

Supporting science for the review and amendment of the Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas

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Department for Environment and Water
June, 2026

DEW Technical report DEW-TR-2026-10



**Government
of South Australia**

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July 2026

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Preferred way to cite this publication

Department for Environment and Water (2026). Supporting science for the review and amendment of the Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas, DEW Technical report 2026/10, Government of South Australia, Department for Environment and Water, Adelaide.

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Foreword

The Department for Environment and Water (DEW) is responsible for the management of the State's natural resources, ranging from policy leadership to on-ground delivery in consultation with government, industry and communities.

High-quality science and effective monitoring provide the foundation for the successful management of our environment and natural resources. This is achieved through undertaking appropriate research, investigations, assessments, monitoring and evaluation.

DEW's strong partnerships with educational and research institutions, industries, government agencies, Landscape Boards and the community ensures that there is continual capacity building across the sector, and that the best skills and expertise are used to inform decision making.

Ben Bruce
CHIEF EXECUTIVE
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Acknowledgements

The science support for the Musgrave and Southern Basins Prescribed Wells Areas Water Allocation Plan project was jointly funded by the Eyre Peninsula Landscape Board (EP LB) and the Department for Environment and Water (DEW).

The authors gratefully acknowledge the contributions of Peter Baker (DEW), Kyle Horner (DEW), Darren Alcoe (DEW), and Cameron Wood (DEW) for their guidance, technical input, and support throughout the project.

Darren Alcoe provided valuable experience and perspective during the review process, and Cameron Wood provided specialist advice on the groundwater modelling aspects of the work.

The authors also thank Peter Baker and Kyle Horner for their constructive reviews, which strengthened the final report. Appreciation is also extended to Simone Stewart (DEW) for sharing her extensive knowledge of the Eyre Peninsula and providing valuable policy and planning insights.

Table of Contents

Foreword	ii
Acknowledgements	iii
Summary	xii
1. Introduction	1
1.1. Purpose	1
1.2. Scope	1
1.3. Background	1
1.4. Historical trends of extraction	2
1.5. Description of PWAs	5
1.5.1. Southern Basins PWA	5
1.5.2. Musgrave PWA	7
2. Climate	9
2.1. Southern Basins climate conditions	11
2.2. Musgrave climate conditions	13
2.3. Climate variability and impacts	16
2.4. Regional geological setting	18
3. Hydrogeology	19
3.1. Aquifers	19
3.1.1. Quaternary Limestone aquifer	19
3.1.2. Tertiary Sands aquifer	20
3.1.3. Jurassic aquifer	20
3.1.4. Basement aquifers	25
3.2. Aquifer recharge and discharge processes	25
3.2.1. Quaternary Aquifer recharge	25
3.2.2. Recharge of Uley South Basin in the Southern Basins PWA	26
3.2.3. Recharge of the Polda and Bramfield Basins	27
3.2.4. Tertiary Sands aquifer recharge	29
3.2.5. Jurassic aquifer recharge	29
3.2.6. Basement aquifer recharge	29
4. Groundwater resources condition	30
4.1. Southern Basins PWA	31
4.1.1. Coffin Bay Consumptive Pool	31
4.1.2. Uley North Consumptive Pool	36
4.1.3. Uley Wanilla Consumptive Pool	39
4.1.4. Uley South Consumptive Pool	42

4.1.5.	Lincoln North Consumptive Pool	48
4.1.6.	Lincoln South Consumptive Pool	51
4.2.	Musgrave PWA	56
4.2.1.	Bramfield Consumptive Pool	56
4.2.2.	Polda Consumptive Pool	59
4.2.3.	Sheringa Consumptive Pool	64
4.3.	Groundwater-dependent ecosystems – responses to historic groundwater level changes	66
5.	Capacity of groundwater resources	67
5.1.	Management areas used to determine consumptive pools	68
5.1.1.	Uley Wanilla Consumptive Pool	74
5.1.2.	Lincoln South Consumptive Pool	74
5.2.	Licensed Quaternary Limestone aquifers	74
5.2.1.	Aquifer recharge zones	74
5.2.2.	Aquifer recharge rates	78
5.2.3.	Resource capacity estimates	82
5.3.	Uley South and Bramfield Quaternary Limestone aquifers	83
5.4.	Uley South groundwater modelling results	83
5.5.	Bramfield groundwater investigation results	84
5.6.	Aquaculture Elliston management area	87
5.7.	Non-licenced Quaternary aquifer management areas	87
5.8.	Tertiary Sands and Basement aquifer management areas	88
5.9.	Tertiary Sands aquifer management areas	88
5.10.	Basement aquifer management areas	88
6.	Water demand	90
6.1.	Non-licensed water demand	90
6.1.1.	Stock water use estimation	90
6.1.2.	Domestic water use estimation	91
6.1.3.	Summary of non-licensed demand	91
6.2.	Licensed water demand	91
6.2.1.	Southern Basins PWA	94
6.2.2.	Musgrave PWA	94
6.2.3.	Assessment of demand relative to resource capacity	94
7.	Adaptive management	97
7.1.	Background	97
7.2.	Development of the adaptive management approach	97
7.2.1.	Previous approach (2016 Framework)	97
7.2.2.	Revised Approach (2026 Framework)	99

7.2.3.	Conversion of storage triggers to groundwater level triggers	101
7.2.4.	Adaptive management method	107
7.3	Systems not subject to adaptive management	108
7.3.1.	Coffin Bay.....	108
7.3.2.	Uley South.....	108
7.3.3.	Lincoln North.....	108
7.3.4.	Aquaculture Elliston	108
7.3.5.	Deeper groundwater resources	109
8.	Monitoring.....	110
8.1.	Purpose and role of monitoring	110
8.2.	Groundwater level monitoring.....	110
8.3.	Groundwater salinity	111
8.4.	Climate and recharge monitoring.....	114
8.5.	Monitoring network within PWAs	114
8.5.1.	Resource condition monitoring (core program).....	114
8.5.2.	Adaptive management monitoring (trigger wells)	115
8.5.3.	Risk-based monitoring under the Risk Monitoring and Management Plan	118
8.6.	Data quality, calibration and monitoring frequency.....	118
8.7.	Monitoring resourcing and operational delivery	118
8.8.	Monitoring procedures	119
8.9.	Monitoring in-recovery systems (Lincoln South and Uley Wanilla)	120
8.10.	Targeted investigations and new monitoring infrastructure	120
8.10.1.	Uley South Consumptive Pool	120
8.10.2.	Bramfield Consumptive Pool.....	120
8.10.3.	Lincoln North Consumptive Pool	120
9.	Conclusions and recommendations	122
9.1.	Conclusions.....	122
9.2.	Recommendations.....	123
10.	Appendices	124
A.	Water Table Fluctuation method.....	124
B.	Adaptive management statistical analysis of well groundwater levels	124
11.	Units of measurement.....	151
11.1	Units of measurement commonly used (SI and non-SI Australian legal).....	151
11.2	Shortened forms	151
12.	Glossary.....	153
13.	References.....	156

List of figures

Figure 1-1	Historical use and source of public water supply for Eyre Peninsula prescribed water resources	4
Figure 1-2	Water demand on the Eyre Peninsula by customer segment (SA Water, 2024)	4
Figure 1-3	Map of the Southern Basins PWA	6
Figure 1-4	Map of the Musgrave PWA	8
Figure 2-1	Rainfall reliability maps for Eyre Peninsula (BoM et al. 2019)	10
Figure 2-2	South Australian historical temperature anomaly maps, 1990 to 2024 (BoM 2025).	10
Figure 2-3	BoM 18017 – Big Swamp annual rainfall compared to the long-term mean	11
Figure 2-4	BoM 18137 – Westmere annual rainfall compared to the long-term mean	11
Figure 2-5	Annual rainfall and cumulative deviation from the mean annual rainfall for BoM station 18137 – Westmere.....	12
Figure 2-6	Annual mean maximum temperature for BoM 18070 Port Lincoln and 018192 North Shields climate monitoring stations	13
Figure 2-7	BoM 18069 – Elliston annual rainfall compared to the long-term mean	14
Figure 2-8	BoM 18165 – Terrah Winds annual rainfall compared to the long-term mean	14
Figure 2-9	Annual rainfall and cumulative deviation from mean annual rainfall for BoM station 18069 – Elliston	15
Figure 2-10	Annual mean maximum temperature for BoM 018044 Kyancutta climate monitoring station	15
Figure 2-11	Changes in modelled recharge for changes in rainfall in the Musgrave PWA	17
Figure 2-12	Hydrograph projection for monitoring station WAD031 including the 10th, 50th and 90th percentile rainfall datasets	17
Figure 3-1	Indicative groundwater flow directions for the Quaternary Limestone aquifer in the Southern Basins PWA	21
Figure 3-2	Indicative groundwater flow directions for the Quaternary Limestone aquifer in the Musgrave PWA	22
Figure 3-3	Saturated thickness of the Quaternary Limestone aquifer in the Southern Basins PWA	23
Figure 3-4	Saturated thickness of the Quaternary Limestone aquifer in the Musgrave PWA	24
Figure 3-5	Uley South groundwater level and rainfall correlation	27
Figure 3-6	Polda groundwater level and rainfall correlation	28
Figure 4-1	Location map for monitoring wells and public water supply wells for Coffin Bay Consumptive Pool.....	32
Figure 4-2	Groundwater level, rainfall and extraction trends for the Coffin Bay Consumptive Pool.....	32
Figure 4-3	Coffin Bay historical groundwater level rankings for selected monitoring wells with good historical records	33
Figure 4-4	Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Coffin Bay Consumptive Pool with 10-year salinity trends.	34
Figure 4-5	Conductivity–depth section for a subset of flightline 10260 which transects the south-western margin of the Coffin Bay wellfield (from Munday et al. 2024)	35
Figure 4-6	Comparative responses between the modelled TEMPEST data, and downhole EM and modelled sTEM data (from Munday et al. 2025)	35

Figure 4-7	Cross-section of modelled seawater interface with the EM surface survey results (from Munday et al. 2025)	36
Figure 4-8	Location map for monitoring wells and rainfall stations for Uley North Consumptive Pool....	37
Figure 4-9	Groundwater level, rainfall and extraction trends for the Uley North Consumptive Pool	37
Figure 4-10	Uley North historical groundwater level rankings for selected monitoring wells with good historical records	38
Figure 4-11	Groundwater level hydrographs for representative monitoring wells in Uley North	38
Figure 4-12	Uley North Consumptive Pool salinity with 10-year trend	39
Figure 4-13	Location map for monitoring wells and rainfall stations for Uley Wanilla Consumptive Pool .	40
Figure 4-14	Groundwater level, rainfall and extraction trends for Uley Wanilla Consumptive Pool	40
Figure 4-15	Uley Wanilla historical groundwater level rankings for selected monitoring wells with good historical records	41
Figure 4-16	Groundwater level hydrographs for representative monitoring wells in Uley Wanilla	41
Figure 4-17	Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Uley Wanilla Consumptive Pool with 10-year salinity trends	42
Figure 4-18	Location map for monitoring and public water supply wells for the Uley South Consumptive Pool.....	43
Figure 4-19	Groundwater level, rainfall and extraction trends for the Uley South Consumptive Pool	44
Figure 4-20	Uley South historical groundwater level rankings for selected monitoring wells with good historical records	44
Figure 4-21	Groundwater level hydrographs for representative monitoring wells in Uley South.	45
Figure 4-22	Uley South historical total dissolve solids – percentage difference from the mean for selected monitoring wells with good historical records.....	46
Figure 4-23	Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Uley South Consumptive Pool with 10-year salinity trends	47
Figure 4-24	Groundwater salinity trends in representative public water supply wells	47
Figure 4-25	Location map for monitoring wells for Lincoln North Consumptive Pool	48
Figure 4-26	Groundwater level, rainfall and extraction trends for Lincoln North Consumptive Pool	49
Figure 4-27	Groundwater level hydrographs for select monitoring wells in Lincoln North	50
Figure 4-28	Select salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Lincoln North Consumptive Pool with 10-year salinity trends.....	51
Figure 4-29	Location map for monitoring wells, public water supply wells and rainfall stations for Lincoln South Consumptive Pool	52
Figure 4-30	Groundwater level, rainfall and extraction trends for the Lincoln South Consumptive Pool ..	53
Figure 4-31	Lincoln South historical groundwater level rankings plot for selected monitoring wells with good historical records.....	53
Figure 4-32	Groundwater level hydrographs for select monitoring wells in Lincoln South	54
Figure 4-33	Lincoln South historical total dissolved solids – percentage difference from the mean for selected monitoring wells with good historical records.....	55
Figure 4-34	Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Lincoln South Consumptive Pool with ten-year salinity trends	55

Figure 4-35	Location map for monitoring wells and rainfall stations for Bramfield Consumptive Pool	57
Figure 4-36	Groundwater level, rainfall and extraction trends for the Bramfield Consumptive Pool	57
Figure 4-37	Bramfield historical groundwater level rankings for selected monitoring wells with good historical records	58
Figure 4-38	Groundwater level hydrographs for select monitoring wells in Bramfield	58
Figure 4-39	Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Bramfield Consumptive Pool with ten-year salinity trends	59
Figure 4-40	Location map for monitoring wells and rainfall stations for Polda Consumptive Pool	60
Figure 4-41	Groundwater level, rainfall and extraction trends for the Polda Consumptive Pool.....	60
Figure 4-42	Polda historical groundwater level rankings for selected monitoring wells with good historical records	61
Figure 4-43	Groundwater level hydrographs for select monitoring wells in Polda	62
Figure 4-44	Polda historical total dissolved solids – percentage difference from the mean for selected monitoring wells with good historical records.....	63
Figure 4-45	Select salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Bramfield Consumptive Pool with ten-year salinity trends	63
Figure 4-46	Location map for monitoring wells and rainfall stations for Sheringa Consumptive Pool	64
Figure 4-47	Groundwater level and rainfall trends for the Sheringa Consumptive Pool	65
Figure 4-48	Select salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Sheringa Consumptive Pool with ten-year salinity trends	66
Figure 5-1	Management areas for the saturated and unsaturated Quaternary Limestone aquifer of the Southern Basins PWA.....	70
Figure 5-2	Management areas for the saturated and unsaturated Quaternary Limestone aquifer of the Musgrave PWA.....	71
Figure 5-3	Management areas for the TS and Basement aquifers of the Southern Basins PWA.....	72
Figure 5-4	Management areas for the TS and Basement aquifers of the Musgrave PWA.....	73
Figure 5-5	Recharge zones for the saturated Quaternary Limestone aquifer of the Southern Basins PWA	76
Figure 5-6	Recharge zones for the saturated Quaternary Limestone aquifer of the Musgrave PWA.....	77
Figure 5-7	Modelled aquifer storage levels from 2002 to 2024 – Musgrave Basins PWA saturated Quaternary water resources	78
Figure 5-8	Annual rainfall at the BoM Big Swamp rainfall station	80
Figure 5-9	Recharge rates for the Musgrave and Southern Basins PWA Quaternary Limestone aquifers using the Water Table Fluctuation method	80
Figure 5-10	Conceptual model of the Bramfield study area	85
Figure 5-11	Map showing the likely extent of seawater intrusion (red hatching) near Elliston, SA based on the hydrogeophysics surveys.	86
Figure 6-1	Portion of water access entitlements used for differing purposes for all Quaternary Limestone consumptive pools in the Southern Basins and Musgrave PWAs	92
Figure 6-2	Public water supply extraction, 2001–02 to 2024–25.....	93
Figure 7-1	Schematic representation of trigger level in a typical aquifer.....	98

Figure 7-2	Schematic representation of trigger levels in a hypotheticalal consumptive pool.....	99
Figure 7-3	Proportional relationship for the Uley North management area	100
Figure 7-4	Proportional relationship for the Bramfield management area	100
Figure 7-5	Proportional relationship for the Polda management area	101
Figure 7-6	Proportional relationship for the Sheringa management area	101
Figure 7-7	Example of conversion of the assessed level of storage vs RSWL – Polda	104
Figure 7-8	Example of new groundwater level triggers RSWL – Polda	104
Figure 7-9	Uley North – results of modelling compared to the groundwater level method	105
Figure 7-10	Bramfield – results of modelling compared to the groundwater level method	105
Figure 7-11	Polda – results of modelling compared to the groundwater level method	106
Figure 7-12	Sheringa – results of modelling compared to the groundwater level method	106
Table 8-1	Groundwater monitoring wells by aquifer within the Southern Basins and Musgrave PWA..	111
Figure 8-1	Location of current monitoring network within the Southern Basins PWA	112
Figure 8-2	Location of current monitoring network within the Musgrave PWA.....	113
Figure 8-3	Location of adaptive management trigger wells within the Sothern Basins PWA.....	116
Figure 8-4	Location of adaptive management trigger wells within the Musgrave PWA	117

List of tables

Table 2-1	Stratigraphy and lithological characteristic of Eyre Peninsula	18
Table 3-1	Summary of recharge rates in the Uley South Basin.	26
Table 5-1	Management areas within the Southern Basins and Musgrave PWAs.....	69
Table 5-2	Updated recharge estimates using the WTF method for Uley North and Coffin Bay.	81
Table 5-3	Assessment of the capacity of the Southern Basins PWA licensed Quaternary Limestone water resources	82
Table 5-4	Assessment of the capacity of the Musgrave PWA licensed Quaternary Limestone water resources	83
Table 5-5	Estimated resource capacities of the Non-licensed Quaternary Limestone, Tertiary Sand and Basement management areas	89
Table 6-1	Metered groundwater extraction by use type, 2023–24	92
Table 6-2	Metered usage (ML) for licensed Quaternary Limestone aquifer management areas 2015–16 to 2024-25	93
Table 6-3	Metered usage (ML) for public water supply 2015–16 to 2024–25.	93
Table 6-4	Assessment of the capacity and demands for Southern Basins PWA water resources	95
Table 6-5	Assessment of the capacity and demands for the Musgrave PWA water resources	96
Table 7-1	2026 WAP trigger levels and rates of change for the saturated Quaternary Limestone management areas	99
Table 7-2	Monitoring wells to be used in the monitoring of resource condition triggers and correlations between autumn groundwater levels and modified aquifer storage	103
Table 10-1	Count of wells with high-frequency monitoring (≥ 8 events/y).....	124

Summary

This report presents the hydrogeological evidence supporting the review and amendment of the Water Allocation Plan (WAP) for the Southern Basins and Musgrave Prescribed Wells Areas (PWAs) on the Eyre Peninsula. The assessment draws on long-term groundwater monitoring, recharge investigations, groundwater quality assessments, geophysical surveys and numerical groundwater modelling to evaluate groundwater condition, resource capacity, water demand and future risks.

The Quaternary Limestone (QL) aquifer is the primary source of groundwater for the Eyre Peninsula, supporting public water supply (PWS), agriculture, industry, stock and domestic use, and groundwater-dependent ecosystems (GDEs). Assessment of groundwater monitoring records indicates that many groundwater systems have experienced declining groundwater levels, increasing salinity and reduced storage over recent decades.

Groundwater recharge across the PWAs is highly dependent on winter rainfall. Multiple lines of evidence, including water table fluctuation (WTF) analyses and numerical modelling, indicate that recharge has declined substantially since the 1990s, particularly during the past decade. Recharge estimates suggest reductions of approximately 36% in Uley South and 65% in Bramfield compared with earlier periods. Recharge processes are highly threshold dependent with relatively small reductions in rainfall capable of producing disproportionately large reductions in groundwater recharge.

Climate records show a long-term trend towards warmer and drier conditions across the Eyre Peninsula, while climate projections indicate continued reductions in rainfall and increased temperatures. These changes are expected to reduce recharge opportunities and increase pressure on groundwater systems that are already highly dependent on episodic rainfall-driven recharge.

The results from groundwater quality monitoring, geophysical investigations and modelling indicate increasing risks associated with saline groundwater encroachment within several coastal aquifers. These risks include seawater intrusion, migration of saline groundwater and localised upconing beneath production town water supply (TWS) wells. The nature and magnitude of these risks vary between groundwater systems but are generally associated with declining groundwater levels and reduced freshwater storage.

Uley Wanilla and Lincoln South consumptive pools show evidence of substantial freshwater depletion, limited recovery during recent wetter periods and increasing salinity, indicating a reduced capacity to support ongoing consumptive use. Uley South and Bramfield consumptive pools remain important PWS resources but are increasingly vulnerable to declining recharge and groundwater quality risks.

Resource capacity assessments indicate that groundwater availability is increasingly constrained in some areas. In response, revised consumptive pool volumes, updated groundwater level triggers and an adaptive management framework have been reviewed and revised to provide a transparent and scientifically defensible basis for future resource management.

The findings of this report are supported by multiple independent sources of evidence, including groundwater level monitoring, salinity monitoring, recharge investigations, hydrochemical analyses, geophysical surveys and numerical groundwater modelling. While uncertainty remains regarding future climate conditions and recharge rates, the available evidence consistently indicates that groundwater resources across the Southern Basins and Musgrave PWAs are becoming increasingly constrained. These findings provide the scientific basis for the resource assessments, monitoring program and adaptive management approaches supporting implementation of the 2026 WAP.

1. Introduction

1.1. Purpose

The purpose of this report is to provide technical hydrogeological advice, based on the best available scientific information, to support the Eyre Peninsula Landscape Board (EP LB) in preparing the Water Allocation Plan (WAP) for the Southern Basins and Musgrave Prescribed Wells Areas (PWAs).

Specifically, this report aims to:

- assess resource capacity and provide an evidence base to inform allocation limits within the PWAs;
- support the development of management approaches for future allocation decisions; and
- identify groundwater level trigger thresholds within consumptive pools that may inform management responses to reduce the risk of unacceptable impacts on groundwater resources.

1.2. Scope

The scope of the hydrogeological component of the EP WAP review includes:

- assessing the condition of groundwater resources across all management areas, including the influence of recharge variability and climate conditions;
- reviewing and quantifying current groundwater demand, including licensed and non-licensed use;
- providing technical advice to inform:
 - the delineation of management areas and consumptive pools;
 - the estimation of resource capacity and corresponding allocation limits; and
 - the application of adaptive allocation approaches, including the use of triggers and proportional allocation responses where appropriate.
- recommending a monitoring program that:
 - supports assessment of groundwater resource condition;
 - informs potential allocation variability;
 - supports decision-making under variable climatic conditions; and
 - enables early detection of trends indicating that management limits may be approached or exceeded.

1.3. Background

Water supply across the Eyre Peninsula is sourced from a combination of local groundwater resources and imported water from the River Murray via the Morgan–Whyalla and Iron Knob–Kimba pipeline systems. Key groundwater sources include the Southern Basins PWA (Uley South, Uley Wanilla, Lincoln South, and Coffin Bay) and the Musgrave PWA (Elliston). These groundwater

resources have provided water of sufficient quality and quantity to support a range of uses, including PWS, agriculture, industry and domestic consumption.

The Southern Basins and Musgrave regions were proclaimed in 1987 under the *Water Resources Act 1976*, establishing formal regulation of groundwater extraction. Water allocation planning commenced under the *Water Resources Act 1997* with the first WAPs adopted in 2000 (Southern Basins) and 2001 (Musgrave). These were subsequently consolidated into a single plan, which continued under transitional provisions of the *Natural Resources Management Act 2004*.

The 2016 WAP established an adaptive management framework, whereby allocations were determined based on groundwater storage conditions relative to defined trigger levels. This approach was designed to respond to variability in recharge and maintain resource condition.

Since implementation of the 2016 WAP, groundwater levels, particularly within the Uley South Basin, have exhibited a declining trend, reflecting a combination of reduced rainfall, lower recharge and sustained extraction. These changes have increased the risk of adverse outcomes such as seawater intrusion and declining water quality.

The WAP has undergone a 10-year statutory review under the *Landscape South Australia Act 2019* with the revised plan (the 2026 WAP) scheduled to come into effect in July 2026. This review drew on updated scientific understanding, monitoring data, and stakeholder input, and was informed by technical hydrogeological assessments such as those presented in this report.

For clarity, the Water Allocation Plan adopted in 2016 is referred to as the 2016 WAP, and the revised plan scheduled for implementation in July 2026 is referred to as the 2026 WAP.

1.4. Historical trends of extraction

Water was first reticulated on Eyre Peninsula in 1922 from the Tod Reservoir. Over the following years, pipelines were constructed across the peninsula to supply regional towns as far west as Ceduna. As demand increased, it became clear that additional sources were needed to supplement the Tod Reservoir.

Groundwater resources were progressively added to the PWS system, beginning with the commissioning of the Uley Wanilla Basin in the 1948–49 water-use year (Figure 1-1). Over the next 4 decades, several other basins were developed including: Lincoln Basin (1961–62), Poldia Basin (1962–63), Robinson Basin for Streaky Bay (1972–73), Bramfield Basin for Elliston (1973–74), Uley South Basin (1975–76) and Coffin Bay Basin (1985–86). In 2008–09, water from the River Murray was introduced via the Iron Knob–Kimba pipeline.

Figure 1-1 illustrates the sources and volumes of water extracted annually to meet demand and highlights when regulation of groundwater extraction in the PWAs was first implemented. It is important to note that data prior to the commencement of metering in 2004–05 may include estimates. Notable spikes in extraction occurred in the 1950s due to the wool boom and in the 1970s during a livestock boom with total water supply peaking at nearly 15 GL. Following water restrictions introduced in 2002 during the Millennium Drought, demand generally declined and then remained relatively stable over the last 15 years.

SA Water's 2024 *Water Security Response Plan Eyre Peninsula* states they provide 8 GL/y of water through the Eyre Peninsula PWS systems. This water supports industry, primary production and residential customers. While annual demand varies with seasonal conditions, it is trending upwards due to population growth and industrial expansion (SA Water 2024). According to the plan, primary production accounts for the largest share of water demand (38%), followed by residential use (31%), commercial and industrial sectors (19%) and public institutions and recreational use (12%)

(Figure 1-2). This increasing demand is placing pressure on existing groundwater sources which are becoming less sustainable under current extraction rates.

Several sources have been retired from public supply.

- Tod Reservoir was decommissioned in 2002 due to high salinity and pesticide contamination from upstream agricultural runoff;
- Extractions from Robinson Basin ceased in 2007 due to rising groundwater salinity with Streaky Bay now supplied via the Ceduna Pipeline; and
- A Ministerial Notice of Prohibition, which restricted the taking of water in Polda Basin, was put in place in 2008 due to diminished water availability. In 2016, the Ministerial Notice of Prohibition was revoked to allow for the water allocation plan to be implemented; SA Water relinquished its water entitlement for the basin in 2015.

Over the past decade, Eyre Peninsula's water supply has faced declining rainfall and rising salinity in groundwater sources. The Southern Basins PWA, particularly the Uley South Basin, continues to supply the majority of the region's drinking water. However, successive years of low rainfall have resulted in low recharge of aquifers, prompting concerns about the long-term sustainability of current groundwater extraction rates.

The 2016 WAP introduced an adaptive groundwater management framework for managing authorised extraction. Under the 2016 WAP, the consumptive pool volume was determined annually based on groundwater storage levels which reflect rainfall and recharge conditions and account for natural and anthropogenic discharges from the system. A reference level (based on 1993 groundwater storage) was used to assess resource condition with allocation volumes reduced proportionally when defined trigger thresholds were reached.

Since implementation of the 2016 WAP, groundwater levels in the Bramfield and Sheringa consumptive ools have generally remained above the lower storage trigger, while Polda and Uley North have remained below the lower storage trigger for much of this period.

The analyses presented in this report evaluate the performance of the framework established under the 2016 WAP and provide technical information to inform the development of allocation approaches for the 2026 WAP.

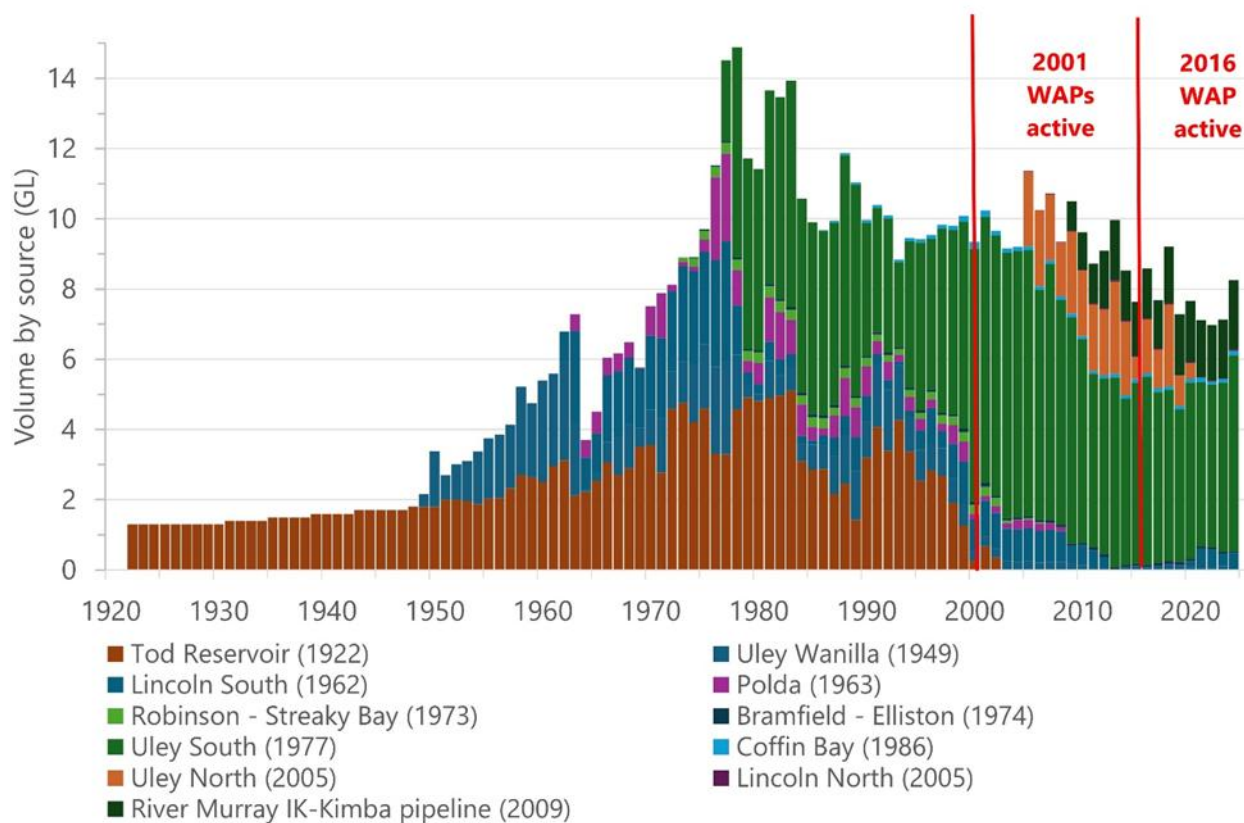


Figure 1-1 Historical use and source of public water supply for Eyre Peninsula prescribed water resources

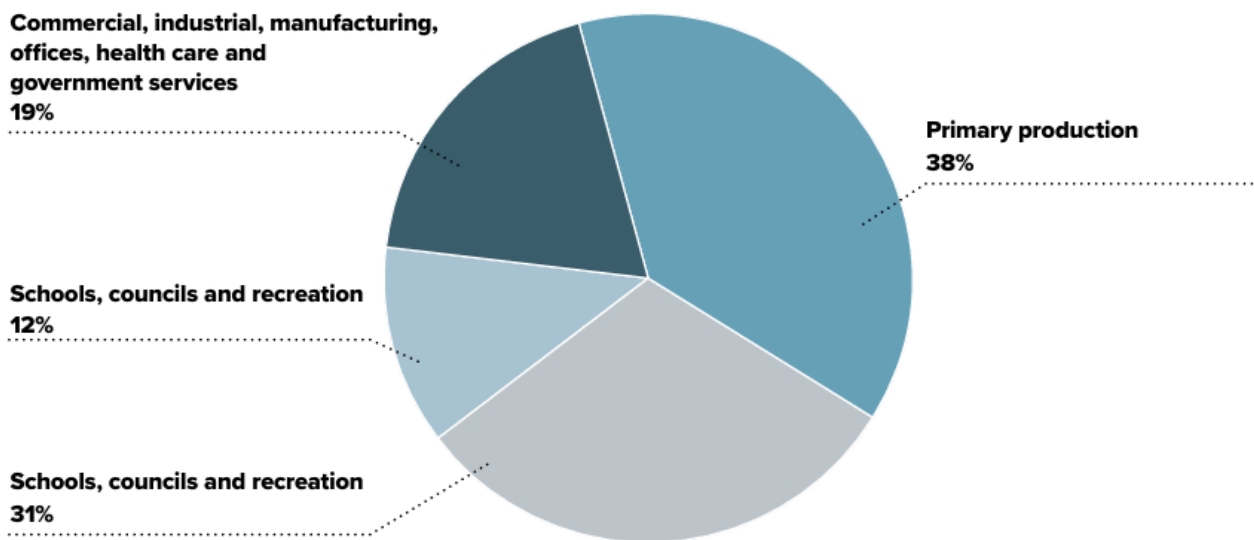


Figure 1-2 Water demand on the Eyre Peninsula by customer segment (SA Water, 2024)

In 2025, a Risk Management and Monitoring Plan was established to manage the risk of seawater intrusion into the Uley South Consumptive Pool, which supplies Port Lincoln's drinking water. While short-term impacts of increased extraction were deemed minimal, sustained extraction beyond 2026–27 poses significant risks. The Minister approved a higher allocation with a condition requiring strict compliance with the Risk Management and Monitoring Plan, which remains in effect for 2025–26. Non-compliance with conditions on a water licence is an offence under the *Landscape South Australia Act 2019*.

1.5. Description of PWAs

The following Sections refer to the groundwater resources of the QL aquifer across both PWAs as consumptive pools. The term consumptive pool is provided for under the *Landscapes South Australia Act 2019* and represents a management area within a resource whereby specific management actions are required, and volumetric limits are applied to the water which can be used for consumptive purposes.

The term Basin refers to the broader hydrogeological system and is used when discussing groundwater occurrence, recharge, flow systems, hydrogeological processes and groundwater modelling. The term Lens refers to a localised groundwater body, typically comprising fresh to potable groundwater within the broader basin.

1.5.1. Southern Basins PWA

The Southern Basins PWA covers an area of 870 km² and comprises all or parts of the Hundreds of Lincoln, Wanilla, Lake Wangary, Uley, Sleaford and Flinders (Figure 1-3). The main townships near the PWA are Port Lincoln and Coffin Bay. The land surface is predominantly undulating with elevations ranging from sea level to approximately 200 m above Australian Height Datum (AHD).

The PWA can be described as having a topographic relief which is typical of the ancient dune systems which formed about 100,000 years ago with coastal cliffs rising to around 140 mAHD. Inland, there are generally large, enclosed depressions with elevations that are often close to sea level, while Basement rock outcrops form topographic highs up to 200 mAHD. The dunes are capped by a very hard calcrete layer with a soil cover that is thin or absent over large areas. The groundwater resources of the Southern Basins PWA are found within the Quaternary Bridgewater Formation sedimentary aquifer, the Tertiary Sands (TS) sedimentary aquifer and the Basement fractured rock aquifer.

There are limited surface water resources because of the permeable nature of the dune landscape which readily absorbs most of the rainfall. The few surface water features that do persist include Sleaford Mere, a permanent saline lake which is the surface expression of the regional water table, and Big Swamp and Little Swamp which are ephemeral lakes which generally contain brackish water derived from surface water flows originating in catchments predominantly external to the PWA. The overall water regime of both Big and Little Swamps is not considered to be primarily dependent on groundwater. However, both swamps contribute water to the regional groundwater system during periods of overflow. Red gum communities adjacent to Big and Little Swamps are likely to be dependent on the shallow groundwater, especially during dry periods.

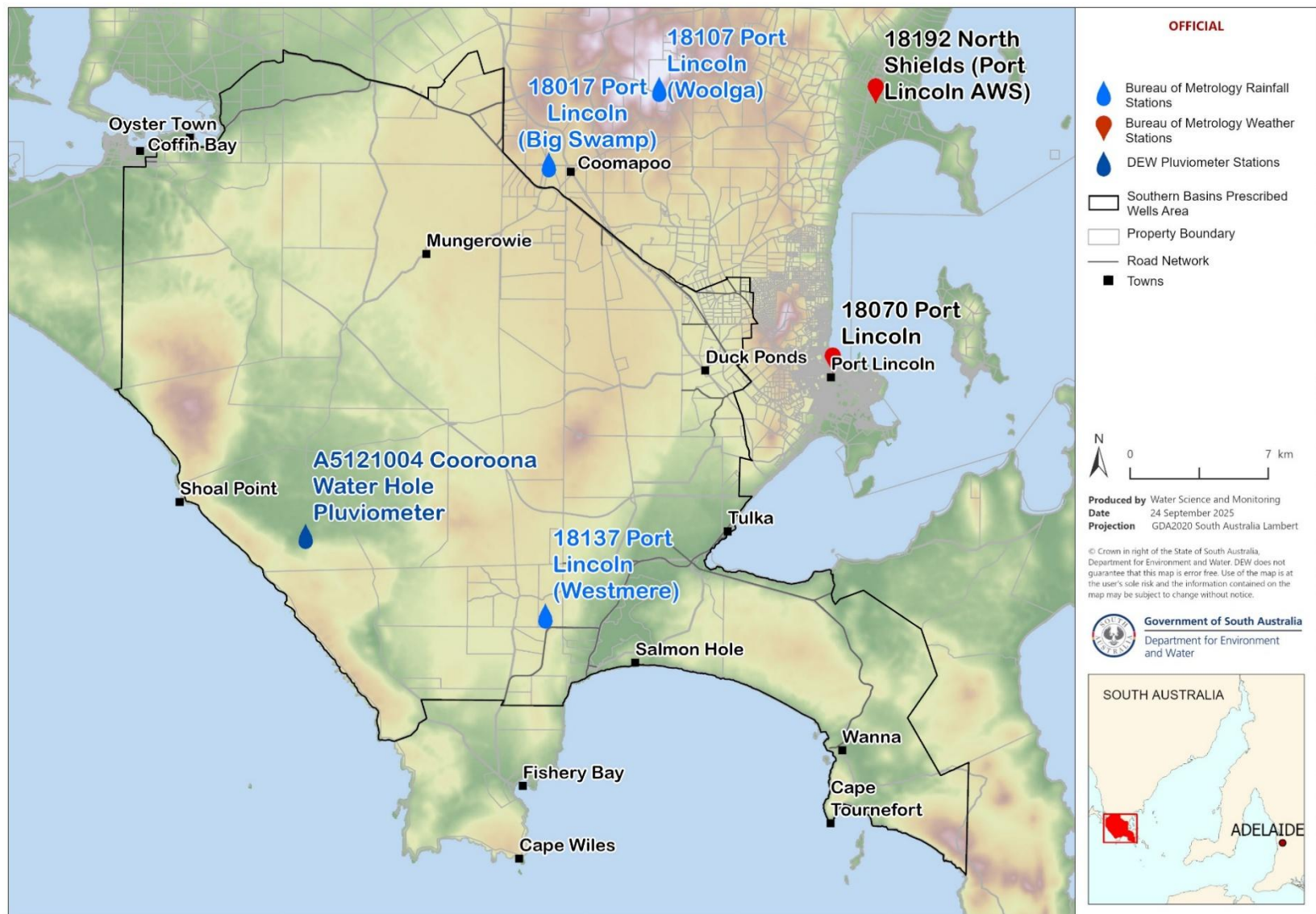


Figure 1-3 Map of the Southern Basins PWA

1.5.2. Musgrave PWA

The Musgrave PWA spans an area of approximately 3,595 km² and comprises the Hundreds of Colton, Talia, Tinline, Squire, Ward, Hudd, Kappawanta, Blesing, Way, Pearce and Haig. The PWA encompasses the townships of Elliston and Bramfield. Elevations range from sea level to approximately 248 mAHD at Mount Wedge (Figure 1-4).

The PWA features a varied landscape shaped by both coastal and inland geomorphic processes. Topographically, the Musgrave PWA is underlain largely by coastal dune systems, part of the Quaternary Bridgewater Formation, which are geologically and geomorphologically similar to those found in the Southern Basins PWA.

These coastal dunes form prominent north–south aligned ridges and interdunal depressions, particularly along the western fringe, where Lake Newland, Salt Lake, Middle Lake and other ephemeral lakes occupy lower-lying areas. These interdunal wetlands represent areas where the shallow water table intersects the land surface forming seasonal or permanent wetland systems that receive local surface runoff and are directly connected to underlying aquifers.

Inland, the terrain transitions to gently undulating plains and low hills. These areas include local depressions that host wetland features such as Lake Hamilton and Sheringa Lagoon, which also reflect where the shallow water table intersects the land surface. The elevation gradient from inland areas towards the coast influences the regional direction of groundwater flow, supporting natural discharge zones in the western part of the PWA.

The predominant land use is extensive stock grazing, although some cropping is also practised in areas where soil depth, fertility and extent are suitable. This pattern is particularly visible in the more cleared eastern portions of the PWA.

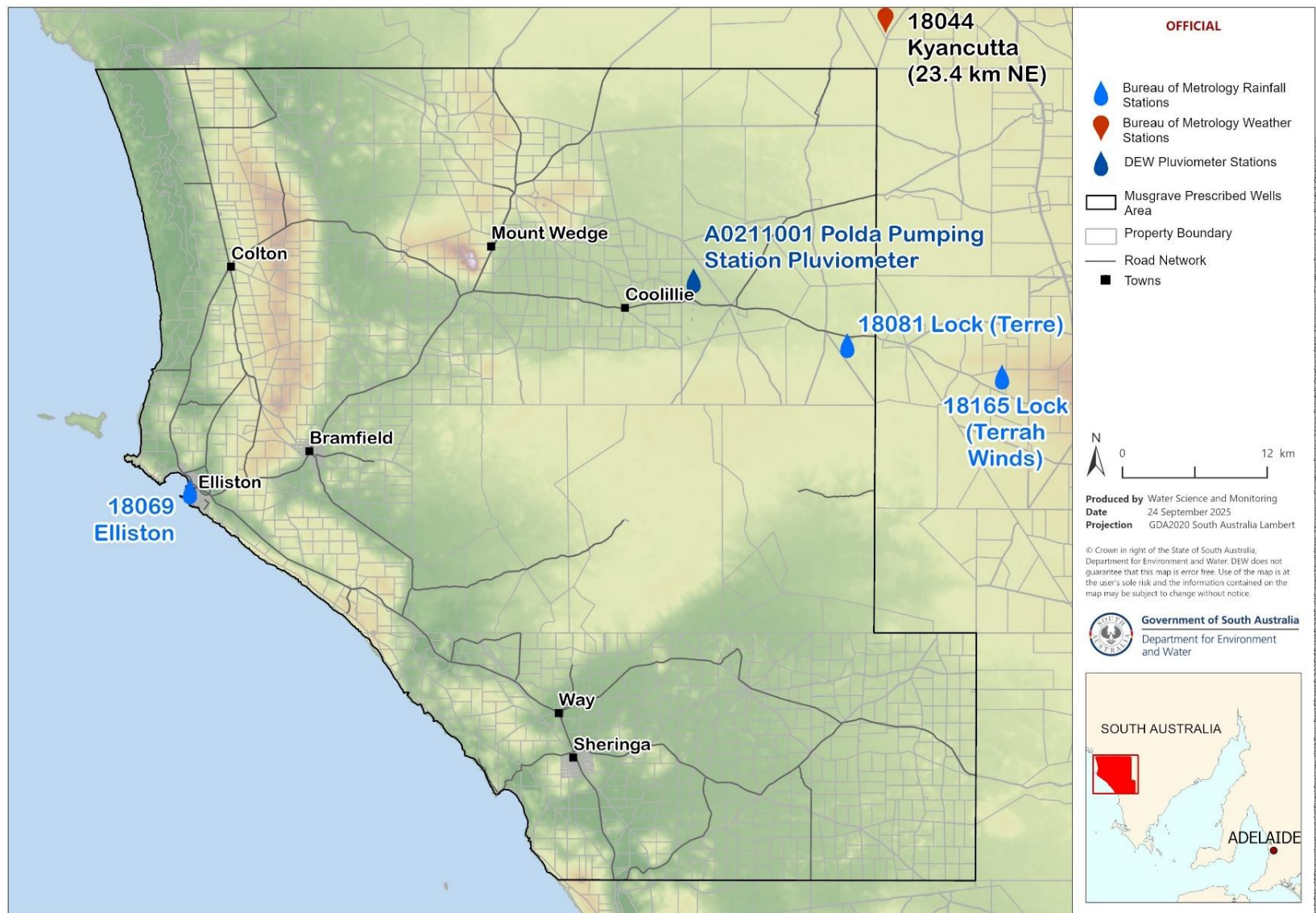


Figure 1-4 Map of the Musgrave PWA

2. Climate

The Eyre Peninsula experiences a Mediterranean climate characterised by cool, wet winters and hot, dry summers. Rainfall generally decreases from south to north, with the north-west parts inland areas exhibiting semi-arid conditions (URPS 2025). Annual rainfall across Eyre Peninsula is generally higher in the coastal areas than inland. Mean annual rainfall varies from approximately 350 mm in the north-west of the Musgrave PWA to around 550 mm in the Southern Basins PWA (DEW 2024e).

Climate data for the study area are available from a number of BoM rainfall and weather stations with record lengths varying considerably between stations. Weather stations have been used to characterise temperature trends, while rainfall stations have been used for rainfall analyses and calculation of cumulative departure from mean rainfall, as they generally provide longer and more complete records. For the analyses presented in Section 4, rainfall stations were selected based on their proximity to the relevant consumptive pools and the availability of long, continuous rainfall records. The locations of the selected rainfall and weather stations are shown in Figure 1-3 and Figure 1-4.

The Bureau of Meteorology's (BoM's) rainfall variability map (1900 to 2023) shows that the Eyre Peninsula predominantly falls within the moderately low rainfall variability category with a variability index ranging from 0.5 to 0.75 (BoM et al. 2019). The rainfall variability index quantifies the degree to which annual rainfall varies from year to year and is derived from the statistical relationship between the standard deviation and mean of long-term annual rainfall records. An index of 0.5 to 0.75 indicates that annual rainfall across the Eyre Peninsula has historically been relatively consistent compared with more inland regions of Australia, where rainfall variability is considerably higher. However, seasonal analyses reveal a more complex pattern.

From 1989 to 2018, rainfall patterns reveal a noticeable decline in autumn and spring rainfall, particularly around locations like Kyancutta and Port Lincoln, while winter rainfall remains moderately reliable (Figure 2-1). Summer rainfall is the least dependable, displaying erratic patterns and limited consistency. The timing of the autumn break, defined as receiving 15 mm of rain over 3 days, varies across the peninsula; occurring in early May in the south, late May to early June in central areas, and as late as July in the north. This break has slightly shifted over the years, appearing later in northern regions and earlier in some coastal zones (BoM et al. 2019).

In 2019, the Eyre Peninsula experienced significantly below-average annual rainfall, consistent with it being South Australia's driest year on record. A short-term recovery in rainfall occurred between 2020 and 2022, during which the highest rainfall totals were generally recorded in the spring season. In 2023 and 2024, the Eyre Peninsula experienced rainfall patterns consistent with longer-term declining trends, particularly in autumn and spring, very much below-average rainfall conditions (BoM 2025).

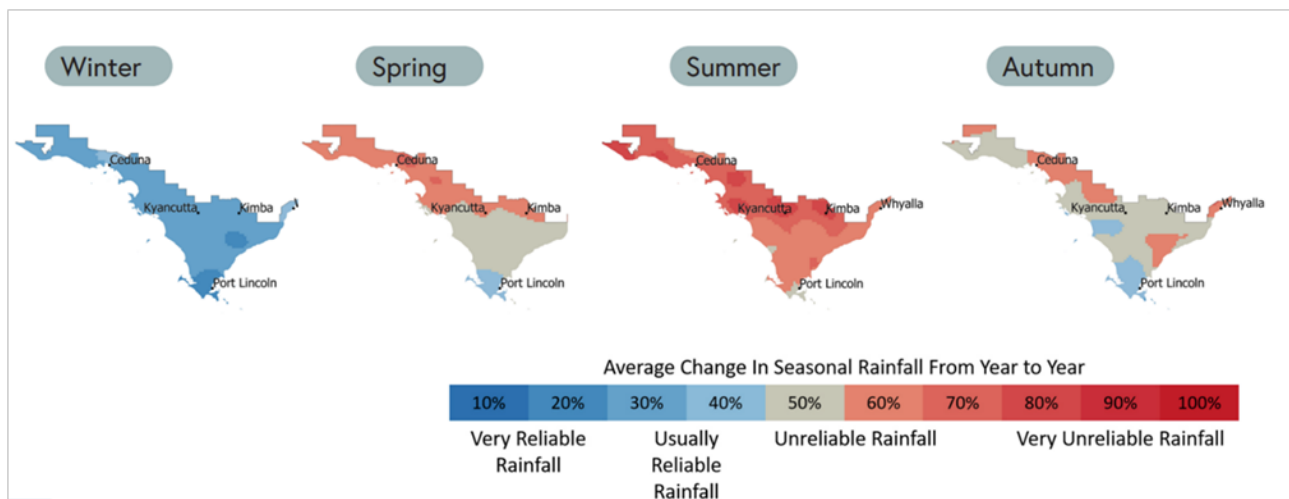


Figure 2-1 Rainfall reliability maps for Eyre Peninsula (BoM et al. 2019)

The Eyre Peninsula experiences mean annual maximum temperatures of 18 to 27°C and mean summer maximum temperatures of 21 to 33°C. A significant increase in the number of days exceeding 38°C has been recorded over the past 2 decades. From 2004 to 2024, BoM weather stations 018070 Port Lincoln and 018192 North Shields recorded a mean of 5 days per year above 38°C, compared to a mean of 2 days per year between 1974 and 2003. At BoM station 018044 Kyancutta, the mean rose to 25 days per year between 2004 and 2024, compared with 22 days per year between 1974 and 2003. The highest annual total was recorded in 2019, with 44 days exceeding 38°C (BoM 2025). The temperature anomaly maps for the period 1990 to 2024 reveal a clear warming trend across South Australia, including the Eyre Peninsula (Figure 2-2). During the Millennium Drought (1997 to 2009), temperatures were near to slightly above the long-term mean, compounding the impacts of reduced rainfall. From 2013 onwards, the region experienced temperatures that were consistently above the long-term mean temperatures, with extreme heat events evident in 2013, 2014, 2016, 2019, 2020 2023 and 2024.

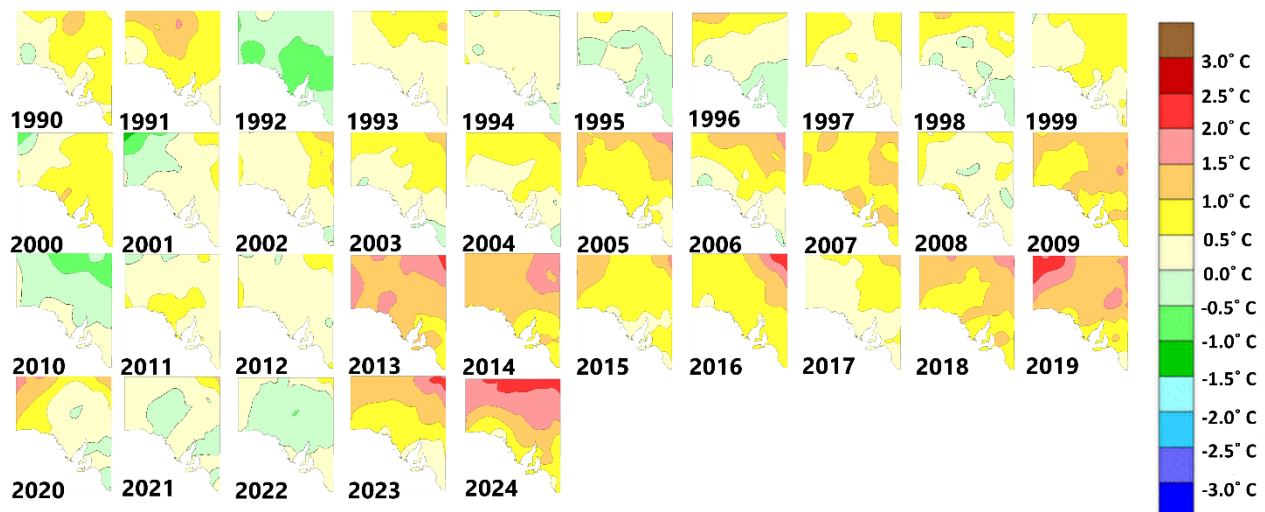


Figure 2-2 South Australian historical temperature anomaly maps, 1990 to 2024 (BoM 2025).

A network of rainfall and weather stations operated by the BoM and DEW have been strategically selected to represent rainfall distribution and temperature patterns across the Southern Basins and Musgrave PWAs (Figure 1-3 and Figure 1-4). These stations are used to calculate long-term means and evaluate changes in rainfall over time.

2.1. Southern Basins climate conditions

The Southern Basins PWA, located within the southern portion of the peninsula, generally experiences a cooler, wetter Mediterranean climate, especially along the southern and western coastal margins. The long-term annual rainfall totals (1971 to 2024) based on Big Swamp and Westmere rainfall stations range from 370 to 870 mm/y with a long-term mean annual rainfall of 555 and 556 mm respectively. There is a pronounced wet winter period between May and August during which mean monthly rainfall exceeds mean monthly potential evaporation.

The long-term trends for Big Swamp and Westmere show a significant downward trend in annual rainfall, particularly over the past 2 decades. In 2024, total annual rainfall at Big Swamp was recorded at 401 mm, representing a 28% decline (154 mm) below the long-term mean of 555 mm/y (Figure 2-3). Similarly, Westmere recorded 391 mm, which is 30% (165 mm) below the long-term mean of 556 mm/y age (Figure 2-4).

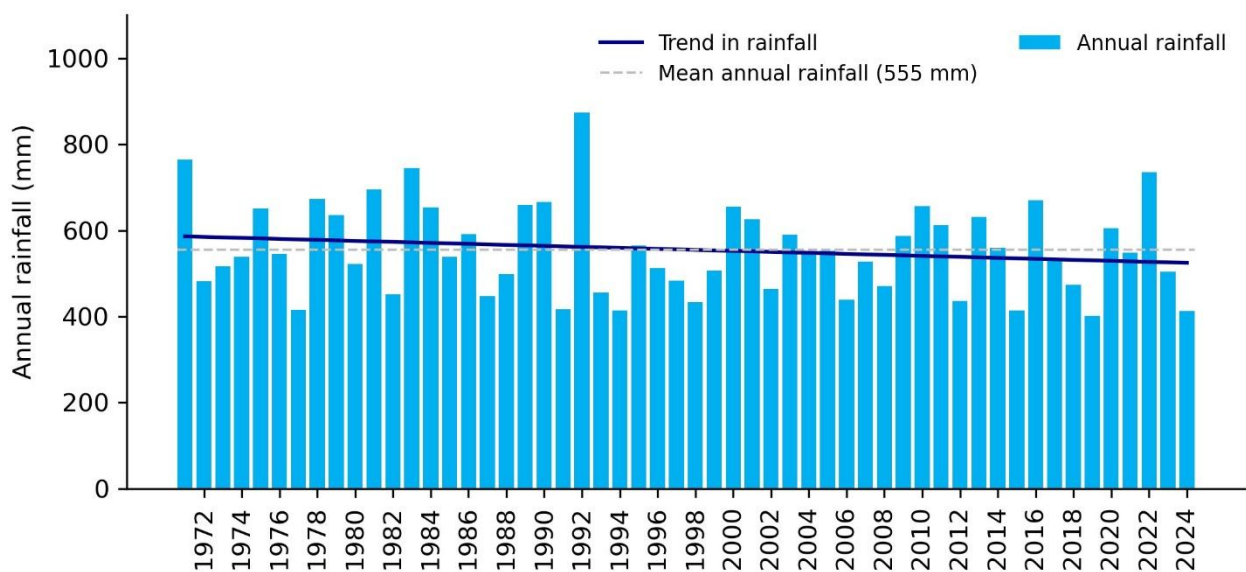


Figure 2-3 BoM 18017 – Big Swamp annual rainfall compared to the long-term mean

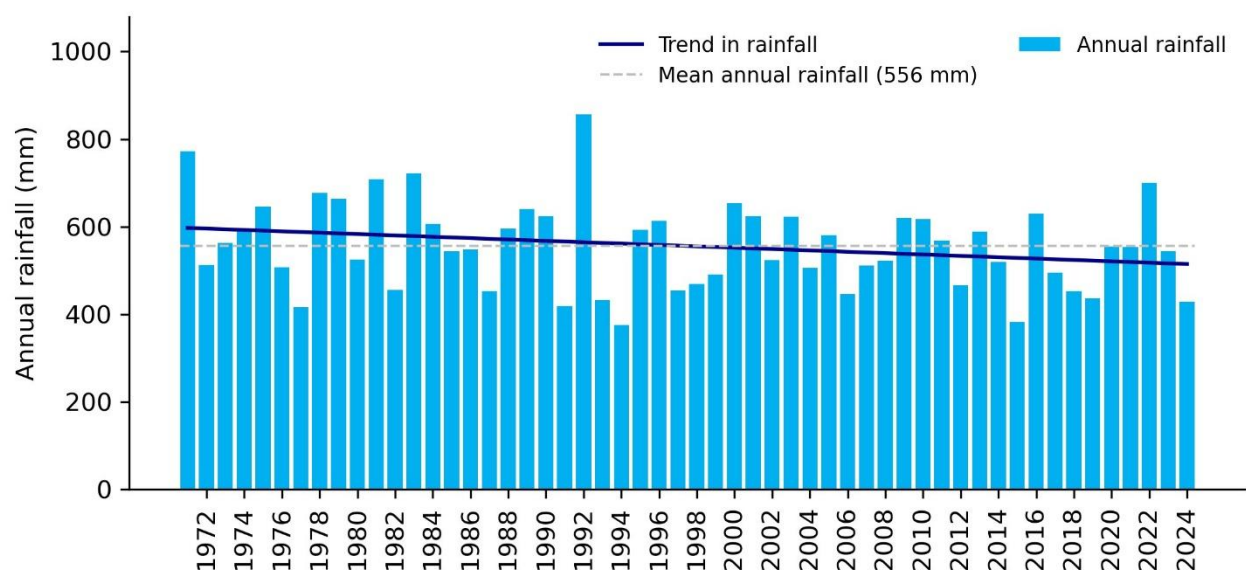


Figure 2-4 BoM 18137 – Westmere annual rainfall compared to the long-term mean

Climate pattern shifts are shown by the cumulative deviation rainfall chart for Westmere station (Figure 2-5). This chart presents the relationship between annual rainfall trends and long-term climate variability overtime. The blue bars represent annual rainfall (1906 to 2024), while the orange line shows how rainfall has deviated from the long-term mean over time. An upward trend represents a period where rainfall was above the long-term mean rainfall and a downward trend indicates a drier-than-average period. From the early 1900s to around the mid-1950s, rainfall was relatively stable but often fell below the long-term mean. A marked increase in rainfall occurred from the 1960s through the 1980s with this period contributing to a significant rise in the cumulative deviation, indicating wetter than average conditions. Following a peak around the early 1990s, there is a notable downward trend in the cumulative deviation, indicating a shift to drier conditions in recent decades. The decline aligns with well-documented dry periods in Southern Australia, including the Millennium Drought (1997 to 2009).

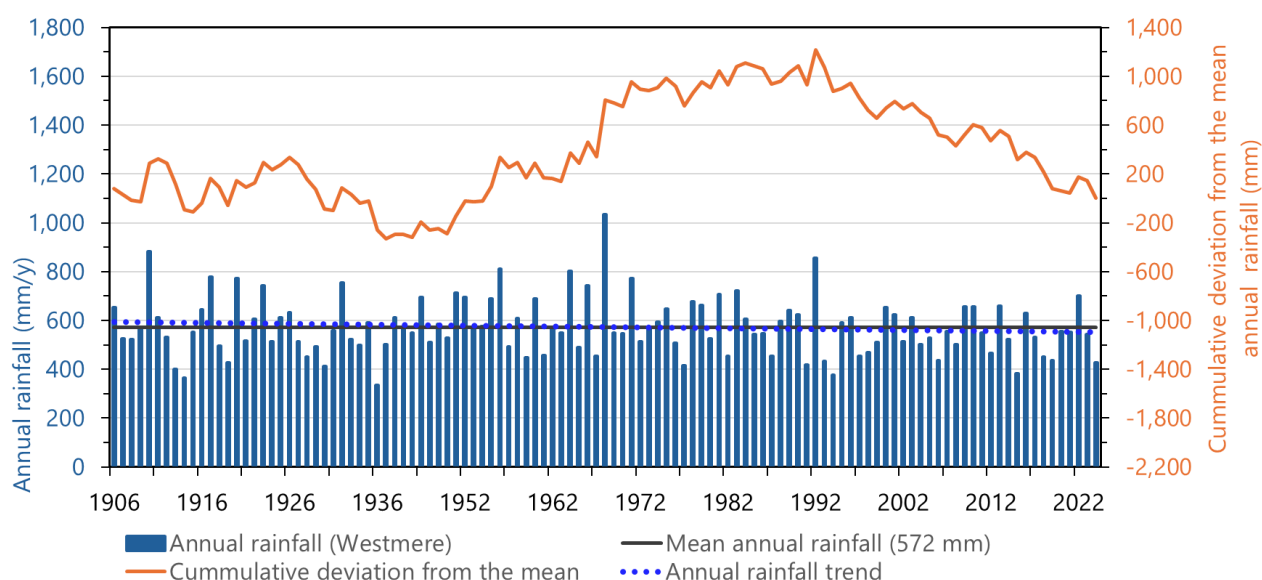


Figure 2-5 Annual rainfall and cumulative deviation from the mean annual rainfall for BoM station 18137 – Westmere

Since there is no continuous temperature record at a single station within the Southern Basins dating back to the early 20th century, data from Port Lincoln (Station 018070) are used up to 1992, and North Shields (Station 018192) thereafter. North Shields is located approximately 9 km north-north-east of Port Lincoln. Between 1910 and 1980 (Figure 2-6), maximum temperatures remained relatively stable. However, from the mid-1990s onward at North Shields, there is a clear upward trend in maximum temperatures. This warming pattern closely coincides with a decline in annual rainfall over the same period, indicating a shift towards hotter and drier conditions. However, caution is required when interpreting long-term trends as the temperature record comprises data from two stations with different locations and potentially different microclimatic influences.

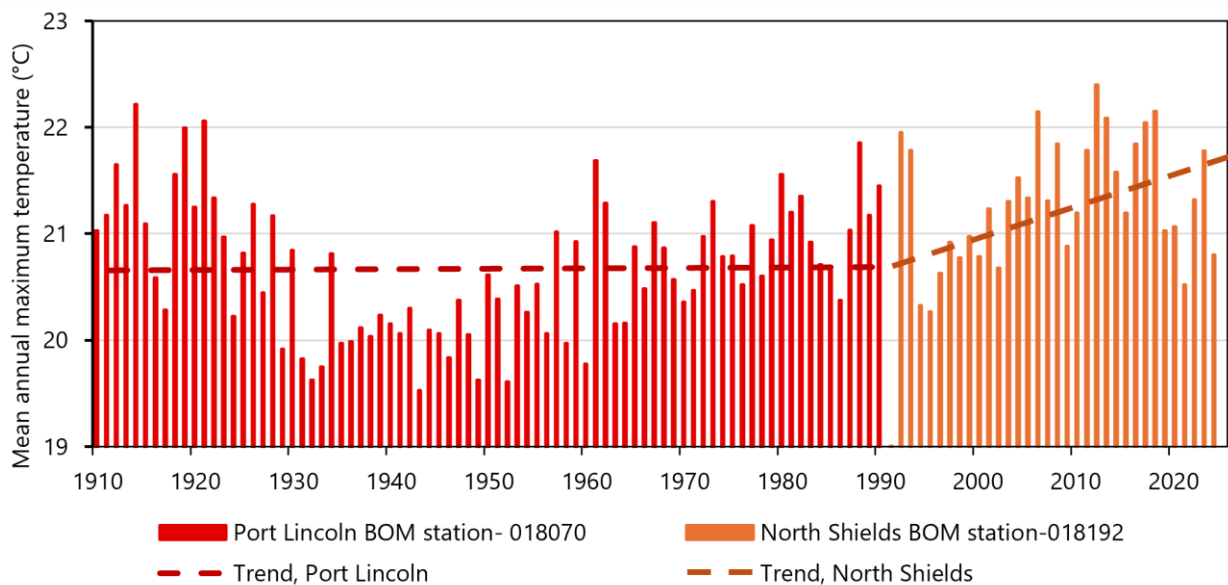


Figure 2-6 Annual mean maximum temperature for BoM 18070 Port Lincoln and 018192 North Shields climate monitoring stations

2.2. Musgrave climate conditions

The Musgrave PWA, located in the northern inland portion of the Eyre Peninsula, is characterised by a semi-arid climate typically with hot, dry summers and mild, wet winters. Annual rainfall based on Elliston and Terrah Winds rainfall stations ranges from 218 to 641 mm/y with a long-term (1971 to 2024) mean annual rainfall of 424 and 370 mm respectively (Figure 2-7) and (Figure 2-8). Rainfall is predominantly winter-dominant, while summers are typically hot and dry and winters are mild and wetter. Due to the arid conditions, recharge events are sporadic and often limited, generally occurring only after extreme rainfall events or episodic wet years. Mean monthly rainfall exceeds mean monthly potential evaporation only in June and July.

The long-term trend for both Elliston (Figure 2-7) and Terrah Winds (Figure 2-8) shows a significant downward trend in annual rainfall, particularly over the past 2 decades. In 2024, total annual rainfall at Elliston was recorded at 303 mm, representing a 29% decline (121 mm) from the long-term mean of 424 mm/y. Terrah Winds recorded 316 mm, which is a 15% decline (54 mm) from the long-term mean of 370 mm/y.

Climate pattern shifts are shown by the cumulative deviation rainfall chart for Elliston, covering the period 1882 to 2024 (Figure 2-9). The blue bars represent yearly rainfall totals while the orange line shows the cumulative deviation from the long-term mean annual rainfall over time. An upward trend indicates a period when annual rainfall was generally above the long-term mean, whereas a downward trend indicates drier-than-average conditions. Between the 1880s and late 1950s, rainfall patterns exhibited pronounced variability with frequent below-average years indicating a period of fluctuating but generally drier conditions. A notable upward trend in the cumulative deviation from the mean was observed from the 1950s to the mid-1980s, indicating a sustained period of above-average rainfall and a shift towards wetter climatic conditions. From the late 1980s onward, the cumulative deviation shows a gradual and consistent decline, marking a transition to drier conditions that continues into recent decades. Although a brief recovery occurred in the early 1990s, it was subsequently followed by a sustained decline that coincided with the onset of the Millennium Drought.

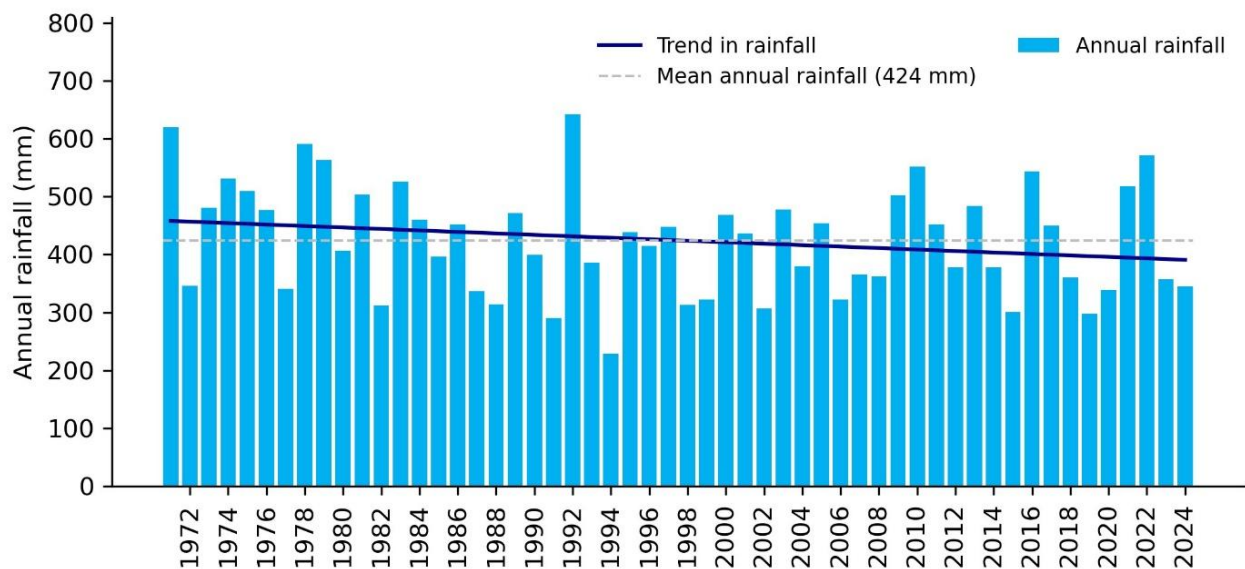


Figure 2-7 BoM 18069 – Elliston annual rainfall compared to the long-term mean

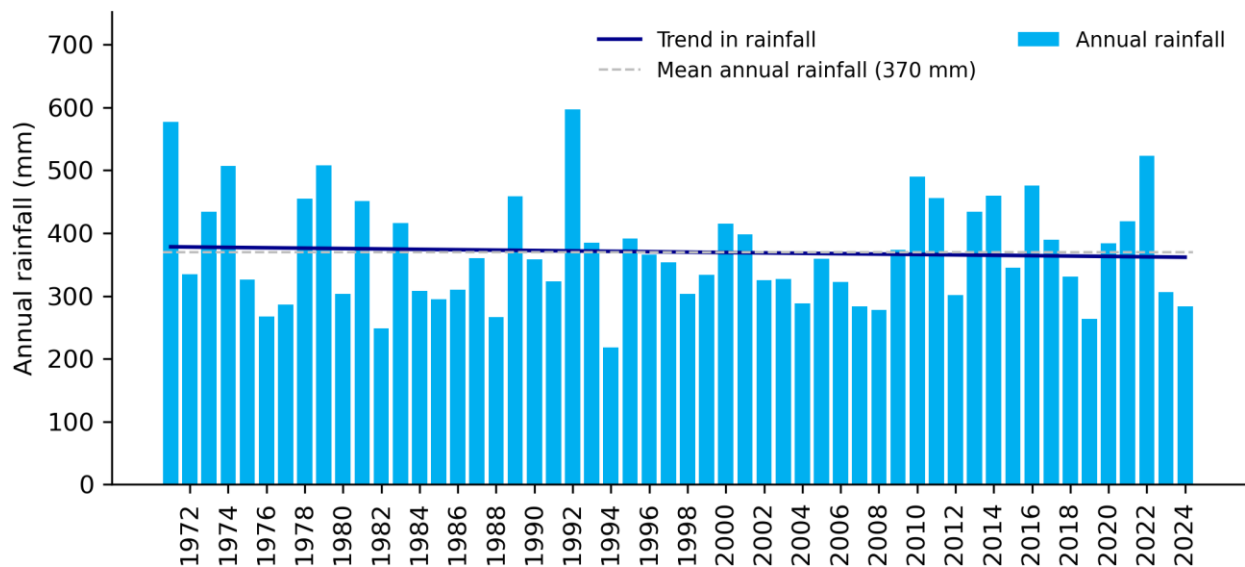


Figure 2-8 BoM 18165 – Terrah Winds annual rainfall compared to the long-term mean

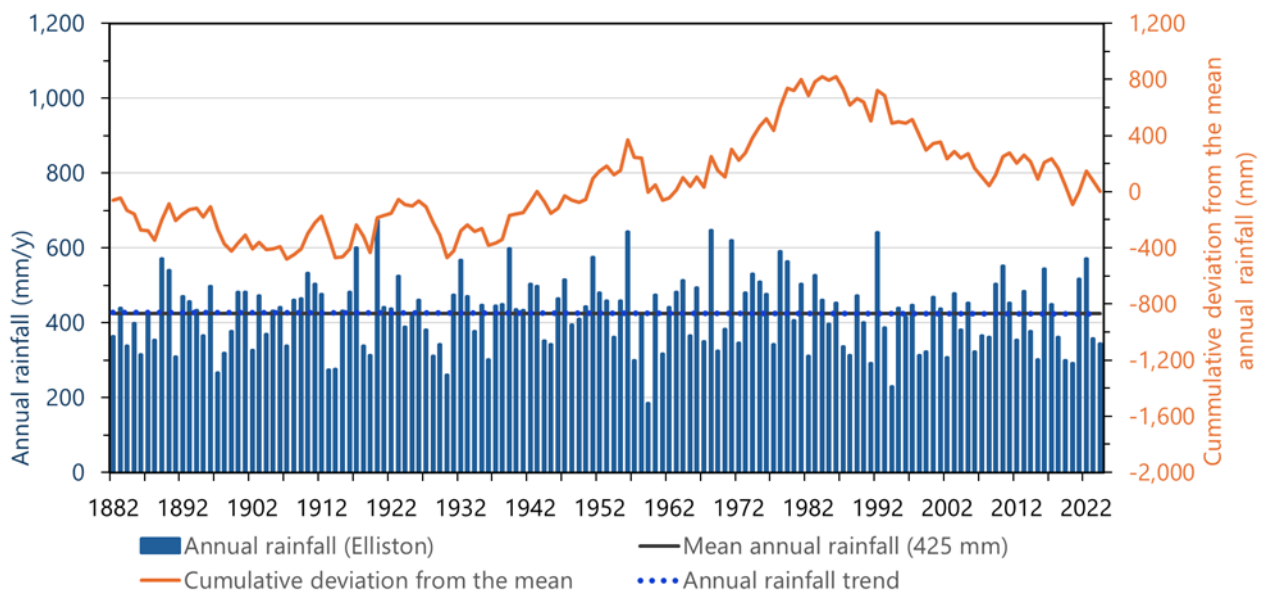


Figure 2-9 Annual rainfall and cumulative deviation from mean annual rainfall for BoM station 18069 – Elliston

The annual mean maximum temperature data from the 018044 Kyancutta weather station show a long-term increasing trend in annual maximum temperatures from 1931 to 2022 (Figure 2-10). Earlier decades (1930s to 1970s) experienced relatively stable temperatures around 24 to 25°C with some year-to-year variability. However, from the late 1990s onward, a noticeable warming trend is evident with several of the hottest years on record occurring in the 2000s and 2010s. The rise in maximum temperature during recent decades aligns with broader climate change observations and likely contributes to increased evaporation and reduced water availability.

