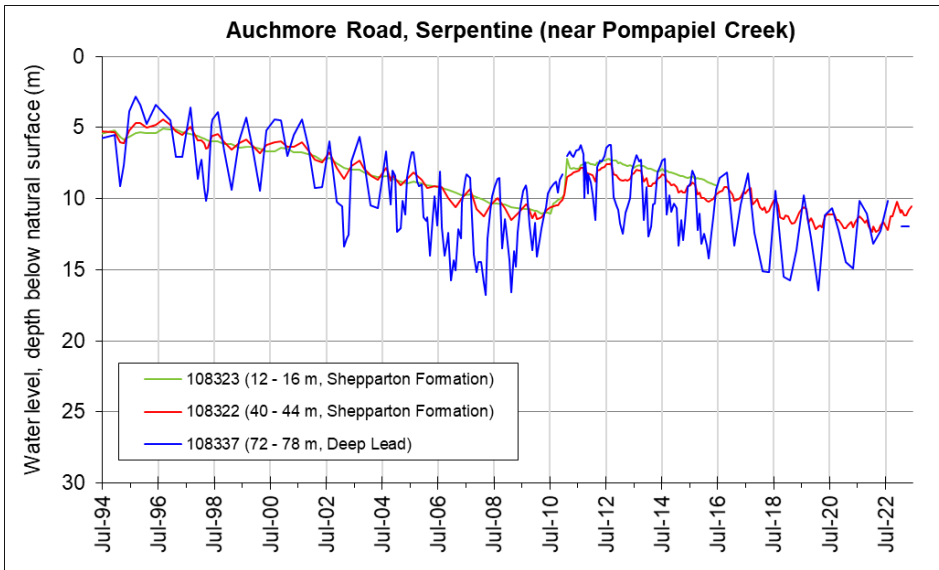
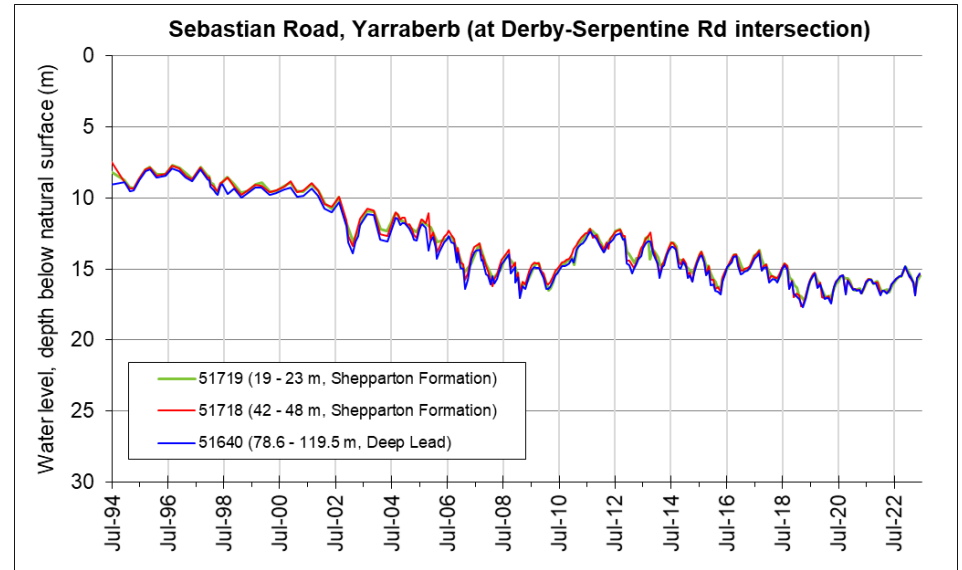
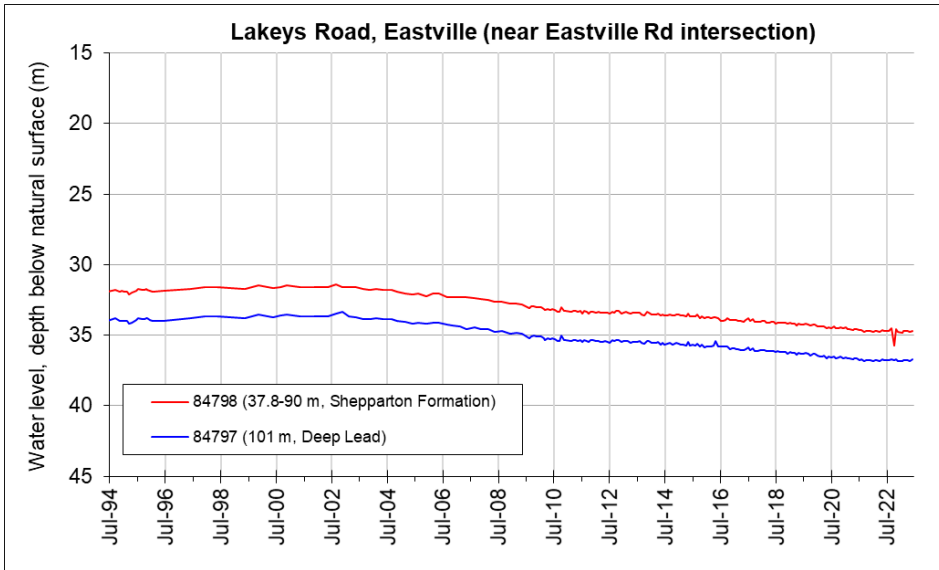
Hydrographs for key monitoring bores in the GMA. For sites that have hourly records, only one level per month is presented in the hydrographs – 12:00 PM on the 15th day (or the closest available).

