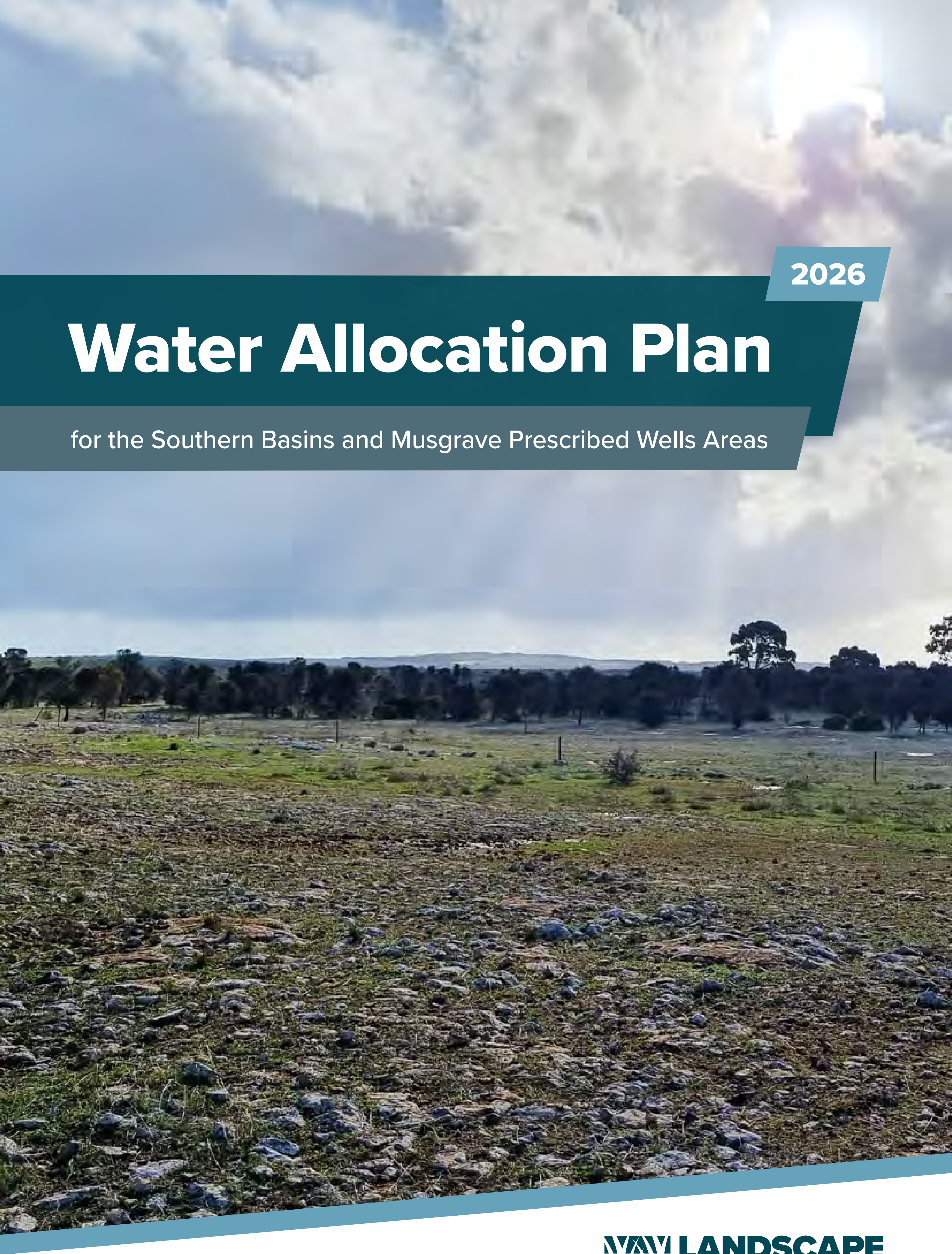


2026

Water Allocation Plan

for the Southern Basins and Musgrave Prescribed Wells Areas

LANDSCAPE SOUTH AUSTRALIA EYRE PENINSULA

Landscape South Australia Act 2019

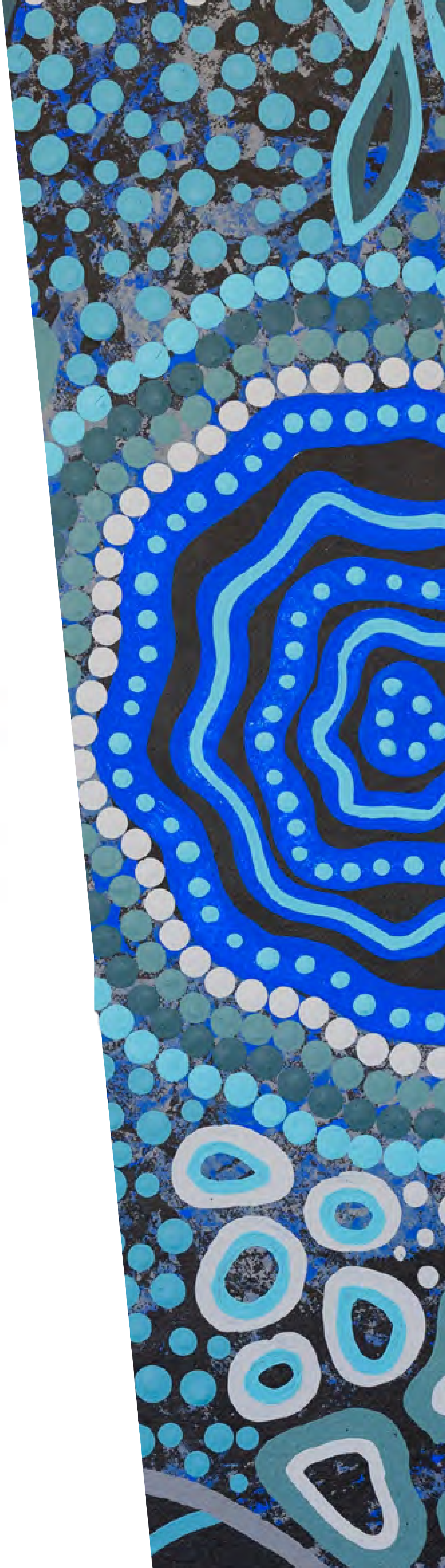
Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas