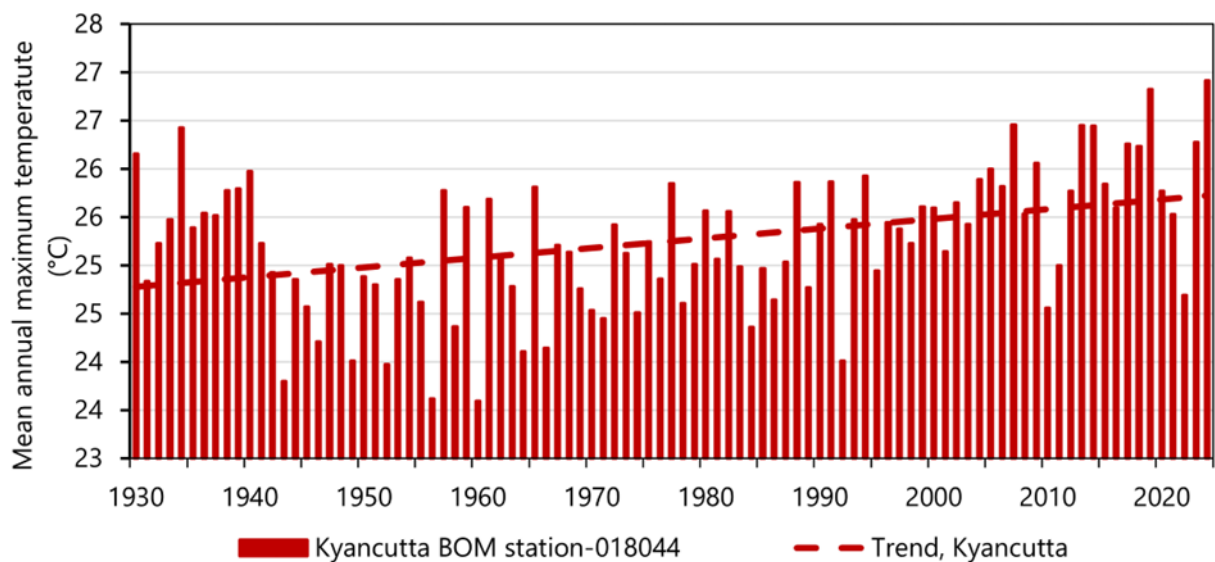


Figure 2-10 Annual mean maximum temperature for BoM 018044 Kyancutta climate monitoring station

2.3. Climate variability and impacts

Groundwater systems in the Eyre Peninsula are highly vulnerable to impacts of climate variability due to their reliance on localised winter rainfall for recharge. These unconfined Quaternary Limestone (QL) aquifers lack significant surface water inputs and are therefore sensitive to changes in rainfall and temperature (Green et al. 2012).

Projections for the Eyre Peninsula by 2050, based on the high-emissions scenario (that is Representative Concentration Pathway (RCP) 8.5), indicate annual rainfall will decrease by 5 to 10% compared to the 1994 to 2023 mean, with northern areas seeing larger drops in summer and autumn, and southern areas in spring (My Climate View 2025). Mean temperatures will rise and the number of hot days will increase across all locations. These changes will be accompanied by greater year-to-year variability, leading to more frequent dry years and fewer heavy rainfall events (Green et al. 2012).

In addition, the hydrological modelling conducted by the (Green et al. 2012) highlights the non-linear relationship between rainfall and recharge: even small reductions in rainfall can lead to disproportionately large declines in recharge as drier conditions often fail to meet the infiltration threshold (Figure 2-11). These modelling simulations suggest that by 2070, recharge could decline by up to 49% in the Musgrave PWA and 47% in the Southern Basins PWA with a 10% drop in rainfall potentially causing a >30% reduction in recharge due to increased evapotranspiration and reduced water surplus.

The reliability of recharge is also expected to deteriorate. Under these future climate scenarios, the frequency of low recharge years (below the 20th percentile) may increase by up to 200%, while high recharge years (above the 80th percentile) could decrease by up to 70%. This shift signals a transition from relatively stable recharge patterns to prolonged drought conditions, placing cumulative stress on groundwater systems.

Investigations by DEW (2026a) focused on the Bramfield Consumptive Pool to estimate potential changes in QL aquifer groundwater levels under projected climate change. Groundwater level responses to future climate change were evaluated using the Hydrograph Analysis: Rainfall and Time-Trends (HARTT) modelling framework. Three global climate models were assessed, comprising two from the South Australian Climate Ready dataset and one from the NARClIM 1.5 dataset, under both RCP 4.5 and RCP 8.5 emission scenarios.

Results indicate a significant decline in water table depth with median projections ranging from a decline in water table depth of 0.8 to 8 m by 2065 (Figure 2-12).

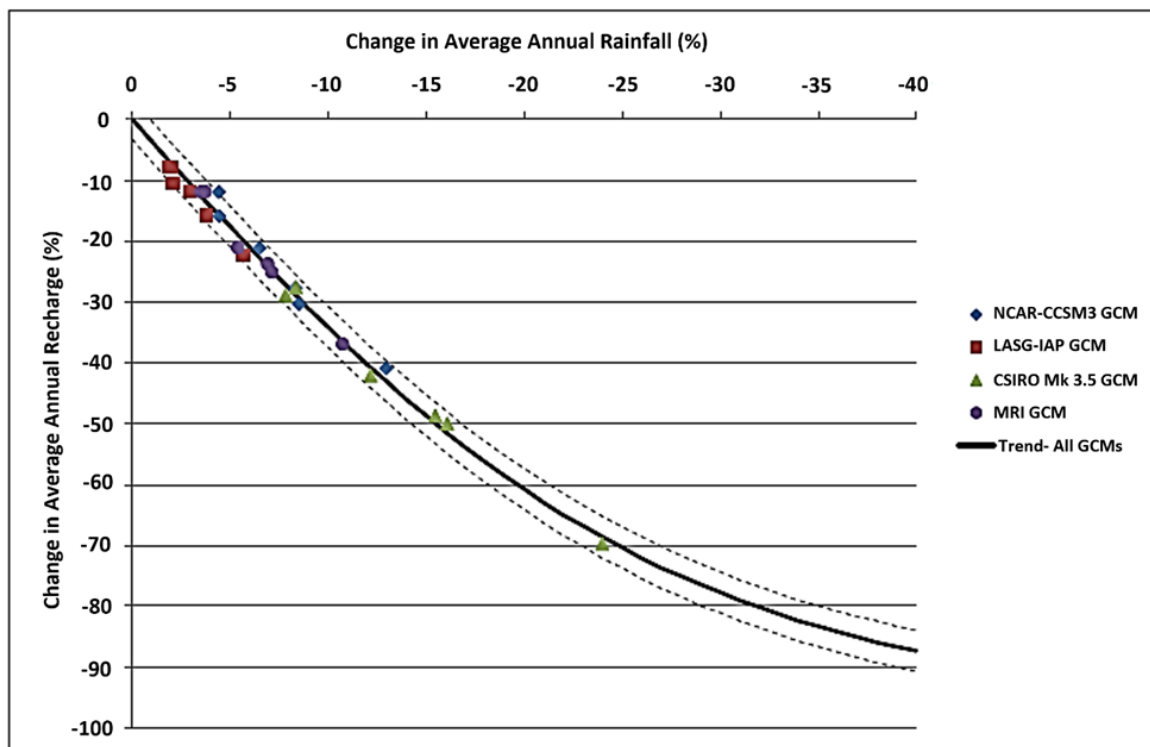


Figure 2-11 Changes in modelled recharge for changes in rainfall in the Musgrave PWA

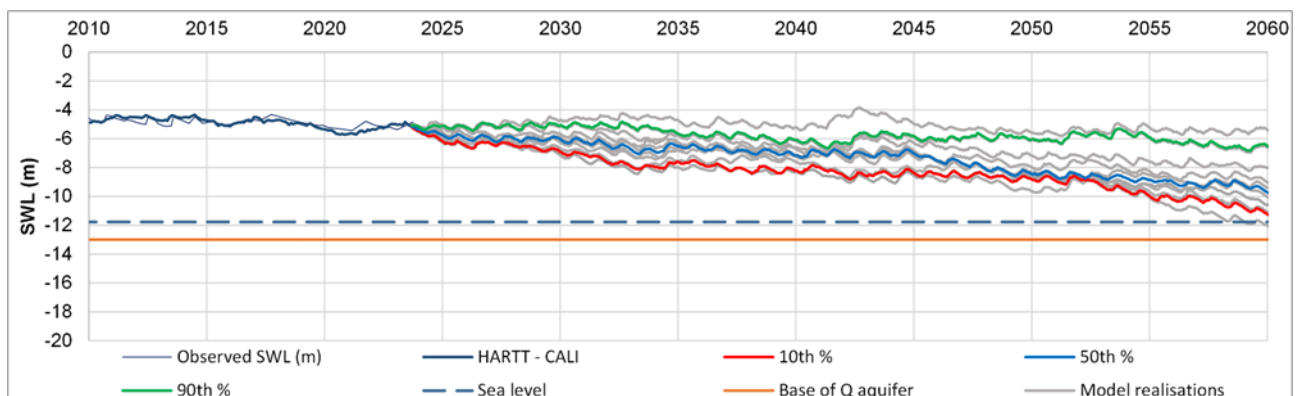


Figure 2-12 Hydrograph projection for monitoring station WAD031 including the 10th, 50th and 90th percentile rainfall datasets

Building on this, DEW (2026b) developed a groundwater flow model to further assess the risk of aquifer drying and seawater intrusion in the Bramfield Consumptive Pool. Based on NARClIM 2.0 projections, an average 14% decline in rainfall by 2050 is anticipated. While PWS and irrigation wells are expected to remain viable under current conditions, stock and domestic wells are more vulnerable. Anecdotal evidence suggests that a number of non-licensed wells have lost access to groundwater in recent years due to declining groundwater levels.

In addition to reduced availability, groundwater quality is also at risk. Lower water tables may lead to seawater intrusion particularly in coastal margins such as Coffin Bay, Uley South, Lincoln Basins and the Bramfield resource.

2.4. Regional geological setting

The Eyre Peninsula forms part of the Gawler Craton, a major tectonic province in South Australia. The craton's margins are defined by adjacent crustal regions that have undergone deformation. The peninsula's geological evolution spans nearly 2,700 million years (Table 2-1), making it one of the most complete geological records in South Australia. The oldest rock units, part of the Sleaford Complex, are of Late Archaean to Early Proterozoic age (2,700 to 2,300 million years ago (Ma)). The craton has remained tectonically stable since approximately 1,450 Ma. Over the last one million years, widespread deposits of aeolian dune sands, alluvial silts and sands, conglomerates and calcareous crusts formed a thin but persistent surface veneer across much of the peninsula (Parker et al. 1985).

Table 2-1 Stratigraphy and lithological characteristic of Eyre Peninsula

Period	Age (million years)	Environment	Sediment/rock type	Geological Unit
Quaternary	Up to 1	Wind deposited dunes (aeolian)	Limestone	Bridgewater Formation
Tertiary	30 to 40	Rivers and lakes (fluvial)	Sands and clays	Vanilla Formation and Poelpena Formation
Jurassic	150 to 200	Rivers and lakes (fluvial)	Sands and clays (carbonaceous)	Polda Formation
Early Proterozoic	1,700 to 2,000	Basement	Quartzite, gneiss, schist, iron formation, marble, granite gneiss and amphibolite	Hutchison Group and Lincoln Complex
Archean	2,300 to 2,700	Basement	Gneiss and granite gneiss	Sleaford Complex

3. Hydrogeology

A scientific understanding of the hydrogeology of the PWAs has been derived from 4 main sources:

- DFW (2011);
- Stewart et al. (2012);
- Stewart (2013); and
- DEW (2024f).

3.1. Aquifers

Groundwater resources within the PWAs of the Eyre Peninsula are primarily hosted in 4 main aquifers: Quaternary Limestone (QL); Tertiary Sands (TS); Jurassic sedimentary; and Basement fractured rock aquifers. Among these, the QL aquifer is the most significant in both the Southern Basins and Musgrave PWAs as it contains low salinity to brackish water because of effective recharge from incident rainfall, which is attributed to the region's thin soil cover and the highly permeable nature of the limestone. The freshwater resources stored in the QL aquifer are critical to the long-term water security of the Eyre Peninsula water supply.

3.1.1. Quaternary Limestone aquifer

The QL aquifer (Bridgewater Formation) forms a generally thin layer over the older Tertiary sediments and is continuous across both PWAs. The limestone consists of sand-size shell fragments, calcareous algae fragments and quartz grains that were deposited as large barrier dunes on ancient shorelines during the Pleistocene era when sea levels were higher than today. These sediments are known to be over 130 m thick in parts of the Uley South Basin. Wind-blown sand sheets form extensive layers extending inland from the coast. The Bridgewater Formation varies from consolidated to unconsolidated across its extent, with karstic features occurring commonly throughout. Surface-solution features such as sink holes are ubiquitous and enhance rainfall recharge via preferential flow.

The majority of groundwater extractions from within the PWAs are from the QL aquifer (see Section 6). Groundwater salinities range between 400 and 1,800 mg/L, and well yields are generally high, ranging between 5 and 50 L/s.

Maps of the QL aquifer water table elevations indicate 2 predominant groundwater flow directions within the Southern Basins PWA: a west to north-westerly trend; and a west to south-westerly trend (Figure 3-1). In contrast, groundwater in the Musgrave PWA predominantly flows in a west to south-westerly trend (Figure 3-2). In both instances, groundwater ultimately discharges to the sea supporting near-shore marine ecosystems. Hydrochemical evidence indicates that groundwater in the QL aquifer in the Uley South Basin is less than 30 years old (Love et al. 1994).

The saturated thickness and porosity of the QL aquifer; and, hence the amount of groundwater stored within the aquifer, varies spatially throughout the prescribed areas (Figure 3-3 and Figure 3-4). Generally, the saturated thickness is small in the areas of highest elevation, which are furthest inland (for example, the Lincoln North and Poldas Basins), but increases towards the coast. There are considerable areas over which the saturated thickness is less than 10 m suggesting low robustness of these aquifers when compared to many of the groundwater systems across South Australia. The QL

aquifer saturated thickness can also vary rapidly over time as the water table fluctuates in response to rainfall.

The QL aquifer has been subdivided into discrete basins which contain significant volumes of groundwater in storage. These basins are separated by areas where the QL aquifer is dry or has a very small, saturated thickness (which would result in poor connectivity between the thicker saturated basins).

3.1.2. Tertiary Sands aquifer

The TS aquifer extends over most of the PWAs and consists of unconsolidated fine- to medium-grained quartz sand, silt and clay. The Wanilla Formation forms the TS aquifer in the Southern Basins PWA and consists of fine-grained to gravelly fluvial sands and clays interbedded with variable thicknesses of silty carbonaceous clay at its base. It generally infills troughs in the underlying Basement surface and has a maximum thickness of around 80 m. Groundwater salinities range between 500 and 7,500 mg/L and well yields are generally less than 0.5 L/s.

The Poelpena Formation forms the TS aquifer in the Musgrave PWA and consists of poorly sorted, fine- to coarse-grained quartz sand, silt and clay. The formation has a highly variable thickness but commonly exceeds 100 m in the eastern part of the Musgrave PWA. Salinities range between 240 and 35,000 mg/L with well yields averaging about 1 L/s.

The TS aquifer is generally separated from the overlying QL aquifer by low permeability confining layers. Within the Musgrave PWA, clays at the top of the Poelpena Formation act as a confining layer between the sand layers and the overlying QL aquifer. Within the Southern Basins PWA, the Uley Formation confining layer is a sequence of sandy clay and clayey sands that separates the underlying sand aquifer from the overlying QL aquifer. These formations are observed to be absent in some areas within both PWAs. Where the overlying Quaternary sequence is absent or dry, the TS aquifer can contain the water table.

Hydrochemical evidence indicates groundwater in the TS aquifer is generally older than 35 years and perhaps is of the order of 3,000 to 6,500 years old (Harrington et al. 2006).

3.1.3. Jurassic aquifer

The Jurassic aquifer occurs primarily in the east of the Musgrave PWA in a deep east–west trending trough that occurs below the Tertiary sediments. It consists of fine-grained sands, sandstone and conglomerate of the Poldia Formation that is up to 86 m thick. Groundwater salinities within this sequence are high, ranging between 30,000 and 50,000 mg/L.

The Jurassic aquifer does not occur in the Southern Basins PWA.

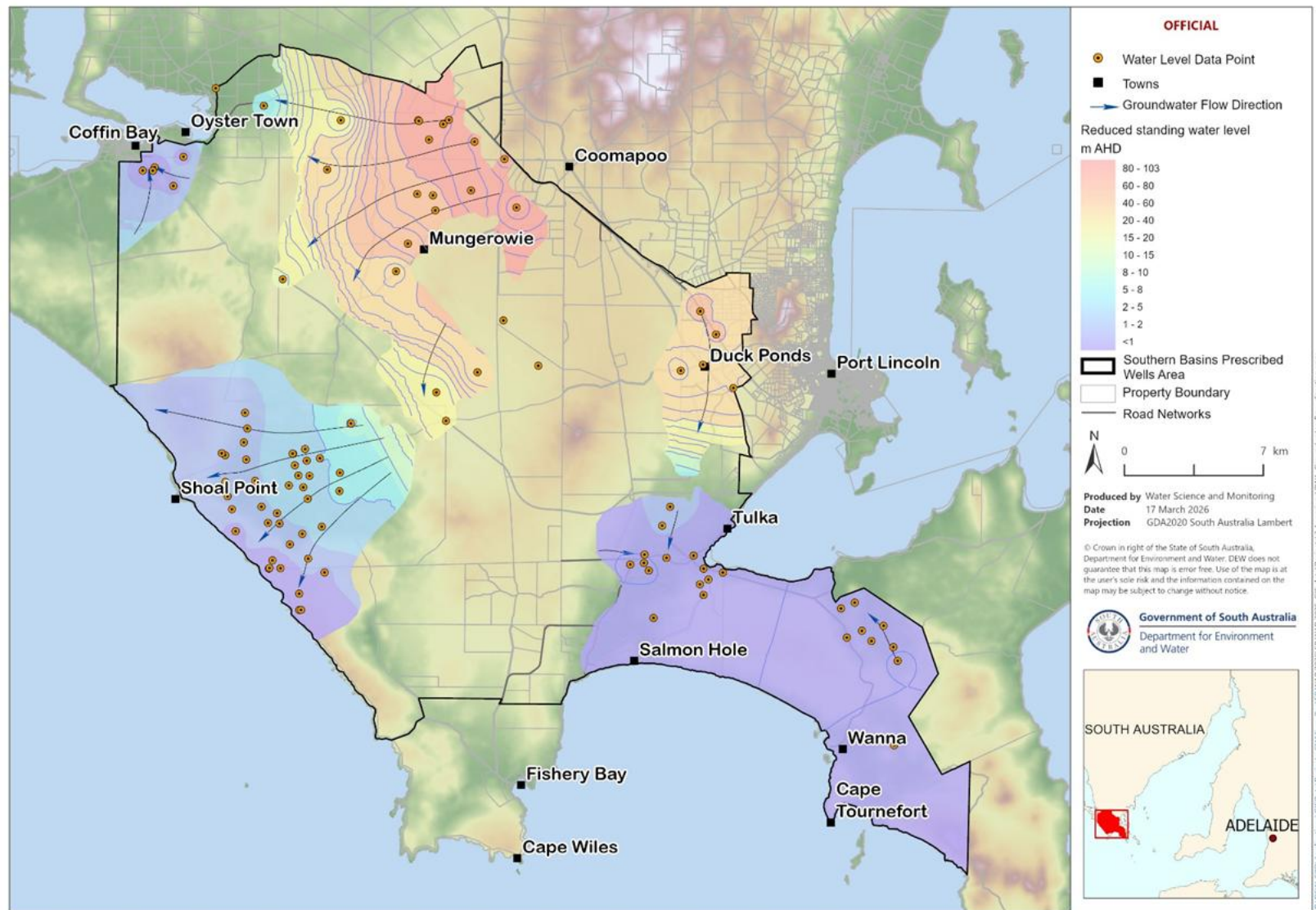


Figure 3-1 Indicative groundwater flow directions for the Quaternary Limestone aquifer in the Southern Basins PWA

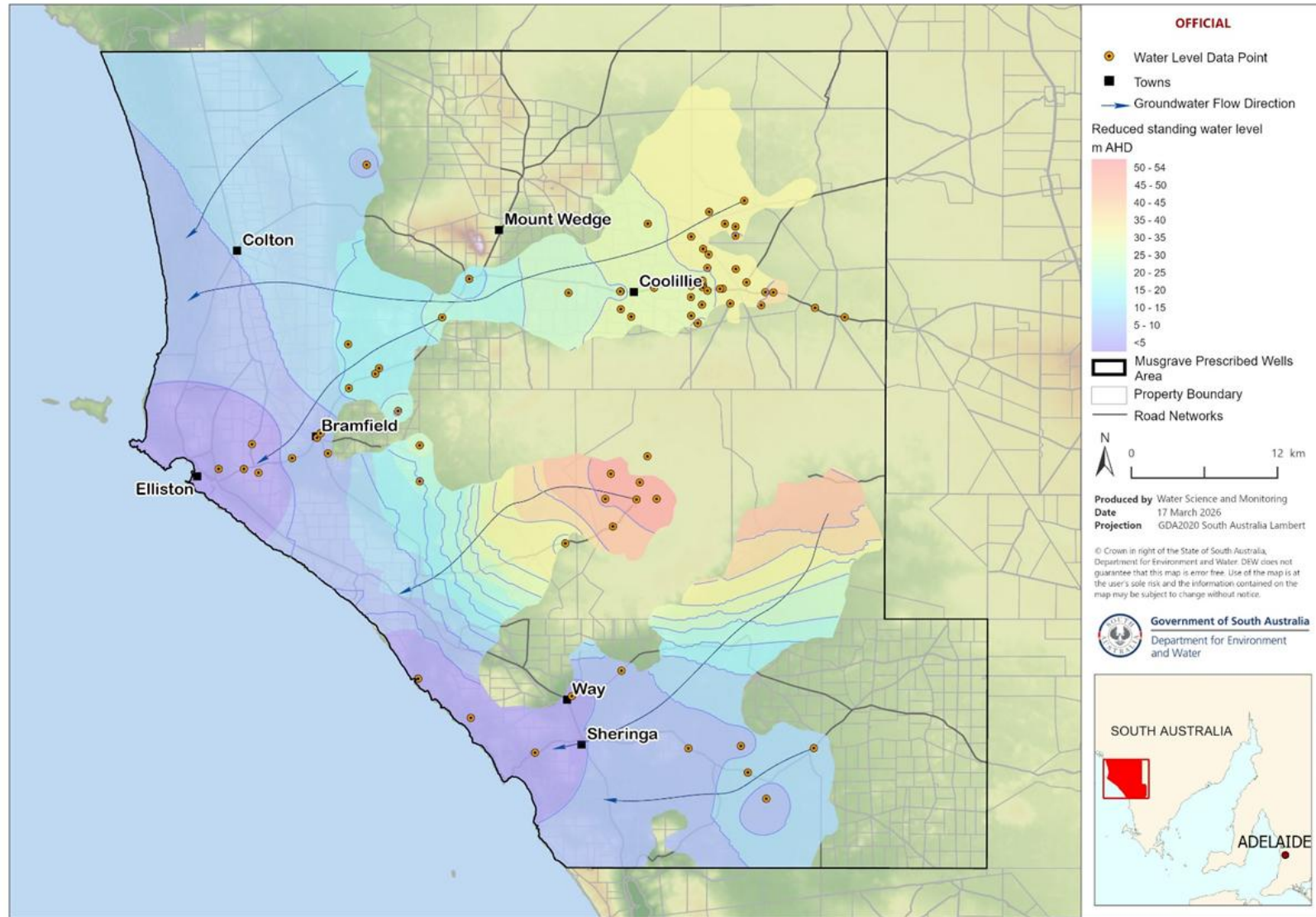


Figure 3-2 Indicative groundwater flow directions for the Quaternary Limestone aquifer in the Musgrave PWA

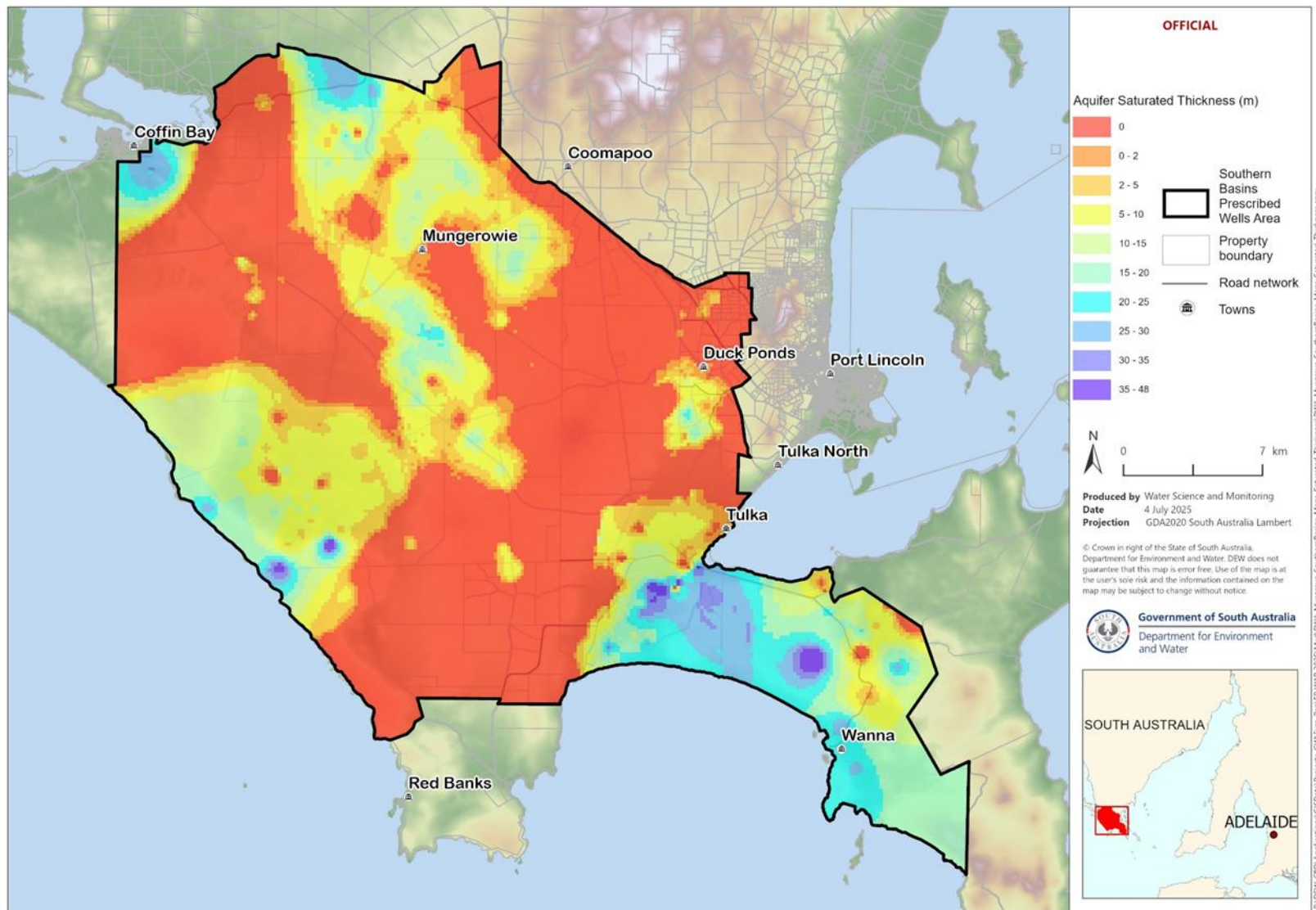


Figure 3-3 Saturated thickness of the Quaternary Limestone aquifer in the Southern Basins PWA

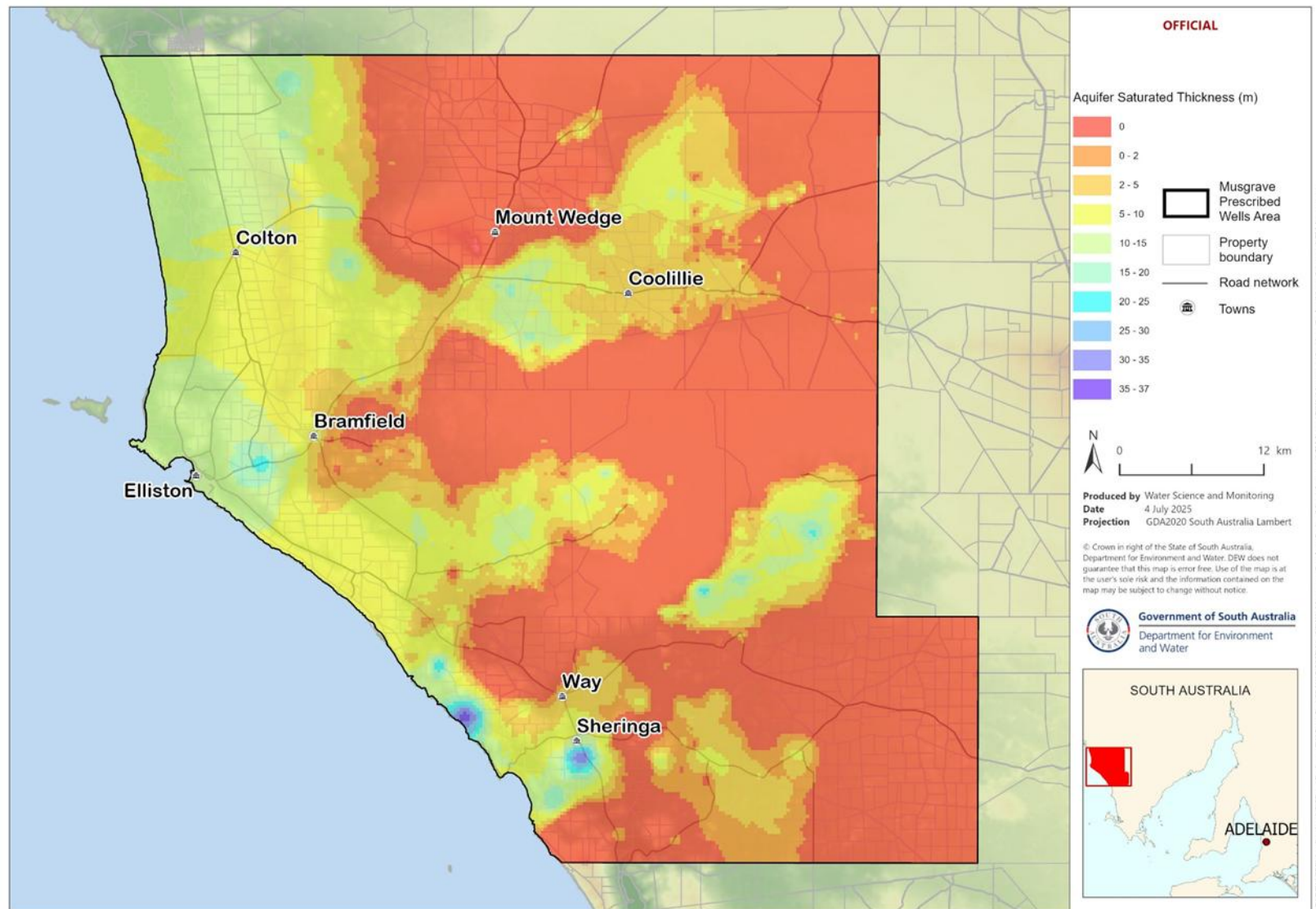


Figure 3-4 Saturated thickness of the Quaternary Limestone aquifer in the Musgrave PWA

3.1.4. Basement aquifers

There are two broad groups of Basement aquifers. The Hutchison Group comprises a basal quartzite sequence, which is overlain by carbonate, banded iron formation, amphibolite and schist (all of which are subject to mineral exploration). The Hutchison Group is comprised of crystalline rocks of mainly very low permeability. However, during the Tertiary weathering process, local solution cavities formed near the surface in some of the carbonate rocks (marble and calcsilicate gneiss) (EPNRMB 2016; Stewart et al. 2012).

Rocks of the Lincoln Complex and Sleaford Complex consist mainly of very low permeability granite, granite gneiss and amphibolite. Although there are limited data, hydrochemical evidence indicates that Basement groundwater is generally older than 35 years (maybe older than 1,000 years), and salinities range between 500 and 30,000 mg/L (EPNRMB 2016).

These Basement fractured rock aquifers typically show irregular yields and salinities that are difficult to predict due to the highly variable nature of the joints and fractures that control groundwater mixing and movement. The Basement aquifer around Green Patch (immediately north-west of the Southern Basins PWA) has been developed for irrigation purposes, although the volumes extracted are likely to be low.

3.2. Aquifer recharge and discharge processes

Recharge and discharge processes provide inputs and outputs to the groundwater systems. These processes occur naturally where recharge to aquifers can occur from rainfall and surface water. Discharge from aquifers can occur by evapotranspiration, lateral flow to the sea and discharge to surface water features such as swamps and wetlands. Human activities can also contribute to these processes, through managed aquifer recharge schemes or extraction by pumping from wells (including extraction PWS).

Natural groundwater discharge processes generally occur continuously, whereas groundwater recharge is quite variable as it is primarily controlled by rainfall duration and intensity, the nature of the soil profile, and the underlying geology (Freeze and Cherry 1979). Vegetation is also understood to be significant for recharge and discharge processes in terms of interception of rainfall by the leaf canopy and transpiration of water in the soil profile or shallow water table by the root system.

Groundwater level trends give an indication of the state of the balance between the discharge processes and the variable recharge inputs from rainfall. Groundwater level declines indicate that discharges from the aquifer (which may also include extraction) are higher than the recharge entering the aquifer. Conversely, groundwater level rises are observed when recharge exceeds the groundwater discharge processes.

In general, systems without extraction tend to remain in steady state (that is, long-term groundwater levels remain static with only seasonal variations observed). However, within the QL aquifers of the Southern Basins and Musgrave PWAs, groundwater level declines are commonly observed in areas where no extraction occurs. This indicates that, over the period of observation, recharge has been insufficient to offset ongoing natural discharge from the aquifer.

3.2.1. Quaternary Aquifer recharge

Hydrogeological assessments have shown that the QL aquifer, which is either exposed or covered by thin soils, readily receives recharge from rainfall. Its groundwater levels are strongly influenced by seasonal rainfall and recharge dynamics. Karst features such as sinkholes, visible in surface geology, act as preferential pathways for infiltration (Ordens et al. 2011; Somaratne et al. 2018), and high

transmissivity values from aquifer tests suggest extensive secondary porosity such as fractures and dissolution features (Sibenaler 1976; Watkins et al. 2015).

As there is no evidence of regional scale lateral inflows from other nearby aquifers outside the prescribed areas, it can be concluded that the main groundwater resources within the Southern Basins and Musgrave PWAs are dependent on recharge from local rainfall as their main input, which is also the predominant control on groundwater levels.

3.2.2. Recharge of Uley South Basin in the Southern Basins PWA

Groundwater recharge has been extensively investigated in the Uley South Basin with high variability in estimated recharge rates. Estimated recharge rates range from less than 25 mm/yr to more than 240 mm/y (Table 3-1). Much of this variability is due to the natural spatial and temporal variability in recharge. However, the method applied to estimate recharge is also likely to influence the result. In summarising recharge in the Uley South Basin in the 2016 Water Allocation Plan for the Southern Basins and Musgrave PWAs, the Eyre Peninsula Natural Resources Management Board (EPNRMB) (2016) gave a recharge rate of 129 mm/y based on the work of Ordens et al. (2011), noting that the then-stable groundwater levels could not be sustained with lower recharge rates given the extraction rate of $\approx 5,700$ ML per year (Stewart 2013).

Table 3-1 Summary of recharge rates in the Uley South Basin.

Study	Method	Recharge rate (mm/y)
Sibenaler (1976)	Recharge is 10% of rainfall	55
Barnett (1978)	Hydrograph analysis	105
Evans (1997)	Chloride mass balance	63.6 to 70.5
Evans (1997)	Water table fluctuation	46
Evans (1997)	Water balance	78
Evans (1997)	Flow net analysis	157
Evans (1997)	CFC	25 to 200
Ordens et al. (2012)	Chloride mass balance	52 to 63
Ordens et al. (2012)	Water table fluctuation	47 to 129
Green et al. (2012)	Unsaturated zone modelling	57 to 153
Ordens et al. (2014)	Unsaturated zone modelling	0 to 240
Bresciani et al. (2014)	Chloride mass balance (accounting for chloride deposition)	69 to 73
EPNRMB (2016)	Summary of existing methods	129

Figure 3-5 shows hydrographs spanning 2009 to 2024 for daily groundwater level trends for monitoring wells ULE135 and ULE196, alongside monthly rainfall data from the nearby Cooroona Water Hole pluviometer (Station A5121034), located within the Uley South Basin. Both groundwater hydrographs demonstrate a clear seasonal pattern with groundwater level peaks typically occurring between May and October each year, following the winter rainfall period (June to August). These wet season months correspond with recharge events when rainfall is sufficient to infiltrate the unsaturated zone and raise the water table.

Conversely, the lowest groundwater levels (that is, troughs) are generally observed during January to April, coinciding with late summer and early autumn, when rainfall is minimal and evapotranspiration is highest. While groundwater levels show rises following periods of increased rainfall, the magnitude of these responses varies through time, indicating that recharge processes are not solely controlled by rainfall totals. Over the 15-year period, both wells exhibit a gradual long-term decline in groundwater

levels, particularly evident from 2013 onwards, reflecting the effects of below-average rainfall years and potential sustained groundwater extraction.

According to the calibrated transient groundwater model developed by DEW, the long-term mean recharge across the model domain from 1961 to 2024 is estimated at 89 mm/y, while the mean recharge over the last decade (2015 to 2024) has declined to 52 mm/y (DEW 2020b). This figure masks considerable spatial heterogeneity. Areas underlain by deep carbonate sands, particularly along the western margins of the basin, experience the highest recharge rates, reaching up to 153 mm/y. These zones are characterized by minimal vegetation and highly permeable soils which promote rapid infiltration of rainfall. In contrast, the central basin – composed largely of shallow calcareous soils over calcrete – experiences moderate recharge, averaging approximately 84 mm/y. Meanwhile, recharge is lowest or effectively absent in regions covered by dense mallee woodland, particularly in the eastern basin, where evapotranspiration exceeds precipitation. These areas contribute little to recharge due to the water uptake by deep-rooted vegetation and the limited infiltration capacity of soils (Swaffer 2017; Allison et al. 1985).

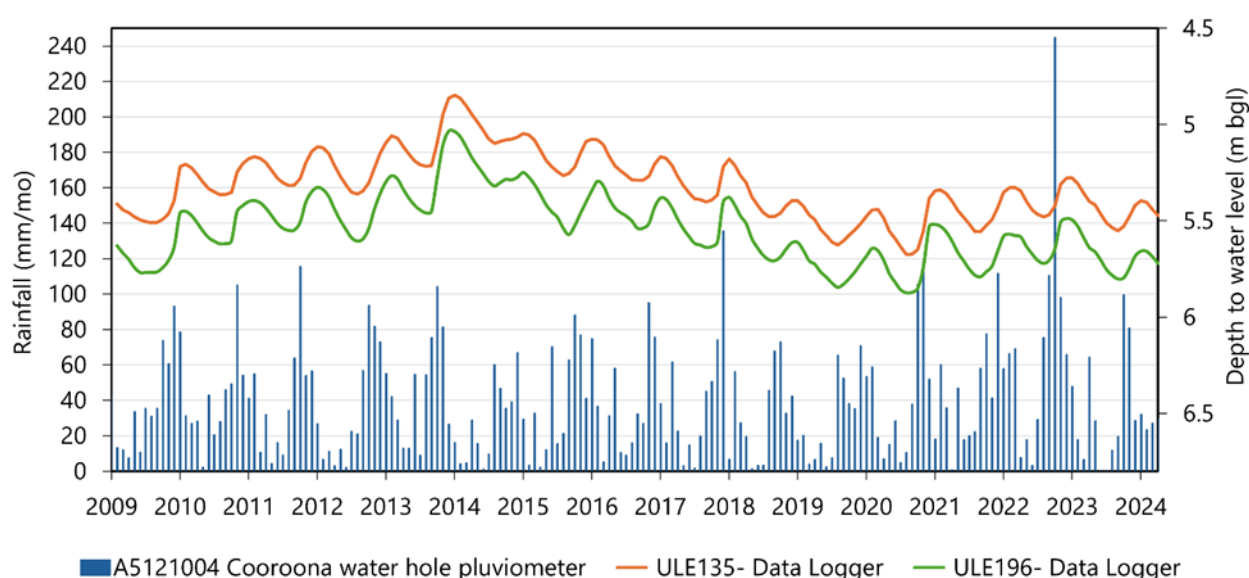


Figure 3-5 Uley South groundwater level and rainfall correlation

3.2.3. Recharge of the Poldas and Bramfield Basins

Groundwater recharge in the Musgrave Basin PWA has been investigated through long-term monitoring and modelling. A hydrograph from observation well SQR101, located in Poldas, alongside monthly rainfall data from the Poldas pluviometer (Station A0211001), illustrate the aquifer's response to rainfall events (Figure 3-6). This hydrograph shows strong agreement between data logger and manual measurements, confirming data reliability. Groundwater levels generally decline when monthly rainfall is below 50 mm, while rainfall exceeding 60 mm often results in a rise in the groundwater table, typically with a one-month lag. However, not all rainfall above 60 mm/month triggers recharge, likely due to low rainfall intensity.

Earlier studies suggested that recharge in the Poldas area only occurs when monthly rainfall exceeds 60 mm between May and October. Since PWS extraction from the Poldas lens ceased in 2008, observed groundwater level fluctuations are likely driven by natural recharge and discharge processes.

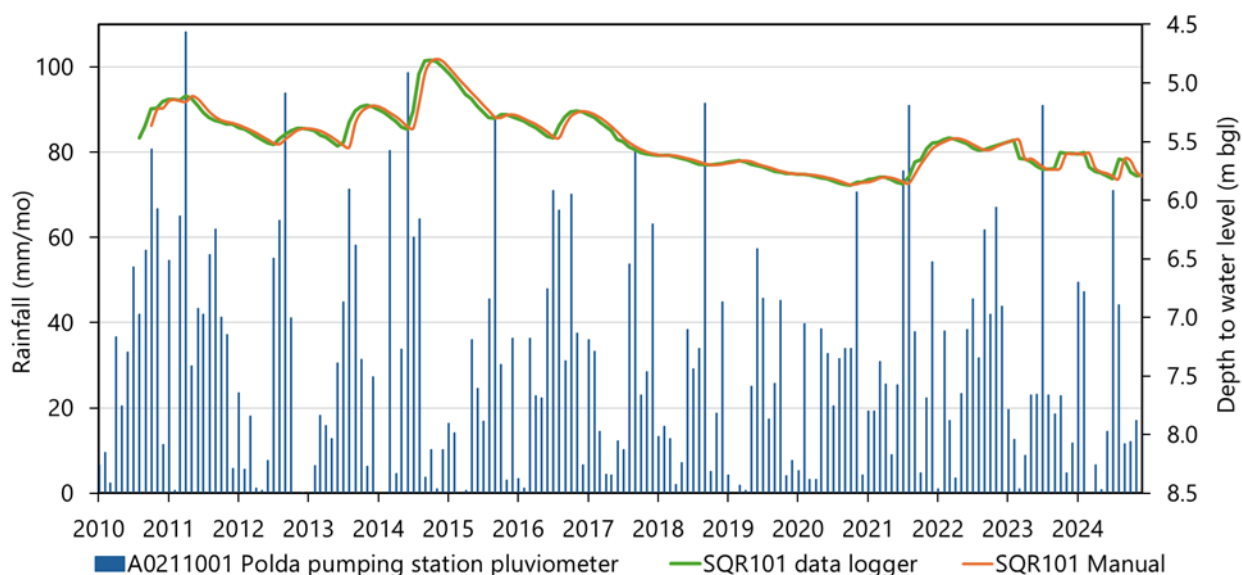


Figure 3-6 Poldra groundwater level and rainfall correlation

Recharge estimates in the Bramfield area were reported by Love et al. (1994) using the chloride mass balance method, ranging from 15 to 78 mm/y (mean 31 mm/y). Additional estimates using the Water Table Fluctuation (WTF) method with specific yields of 0.1 to 0.3 suggest recharge rates of 130 to 151 mm/y in 2 wells, though these results were considered less reliable than the chlorine mass balance method. The authors also noted that recharge is most likely when monthly rainfall exceeds 60 mm.

As part of the National Water Grid Fund project, *Ensuring water security, economic prosperity and nature positive outcomes for Elliston, Eyre Peninsula*, investigations are being undertaken to better understand the relationship between rainfall and groundwater recharge within the Bramfield area in the context of a changing climate. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is leading the work, which includes installing an underground drip water monitoring network to identify rainfall recharge thresholds and conducting hydrochemical and environmental tracer analysis to estimate recharge rates.

Results from these investigations, to date, indicate a range of mean annual recharge estimates depending on method and conceptual assumptions. Tritium-derived estimates range from approximately 15 to 25 mm/y assuming saturated flow, increasing to 15 to 65 mm/y when combined unsaturated and saturated flow processes are considered. Estimates derived from dichlorodifluoromethane (CFC-12) range from 2 to 24 mm/y, while chloride mass balance yields recharge estimates of 16 to 33 mm/y. Rainfall–recharge thresholds identified from isotope sampling indicate that a minimum threshold of approximately 40 mm/month may trigger localised, low-magnitude recharge to the lens, whereas broader, more effective recharge across the lens typically occurs when monthly rainfall reaches approximately 60 mm or higher (Taylor et al. 2026). Collectively, these multiple lines of evidence suggest contemporary mean annual recharge rates are most likely within the range of approximately 5 to 30 mm/y, reflecting the influence of recent drier climatic conditions and the episodic nature of recharge in the Bramfield lens (Taylor et al. 2026).

Recent transient modelling by DEW (2026b) for the Bramfield area estimates recharge across the model domain ranging from 0.1 to 67 mm/y. Recharge zones were delineated based on soil type, vegetation cover and depth to groundwater with initial rates informed by groundwater level fluctuations and rainfall correlations. These were calibrated against historical estimates (Love et al. 1994) to achieve a good model fit. Recharge is applied seasonally from May to October, when rainfall typically exceeds evapotranspiration and water table rises are observed.

The mean recharge for the baseline period of 1965 to 1994 is 24 mm/y and over the full modelling period (1965 to 2024), the long-term mean recharge is 19 mm/y. However, in the most recent decade (2015 to

2024), the mean recharge has declined significantly to 7.8 mm/y with values ranging from 0.1 to 32 mm/y. These findings are consistent with the Uley South modelling by DEW (DEW 2021b; DEW 2023b, c) and highlight a significant decline in recharge over the past decade, reinforcing the need for adaptive groundwater management strategies in the Musgrave Basin PWA.

The Bramfield Basin is likely connected to other saturated areas of the Musgrave PWA; however, the main inflow to the QL aquifer is rainfall recharge. Recharge to the QL aquifer is reliant upon annual rainfall but with a high degree of spatial and temporal variability. Higher recharge (>100 mm/y) may occur preferentially through karst features, while lower recharge (<12 mm/y) is expected in areas covered by native vegetation.

3.2.4. Tertiary Sands aquifer recharge

Recharge to the TS aquifer is limited due to confinement by clay layers. Where the clay is thin or absent, vertical leakage from the overlying QL aquifer may occur. In the Uley South Basin, groundwater isotope and chemistry data suggest that recharge to the TS aquifer occurs primarily via lateral inflow from upgradient areas and downward leakage from the QL aquifer in the Uley Wanilla lens (Evans 1997; Harrington et al. 2006). Groundwater levels in the TS aquifer downgradient of Uley East Basin have remained stable, while those downgradient of Uley Wanilla Basin have declined since the mid-1980s. This decline correlates with falling QL aquifer levels, suggesting reduced recharge from QL to TS aquifer in that area.

Evidence from Dowie and Love (1996) suggests that improvements in TS aquifer salinity during aquifer tests may result from leakage through preferential flow paths, rather than uniform clay permeability. Hydrochemical data in the Bramfield area, using Piper plots, show similar water quality ranges in both aquifers, reinforcing the conceptual model of QL -derived recharge to the TS aquifer (DEW 2026b). In addition, stable isotope analysis shows that QL and TS groundwater types plot near the Adelaide meteoric water line, indicating rapid recharge with minimal evapotranspiration. This supports the idea that QL aquifer recharge occurs after significant rainfall events and TS aquifer recharge follows via downward leakage.

Overall, the TS aquifer receives limited but episodic recharge, primarily via leakage from the QL aquifer, with spatial variability influenced by geology, vegetation and rainfall intensity.

3.2.5. Jurassic aquifer recharge

Given the high groundwater salinity of the Jurassic aquifer, its depth below the ground surface and the fact there is no known outcrop of Jurassic sediments, it is highly unlikely that any significant recharge has occurred to this aquifer in modern times.

3.2.6. Basement aquifer recharge

Recharge to the Basement aquifer is likely to occur in areas where Basement rocks are exposed at the ground surface (for example, in the hills around Green Patch or north of Big Swamp). The recharge rate is a function of the degree of fracturing, the composition of the rock, and the presence of any impermeable clayey weathered zone at the surface. In addition, it is possible that some vertical leakage from overlying aquifers may also occur. Because of the limited areas of outcrop, inputs to this aquifer on a regional scale are not likely to vary greatly over time.

4. Groundwater resources condition

Long-term assessment of groundwater resources within the Southern Basins and Musgrave PWAs indicates a persistent decline in groundwater levels, reflecting increasing stress on the region's aquifers. Consequent impacts include rising groundwater salinity and reductions in overall groundwater storage.

To address uncertainty regarding potential climate change, declining rainfall and rising salinity, targeted investigations have been undertaken in the Uley South, Uley Wanilla, Lincoln South, Coffin Bay and Bramfield Basins, including:

- a multi-model approach commissioned by SA Water to simulate groundwater flow and seawater intrusion in the Uley South Basin and to support future supply planning (DEW 2020b, 2021b, 2021c, 2023b, 2023c, and 2024b). A recent post-audit (DEW 2024c) confirmed the model is fit for ongoing use. This modelling effort built on previous field and modelling studies and incorporated new data collected during the investigation. The multi-model framework helps address both conceptual and parameter uncertainty, providing a robust basis for future supply planning;
- a project jointly funded by the Australian Government (via the National Water Grid Fund) and the South Australian Government titled 'Ensuring water security, economic prosperity and nature positive outcomes for Elliston' commenced in 2024 to assess the long-term sustainability of fresh groundwater resources within the Bramfield area under changing climate conditions and increasing demand (DEW 2026b). The study focuses on the resource's capacity to support cultural water flows, water-dependent ecosystems and licenced and non-licensed users;
- an investigation undertaken in 2024 to assess the current state and condition of the groundwater resources that comprise the Uley Wanilla and Lincoln South consumptive pools. It also evaluated their capacity to sustain groundwater-dependent ecosystem (GDEs) and further groundwater extractions into the future (DEW 2024d); and
- recent geophysical studies in Coffin Bay, involving reprocessed airborne electromagnetic (AEM) data (Munday et al. 2024) and surface geophysics conducted in April 2025 (Munday et al. 2025), which have provided valuable insights into the extent and dynamics of the freshwater lens within the QL aquifer.

Below is a summary of trends in rainfall, groundwater levels, salinity and the volumes of water extracted for licenced purposes from the various groundwater resources within the PWAs. Locality maps are included with accompanying graphs presenting: rainfall data from the closest BoM station with available long-term rainfall data; groundwater level measurements from the existing observation well network; and extraction data from licensed water users within the consumptive pool. Rainfall trends are represented by the cumulative deviation from mean annual rainfall. An upward slope of the cumulative deviation line indicates a period of above-average rainfall whilst a downward slope indicates a period of below-average rainfall.

The groundwater level and salinity rankings presented in this section were determined in accordance with the methodology described in DEW (2024e) which is the current approach applied by DEW for water resource assessments across all PWAs in South Australia.

The following sections refer to the groundwater resources of the QL aquifer across both PWAs as consumptive pools. The term consumptive pool is provided for under the *Landscape South Australia Act 2019* and represents a management area within a resource whereby specific management actions are required, and volumetric limits are applied to the water which can be used for consumptive purposes. A map of the management areas for each PWA can be found in Figure 5-1 and Figure 5-2.

4.1. Southern Basins PWA

4.1.1. Coffin Bay Consumptive Pool

Groundwater trends in the Coffin Bay Consumptive Pool have been assessed by correlating rainfall data from BoM station 018017 Port Lincoln (Big Swamp), groundwater level measurements from the existing observation well network, and extraction data from licensed water use within the pool. The hydrograph (Figure 4-2) presents the long-term interactions between climate variability, extraction pressures and aquifer response over time with monitoring locations shown in Figure 4-1.

Over the past decade, groundwater levels in the Coffin Bay Consumptive Pool (Figure 4-2 and Figure 4-3) have remained relatively stable, as observed in the data from wells LKW038 and LKW027. This stability is likely due to the wells' coastal location, where groundwater levels are buffered by proximity to the ocean and are less sensitive to fluctuations in rainfall or extraction volumes.

Groundwater extraction data indicate historical peaks in the late 1990s to early 2000s, followed by a marked reduction in extraction volumes. While allocation volumes have remained relatively stable, this decline reflects changes in water management and supply arrangements during and following the Millennium Drought. Groundwater extraction did not return to pre-drought levels after conditions improved.

In 2019, SA Water constructed a pipeline connecting Coffin Bay township to the Eyre South system, providing supplementary supply during periods of elevated demand and reducing reliance on local extraction. Licensed groundwater extraction in 2023–24 was 118 ML, representing a 12.4% increase from 105 ML in 2022–23.

Salinity monitoring data collected between 2014 and 2024 indicate mixed but generally increasing trends across the Coffin Bay Consumptive Pool (Figure 4-4). Between 2016 and 2024, salinity increased at rates of approximately 0.3% to 1.0% per year with a median annual increase of 0.6%, indicating a gradual decline in groundwater quality.

In 2024, salinity concentrations within the QL aquifer ranged from 355 to 1,177 mg/L, demonstrating notable spatial variability. The most significant increases occur in monitoring wells closest to the PWS wellfield (for example, LKW039, LKW040 and SA Water production wells). In contrast, wells located between the extraction area and the coastline (for example, LKW037, LKW042 and LKW043) show little to no increasing trend. Time-series data (Figure 4-4) indicate moderate variability around a relatively stable long-term mean.

This spatial distribution indicates that salinity increases are localised and associated with groundwater extraction, rather than representing regional-scale seawater intrusion.

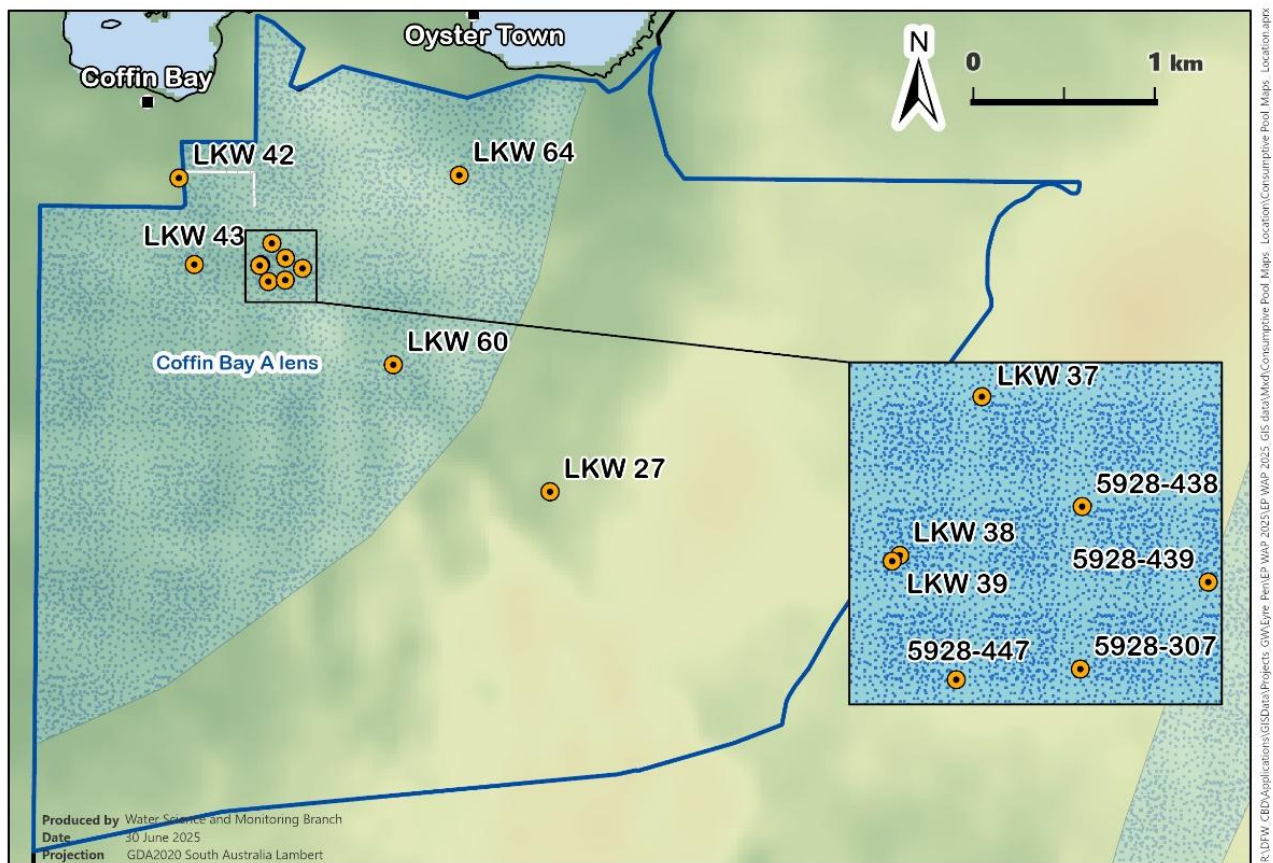


Figure 4-1 Location map for monitoring wells and public water supply wells for Coffin Bay Consumptive Pool

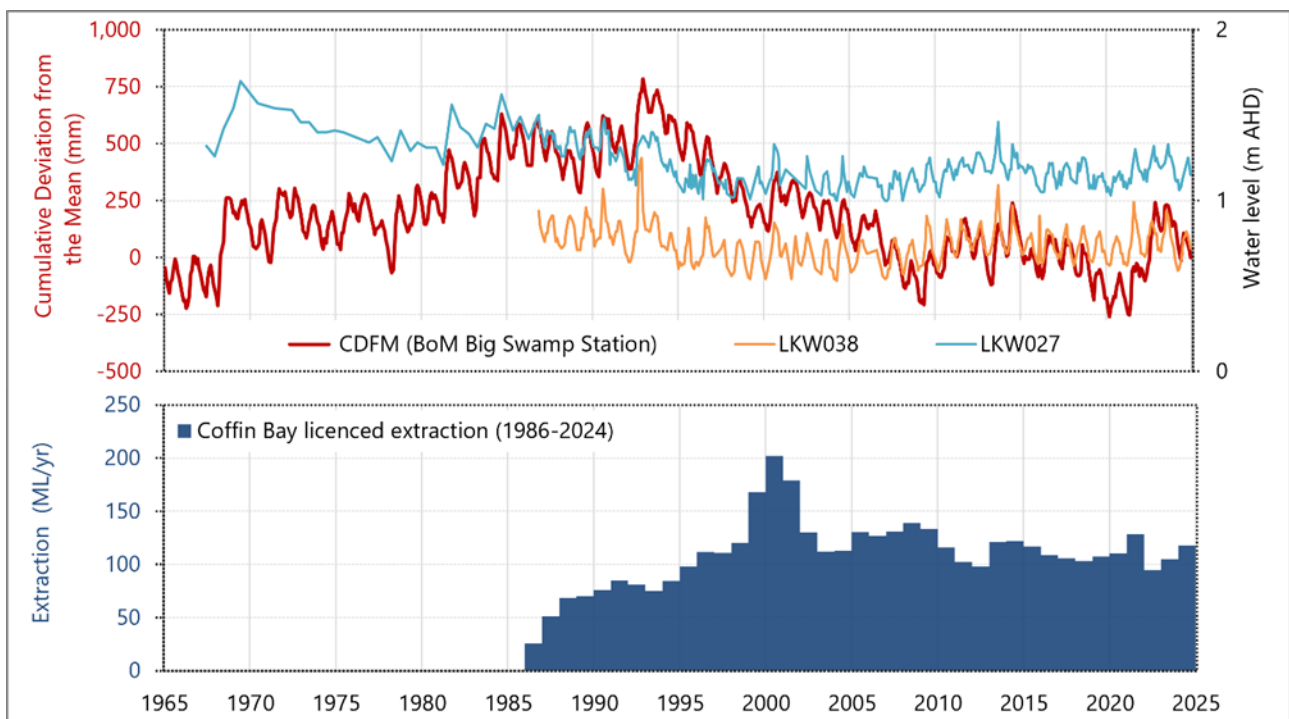


Figure 4-2 Groundwater level, rainfall and extraction trends for the Coffin Bay Consumptive Pool

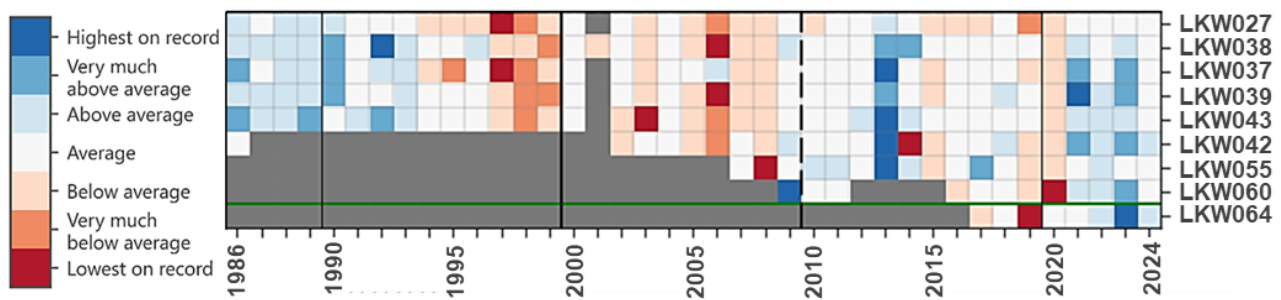


Figure 4-3 Coffin Bay historical groundwater level rankings for selected monitoring wells with good historical records

These observations are consistent with earlier findings (Ward 2009), which identified elevated salinity ($\approx 11,000$ mg/L total dissolved solids (TDS)) in deeper groundwater near the wellfield (for example in LKW040 at approximately 50 m below sea level), demonstrating the proximity of the saline interface. Ward (2009) also showed that concentrated pumping resulted in progressive salinity increases and eventual failure of a production well due to upconing. This confirms the sensitivity of groundwater salinity to localised extraction pressures. Recent geophysical investigations provide clear evidence that upconing of underlying saline groundwater is the primary risk to the Coffin Bay resource (Munday et al. 2024, 2025).

Reprocessed TEMPEST AEM data and new stationary transient electromagnetic (sTEM) surveys (Munday et al. 2024, 2025) indicate that the seawater–freshwater interface extends several kilometres inland and is elevated beneath the PWS wellfield with vertical displacement exceeding 30 m relative to surrounding areas (Figure 4-5 and Figure 4-6). Conductivity–depth sections and model outputs (Figure 4-5, Figure 4-6 and Figure 4-7) further indicate uplift of the interface beneath areas of concentrated groundwater extraction.

These datasets demonstrate that:

- the interface is shallow beneath the PWS wellfield;
- it is responding to groundwater extraction; and
- localised upconing is occurring near production wells.

While additional wells and redistribution of pumping since 2009 have reduced localised drawdown, most ground electromagnetic (EM) data indicate that the interface continues to rise beneath the wellfield, confirming ongoing sensitivity to extraction.

Accordingly, the dominant risk to the Coffin Bay Consumptive Pool is localised saltwater upconing driven by groundwater extraction, rather than regional seawater intrusion. This risk is highest in areas of concentrated extraction near the PWS wellfield and is reflected in observed salinity increases in adjacent monitoring wells.

Upconing remains an operationally controllable risk that can be managed through:

- reducing extraction rates at individual wells;
- distributing extraction across a broader wellfield footprint; and
- optimising pumping regimes to minimise localised drawdown.

Overall, the latest geophysical data confirm that the Coffin Bay system remains highly responsive to extraction pressures, and continued management of extraction distribution will be critical to maintaining groundwater quality.

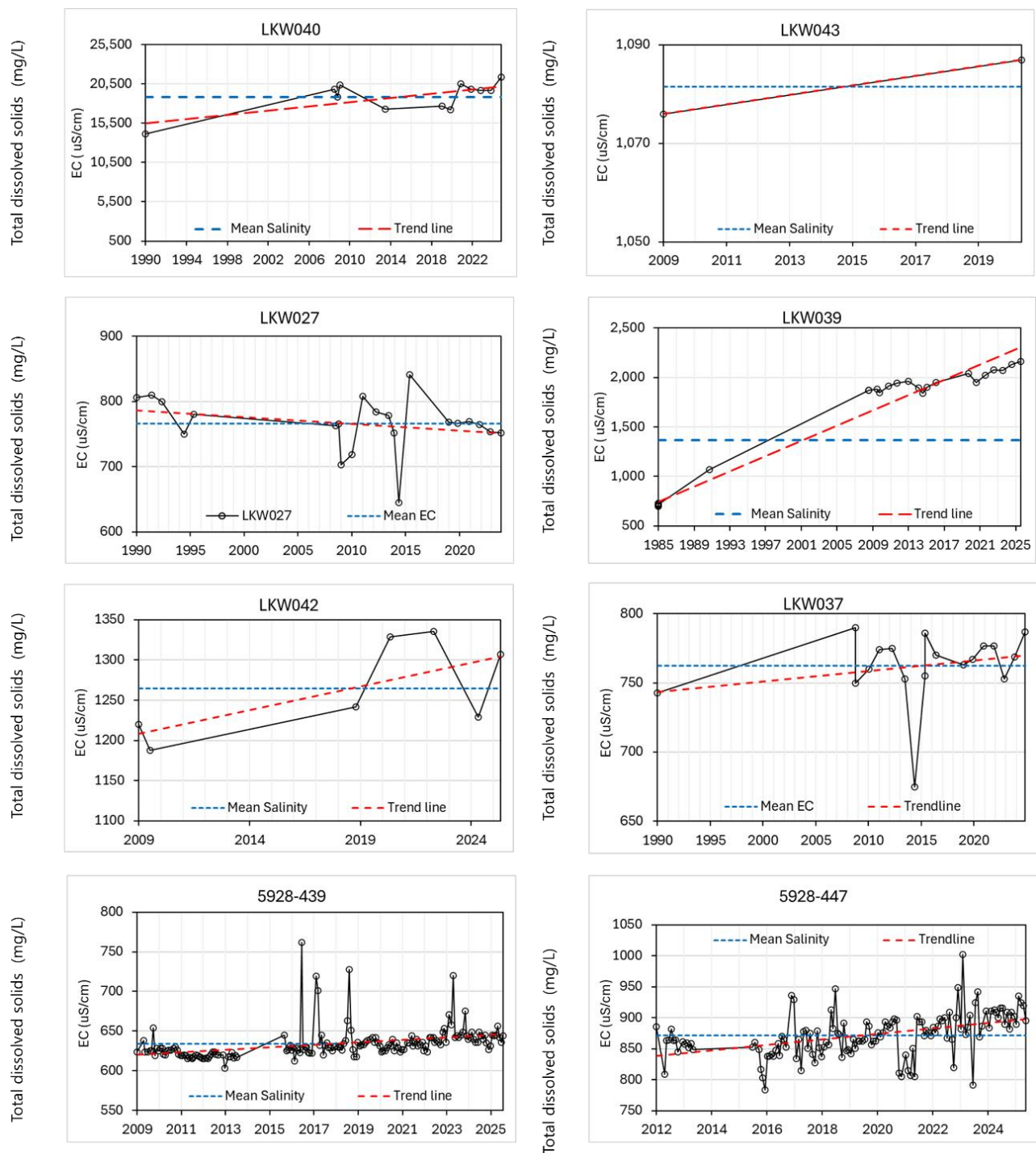


Figure 4-4 Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Coffin Bay Consumptive Pool with 10-year salinity trends.