All data was sourced from the *Water Measurement Information System (WMIS)* in September 2023 (DEECA, 2023). All hydrographs show the time period July 1994 to June 2023 – further groundwater level information is available on the WMIS website, at <https://data.water.vic.gov.au>

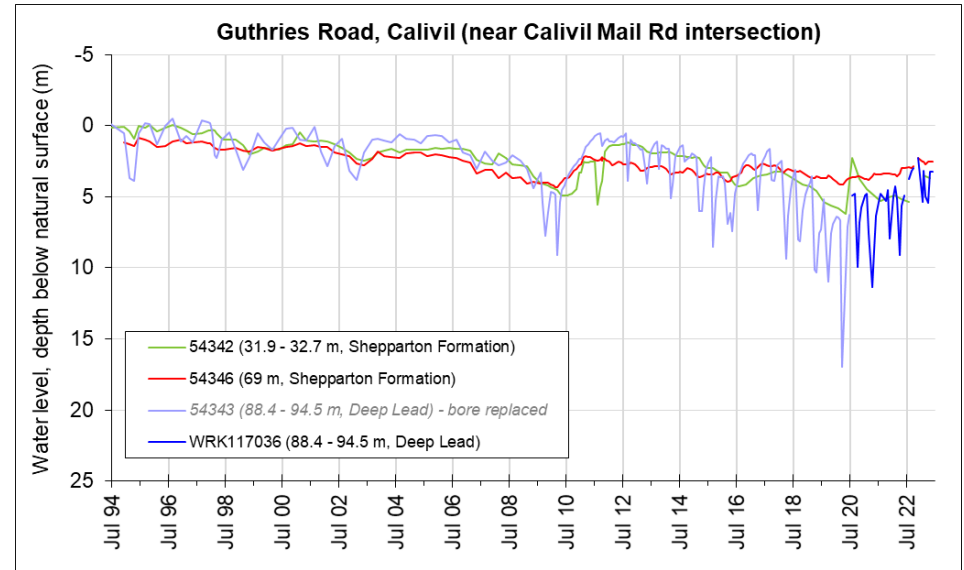
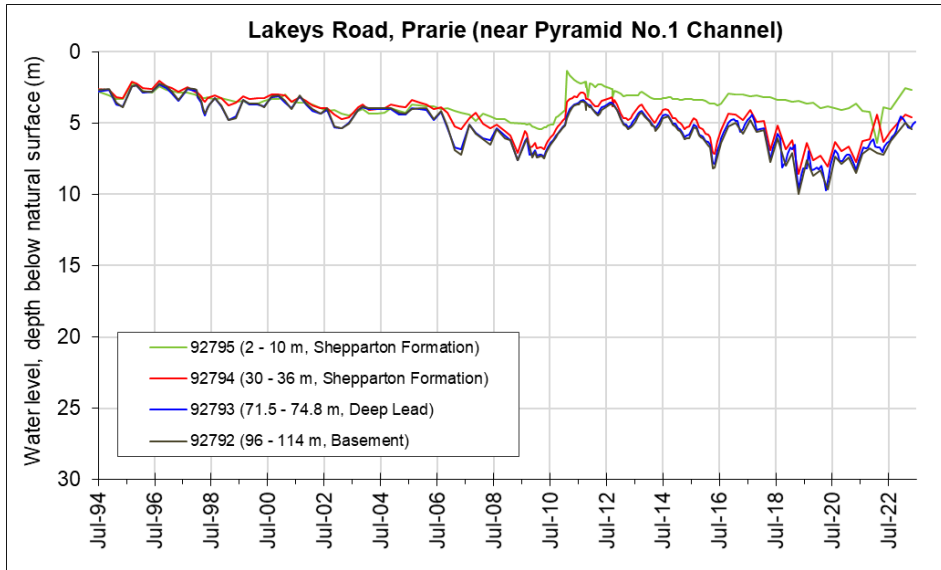
## Moolort Zone (1011)