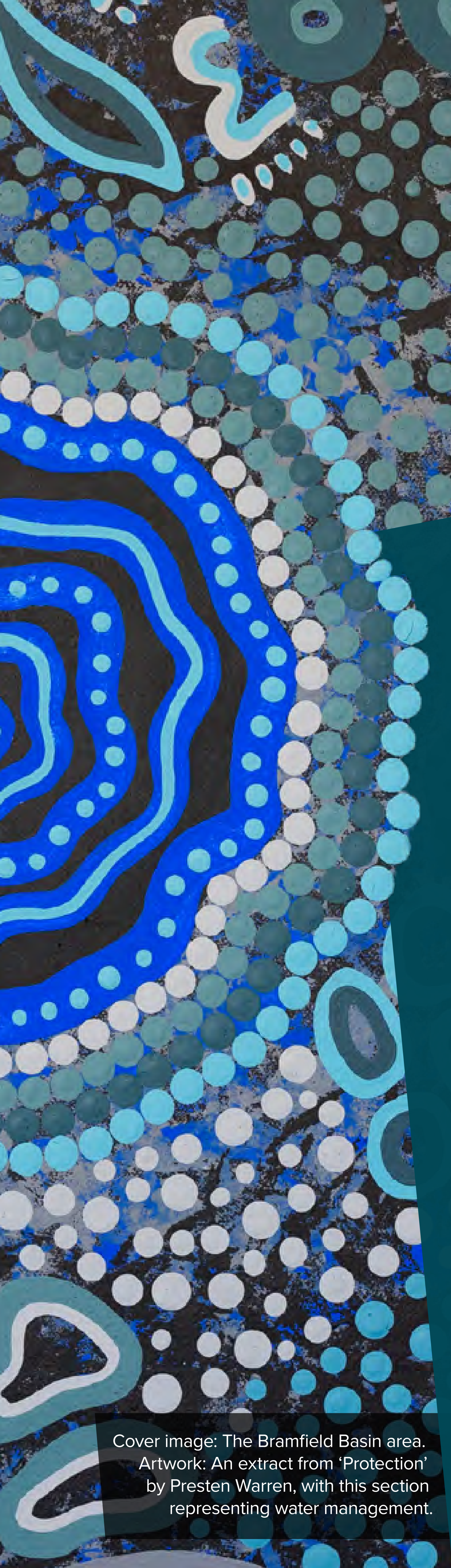
I, Emily Bourke MLC, Minister for Climate, Environment and Water, hereby approve this Water Allocation Plan pursuant to section 56(2)(a) of the *Landscape South Australia Act 2019*.

This Water Allocation Plan will become operational on 1 July 2026.

Minister for Climate, Environment and Water

Date: 7/5/26





Cover image: The Bramfield Basin area.
Artwork: An extract from 'Protection' by Presten Warren, with this section representing water management.

Acknowledgment of Country

The Eyre Peninsula region encompasses the lands of numerous Traditional Owner groups.

The Eyre Peninsula Landscape Board acknowledges and respects the traditional custodians whose ancestral lands are part of our landscape board region, and we pay our respects to their Elders past and present.

We acknowledge and respect the deep spiritual attachment and the relationship that Aboriginal people have to Country.

The Board is committed to supporting the involvement of Aboriginal people and organisations in the management of the region's landscapes and in recognising Aboriginal culture and knowledge of natural resources in the landscape.

The Board seeks active partnerships across the landscape that enable Traditional Owners and Aboriginal people living in the region to maximise opportunities for maintaining connection with the land and to protect and maintain culture, cultural sites and natural resources of the lands and waters of the Eyre Peninsula region.

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Lake Newland, a groundwater fed lake

1. Introduction

1.1. Background to the Water Allocation Plan

This document is the Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas, 2026. The Water Allocation Plan (the Plan) for the Southern Basins and Musgrave Prescribed Wells Areas (PWAs) is prepared pursuant to Part 4, Division 2 of the *Landscape South Australia Act 2019* (the Landscape Act) and is consistent with the objects and requirements of this Act. It replaces the Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas, 2016.

This Plan manages the groundwater resources of the Quaternary, Tertiary and Basement aquifers of the Southern Basins and Musgrave PWAs and provides water to ecosystems dependent on these groundwater sources (for example, red gums, wetlands, soaks) to protect them from impacts due to the taking of water. The groundwater managed through this Plan is divided into consumptive pools, including Bramfield, Coffin Bay, and Uley South, which provide water for public water supply purposes.

The Landscape Act requires the Eyre Peninsula Landscape Board (the Board) to prepare and review a plan for each of the prescribed water resources in its region. The Landscape Act allows a Plan to relate to more than one prescribed water resource. Both the Southern Basins and the Musgrave PWAs were amalgamated into a single Plan in 2016 and this Plan also covers both water resources. The development of this Plan and the 10-year statutory review have been undertaken simultaneously by the Board.

This Plan has been produced using the *Intergovernmental Agreement on a National Water Initiative* (NWI) (COAG 2004) as a guiding document. The NWI is an agreement signed by all state and territory governments and the Australian Government. It sets out principles on how freshwater resources should be shared for the benefit of communities, freshwater ecosystems and economic development. These principles relate to matters such as the need for science-based water planning, adaptive management of the resource, open engagement with communities, secure water rights for consumptive purposes and the provision of environmental water requirements.

This Plan is a statutory document that provides for the management of water property rights through a legally robust licensing regime, the apportioning of available water in a resource for groundwater-dependent ecosystems (GDEs) and for consumptive purposes, the management of the taking and use of water and the transfer of water rights between users. This Plan aims to achieve an equitable long-term balance between environmental, social and economic needs for water. This Plan also sets out the requirements for those water affecting activities that are specific to the areas managed by this Plan and are additional to those contained in the Eyre Peninsula Water Affecting Activity Control Policy.

This Plan does not encompass the management, take and use of surface water or water in watercourses as these resources are not prescribed in this region.

The Board has commissioned significant research and investigation, including groundwater modelling, to further develop the knowledge and understanding of the region's groundwater systems. This knowledge underpins the ability to adaptively manage the groundwater resources over time.

1.1.1. Objectives

By managing the take and use of water from the groundwater resources within the Southern Basins and Musgrave PWAs within the limits set by the Plan, this Plan aims to meet the following objectives:

- Allocate water for licensed consumptive purposes including (but not limited to) public water supply, irrigation for agricultural and recreational purposes and mining, in a manner that seeks to protect the sustainability of the water resources.
- Minimise the impact of the authorised taking of water on:
  - other water resources (adjacent or overlying water resources)
  - groundwater-dependent ecosystems (GDEs)
  - existing users of groundwater, including for stock and domestic purposes.

- Support the water interests of Aboriginal people relating to:
  - the traditional and cultural importance of groundwater, including access to the water resources
  - the authorised taking of water from a particular location to avoid damage, disturbance or interference with any site of cultural significance
  - legal rights to take water arising from Native Title determinations
  - possible economic benefits from entitlements to groundwater in the future.
- Minimise the risk of seawater intrusion due to the taking of authorised water in coastal aquifers.
- Minimise the risk of increasing groundwater salinities from the authorised taking of water.

1.1.2. History of groundwater management

Drinking water supply for the majority of the Eyre Peninsula has been sourced from a range of local groundwater aquifers, including the Southern Basins Prescribed Wells Area (Uley South, Uley Wanilla, Lincoln South and Coffin Bay) and the Musgrave Prescribed Wells Area (Bramfield) for Elliston, as well as the River Murray, via the Morgan to Whyalla and Iron Knob to Lock pipelines. Of the region's groundwater systems, those within the Southern Basins and Musgrave PWAs have historically provided water of sufficient quality and quantity to support a range of uses, including public supply, agriculture, industry, recreation and domestic consumption.