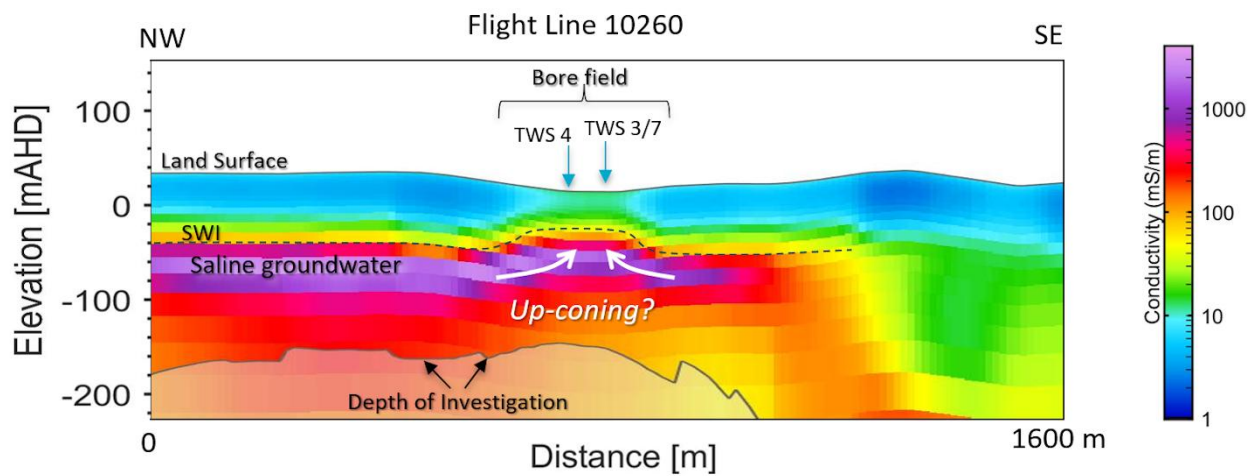


Figure 4-5 Conductivity-depth section for a subset of flightline 10260 which transects the south-western margin of the Coffin Bay wellfield (from Munday et al. 2024)

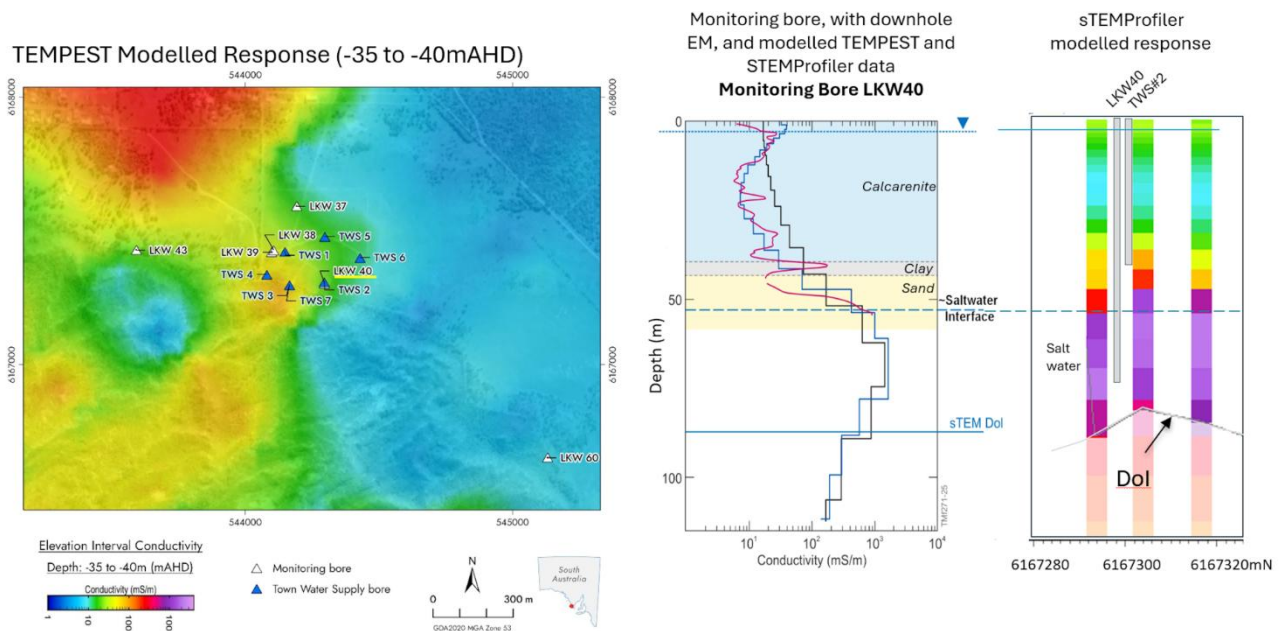


Figure 4-6 Comparative responses between the modelled TEMPEST data, and downhole EM and modelled sTEM data (from Munday et al. 2025)

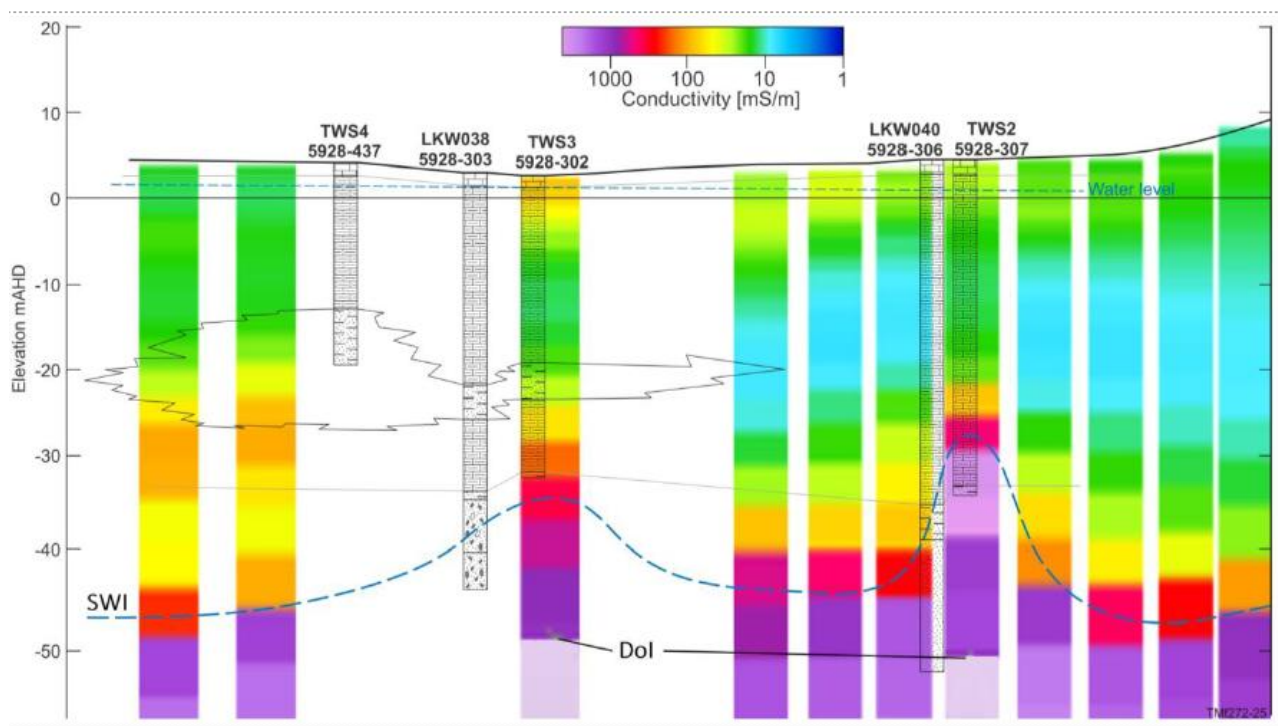


Figure 4-7 Cross-section of modelled seawater interface with the EM surface survey results (from Munday et al. 2025)

4.1.2. Uley North Consumptive Pool

Groundwater trends in the Uley North Consumptive Pool have been assessed by correlating rainfall data from the BoM station 018017 Port Lincoln (Big Swamp), groundwater level measurements from the existing observation well network, and extraction data from licensed water use within the pool (Figure 4-8). The hydrograph for Uley North Consumptive Pool (Figure 4-9) presents the long-term interactions between climate variability, extraction pressures and aquifer response over time.

Over the past 20 years, groundwater levels have varied in the Uley North Consumptive Pool (Figure 4-9) with changes ranging from a decline of 1.19 m to a rise of 1.03 m and a median decline of approximately 0.4 m. ULE0179 demonstrates a dynamic hydrological response with groundwater levels closely aligned with rainfall variability (Figure 4-9). This is particularly evident in the correlation with the cumulative deviation from the mean rainfall trend, where peaks and troughs in groundwater levels correspond with wet and dry climatic periods respectively, indicating a direct rainfall–recharge relationship.

A long-term declining trend in groundwater levels is evident in most monitoring wells (Figure 4-10 and Figure 4-11). In 2024, reduced standing water levels (RSWL) in 10 out of 13 monitoring wells (77%) in the Quaternary aquifer remained classified as below average or lower. ULE183 has experienced a gradual decline in groundwater levels beginning in the 1990s, following a relatively sharp decline period during the late 1960s through the 1980s. This change in downward trend may be influenced by factors such as changes in groundwater extraction, land use or recharge conditions.

Extraction volumes appear to follow a similar pattern to rainfall variability, indicating a strong relationship between climatic conditions and extraction rates. Periods of low rainfall often coincide with reduced extraction, while the peak in 2014 aligns with a phase of relatively higher rainfall. However, a significant reduction in pumping is observed in the years that followed with no licenced extraction reported since 2019.

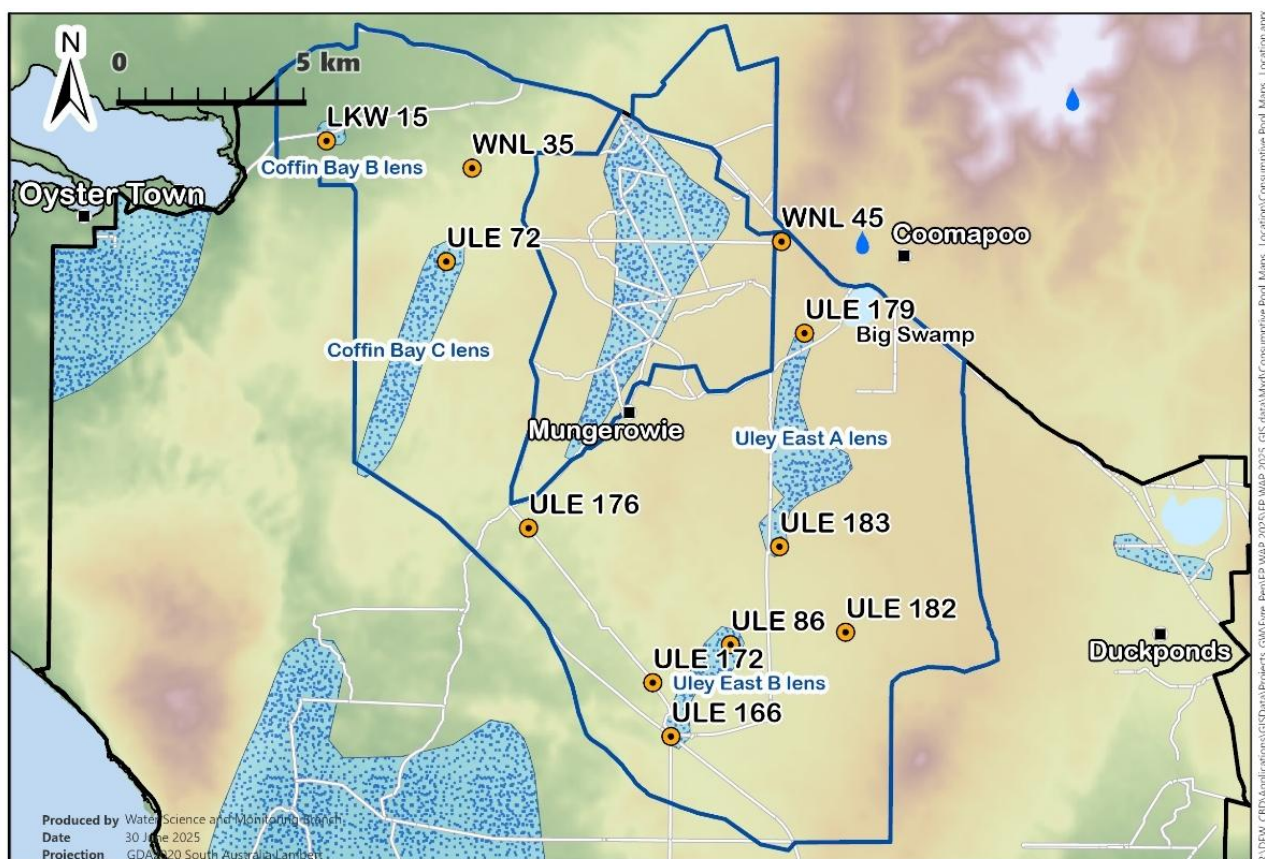


Figure 4-8 Location map for monitoring wells and rainfall stations for Uley North Consumptive Pool

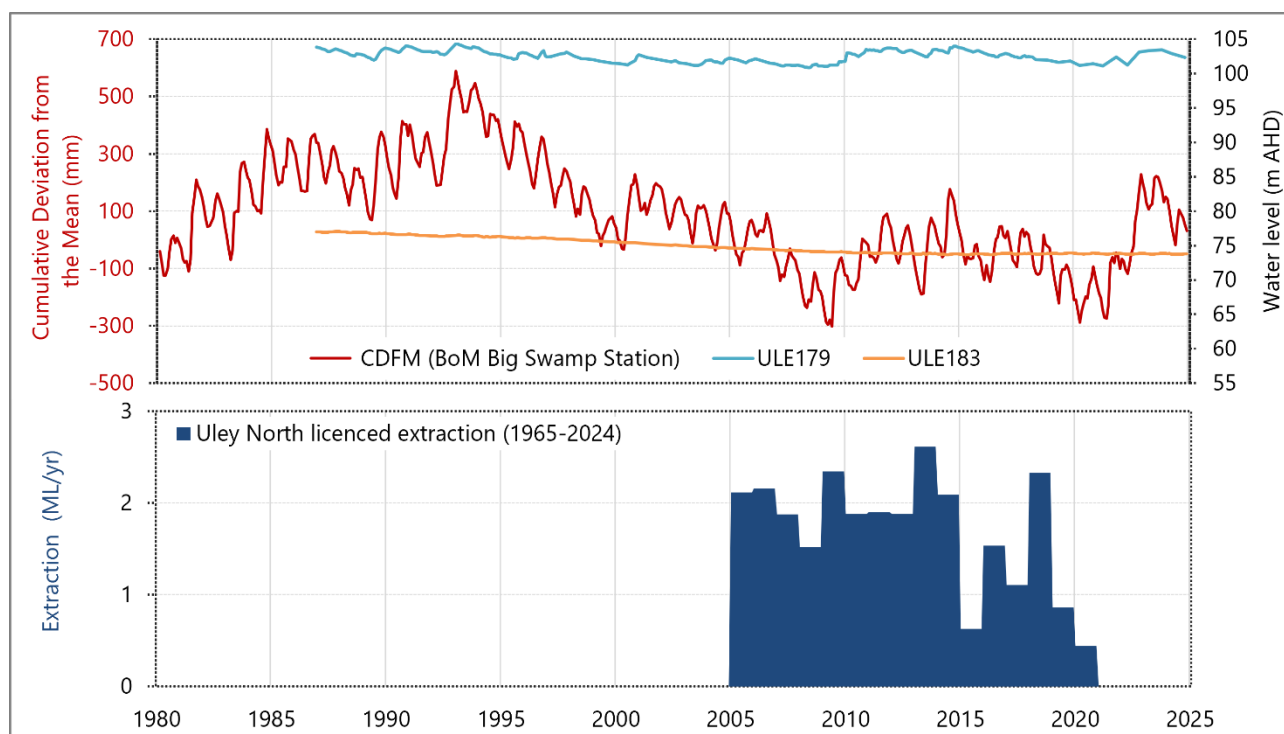


Figure 4-9 Groundwater level, rainfall and extraction trends for the Uley North Consumptive Pool

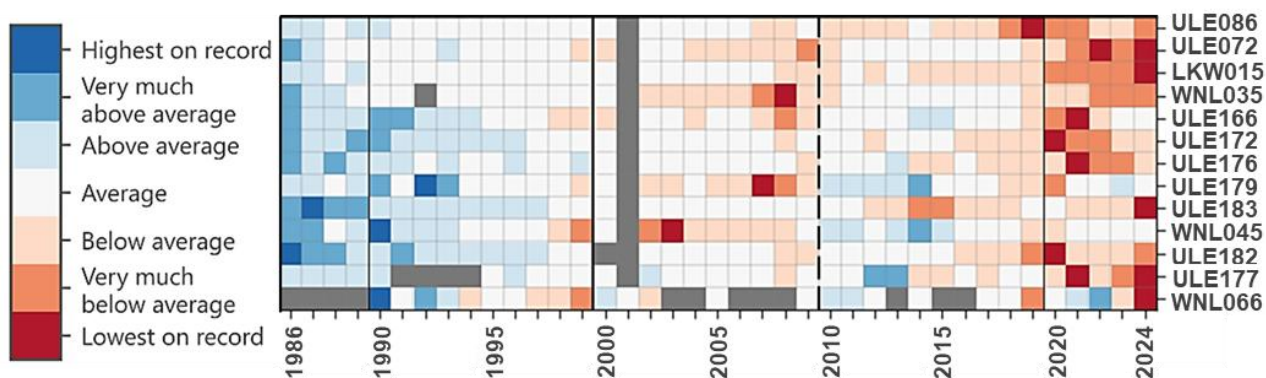


Figure 4-10 Uley North historical groundwater level rankings for selected monitoring wells with good historical records

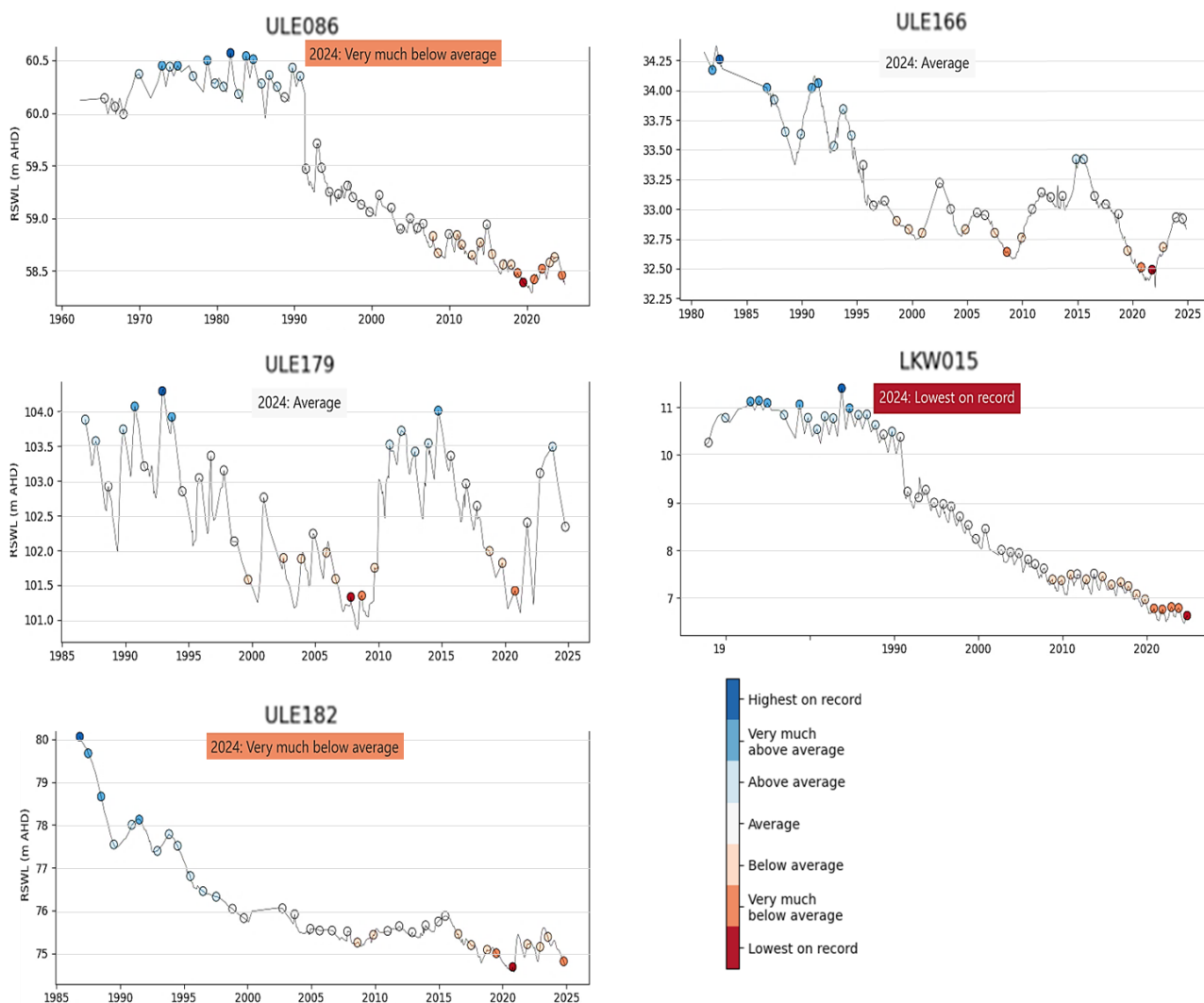


Figure 4-11 Groundwater level hydrographs for representative monitoring wells in Uley North

Only one well (ULE183) is currently monitored for salinity in the Uley North area. This well has shown a consistent increase in salinity levels, rising from 781 mg/L in 2009 to 1,138 mg/L in 2024 (Figure 4-12). The Uley Wanilla Consumptive Pool, located within the Uley North Consumptive Pool, also exhibits an increasing trend in salinity and is detailed in the Section 4.1.3.

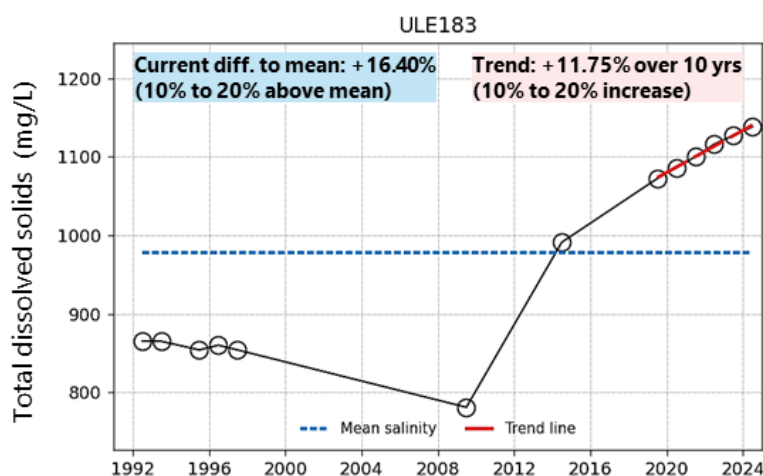


Figure 4-12 Uley North Consumptive Pool salinity with 10-year trend

4.1.3. Uley Wanilla Consumptive Pool

The Uley Wanilla Basin was the first groundwater basin to be developed in 1949 after recognition that the Tod River Reservoir was insufficient to supply the region’s growing demand for water. Extractions from Uley Wanilla Basin have been decreasing steadily since 1993 with marked reductions from 2008. Extraction in 2023–2024 was 12 ML, lower than the extracted volume in 2022–2023.

Groundwater trends in the Uley Wanilla Consumptive Pool have been assessed by correlating rainfall data from BoM station 018017 Port Lincoln (Big Swamp), groundwater level measurements from the existing observation well network, and extraction data from licensed water use within the pool (Figure 4-13). The hydrograph for Uley Wanilla Consumptive Pool presents the long-term interactions between climate variability, extraction pressures and aquifer response over time (Figure 4-14).

However, since around 2010, rates of extraction in the Uley Wanilla Basin have been consistently low (DEW 2024f) allowing for a clearer expression of the relationship between rainfall and the corresponding response in groundwater levels.

From 2010 to 2016, a period of mostly above-average rainfall, groundwater level recovery was observed in most Uley Wanilla monitoring wells. In the period 2017 to 2019, annual rainfall was below average and a rapid decline in groundwater levels was observed. Annual rainfall in 2020 and 2022 was above average and yet recovery in groundwater levels is not apparent in most monitoring wells. These observations of somewhat inconsistent responses suggest there the groundwater level response to rainfall may have changed over time. Potential explanations include leading to reduced recharge, and/or prolonged dry conditions altering unsaturated zone hydraulic behaviour, thereby reducing the effectiveness of recharge pathways. Further investigation is required to test these hypotheses.

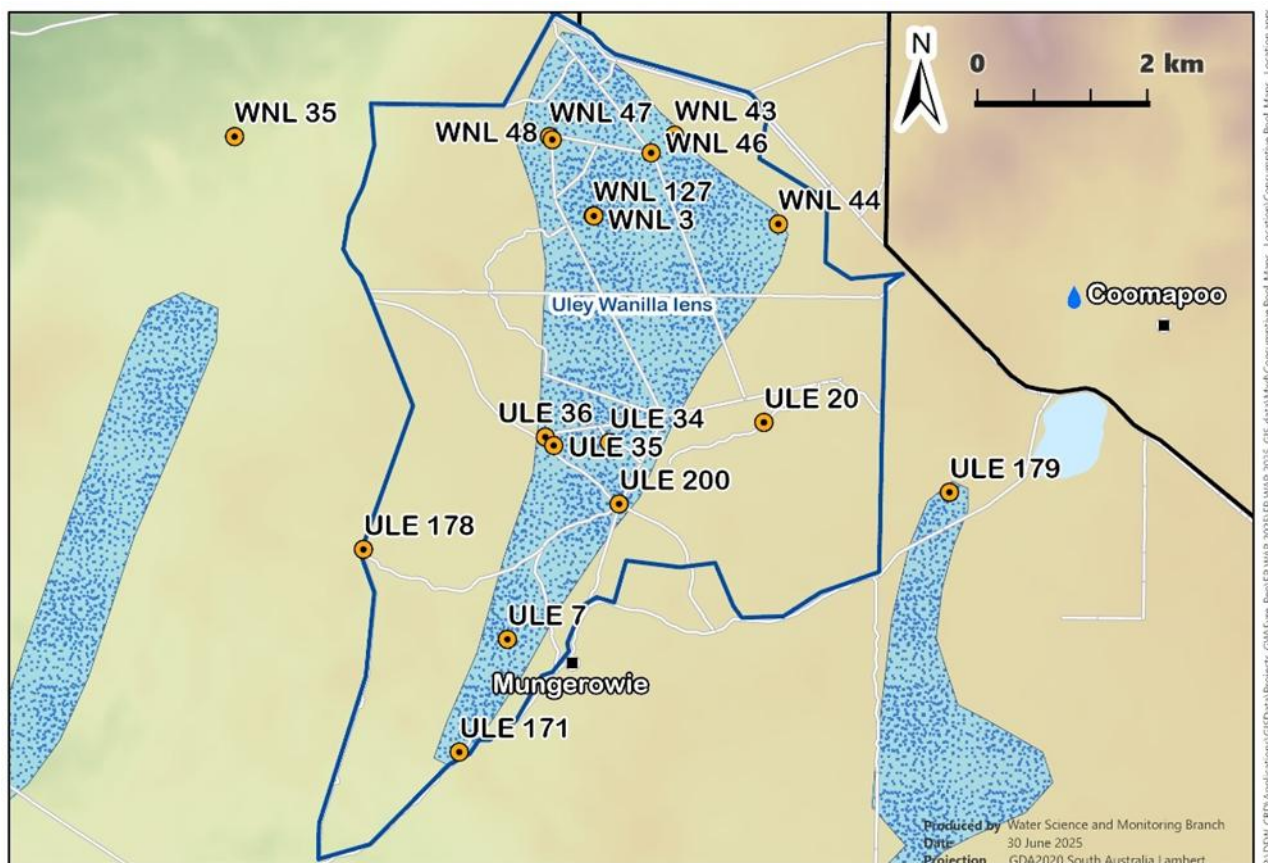


Figure 4-13 Location map for monitoring wells and rainfall stations for Uley Wanilla Consumptive Pool

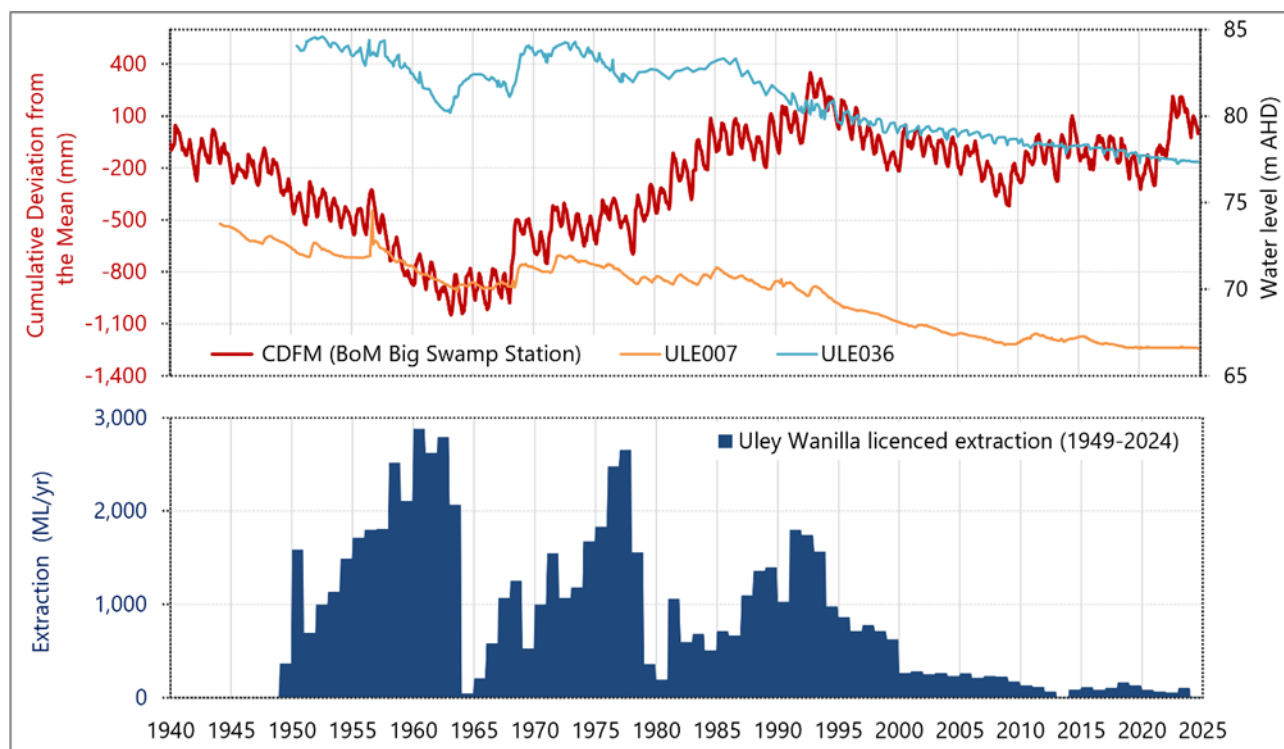


Figure 4-14 Groundwater level, rainfall and extraction trends for Uley Wanilla Consumptive Pool

Monitoring wells with long-term records (for example, ULE007, ULE034) show very large groundwater level declines of around 8 m which strongly suggests the risk of detrimental impacts to local GDEs (for example, Wanilla River red gum communities) has been increasing with time (EPNRMB, 2016). The status of the median groundwater level of all Uley Wanilla Basin groundwater resource monitoring wells has been classified ‘Lowest on record’ for 4 consecutive years over the period 2018 to 2021 (DEW 2020a, 2021a, 2022, 2023a). Similar groundwater level trends have been observed in Uley South (DEW 2024f) (Figure 4-15 and Figure 4-16).

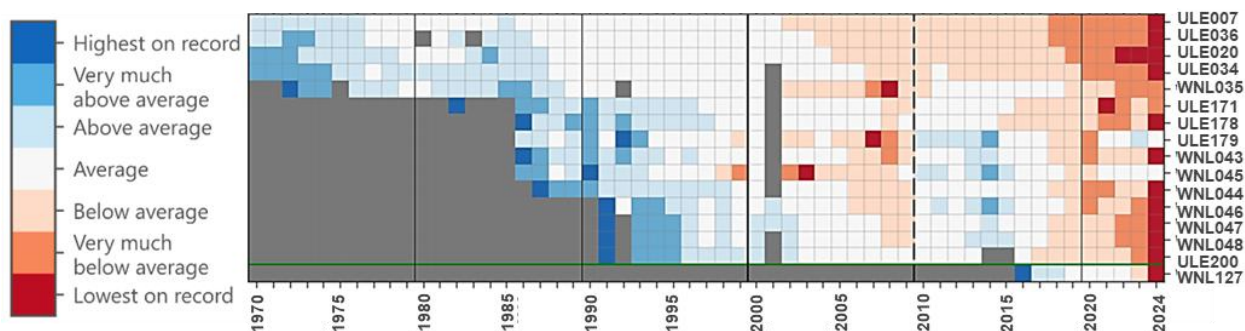


Figure 4-15 Uley Wanilla historical groundwater level rankings for selected monitoring wells with good historical records

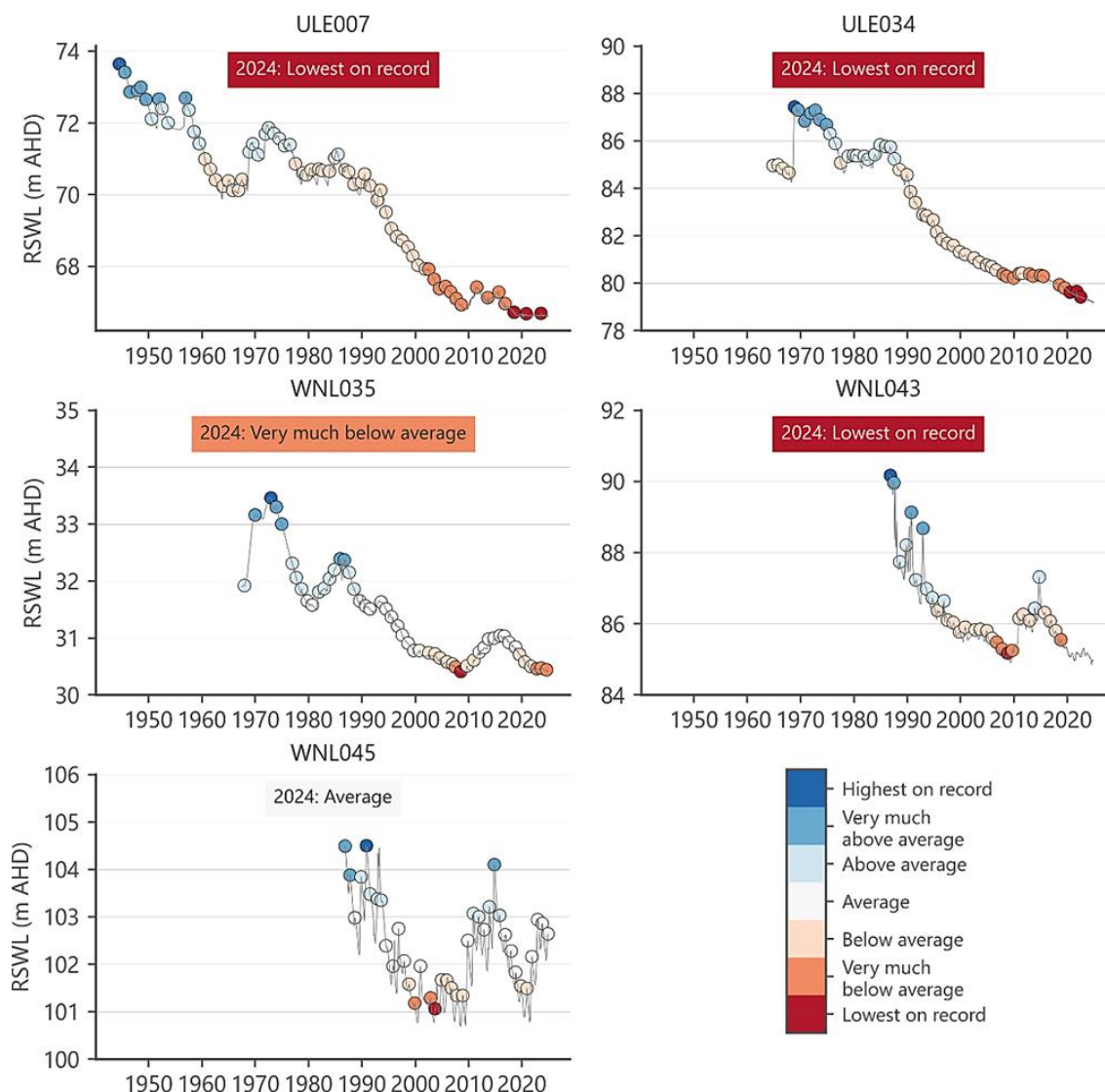


Figure 4-16 Groundwater level hydrographs for representative monitoring wells in Uley Wanilla

By means of analogy, a highly parameterised numerical groundwater model of Uley South, Knowling and Werner (2015) demonstrated that between 1978 and 2012, groundwater extraction contributed to aquifer depletion at rates 1.4 to 2.9 times greater than climate impacts. These findings were broadly confirmed by modelling undertaken by DEW (DEW 2020b). Given the similarities between Uley South and Uley Wanilla – both karstic limestone systems in the same climatic and physiographic setting – it is possible that historical extractions have also driven groundwater level declines in the Uley Wanilla Basin.

The majority of salinity monitoring wells within Uley Wanilla are located within the PWS wellfield with salinity ranging between 488 and 1,086 mg/L with a median of 570 mg/L. Ten-year salinity monitoring shows a general increasing trend, with rates of change varying from a decrease of 0.3% per year to an increase of 3.6% per year, with an increasing median rate of 1.0% (Figure 4-17).

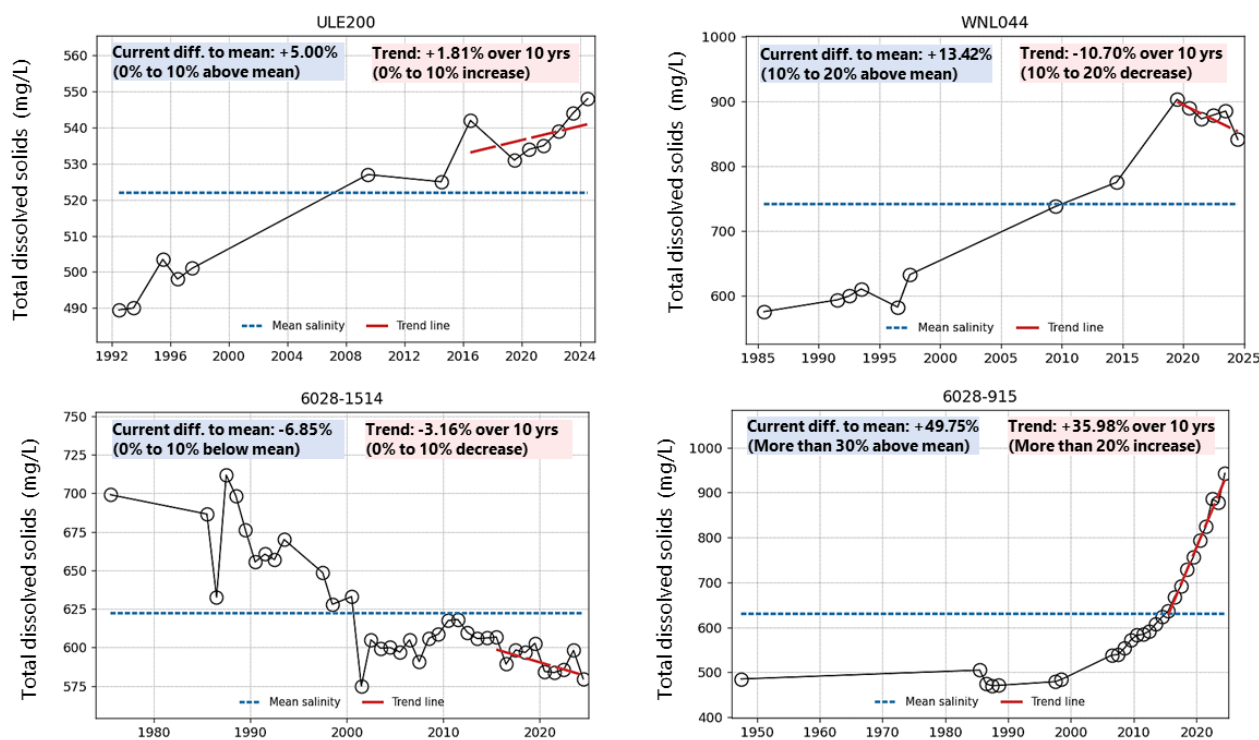


Figure 4-17 Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Uley Wanilla Consumptive Pool with 10-year salinity trends

4.1.4. Uley South Consumptive Pool

Groundwater trends in the Uley South Consumptive Pool have been assessed by correlating rainfall data from the BoM station 018137 Port Lincoln (Westmere), groundwater level measurements from the existing observation well network and extraction data from licensed water use within the pool (Figure 4-18). The hydrograph for Uley South Consumptive Pool (Figure 4-19) presents the long-term interactions between climate variability, extraction pressures and aquifer response over time.

Prior to the commencement of groundwater extraction in the 1976-77 water-use year, groundwater levels in the Uley South Consumptive Pool exhibited a gradual long-term decline with natural fluctuations occurring intermittently in response to seasonal variability. Average to above average groundwater levels prevailed from the 1960s to the mid-1990s. The highest groundwater levels were recorded in the early 1970s, mid-1980s, and early 1990s, prior to the onset of the Millennium Drought in 1997. Relatively high extraction volumes also coincided with these peak groundwater level periods, indicating sufficient recharge. During the Millennium Drought (1997 to 2009), groundwater levels in most monitoring wells were classified as below average to very low (Figure 4-20). Despite these low

The figure consists of two vertically stacked panels sharing a common x-axis representing years from 1965 to 2024.

Top Panel: This panel displays cumulative deviation from the mean (mm) on the left y-axis (ranging from -100 to 1,400) and water level (m AHD) on the right y-axis (ranging from 0 to 8). Four data series are plotted: CDFM (BoM Westmere Station) in red, ULE101 in orange, ULE139 in green, and ULE145 in blue. All four series show a general downward trend over the period, with ULE139 consistently having the highest cumulative deviation and ULE145 the lowest.

Bottom Panel: This panel displays Uley South licenced extraction (ML/y) on the y-axis (ranging from 0 to 8,000). The extraction is represented by a dark blue bar chart. Extraction begins around 1977 at approximately 2,200 ML/y, peaks around 1984 at approximately 6,500 ML/y, and then fluctuates between 4,000 and 7,500 ML/y until 2024.

Figure 4-19 Groundwater level, rainfall and extraction trends for the Uley South Consumptive Pool

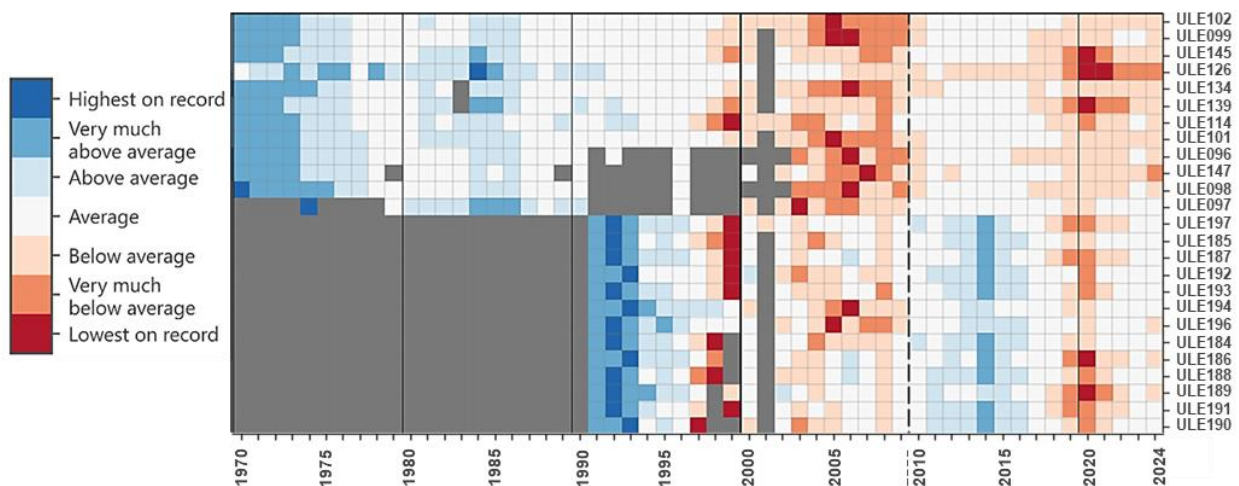


Figure 4-20 Uley South historical groundwater level rankings for selected monitoring wells with good historical records

Over the last decade, changes in groundwater level across 38 monitoring wells have ranged from a 0.55 m decline to a 0.11 m rise with a median change of around 0.4 m decline. A recovery in groundwater levels was observed between 2011 and 2017, followed by a general decline beginning in 2018. In 2024, of the monitored wells where groundwater levels recovered during winter, 20 out of 38 wells (53%) within the QL aquifer of the Uley South Consumptive Pool were classified as below average or lower (Figure 4-21). Peak extraction from Uley South of around 7,500 ML occurred around 2000 which was followed by a reduction during 2010 and 2011 to around 5,000 ML with extraction rates over the last 10 years remaining relatively stable. Licensed extraction in 2023–24 from the Uley South Consumptive Pool totalled 5,578 ML, an increase of 16.0% compared to 2022–23.

Figure 4-22 indicates a consistent upward trend in salinity levels across the Uley South Consumptive Pool. Over the 10-year period from 2015 to 2025, 14 of 17 wells monitored by DEW (82%) showed an increasing trend in salinity, reflecting a progressive decline in groundwater quality. In 2024, salinity concentrations measured in 29 monitoring wells within the QL aquifer varied from 448 to 3,195 mg/L. Salinity samples were obtained from a combination of PWS production wells and DEW monitoring wells. Historic monitoring of groundwater salinity from PWS wells, since extraction commenced, indicate generally stable trends until the mid-2000s when salinity started rising.

Within the central portion of Uley South, salinity levels are notably lower (<500 mg/L), suggesting dilution from rainfall recharge. Salinity in the TS aquifer ranges from 400 to 1,550 mg/L. Near the margins of the QL aquifer, groundwater chemistry closely resembles that of the underlying TS aquifer. This supports the hypothesis that TS aquifer water may flow into the QL aquifer in areas where the Tertiary Clay confining layer is absent.

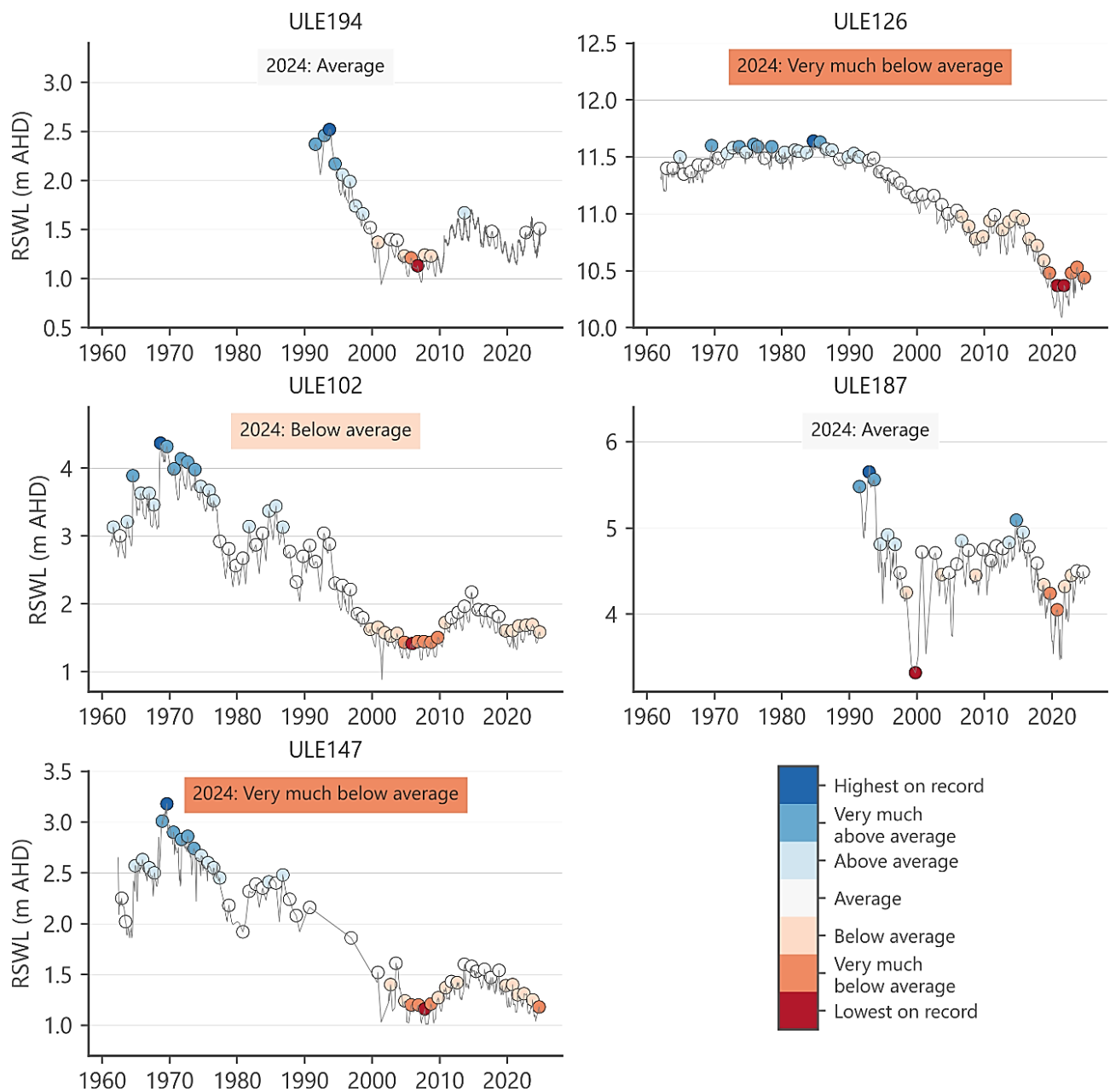


Figure 4-21 Groundwater level hydrographs for representative monitoring wells in Uley South.

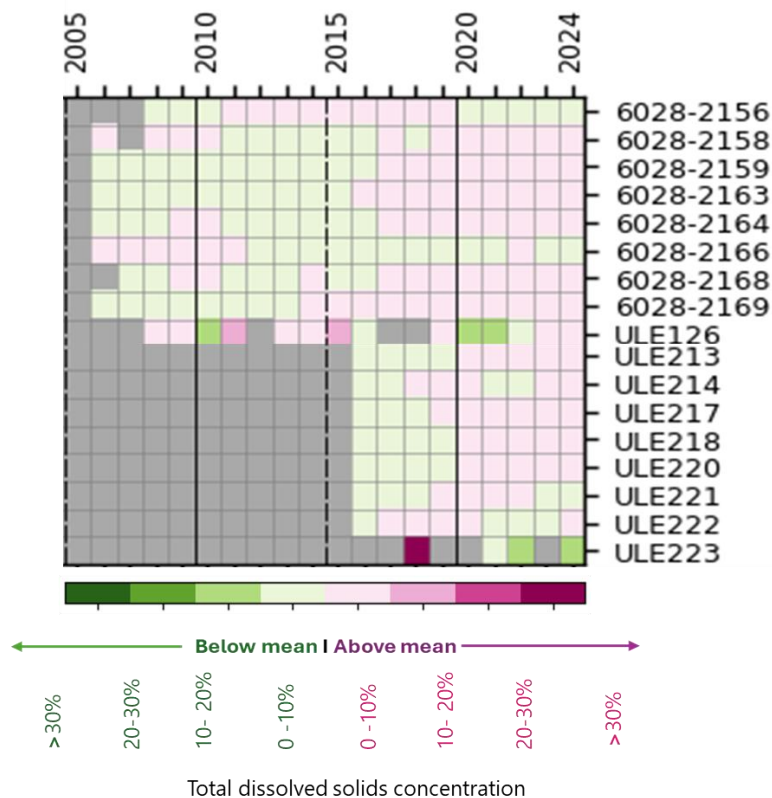


Figure 4-22 Uley South historical total dissolve solids – percentage difference from the mean for selected monitoring wells with good historical records.

Figure 4-23 indicates a consistent upward trend in salinity levels in many wells across the Uley South Consumptive Pool. Over the 10-year period from 2015 to 2025, 14 of 17 wells monitored by DEW (82%) show an increasing trend in salinity, reflecting a progressive decline in groundwater quality. In 2024, salinity concentrations measured in 29 monitoring wells within the QL aquifer varied from 448 to 3,195 mg/L. Salinity samples were obtained from a combination of PWS production wells and DEW monitoring wells. Historic monitoring of groundwater salinity from PWS wells, since extraction commenced, indicates generally stable trends until the mid-2000s when salinity started rising.

Groundwater salinity in PWS wells has shown stable trends over the period of monitoring with the exception of 6028-2159 (PWS 11), 6028-2169 (PWS 12) and 6028-702/2803 (PWS 2 and its replacement PWS 19), which have shown a trend of rising salinity since the mid-2000s. Groundwater salinity in PWS 3 (6028-701) showed an increase in the late 1990s of between less than 500 to more than 600 mg/L, as groundwater extraction increased and groundwater levels declined (Figure 4-24). Salinity decreased again in 2010 as groundwater extraction decreased and a period of above-average rainfall was observed. As PWS 3 is located 4.6 km inland, this isolated trend is unlikely to relate to seawater intrusion. It is more likely that reduced groundwater levels in the Quaternary and increased pumping resulted in increased flow from the TS aquifer in this area (note PWS 20 replaced well 3 in 2016).

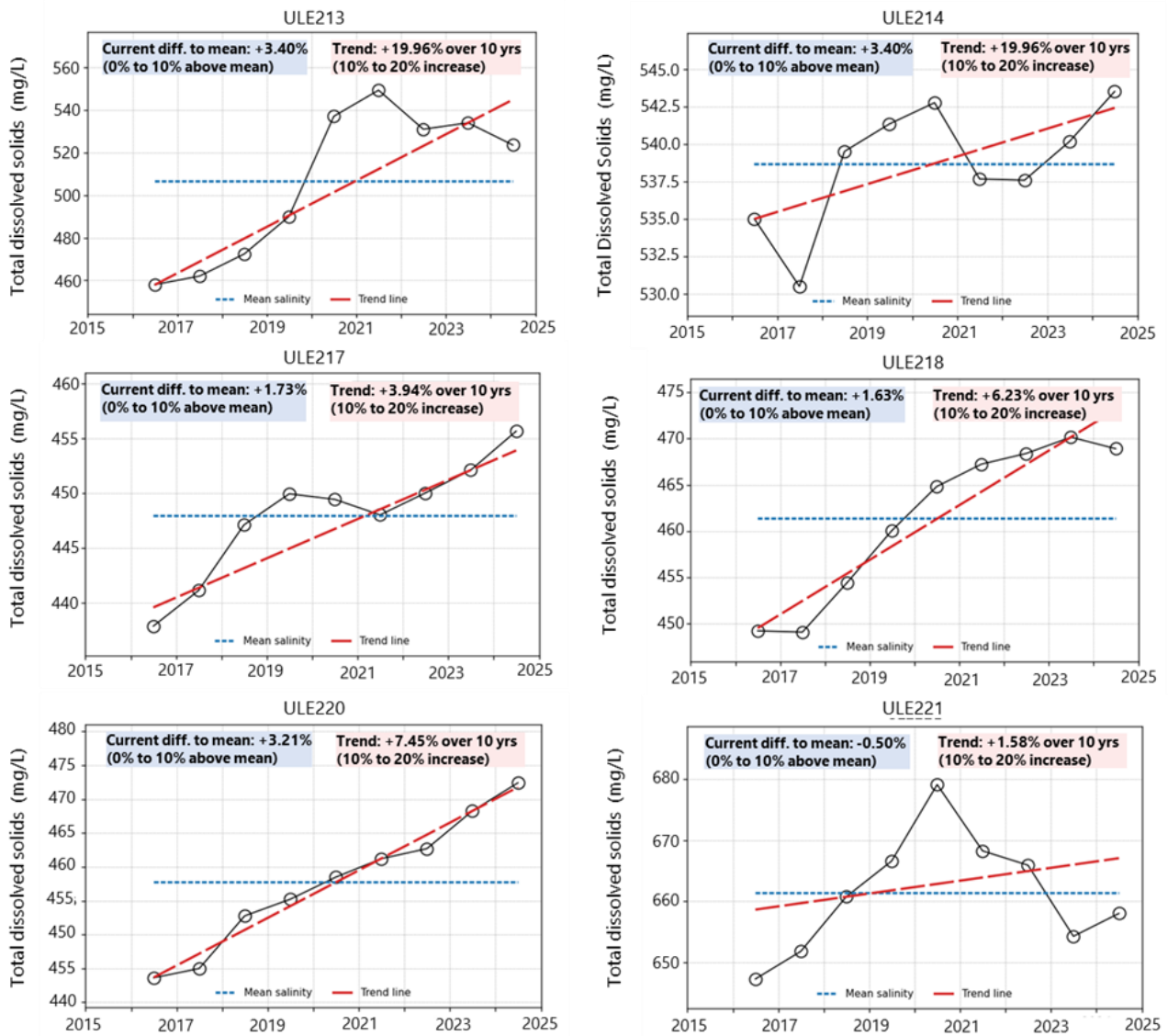


Figure 4-23 Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Uley South Consumptive Pool with 10-year salinity trends

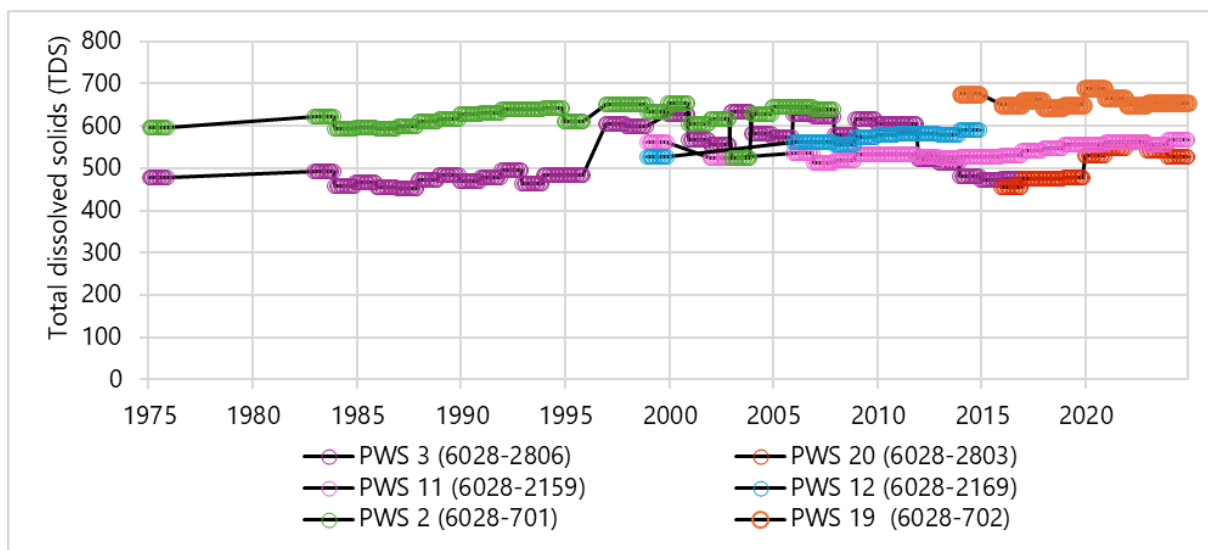


Figure 4-24 Groundwater salinity trends in representative public water supply wells

4.1.5. Lincoln North Consumptive Pool

Groundwater trends in the Lincoln North Consumptive Pool have been assessed by correlating rainfall data from BoM station 018017 Port Lincoln (Big Swamp), groundwater level measurements from the existing observation well network, and extraction data from licensed water use within the pool (Figure 4-25). The hydrograph for Lincoln North Consumptive Pool illustrates the long-term interactions between climate variability, extraction pressures, and aquifer response (Figure 4-26).

Extraction volumes in the Lincoln North Consumptive Pool generally follow a pattern similar to rainfall variability, suggesting a strong link between climatic conditions and extraction rates. Licensed groundwater extraction at Lincoln North began in the 2004-05 water-use year with notable peaks recorded in 2012 to 2014 and again in 2024 (Figure 4-26). However, some current licence holders are exempt from reporting their extraction which requires reconsideration. The lowest recorded extraction was 9 ML in 2023, approximately 80% lower than the 47 ML extracted in 2024.

Groundwater level monitoring in the Lincoln North pool is limited with data available only for the periods 1999 to 2002 and from 2016 onwards. In 2016, six monitoring wells were drilled: LNC20, LNC21, LNC22 and LNC25 have screened zones that target the QL aquifer; while LNC23 and LNC24 intersect both the QL and TS aquifers. Currently, only basic driller's logs are available for these wells, limiting detailed geological and hydrogeological interpretation.

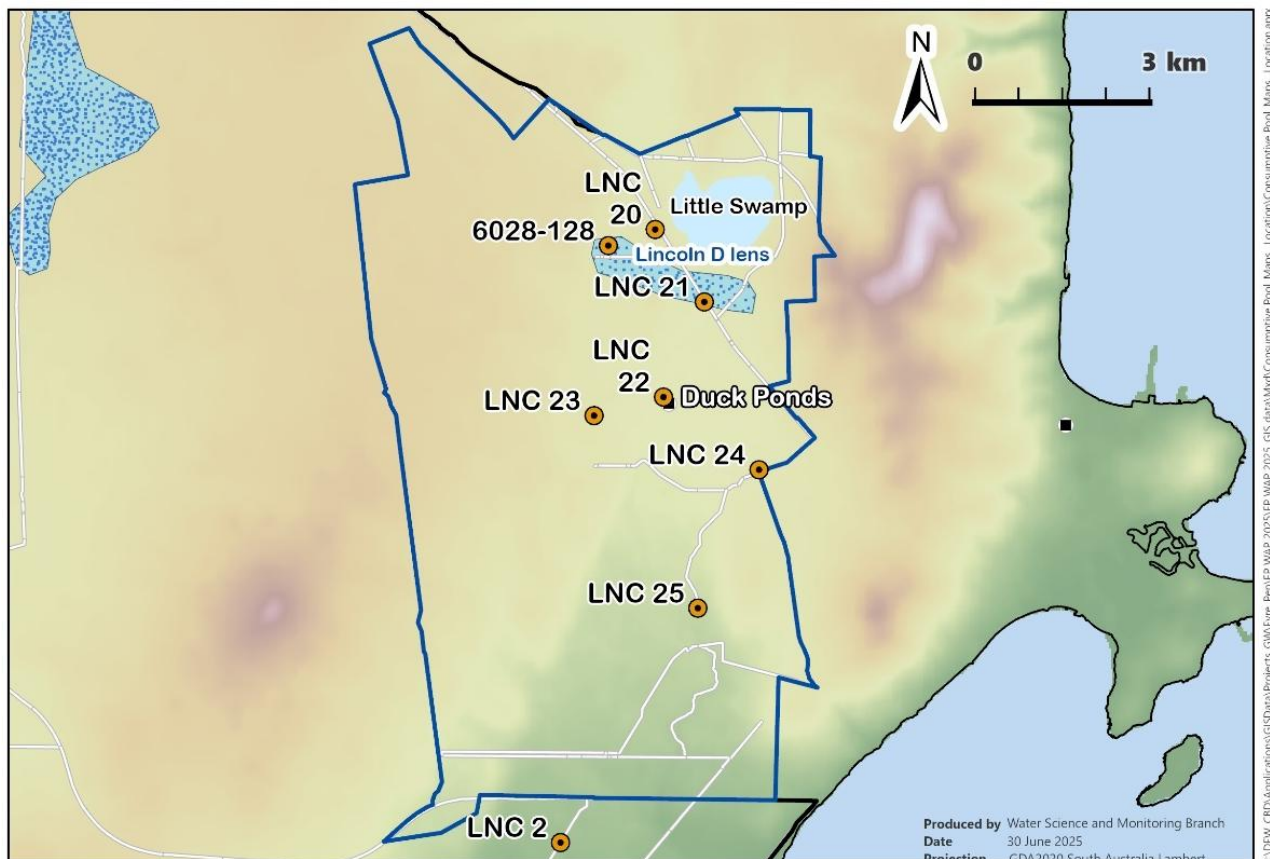


Figure 4-25 Location map for monitoring wells for Lincoln North Consumptive Pool

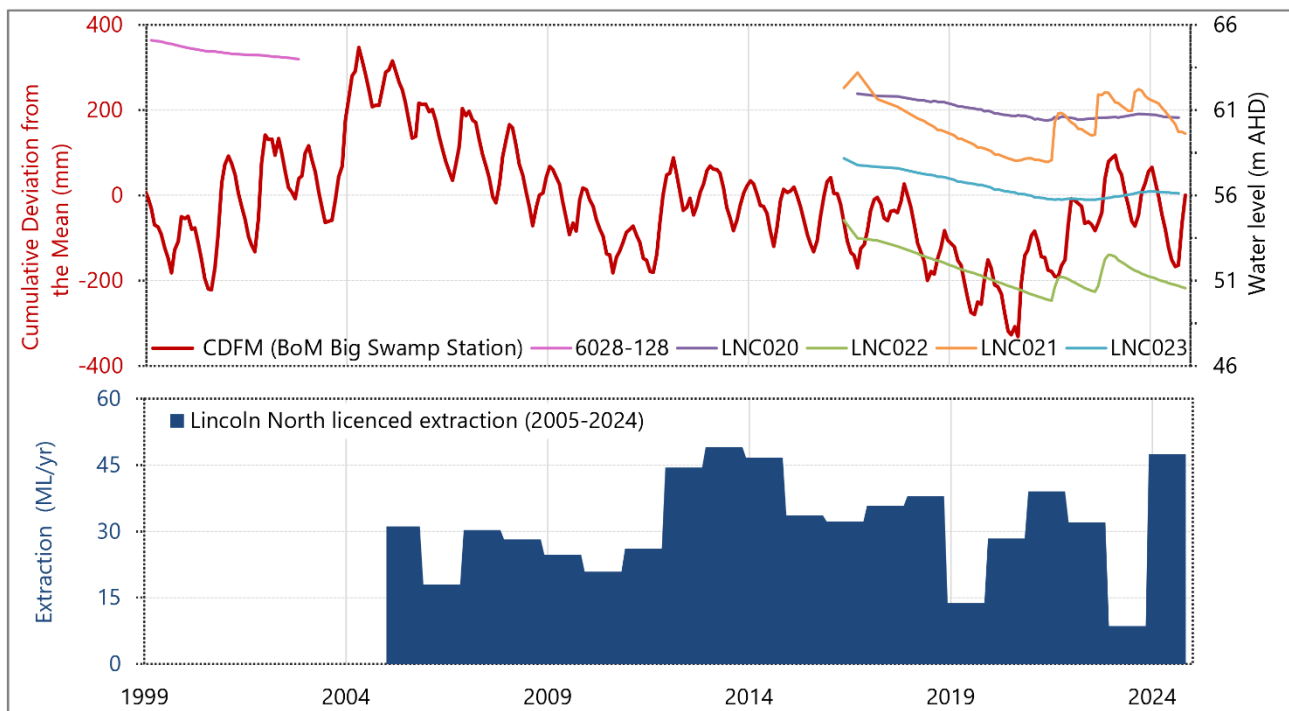


Figure 4-26 Groundwater level, rainfall and extraction trends for Lincoln North Consumptive Pool

A general decline in groundwater levels is evident across the monitoring wells with the lowest levels recorded in 2021 and relatively higher levels observed in 2016. Notably, wells LNC021 and LNC022 showed a significant rise in groundwater levels in 2023 following a decline during 2021 and 2022 (Figure 4-27). This downward trend appears to correlate with periods of reduced rainfall, suggesting a strong link between recharge and climate variability.

Since 2016 monitoring wells within the QL aquifer have recorded groundwater level declines ranging from 1.36 to 3.46 m, while longer term data indicates an overall decline of approximately 4.5 m. Notably, well LNC020, located within 3 km of historical monitoring well 6028-128, provides a valuable comparison point with combined data from 1999 to 2024 showing a groundwater level reduction of 4.7 m, from 65.1 to 60.4 mAHD. In 2025, the saturated thickness ranges from approximately 15 m in the south to less than 5 m in the north. This variability suggests that saturation may have been more extensive in the past and this now poses a risk of dry wells or reduced yields, particularly during peak demand periods.

Salinity levels have increased despite relatively stable extraction rates. Between 2017 and 2025, salinity at LNC020 rose from 670 to 1,117 mg/L, and at LNC022 from 2,770 to 3,575 mg/L. In contrast, LNC024 remained relatively stable, ranging between 898 and 981 mg/L (Figure 4-28). Given the limited extractions in this area, these declines are likely driven by prolonged below-average rainfall and reduced recharge.

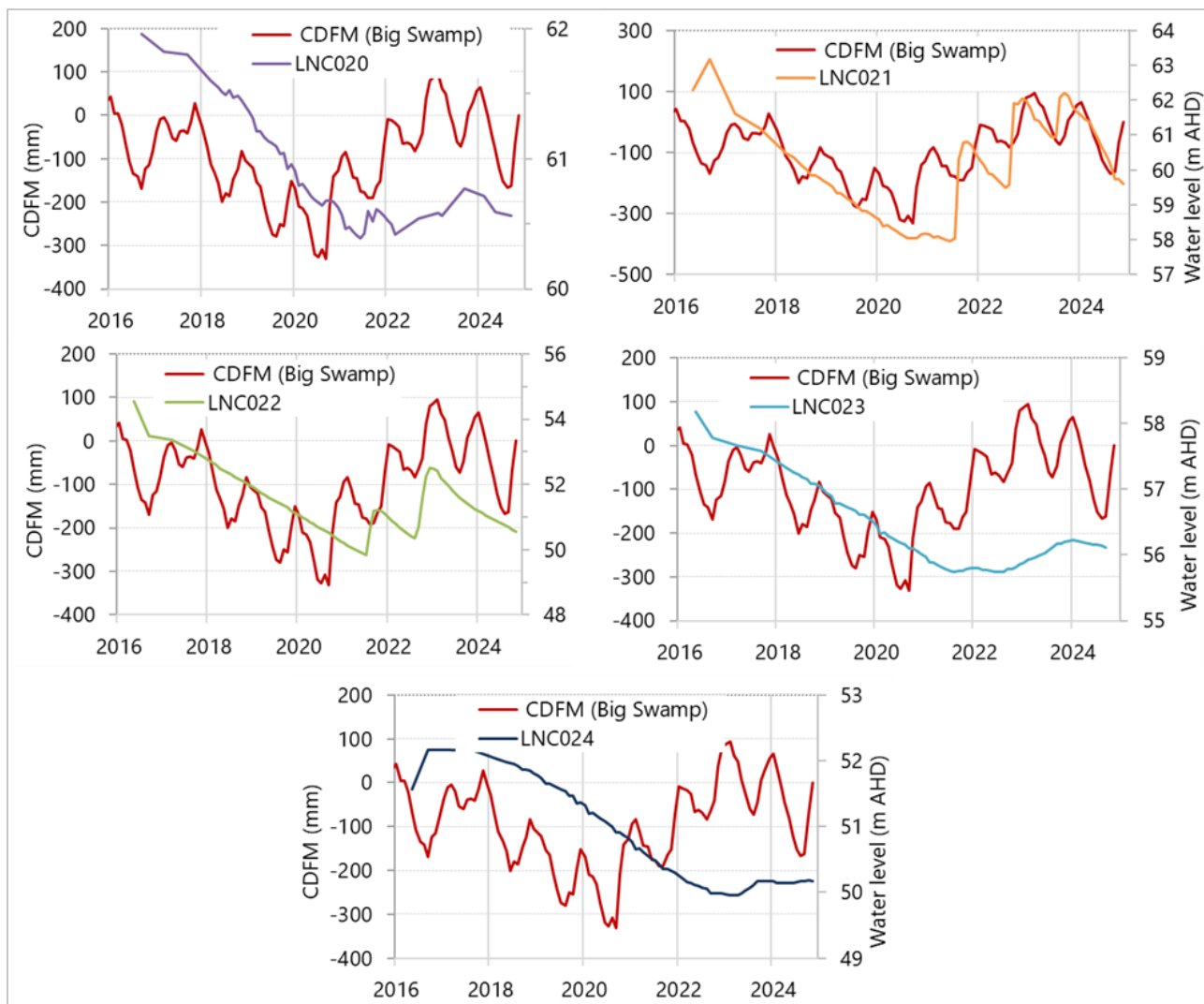


Figure 4-27 Groundwater level hydrographs for select monitoring wells in Lincoln North

Anecdotal evidence suggests that upstream dams in Green Patch, north of the Lincoln North Consumptive Pool, have reduced flow through Little Swamp, potentially decreasing aquifer recharge from associated streams (GS Bobrige, personal communication, April 2015). However, the Department of Water, Land and Biodiversity Conservation (DWLBC) Report 2009/26 (Alcorn 2009) found that in median-to-wet years, farm dams have minimal impact on annual streamflow – typically around 5%. During dry years, the impact increases to approximately 12%, raising concerns during extended dry periods. Nevertheless, this is unlikely to significantly affect recharge to the QL aquifers, as the streams are predominantly gaining and underlain by Basement aquifers. Little Swamp, Big Swamp and numerous minor surface water bodies rely on rainfall and local ephemeral surface water inflows as water sources. Surface water from Little Swamp and Big Swamp has been observed to either overflow or infiltrate down to the QL aquifers of the Lincoln and Uley Basins respectively (Harrington et al. 2006; Evans et al. 2009). The taking of groundwater from adjacent consumptive pools is unlikely to impact these surface water bodies as they are disconnected and lie at a higher elevation than the water table.

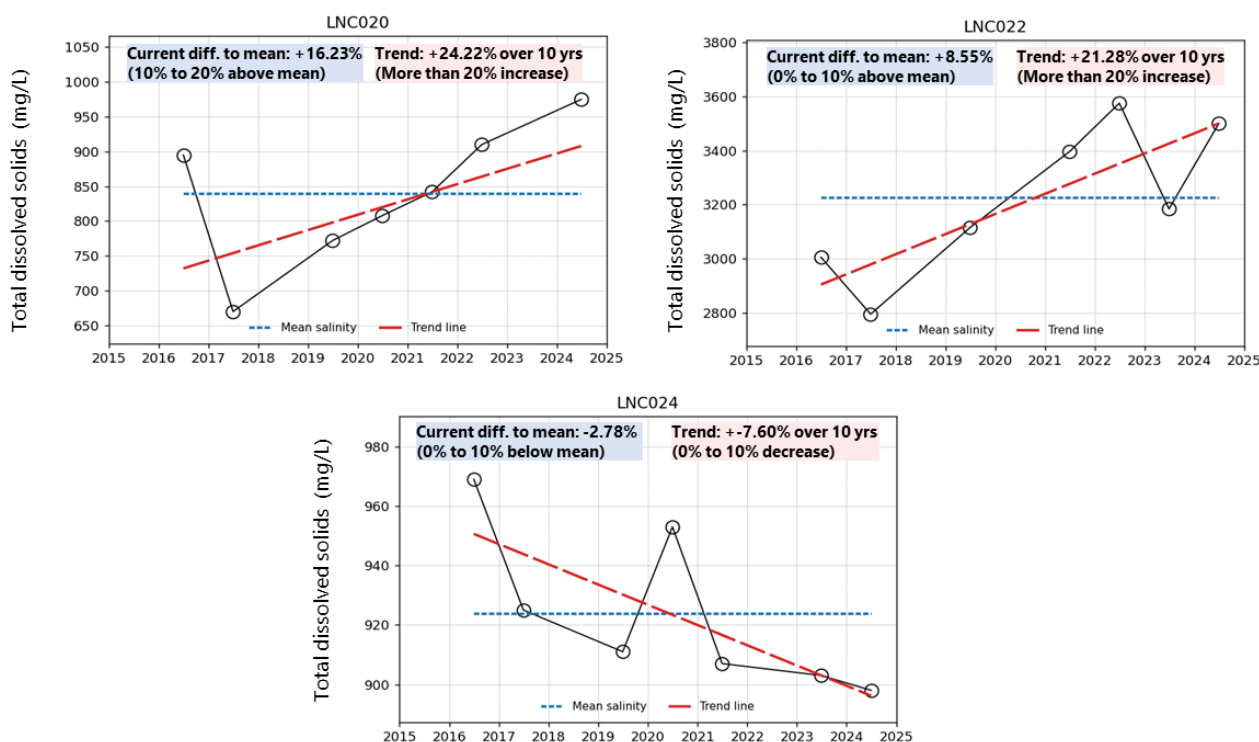


Figure 4-28 Select salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Lincoln North Consumptive Pool with 10-year salinity trends

4.1.6. Lincoln South Consumptive Pool

Groundwater trends in the Lincoln South Consumptive Pool have been assessed by correlating rainfall data from BoM station 018137 Port Lincoln (Westmere), groundwater level measurements from the existing observation well network, and extraction data from licensed water use within the pool (Figure 4-29). The hydrograph for Lincoln South Consumptive Pool (Figure 4-30) presents the long-term interactions between climate variability, extraction pressures and aquifer response over time.