### Laanecoorie-Serpentine Zone (1012)



### Jarklin Zone (1013)



## Appendix C – Groundwater quality results

Analytical chemistry results for key State observation bores sampled during the 2022/23 water year. All data sourced directly from laboratory reports completed by *Australian Laboratory Services* (ALS, 2022). Further information is available on the *Water Measurement Information System* website, at <https://data.water.vic.gov.au>.

		<b>Bore:</b>	<b>88214</b>	<b>WRK059856</b>
		<b>Aquifer:</b>	<b>Deep Lead</b>	<b>Deep Lead</b>
		<b>Date:</b>	<b>11/10/2022</b>	<b>11/10/2022</b>
<b>Analyte</b>	<b>Unit</b>			
Conductivity @ 25°C	µS/cm		2,600	3,700
pH	pH units		8.7	7.7
Ionic balance	%		9.29	5.78
Total Anions	meq/L		18	36
Total Cations	meq/L		15	32
Ion Balance - TDS (EC) vs TDS	mg/L		0.5	0.5
Total Alkalinity, as CaCO <sub>3</sub>	mg/L		190	200
Bicarbonate Alkalinity, CaCO <sub>3</sub>	mg/L		170	200
Calcium, as Ca	mg/L		13	49
Carbonate Alkalinity, as CaCO <sub>3</sub>	mg/L		18	<2
Chloride, as Cl	mg/L		700	1,000
Hydroxide Alkalinity, as CaCO <sub>3</sub>	mg/L		<2	<2
Potassium, as K	mg/L		8	8
Sodium, as Na	mg/L		390	520
Ammonia, as N	mg/L		0.4	<0.1
Nitrite, as N	mg/L		<0.01	<0.01
Nitrate, as N	mg/L		<0.01	<0.01
Sulphate, as SO <sub>4</sub>	mg/L		34	180
Total Kjeldahl Nitrogen, as N	mg/L		0.4	1.1
Total Nitrogen, as N	mg/L		0.4	1.2
Arsenic, as As	mg/L		<0.001	0.001
Iron, dissolved as Fe	mg/L		<0.01	<0.01
Mercury, as Hg	mg/L		<0.0001	<0.0001
Magnesium, as Mg	mg/L		55	82
Manganese, dissolved as Mn	mg/L		0.045	0.054
Total Dissolved Solids, 180C	mg/L		1,300	2,000
Total Organic Carbon	mg/L		<0.5	<0.5
Turbidity, NTU	NTU		0.4	23
Phosphorus, total as P	mg/L		0.07	0.14
Lead, dissolved (ICP-MS)	mg/L		<0.001	<0.001
Nickel, dissolved (ICP-MS)	mg/L		<0.001	0.002
Cadmium, dissolved (ICP-MS)	mg/L		<0.0002	<0.0002
Chromium, dissolved (ICP-MS)	mg/L		<0.001	<0.001
Copper, dissolved (ICP-MS)	mg/L		<0.001	<0.001
Zinc, dissolved (ICP-MS)	mg/L		-	-

*Note: Results for dissolved Zinc were not provided for these samples.*