To better manage and protect these critical groundwater resources, the Southern Basins and Musgrave Proclaimed Regions were declared Proclaimed Regions in March 1987 under Section 41 of the *Water Resources Act 1976*. This marked the beginning of formal groundwater regulation in the region. Subsequently, water allocation plans were developed under the *Water Resources Act 1997*, to regulate the use of the groundwater resources. These water allocation plans replaced the existing water management document, the *County Musgrave and Southern Basins Water Resources Management Objectives and Policies 1997*. The inaugural Plans for the Southern Basins and Musgrave PWAs were adopted in December 2000 and January 2001, respectively. The Board reviewed these Plans in accordance with the requirements of the *Natural Resources Management Act 2004* and subsequently made the decision to amend both plans and to combine them into a single plan in 2016.

Pursuant to the transitional provisions in the Landscape Act (Schedule 5, Division 7), the original proclamations for the Southern Basins and Musgrave Proclaimed Regions made in 1987 remain in force and effect, as though the regions were proclaimed as the Southern Basins and Musgrave PWAs by regulation under Section 101 of the Landscape Act.

The 2016 Water Allocation Plan (the previous Plan) was made pursuant to Chapter 4, Part 2, Divisions 2 and 3 of the superseded *Natural Resources Management Act 2004*. It introduced a more rigorous framework for groundwater extraction, aiming to balance consumptive use with environmental sustainability. It established annual extraction limits based on scientific assessments and groundwater level monitoring, with trigger levels used to adjust the resource capacity when thresholds were reached – helping to prevent the overuse of groundwater and rising salinity.

However, over the past decade, groundwater levels have continued to decline, particularly in the Uley South Basin, the region's primary source of potable water. This decline is driven by reduced rainfall, altered recharge patterns, and sustained extraction pressure. If groundwater levels fall below sea level, seawater intrusion could permanently compromise the quality of the water resource. In recognition of the status and condition of the region's water resources and legislative requirements, the Board has now prepared this amended Plan, which supersedes all previous Plans.

Concurrently, to secure long-term water supply and reduce reliance on stressed aquifers and the River Murray, the South Australian Government is investing $470 million in a desalination plant at Port Lincoln. This infrastructure will supplement existing sources, including the Iron Knob–Kimba pipeline and local groundwater basins.

1.2. Description of Prescribed Wells Areas

1.2.1. Southern Basins Prescribed Wells Area

The Southern Basins PWA covers an area of 870 km^2 and comprises all or parts of the Hundreds of Lincoln, Wanilla, Lake Wangary, Uley, Sleaford and Flinders (Figure 1-1). 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 an undulating topographic relief which is typical of the ancient dune systems which formed about 100,000 years ago, with dramatic coastal cliffs rising to around 140 m above the sea. 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 m above sea level. 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 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 watertable, 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.

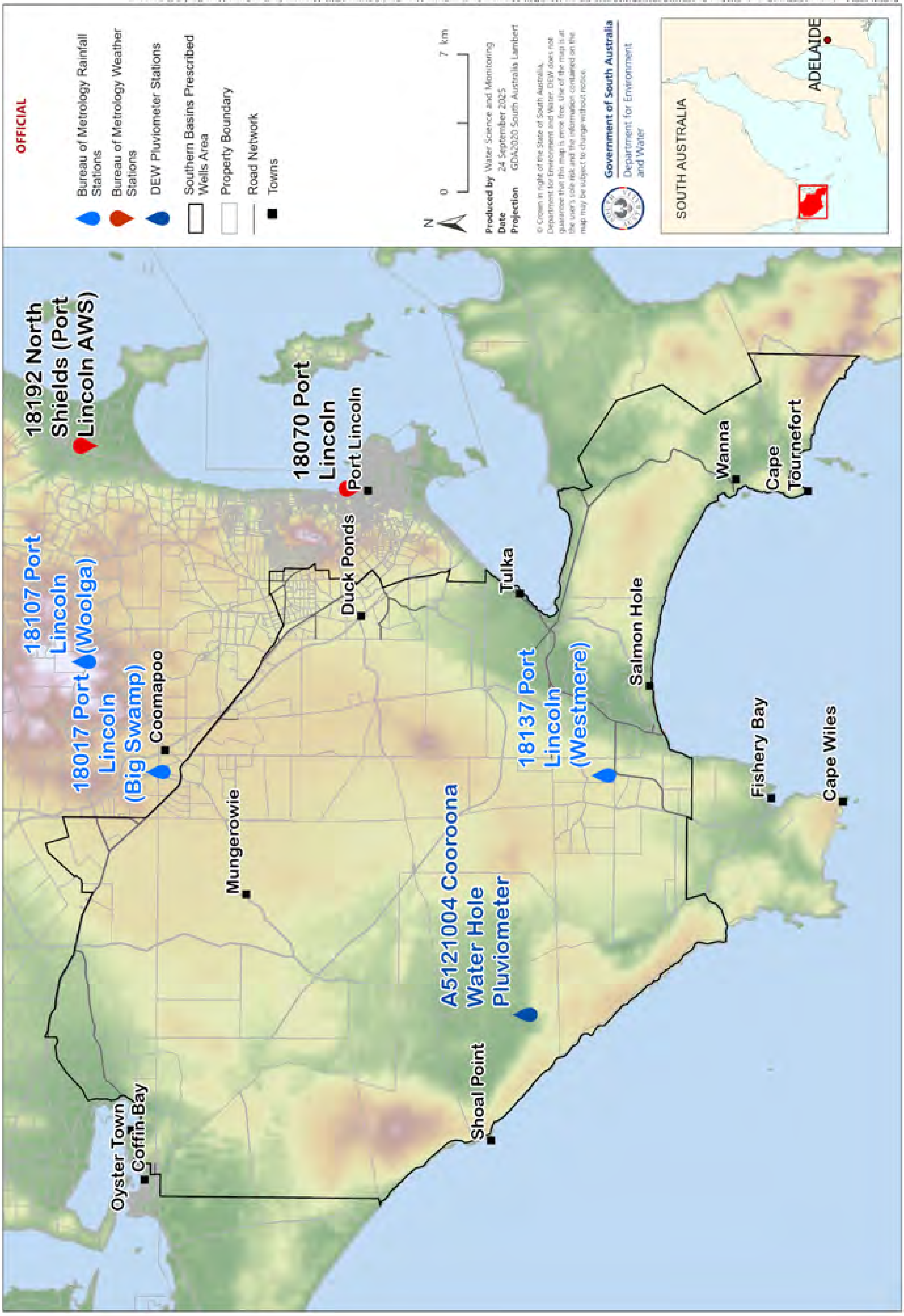

Figure 1-1 Indicative map of the Southern Basins Prescribed Wells Area

1.2.2. Musgrave Prescribed Wells Area

The Musgrave PWA spans an area of 3,595 km^2 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 1-2).