Groundwater extraction from the Lincoln South Basin commenced in the 1961-62 water-use year. From the late 1990s, rates of extraction varied between around 900 to 1,000 ML/y, until reductions began in 2008–09, and decreased further in 2012–13, due to risks of upconing of underlying high-salinity groundwater. Extraction from this area was negligible between 2012–13 and 2018–19. However, regular extraction resumed in recent years, averaging approximately 475 ML/year (Figure 4-30).

Since the 1960s, a long-term decline in rainfall has been reflected by corresponding decreases in groundwater levels across all monitoring wells in the Lincoln South network (Figure 4-31). These declines align with periods of significantly reduced rainfall, marked by sharp drops in 1962, 1968, 1971, 1978 and 1992. In contrast, periods of groundwater level recovery were observed between the late 1960s to early 1970s, the mid-1980s, and the early 1990s prior to the onset of the Millennium Drought (1997 to 2009). During that drought period, below average to very low groundwater levels began to be recorded. A subsequent period of notable recovery occurred between 2013 and 2017, followed by renewed declines in groundwater levels. In 2023 and 2024, groundwater levels (measured at their post-winter maximum) in 100% of Lincoln South monitoring wells were classified ‘below average’ or lower (Figure 4-32). Some wells were showing groundwater levels near or below mean sea level despite above-average rainfall in 2020. Observation well LNC002 is located further inland. Historically, groundwater levels in that well were as high as 5 mAHD but have declined to around 2 mAHD over the past 50 years. Even in high rainfall years, groundwater levels in this resource are not materially recovering.

The Lincoln South freshwater lenses (refer to Figure 5-5) are contiguous with the surrounding brackish QL aquifer and exist in the landscape due to the difference in density between the fresh and brackish groundwater. The brackish aquifer is itself directly connected to the ocean and evidence strongly suggests it is also directly connected to the saline lake, Sleaford Mere (EPNRMB 2016). Groundwater levels measured at many of the monitoring wells located within Lincoln South are now at, or below, mean sea level. Consequently, instead of these resources discharging to the ocean or Sleaford Mere, as would have occurred prior to development of the natural system, a reversal in hydraulic gradient has occurred and recharge is now being induced from the ocean, and very likely also induced from the saline water that comprises Sleaford Mere, combined with a small loss in aquifer storage (DEW 2024f).

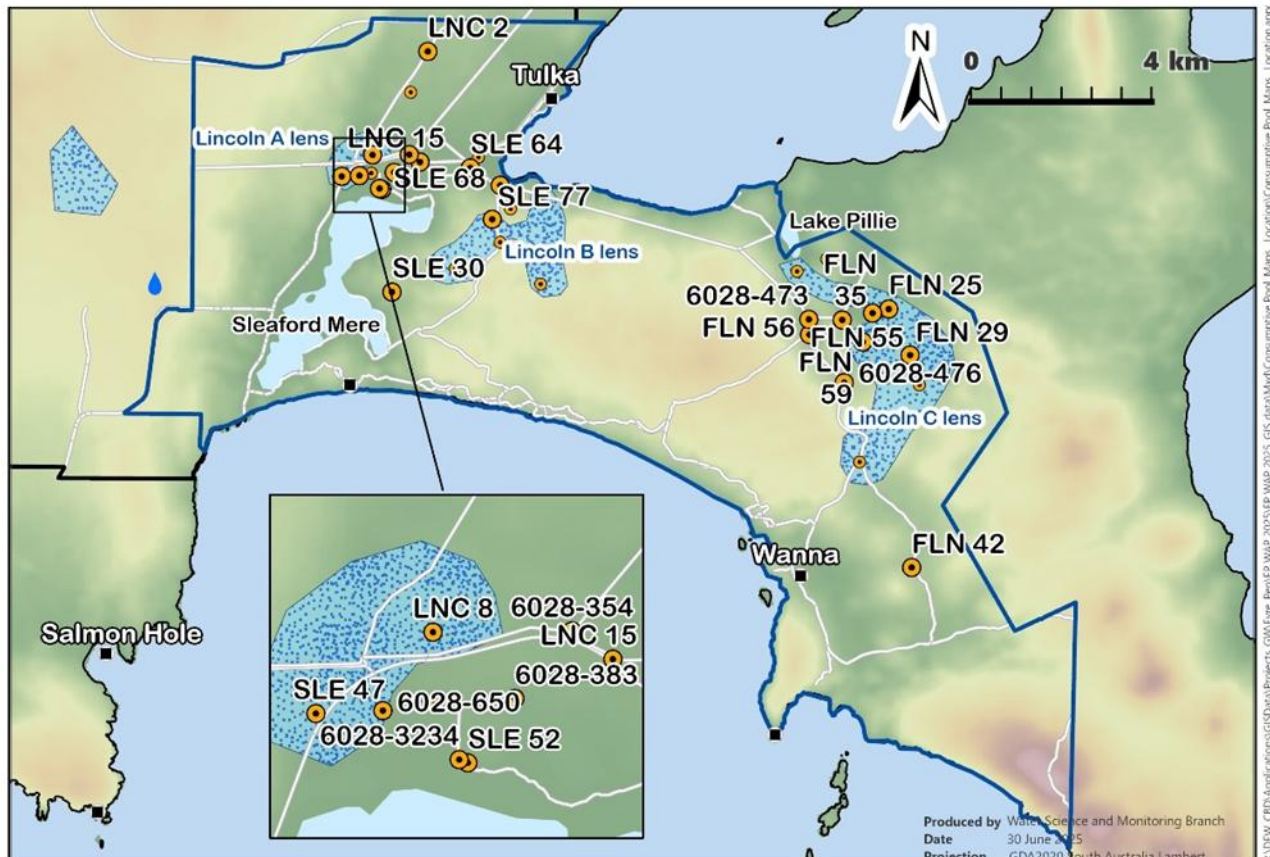


Figure 4-29 Location map for monitoring wells, public water supply wells and rainfall stations for Lincoln South Consumptive Pool

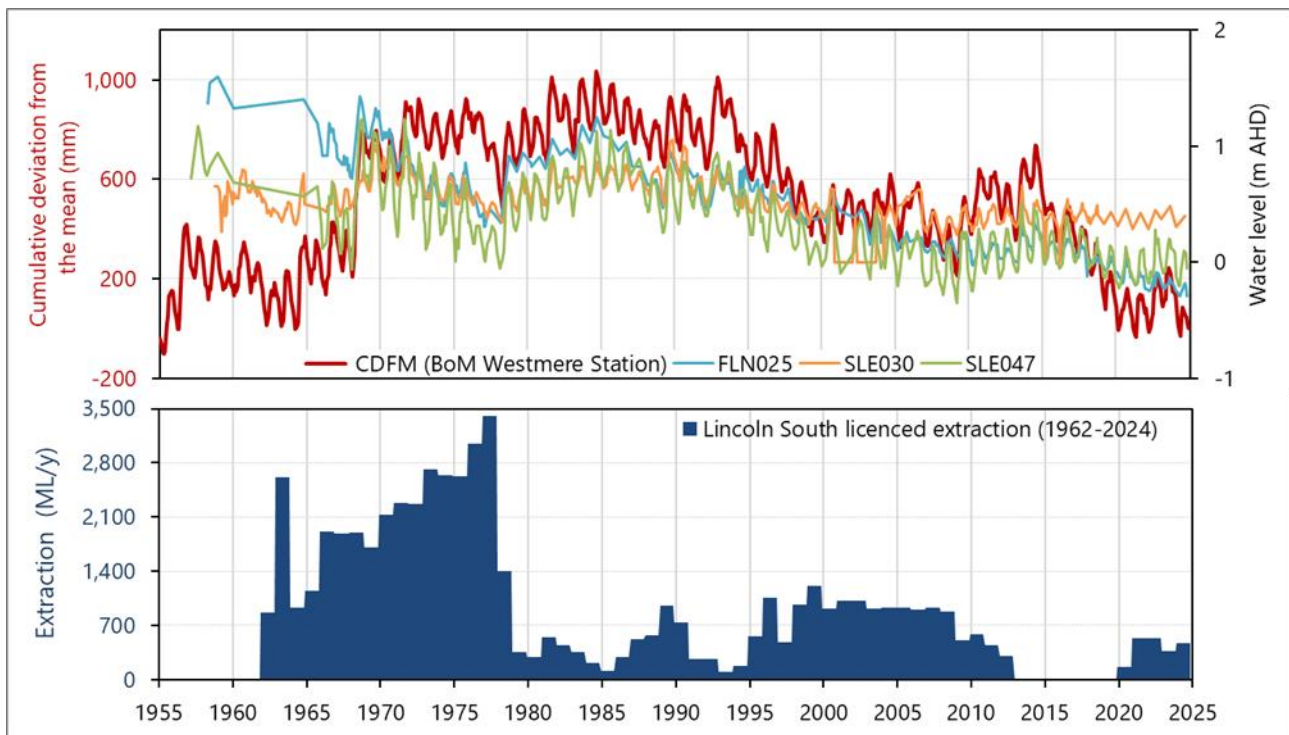


Figure 4-30 Groundwater level, rainfall and extraction trends for the Lincoln South Consumptive Pool

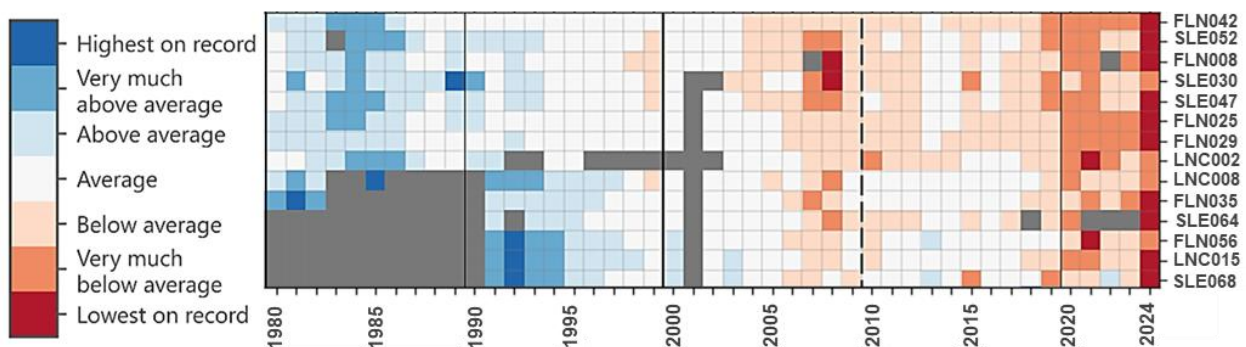


Figure 4-31 Lincoln South historical groundwater level rankings plot for selected monitoring wells with good historical records

Ten-year salinity monitoring in the Lincoln South area has shown increasing concentrations (Figure 4-33 and Figure 4-34). In 2024, sampling results from 16 wells in the QL aquifer ranged between 671 and 1,625 mg/L with a median of 1,168 mg/L. Over the decade leading up to 2024, 8 out of 9 wells show trends of increasing salinity with rates of change in salinity increasing by up to 2.6% per year and a median rate of 0.5% increase per year.

These trends suggest that an ingress of saline groundwater, likely driven by declining groundwater levels and a reversal of the hydraulic gradient, from discharge towards the ocean and Sleaford Mere, resulting in recharge flowing back from these sources into the freshwater lenses. Declining groundwater levels also increase the risk of upconing of high-salinity groundwater that lies beneath the freshwater lenses.

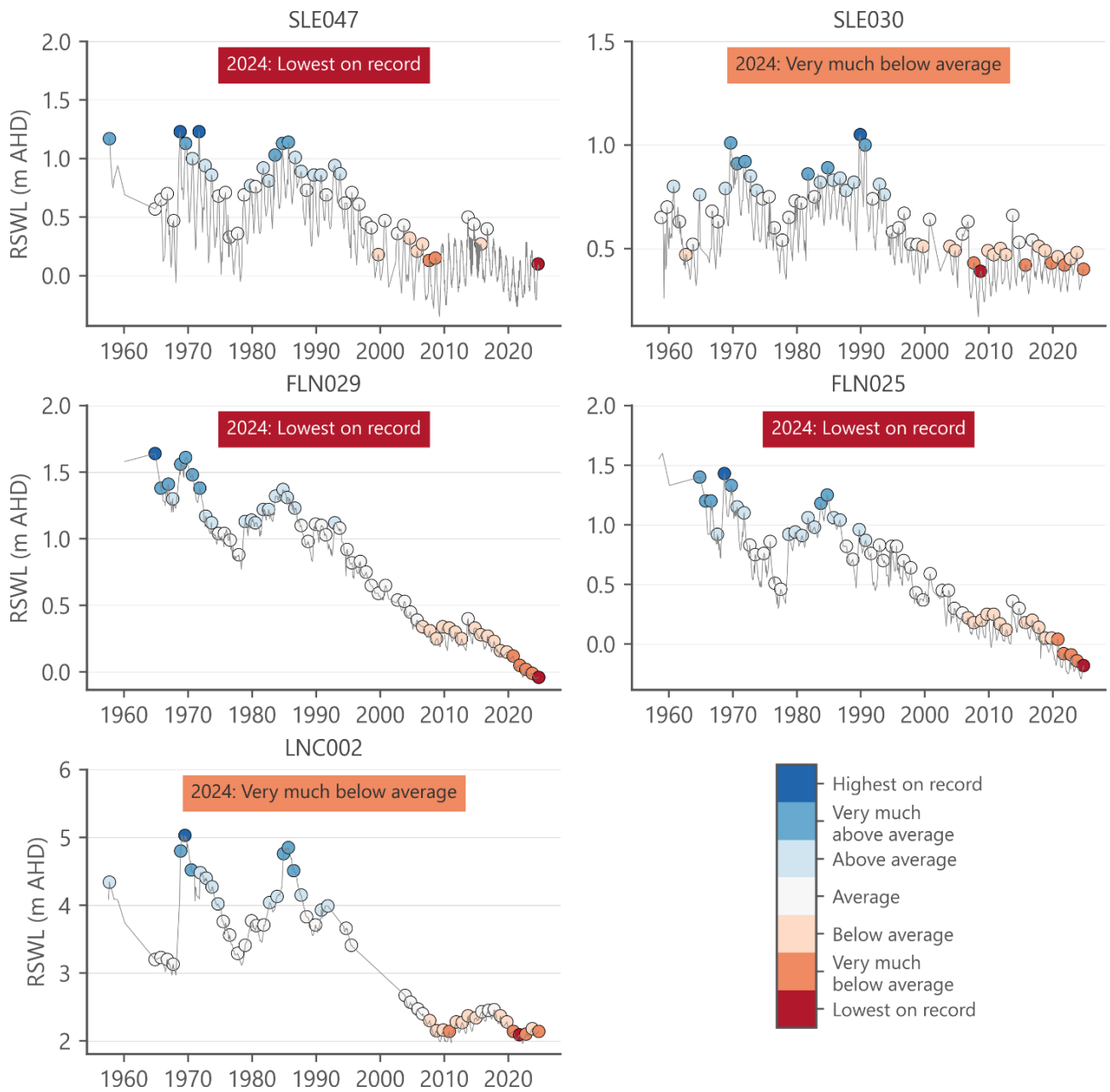


Figure 4-32 Groundwater level hydrographs for select monitoring wells in Lincoln South

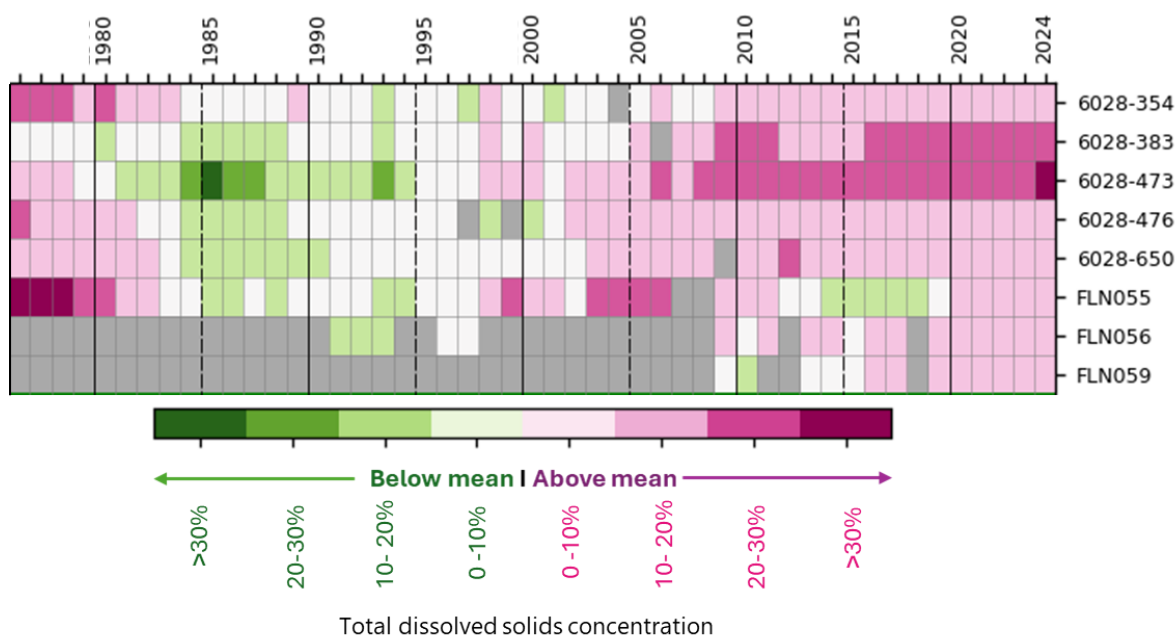


Figure 4-33 Lincoln South historical total dissolved solids – percentage difference from the mean for selected monitoring wells with good historical records

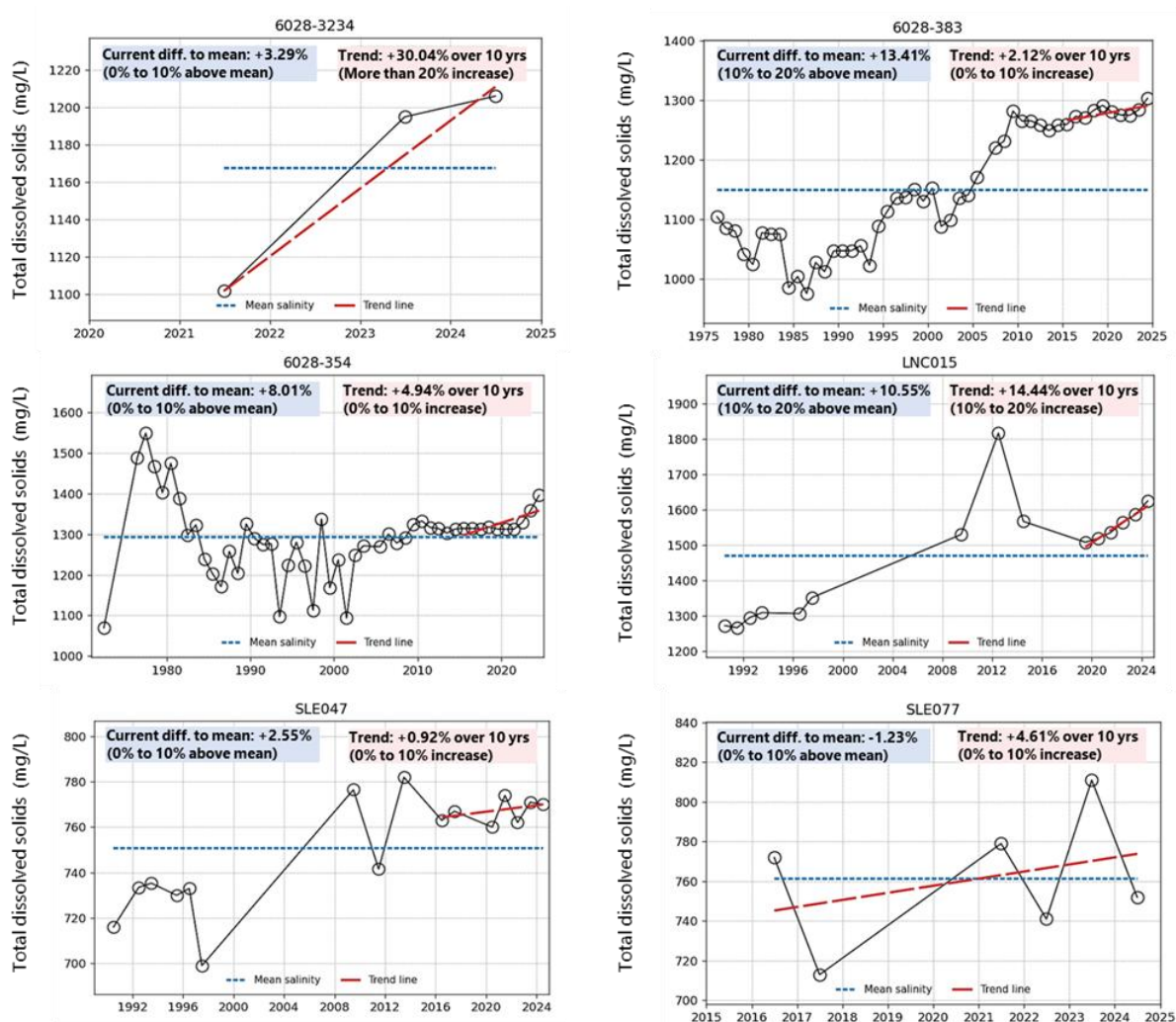


Figure 4-34 Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Lincoln South Consumptive Pool with ten-year salinity trends

4.2. Musgrave PWA

4.2.1. Bramfield Consumptive Pool

Groundwater trends in the Bramfield Consumptive Pool have been assessed using rainfall data from BoM station 018069 at Elliston, groundwater level measurements from the existing observation well network, and extraction data from licensed water use within the pool (Figure 4-35). The hydrograph for the Bramfield Consumptive Pool (Figure 4-36) illustrates long-term interactions between climate variability, extraction pressures, and aquifer response.

Licensed groundwater extraction from the Bramfield Consumptive Pool commenced in the 1973–74 water-use year and steadily increased, peaking during the 1990s and early 2000s (Figure 4-36). While extraction volumes have fluctuated slightly in more recent years, groundwater levels remain at or near their historical lows. In 2023–2024, total licensed use from the Bramfield Consumptive Pool was 64 ML, sourced for the purposes of providing PWS to the township of Elliston and for fruit and nut tree irrigation.

A gradual increase in rainfall from the late 1960s to the mid-1980s is reflected in groundwater level trends across the observation well network. Above average to very high groundwater levels were recorded between 1968 and 1986. This was followed by a decline in rainfall from 1987 to 1992 with a sharp drop in 1989. Groundwater levels began to recover in early 1993 but declined again leading up to the Millennium Drought. Following the low groundwater levels at the end of this drought, all wells showed considerable recovery corresponding with above-average rainfall between 2010 and 2017, primarily driven by La Niña conditions. While most wells responded positively to above-average rainfall, recent recoveries have generally been less pronounced than those observed between 2009 and 2011, despite similar annual rainfall totals.

Over the past decade, groundwater level variations have ranged from a decline of 2.43 m to a rise of 0.19 m with a median decline of 0.4 m. The 2025 water resource assessment (DEW 2026d) found that groundwater levels in 62% of observation wells within the QL aquifer of the Bramfield Consumptive Pool were classified as below average or lower for 2023-24 (Figure 4-37).

TAA005 and TAA058 are located inland, towards the eastern and central parts of the Bramfield lens respectively. Despite annual rainfall in 2021 and 2022 that was well above average, groundwater levels in 2023 in both wells are classified below average (Figure 4-38). WAD031 and TAA061 are located closer to the coast, where groundwater levels tend to show a greater response to rainfall; groundwater levels in these wells in 2023 are classified ‘average’ (DEW 2024e).

There are no long-term monitoring records closer to the coast; nevertheless, available data indicate that groundwater generally flows from east to west through the aquifer towards the coast. Wells near the coast with observations from 2014 onwards show relatively stable groundwater levels since that time.

Groundwater salinity data are limited, particularly in terms of long-term time series. The most reliable data come from PWS wells 5830-257 and 5830-258 monitored since 1999 (Figure 4-39). All PWS wells show increasing salinity trends with the highest concentrations recorded in the western-most well, 5830-258. Salinity monitoring across the Bramfield Lens indicates that 75% of sampled monitoring wells have experienced increasing concentrations over the past decade. Rates of change range from a decrease of 0.1% to an increase of 0.7% per year with a median increase of 0.3% per year. In 2024, salinity levels across 15 wells in the QL aquifer ranged from 464 mg/L to 2,789 mg/L with a median of 646 mg/L.

Water supply wells 5830-257 and 5830-258 near Elliston show a gradual salinity increase of approximately 50 mg/L over the past 25 years. In contrast, well TAA058m located inland, has remained

relatively stable between 450 and 550 mg/L since the 1970s, suggesting less influence from coastal or anthropogenic factors.

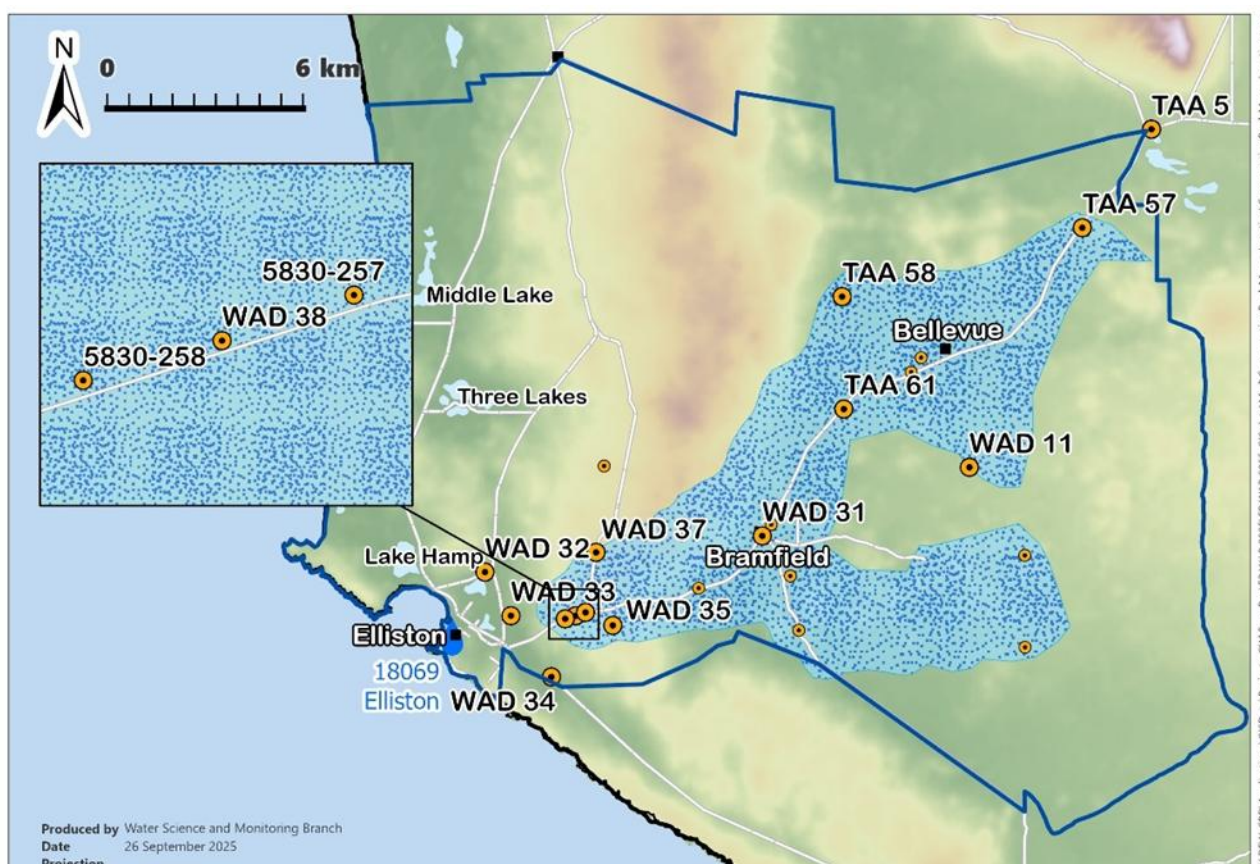


Figure 4-35 Location map for monitoring wells and rainfall stations for Bramfield Consumptive Pool

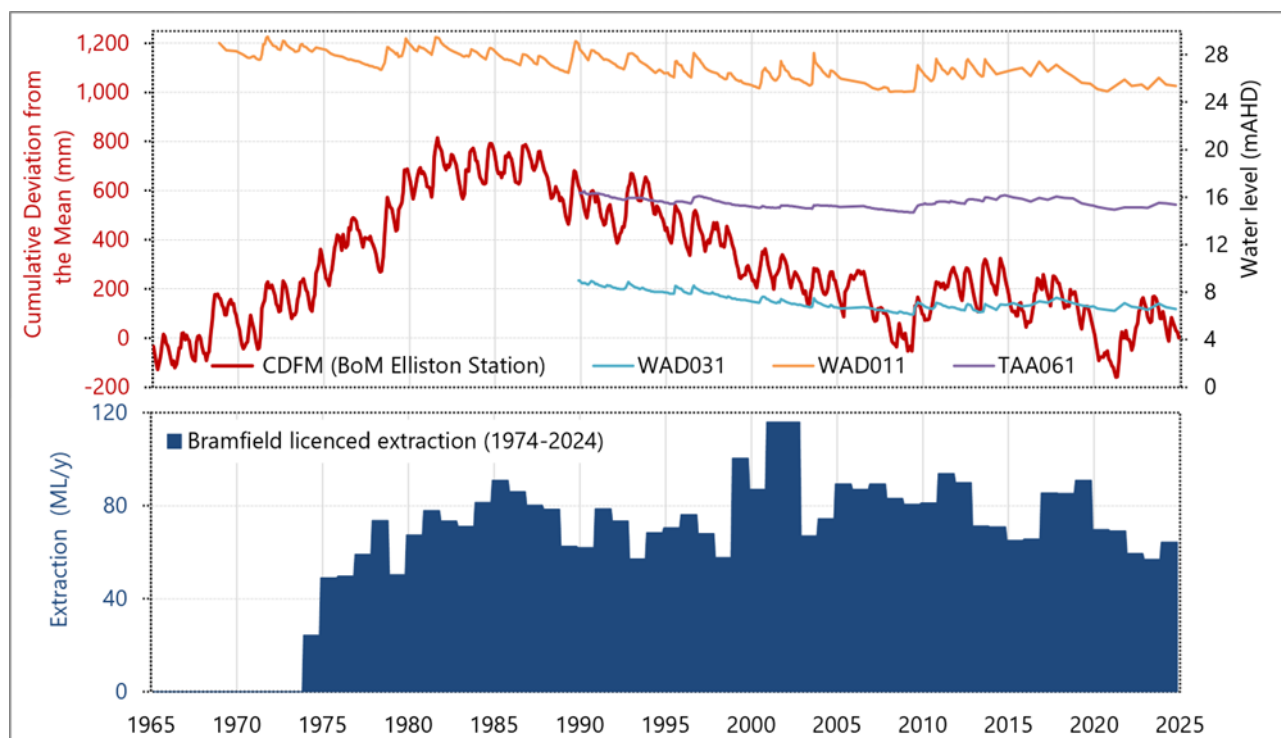


Figure 4-36 Groundwater level, rainfall and extraction trends for the Bramfield Consumptive Pool

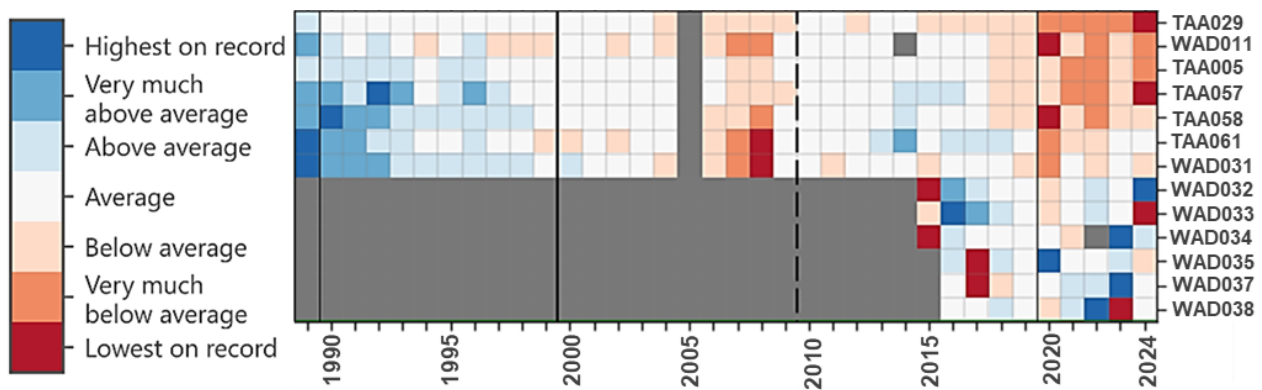


Figure 4-37 Bramfield historical groundwater level rankings for selected monitoring wells with good historical records

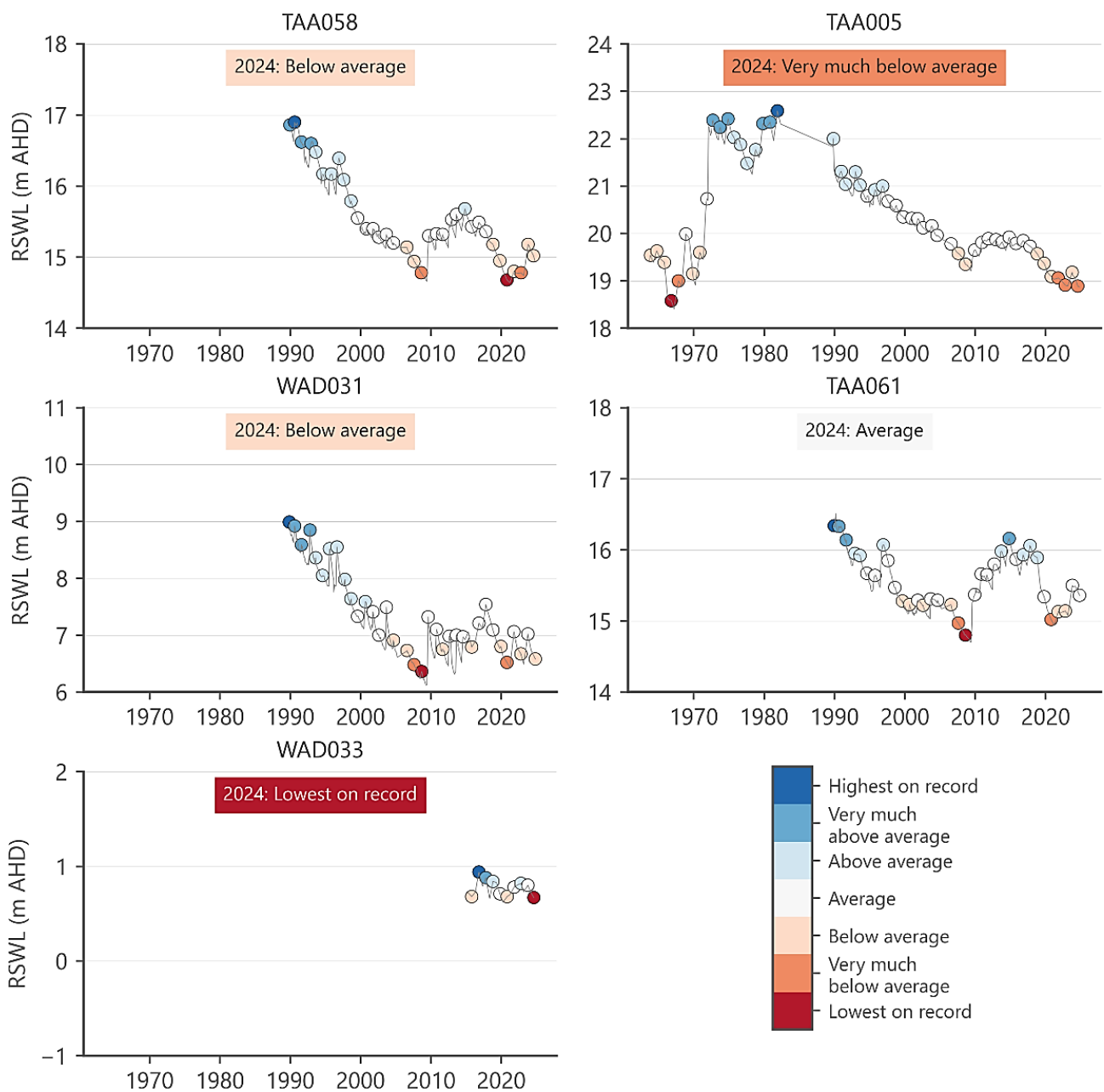


Figure 4-38 Groundwater level hydrographs for select monitoring wells in Bramfield

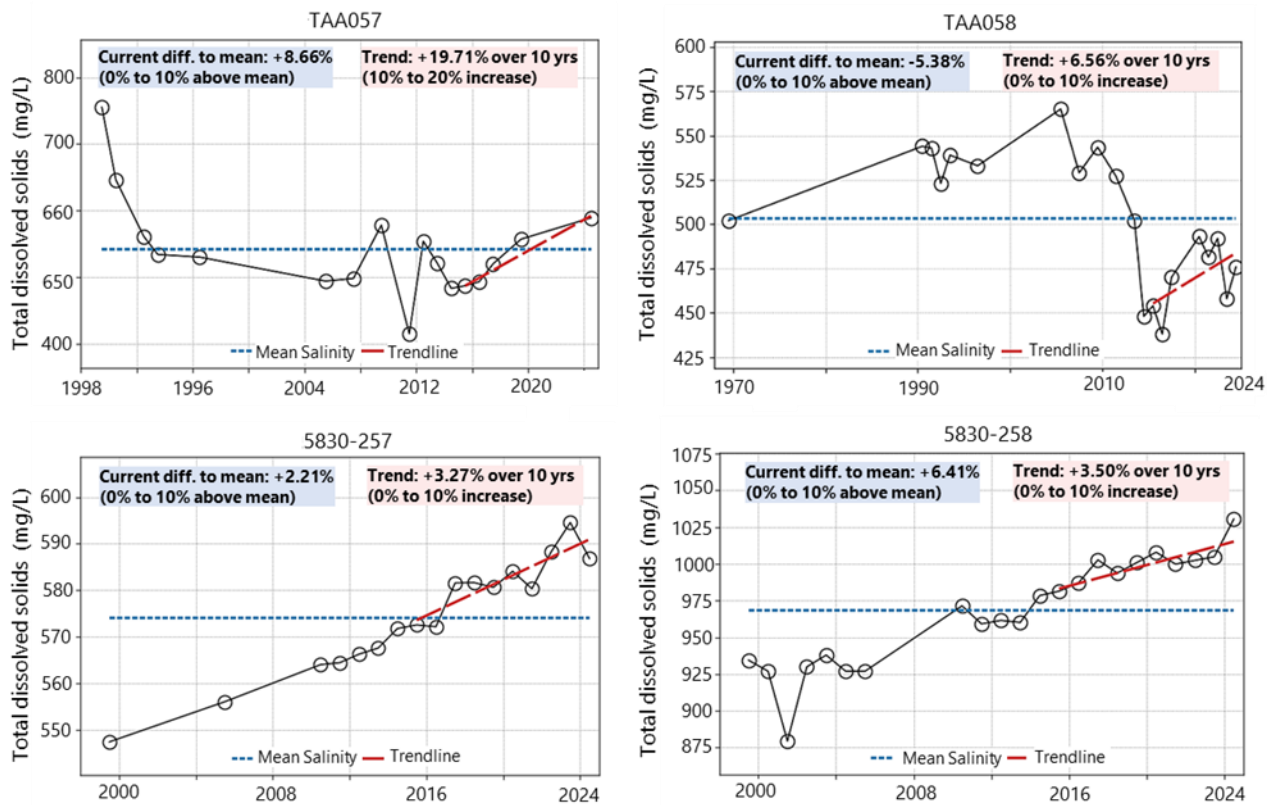


Figure 4-39 Representative salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Bramfield Consumptive Pool with ten-year salinity trends

4.2.2. Polda Consumptive Pool

Groundwater trends in the Polda Consumptive Pool have been assessed by correlating rainfall data from BoM stations 018165 Lock (Terre and Terrah Winds), groundwater level measurements from the existing observation well network, and extraction data from licensed water use within the pool (Figure 4-40). The groundwater hydrograph for Polda Consumptive Pool presents the long-term interactions between climate variability, extraction pressures and aquifer response over the time (Figure 4-41).

Extraction from the QL aquifer near Polda Polda began in the 1960s with historic extraction levels varying significantly over time. Use from the Polda Consumptive Pool declined due to worsening water quality and declining groundwater levels, limiting access to the resource. In 2008, SA Water ceased extraction due to rising salinity (SA Water 2008). This was followed by a Notice of Prohibition that halted all licensed use until 2016. SA Water voluntarily relinquished its licence for the Polda Lens in 2015 (EPNRMB 2016).

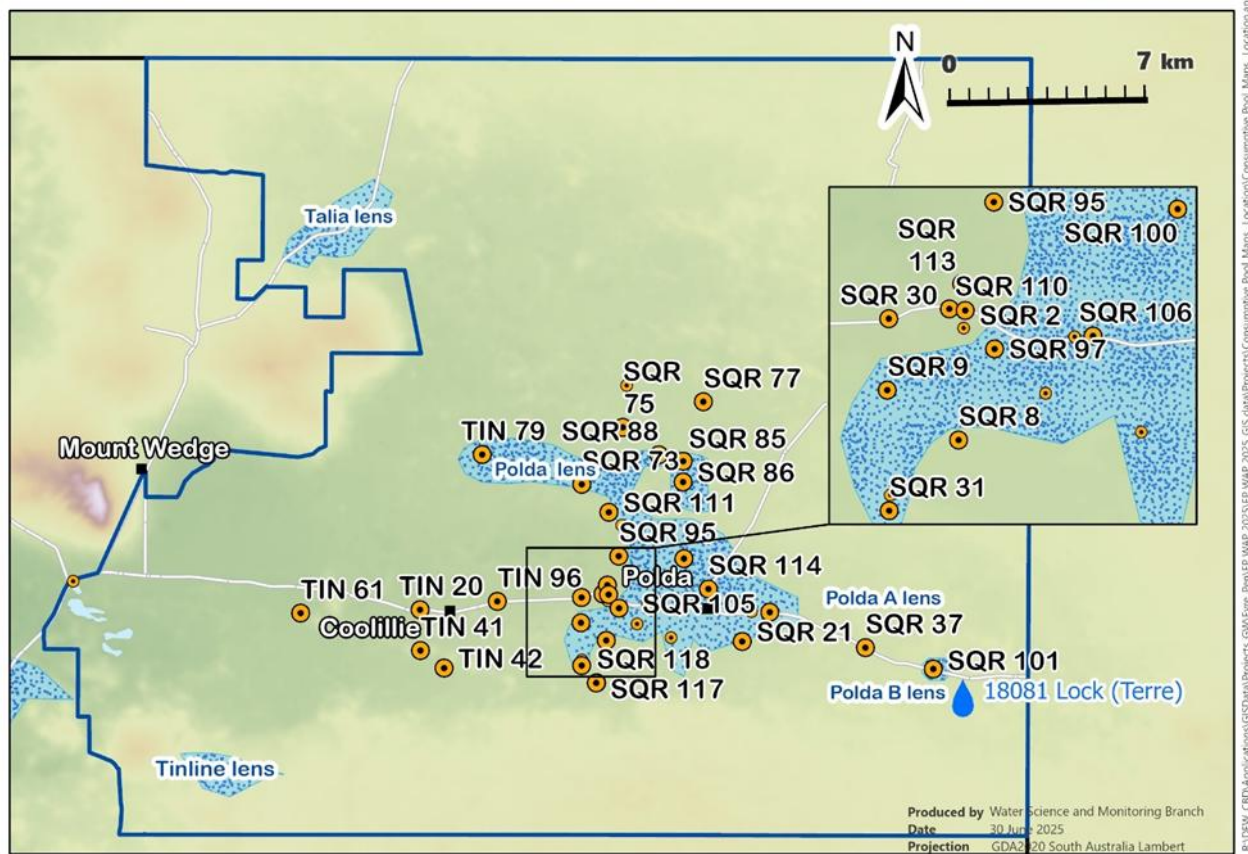


Figure 4-40 Location map for monitoring wells and rainfall stations for Polda Consumptive Pool

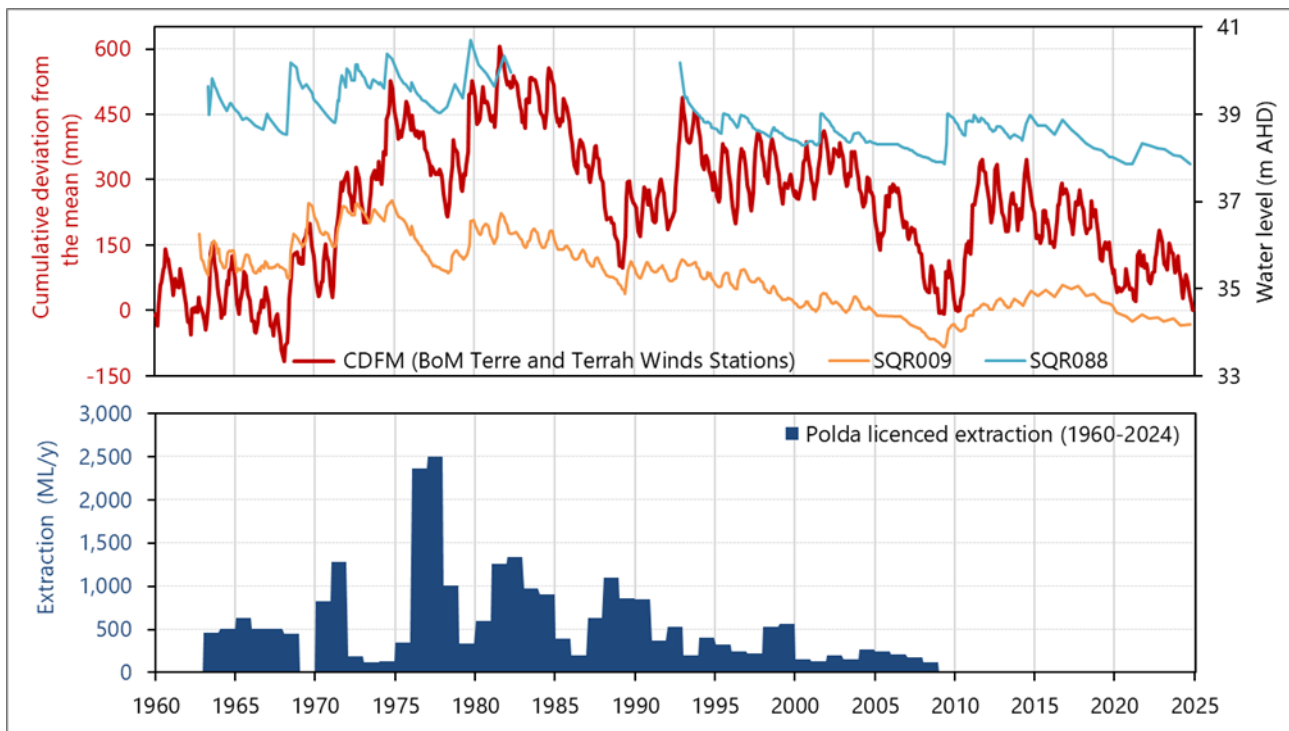


Figure 4-41 Groundwater level, rainfall and extraction trends for the Polda Consumptive Pool

Groundwater levels across the monitoring wells generally reflect fluctuations in rainfall trends. Beginning in 1960, rainfall showed a noticeable upward trend with brief but significant drops in 1968, 1971, 1978 and 1981, before peaking in 1969, 1972, 1974 and 1981. Average to very high groundwater levels in most wells were recorded during these peak periods. From 1982 onward, rainfall exhibited a general declining trend. Although seasonal variations continued to produce short-term fluctuations, a pronounced drop in 1989 marked the lowest point and corresponded with a significant decrease in groundwater levels.

Significant increase in the rainfall in the early 1990s led to the recovery of groundwater levels as observed in most of the wells. Average to very high groundwater levels were then again recorded in this period. Towards the late 1990s, a general declining trend in rainfall was observed, culminating in the onset of the Millennium drought (1997 to 2009), during which below average to very low groundwater levels were recorded across the network.

In the past decade, groundwater levels in 32 wells have declined between 0.49 and 1.70 m with a median drop of 0.9 m (Figure 4-42). Above-average rainfall from 2010 to 2016 has correspondingly resulted in widespread recovery in groundwater levels. However, following a significant decline in rainfall during 2018–19, groundwater levels began to gradually decrease. From 2018 to 2024, below average to very low groundwater levels were recorded consecutively across the monitoring network.

Salinity monitoring between 2014 and 2024 revealed worsening trends in groundwater quality. Of the 14 monitoring wells, 86% showed an increasing trend in salinity, with rates of change ranging from a 0.8% annual decrease to a 3.2% annual increase, and a median increase of 0.6% per year (Figure 4-44 and Figure 4-45). In 2024, salinity levels within the QL aquifer ranged between 501 and 3,552 mg/L with a median of 902 mg/L. Most monitoring wells show a gradual long-term increase in salinity concentration.

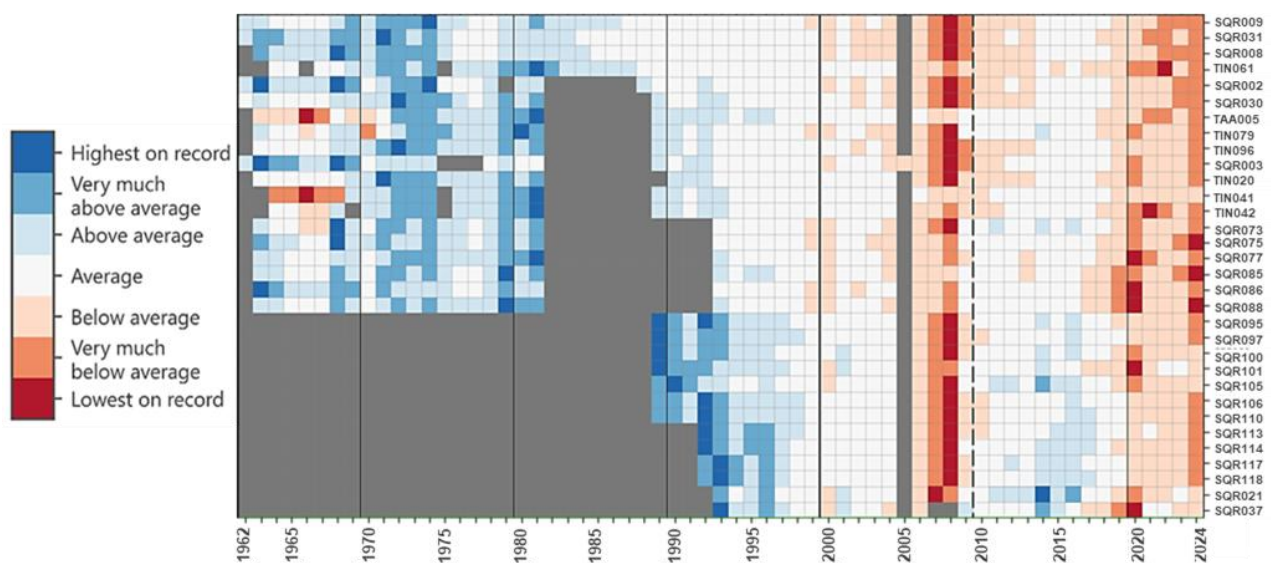


Figure 4-42 Poldra historical groundwater level rankings for selected monitoring wells with good historical records

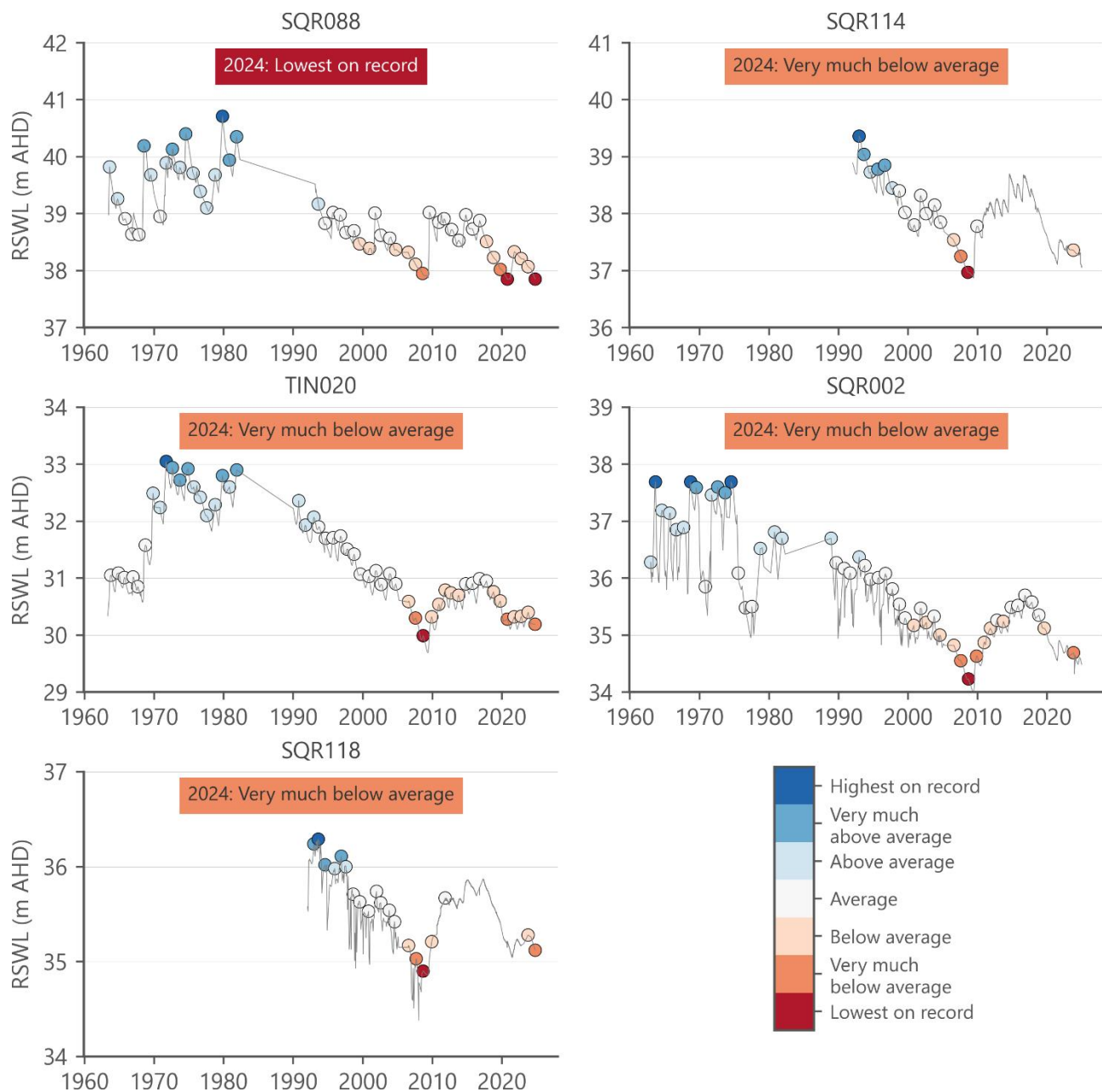


Figure 4-43 Groundwater level hydrographs for select monitoring wells in Polder

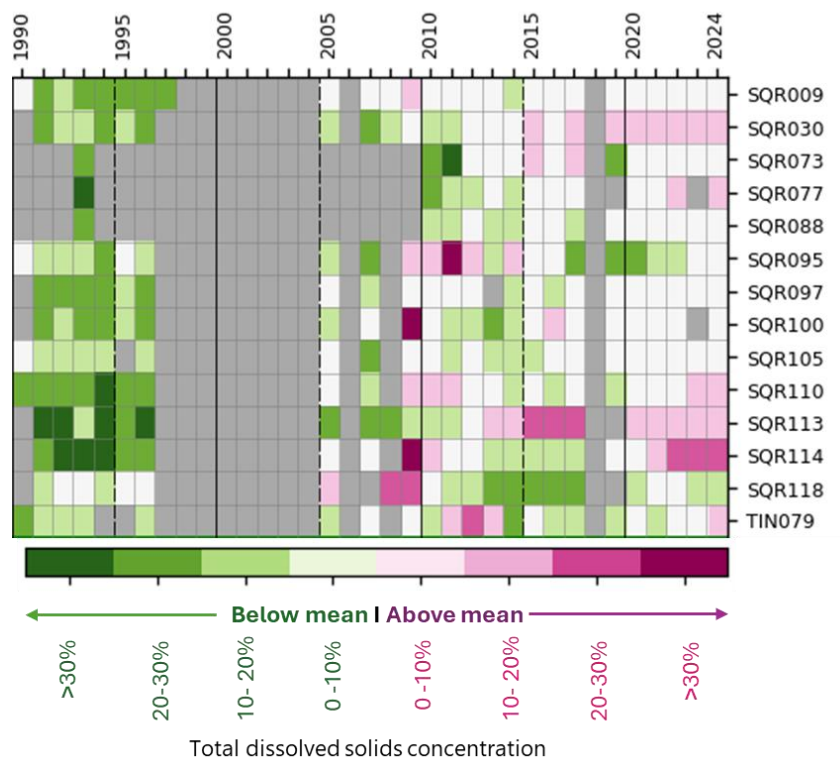


Figure 4-44 Polda historical total dissolved solids – percentage difference from the mean for selected monitoring wells with good historical records

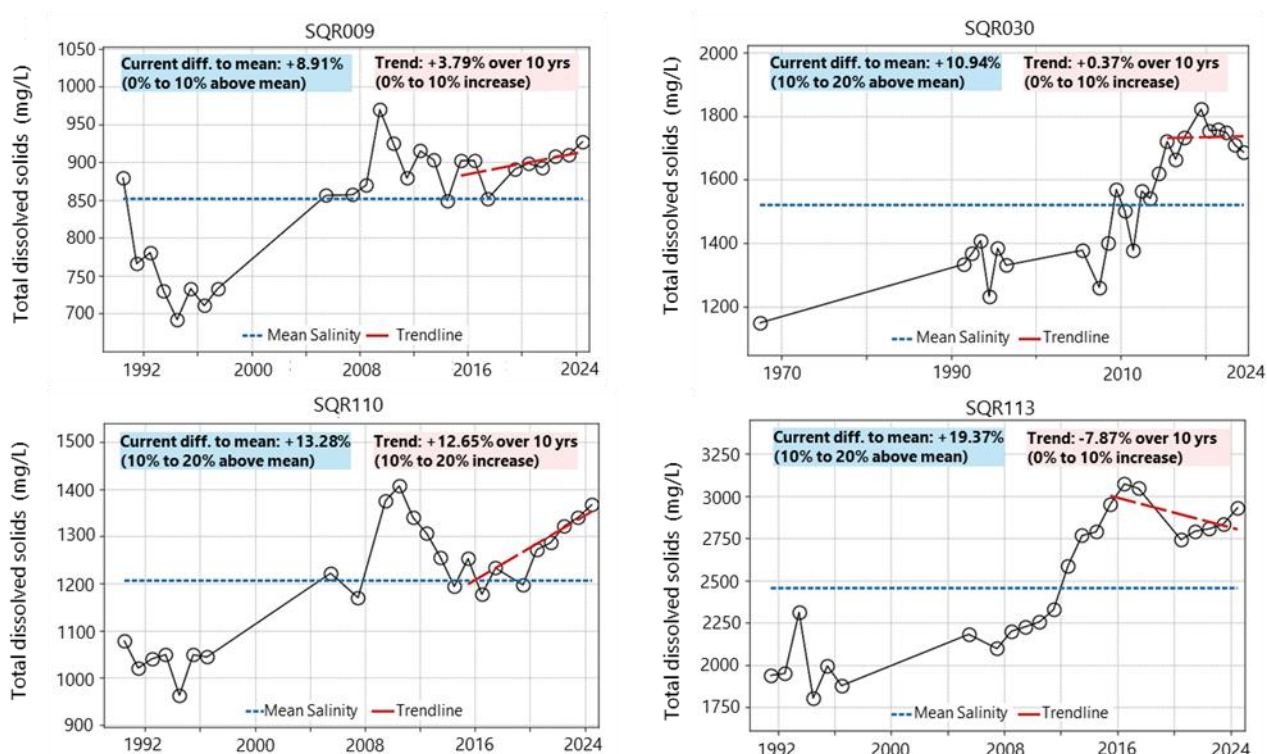


Figure 4-45 Select salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Bramfield Consumptive Pool with ten-year salinity trends

4.2.3. Sheringa Consumptive Pool

Groundwater trends in the Sheringa Consumptive Pool have been assessed by correlating rainfall data from BoM station 018165 Lock (Terrah Winds), groundwater level measurements from the existing observation well network, and extraction data from licensed water use within the pool (Figure 4-46). The hydrograph for Sheringa Consumptive Pool presents the long-term interactions between climate variability, extraction pressures and aquifer response over the time (Figure 4-47). No significant extraction volumes have been recorded in Sheringa to date, as the resource primarily functions to support GDEs within the pool and sustain the non-licensed groundwater use for stock and domestic purposes.

Generally, the trend of groundwater level in the Sheringa Consumptive Pool (Figure 4-47) demonstrates a strong climatic influence with groundwater levels generally reflecting fluctuations in rainfall. In the earlier records from 1965 to 1975, groundwater level in most of the wells showed a steady upward trend, consistent with the gradual increasing above-average rainfall. Early rainfall peaks in 1975, 1979 and 1981 were followed by both gradual and sharp declines, which corresponded with noticeable drops in groundwater levels, as observed in wells KPW038 and PER001. Notable declines were observed in the years 1978, 1981, 1983, 1986, 1989 and 1992. A significant increase in rainfall in 1993 led to a recovery in groundwater levels. This was followed by a fluctuating yet overall declining trend leading up to the Millennium Drought (1997 to 2009), during which further reductions in groundwater levels occurred. A brief rising trend was observed around 2013 to 2018, coinciding with improved rainfall conditions, but this was followed by a longer-term downward trend as rainfall gradually declined in subsequent years.



Figure 4-46 Location map for monitoring wells and rainfall stations for Sheringa Consumptive Pool

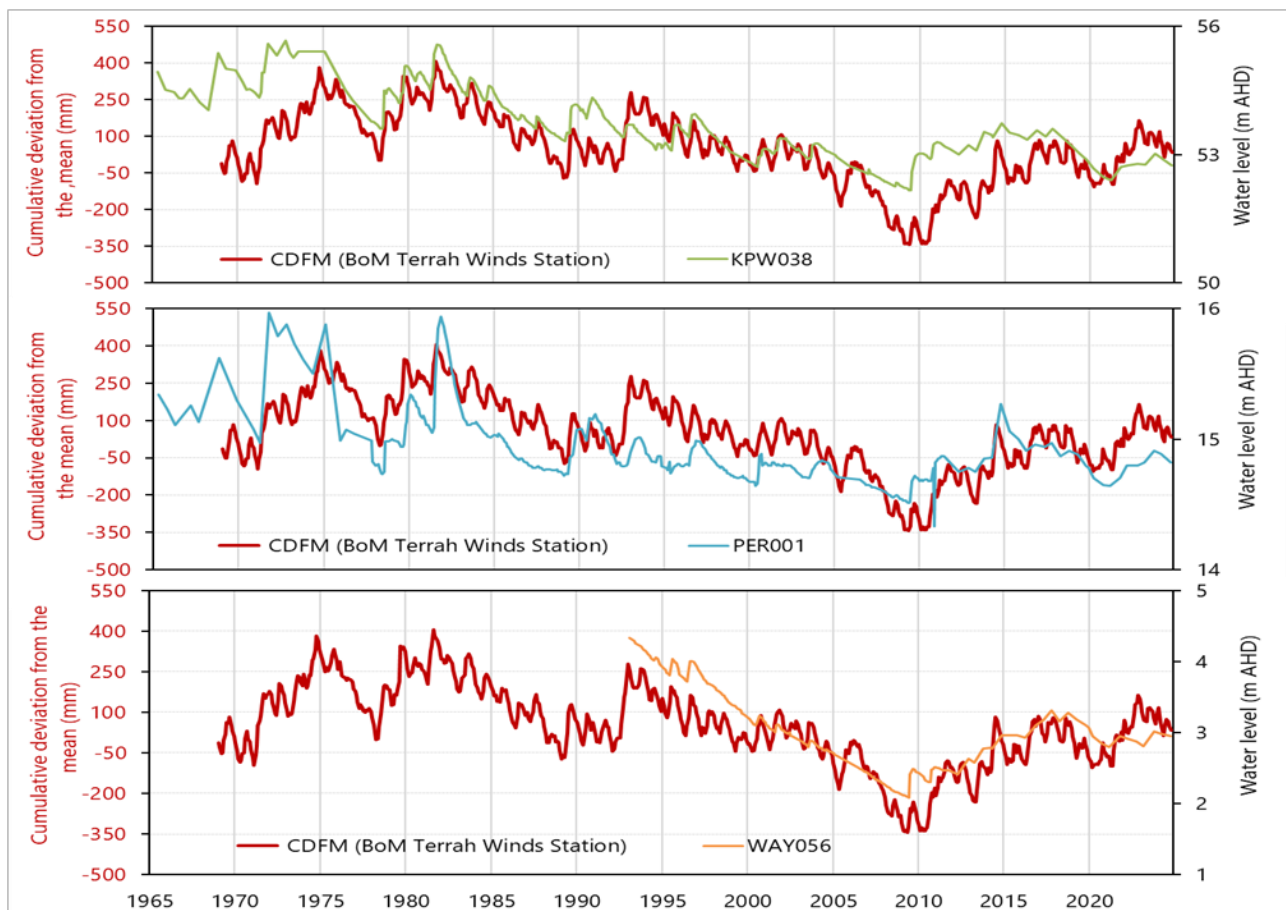


Figure 4-47 Groundwater level and rainfall trends for the Sheringa Consumptive Pool

Groundwater quality monitoring is limited in the Sheringa Consumptive pool. Salinity levels have been decreasing in concentration. Between 1990 and 2025, salinity at PER001 ranged from 424 to 1,614 mg/L. In 1990, 1991 and 1992 data from three collection points were obtained without adequate well purging and are therefore not considered representative of site conditions. Salinity at PER015 ranged from 696 to 1,707 mg/L (Figure 4-48). In contrast, KPW038 remained relatively stable, ranging in salinity between 381 and 599 mg/L. Given the limited extractions in this area, these changes in groundwater levels and variation of salinity are likely driven by sampling methods, rainfall and reduced recharge.

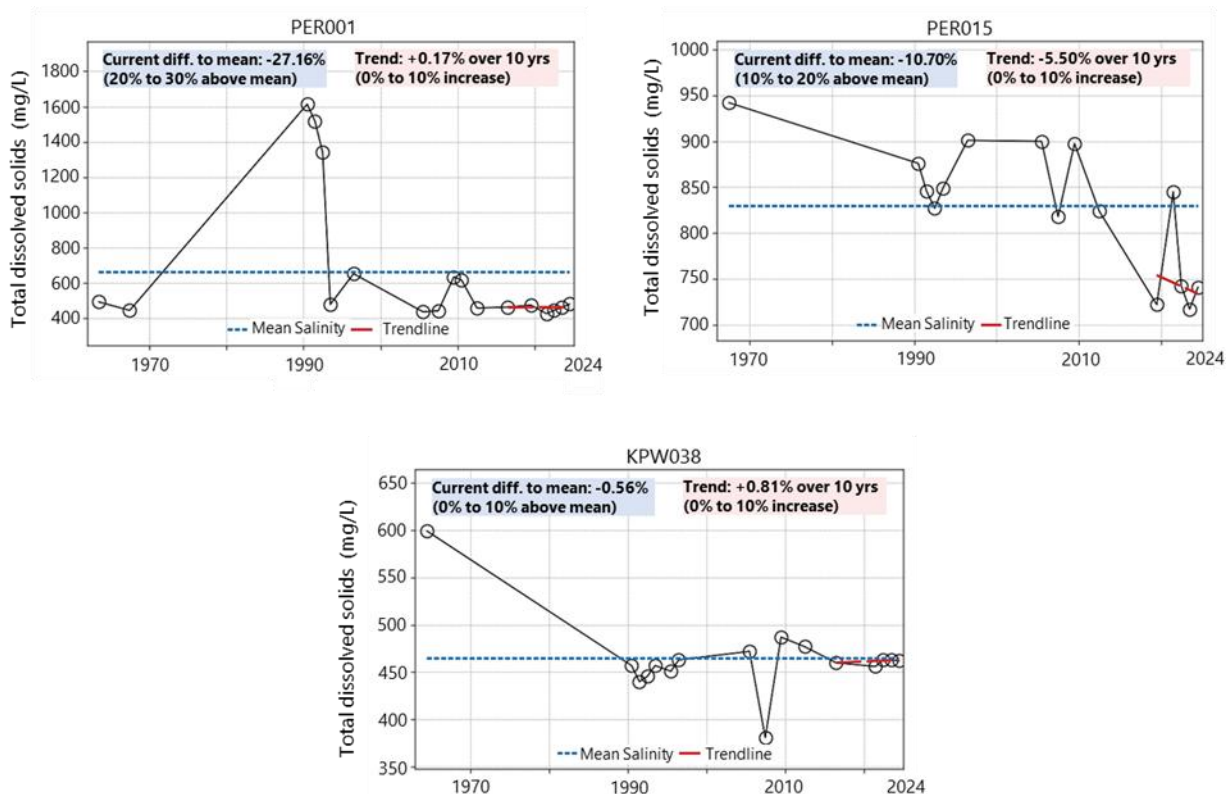


Figure 4-48 Select salinity graphs for monitoring wells in the Quaternary Limestone aquifer in the Sheringa Consumptive Pool with ten-year salinity trends

4.3. Groundwater-dependent ecosystems – responses to historic groundwater level changes

It is thought that up until the 1950s and 1960s (over 20 years prior to formal water management commencing in the region), the groundwater levels were significantly higher in some aquifers. This is most likely due to the wetter-than-average period from 1950 to 1958, relatively low rates of water extraction prior to the 1950s, and a lag in response to increased extraction. In some areas, the groundwater was expressed for most of the year as surface water in wetlands that are no longer present or have changed significantly in ecological character. For example, in Uley South there were surface water wetlands (waterholes), such as Paradise Swamp, that have been dry since the 1960s and now support tussock grasslands. There is also anecdotal evidence that Lake Pillie has transitioned from a permanent surface water wetland to a basin being colonised by terrestrial plants in the late 1990s and early 2000s (EPNRMB 2016).

These recollections by long-term community members and landholders are consistent with the historically higher groundwater levels measured in the QL aquifer of Uley Wanilla and Uley South Basins. The period of high rainfall and high water tables may be typical of what were once wetter conditions in the wetlands, and it may be that the wetlands would have retracted during extreme drying events such as droughts prior to European settlement. A WAP cannot restore wetlands lost due to climatic changes or historic over-extraction. It has the objective of minimising the impact of the authorised taking of water on GDEs as they occurred in the 2007 to 2012 baseline period. It was during this period that observations and analysis were used to determine the environmental water requirements of the GDEs (Semeniuk & Semeniuk 2007; Doeg et al. 2012).

5. Capacity of groundwater resources

Section 53(1)(f) of the *Landscape South Australia Act 2019* requires a water allocation plan to ‘assess the capacity of the resource to meet the demands for water on a continuing basis...’

This Section outlines the methodology used to determine the volumetric capacity of groundwater resources within defined geographic areas, referred to as management areas. While the management areas used to define the resource capacity and recommended allocation limits remain fixed for the duration of the WAP, the volume of water available for consumptive use may be recalculated annually in some cases, as detailed in Section 7.

The resource capacity within these PWAs is expressed as a volume and represents the maximum quantity of water available for all uses, including consumptive and non-consumptive uses. Consumptive use includes licensed water use (irrigation, industrial, recreational, mining and PWS) and non-licensed water use includes water for stock or domestic use or water authorised by the Minister under Section 105 of the *Landscapes South Australia Act 2019*. Non-consumptive use also includes water for maintaining natural processes such as aquifer throughflow and discharge, and water for GDEs where they are present.