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 watertable intersects the land surface, forming seasonal or permanent wetland systems that receive local surface runoff and are directly connected to underlying aquifers.

Moving 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 the surface expression of groundwater. The elevation gradient from inland areas toward 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.

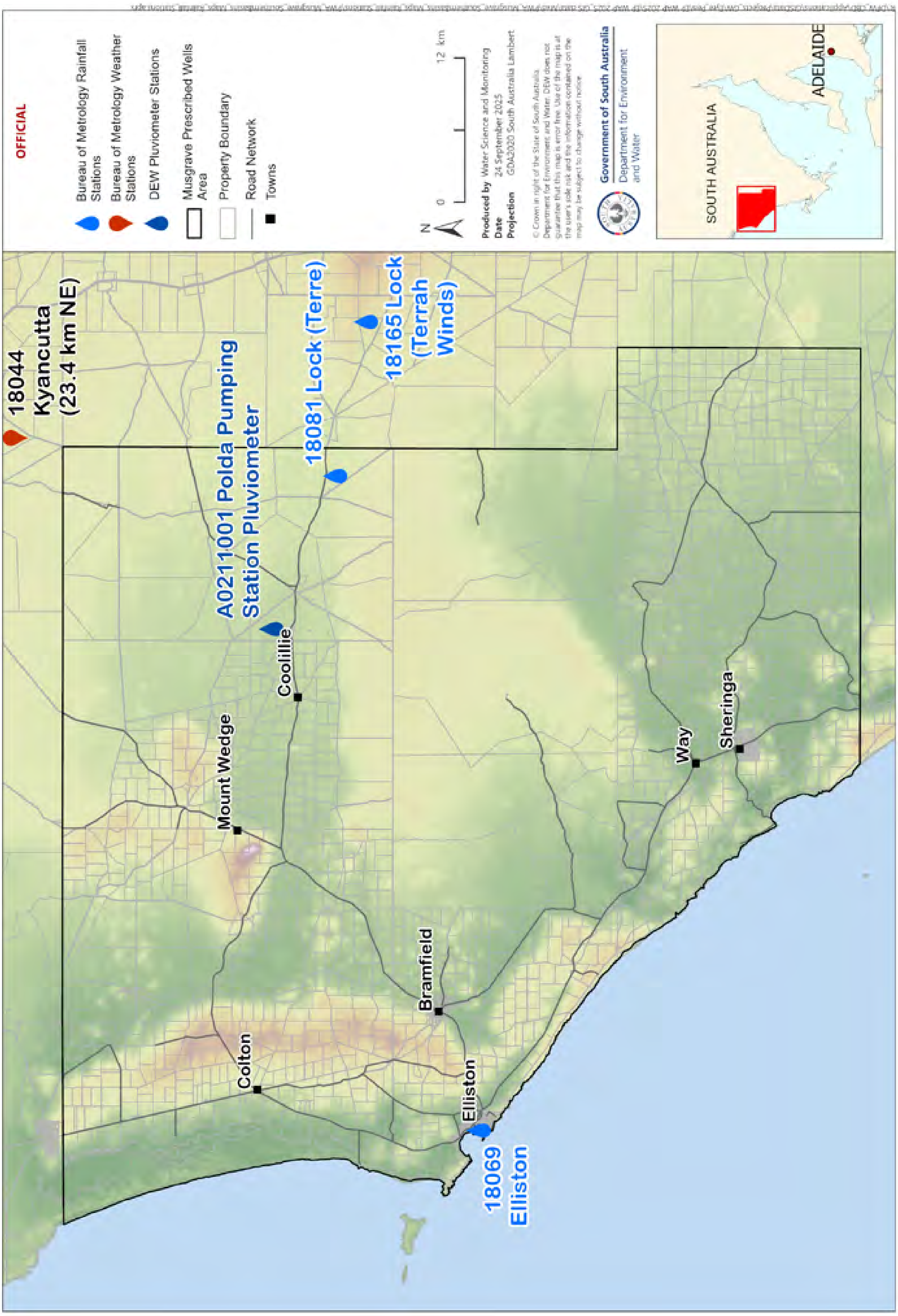

Figure 1-2 Indicative map of the Musgrave Prescribed Wells Area

1.3. Climate

The Eyre Peninsula experiences a Mediterranean climate characterised by cool, wet winters and hot, dry summers. The southern areas have a milder, wetter climate compared with the warmer and drier north and north-west parts of the region (URPS 2025). Annual rainfall across Eyre Peninsula is generally higher in the coastal areas than inland. Average annual rainfall varies from approximately 350 mm in the north-west of the Musgrave PWA to around 558 mm in the Southern Basins PWA (DEW 2024c).

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). This indicates that, on an annual scale, the region has historically experienced relatively stable rainfall compared to inland Australia, where rainfall is far more erratic. 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 1-3). 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. It occurs 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, with very much below average rainfall (BoM, 2025).

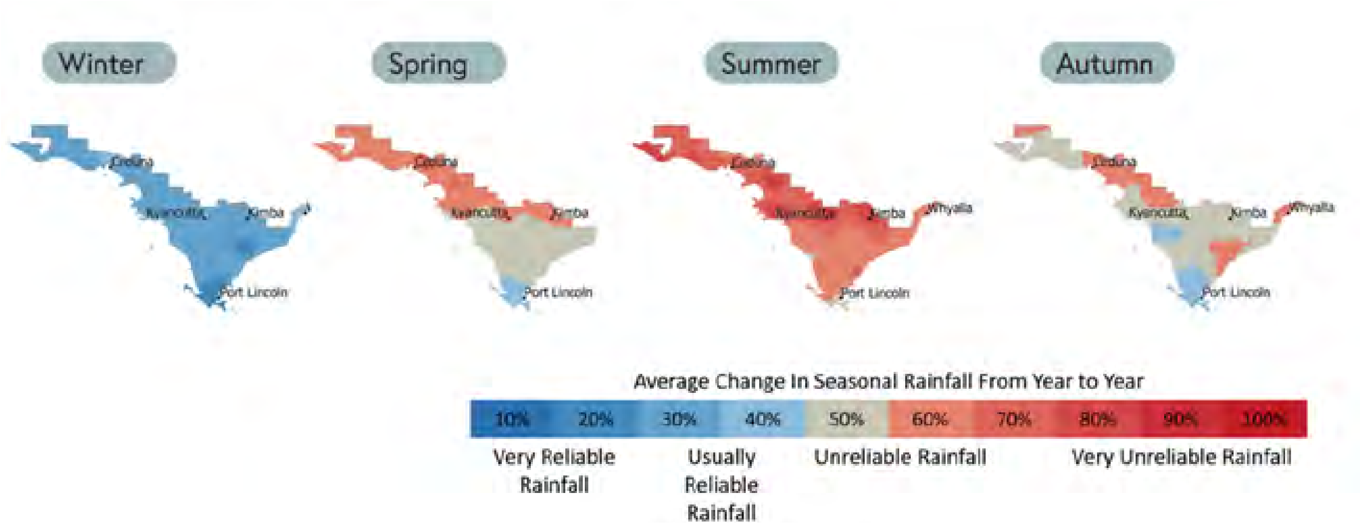

Figure 1-3 Rainfall reliability maps for Eyre Peninsula, sourced from BoM et al. 2019

The Eyre Peninsula experiences average annual maximum temperatures of 18 to 27°C and average 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 an average of 5 days per year above 38 °C, compared to an average of 2 days per year between 1974 and 2003. At BoM station 018044 Kyancutta, the average rose to 25 days per year between 2004 and 2024, compared with 22 days per year between 1974 to 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 1-4, BoM 2025). During the Millennium Drought (1997 to 2009), temperatures were near to slightly above average, compounding the impacts of reduced rainfall. From 2013 onwards, the region experienced frequent above-average temperatures, with extreme heat events evident in 2013, 2014, 2016, 2019, 2023 and 2024.