Given the fragile nature of the QL aquifer on the Eyre Peninsula (thin and heavily reliant on rainfall recharge), it is not possible to provide an assessment of the capacity of the resources in the same way as other groundwater resources in South Australia. In the Mallee and the Southeast for instance, the large and robust sedimentary aquifers enable a portion of the water stored in the aquifers to be considered as a part of the resource capacity.

Resource capacity is assessed using the water balance method, a widely accepted approach for determining sustainable groundwater extraction. It quantifies recharge, discharge and changes in storage to estimate the volume that can be safely taken from the resource without compromising aquifer integrity or dependent ecosystems. This method is particularly suited to the dynamic aquifer systems of the Eyre Peninsula.

However, limitations exist, especially in estimating the volume available for consumptive use. Recharge estimates can vary by over 100% depending on the method applied (Cranswick et al. 2015). Aquifers with low storage, such as fractured rock systems, are more sensitive to recharge variability and may not support sustained extraction during dry periods. As discussed in Section 3, the QL aquifer is highly dependent on rainfall recharge and vulnerable in areas with limited thickness, where groundwater levels and storage volumes fluctuate with rainfall.

To address these uncertainties, a risk-based approach has been adopted for the Uley South and Bramfield consumptive pools. This method evaluates the likelihood and consequences of impacts on groundwater condition and associated environmental, social, and economic values. Numerical modelling simulates aquifer responses to stressors such as extraction, land-use change and climate variability. Biophysical indicators are used to monitor system performance, and stakeholder input informs impact assessments. This supports the development of risk profiles for proposed extraction volumes, consistent with a resource condition limit framework (Richardson et al. 2011).

Data availability varies across aquifers. The QL aquifer is comparatively well characterised, compared to the other aquifers in the PWAs, due to its widespread use for PWS, irrigation, industry, recreation, and stock and domestic purposes. In contrast, the deeper TS and Basement aquifers are less understood. Consequently, resource capacity estimates for the five consumptive pool groupings have been derived using different methodologies.

This Section defines the geographic locations (referred to as management areas) used to determine the volumetric capacity of the groundwater resource, as well as a subset of this volumetric capacity, the water available for consumptive purposes (the consumptive pool). While the boundaries of management areas remain fixed for the life of the Plan, the volume of the consumptive pool, in some instances, will be re-calculated annually, as detailed in Section 8.

5.1. Management areas used to determine consumptive pools

Consumptive pools are delineated based on these management areas. For each management area, a volumetric resource capacity to account for both consumptive and non-consumptive demands have been established. The portion of the resource capacity available for consumptive demand is referred to as the consumptive pool.

Management areas are grouped into the following categories:

- licensed QL aquifers (excluding Uley South, Bramfield and Aquaculture Elliston);
- licensed QL aquifers – Uley South and Bramfield;
- Aquaculture Elliston;
- unlicensed QL aquifers; and
- management areas associated with the TS and Basement aquifers.

There are 7 management areas with defined consumptive pools in the Southern Basins PWA, and 7 in the Musgrave PWA. These management areas are listed in Table 5-1. The QL aquifer management areas are displayed in Figure 5-1 for the Southern Basins and in Figure 5-2 for the Musgrave PWA. The management areas for the TS and Basement aquifers of the Southern Basins PWA (Figure 5-3) and the Musgrave PWA (Figure 5-4) align with the relevant PWA boundaries.

Although the Jurassic aquifer is present within the Musgrave PWA no consumptive pool has been established for this aquifer as there is currently no known extraction for consumptive purposes.

The boundaries of the licensed QL aquifer management areas are for the most part based on the maximum historical extent of the aquifer, as determined by the highest recorded groundwater levels (refer to Figures 14 and 15 in Stewart (2013)). This approach allows for potential lateral expansion of the saturated zone during periods of significant recharge. To improve clarity and enforceability, these boundaries are aligned with the nearest cadastral boundaries, ensuring they can be clearly identified on the ground. This is particularly important where principles apply to the location of new wells or where additional volumes of water can be taken.

The size of the Bramfield Consumptive Pool has been reduced to focus on the area of greatest interest – where the freshwater lens occurs and the current licences holders are located. A numerical model was developed to assess the risk of seawater intrusion and the long-term vulnerability of the resource. Given the critical importance of maintaining the supply of potable water, this refined delineation allows for more targeted management and a better understanding of the resource, supporting more accurate and sustainable allocation.

Historically, Uley Wanilla and Lincoln South were available for licensed use; however, evidence indicates that ongoing extraction from these resources is not sustainable for PWS. Given their degraded condition and the associated risks to GDEs and other groundwater users, it is recommended that the Lincoln South and Uley Wanilla management areas be excluded from the licensed consumptive pool and reclassified as part of the unlicensed QL aquifer. While licensed extraction would no longer be permitted, water may continue to be taken for stock and domestic purposes, which do not require a licence.

Table 5-1 Management areas within the Southern Basins and Musgrave PWAs

PWA	Aquifer type grouping	Management area
Southern Basins	Licenced QL aquifers	Coffin Bay
		Uley North
		Uley South
		Lincoln North
	Non-licenced QL aquifer	Non-licenced QL aquifer
	TS and Basement aquifers	Tertiary Sands
		Basement
Musgrave	Licenced QL aquifers	Polda
		Bramfield
		Sheringa
		Aquaculture Elliston
	Non-licenced QL aquifer	Unsaturated QL
	TS and Basement aquifers	Tertiary Sands
		Basement

The smaller Uley Wanilla and Lincoln South groundwater resources have supplemented supply from the primary Uley South resource during periods of peak seasonal demand. However, long-term declines in rainfall and associated recharge (refer to Sections 4.1.3 and 4.1.6), persisting beyond the end of the Millennium Drought (post-2009), have significantly impacted these resources and the GDEs that rely on them.

As a result, these resources no longer possess the capacity to support any ongoing licenced extraction for any purpose, including PWS. Investigations into groundwater levels and storage capacity within these consumptive pools support this conclusion (DEW 2024f). General findings from these investigations are summarised in the following subsections.

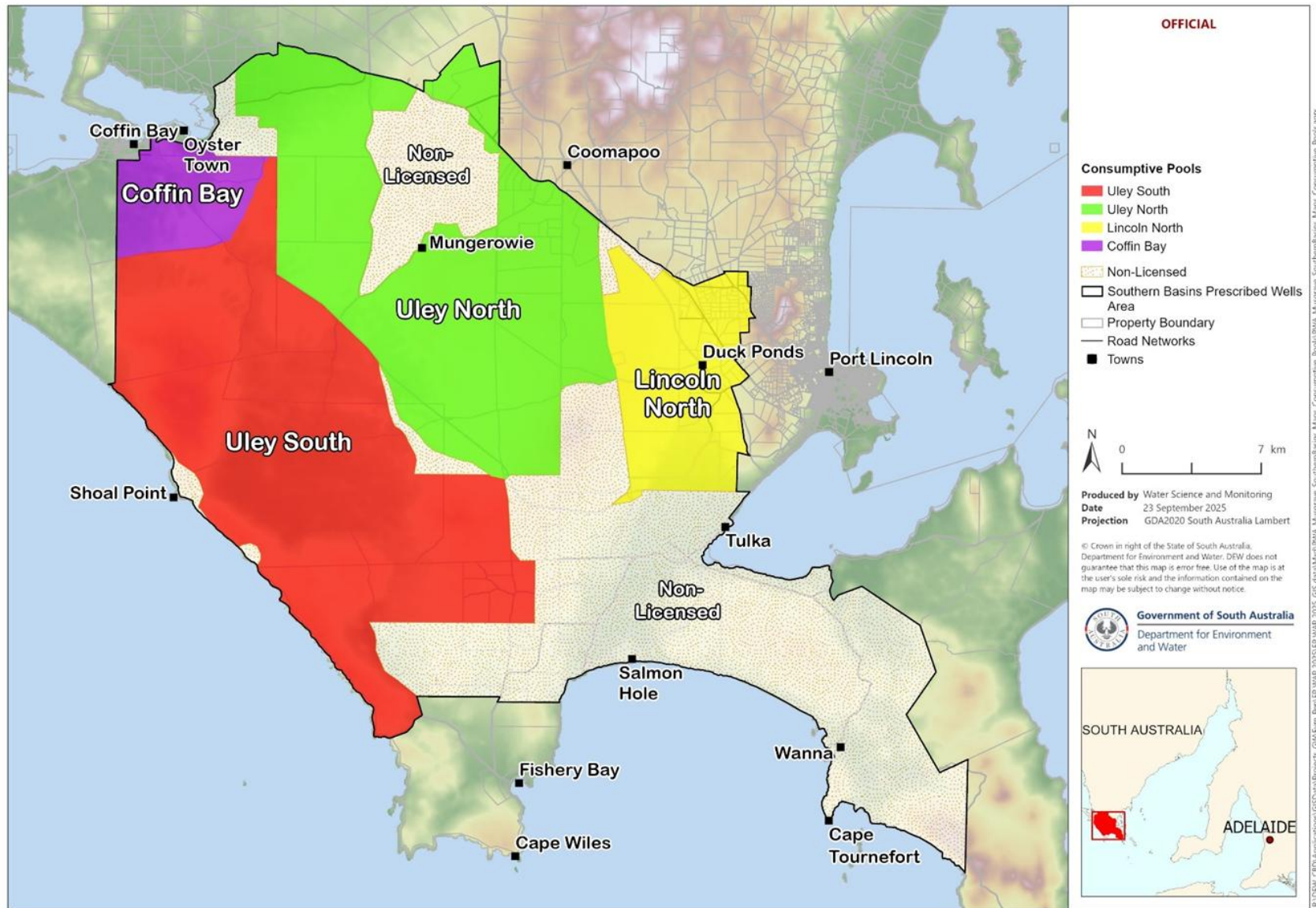


Figure 5-1 Management areas for the saturated and unsaturated Quaternary Limestone aquifer of the Southern Basins PWA

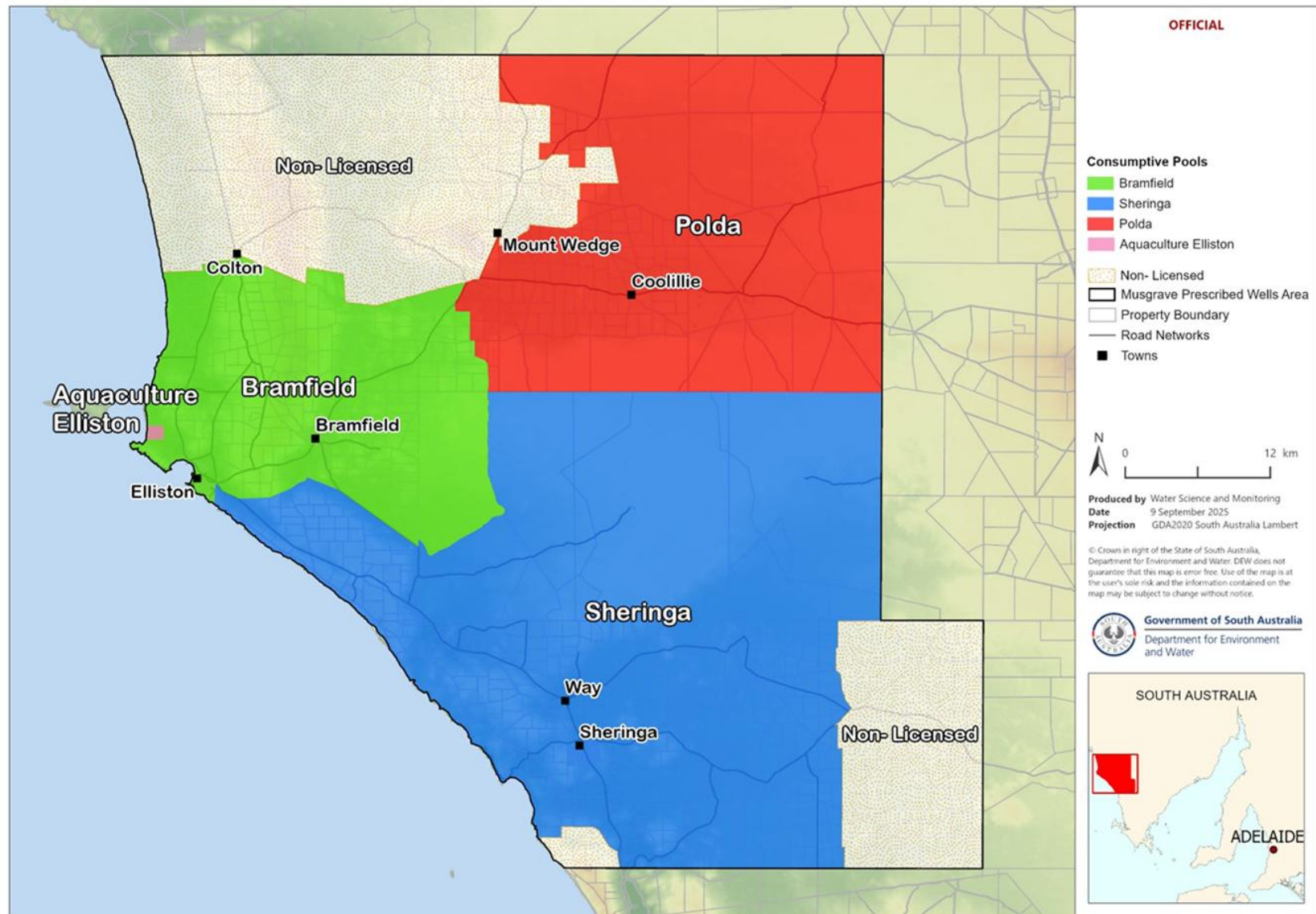


Figure 5-2 Management areas for the saturated and unsaturated Quaternary Limestone aquifer of the Musgrave PWA

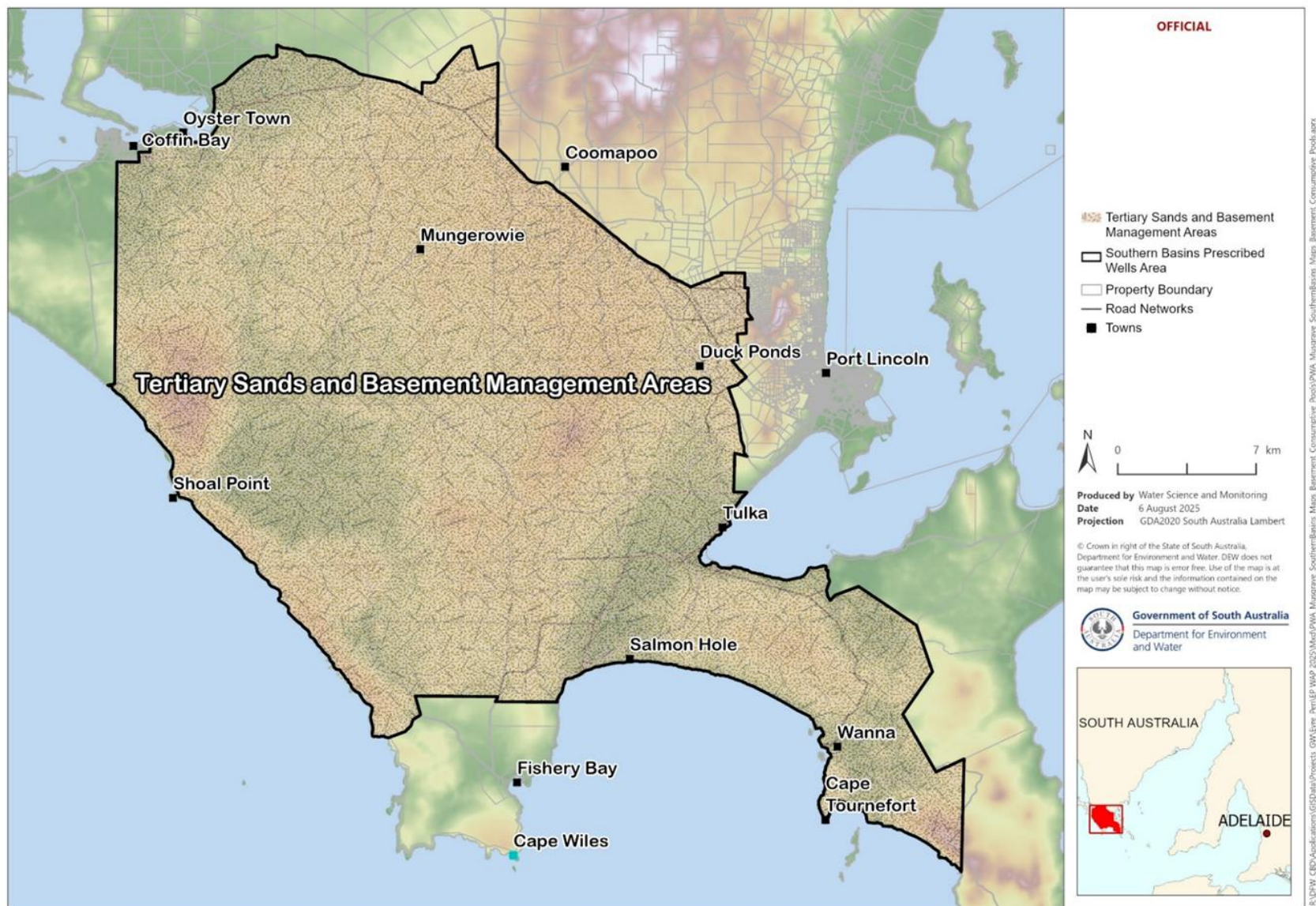


Figure 5-3 Management areas for the TS and Basement aquifers of the Southern Basins PWA

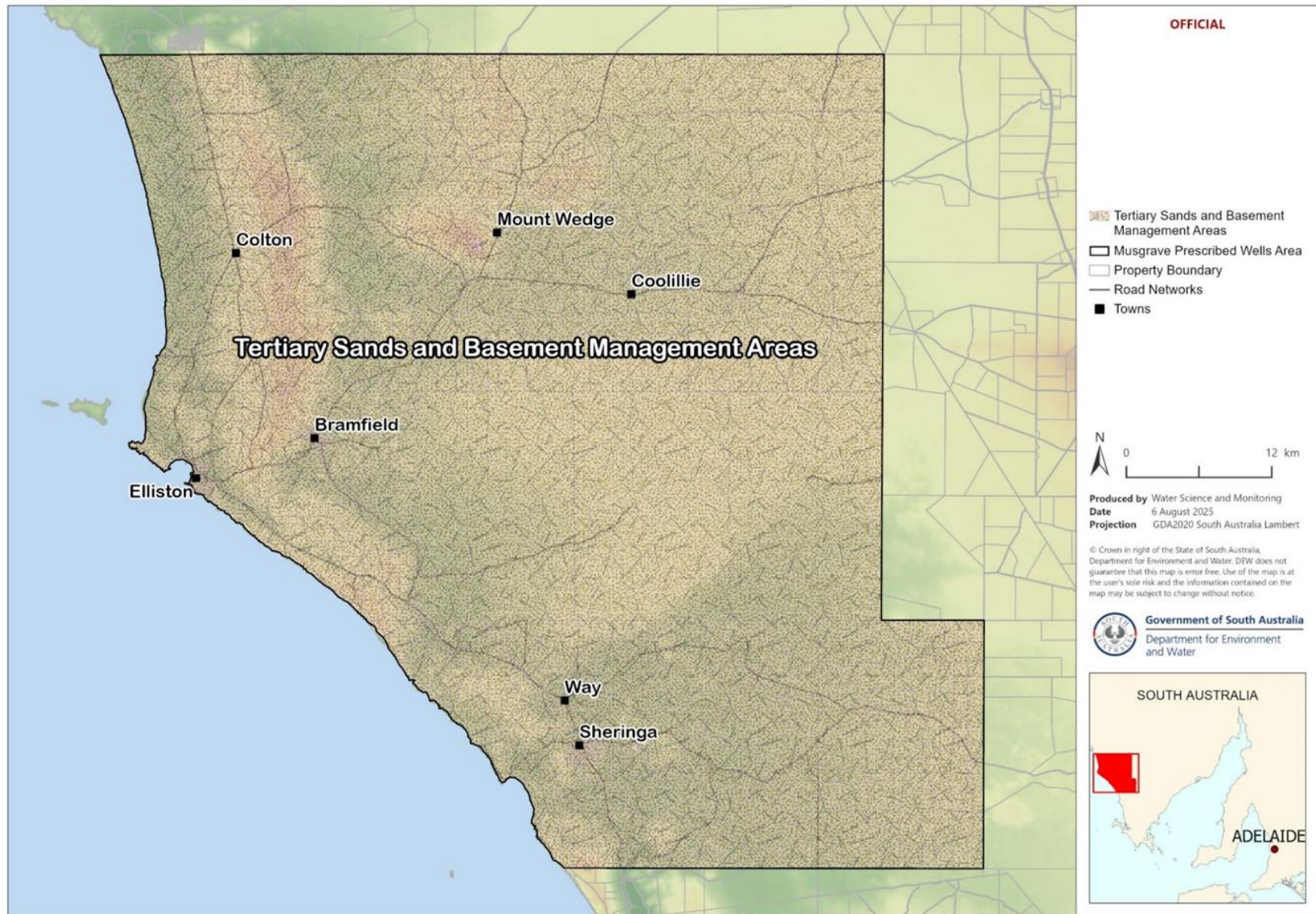


Figure 5-4 Management areas for the TS and Basement aquifers of the Musgrave PWA

5.1.1. Uley Wanilla Consumptive Pool

Uley Wanilla is exhibiting long-term groundwater level decline, declining storage and increasing evidence of stress on groundwater-dependent ecosystem. The groundwater lens is hydraulically constrained and has limited capacity to obtain recharge from surrounding groundwater systems. Current water access entitlements comprise a substantial proportion of the estimated freshwater resource capacity and continued extraction is expected to be balanced primarily through reductions in natural groundwater discharge and groundwater storage. Available evidence indicates that current management arrangements have reduced, but not reversed, resource decline.

Compounding these risks is the very short groundwater residence times of around 30 years. This means that any perturbations to the system, such as groundwater pumping, will result in dynamic changes in groundwater levels and/or a decrease in natural discharge and a new, in this case unfavourable, equilibrium will be reached very rapidly.

5.1.2. Lincoln South Consumptive Pool

In the Lincoln South PWS Consumptive Pool, groundwater levels in 2022–23 (measured at their post-winter maximum) in 77% of observation wells were classified ‘Below average’ or lower. Some wells are showing groundwater levels near, or below, mean sea level despite above-average rainfall in 2020 and 2022. Multiple lines of evidence demonstrate that a reversal in hydraulic gradient has occurred, and seawater ingress is now being induced from the ocean and very likely also induced from the saline water that comprises Sleaford Mere. Consequently, if groundwater is continued to be extracted from Lincoln South, then this volume will be met by a small loss in groundwater storage with the balance being met by induced ingress from the ocean and saline water from Sleaford Mere. This volume of seawater and high-salinity groundwater being entrained into the fragile Lincoln South lens will have deleterious impacts on the health and/or survival of any ecosystems that are dependent on fresh groundwater.

Recovery from these processes is likely to occur over very long timescales and may not be achievable within management-relevant timeframes. Continued extraction is expected to increase the likelihood of further salinity increases within the freshwater lenses and associated impacts on GDEs.

5.2. Licensed Quaternary Limestone aquifers

The capacities of the Coffin Bay, Uley North, Lincoln North, Poldia and Sheringa management areas are defined and calculated as the recharge zone areas multiplied by the recharge rates.

The resource capacity of the licenced QL aquifer management areas represents the estimated volume of water that has recharged the aquifer over a period of one year. This volume is considered a starting point from which to provide water for the environment, and for consumptive non-licensed and licensed use.

5.2.1. Aquifer recharge zones

Recharge zones within the management areas (Figure 5-5 and Figure 5-6) are delineated based on 2 criteria:

1. the extent of fresh groundwater lenses (defined as <1,000 mg/L TDS); and
2. the saturated extent of the remaining brackish QL aquifer.

This approach follows the methodology outlined in the initial science supporting the 2016 WAP with further detail provided in Stewart et al. (2012). The Spatial geological surfaces representing the top of the Tertiary Clay aquitard – Poelpena Formation in the Musgrave PWA and Uley Formation in the Southern Basins PWA, were also sourced from the Stewart et al. (2012) study, which included a detailed review of stratigraphic logs across the basins.

The saturated extent of the QL aquifer was mapped using groundwater level monitoring data from autumn 2024. Autumn was selected to represent a conservative estimate of aquifer saturation, as it typically coincides with the annual low point in the water table, following summer discharge and preceding significant recharge events.

The brackish zone boundaries were derived from salinity data collected during 2009–10. This dataset was preferred over more recent records due to its broader spatial coverage collected during the development of the previous Plan. For Bramfield, additional groundwater monitoring was undertaken in 2023 and 2024.

To determine the areas which are saturated in both the Musgrave and Southern Basins PWAs, the 2024 RSWL surface was overlaid on the map surface representing the top of the Tertiary Clay aquitard, the Poelpena Formation, in the Musgrave PWA and Uley Formation in the Southern Basins PWA. The Cut/Fill 3D tool was used to identify areas where the interpolated RSWL lies above the aquitard surface, indicating zones where the QL aquifer is saturated with either fresh or brackish groundwater.

The recharge zones delineated in 2024 are broadly consistent in area with those defined in 2011 for the previous WAP. Notable observations include:

- the freshwater lens has expanded slightly at Coffin Bay, increasing from approximately 13.8 to 15.1 km². This is due to the inclusion of an additional well known to be in the freshwater lens;
- the Uley North results indicate that the QL aquifer is not saturated between Lincoln North and Lincoln South. While continuous saturation is likely, the recharge area has been conservatively reduced to reflect uncertainty and ensure conservative capacity calculations;
- a paucity of data in the Lincoln North groundwater management areas limits the ability to estimate annual variations in total aquifer storage; and
- the delineation of unsaturated zones and freshwater lenses was constrained by the availability of groundwater level data at the time of modelling.

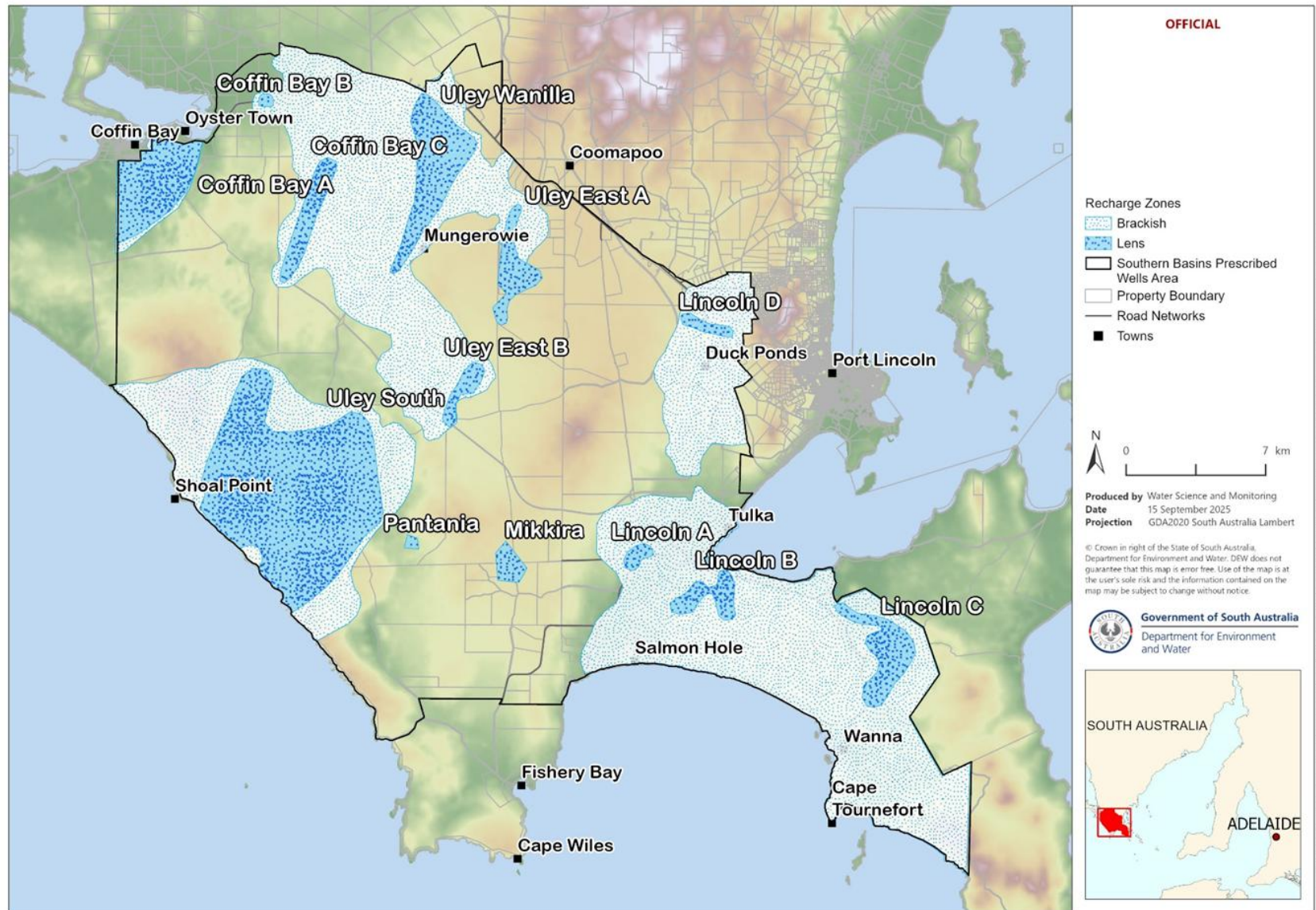


Figure 5-5 Recharge zones for the saturated Quaternary Limestone aquifer of the Southern Basins PWA

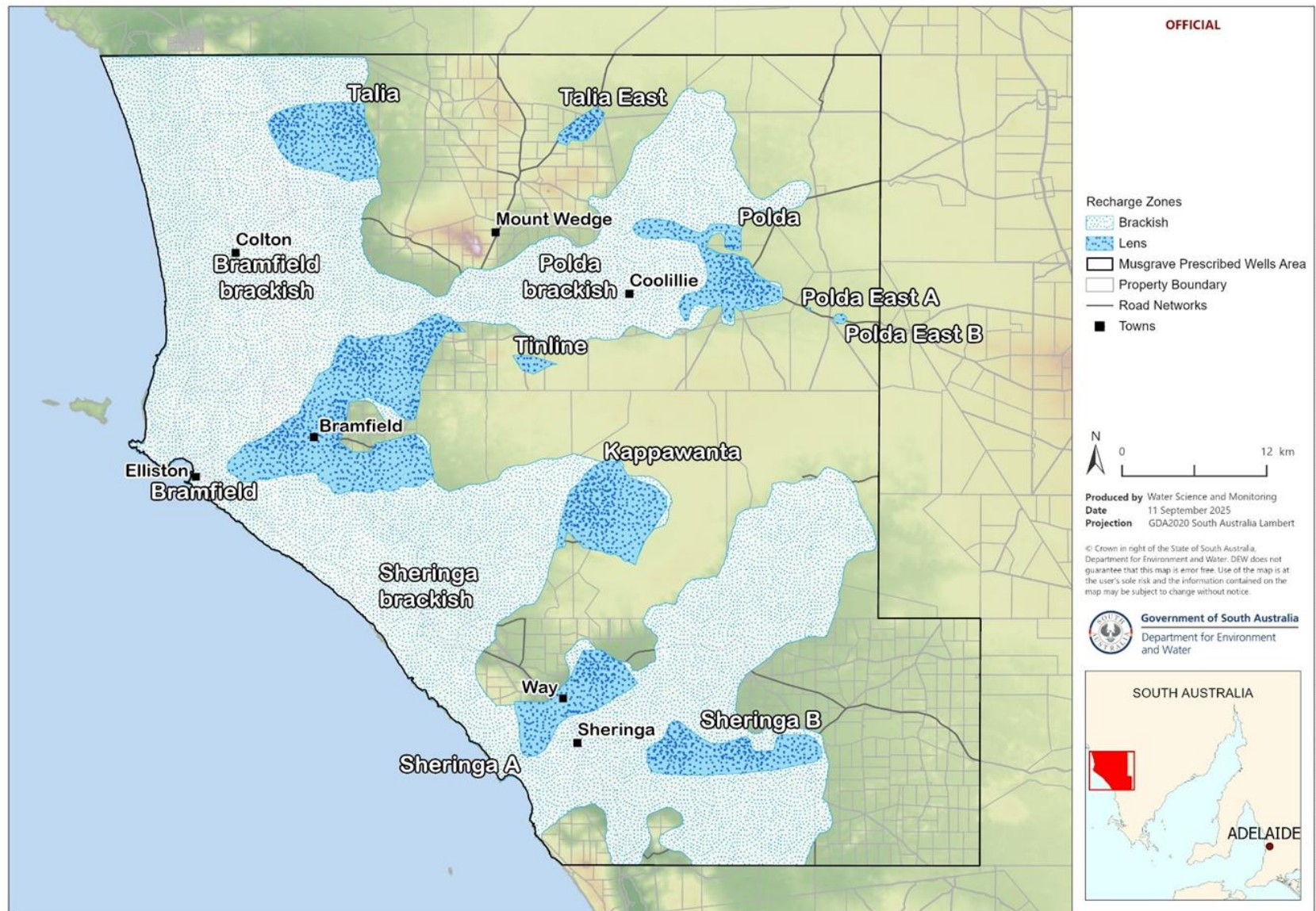


Figure 5-6 Recharge zones for the saturated Quaternary Limestone aquifer of the Musgrave PWA

5.2.2. Aquifer recharge rates

To quantify the resource capacity within the licensed QL management areas using the equation provided at the outset of Section 5.3, it was necessary to obtain recharge rates specific to each delineated recharge zone. This section presents several methodologies employed to evaluate changes in recharge rates following the implementation of the 2016 WAP. These include the Water Table Fluctuation (WTF) method, transient groundwater modelling, and aquifer storage analysis. The use of multiple methods was necessitated by limitations in data availability and quality.

The aquifer storage method evaluated modelled aquifer storage levels from 2002 to 2024 to assess changes in water availability over time (Figure 5-7). Storage volumes were expressed as a percentage relative to a defined baseline, informing annual allocation adjustments under the previous Plan. This method, while simple, accounts for both the saturated thickness and aerial extent of the aquifer, providing a more comprehensive indicator of resource condition.

Key findings from the aquifer storage evaluation are that:

- there is a consistent decline in storage levels across both the Musgrave and Southern Basins throughout the assessment period;
- five-year average comparisons show a decline in storage of 4.3% (3.2 to 5.0%) in the Southern Basins and 9.6% (1.7 to 17.2%) in the Musgrave PWA;
- Coffin Bay was excluded from basin-level recharge analysis due to its coastal buffering and water level values consistently being below 1 mAHD; and
- combined analysis of recharge and storage trends indicates a reduction in resource capacity of 4 to 24% across the Southern Basins.

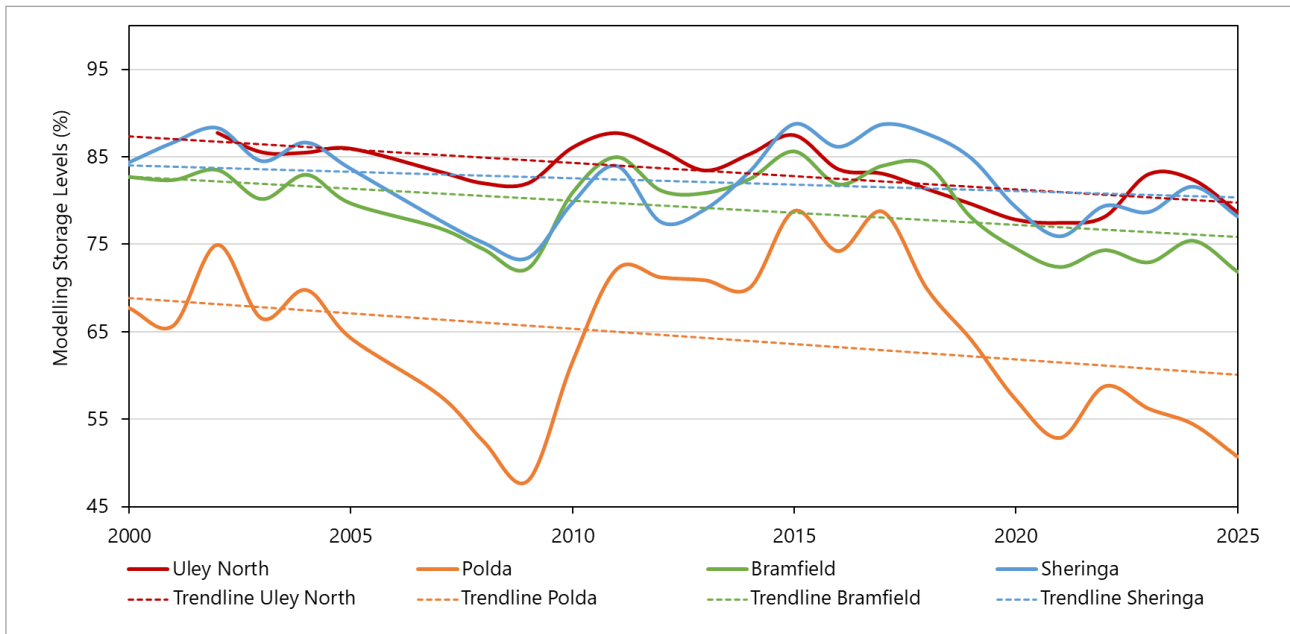


Figure 5-7 Modelled aquifer storage levels from 2002 to 2024 – Musgrave Basins PWA saturated Quaternary water resources

Transient modelling conducted for the Uley South area in 2024 and the Bramfield area in 2025 yielded the following recharge estimates.

- Uley South: The long-term average recharge rate modelled for Uley South over the period 1961 to 2024 is 90 mm/y. Recharge rates remained close to this long-term average during 2005 to 2014 (90 mm/y) but declined to 58 mm/y during 2015 to 2024, representing a 36% reduction. This indicates that recharge during the most recent decade has been substantially lower than the long-term average; and
- The long-term average recharge rate for Bramfield over the modelled period (1965 to 2024) is 19 mm/y. Recharge averaged 19.6 mm/y during 2005 to 2014 but decreased to 7.0 mm/y during 2015 to 2024, representing a 65% reduction relative to the preceding decade and the long-term average.

These findings are broadly consistent with recent CSIRO investigations in the Bramfield area (CSIRO 2026), which found evidence that recharge has declined under the drier climatic conditions experienced since the 1990s. Using independent environmental-tracer and hydrochemical techniques, CSIRO estimated contemporary recharge rates ranging between 5 and 30 mm/y. While the methods and temporal scales differ from those used in the transient groundwater model, both studies indicate that recharge under recent climatic conditions is lower than estimates derived from earlier, wetter periods and that reduced frequency of high-magnitude rainfall events is contributing to declining recharge.

In addition to aquifer storage analysis, recharge rates for the QL aquifers within the Southern Basins PWAs were estimated using the WTF method, consistent with the approach adopted in the previous Plan. This method is appropriate for unconfined aquifers and is based on the principle that rises in groundwater levels reflect recharge reaching the water table (Healy and Cook 2002). The detailed methodology is outlined in Stewart (2015). The WTF method was applied in the Coffin Bay and Uley North management areas.

To assess recharge since the previous WAP's implementation, rainfall and groundwater level data from 2016 to 2024 were analysed using the same WTF method. Previous analyses for 2008 and 2013 are documented in Stewart 2015. To enable comparison with more recent low-rainfall years, assessments were conducted for 2015, 2018, 2019, and 2024 (Figure 5-8).

During community consultation for the 2016 WAP, concerns were raised regarding the use of a 10-year rolling average for recharge estimation, particularly under conditions of reduced recharge. In response, a conservative approach was adopted, using 2008 as it was the year of the lowest average recharge rate over the time period analysed.

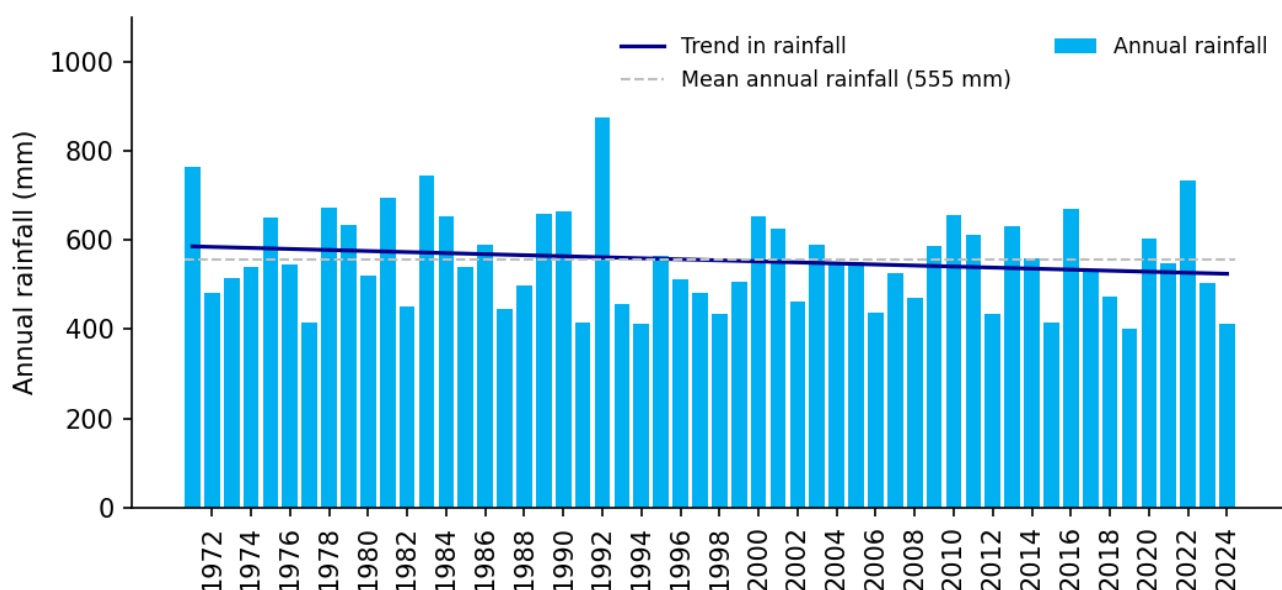


Figure 5-8 Annual rainfall at the BoM Big Swamp rainfall station

Monitoring wells were selected based on the robustness of their monitoring records, requiring a minimum of 8 readings per year. The count of wells with high-frequency monitoring (≥ 8 events/y) are presented in Appendix A. Due to a reduction in the number of wells monitored monthly, the WTF method could only be applied in the Coffin Bay and Uley North management areas (Figure 5-9). To minimise the influence of groundwater extraction on recharge estimates, wells located near production wells (defined as those extracting more than 10 ML/y) were excluded.

The lowest measured groundwater level was used to define the groundwater table minimum, rather than extrapolating from antecedent recession curves. This conservative approach results in a smaller calculated change in groundwater level and, consequently, a lower recharge estimate. Where no suitable monitoring wells were available within a recharge zone, or where no rise in the groundwater table was observed, a recharge rate of 0 mm/y was applied.

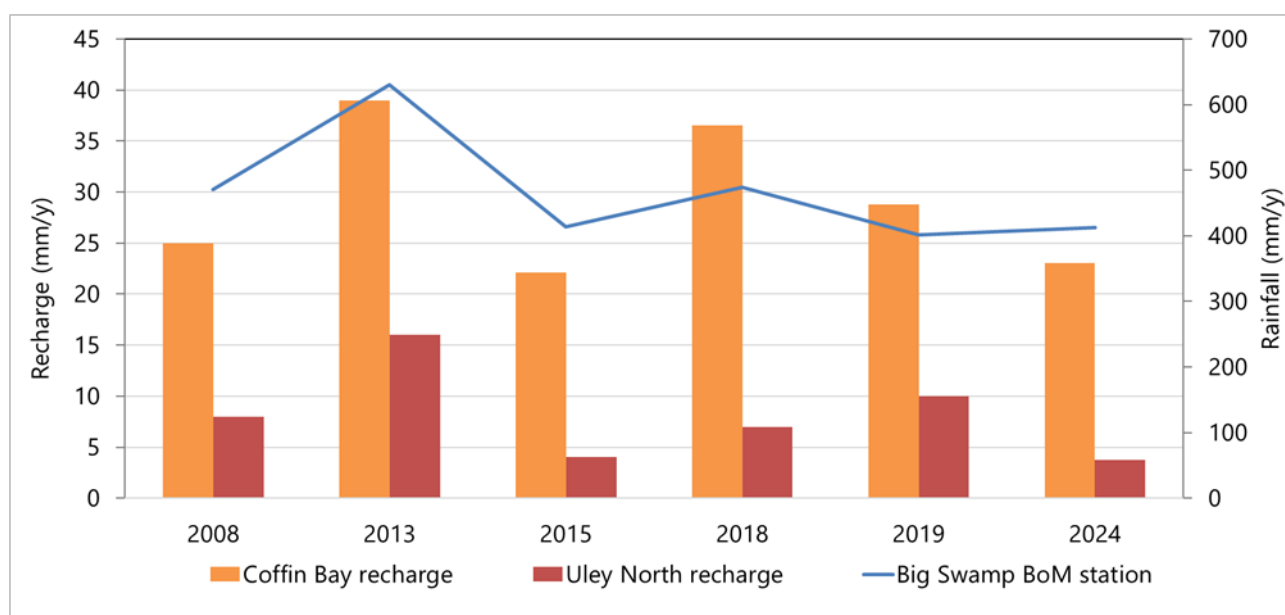


Figure 5-9 Recharge rates for the Musgrave and Southern Basins PWA Quaternary Limestone aquifers using the Water Table Fluctuation method

For Uley North management area, additional monitoring wells were identified and incorporated into the analysis to improve the robustness of the assessment. The WTF method was subsequently re-applied for the years 2008 and 2013 using the expanded dataset. The updated recharge estimates are presented in Table 5-2 and details of analysis are in Appendix B. The results indicate a decline in recharge over the past decade, consistent with reduced rainfall observed during the same period (Figure 5-9).

Table 5-2 Updated recharge estimates using the WTF method for Uley North and Coffin Bay.

Management area	Recharge zone	Recharge rate (mm/y)					
		2008	2013	2015	2018	2019	2024
Coffin Bay	Coffin Bay A lens	25.0	38.4	22.1	36.5	28.8	23.0
Uley North	Coffin Bay B lens	0	0	0	0	0	0
	Coffin Bay C lens	0	20.2	0	10.6	14.4	0
	Uley East A lens	36.7	14.2	12	12.8	27.7	9
	Uley East B lens	0	12.7	5.3	6	0	0
	Uley North brackish	5.3	32.6	4.1	8.6	7.9	9.8

The lowest recharge estimates from 2008 were compared to the lowest recharge rates observed between 2015 and 2024. Key findings from the water table fluctuation evaluation are that:

- Coffin Bay A freshwater lens recharge declined from 25 mm/y in 2008 to 22 mm/y in 2015, representing a 12% reduction; and
- Uley North, revised 2008 average recharge rate, incorporating additional wells, was 8 mm/y (0 to 37 mm/y). By 2015, this had decreased to 4 mm/y (0 to 12 mm/y), equating to a 50% reduction in recharge and a 34% reduction in estimated resource capacity.

Due to limited site-specific data, recharge calculated for the Lincoln North Consumptive Pool has been estimated using a proxy approach. A conservative recharge rate of 7 mm/y was adopted, based on the adjacent Uley North Consumptive Pool, as calculated using the WTF method in the 2008 assessment for the 2016 WAP. The saturated extent and recharge area have been based on the 2024 groundwater levels in the absence of comprehensive historical static water levels.

To reflect the observed decline in recharge and the increasing influence of a drying climate, a 10% reduction has been applied to the QL aquifer recharge rates, relative to the already conservative 2016 WAP recharge-based estimates. This recommendation is supported by the following multiple lines of evidence.

- Modelled aquifer storage trends (2002 to 2024), showing consistent declines in groundwater levels across both the Musgrave and Southern Basins;
- Transient recharge modelling for Uley South and Bramfield lenses, which revealed reductions in recharge rates between 2005 to 2014 and 2015 to 2024;
- WTF analysis, indicating reduced recharge over time; and
- Observed reductions in rainfall and increased climate variability, consistent with regional climate change projections.

Collectively, these indicators demonstrate a sustained downward trend in both recharge and aquifer storage, suggesting increasing stress on groundwater resources under current and future climate conditions. The 10% reduction is intended to:

- mitigate the risk of over-allocation;
- support the long-term sustainability of the groundwater resource; and
- provide a precautionary buffer against further climate-driven declines.

This approach was developed in consultation with the EP LB and reflects a balanced response, ensuring continued access to groundwater while prioritising the protection of aquifer integrity in a changing climate.

5.2.3. Resource capacity estimates

Recharge rates for the individual recharge zones were used to calculate the resource capacity of the licensed QL management areas using the following formula:

$$\text{Resource capacity (ML)} = \text{Recharge area (km}^2\text{)} \times \text{Recharge rate (mm)}$$

The revised resource capacity estimates for the Southern Basins and Musgrave PWA licensed Quaternary water resources are shown in Table 5-3 and Table 5-4 respectively.

Table 5-3 Assessment of the capacity of the Southern Basins PWA licensed Quaternary Limestone water resources

Management area	Recharge zone	Adopted recharge Rate (mm/y)	Area of recharge (km ²)	Resource capacity (2016 WAP) (ML)	Resource capacity (ML)
Coffin Bay	Coffin Bay A*	22.5*	15.340	345.2	345.2
Uley North	Coffin Bay B Lens	0.0	0.418	0.0	0.0
	Coffin Bay C Lens	1.7*	5.471	9.3	9.3
	Uley East A Lens	66.2	5.476	362.5	362.5
	Uley East B Lens	0.0	2.418	0.0	0.0
	Uley North Brackish	6.8	92.967	632.2	632.2
	Total			Uley North Total	1,004.0
Lincoln North	All zones	7.0	35.0	NA	243.8

*The reduction in recharge rate was offset by an increase in the mapped recharge area, resulting in minimal change to overall resource capacity.

Table 5-4 Assessment of the capacity of the Musgrave PWA licensed Quaternary Limestone water resources

Management area	Recharge zone	Adopted recharge rate (mm/y)	Area of recharge (km ²)	Resource capacity (2016 WAP) (ML)	Resource capacity (ML)
Polda	Polda Lens	5.0	37.208	208.4	186.0
	Polda East Lens A	0.0	0.072	0.0	0.00
	Polda East Lens B	0.0	0.724	0.0	0.00
	Polda Brackish	10.1	273.840	3,067.0	2,765.8
	Tinline Lens	0.0	3.125	0.0	0.00
	Talia East Lens	0.0	6.148	0.0	0.00
	Total			3,067.0	2,951.8
Sheringa	Sheringa A Lens	0.0	37.208	0.0	0.00
	Sheringa B Lens	0.6	38.986	27.3	23.4
	Kappawanta Lens	10.1	48.856	557.0	493.4
	Sheringa Brackish	5.3	519.818	3,066.9	2,755.0
	Total			3,651.2	3,271.9

5.3. Uley South and Bramfield Quaternary Limestone aquifers

Numerical groundwater models have been developed for both the Uley South and Bramfield management areas which have provided robust assessments of the long-term water availability within these areas. The volume of the consumptive pool recognises the sustainable use of these resources and incorporates the results of the modelling work. Such limits recognise the fundamental properties of the aquifer that need to be protected and the ecosystems that rely on the groundwater resource for their survival. As a result, the standard methodology used to determine resource capacity for Licensed QL aquifer management areas was not considered appropriate for these aquifers.

5.4. Uley South groundwater modelling results

The preservation of groundwater quality in the Uley South aquifer is critical to ensuring both short- and long-term water security for SA Water customers on the Eyre Peninsula. As the sole consumptive user of this resource, SA Water relies on Uley South as the primary water source while a desalination plant is under development.

The principal risks to the aquifer are the landward movement of the freshwater–seawater interface, the inflow of high-salinity water from deeper aquifers in inland wells and saline up-coning from Tertiary aquifer sediments in the northern zone, all driven by groundwater extraction. These processes pose a serious threat to water supply capacity, particularly through irreversible saline intrusion into SA Water’s near-coastal production wells.

To assess this risk, SA Water commissioned DEW to develop a groundwater flow model for the Uley South Basin (DEW 2020b), which has been updated annually with new climate and extraction data. The model

has supported scenario testing across six reports (DEW 2020b, 2021b, 2021c, 2023b, 2023c, 2024a), and several external reviews (Middlemiss et al. 2019; Cook and Post 2021a, b; Cook 2024). A recent post-audit (DEW 2024b) confirmed the model is fit for ongoing use.

Modelling results indicate that that movement of the freshwater-seawater interface is highly sensitive to the groundwater extraction rates with increased pumping accelerating the risk of seawater intrusion. At an extraction rate of 5.5 GL/y there is a clear risk of further groundwater decline and accelerated interface migration. This process, if unchecked, could lead to irreversible saline intrusion into coastal production wells, compromising the aquifer's long-term viability.

To mitigate these risks, modelling indicates that reducing extraction to 3.5 GL/y is necessary. This rate would help stabilise groundwater levels, reduce the inflow of high-salinity water from deeper aquifers, and limit the progression of seawater intrusion near the coast. The allocation of 7.3 GL/y under the previous WAP significantly exceeds this sustainable threshold, reinforcing the need for a revised extraction strategy based on current scientific understanding. It is important to note that groundwater level decline may continue at extraction rates of 3.5 GL/y if rainfall is low which means ongoing monitoring is required.

Based on the modelling results and scientific review, the following recommendations are made:

- reduce extraction to a maximum of 3.5 GL/y to stabilise groundwater levels to minimise the risk of saline intrusion into coastal and inland production wells and protect long-term resource integrity;
- continue model updates when necessary, with new climate and extraction data to refine predictions and support adaptive management; and
- maintain monitoring networks, particularly near the coast, to validate model predictions and detect early signs of interface movement.

5.5. Bramfield groundwater investigation results

Elliston has relied solely on the Bramfield lens for water supply since 1974. Its isolation from the regional distribution network and dependence on a climate-sensitive resource heighten the risk of water availability issues in the short- to medium-term.

A groundwater flow model (DEW, 2026b) was developed to investigate the long-term sustainability of the Bramfield lens by examining: the impacts of declining recharge on aquifer longevity; the response of the seawater interface to current extraction and reduced recharge; and the vulnerability of potential GDEs, both terrestrial and marine, under future climate conditions.

The model simulates changes in groundwater level from 1965 to 2024 which is the extent of available groundwater level data. The model produces a good fit to measured data, matching interannual fluctuations related to rainfall-recharge, and long-term declines related to declining rainfall.

The model also simulates the position and movement of the seawater interface in the coastal zone using the SWI2 MODFLOW package which simulates the interface as a sharp line with no dispersive mixing. The model results compare well with the limited information that is available on the position of the seawater interface, much of which (through geophysics and drilling) was collected during the model build. The modelling study also highlights several areas where further data could be collected to help improve conceptualisation and reduce uncertainty.

For illustrative purposes, the Bramfield lens can be conceptualised in much the same as was presented by Evans (2002a), except for the regional extent of the TS aquifer, which is likely to be absent west of the PWS wells, where the QL is underlain by Basement (Figure 5-10, modified from the conceptual model of Evans 2002a).

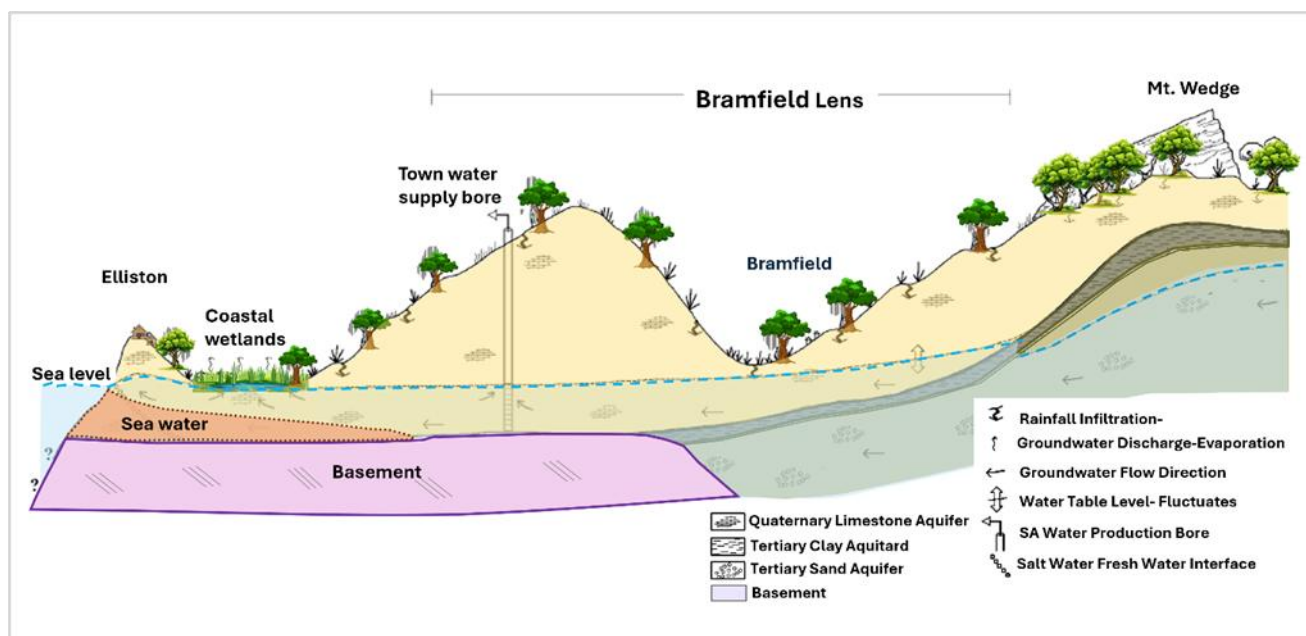


Figure 5-10 Conceptual model of the Bramfield study area

The numerical groundwater model was used to simulate 3 scenarios incorporating variations in pumping and climate projections through to 2050. Scenario 1 represents current full allocation with historical (2015 to 2024) recharge, while Scenario 2 reduces town and irrigation pumping but retains the same historical recharge. Scenario 3 applies the same reduced pumping as Scenario 2 but incorporates lower recharge, reflecting projected rainfall declines under potential climate change scenarios.

Across all scenarios, groundwater levels are projected to continue declining, primarily due to ongoing reductions in rainfall recharge. While groundwater extraction contributes to this decline, pumping at current rates represents a relatively minor component of the overall water balance and has limited influence at the scale of the Bramfield Consumptive Pool.

All scenarios indicate continued inland movement of the seawater interface (defined by the 50:50 isohaline between freshwater and seawater) as groundwater levels fall with intrusion distances ranging from 200 to 600 m across different parts of the study area by 2050. In addition to declining groundwater levels, geological controls may influence both the extent and rate of seawater intrusion. Banks et al. (2026) noted that the basement topography, bedding-plane orientation and variations in depth to basement rock are likely to affect seawater migration within the overlying Bridgewater Formation. sTEM data indicate a decrease in subsurface conductivity beneath a geological wedge interpreted to represent the basement surface, suggesting that seawater intrusion may be preferentially tracking inland along this gently inclined geological boundary. Additional drilling between monitoring well 5830-537 (WAD049) and the PWS production bores would help confirm this conceptual model.

Model results suggest that the 50:50 seawater interface is unlikely to reach the PWS wells by 2050. However, the dispersive mixing zone that occurs ahead of the interface is not represented in the model. Surface geophysics and observed salinity trends indicate that diffusion and dispersion of saline groundwater are already occurring in advance of the modelled seawater interface (Figure 5-11, Banks et al. 2026). The lateral extent of this transition zone may extend hundreds of metres, depending on local groundwater flow conditions and the hydraulic properties of the Bridgewater Formation. Furthermore, groundwater salinity data from the PWS production bores show a continuing upward trend. Although salinity remains within current drinking water guidelines (EC <1,600 $\mu\text{S}/\text{cm}$; TDS <1,000 mg/L), the observed increases suggest that the influence of saline groundwater mixing may be more significant than previously assumed. The outcome of this is that water quality may exceed water quality guidelines while the seawater intrusion interface 'proper' is still hundreds of metres from the town water supply wells.



Figure 5-11 Map showing the likely extent of seawater intrusion (red hatching) near Elliston, SA based on the hydrogeophysics surveys.

Consequently, salinity within the PWS wells is expected to continue increasing under current management settings, even if the modelled 50:50 seawater interface does not reach the wellfield by 2050.

The model is considered fit-for-purpose to inform short- to medium-term water security planning for the Bramfield Consumptive Pool. However, several conceptual uncertainties have been identified. To improve the model and its utility for future decision-making, the following recommendations are made:

- reassess model conceptualisation at the conclusion of the current National Water Grid Fund project to ensure it is still valid and explore any potential impacts on results and scenario assumptions;
- monitor salinity at the newly installed well (5830-357) to track changes in the seawater interface. Ideally, additional monitoring wells should be installed along the transect between 5830-357 and the PWS wells to detect salinity changes associated with seawater intrusion;
- collect additional groundwater level data in and around wetlands to better understand their connection to the aquifer; and
- improve estimates of stock and domestic well use, either through metering or by updating livestock numbers associated with relevant land parcels and tracking changes over time.

Given the continued increase in salinity at production wells and the ongoing decline in recharge, a reduction in PWS allocation is warranted and continued monitoring is essential. It is recommended that SA Water review the operational philosophy of the production wells, particularly considering reduced or discontinued use of production well PWS 2a, which is closest to the seawater interface. Further, as the

groundwater modelling indicates that the freshwater lens is drying from the east towards Bramfield, there are, effectively, no other known locations where additional PWS wells can be installed. Additional modelling of the diffusion zone is also recommended to better understand potential impacts on water quality.

Based on the outcomes of transient modelling, projected climate and rainfall trends, and observed increases in salinity at PWS wells, the following recommendations are proposed to guide future water management under the WAP:

- maintain the allocation limit of 80 ML/y to minimise additional stress on the aquifer;
- enhance monitoring of groundwater levels and salinity to track interface movement and inform adaptive management;
- support targeted data collection to improve model confidence and refine future predictions; and
- develop and implement plans for alternative water sources or infrastructure upgrades to reduce Elliston's vulnerability to future water shortages.

This approach reflects a balanced response, ensuring ongoing access to groundwater while prioritising the protection of aquifer integrity in a changing climate.

5.6. Aquaculture Elliston management area

The Aquaculture Elliston management area consists of a saline QL aquifer located along the coast within the Bramfield management zone, part of the Musgrave PWA. This aquifer supports aquaculture operations and is managed under a dedicated consumptive pool. Ongoing monitoring and reporting are required under a groundwater management plan to ensure sustainable use and to inform adaptive management in response to any emerging risks or environmental changes. This volume will remain fixed for the duration of the 2026 WAP.

5.7. Non-licensed Quaternary aquifer management areas

The non-licensed QL management area is comprised of the unsaturated portion of the QL aquifer, along with the Lincoln South and Uley Wanilla management areas. As discussed in Section 5.1, Lincoln South and Uley Wanilla no longer have the capacity to support any ongoing licensed extraction, including for PWS. While these areas may not be subject to volumetric licensing under the forthcoming 2026 WAP, they remain critical for understanding broader aquifer dynamics and regional water resource conditions.

The unsaturated portion of the QL aquifer may offer limited and highly unreliable water supplies in small, isolated pockets. These areas are likely associated with gaps in groundwater level or geological data used during the spatial modelling process to delineate saturated zones.

To account for potential non-licensed use – such as stock and domestic purposes, and any extractions authorised by the Minister – a defined volumetric capacity is required for the non-licensed QL management area. Due to the absence of reliable groundwater level and recharge data across the unsaturated QL, its resource capacity cannot be calculated using the standard methodology applied to other QL management areas. Instead, the consumptive pool volume is estimated based on projected non-licensed demand within the area. This volume will not be re-calculated annually.

No provision is made for environmental or licensed water allocations within this pool. Should future hydrogeological investigations identify additional water available for consumptive use, a new consumptive pool may be established to reflect that availability.

5.8. Tertiary Sands and Basement aquifer management areas

Detailed information on groundwater level trends and recharge rates for the deeper TS and Basement aquifers is lacking due to limited available data. Due to minimal historical extractions, robust monitoring has not been required for these resources. As a result, the standard methodology used to determine resource capacity for saturated QL management areas was not considered appropriate for these aquifer systems. Instead, existing or historical demand has been used to identify the volume of water available to be used for consumptive purposes (licensed and non-licensed) in place of determining a resource capacity.

5.9. Tertiary Sands aquifer management areas

There is currently no licensed extraction from the TS Consumptive Pool in either the Southern Basins or Musgrave PWAs. Given the depth and confined nature of the TS aquifer, it is unlikely to contribute to, or be hydraulically connected with, any known GDEs. Consequently, groundwater within these management areas is required solely to meet non-licensed demands.

In this context, the existing low volumes of non-licensed extraction are not considered to have any observable adverse impacts on other water resources. Therefore, these volumes are deemed appropriate for defining the resource capacity of the TS management area with an additional nominal allowance to accommodate potential future extractions authorised by the Minister. This volume will not be re-calculated annually.

Should future hydrogeological investigations identify additional water available for consumptive use from the TS aquifer, a new consumptive pool may be established to reflect that availability.

5.10. Basement aquifer management areas

Whilst there is some licensed extraction from the Basement management area in the Southern Basins PWA, no licensed extraction currently occurs from the Basement management area in the Musgrave PWA. Due to the depth of the confined Basement aquifer, it is unlikely to contribute to, or be hydraulically connected with, any known GDEs (see Section 3.2.6). Accordingly, groundwater in these management areas is required solely to meet licensed and non-licensed demands in the Southern Basins PWA, and non-licensed demands in the Musgrave PWA.

Consistent with the overlying TS aquifer, current extractions are considered to have no observable adverse impacts on other water resources. Therefore, these volumes are deemed appropriate for defining the resource capacity of the Basement aquifer management area with an additional nominal allowance to accommodate potential future extractions authorised by the Minister. This volume will not be re-calculated annually.

Should future hydrogeological investigations identify additional water available for consumptive use from the Basement aquifer, a new consumptive pool will be established in accordance with the WAP.

Refinement of the estimates of the capacity of the TS aquifers (Poelpena Formation in the Musgrave PWA and Wanilla Formation in the Southern Basins PWA) and the Basement aquifers is not possible due to a lack of new data and; therefore, it is suggested that the existing estimates of resource capacities as outlined in the previous WAP should be retained (Table 5-5).

Table 5-5 Estimated resource capacities of the Non-licensed Quaternary Limestone, Tertiary Sand and Basement management areas

PWA	Management area	Domestic use (ML)	Stock use (ML)	Minister's authorisation (ML)	Licensed use (ML)	Resource capacity (ML)
Southern Basins	Non-licenced Quaternary	4.8	1.42	5.0	0	11.22
	Tertiary Sand	1.12	23.02	5.0	0	29.14
	Basement	0.3	23.0	5.0	462.2	490.5
Musgrave	Aquaculture Elliston	0.0	0.0	0.0 ^a	10.0	10.0
	Non-licenced Quaternary	13.0	76.0	5.0	0.0	94.0
	Tertiary Sand	1.1	62.3	5.0	0.0	68.4
	Basement	0.0	62.3	5.0	0.0	67.3

^aNote that the Minister's authorisation is not enabled for this purpose-based consumptive pool developed under the previous Plan.

6. Water demand

Section 53(1)(f) of the *Landscape South Australia Act 2019* requires that a water allocation plan assess the capacity of the resource to meet current and future water demands on a continuing basis. These demands include both consumptive and non-consumptive uses.

Consumptive demands include licensed water use (for example, irrigation and PWS) as well as non-licensed uses such as stock and domestic extraction and water authorised by the Minister under Section 105 of the *Landscape South Australia Act 2019* (for example, emergency firefighting and public works). Non-consumptive demands include groundwater processes such as aquifer throughflow and groundwater discharge that contribute to environmental values.

This section summarises the estimation of water demand used to inform the assessment of resource capacity and allocation approaches considered for the 2026 WAP.

6.1. Non-licensed water demand

Non-licensed water use includes stock and domestic extraction and water authorised by the Minister under Section 105 of the *Landscape South Australia Act 2019*. Estimates of these demands were established for the 2016 WAP and have been reviewed as part of this assessment.

Community consultation undertaken to inform the 2026 WAP indicated that stock and domestic water use has remained largely unchanged since the 2016 WAP. Accordingly, a full recalculation of demand was not undertaken. However, estimates were updated where required to align with revised consumptive pool and management area boundaries.

It is considered unlikely that stock and domestic water use will vary significantly over the life of the 2026 WAP; however, estimates of use are inherently uncertain and may change in response to land use, climatic conditions and market drivers. A nominal allowance of 5 ML per management area has been applied to represent potential future Ministerial authorisations.

6.1.1. Stock water use estimation

Stock water demand was estimated by normalising livestock numbers to a common unit, the Dry Sheep Equivalent (DSE). The DSE provides a standardised measure of grazing pressure and enables comparison across different livestock classes.

The Eyre Peninsula Demand and Supply Statement (DFW 2011a) estimates water consumption for sheep at 10 L/head/day, equivalent to 7.14 L/DSE/day. This estimate, based on advice from PIRSA (Mary Chirgwin, PIRSA Biosecurity, personal communication, September 2010), includes an allowance for on-farm losses and is consistent with the approach adopted for the 2016 WAP.

Livestock numbers were obtained from the Primary Industries Information Management System (PIIMS), which provides spatially referenced livestock data for properties registered under the *Livestock Act 1997*. This dataset enables stock numbers to be assigned to management areas and aquifers.

Stock water demand was calculated by spatially intersecting PIIMS parcel data with recharge zones and management area boundaries. Stock numbers were converted to DSE values and subsequently to water demand using the consumption rate of 7.14 L/DSE/day (Stewart 2013). This approach is consistent with previous assessments and provides an estimate appropriate for regional-scale resource evaluation.

The distribution of estimated stock water use across Licensed QL aquifer management areas is indicated in Table 6-1.

6.1.2. Domestic water use estimation

Domestic water use was estimated by combining the number of wells designated for domestic purposes with an assumed annual per-well consumption.

Well data were sourced from the SA Geodata database, which records the intended purpose of wells at the time of permitting. Wells classified as “domestic use” were included in the assessment.

Average household water consumption was assumed to be 280 kL/year per well, based on *Water for Good* (DWLBC, 2009). This value represents average mains water consumption in the greater Adelaide region prior to water restrictions and is considered a conservative estimate of groundwater use, recognising that domestic supply in the region is often supplemented by rainwater and, in some cases, mains supply.

Domestic water demand was calculated by multiplying the number of domestic wells in each management area by the assumed annual usage rate. The resulting distribution of demand across QL aquifer management areas is presented in

Table 6-1.

6.1.3. Summary of non-licensed demand

The updated assessment of non-licensed demand indicates that:

- stock and domestic water use represent a relatively small proportion of total groundwater demand compared to licensed extraction and long-term recharge;
- PIIMS-derived stock numbers are generally lower than those used in earlier assessments but are considered to better reflect current land use and improve estimation accuracy; and
- the adoption of a higher unit water consumption rate offsets the lower stock numbers, resulting in total demand estimates that are comparable to those adopted for the 2016 WAP.

6.2. Licensed water demand

Licensed groundwater extraction data for the Southern Basins and Musgrave PWAs are maintained by the Department for Environment and Water in the Water Information and Licensing Management Application and, more recently, the MyWater registry. These datasets include annual records of licensed allocation volumes and metered extraction since the 2004–05 water-use year.

Recent data indicate that licensed extraction is strongly dominated by PWS, particularly from the Uley South Basin, which accounted for approximately 89% of total extraction within the Southern Basins PWA in 2023–24 (Table 6-1 and Figure 6-1).

Historical trends indicate a general decline in groundwater demand over time, attributed to water efficiency measures and alternative supply sources. However, short-term variability occurs, including a 15% increase between 2023–24 and 2024–25 (Figure 6-2, Table 6-2 and Table 6-3).

Table 6-1 Metered groundwater extraction by use type, 2023–24

PWA	Irrigation/Industrial use (ML)	Public water supply use (ML)	Total use (ML)
Southern Basins	69.13	6,153.66	6,222.79
Musgrave	7.88	57.50	65.38
Total	77.01	6,211.16	6,288.17

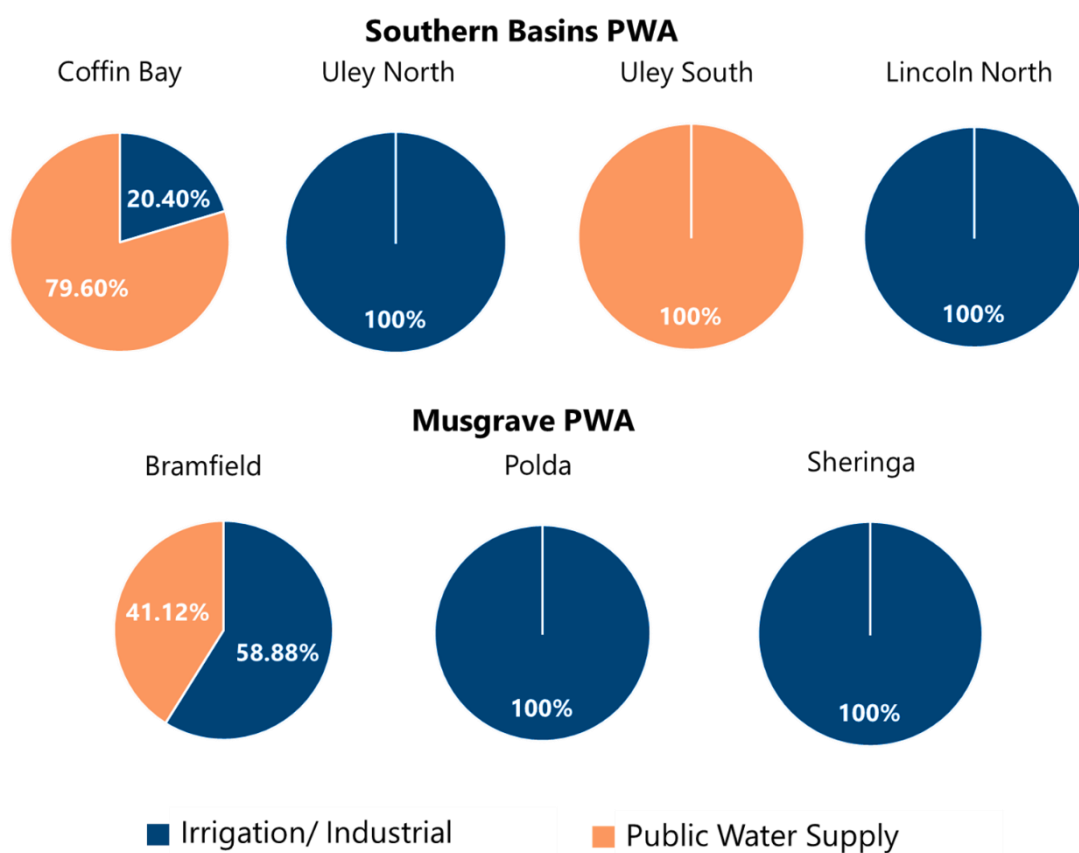


Figure 6-1 Portion of water access entitlements used for differing purposes for all Quaternary Limestone consumptive pools in the Southern Basins and Musgrave PWAs

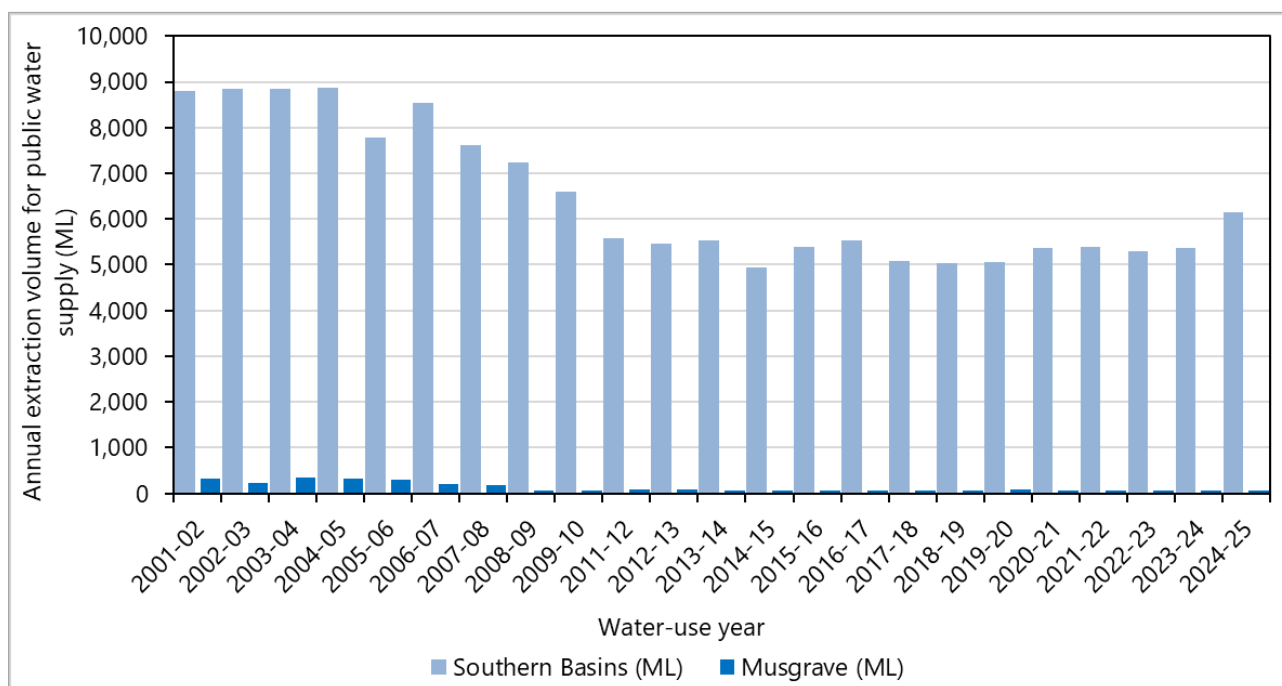


Figure 6-2 Public water supply extraction, 2001–02 to 2024–25

Table 6-2 Metered usage (ML) for licensed Quaternary Limestone aquifer management areas 2015–16 to 2024–25

PWA (ML)	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24	2024–25
Southern Basins	5,577.6	5,127.5	5,096.5	5,098.4	5,410.7	5,443.8	5,342.8	5,365.9	5,691.7	6,222.8
Musgrave	66.3	88.9	88.1	91.9	69.9	69.1	59.5	57.0	57.0	65.4
Total	5,643.9	5,216.4	5,184.6	5,190.3	5,480.6	5,512.9	5,402.3	5,422.9	5,748.7	6,288.2

Table 6-3 Metered usage (ML) for public water supply 2015–16 to 2024–25.

PWA (ML)	2015–16	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22	2022–23	2023–24	2024–25
Southern Basins	5,378.8	5,528.6	5,075.0	5,042.7	5,065.2	5,364.5	5,382.4	5,291.9	5,365.9	6,159.2
Musgrave	54.7	54.4	73.5	73.1	79.5	56.8	59.9	52.3	52.4	57.5
Total	5,433.5	5,583.0	5,148.5	5,115.8	5,144.7	5,421.3	5,442.3	5,344.2	5,418.3	6,216.7

6.2.1. Southern Basins PWA

In the Southern Basins PWA, groundwater use is predominantly associated with PWS with SA Water holding approximately 98% of the licensed allocation. Irrigation and industrial use are relatively limited, with 12 licences primarily issued for activities such as golf course irrigation. There is currently no licensed demand associated with mining in this area.

6.2.2. Musgrave PWA

In the Musgrave PWA, PWS accounts for approximately 26% of the licensed allocation, held by SA Water. Irrigation and industrial use are supported by 7 licences with horticulture representing the dominant activity. There is currently no licensed demand associated with mining in this area.

6.2.3. Assessment of demand relative to resource capacity

Resource capacity is estimated from recharge ($\text{Recharge Area} \times \text{Recharge Rate}$) and is expressed, for accounting purposes, as the total volume available to meet both consumptive and non-consumptive demands. Integrated assessments consider the relationship between resource capacity, non-consumptive requirements, non-licensed use, licensed demand, and the volume of water available for allocation.

Table 6-4 and Table 6-5 present the results of the assessment of the capacity and demands for the Southern Basin and Musgrave PWA water resources.

Table 6-4 Assessment of the capacity and demands for Southern Basins PWA water resources

Management area	Resource capacity (ML) (Total demand)	Non-consumptive demand (ML)	Consumptive demands (ML)	Non-licensed demand			Maximum volume of water available for licensed use (ML) ^a	Licensed demand (ML) ^a	Excess water (ML) ^a
				Domestic demands (ML)	Stock demands (ML)	Minister authorisations (ML)			
Coffin Bay	345.2	206.7	138.5	0.6	0.0	5.0	132.9	132.9	0.0
Uley North	1,004.0	925.6	78.4	0.6	22.3	5.0	50.5	50.5	0.0
Uley South	NA	NA	3,508.1 ^b	0.0	3.1	5.0	3,500.0	3,500.0	0.0
Lincoln North	243.8	121.9	121.9	2.8	31.0	5.0	83.1	83.1	0.0
Southern Basins Non-licensed	NA	NA	11.2	4.8	1.4	5.0	0.0	0.0	0.0
Tertiary Sands	NA	NA	29.1	1.1	23.0	5.0	0.0	0.0	0.0
Basement	NA	NA	490.5	0.3	23.0	5.0	462.2	462.2	0.0

^a Volumes at the date of approval of the 2026 Plan

^b Figure, subject to principle 1c the consumptive pool for the 2026–27 water-use year, is 6,308.1 ML while the desalination plant becomes operational.

Note: Resource capacity = Recharge area x Recharge rate

Note: Resource capacity = Non-consumptive demand + Consumptive demand which is (Non-licensed demand + Licensed demand + Excess water)

Table 6-5 Assessment of the capacity and demands for the Musgrave PWA water resources

Management area	Resource capacity (ML) (Total demand)	Non-consumptive demand (ML)	Consumptive demands (ML)	Non-licensed demand			Maximum volume of water available for licensed use (ML) ^a	Licensed demand (ML) ^a	Excess water (ML) ^a
				Domestic demands (ML)	Stock demands (ML)	Minister authorisation s (ML)			
Bramfield	NA	NA	577.0	18.2	77.0	5.0	476.8	0.0	0.0
Polda	2,951.8	2,894.2	57.6	2.5	27.2	5.0	22.9	22.9	0.0
Sheringa	3,271.9	3,034.4	237.4	3.6	45.9	5.0	182.9	182.9	0.0
Musgrave non-licensed	NA	NA	94.0	13.0	76.0	5.0	0.0	0.0	0.0
Tertiary	NA	NA	68.4	1.1	62.3	5.0	0.0	0.0	0.0
Basement	NA	NA	67.3	0.0	62.3	5.0	0.0	0.0	0.0
Aquaculture Elliston	NA	NA	10.0	0.0	0.0	0	10.0	10.0	0.0

^a Volume at the date of approval of the 2026 Plan

7. Adaptive management

7.1. Background

Groundwater resources across the Eyre Peninsula exhibit characteristics that influence their response to extraction and recharge. These systems are predominantly rainfall-dependent and, in many areas, are characterised by relatively low aquifer robustness, defined by limited saturated thickness and constrained storage capacity relative to recharge.

Therefore, groundwater levels in these systems are sensitive to temporal variability in rainfall and extraction. This sensitivity supports the application of adaptive management approaches in which the volume of water available for consumptive use may vary in response to observed changes in aquifer condition.

Adaptive management concepts applied in this context are consistent with the principles of the *National Water Initiative* (COAG 2004) which recognises the need to account for uncertainty and variability in groundwater systems, particularly in regions subject to climatic variability. Adaptive management based on groundwater level response has been applied to selected QL aquifers where:

- groundwater levels demonstrate a measurable response to recharge variability; and
- sufficient monitoring data are available to characterise aquifer condition.

The aquifers to which this approach has been applied are:

- Uley North (Southern Basins PWA); and
- Bramfield, Poldia, and Sheringa (Musgrave PWA).

In these systems, groundwater levels measured during autumn (March to April) are used as an indicator of aquifer condition, representing a period following peak seasonal demand and prior to significant winter recharge.

7.2. Development of the adaptive management approach

7.2.1. Previous approach (2016 Framework)

Under the 2016 WAP, water access entitlements provided a proportional share of the consumptive pool in selected management areas. While entitlement shares remained fixed, the volume of groundwater available varied annually in response to resource conditions.

For the QL aquifers management areas, Lower Storage Triggers were established through a risk assessment of aquifer robustness, defined as the ratio of aquifer storage to recharge. Aquifers with high robustness (that is, large storage volume relative to recharge) may buffer natural climate variability more effectively (IAH 2004).

Each year, aquifer storage was estimated using groundwater level data and the Aquaveo™ Arc Hydro Groundwater model. Storage was expressed as a percentage of a reference condition based on 1993 groundwater levels with autumn selected as the representative assessment season to reflect post-extraction, pre-recharge conditions.

The 2016 WAP defined three storage condition thresholds (Figure 7-1).

- **Upper Storage Trigger** – aquifer in good condition (100% allocation).
- **Mid Storage Trigger** – low to moderate risk, with allocation varying proportionally.
- **Lower Storage Trigger** – high risk, with allocation reduced to zero for the variable component.

The relationship between storage and allocation was continuous and management-area specific with allocation volumes varying proportionally with changes in storage. This methodology was supported by modelling and technical analyses (Stewart et al. 2012; Stewart 2013).

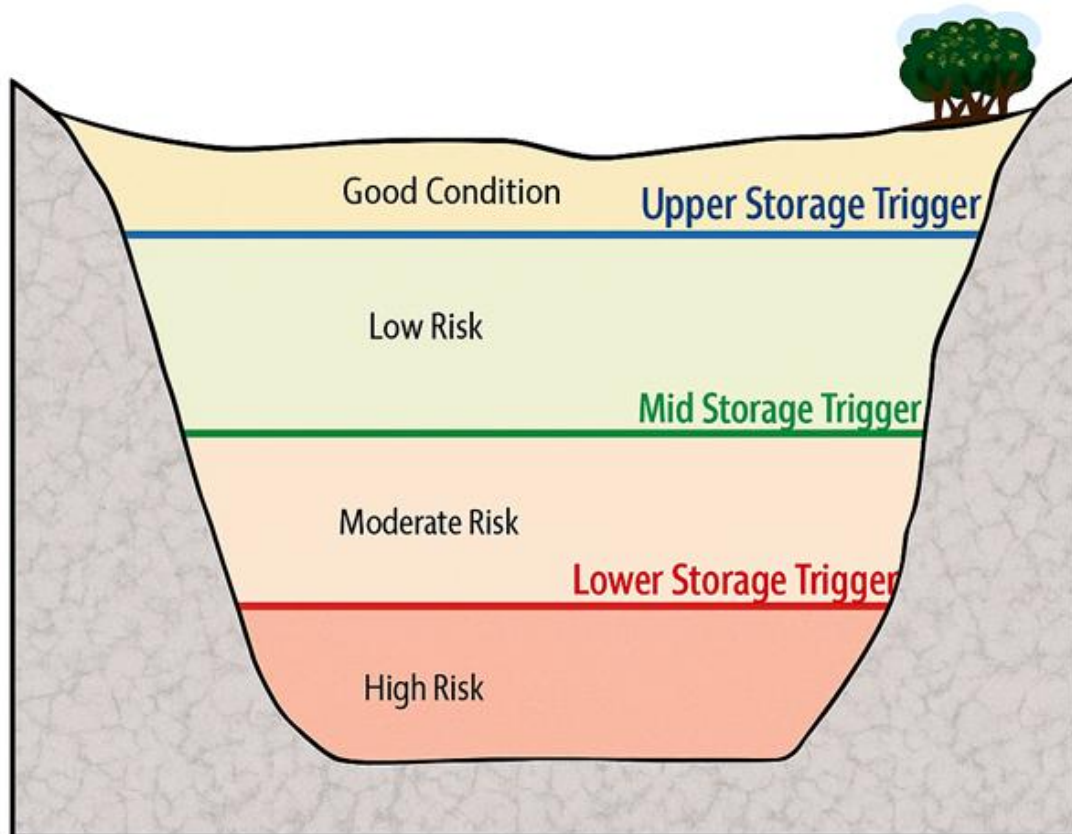


Figure 7-1 Schematic representation of trigger level in a typical aquifer

Figure 7-2 shows how the variable component of the consumptive pool volume for a particular year varies depending on how the calculated level of storage relates to the various trigger levels for a hypothetical management area. The rate of change defines how allocation responds to changes in storage. For example, a rate of 0.5 means that for every 1% change in storage, the variable component changes by 0.5% of the maximum licensed volume.

This methodology is grounded in scientific evidence from technical reports supporting the WAP, including:

- Stewart et al. (2012); and
- Stewart (2013).

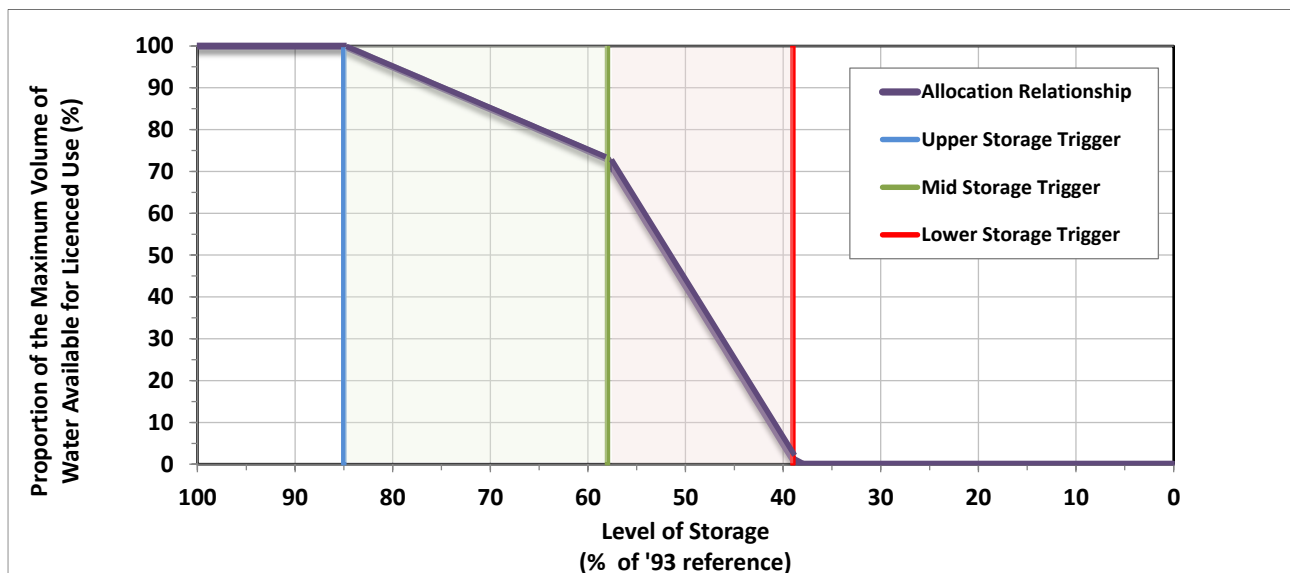


Figure 7-2 Schematic representation of trigger levels in a hypothetical consumptive pool

7.2.2. Revised Approach (2026 Framework)

To improve transparency, robustness, and operational simplicity, the allocation framework has been revised for the 2026 WAP.

The updated approach replaces the proportional allocation model with a discrete, 3-step allocation system, based on defined groundwater level trigger thresholds.

- **100% allocation** when conditions exceed the Upper Trigger Level.
- **65% allocation** when conditions fall between the Upper and Lower Trigger Levels.
- **35% allocation** when conditions fall below the Lower Trigger Level.

This approach simplifies implementation while maintaining a precautionary response to declining groundwater levels. While a minimum allocation of 35% is incorporated into the framework, it remains possible for allocations to be further restricted under provisions of the *Landscape South Australia Act 2019* (for example, Sections 109 and 130) if resource condition warrants.

The new upper and lower storage triggers are presented in Table 7-1 and illustrated in Figure 7-3 to Figure 7-6.

Table 7-1 2026 WAP trigger levels and rates of change for the saturated Quaternary Limestone management areas

PWA	Management Area	Upper Storage Trigger	Lower Storage Trigger
		(% of 1993 reference)	(% of 1993 reference)
Southern Basins	Uley North	86	82
	Bramfield	80	76
Musgrave	Polda	82	74
	Sheringa	87	81

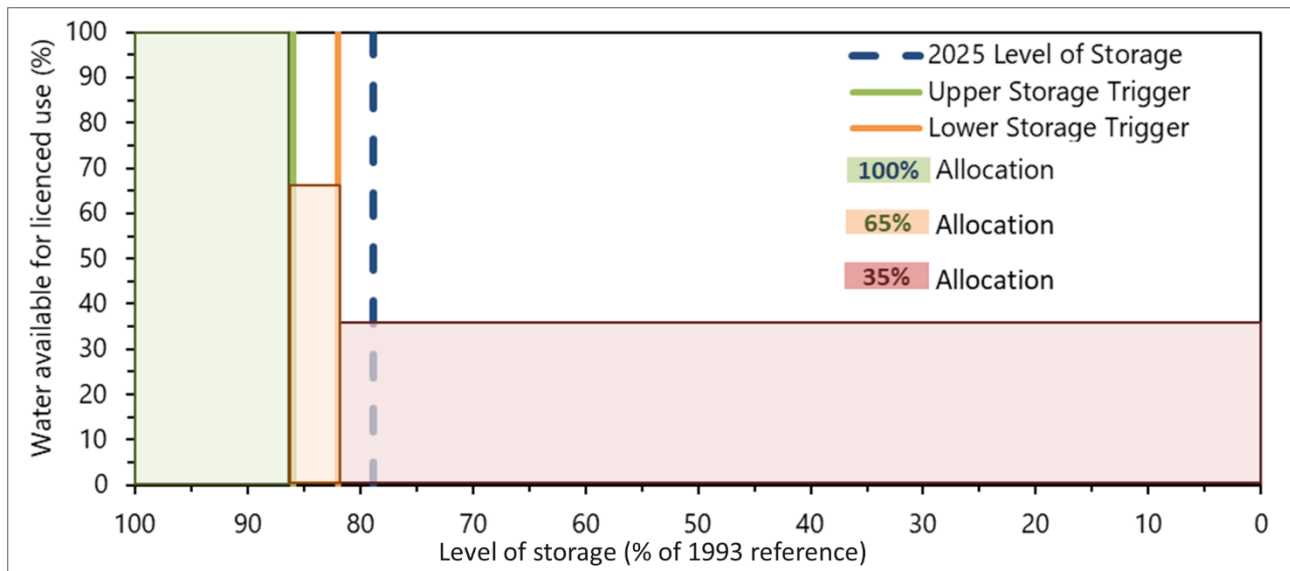


Figure 7-3 Proportional relationship for the Uley North management area

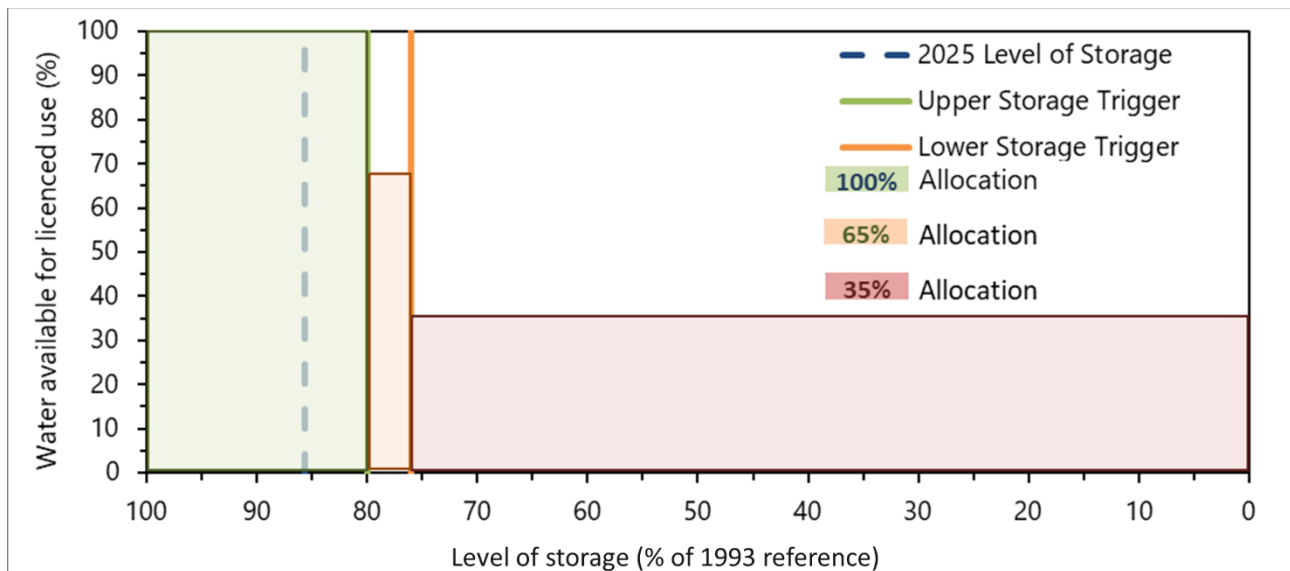


Figure 7-4 Proportional relationship for the Bramfield management area

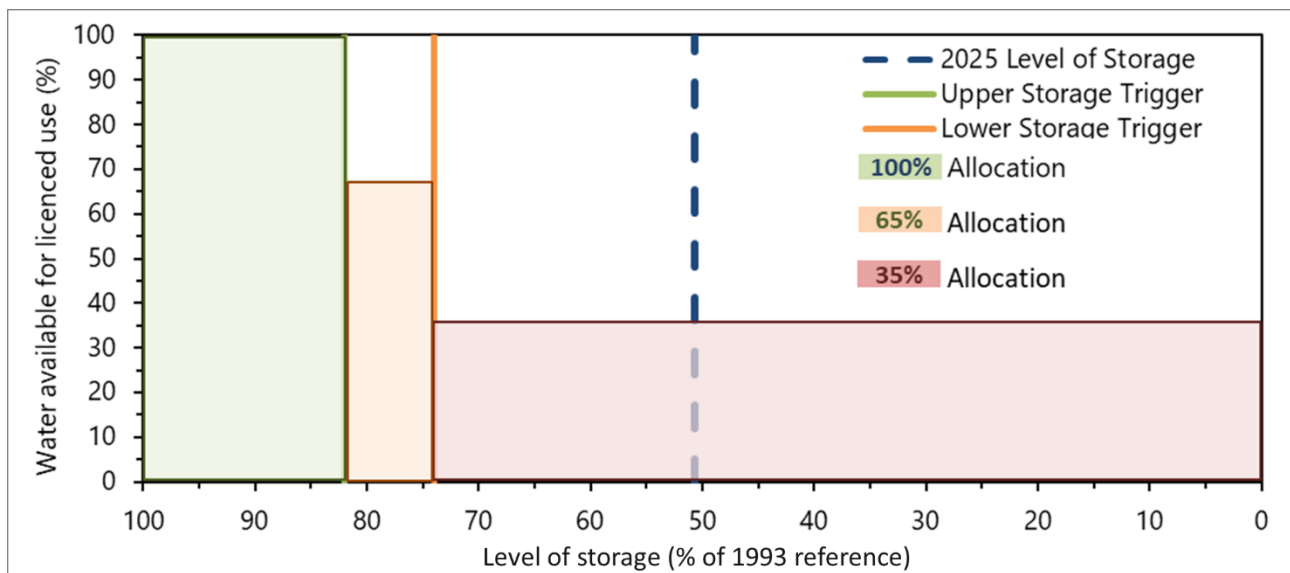


Figure 7-5 Proportional relationship for the Poldra management area

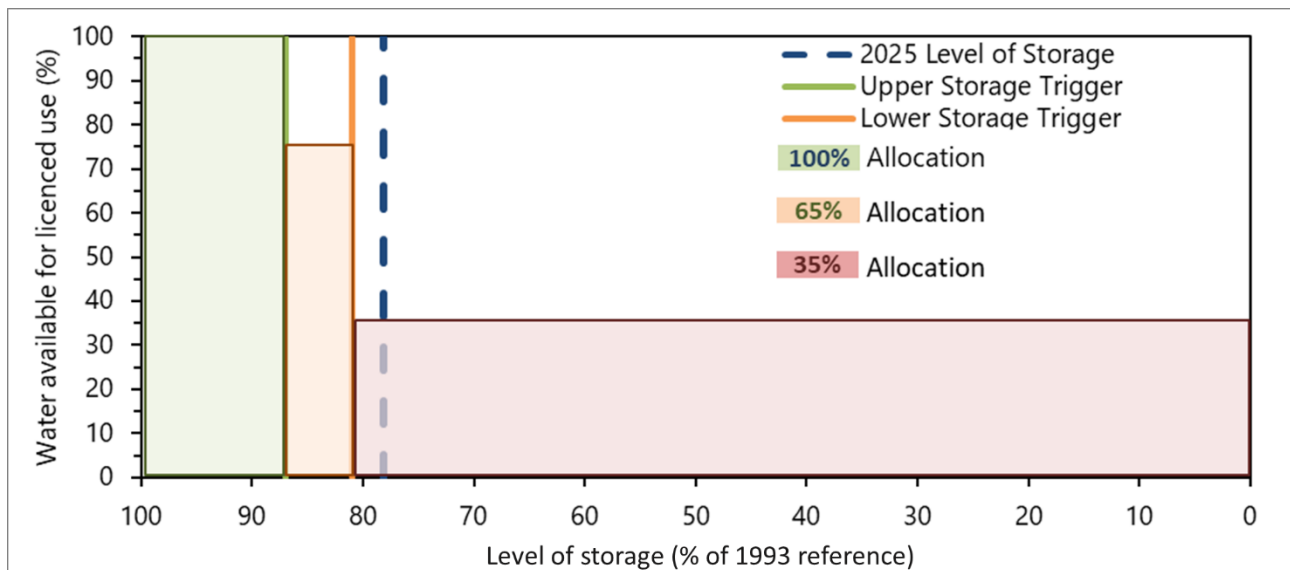


Figure 7-6 Proportional relationship for the Sheringa management area

7.2.3. Conversion of storage triggers to groundwater level triggers

The revised methodology replaces reliance on annual groundwater modelling with a direct assessment of groundwater levels against predefined trigger values.

Groundwater level triggers were derived by establishing statistical relationships between modelled storage volumes and observed groundwater levels for individual wells. For each management area, regression analyses were undertaken to relate autumn groundwater levels to modelled aquifer storage.

Across 4 management areas, 43 monitoring wells were assessed. Of these:

- 38 wells demonstrated strong correlation with modelled storage ($R^2 > 0.7$) and were retained; and

- 5 wells exhibited poor correlation and inconsistent behaviour relative to the broader aquifer system and were excluded.

These discrepancies are attributed to localised influences (for example, pumping effects, lithological variation or land use). The retained wells form the basis of the revised monitoring network (Table 7-2).

Figure 7-7 to Figure 7-12 illustrate how these triggers were derived by comparing autumn groundwater levels to storage volumes calculated by the original model for the corresponding year, establishing proportional relationships for each well.

The resulting groundwater level triggers provide a simplified and transparent means of assessing aquifer condition without requiring annual model updates, while maintaining alignment with the underlying storage-based framework.

Table 7-2 Monitoring wells to be used in the monitoring of resource condition triggers and correlations between autumn groundwater levels and modified aquifer storage

	Well no.	Groundwater level trigger values		
		Upper Storage Trigger (RSWL mAHD)	Lower Storage Trigger (RSWL mAHD)	Data Fit (R ²)
Uley North	6028-872 – ULE172	31.1	30.8	0.95
	6028-910 – ULE077	19.8	19.7	0.70
	6028-854 – ULE086	58.8	58.6	0.91
	6028-1607 – ULE179	102.7	101.9	0.78
	6028-1610 – ULE183	74.2	73.8	0.72
	6028-1159 – WNL35	30.9	30.6	0.81
	6028-1612 – ULE182	75.8	75.3	0.85
Bramfield	5930-57 – TAA005	19.7	19.4	0.89
	5930-1063 – TAA057	22.6	22.1	0.91
	5930-27 – TAA058	15.2	14.9	0.97
	5930-1542 – WAD040	3.2	2.8	0.77
	5830-235 – WAD031	6.7	6.4	0.81
	5931-297 – TAA029	10.3	10.0	0.90
	5930-57 – TAA005	19.7	19.4	0.89
Sheringa	5930-754 – KPW037	54.3	54.0	0.76
	5930-753 – KPW038	53.2	52.8	0.92
	5930-755 – KPW055	51.0	50.6	0.89
	5930-757 – KPW068	54.3	54.1	0.86
	5930-546 – PER001	14.4	14.2	0.87
	5930-535 – PER015	6.2	5.7	0.91
	5930-550 – PER030	9.3	9.0	0.85
	5930-453 – WAY015	6.8	6.4	0.97
	5930-361 – WAY031	1.3	1.1	0.93
	5930-315 – WAY056	3.1	2.7	0.88
	5930-754 – KPW037	54.3	54.0	0.76
	5930-753 – KPW038	53.2	52.8	0.92
Polda	5930-1000 – SQR008	35.60	35.30	0.98
	5930-1001 – SQR009	35.10	34.80	0.98
	5930-912 – SQR021	41.30	41.00	0.88
	5930-1004 – SQR028	36.30	36.00	0.98
	5930-1005 – SQR031	35.40	35.20	0.98
	5931-128 – SQR085	40.10	39.80	0.87
	5931-123 – SQR086	42.10	41.90	0.88
	5930-1050 – SQR097	35.30	35.00	0.93
	5930-1046 – SQR105	42.40	42.00	0.83
	5930-1059 – SQR106	37.00	36.60	0.97
	5930-1073 – SQR114	38.60	38.20	0.98
	5931-200 – TIN079	33.50	33.30	0.85

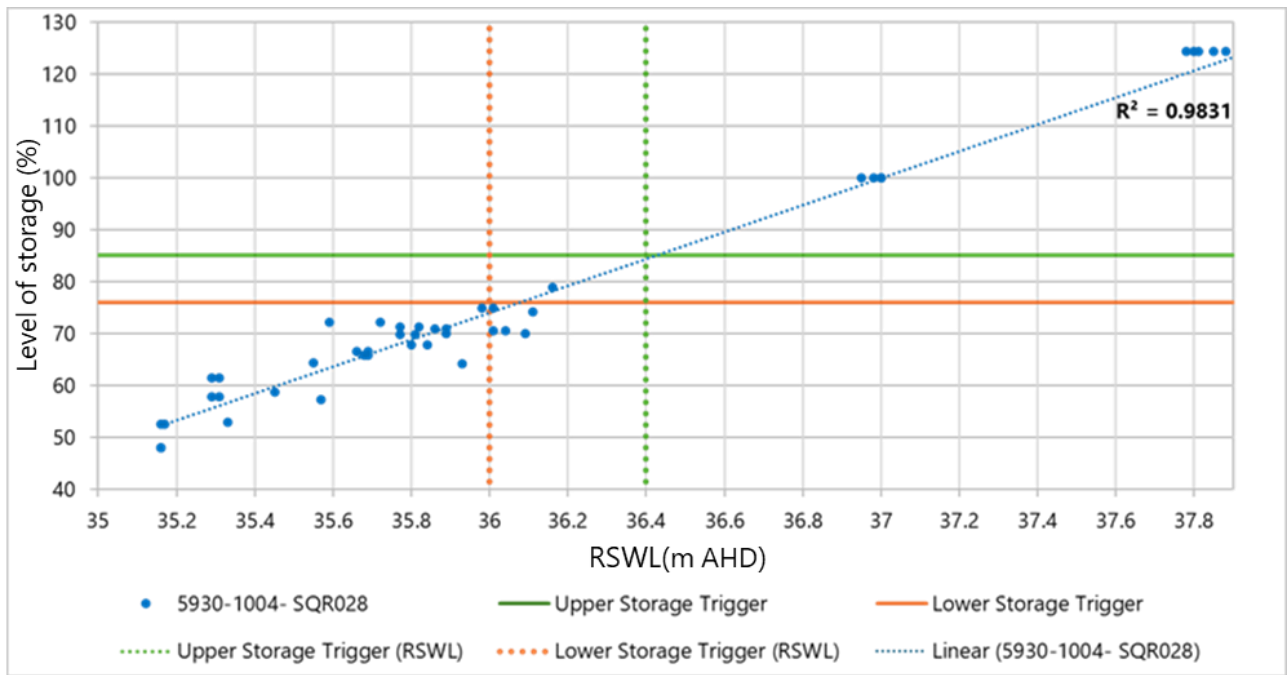


Figure 7-7 Example of conversion of the assessed level of storage vs RSWL – Polda

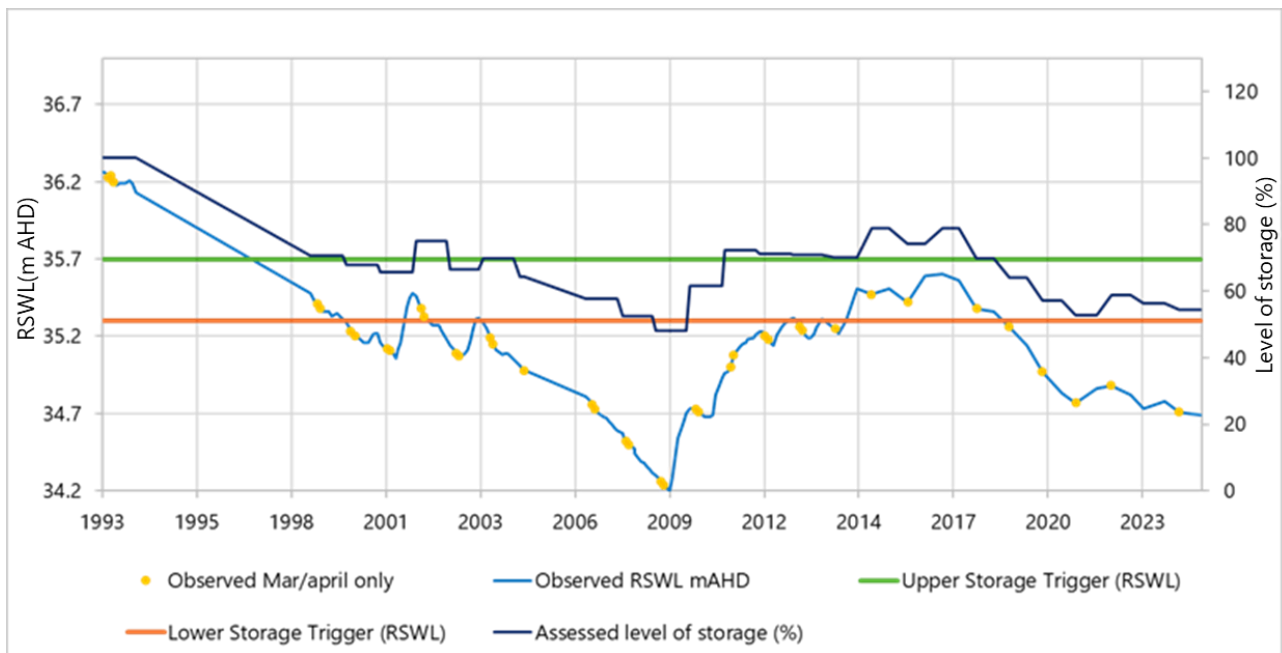


Figure 7-8 Example of new groundwater level triggers RSWL – Polda

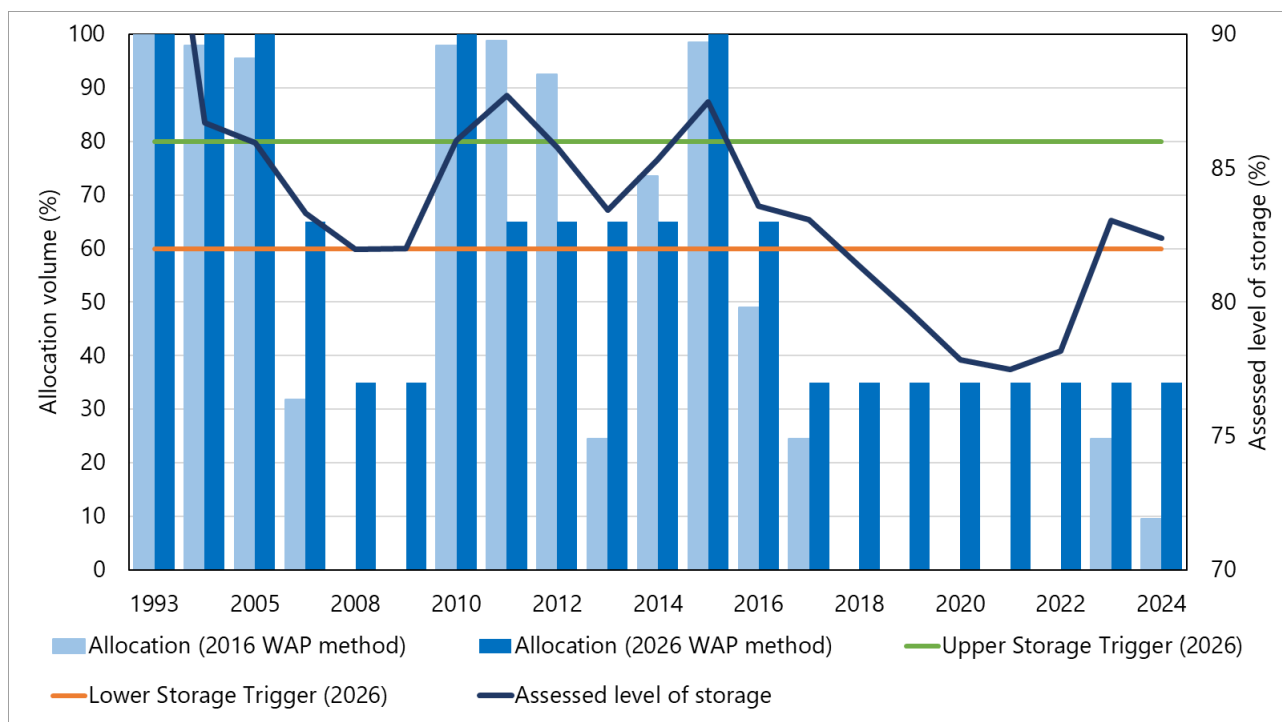


Figure 7-9 Uley North – results of modelling compared to the groundwater level method

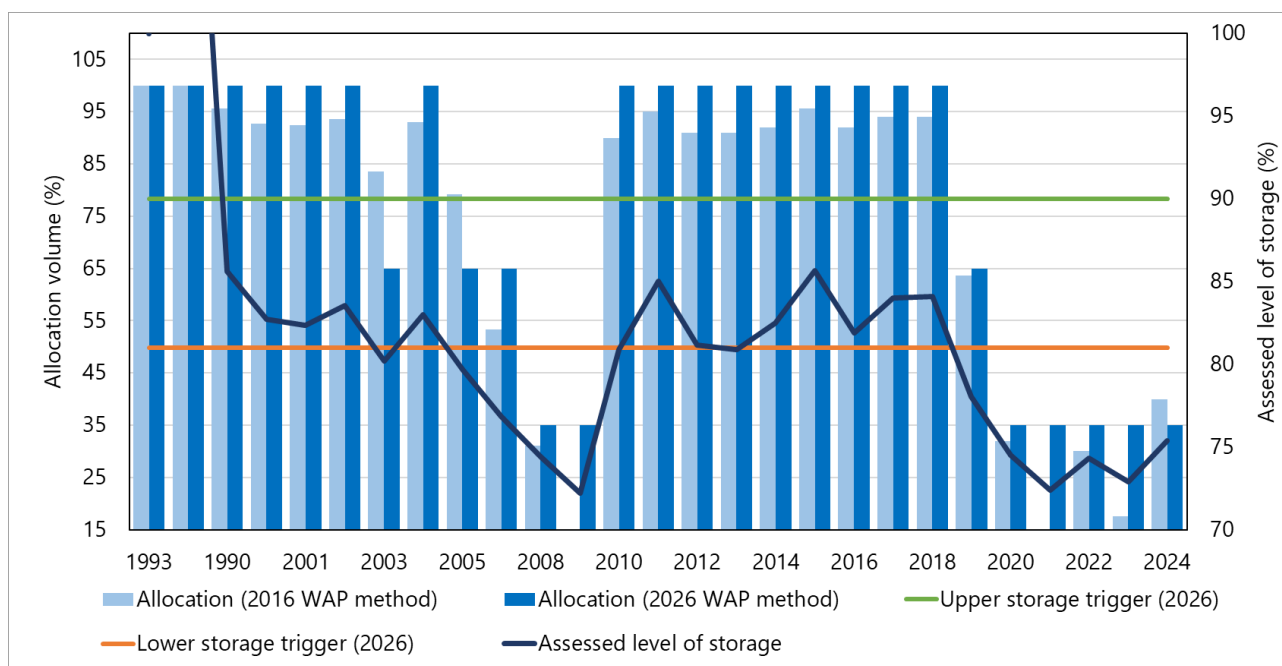


Figure 7-10 Bramfield – results of modelling compared to the groundwater level method

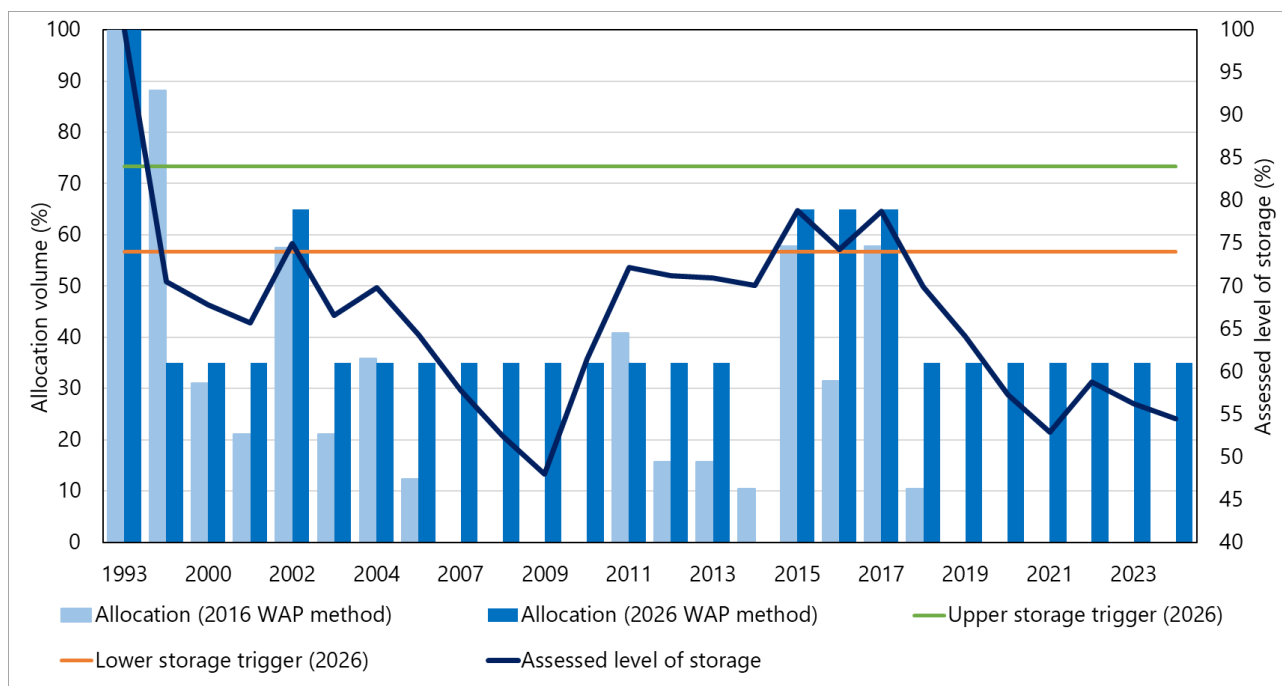


Figure 7-11 Poldra – results of modelling compared to the groundwater level method

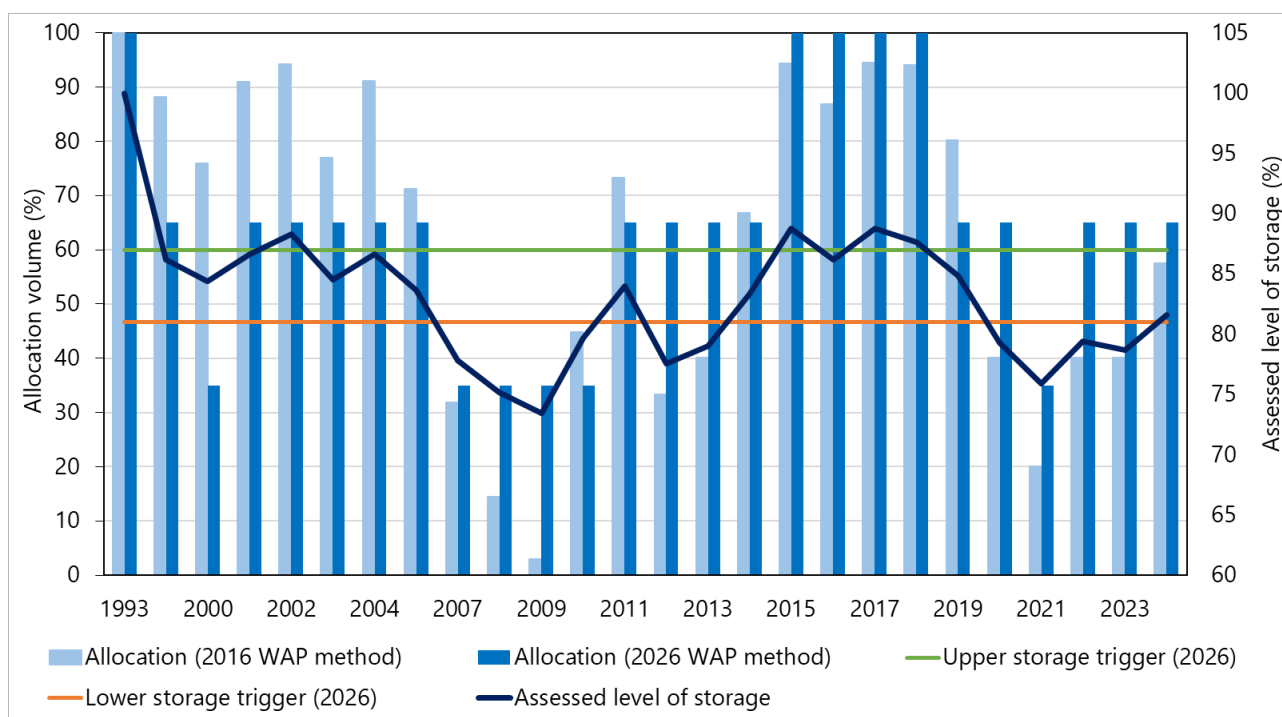


Figure 7-12 Sheringa – results of modelling compared to the groundwater level method

7.2.4. Adaptive management method

The analyses presented in this report support the adoption of a simplified, groundwater level-based adaptive management approach to inform the determination of the variable component of consumptive pool volumes.

It is recommended that, for each water-use year, groundwater levels from all trigger monitoring wells within a management area are assessed against defined Upper and Lower Trigger Levels. Each well is categorised according to its position relative to these thresholds.

The variable component of the consumptive pool volume can then be determined using the mode, defined as the most frequently occurring trigger category across all wells within the management area. This approach provides a robust measure of overall aquifer condition and reduces sensitivity to localised variability in individual monitoring wells.

Based on this method, the following allocation framework is recommended.

- **Upper trigger category (above Upper Trigger Level):**
where the modal category exceeds the Upper Trigger Level, the variable component of the consumptive pool volume would equate to 100% of the maximum volume of water available for licensed use for the management area.
- **Mid trigger category (between Upper and Lower Trigger Levels):**
where the modal category falls between the Upper and Lower Trigger Levels, the variable component would equate to 65% of the maximum volume of water available for licensed use.
- **Lower trigger category (below Lower Trigger Level):**
where the modal category falls below the Lower Trigger Level, the variable component would equate to 35% of the maximum volume of water available for licensed use.

This discrete, mode-based approach is considered to provide a transparent and reproducible method for linking groundwater level observations to allocation outcomes. By relying on the most frequently occurring condition across the monitoring network, the method reflects the prevailing aquifer state, rather than being unduly influenced by isolated or anomalous measurements.

Where the distribution of wells results in an equal frequency between 2 trigger categories, it is recommended that the more conservative category be adopted to determine the variable component of the consumptive pool volume.

In circumstances where monitoring data are incomplete – for example, where an observation well cannot be monitored during the assessment period and a suitable replacement cannot be established – it is recommended that an expert assessment be undertaken.

This assessment should be conducted by DEW on behalf of the EP LB, in consultation with DEW Water Science and Monitoring, and should consider whether sufficient data remain to reliably apply the mode-based method. Where necessary, supplementary analysis may be undertaken to support determination of the variable component.

Similarly, where anomalous monitoring data are identified, it is recommended that these data be reviewed and, where appropriate, excluded from the assessment provided that sufficient data remain to ensure that the resulting determination is representative of aquifer condition.

All such assessments and decisions should be clearly documented to maintain transparency and auditability.

7.3 Systems not subject to adaptive management

Adaptive management has not been applied uniformly across all groundwater systems. The exclusion of certain management areas reflects differences in hydrogeological behaviour, data availability and conceptual understanding.

7.3.1. Coffin Bay

Groundwater levels in the Coffin Bay management area are influenced by hydraulic connectivity with the coastal boundary. This influence moderates fluctuations in groundwater levels, resulting in relatively stable water level conditions compared to inland systems.

Available monitoring data indicate that groundwater levels have not historically exhibited variability of sufficient magnitude to meaningfully engage trigger-based allocation mechanisms. In this context, groundwater level is not considered a sensitive indicator of resource condition.

Key risks to the resource are associated with saltwater up-coning. These risks are more appropriately addressed through operational and site-specific management measures, including extraction controls and salinity monitoring.

7.3.2. Uley South

The Uley South aquifer has been extensively characterised through numerical groundwater modelling, providing a well-developed understanding of aquifer dynamics and long-term behaviour.

Groundwater extraction in this system is dominated by PWS, and management is informed by model-based assessment and ongoing monitoring of groundwater levels and salinity. Under these conditions, groundwater level variability alone is not relied upon as the primary indicator of resource condition for determining allocation adjustments.

7.3.3. Lincoln North

The application of adaptive management in the Lincoln North area is constrained by limitations in available data, including gaps in long-term groundwater level monitoring and incomplete records of historical extraction.

These limitations reduce confidence in the interpretation of groundwater level trends as an indicator of resource condition. Improved monitoring coverage and metering would support future reassessment of the applicability of adaptive management approaches.

Immediate implementation of metering for all licensed users is recommended to enable future consideration of adaptive strategies.

7.3.4. Aquaculture Elliston

This specific consumptive pool was established following a rigorous assessment that confirmed sustainable extraction. As with Uley South, a fixed allocation is appropriate as there is one license used with ongoing monitoring and reporting requirements under a groundwater management plan to ensure

sustainable use and to inform adaptive management in response to any emerging risks or environmental change.

7.3.5. Deeper groundwater resources

Groundwater systems within the TSs and Basement units are generally hydraulically disconnected from contemporary recharge processes and exhibit limited short-term response to rainfall variability.

These aquifers are characterised by longer groundwater residence times and subdued groundwater level responses. As a result, annual groundwater level variation is not considered an appropriate basis for adaptive allocation in these systems.

8. Monitoring

8.1. Purpose and role of monitoring

Groundwater monitoring across the Eyre Peninsula PWAs provides the primary evidence base to:

- assess groundwater resource condition and long-term trends;
- support allocation decision-making under the 2026 WAP;
- detect and manage risks such as groundwater level decline and salinity increase; and
- evaluate the effectiveness of management actions, including recovery of degraded systems.

Monitoring is therefore fundamental to ensuring that groundwater resources are managed sustainably under conditions of climate uncertainty, declining recharge, and increasing pressure on water resources. The locations of the monitoring wells are shown in Figure 8-1 and Figure 8-2.

8.2. Groundwater level monitoring

Groundwater level monitoring provides a primary indicator of groundwater availability and aquifer storage behaviour and underpins allocation decision-making under the 2026 WAP. Monitoring is undertaken across approximately 302 wells with additional data obtained from selected SA Water production wells.

Monitoring is generally undertaken on a biannual basis, depending on the monitoring purpose and location. In priority areas, including major supply wellfields and areas of higher extraction pressure, monitoring is undertaken more frequently (for example, continuously where data loggers are installed).

Groundwater levels are measured using manual dip measurements and data loggers. A number of wells are fitted with telemetry systems, allowing for continuous data collection. The data are used to assess seasonal fluctuations, longer term trends in groundwater storage, and responses to recharge and extraction.

The majority of monitoring wells have now been surveyed to establish accurate reference elevations, enabling reliable determination of Reduced Standing Water Levels (RSWLs). Accurate survey control is critical for interpreting regional groundwater flow directions, hydraulic gradients, and changes in groundwater storage over time. Monitoring sites that currently rely on digital elevation model (DEM)-derived reference elevations should be prioritised for survey using Trimble GPS equipment to improve confidence in groundwater level interpretations. Sites previously surveyed using less accurate manual survey methods should also be reviewed and, where practicable, resurveyed using Trimble GPS equipment to ensure consistency and accuracy across the monitoring network.

Under the 2026 WAP adaptive management framework, a defined network of trigger wells is used to assess groundwater storage condition relative to established trigger thresholds. These wells are monitored during the post-irrigation autumn monitoring period (March to May) and are prioritised for continuous monitoring using pressure loggers and telemetry where practicable.

8.3. Groundwater salinity

Groundwater salinity monitoring provides an indication of groundwater quality and is used to assess spatial and temporal changes in salinity, including movement of freshwater–saline interfaces. Groundwater salinity monitoring is undertaken across 192 wells within the Eyre Peninsula monitoring network (subject to access), which includes data collected from a selected 50 SA Water production wells.

Monitoring is typically carried out on a periodic basis with more frequent monitoring in higher-risk areas, particularly coastal aquifers where there is a risk of seawater intrusion. Salinity is primarily assessed using electrical conductivity (EC) measurements as an indicator for TDS. Field methods include pump sampling following well purging and stabilisation of field parameters with historical datasets also incorporating bailer, airlift, flow-through cell, and grab or hand sampling techniques.

Downhole EC profiling is undertaken in selected wells using conductivity sondes or logging tools to assess vertical salinity distribution within the water column. Induction logging is also used in some locations to characterise formation conductivity and provide additional information on the extent of saline groundwater beyond the well. Laboratory analysis may be undertaken where required to support interpretation of groundwater quality trends.

Future monitoring will progressively transition towards increased use of downhole EC loggers installed at fixed depths, particularly within trigger wells in Risk Monitoring and Management Plan (RMMP) monitoring networks. Pumped groundwater sampling will continue to be undertaken to validate logger data and assess representativeness.

Table 8-1 Groundwater monitoring wells by aquifer within the Southern Basins and Musgrave PWA

	Number of wells	Standing water level monitoring			EC monitoring		
		Loggers	Telemetry	Total	Loggers	Telemetry	Total
Southern Basins							
Quaternary Limestone	156	24	16	40	11	4	15
Quaternary and Tertiary	5	1	0	1	0	0	0
Tertiary Sands	27	7	4	11	6	2	8
Tertiary Aquitard	6	0	0	0	0	0	0
Basement	5	0	0	0	0	0	0
No aquifer data	5	2	0	2	0	0	0
Total Southern Basins	204	33	27	60	17	6	23
Musgrave							
Quaternary Limestone	86	30	15	45	2	1	3
Quaternary and Tertiary	0	0	0	0	0	0	0
Tertiary Sands	50	7	1	8	0	0	0
Basement	2	0	0	0	0	0	0
No aquifer data	4	1	1	2	1	1	2
Total Musgrave	142	38	17	55	3	2	5
Total	346	71	44	115	30	26	56

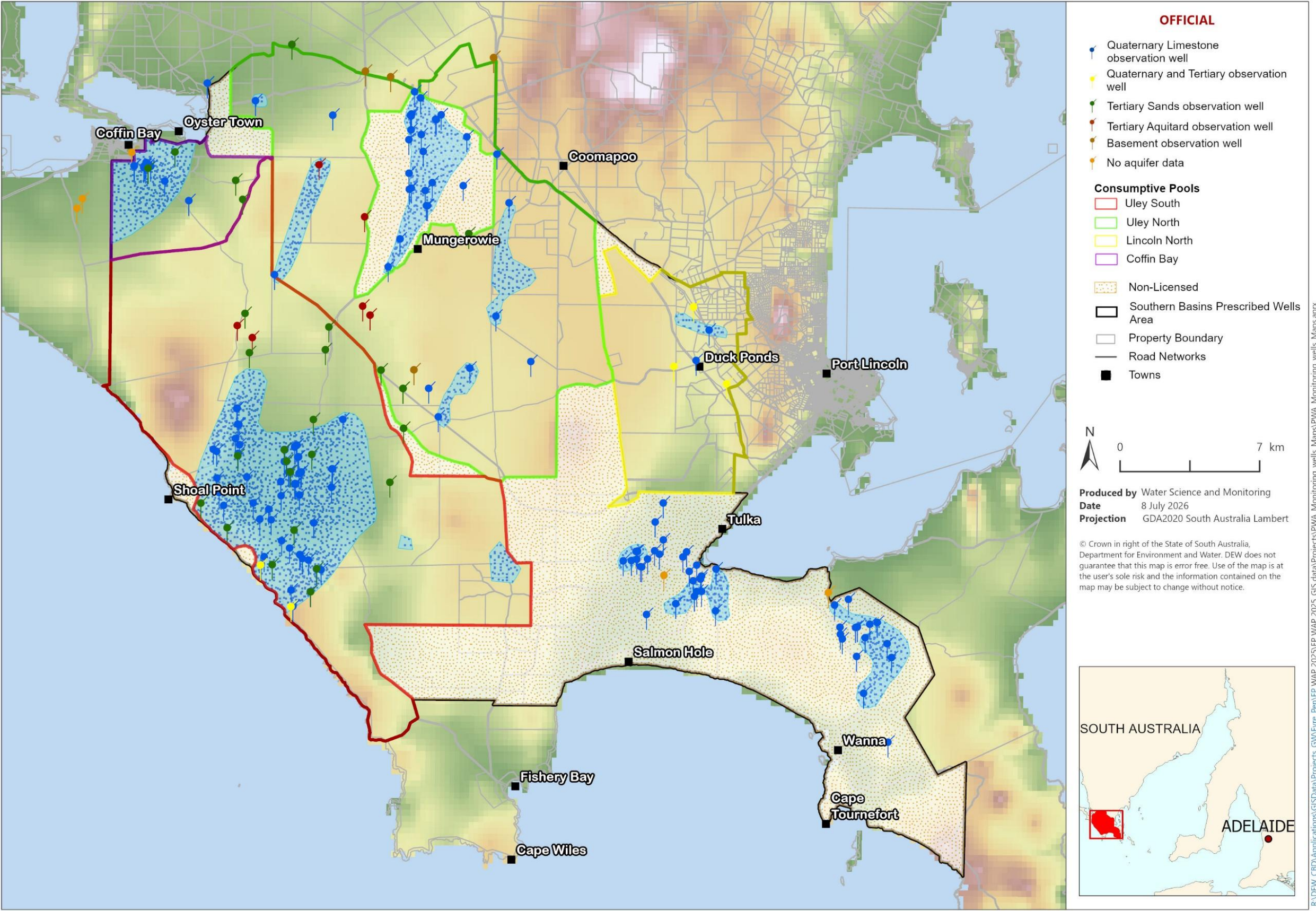


Figure 8-1 Location of current monitoring network within the Southern Basins PWA

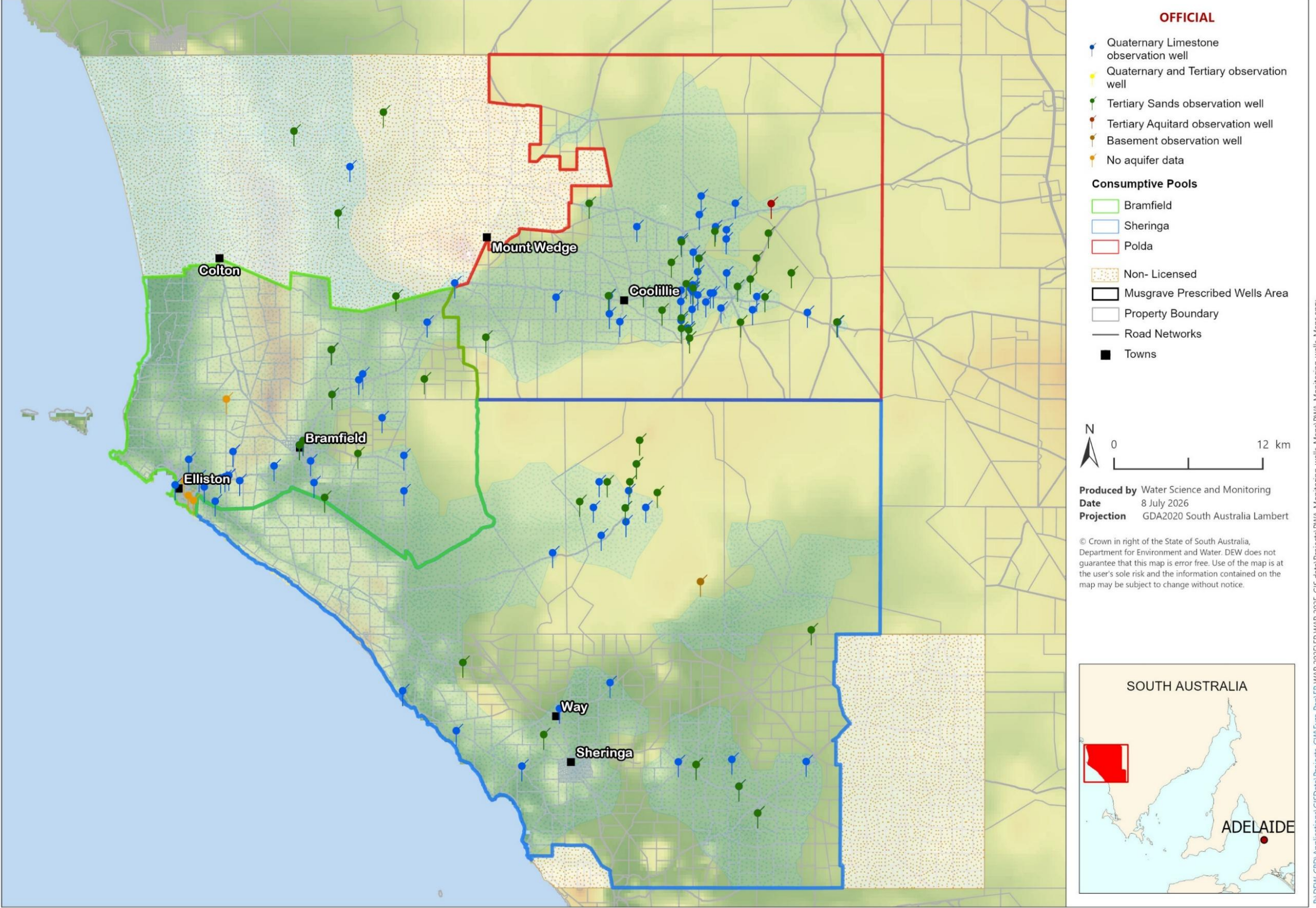


Figure 8-2 Location of current monitoring network within the Musgrave PWA

8.4. Climate and recharge monitoring

Climate data are critical for interpretation of groundwater trends, particularly rainfall-driven recharge. A network of established weather stations will continue to be operated, maintained, calibrated, and integrated with groundwater monitoring datasets.

The network includes stations located at:

- Poldia (2 stations);
- Bramfield (3 stations);
- Coffin Bay (1 station);
- Uley North (1 station);
- Uley South (3 stations); and
- Lincoln South (legacy monitoring locations).

Regular calibration (minimum annual) and maintenance are required to ensure data accuracy and consistency.

8.5. Monitoring network within PWAs

The monitoring network comprises approximately 346 active wells distributed across the Eyre Peninsula PWAs, supported by additional data from SA Water production wells. The network includes:

- resource condition monitoring (long-term regional monitoring wells);
- adaptive management trigger wells;
- RMMP monitoring wells; and
- operational wells associated with PWS.

The network has evolved over time and represents a valuable long-term dataset that underpins groundwater assessments across the region.

8.5.1. Resource condition monitoring (core program)

Resource condition monitoring (Figure 8-1 and Figure 8-2) forms the core of the monitoring program and provides:

- long-term records of groundwater levels and salinity;
- data to assess storage change and recharge variability; and
- evidence to evaluate risks identified to the resource.

Key risks assessed through this network include:

- declining groundwater levels and reduced recharge under a drying climate;

- increasing salinity and seawater intrusion; and
- impacts on GDEs.

Continuation and strengthening of this network are essential with priority given to maintaining dataset continuity and improving data quality.

8.5.2. Adaptive management monitoring (trigger wells)

Under the 2026 WAP, adaptive management is supported by a defined network of trigger wells, as shown in Figure 8-3 and Figure 8-4.

These wells:

- provide groundwater level data used to assess aquifer condition;
- are monitored during the post-irrigation autumn period; and
- inform allocation decisions through comparison with defined trigger thresholds.

Given their direct role in allocation setting, trigger wells are prioritised for installation of loggers and telemetry to ensure reliable and high-resolution datasets.

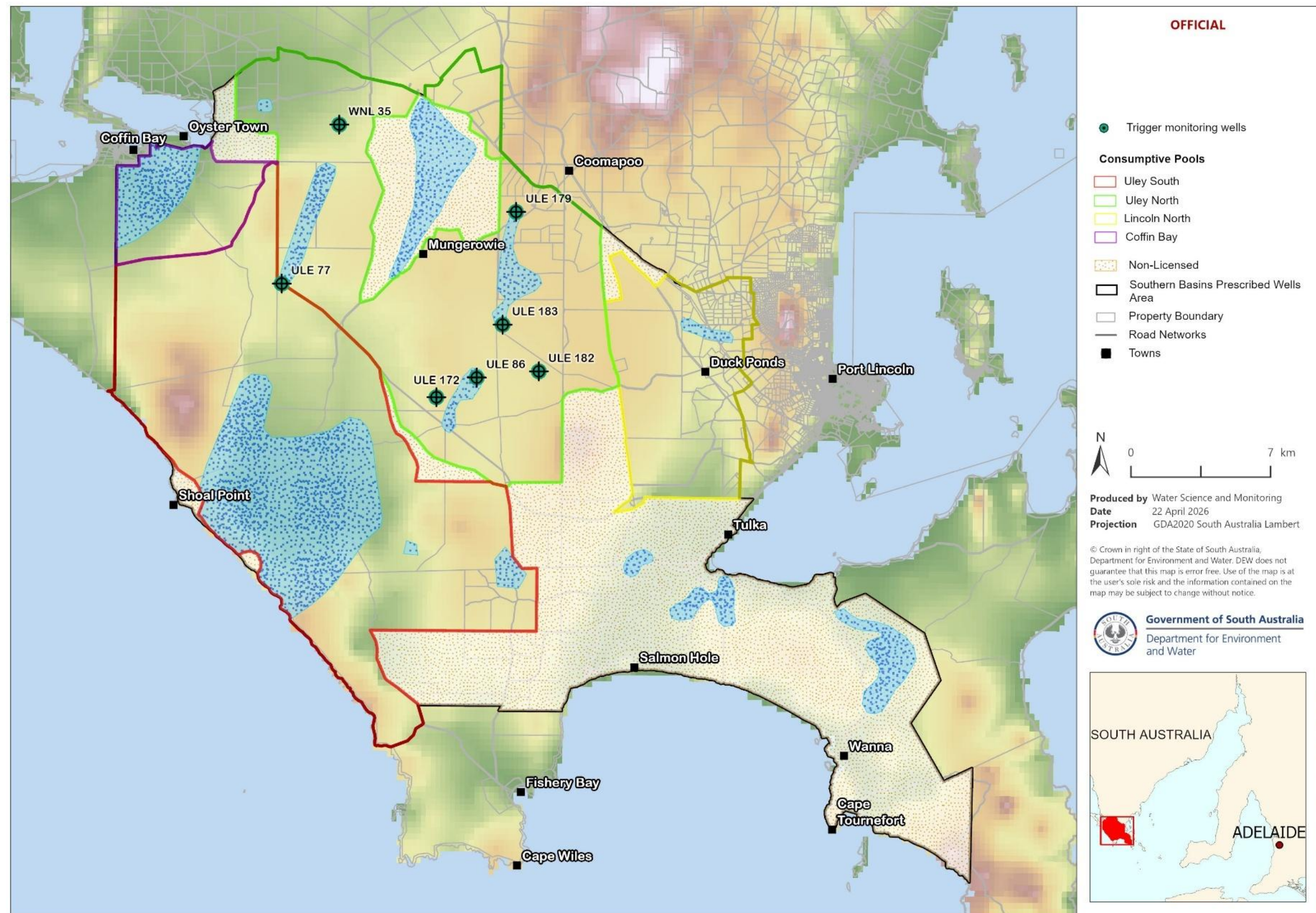


Figure 8-3 Location of adaptive management trigger wells within the Sothern Basins PWA

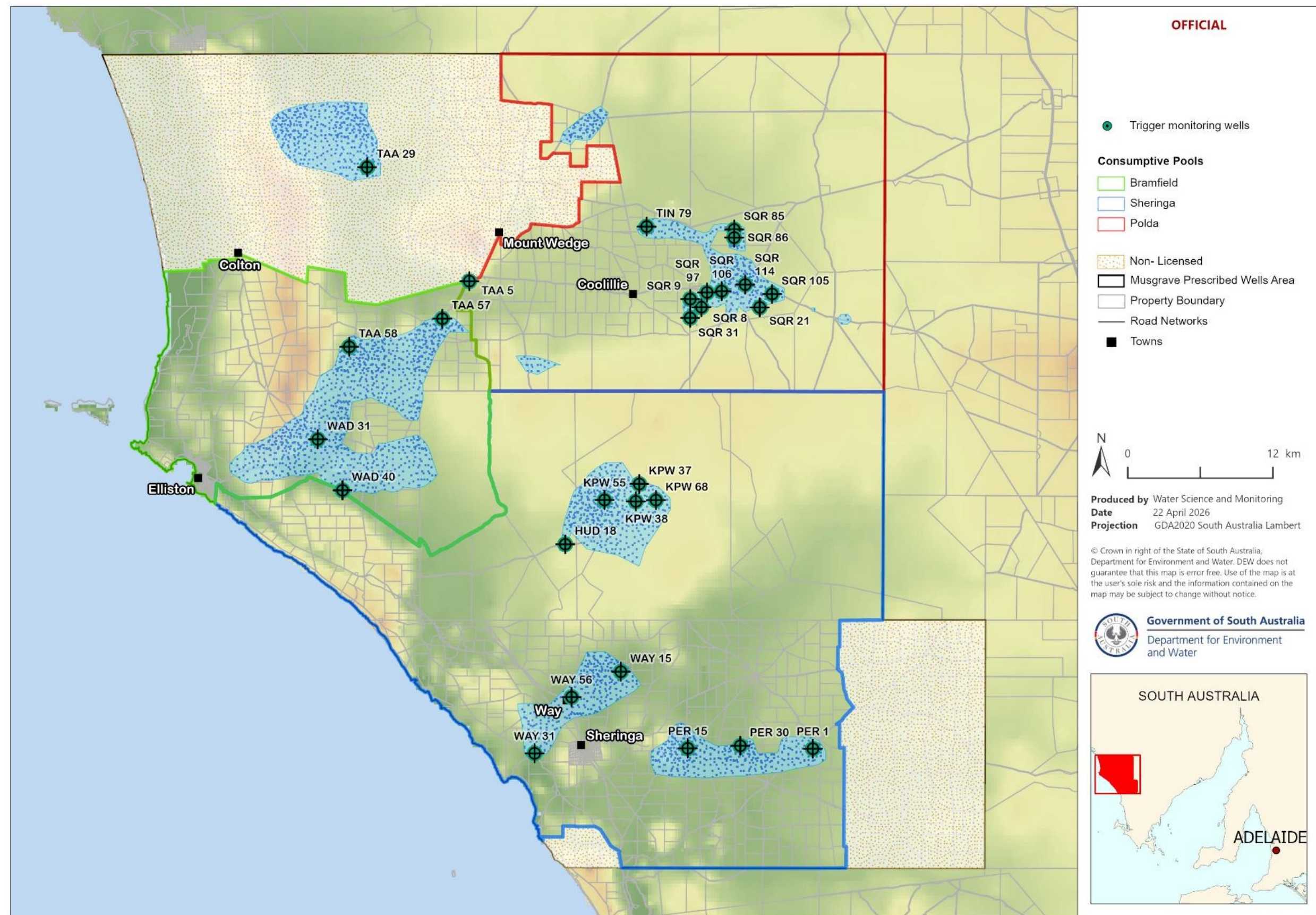


Figure 8-4 Location of adaptive management trigger wells within the Musgrave PWA

8.5.3. Risk-based monitoring under the Risk Monitoring and Management Plan

RMMP monitoring is implemented in higher-risk and extraction locations (for examples, Coffin Bay, Uley South and Bramfield), and focuses on:

- seawater intrusion and salinity increase;
- groundwater level decline near extraction centres;
- changes in hydraulic gradients; and
- protection of water supply users and GDEs.