Data from a network of rainfall and weather stations operated by the BoM and the Department for Environment and Water (DEW) have been strategically selected to represent rainfall distribution and temperature patterns across the Southern Basins and Musgrave PWAs (Figure 1-1 and Figure 1-2). These stations are used to calculate long-term averages and evaluate changes over time.

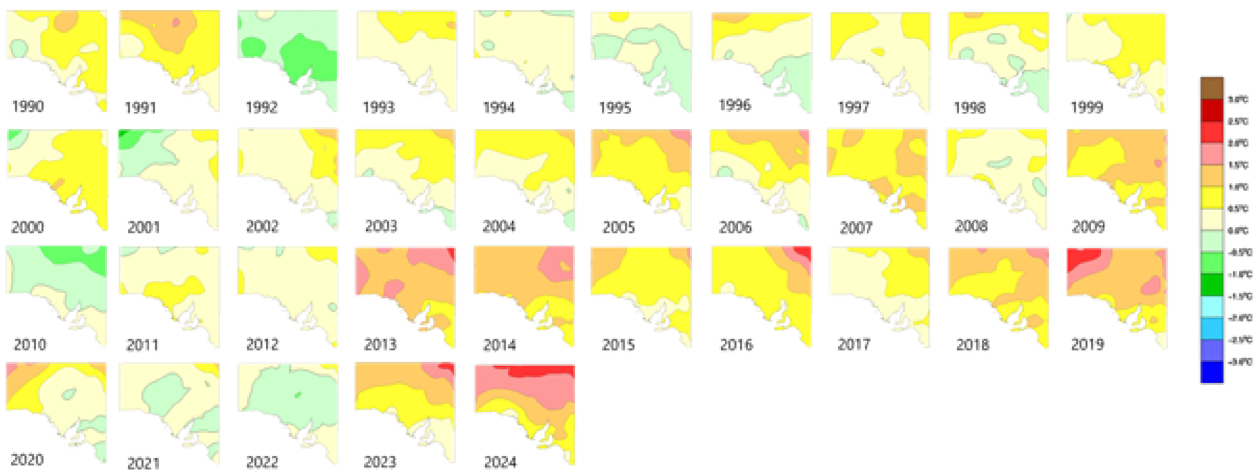

Figure 1-4 South Australia historical mean temperature anomaly maps, 1990 to 2024

1.3.1. 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 average annual rainfall of 555 mm and 556 mm respectively.

The pronounced wet winter period is 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 average of 555 mm/y (Figure 1-5). Similarly, Westmere recorded 391 mm, which is 30% (165 mm) below the long-term average of 556 mm/y (Figure 1-6).

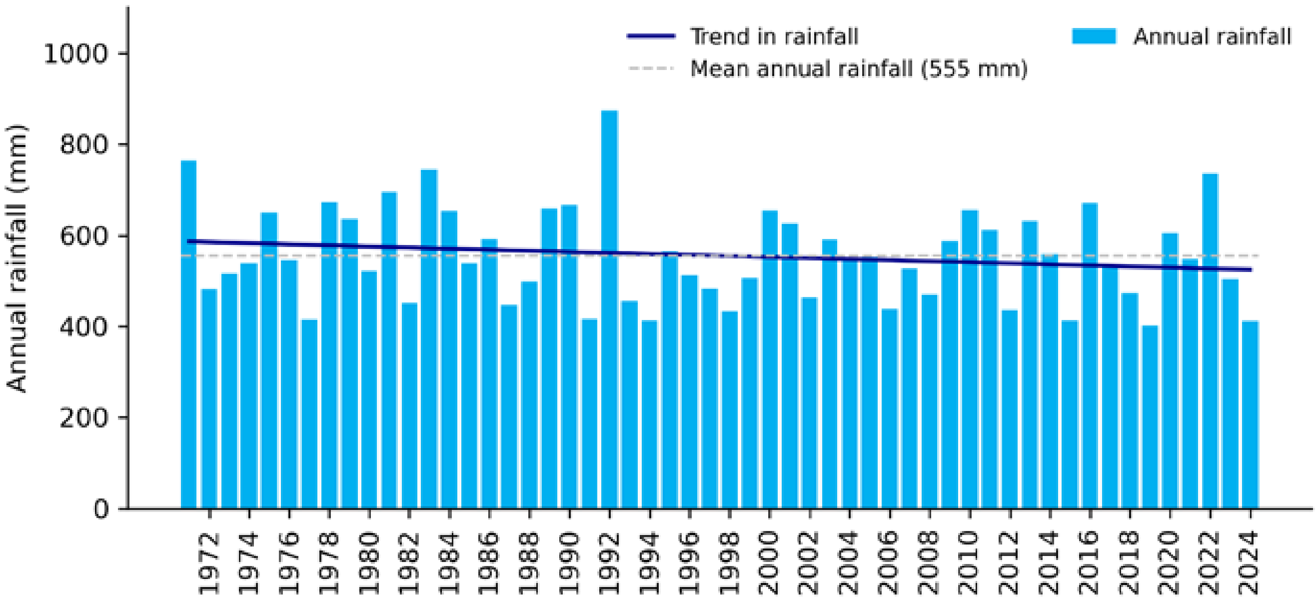

Figure 1-5 BoM 18017 – Big Swamp annual rainfall compared to the long-term average