These systems require higher-resolution monitoring, including:

- installation of groundwater level and EC loggers;
- telemetry for real-time data access; and
- targeted monitoring near coastal and production zones.

RMMP wells should be prioritised for instrumentation and telemetry across the network.

8.6. Data quality, calibration and monitoring frequency

As reliance on automated monitoring increases, maintaining data quality is critical. This includes:

- routine validation against manual measurements;
- identification and correction of data anomalies; and
- consistent data processing.

For salinity monitoring:

- EC loggers will be calibrated when required and at least annually; and
- pumped sampling will continue to support validation.

Where telemetry, stable datasets and adequate resourcing are in place, manual salinity monitoring frequency may be reduced over time.

8.7. Monitoring resourcing and operational delivery

Implementation of the monitoring program requires appropriate resourcing. It is recommended that a dedicated monitoring resource based on the southern Eyre Peninsula is required to ensure that:

- manual groundwater level verification is undertaken;
- logger data are downloaded, checked and validated in a timely manner;
- monitoring anomalies are identified and addressed as part of an initial interpretation; and

- reporting and evaluation requirements are met.

A locally based resource will:

- reduce travel-related delays;
- improve data continuity;
- be 'on-site' to repair or replace equipment; and
- support high-quality datasets required for early detection of adverse trends.

Achievement of monitoring optimisation outcomes, including increased reliance on telemetry and reduced manual monitoring frequency, is contingent on this resourcing.

8.8. Monitoring procedures

To support increased use of automated monitoring and to ensure data quality is maintained as monitoring approaches evolve, it is recommended that standard operating procedures (SOPs) be developed and refined as a priority. These SOPs should clearly define alerts, roles and responsibilities, and quality assurance processes to ensure consistent implementation across the network.

Priority SOPs should include:

- data logger deployment – including installation standards, depth placement, and commissioning checks;
- data logger calibration and validation – including frequency, methods and acceptance criteria;
- data logger data processing – including download procedures, validation checks, correction of drift and version control;
- salinity sampling procedures – including criteria for pumped sampling, stabilisation requirements and alignment with logger calibration;
- telemetry alerts and response protocols – who responds, timeframes and escalation;
- data ownership and responsibility – DEW or SA Water; and
- exception handling – missed readings, access issues and equipment failure.

These procedures will be particularly valuable in supporting the standing water level and salinity monitoring programs. Clear and consistent SOPs are essential to ensure that data collection and processing are undertaken accurately and reliably, reduce duplication of effort, minimise re-sampling and re-processing costs. They will also increase confidence in datasets used for allocation decision-making, risk management and reporting.

As monitoring increasingly incorporates continuous data and telemetry, well-defined SOPs will also support efficient transition towards optimised monitoring approaches, while ensuring that data integrity and management objectives are maintained.

8.9. Monitoring in-recovery systems (Lincoln South and Uley Wanilla)

Monitoring will continue in Lincoln South and Uley Wanilla following removal from licensed consumptive pools.

Monitoring objectives include:

- assessing groundwater level recovery;
- tracking salinity trends and interface movement;
- evaluating hydraulic gradient changes; and
- assessing potential recovery of GDEs.

Existing infrastructure, including former SA Water production wells, will continue to be used.

8.10. Targeted investigations and new monitoring infrastructure

8.10.1. Uley South Consumptive Pool

Targeted investigations are required to address key uncertainties and improve understanding of aquifer behaviour. These include:

- conducting a downhole camera survey and clearing obstructions in an existing monitoring well (ULE 147) to restore functionality and install monitoring instrumentation following remediation; and
- identifying and installing a paired QL and TS aquifer monitoring well in the southeast part of the southern zone.

8.10.2. Bramfield Consumptive Pool

Targeted investigations are required to address key uncertainties and improve understanding of aquifer behaviour. These include:

- installing an additional monitoring bore between the PWS wellfield and existing monitoring locations (subject to funding and approvals) to improve early warning of salinity change;
- installing two new monitoring sites near coastal wetlands, with EC loggers to improve understanding of salinity processes and groundwater–wetland interactions; and
- undertaking an additional survey and groundwater level data collection in wetland areas.

8.10.3. Lincoln North Consumptive Pool

Targeted investigations are required to address key uncertainties and improve understanding of aquifer behaviour. These include:

- undertaking targeted drilling in areas of limited data coverage with lithological and geophysical logging to improve understanding of aquifer extent, stratigraphy and connectivity; and
- installing paired QL and TS monitoring bores in strategic inland and coastal locations to assess vertical hydraulic gradients and connectivity between aquifers.

9. Conclusions and recommendations

9.1. Conclusions

The assessment shows that groundwater resources across the Southern Basins and Musgrave PWAs are under increasing pressure due to the combined effects of declining recharge, sustained extraction and climate variability. Long-term monitoring indicates that groundwater levels are declining across most consumptive pools with associated increases in salinity and reductions in storage. These trends are evident across multiple consumptive pools and are most pronounced within the Uley South, Uley Wanilla, Lincoln South and Bramfield systems.

The QL aquifer remains the principal source of fresh groundwater across the Eyre Peninsula and supports PWS, agricultural production, industry and environmental values. However, the aquifer is characterised by relatively limited storage, high permeability and a strong dependence on local rainfall recharge, making it sensitive to climatic variability and groundwater extraction.

Multiple lines of evidence indicate a substantial decline in groundwater recharge since the 1990s, particularly during the past decade. Groundwater level monitoring, Water Table Fluctuation analyses and numerical modelling consistently show that reductions in rainfall have resulted in disproportionately large reductions in recharge. This reflects the threshold-dependent nature of recharge processes within the QL aquifers.

Climate records and climate projections indicate a continued trend towards warmer and drier conditions across the Eyre Peninsula. Under these conditions, groundwater systems are expected to experience increased pressure through reduced recharge frequencies, lower recharge volumes and increased evaporative demand.

Groundwater quality trends indicate increasing salinity within many consumptive pools. In coastal systems, available groundwater monitoring, geophysical investigations and numerical modelling indicate that declining groundwater levels are increasing the risk of seawater intrusion and/or saline groundwater upconing. These dominant processes and level of risk vary between consumptive pools.

The condition of the Uley Wanilla and Lincoln South consumptive pools differs from that observed in other consumptive pools. Long-term groundwater level declines, limited recovery during recent wetter periods and increasing salinity trends indicate these systems have undergone substantial depletion of freshwater storage. The available evidence also indicates increased risk to GDEs and freshwater lens integrity within these areas.

Uley South and Bramfield consumptive pools continue to represent strategically important groundwater resources for PWS. However, monitoring data and modelling results indicate that both systems are sensitive to ongoing reductions in recharge and are subject to increasing risks associated with groundwater level decline and groundwater quality deterioration.

The conclusions presented in this report are supported by multiple independent sources of evidence, including long-term groundwater level records, salinity monitoring, recharge investigations, hydrochemical analyses, airborne and surface geophysics, and numerical groundwater modelling. Collectively, these datasets demonstrate that groundwater availability across the Southern Basins and Musgrave PWAs is increasingly influenced by declining recharge and changing climatic conditions.

While uncertainty remains regarding the magnitude of future climate change impacts and future recharge rates, the available evidence consistently indicates that groundwater resources across the Eyre Peninsula are becoming increasingly constrained and that continued monitoring, investigation and periodic

reassessment of resource condition will remain important for improving understanding of groundwater system behaviour over time.

9.2. Recommendations

Management under the 2026 WAP should prioritise aligning extraction with available recharge while responding dynamically to changing resource conditions. This requires the application of adaptive allocation frameworks that use groundwater level triggers to guide annual allocation decisions, supported by risk-based approaches in high-risk systems.

Allocation limits should be set conservatively in vulnerable aquifers. Reduced allocations are required in key supply systems such as Uley South and Bramfield to mitigate risks to water quality and maintain long-term availability. Areas where resource condition has significantly declined, including Uley Wanilla and Lincoln South, should be managed for recovery and excluded from licensed consumptive use.

Ongoing investment in monitoring is essential to support adaptive management. This includes maintaining and expanding groundwater level and salinity monitoring networks, prioritising coastal and high-risk areas, and increasing the use of telemetry and real-time data systems to improve responsiveness. Data quality, consistency and reporting processes should be strengthened to ensure monitoring information can be effectively used in decision-making. A dedicated resource based in the southern Eyre Peninsula will help facilitate these objectives.

Targeted investigations should continue in priority systems, particularly Uley South and Bramfield, to improve understanding of recharge processes, aquifer behaviour and the risks of seawater intrusion. These investigations should inform periodic updates to models and management settings.

A precautionary approach should be applied where data gaps remain, particularly in deeper aquifers and less well-characterised systems. Improved estimation of water demand, including non-licensed use, will further support robust allocation decisions.

Collectively, these measures will support a more resilient and evidence-based management framework capable of responding to ongoing climatic pressures and safeguarding water resources for the Eyre Peninsula.

10. Appendices

A. Water Table Fluctuation method

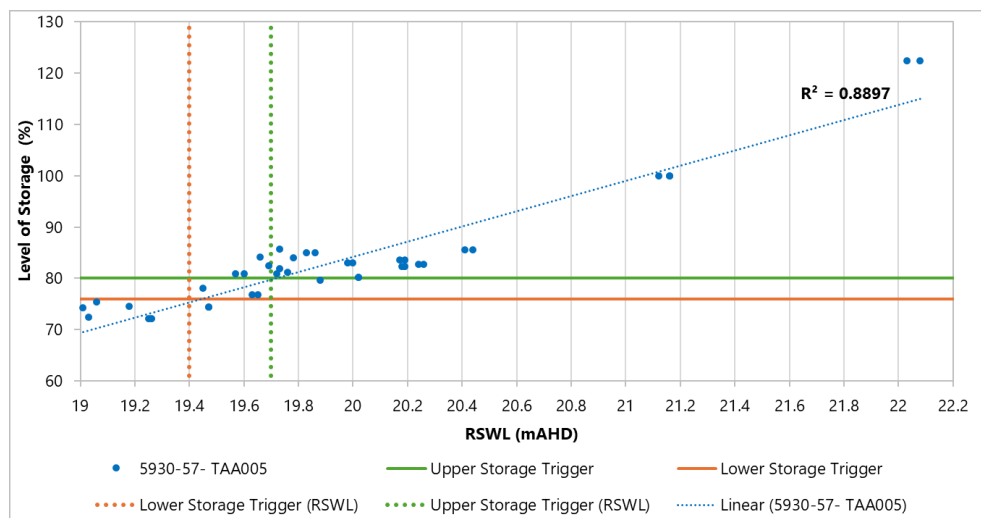
Table 10-1 Count of wells with high-frequency monitoring (≥ 8 events/y)

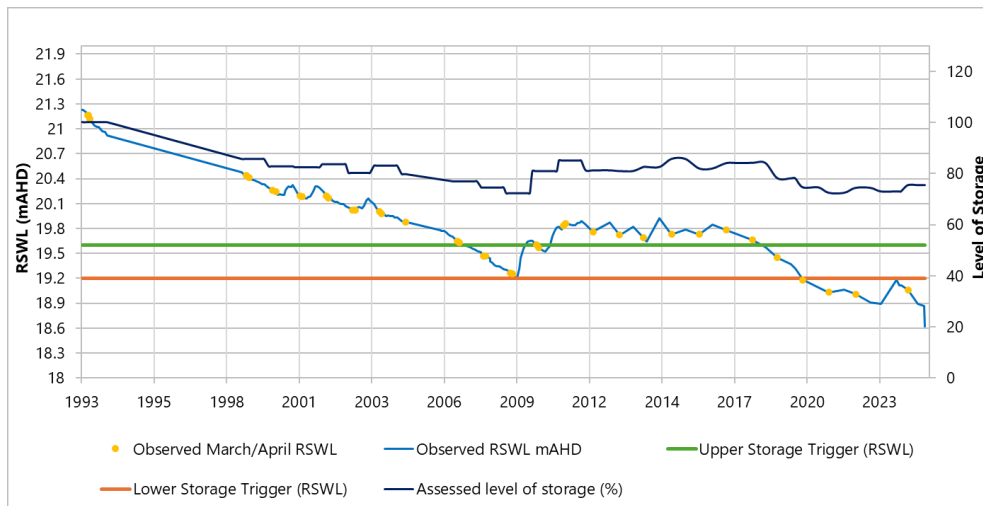
Consumptive pool	2008	2013	2015	2018	2019	2024
Coffin Bay	1	1	1	1	1	1
Uley North	9	8	9	9	9	9
Polda	31	28	8	8	11	3
Sheringa	15	15	0	0	0	1

B. Adaptive management statistical analysis of well groundwater levels

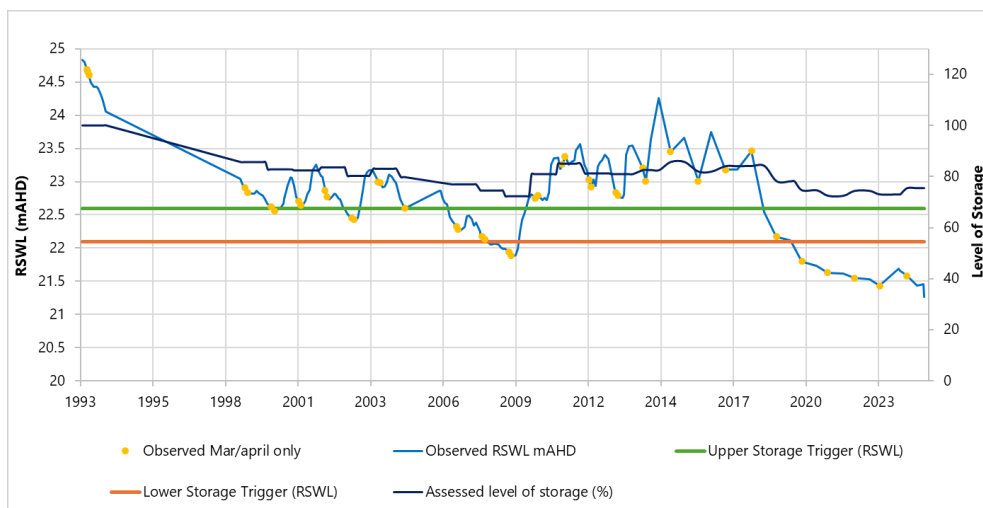
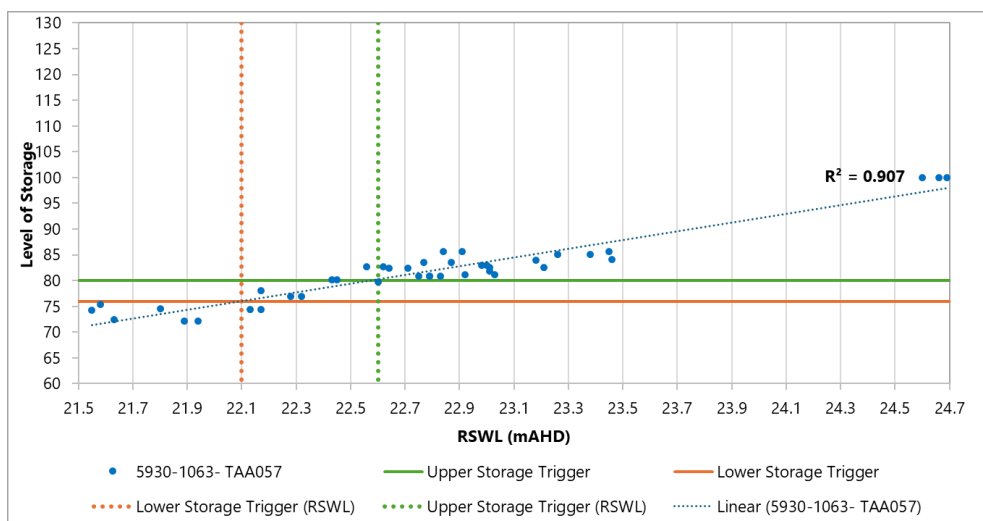
Bramfield

5930-57 – TAA005

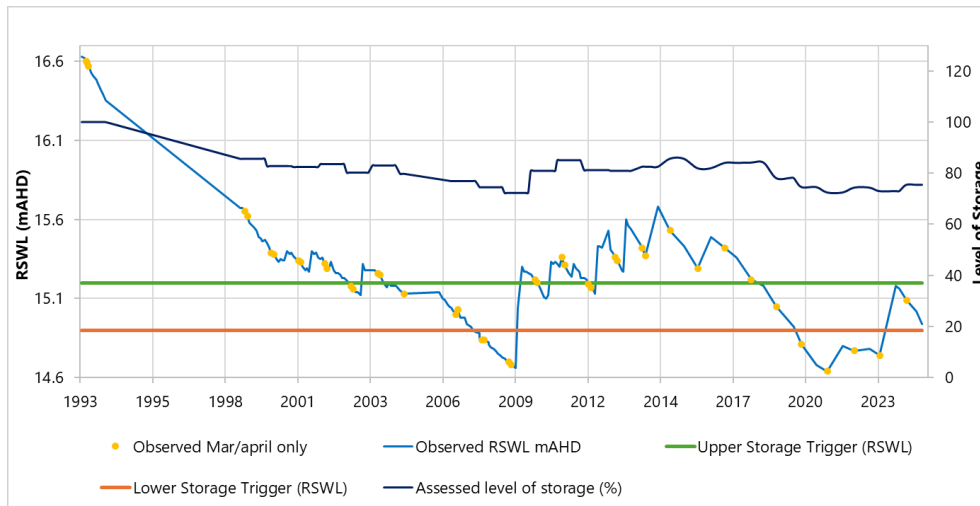
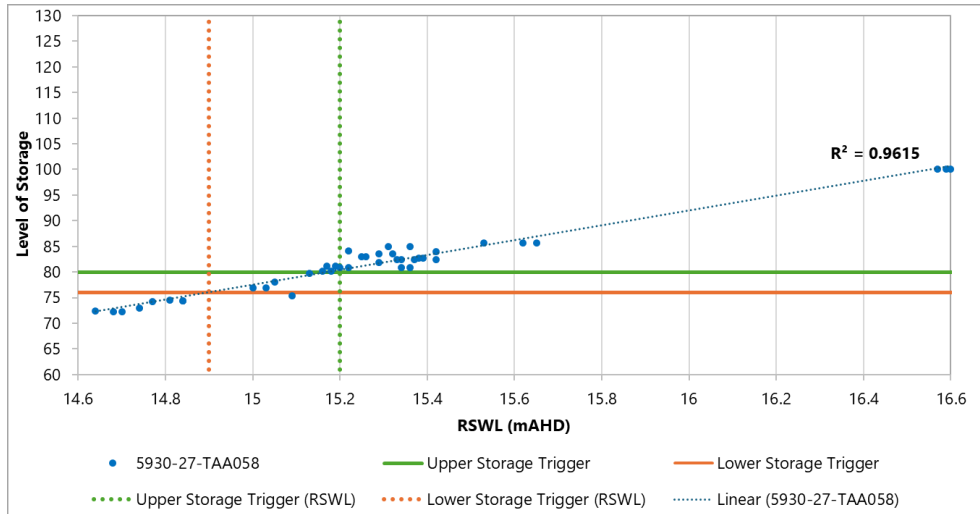




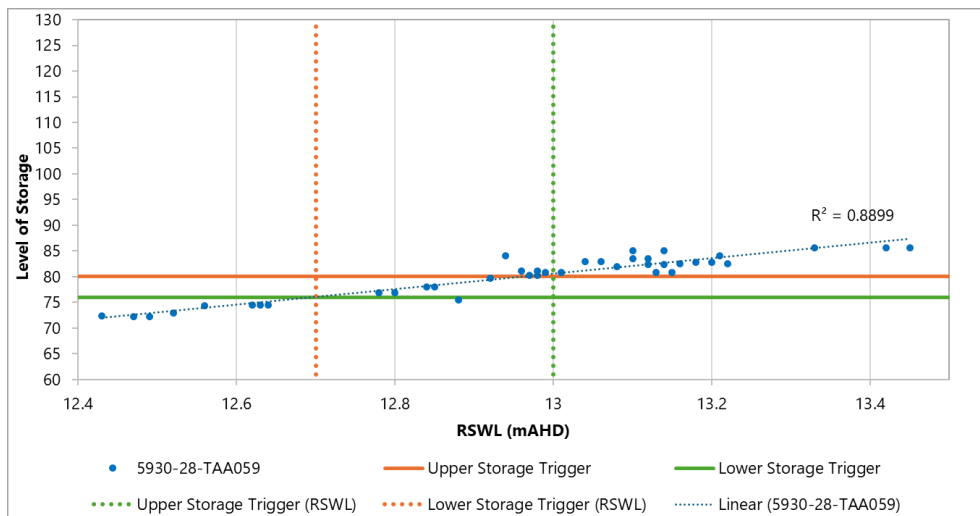
5930-1063 – TAA057



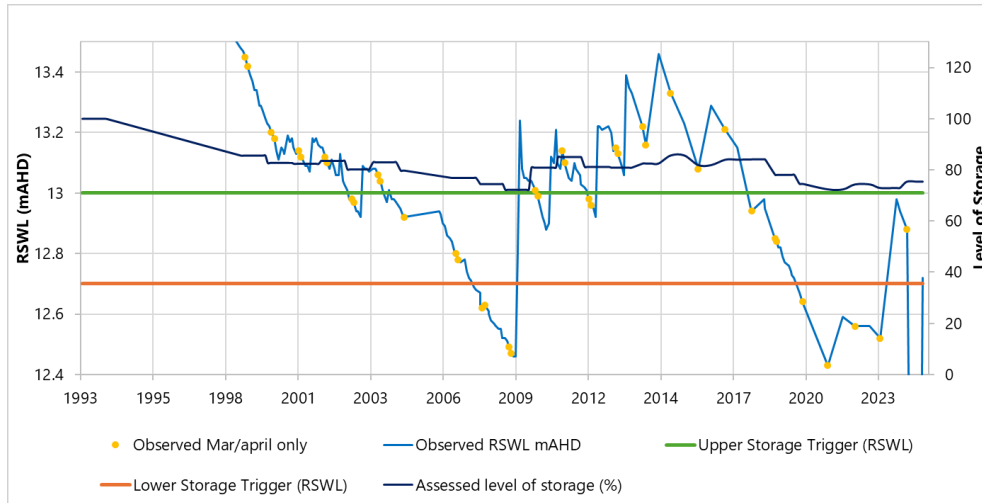
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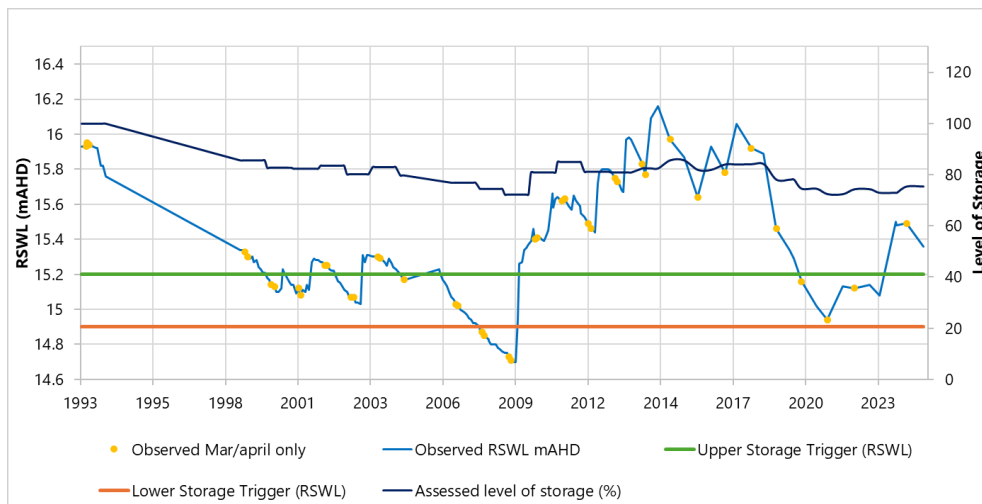
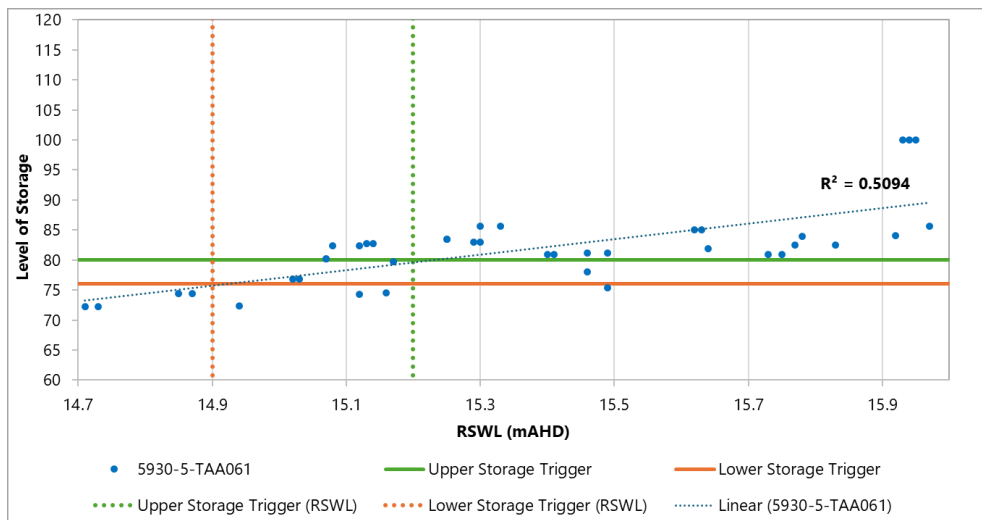
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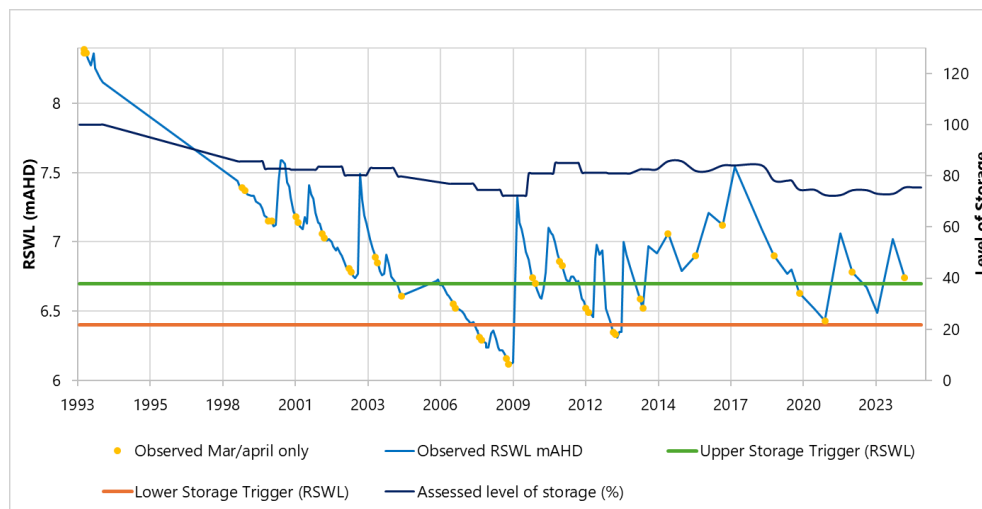
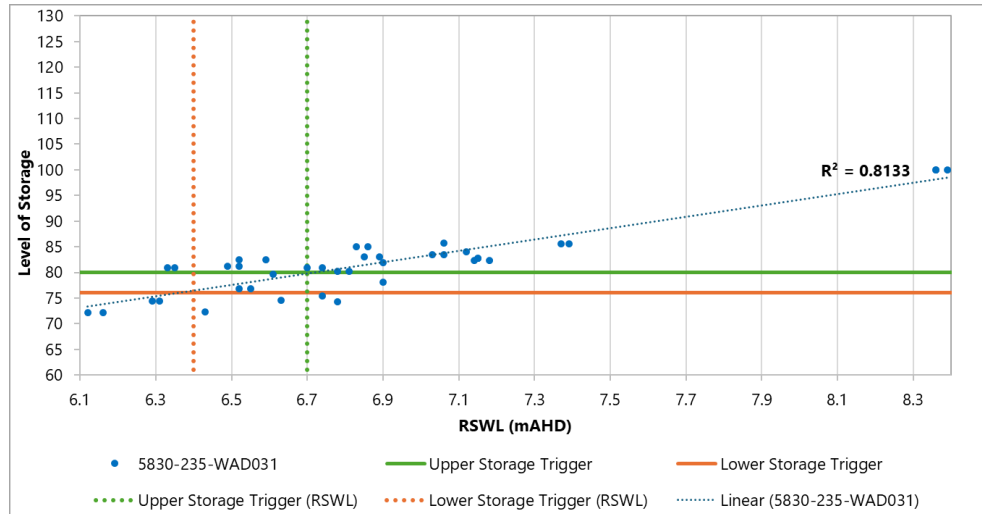
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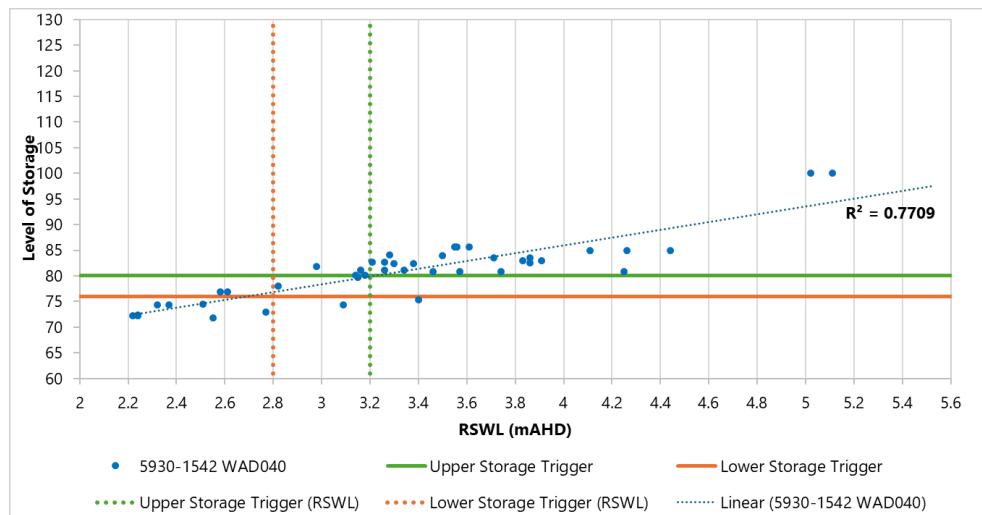
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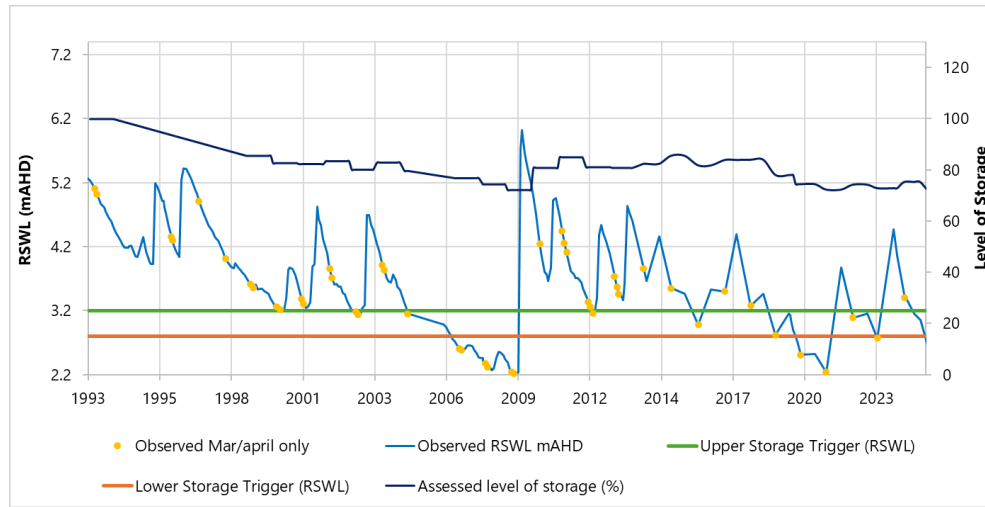
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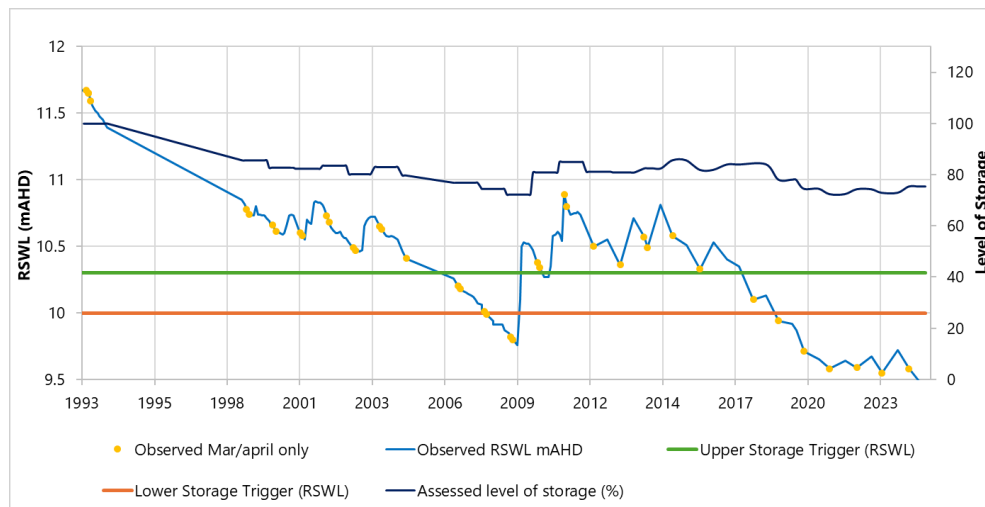
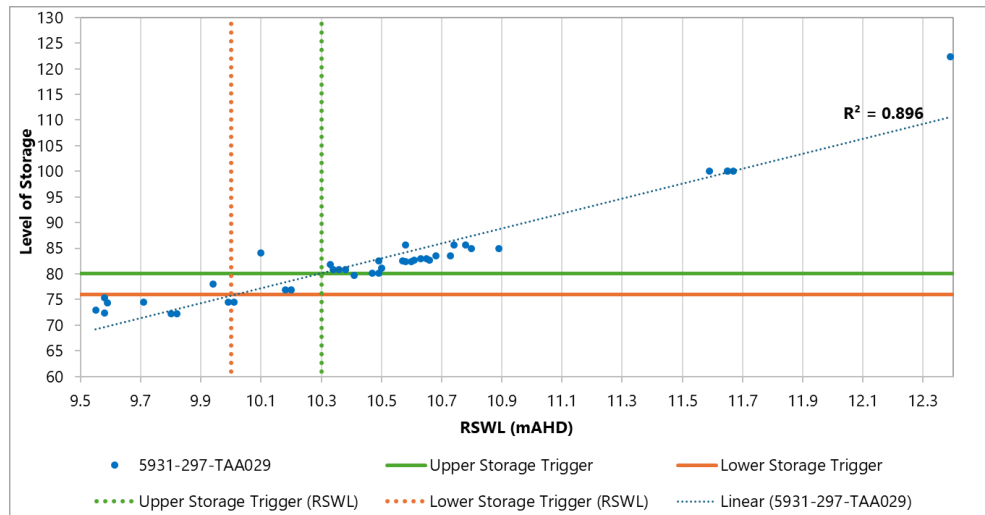
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5930-1542 – WAD040

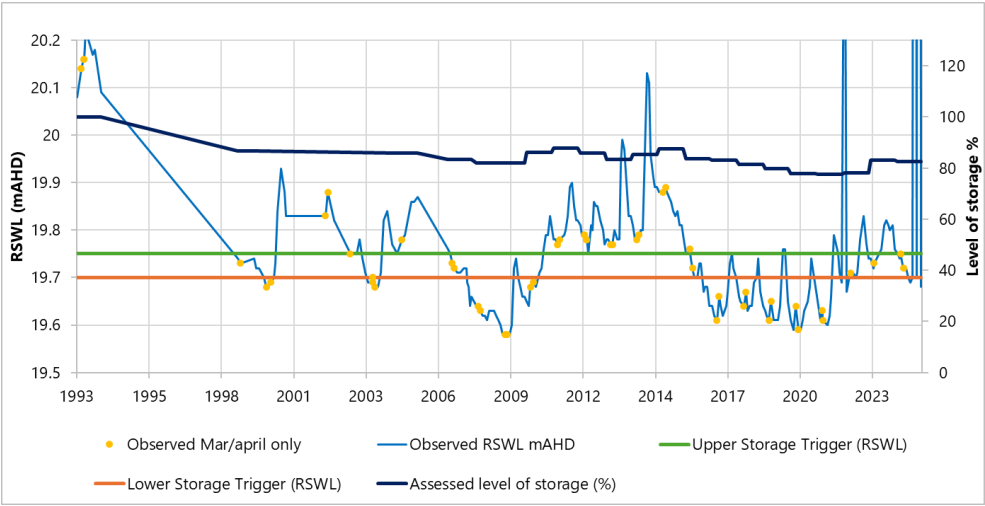
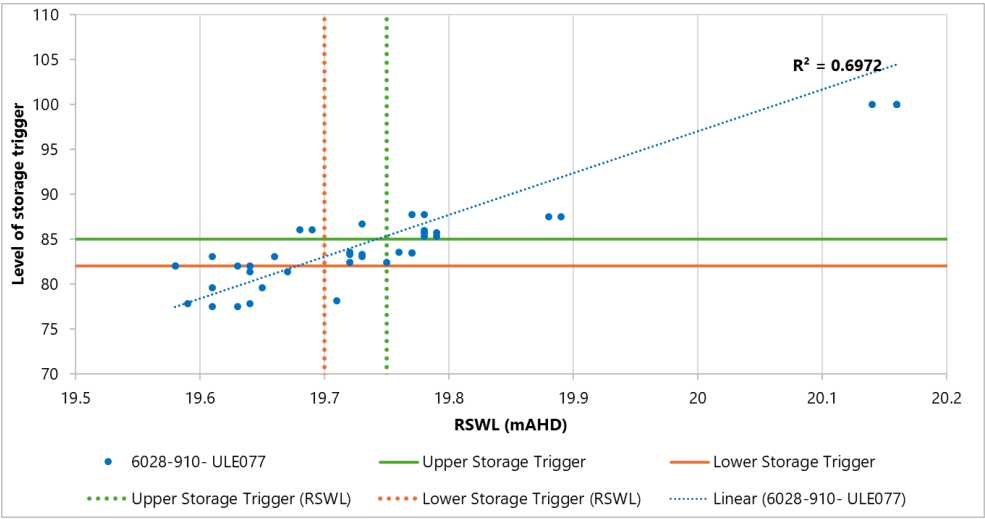


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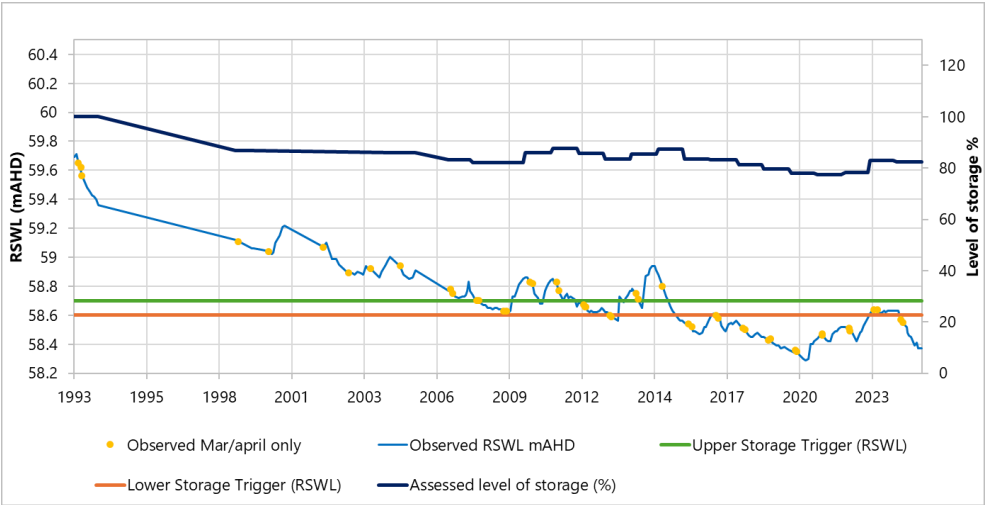


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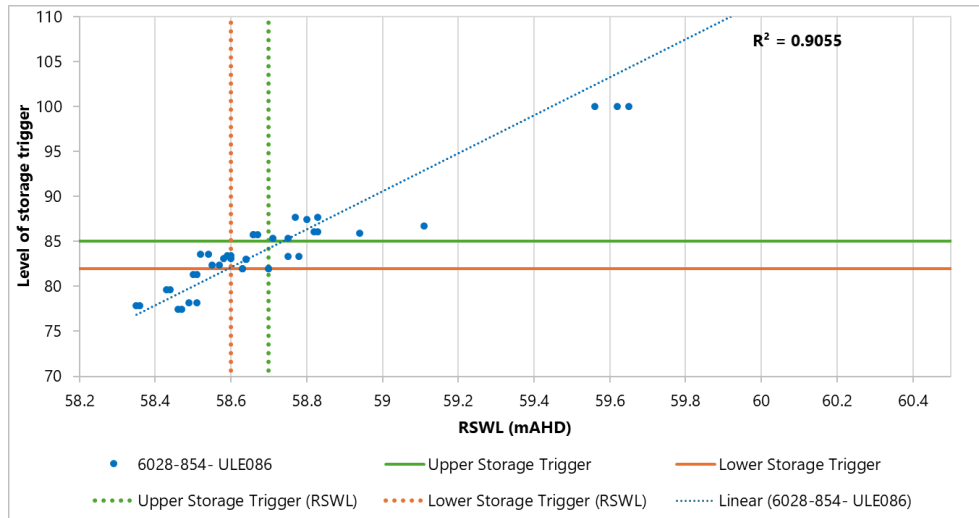
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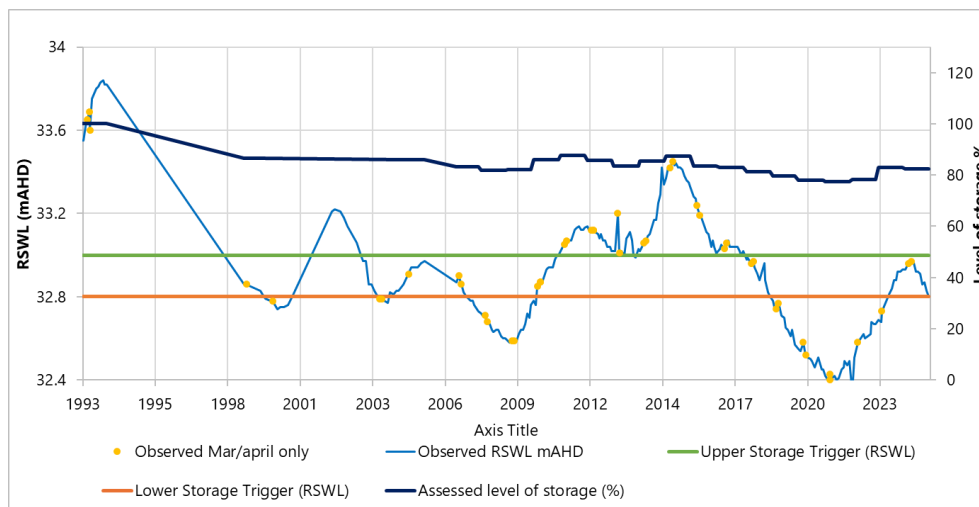
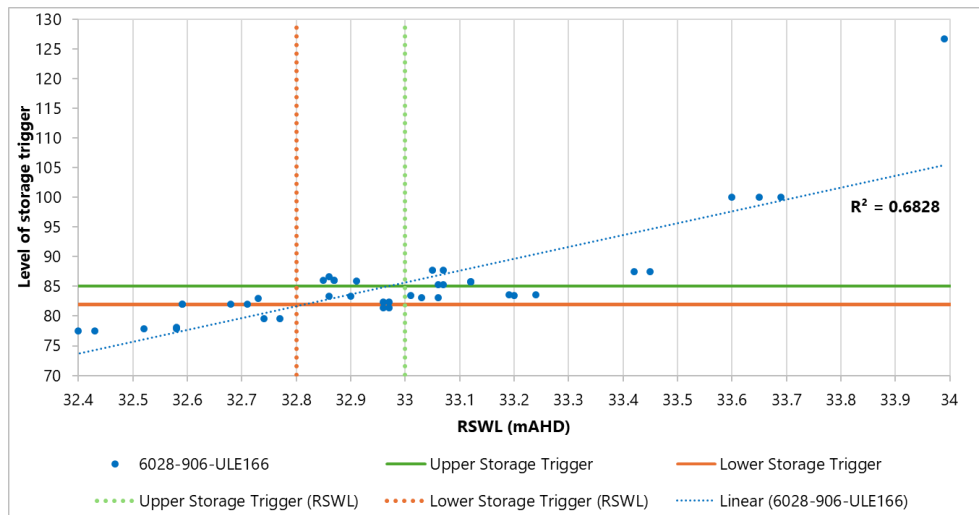
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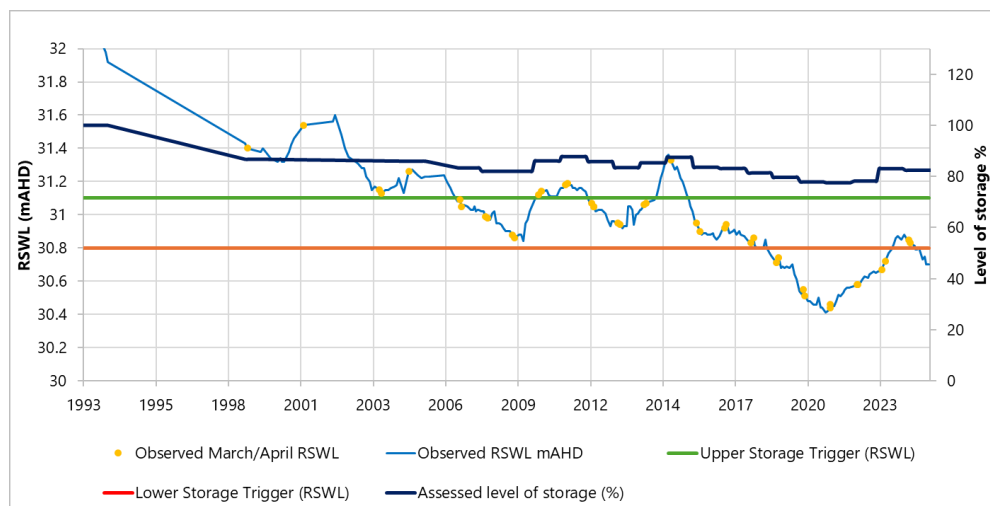
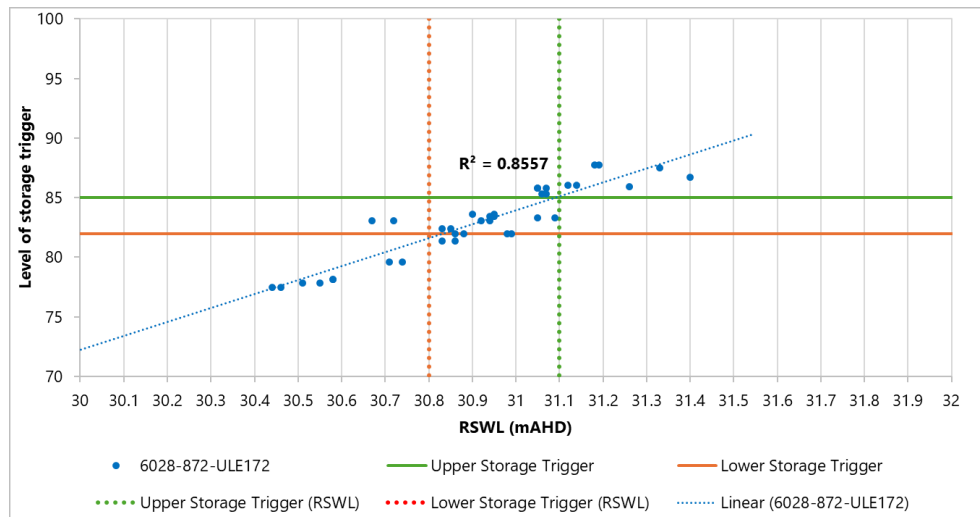
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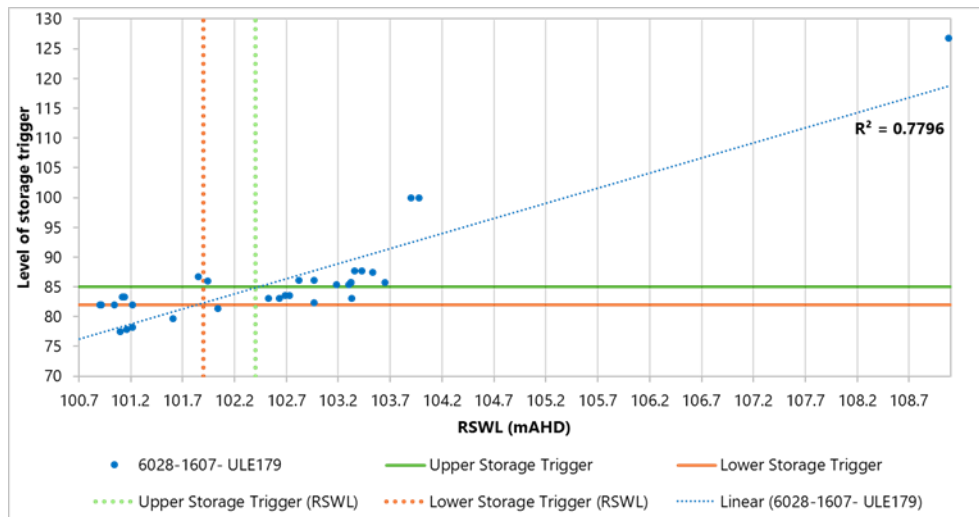
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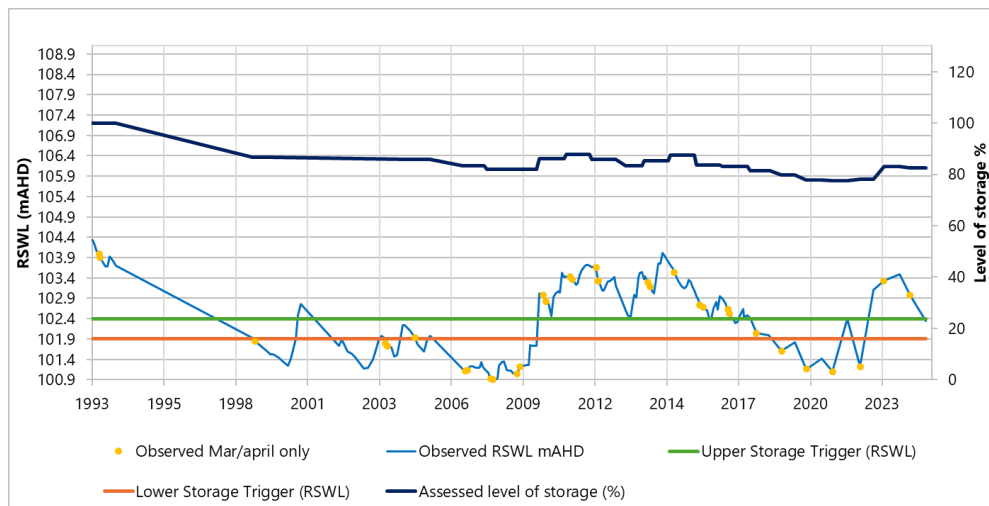
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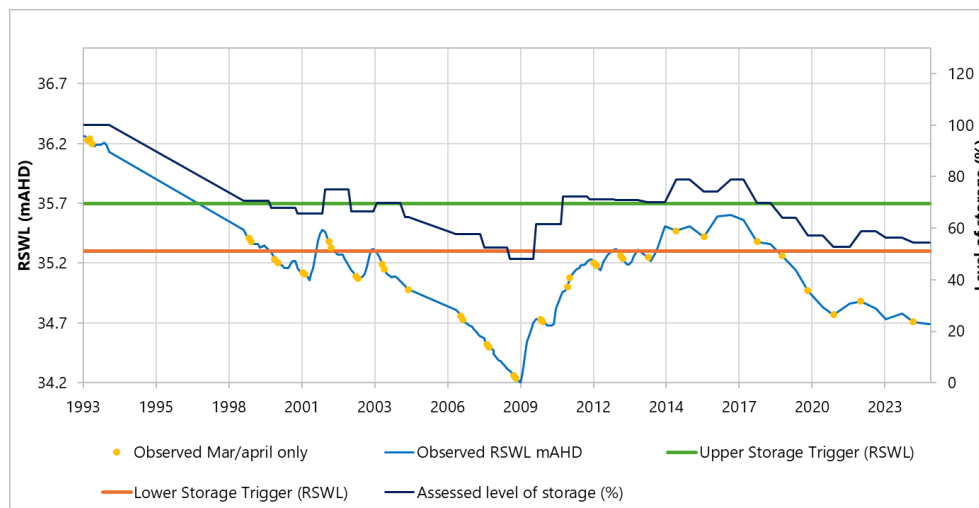
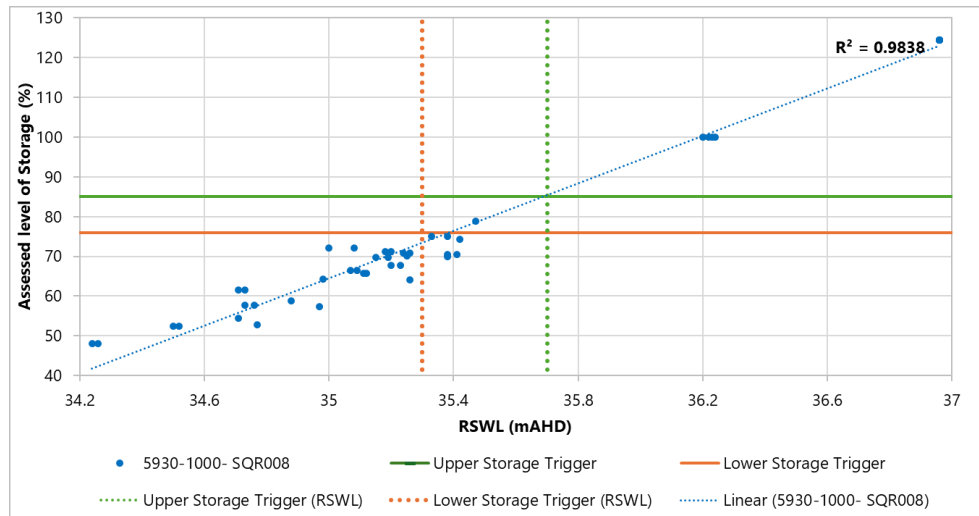


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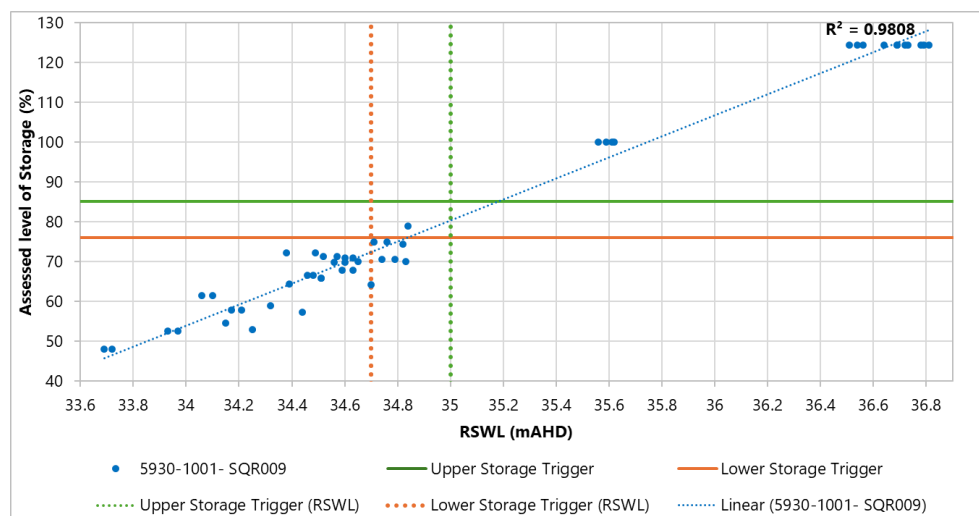