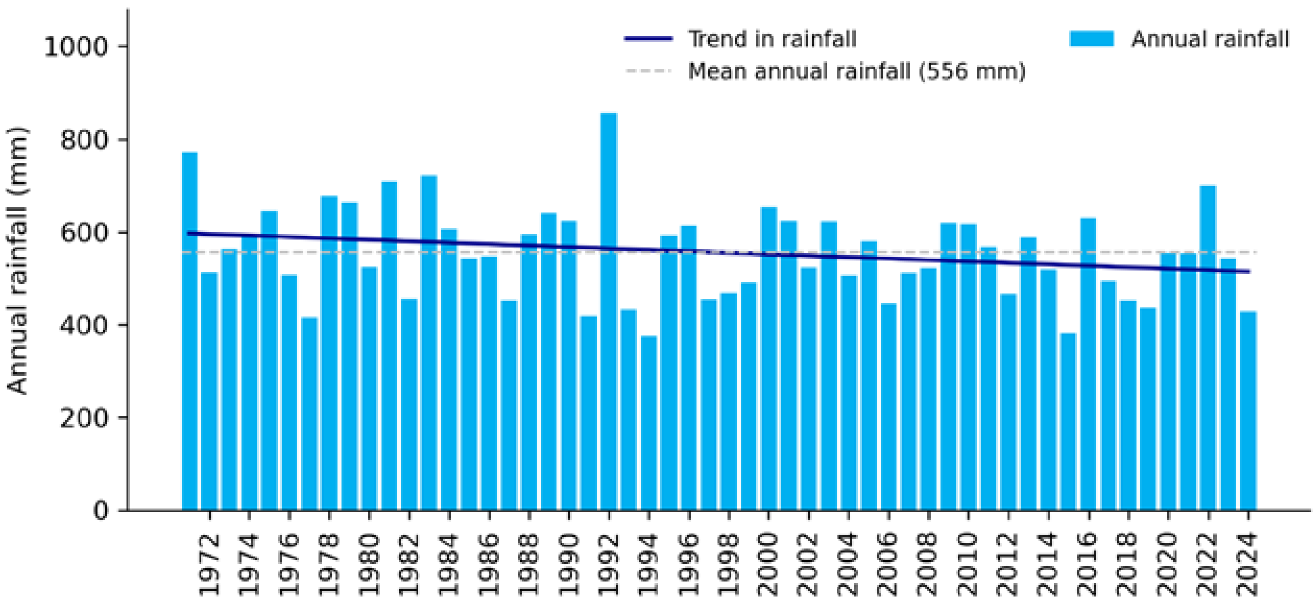

Figure 1-6 BoM 18137 – Westmere annual rainfall compared to the long-term average

Climate pattern shifts are shown by the cumulative deviation rainfall chart for Westmere station (Figure 1-7). The chart presents the relationship between annual rainfall trends and long-term climate variability over time. The blue bars represent annual rainfall (1906 to 2024), while the orange line shows how rainfall has deviated from the long-term average over time. An upward trend represents a period where rainfall was above the long-term average 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 average. 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).

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) is used up to 1992, and North Shields (Station 018192) thereafter. North Shields is located approximately 9 km north-northeast of Port Lincoln. Between 1910 and 1980 (Figure 1-8), 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 toward hotter and drier conditions.

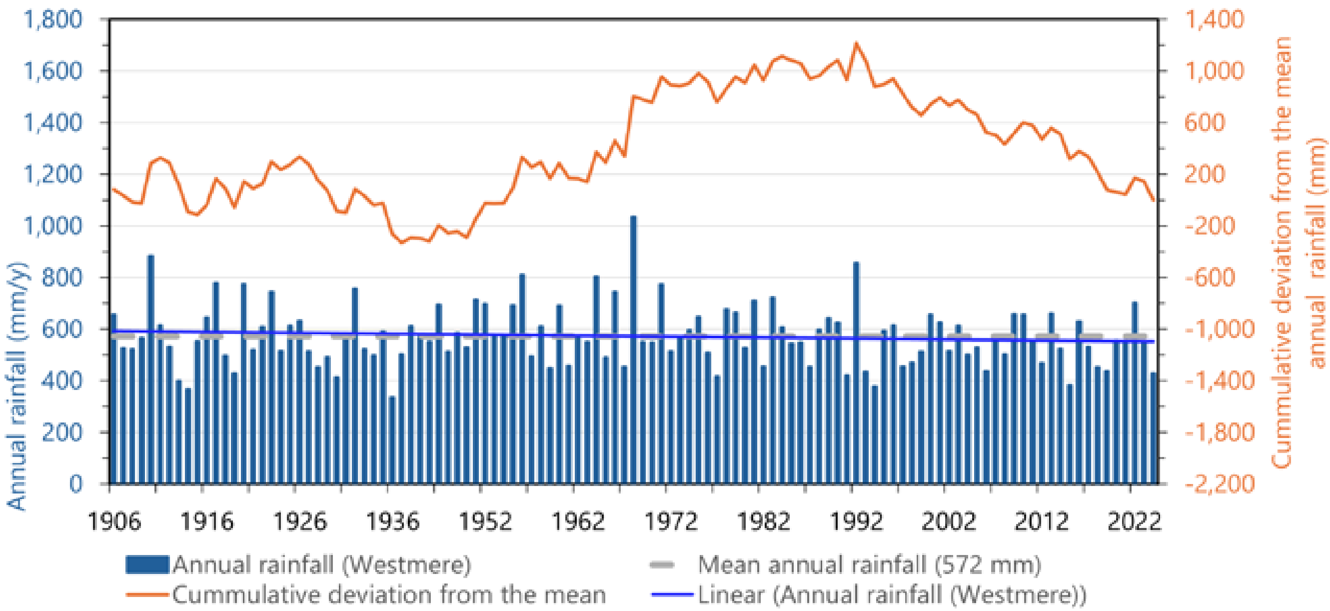

Figure 1-7 Annual rainfall and cumulative deviation from the average annual rainfall for BoM station 18137 – Westmere

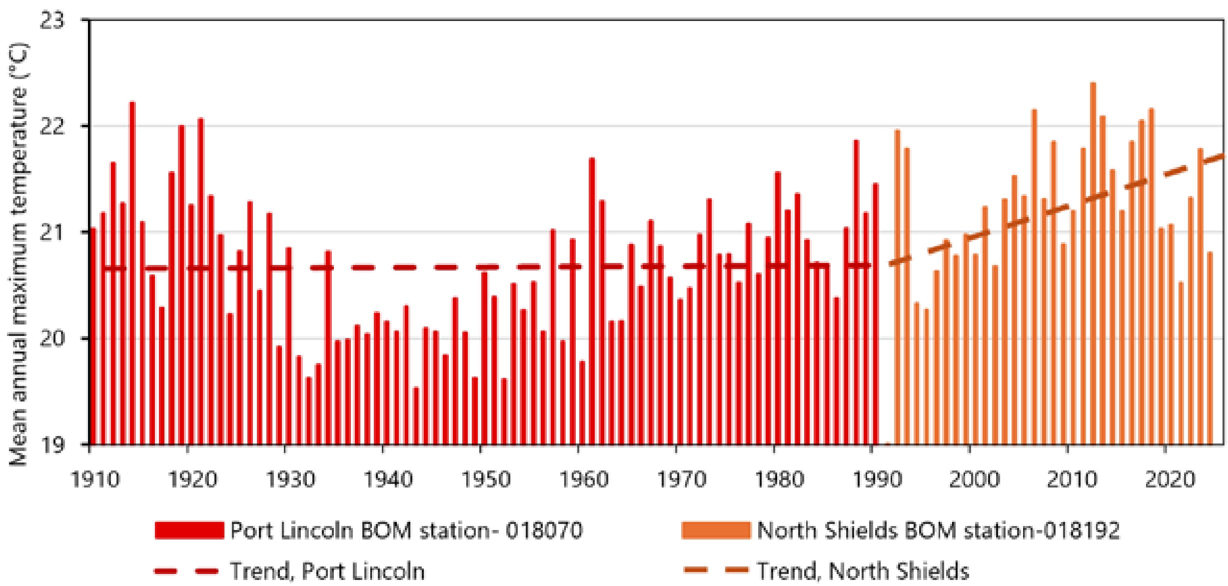

Figure 1-8 Annual average maximum temperature for BoM station 18070 Port Lincoln and 018192 North Shields weather stations

1.3.2. Musgrave climate conditions

The Musgrave PWA, located in the north-western inland portion of the lower 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) average annual rainfall of 424 mm and 370 mm respectively. 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. Average monthly rainfall exceeds average monthly potential evaporation only in June and July.

The long-term trends for Elliston (Figure 1-9) and Terrah Winds (Figure 1-10) show significant downward trends 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) below the long-term average of 424 mm/y. Terrah Winds recorded 316 mm, which is a 15% decline (54 mm) from the long-term average of 370 mm/y.

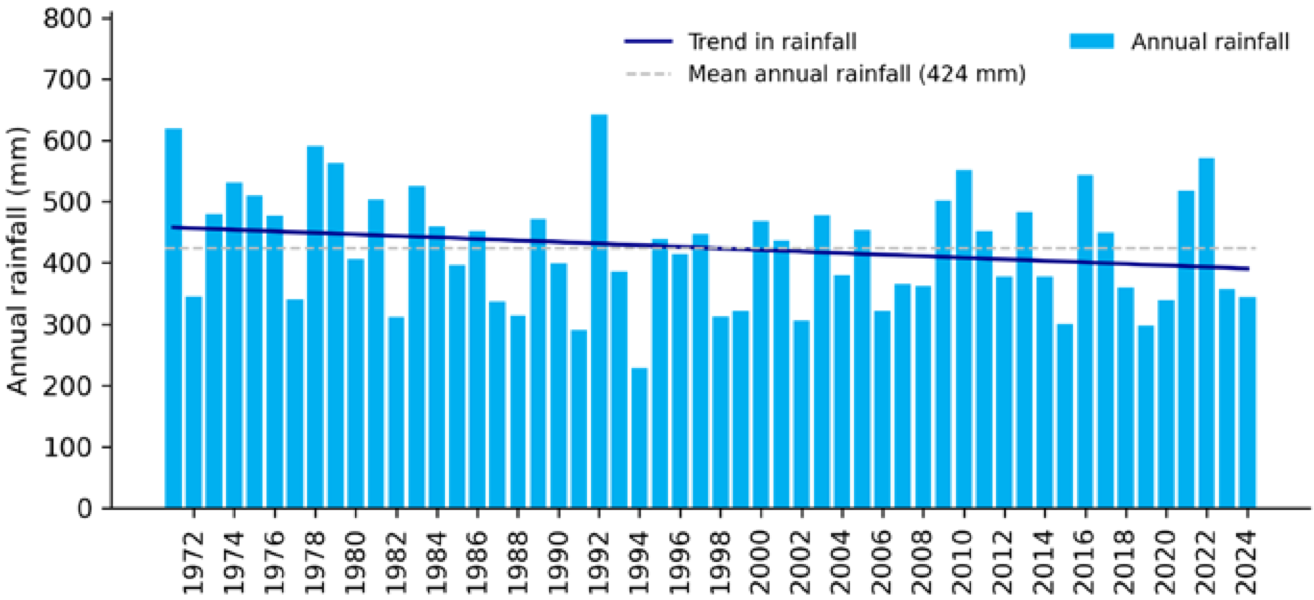

Figure 1-9 BoM 18069 – Elliston annual rainfall compared to the long-term average

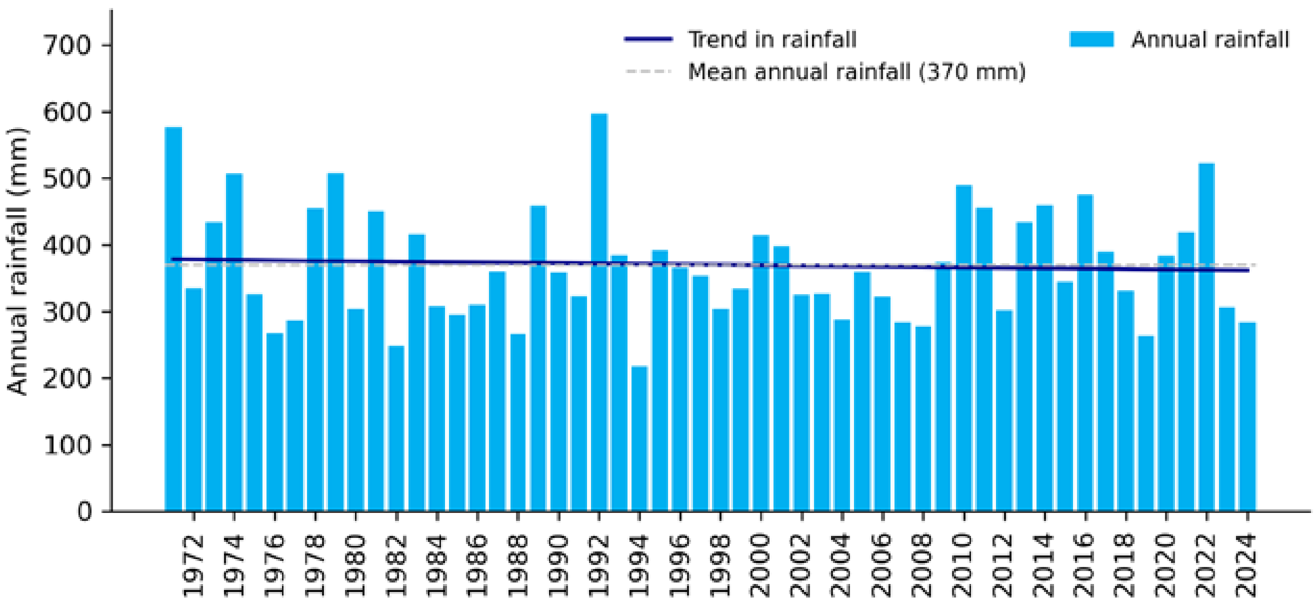

Figure 1-10 BoM 18165 – Terrah Winds annual rainfall compared to the long-term average

Climate pattern shifts are shown by the cumulative deviation rainfall chart for Elliston, covering the period 1882 to 2024 (Figure 1-11). The blue bars represent yearly rainfall while the orange line shows how rainfall has deviated from the long-term average over time. An upward trend represents a period where rainfall was above the long-term average rainfall, and a downward trend indicates a drier than average period. 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 toward 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.