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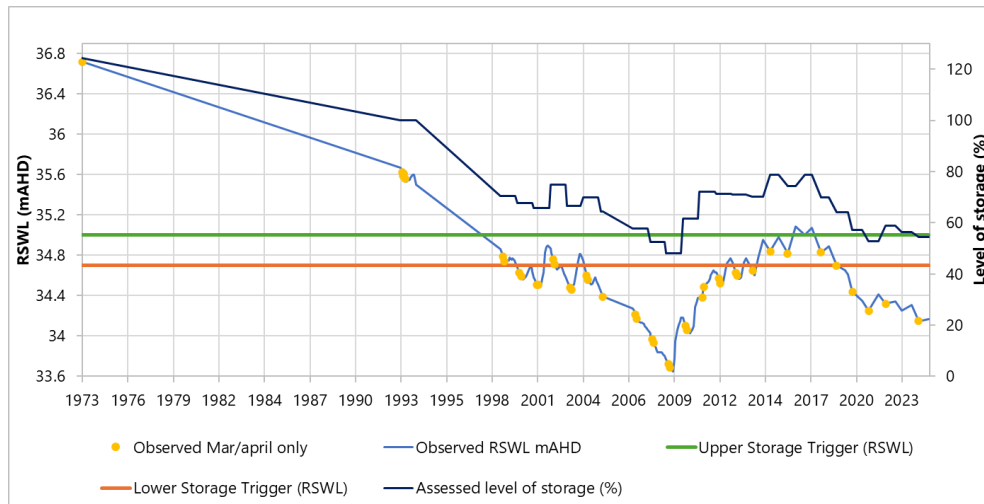
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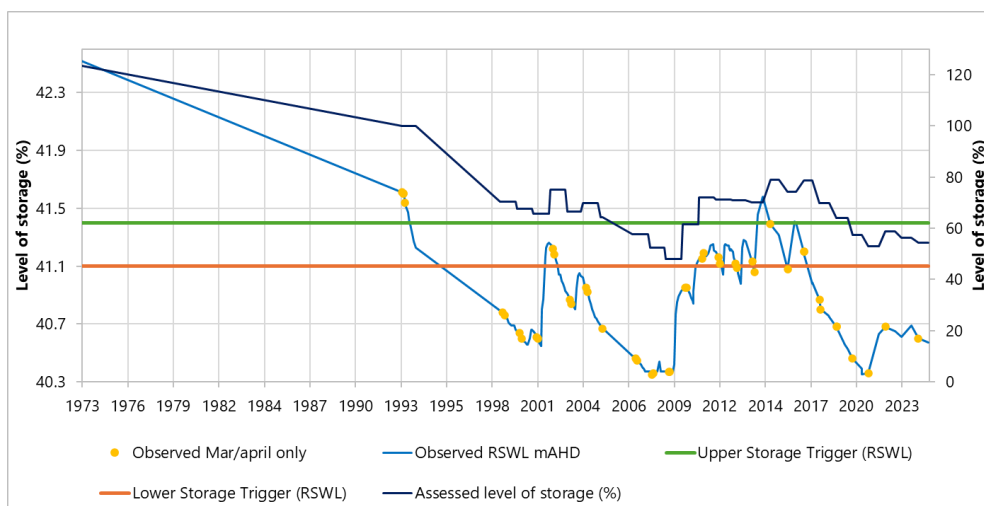
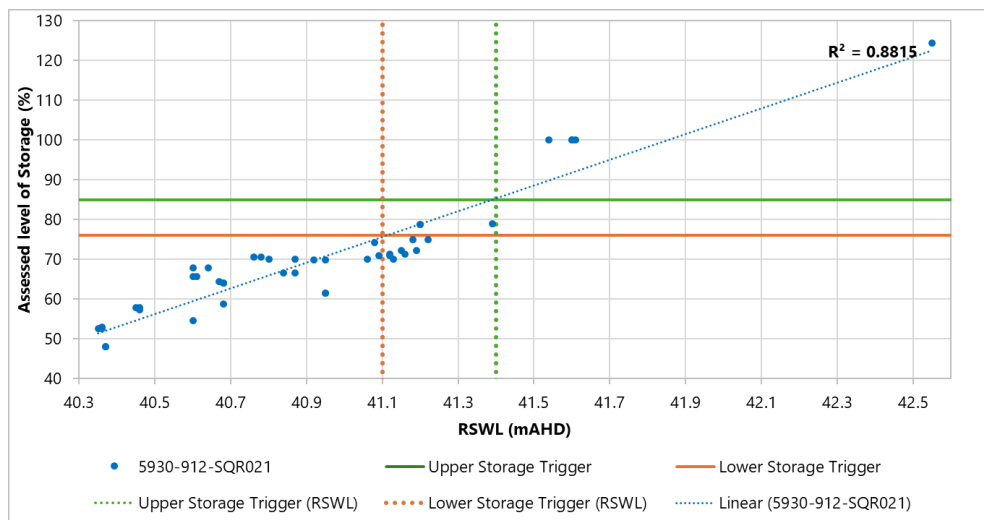
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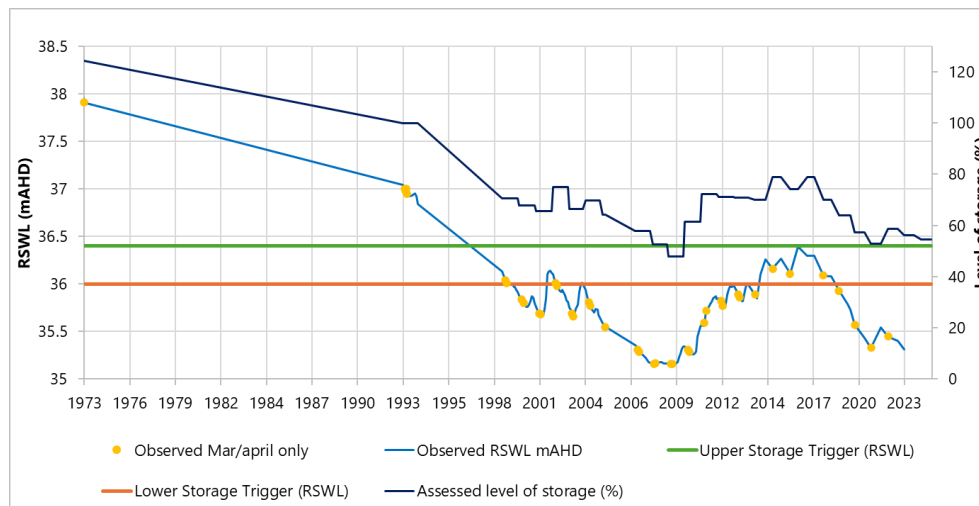
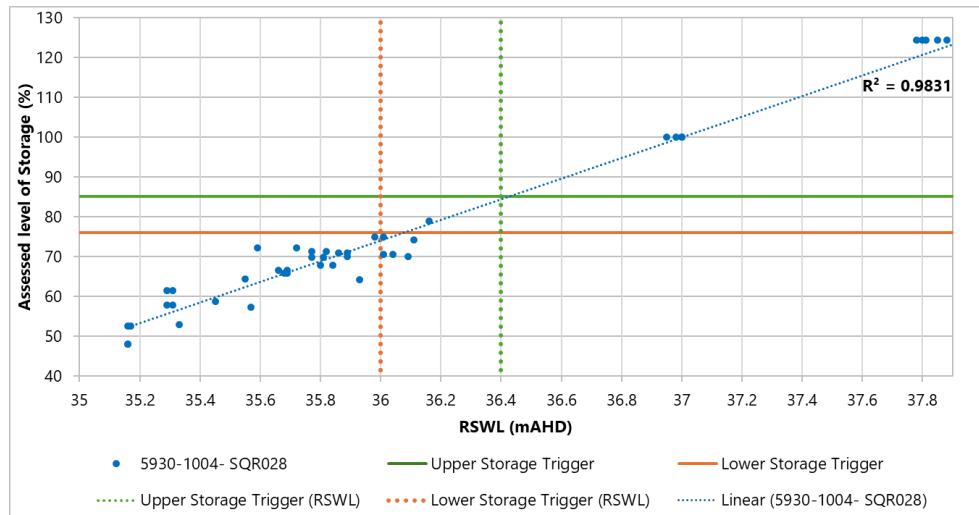
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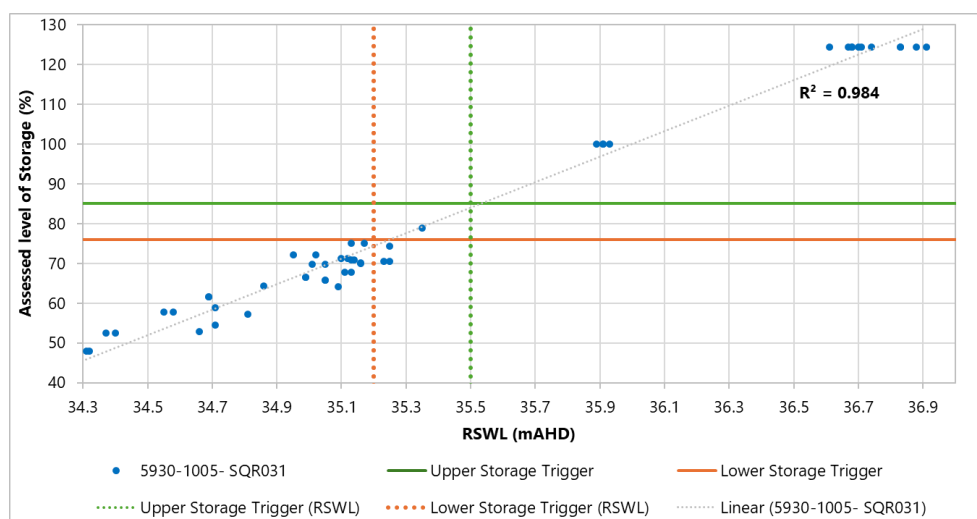
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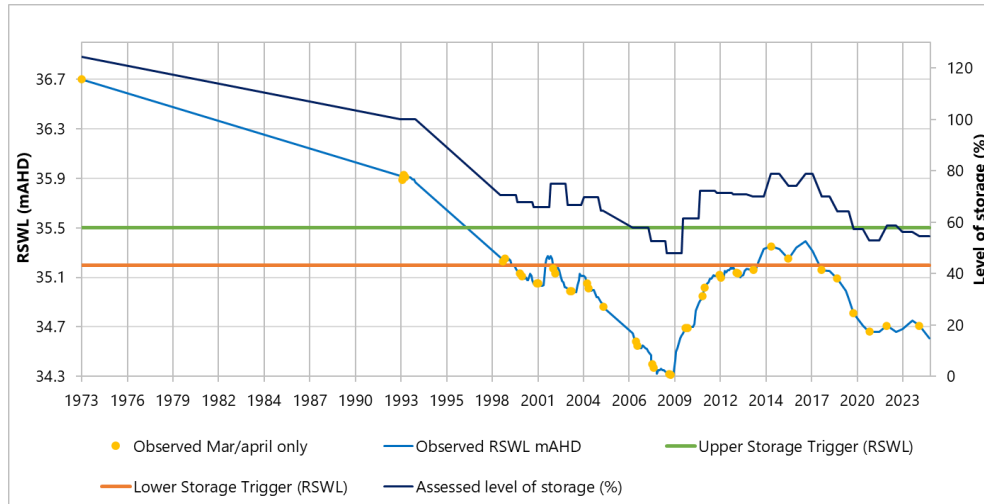
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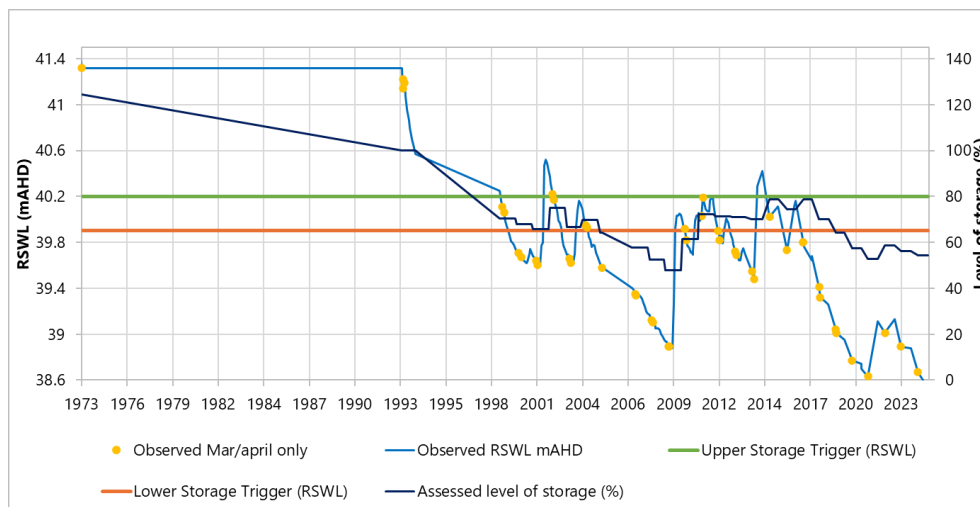
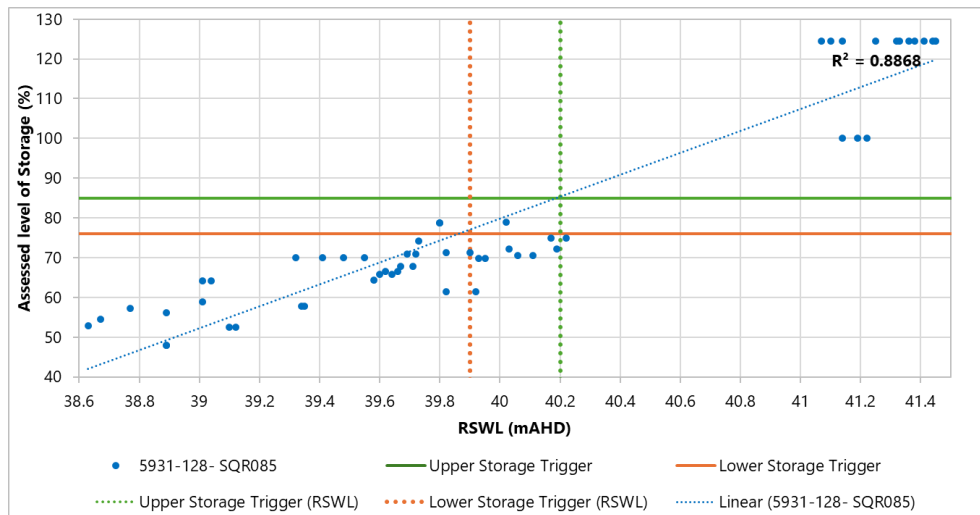
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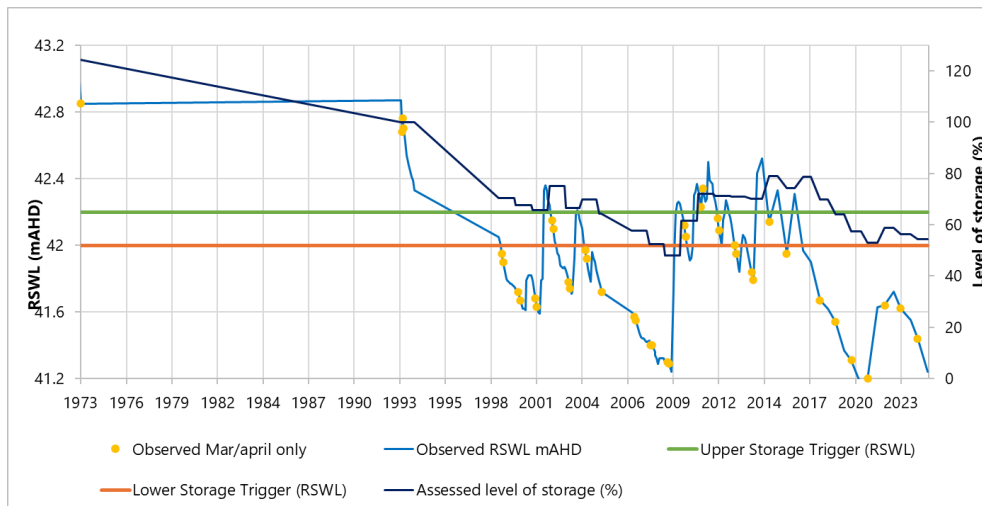
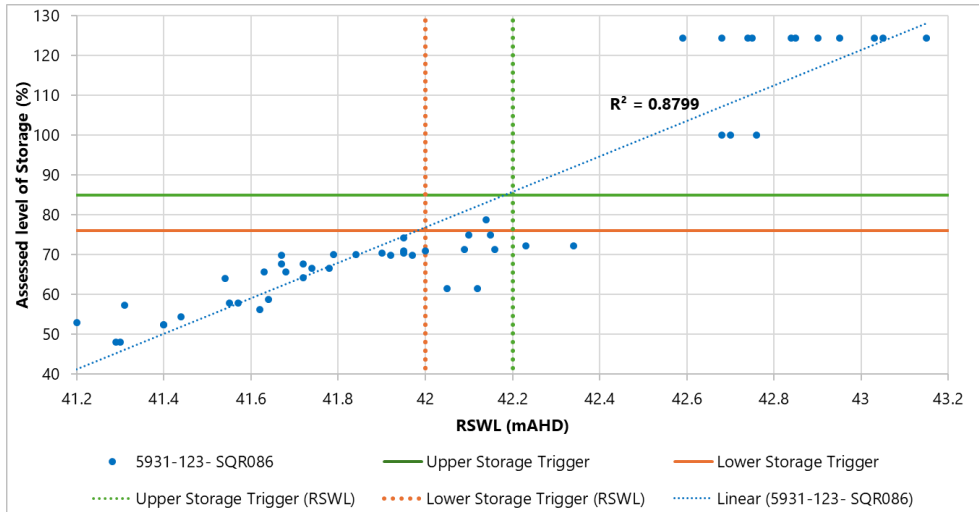
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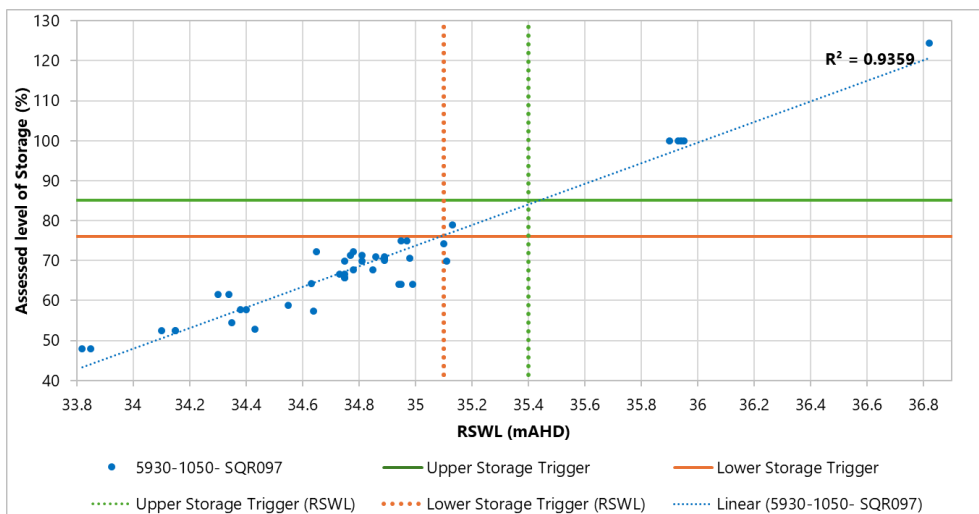
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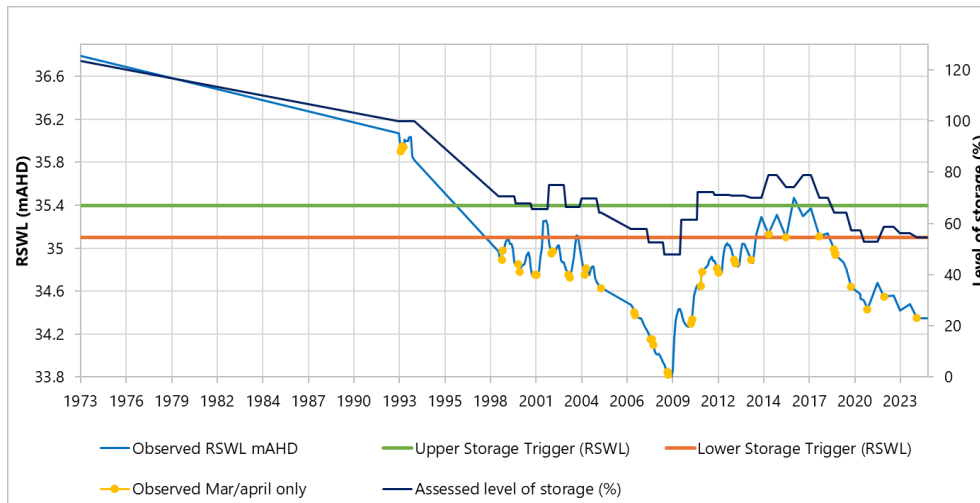
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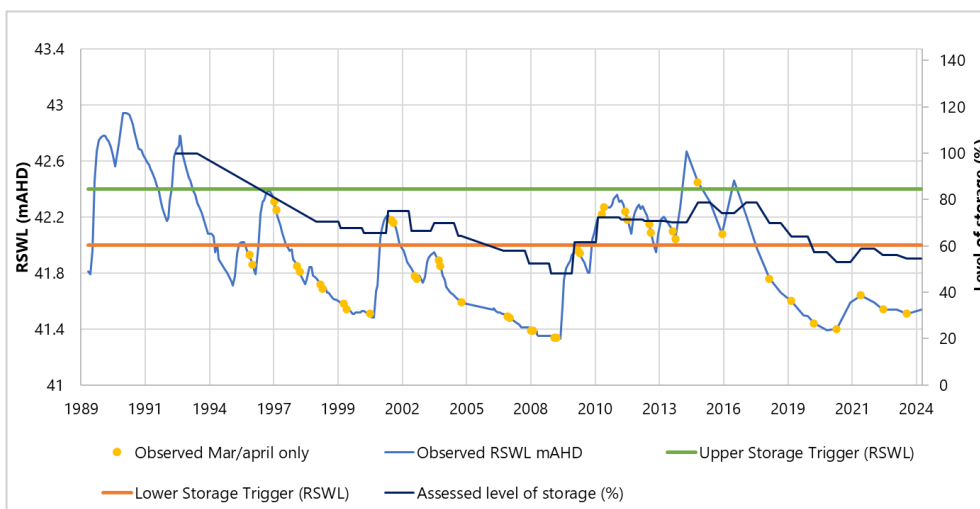
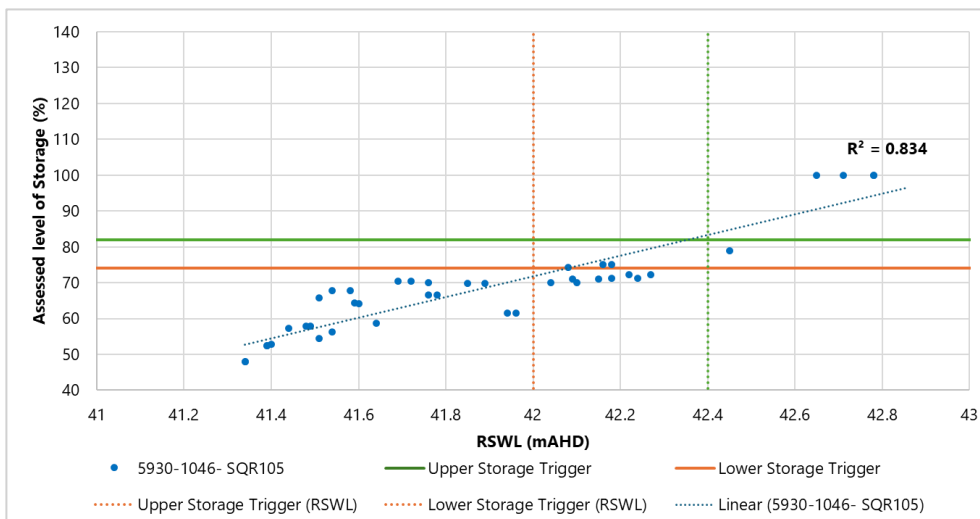
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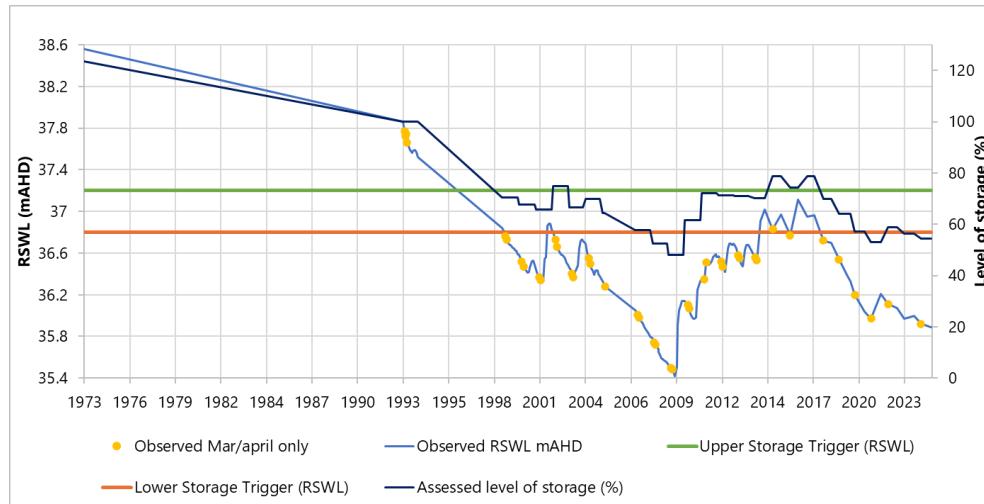
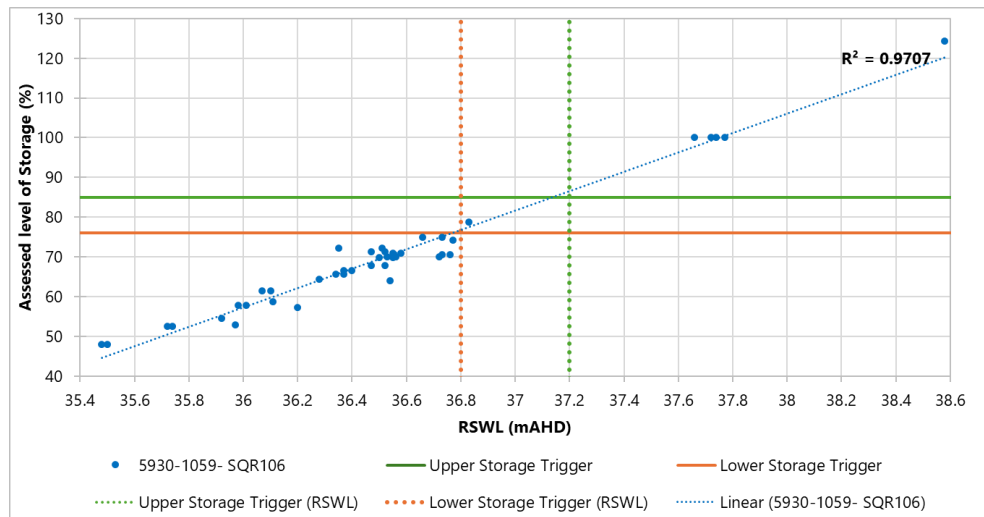
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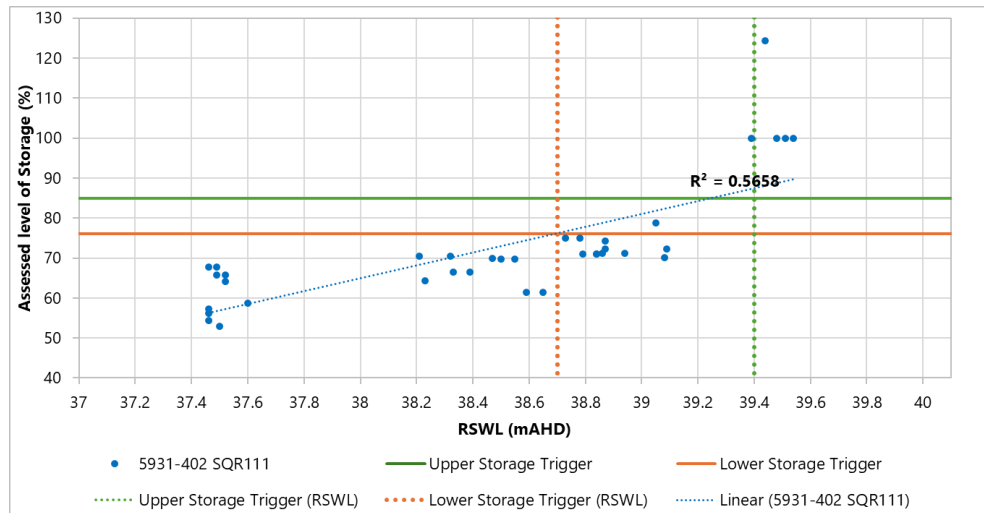
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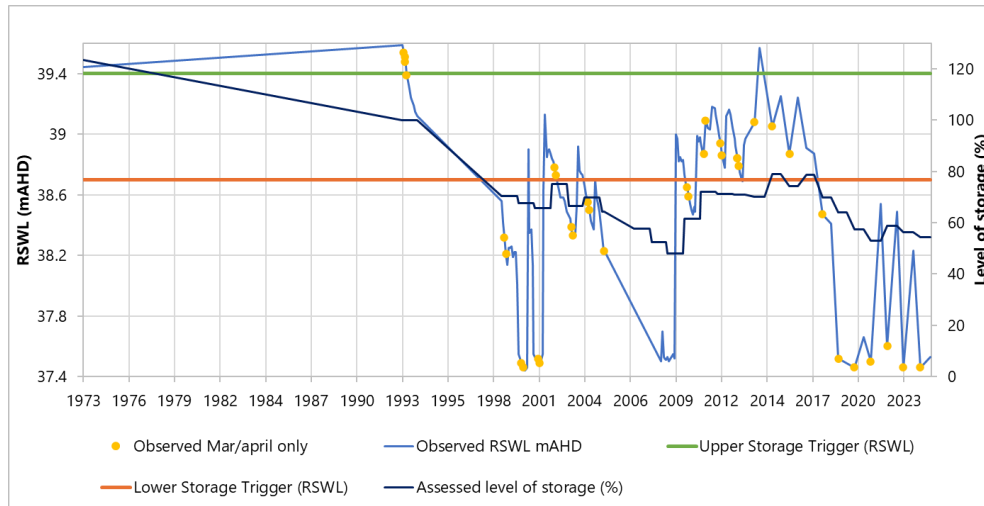
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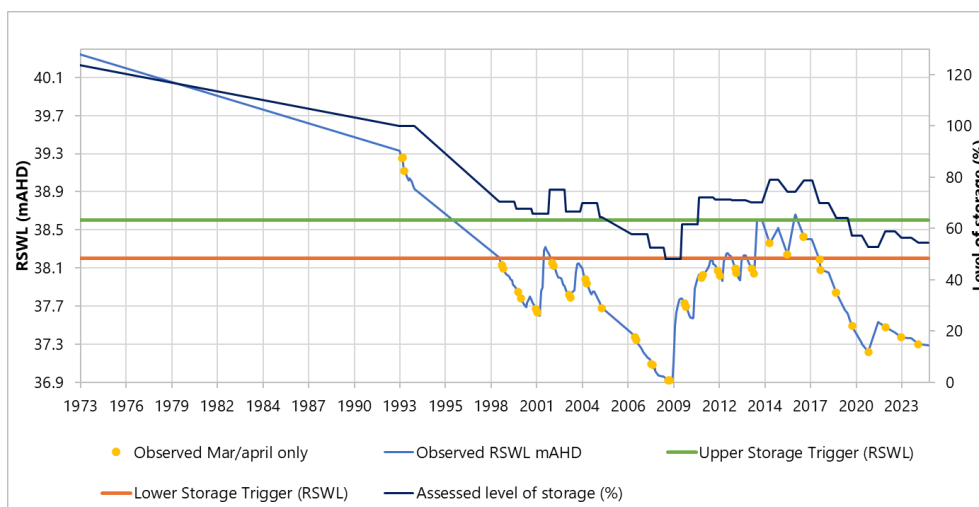
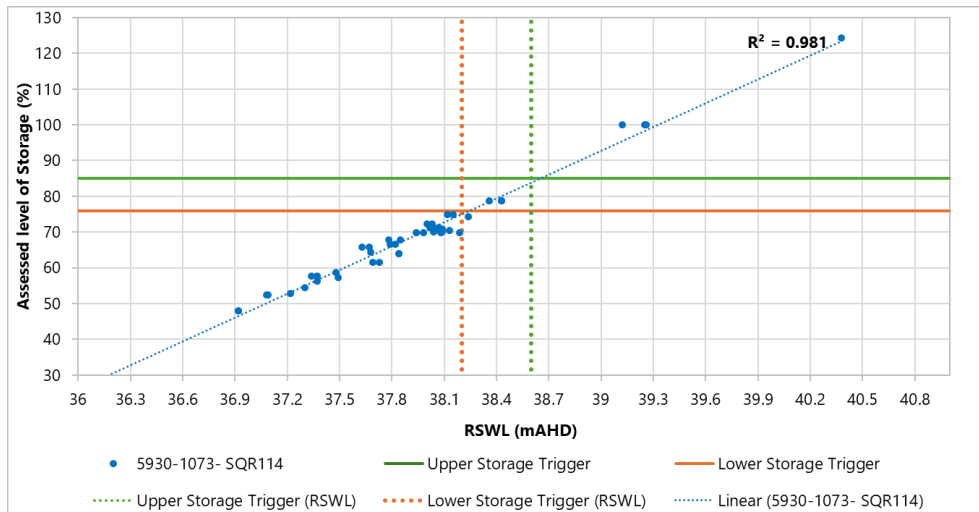
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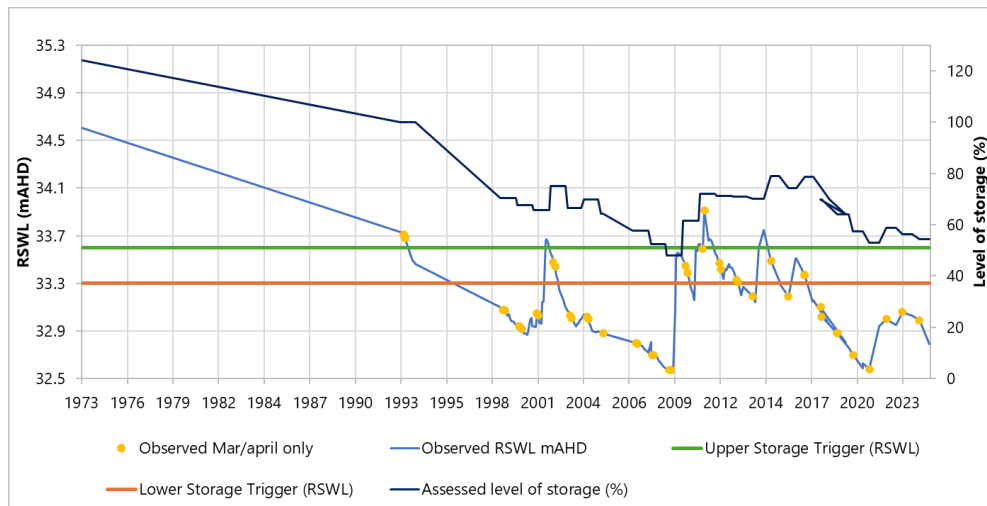
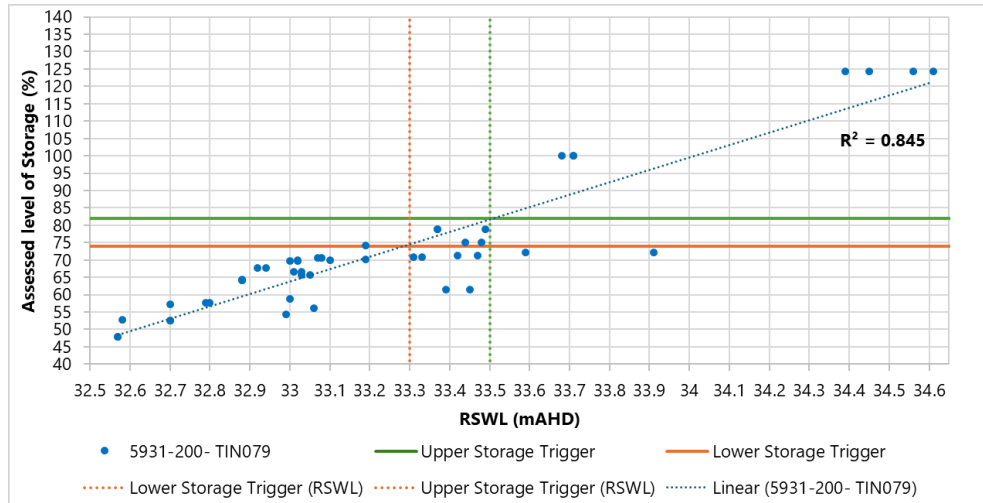
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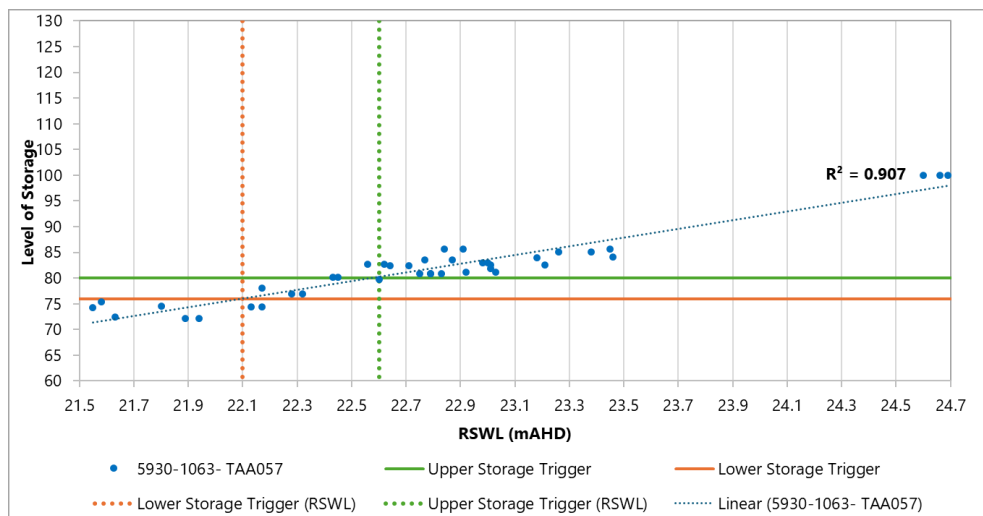


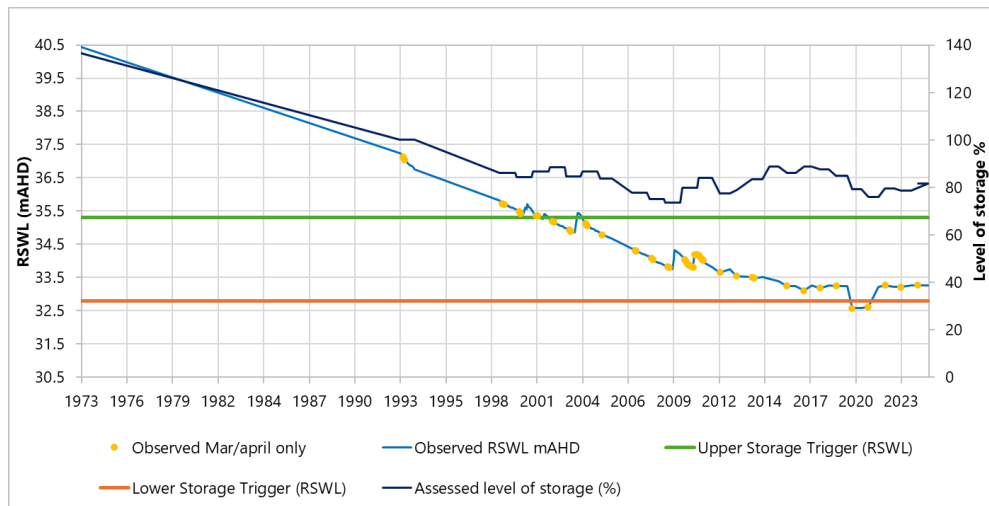
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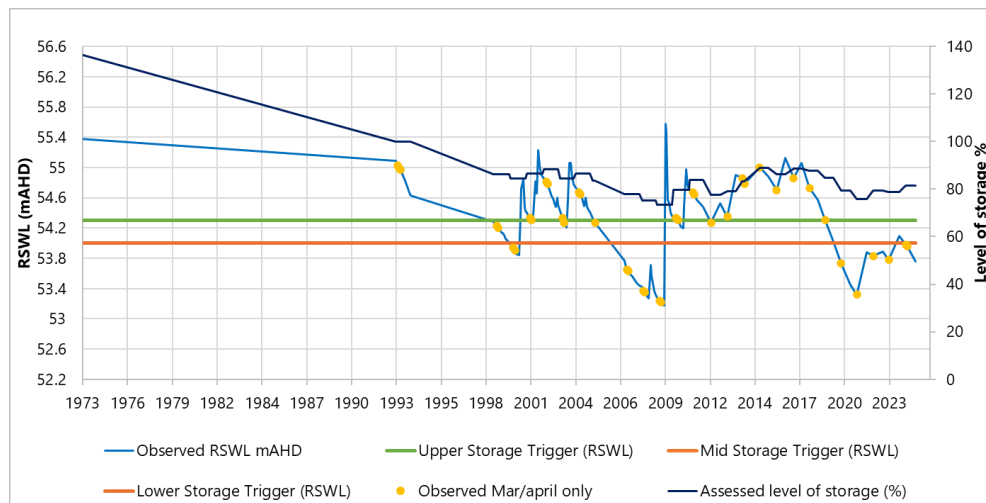
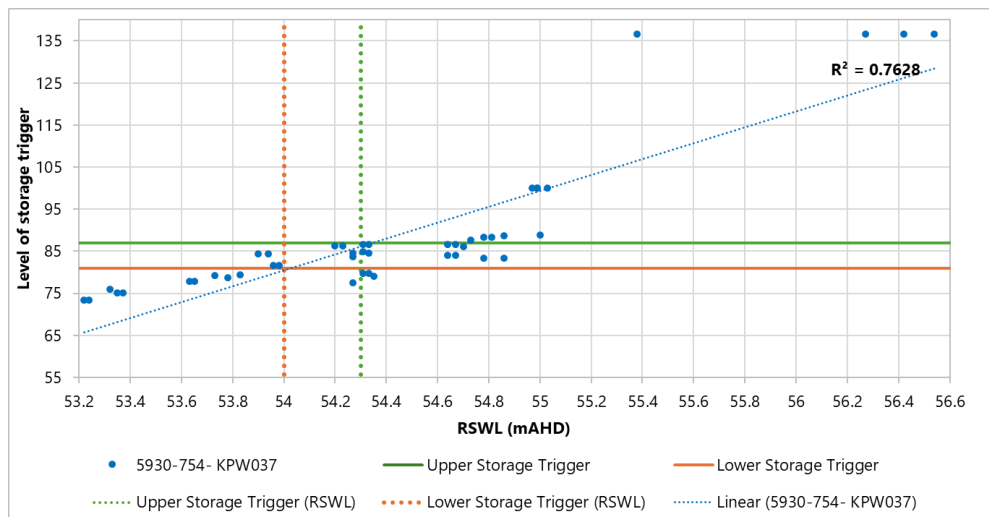
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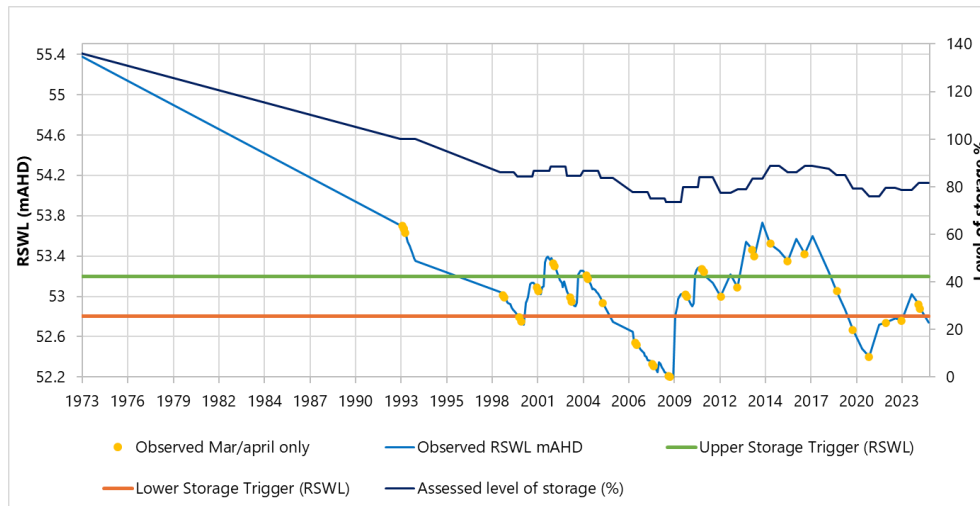
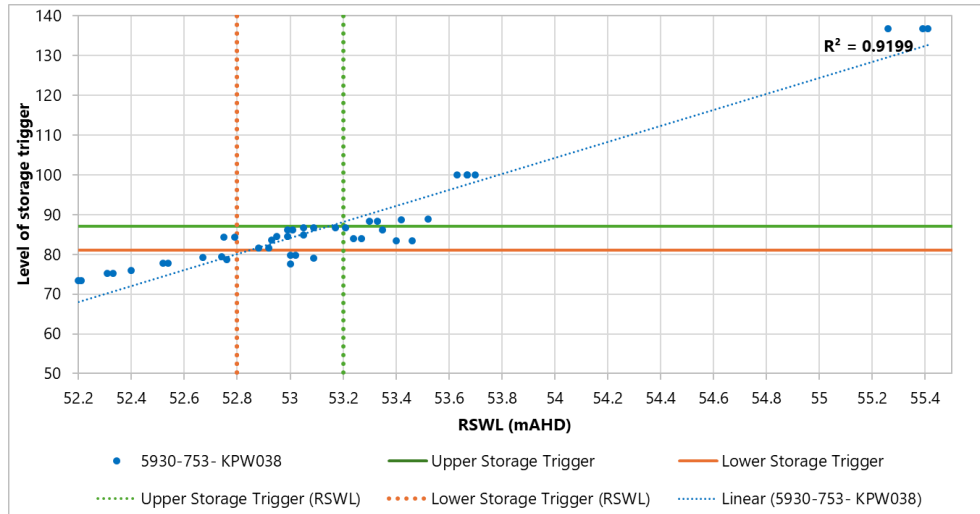




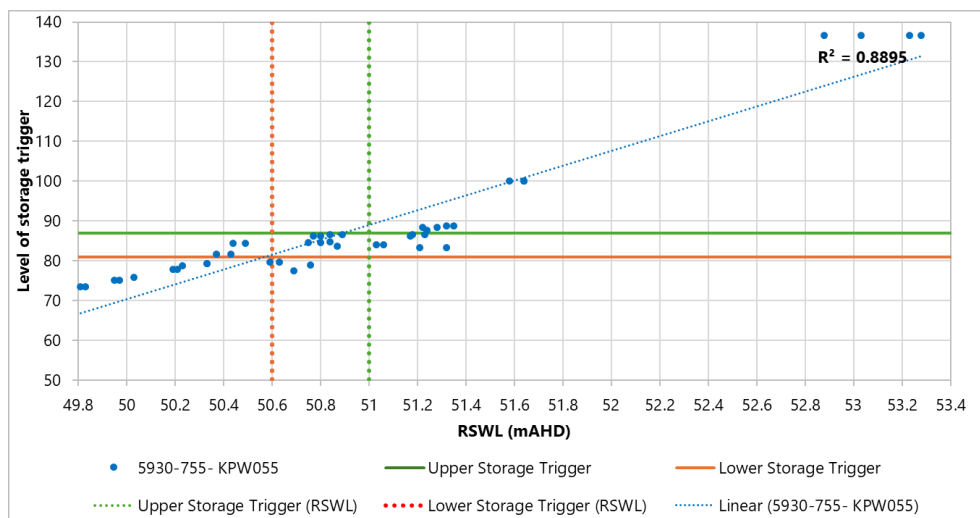
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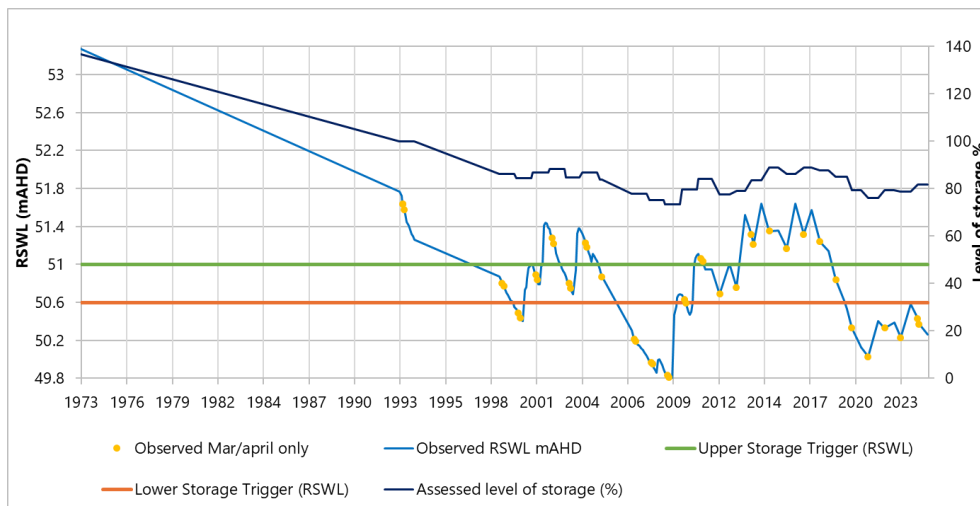
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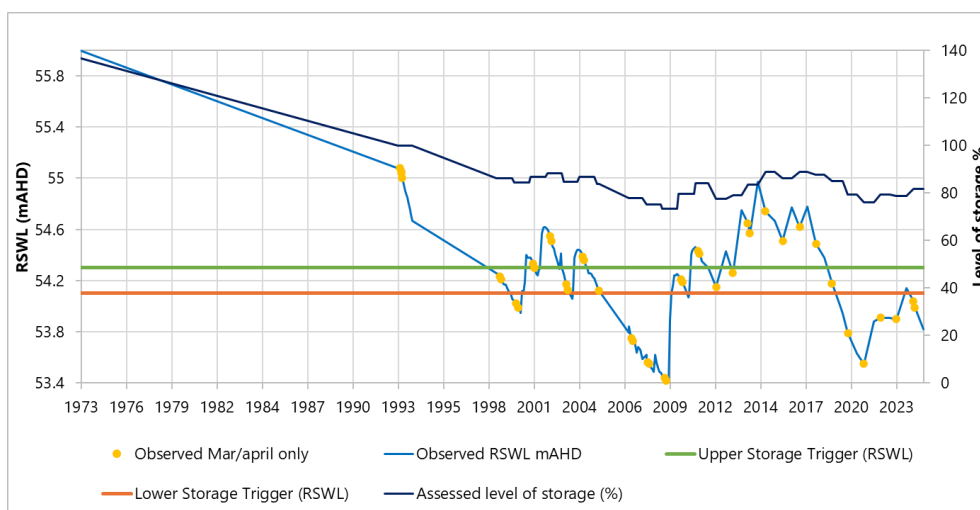
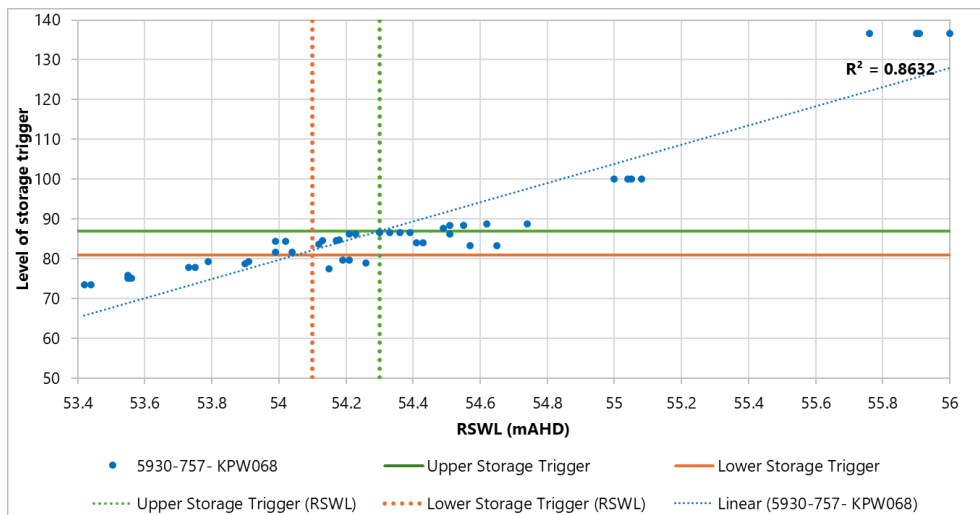
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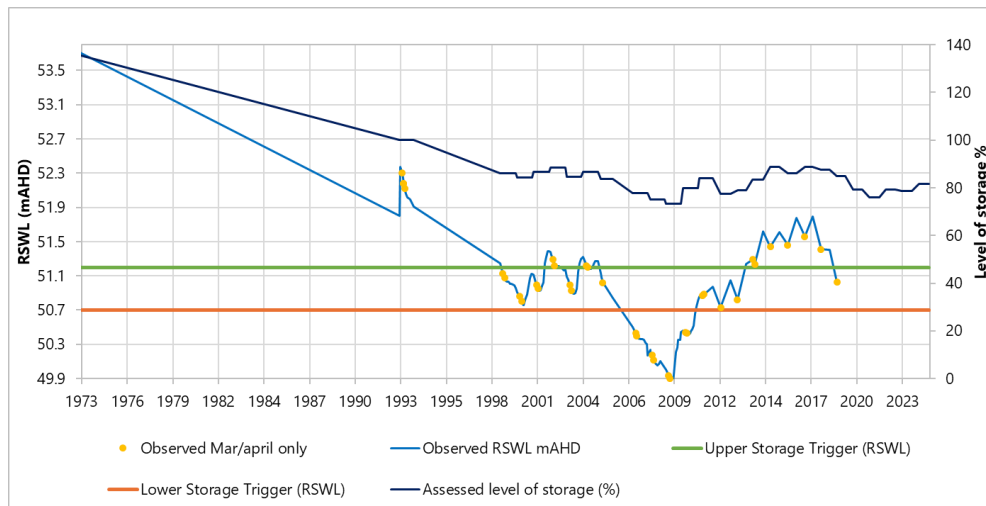
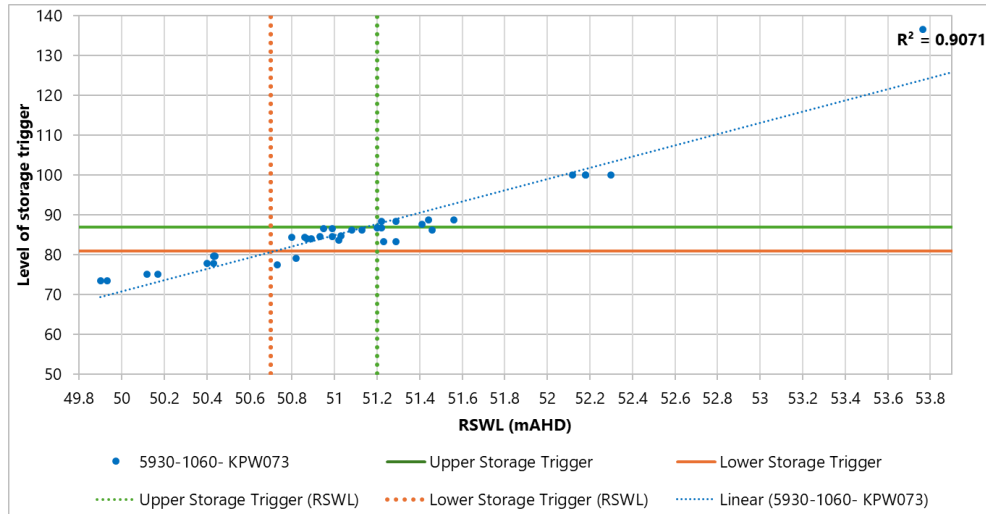
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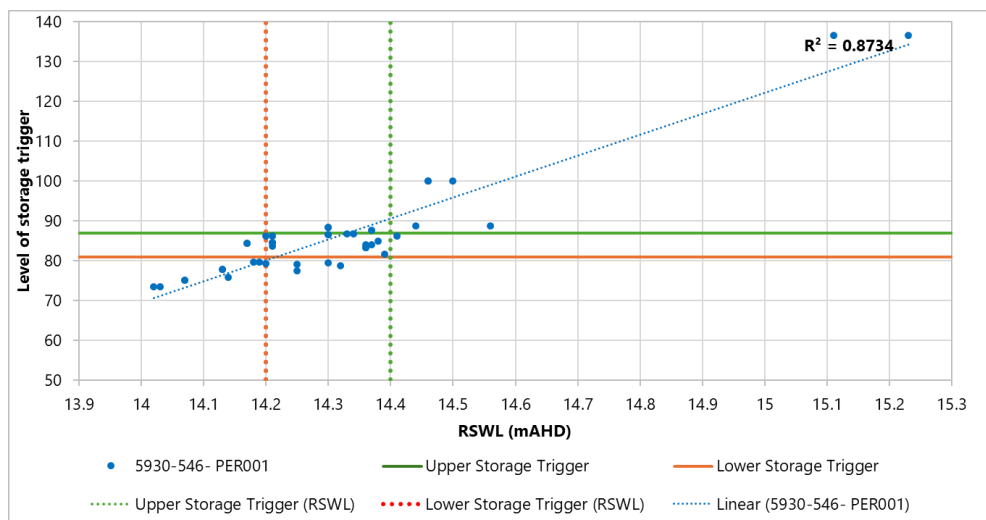
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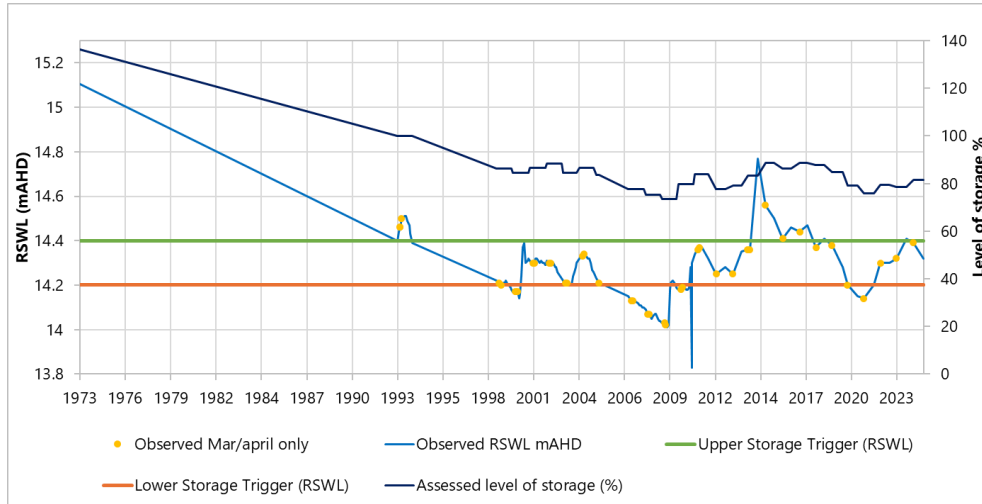
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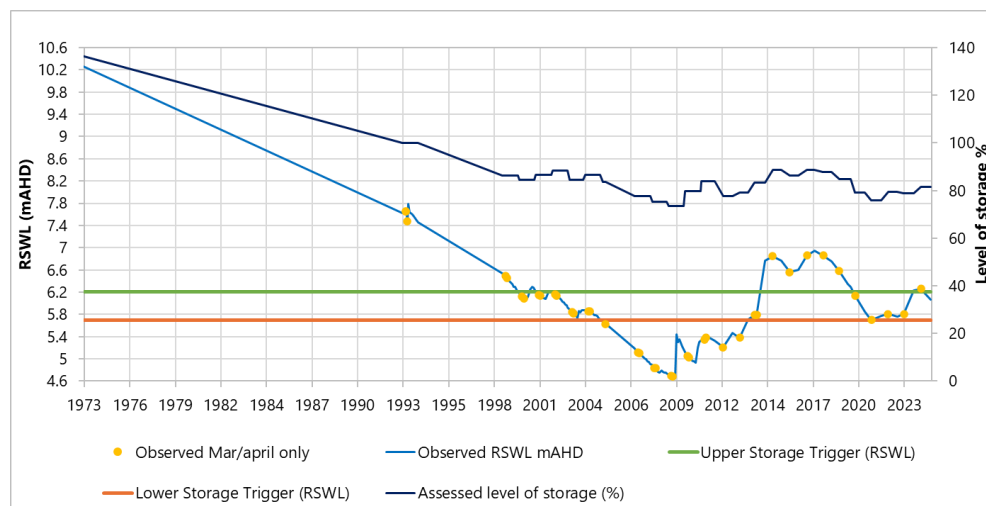
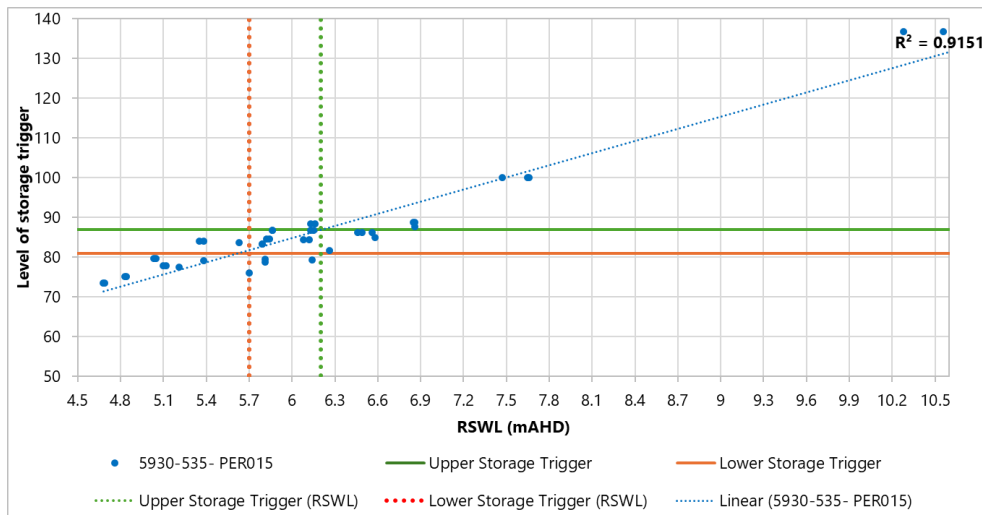
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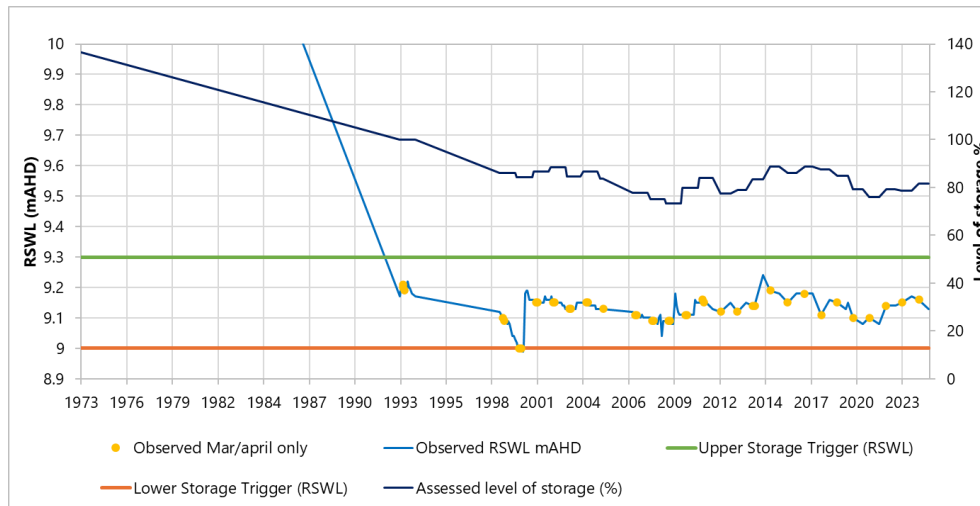
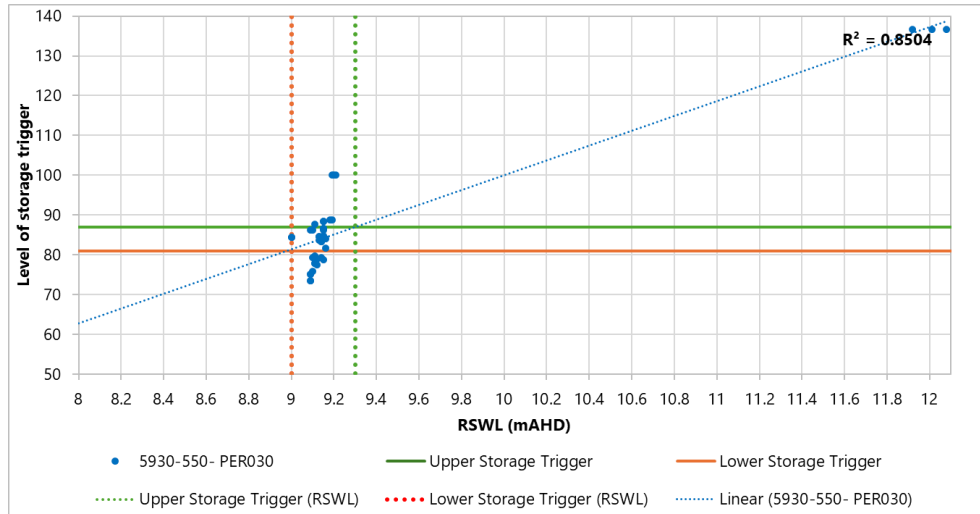
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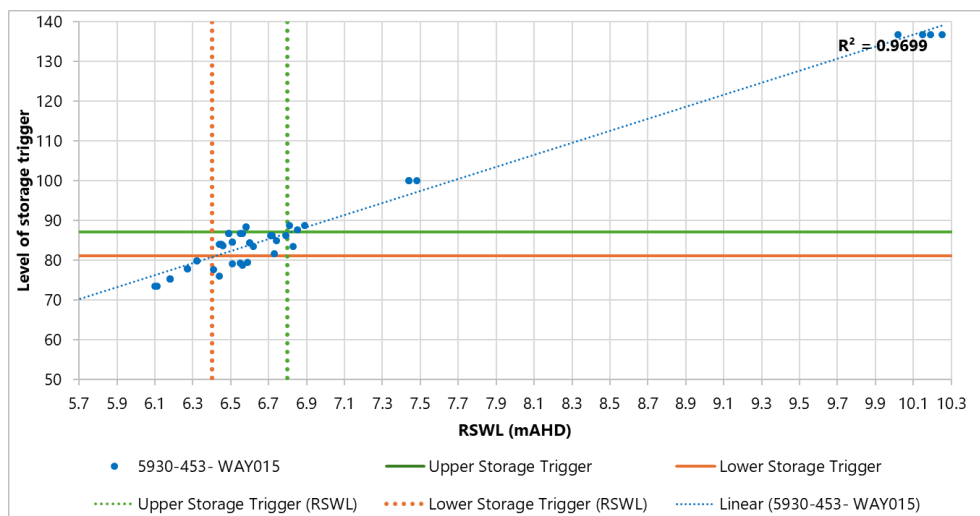
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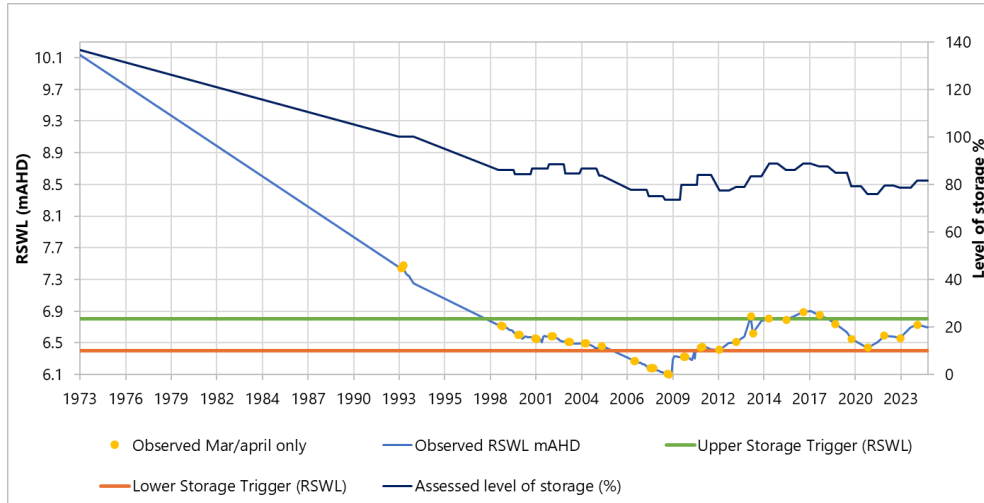
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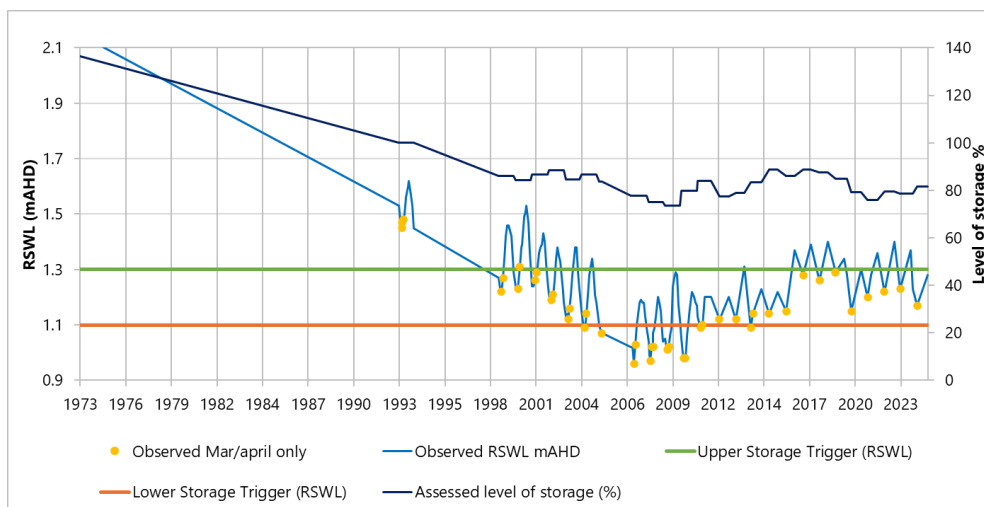
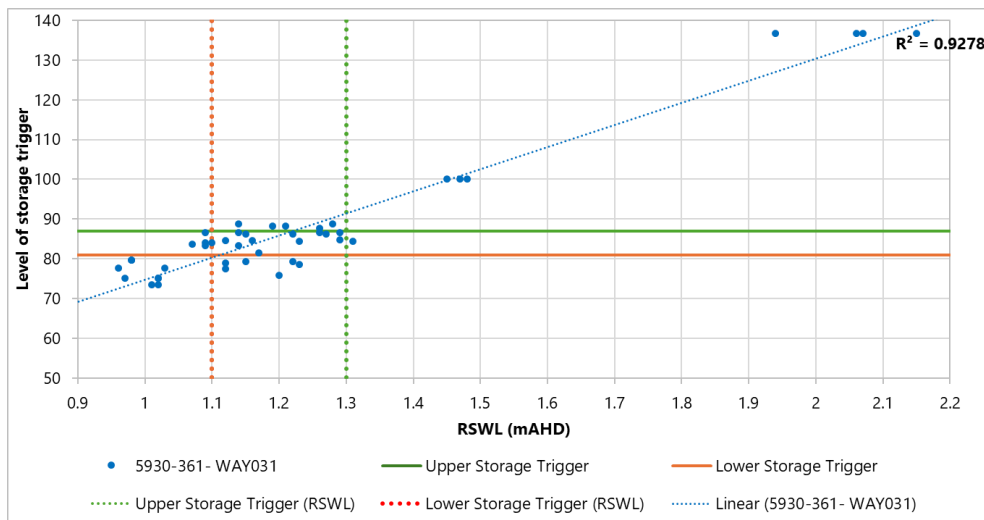
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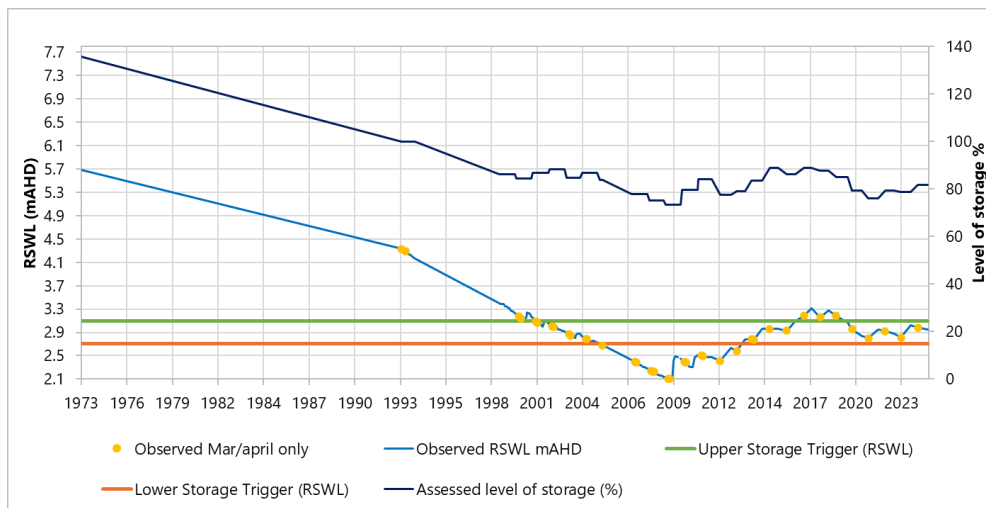
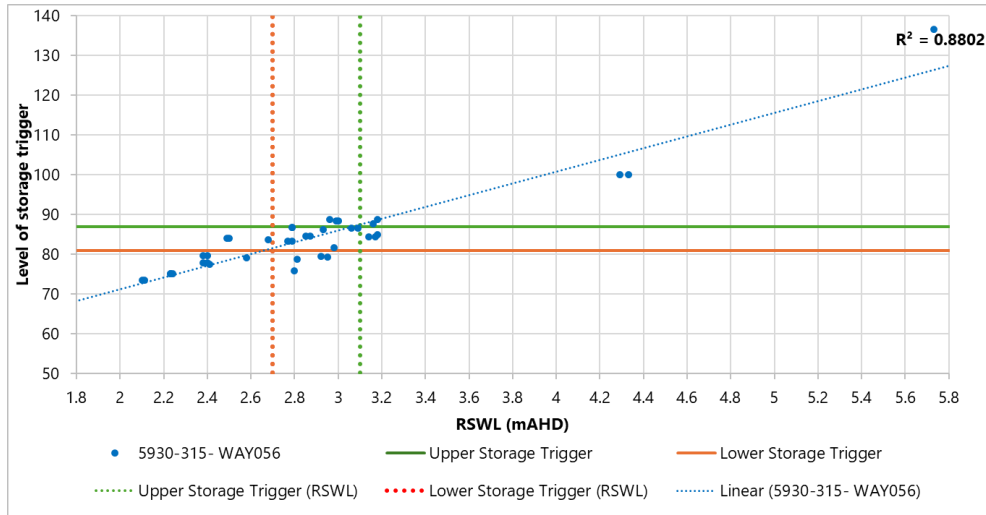
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5930-361 – WAY031



5930-315 – WAY056



11. Units of measurement

11.1 Units of measurement commonly used (SI and non-SI Australian legal)

Name of unit	Symbol	Definition in terms of other metric units	Quantity
day	d	24 h	time interval
gigalitre	GL	10^6 m^3	volume
gram	g	10^{-3} kg	mass
hectare	ha	10^4 m^2	area
hour	h	60 min	time interval
kilogram	kg	base unit	mass
kilolitre	kL	1 m^3	volume
kilometre	km	10^3 m	length
litre	L	10^{-3} m^3	volume
megalitre	ML	10^3 m^3	volume
metre	m	base unit	length
microgram	mg	10^{-6} g	mass
microlitre	mL	10^{-9} m^3	volume
milligram	mg	10^{-3} g	mass
millilitre	mL	10^{-6} m^3	volume
millimetre	mm	10^{-3} m	length
minute	min	60 s	time interval
second	s	base unit	time interval
tonne	t	1000 kg	mass
year	y	365 or 366 days	time interval

11.2 Shortened forms

AEM	Airborne Electromagnetic
AHD	Australian Height Datum
BoM	Bureau of Meteorology
CFC-12	Dichlorodifluoromethane; Chlorofluorocarbon
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEM	Digital elevation model
DEW	Department of Environment and Water
DFW	Department for Water
DMITRE	Department for Manufacturing, Innovation, Trade, Resources and Energy
DSE	Dry Sheep Equivalent

DWLBC	Department of Water, Land and Biodiversity Conservation
EC	Electrical conductivity ($\mu\text{S}/\text{cm}$)
EM	Electromagnetic
EP LB	Eyre Peninsula Landscape Board
EPNRMB	Eyre Peninsula Natural Resources Management Board
GDE	Groundwater-dependent ecosystem
HARTT	Hydrograph Analysis: Rainfall and Time-Trends (HARTT) model
Ma	Million years ago
NARClIM	New South Wales and Australian Regional Climate Modelling
PIIMS	Primary Industries Information Management System
PWA	Prescribed wells area
PWS	Public Water Supply
QL	Quaternary Limestone
RC	Resource capacity
RCP	Resource Concentration Pathway
RMMP	Risk Monitoring and Management Plan
RSWL	Reduced standing water level
SA Water	South Australian Water Corporation
SOP	Standard operating procedure
sTEM	stationary Transient Electromagnetic
TS	Tertiary Sands
TDS	Total Dissolved Solids
WAP	Water allocation plan
WTF	Water Table fluctuation

12. Glossary

Act (the) — In this document, refers to the Landscape South Australia Act 2019.

Adaptive management — A management approach often used in natural resource management where there is little information and/or a lot of complexity, and there is a need to implement some management changes sooner rather than later. The approach is to use the best available information for the first actions, implement the changes, monitor the outcomes, investigate the assumptions, and regularly evaluate and review the actions required. Consideration must be given to the temporal and spatial scale of monitoring and the evaluation processes appropriate to the ecosystem being managed.

Adelaide meteoric water line — A locally derived stable isotope relationship that describes the natural ratio of hydrogen and oxygen isotopes in rainfall across the Adelaide region. Comparison of groundwater isotope data with the Adelaide Meteoric Water Line can provide insight into groundwater recharge mechanisms, water source identification and the extent of evaporation prior to recharge. The relationship is expressed as $\delta^2\text{H} = 8.26 \times \delta^{18}\text{O} + 12.63$.

Aquifer — An underground layer of rock or sediment that holds water and allows water to percolate through

Aquifer, confined — Aquifer in which the upper surface is impervious (see ‘confining layer’) and the water is held at greater than atmospheric pressure; water in a penetrating well will rise above the surface of the aquifer

Aquifer, unconfined — Aquifer in which the upper surface has free connection to the ground surface and the water surface is at atmospheric pressure

Aquitard — A saturated geological unit of relatively low permeability that impedes, but does not completely prevent, the movement of groundwater between aquifers. Aquitards can store groundwater but transmit it only slowly.

Basin = a hydrogeological feature or groundwater basin (e.g. Polda Basin, Bramfield Basin, Uley South Basin).

Bore — See ‘well’.

Catchment — That area of land determined by topographic features within which rainfall will contribute to run-off at a particular point

CFC — Chlorofluorocarbon; measured in parts per trillion (ppt)

Confining layer — A rock unit impervious to water, which forms the upper bound of a confined aquifer; a body of impermeable material adjacent to an aquifer; see also ‘aquifer, confined’

Consumptive pool — A defined part of a water resource from which water may be allocated and taken for consumptive use under a Water Allocation Plan. Consumptive pools are established to manage water extraction from specific aquifers, groundwater lenses, or areas of a prescribed water resource and may have separate allocation and management arrangements.

Domestic — The taking of water for ordinary household purposes; includes the watering of land, in conjunction with a dwelling, not exceeding 0.4 hectares

EC — Electrical conductivity; 1 EC unit = 1 micro-Siemen per centimetre ($\mu\text{S}/\text{cm}$) measured at 25°C; commonly used as a measure of water salinity as it is quicker and easier than measurement by TDS

Ephemeral streams — A stream or watercourse that flows only in direct response to rainfall or runoff events and remains dry for most of the year. Ephemeral streams do not typically receive sustained baseflow from groundwater and cease flowing once rainfall-derived runoff has ended.

Evapotranspiration — The total loss of water as a result of transpiration from plants and evaporation from land, and surface water bodies

Groundwater — Water occurring naturally below ground level or water pumped, diverted and released into a well for storage underground

Lens — A freshwater lens within the Quaternary Limestone aquifer (e.g. Poldia Lens, Bramfield Lens).

Irrigation — Watering land by any means for the purpose of growing plants

Isohaline — Of equal or constant salinity; typically drawn as a contour line on a map

Karstic — Relating to landscapes or aquifers formed by the dissolution of soluble rocks, such as limestone, dolomite or gypsum. Karstic systems are characterised by features including sinkholes, caves, enlarged fractures, conduits and underground drainage networks, which can result in rapid groundwater movement and highly variable recharge processes.

Licence — A licence to take water in accordance with the Act; see also 'water licence'

Licensee — A person who holds a water licence

Australian Height Datum (mAHD) — Defines elevation in metres (m) according to the Australian Height Datum (AHD); 0 mAHD is approximately mean sea level

Model — A conceptual or mathematical means of understanding elements of the real world that allows for predictions of outcomes given certain conditions. Examples include estimating storm run-off, assessing the impacts of dams or predicting ecological response to environmental change

Monitoring — (1) The repeated measurement of parameters to assess the status and changes over time of the parameters measured (2) Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, animals, and other living things

Natural recharge — The infiltration of water into an aquifer from the surface (rainfall, streamflow, irrigation...). See also recharge area

Natural Resources Management — All activities that involve the use or development of natural resources and/or that impact on the state and condition of natural resources, whether positively or negatively

Observation well — A narrow well or piezometer whose sole function is to permit groundwater level measurements

Permeability — A measure of the ease with which water flows through an aquifer or aquitard, measured in m²/d

Piezometer — A narrow tube, pipe or well; used for measuring moisture in soil, groundwater levels in an aquifer, or pressure head in a tank, pipeline...

Prescribed well — A well declared to be a prescribed well under the Act

Production well — The pumped well in an aquifer test, as opposed to a monitoring well; a wide-hole well, fully developed and screened for water supply, drilled on the basis of previous exploration wells

Recharge area — The area of land from which water from the surface (rainfall, streamflow, irrigation) infiltrates into an aquifer. See also natural recharge

Reduced Standing Water Level (RSWL) — The elevation of the groundwater level, typically measured in mAHD. It is calculated by subtracting the Depth to Water from the reference elevation. A negative value indicates that the water level is below mean sea level

Representative Concentration Pathway (RCP) — A greenhouse gas concentration scenario used by the Intergovernmental Panel on Climate Change (IPCC) to assess potential future climate conditions. RCPs represent different trajectories of atmospheric greenhouse gas concentrations and associated radiative

forcing by 2100, and are used to model future changes in temperature, rainfall, evaporation, sea level and other climate variables.

SA Geodata — A collection of linked databases storing geological and hydrogeological data, which the public can access through the offices of DMITRE. Custodianship of data related to minerals and petroleum, and groundwater, is vested in DMITRE and DEW, respectively. DEW should be contacted for database extracts related to groundwater

SA Water — South Australian Water Corporation (Government of South Australia)

Secondary porosity — Refers to voids within rocks which are formed after sedimentary deposition, for example, solution features (that is, sink holes or caves) occurring within limestone formations

Stock use — The taking of water to provide drinking water for stock other than stock subject to intensive farming (as defined by the Act)

Sustainability — The ability of an ecosystem to maintain ecological processes and functions, biological diversity, and productivity over time

Total dissolved solids (TDS) — Measured in milligrams per litre (mg/L); a measure of water salinity

Tertiary aquifer — A term used to describe a water-bearing rock formation deposited in the Tertiary geological period (1–70 million years ago)

To take water — From a water resource includes (a) to take water by pumping or siphoning the water; (b) to stop, impede or divert the flow of water over land (whether in a watercourse or not) for the purpose of collecting the water; (c) to divert the flow of water from the watercourse; (d) to release water from a lake; (e) to permit water to flow under natural pressure from a well; (f) to permit stock to drink from a watercourse, a natural or artificial lake, a dam or reservoir

Transmissivity (T) — A parameter indicating the ease of groundwater flow through a metre width of aquifer section

Underground water — See ‘groundwater’

Water allocation — (a) In respect of a water licence, the quantity of water that the licensee is entitled to take and use pursuant to the licence. (b) In respect of water taken pursuant to an authorisation under section 11 of the Act, the maximum quantity of water that may be taken and used pursuant to that authorisation.

Water allocation, area based — An allocation of water that entitles the licensee to irrigate a specified area of land for a specified period of time, usually per water–use year

Water Allocation Plan (WAP) — A plan prepared by a Catchment Water Management Board or water resources planning committee and adopted by the Minister in accordance with the Act

Water-dependent ecosystems — Those parts of the environment, the species composition and natural ecological processes, that are determined by the permanent or temporary presence of flowing or standing water, above or below ground; the in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries and lakes are all water-dependent ecosystems

Water licence — A licence granted under the Act entitling the holder to take water from a prescribed watercourse, lake or well or to take surface water from a surface-water prescribed area; this grants the licensee a right to take an allocation of water specified on the licence, which may also include conditions on the taking and use of that water; a water licence confers a property right on the holder of the licence and this right is separate from land title

Well — (1) An opening in the ground excavated for the purpose of obtaining access to underground water; (2) An opening in the ground excavated for some other purpose but that gives access to underground water; (3) A natural opening in the ground that gives access to underground water

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