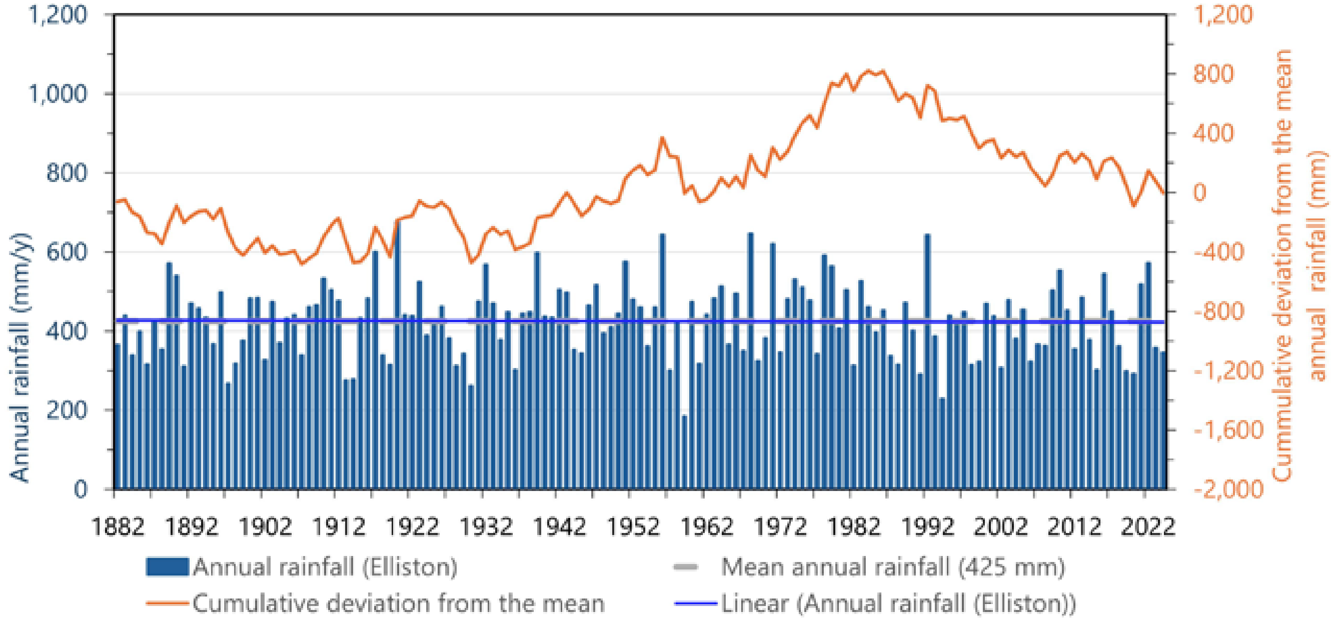

Figure 1-11 Annual rainfall and cumulative deviation from average annual rainfall for BoM station 18069 – Elliston

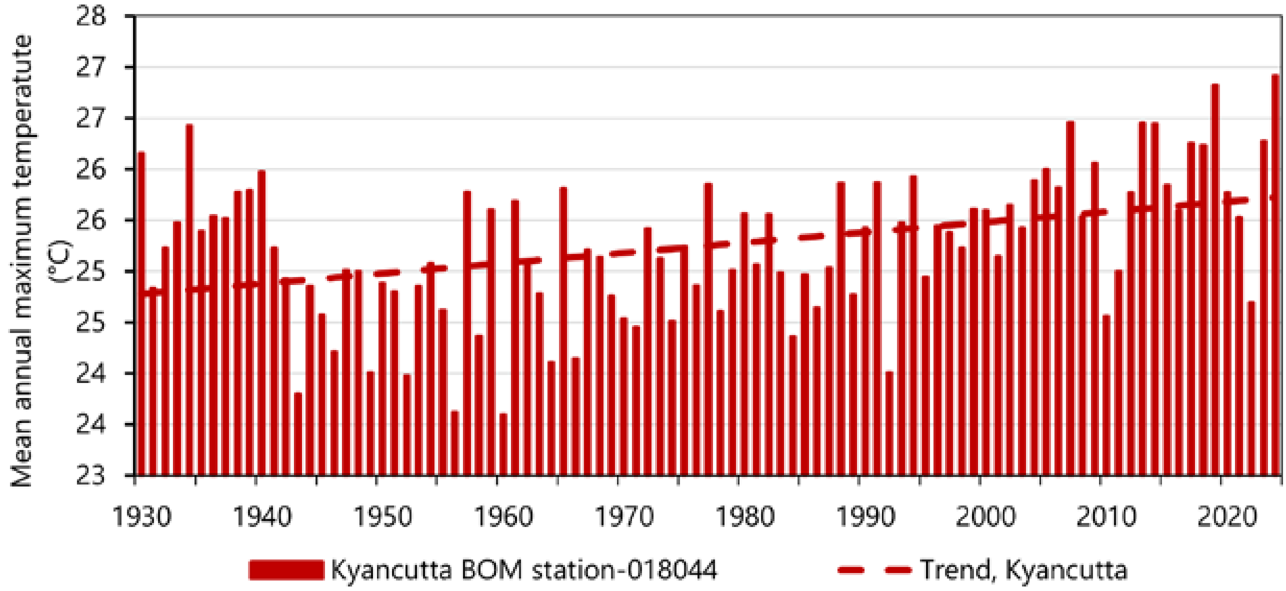

Figure 1-12 Annual average maximum temperature for BoM station 018044 Kyancutta weather station

The annual average maximum temperature data from the 018044 Kyancutta weather station show a long-term increasing trend in annual maximum temperatures from 1931 to 2022 (Figure 1-12). 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.

1.3.3. 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 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, using the high-emissions scenario (Representative Concentration Pathway (RCP) 8.5), indicate annual rainfall will decrease by 5 to 10% compared to the 1994 to 2023 average, with northern areas seeing larger drops in summer and autumn, and southern areas in spring (My Climate View 2025). Average 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.

Hydrological modelling by the Department for Environment and Water (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 1-13). 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 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 Quaternary Limestone aquifer groundwater levels under projected climate change. Using the Hydrograph Analysis: Rainfall and Time-Trends (HARTT) modelling framework, 3 global climate models – 2 from the South Australian Climate Ready dataset and one from New South Wales and Australian Regional Climate Modelling (NARCliM) 1.5 were applied, incorporating both RCP 4.5 and 8.5. Results indicate a significant decline in watertable depth, with median projections ranging from a decline in watertable depth of 0.8 to 8 m by 2065 (Figure 1-14).

Building on this, DEW (2026b) developed a groundwater flow model to further assess the risk of aquifer drying and seawater intrusion in the Bramfield area. Based on NARCliM 2.0 projections, an average 14% decline in rainfall by 2050 is anticipated. While public water supply 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-licenced wells have lost access to groundwater in recent years.

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

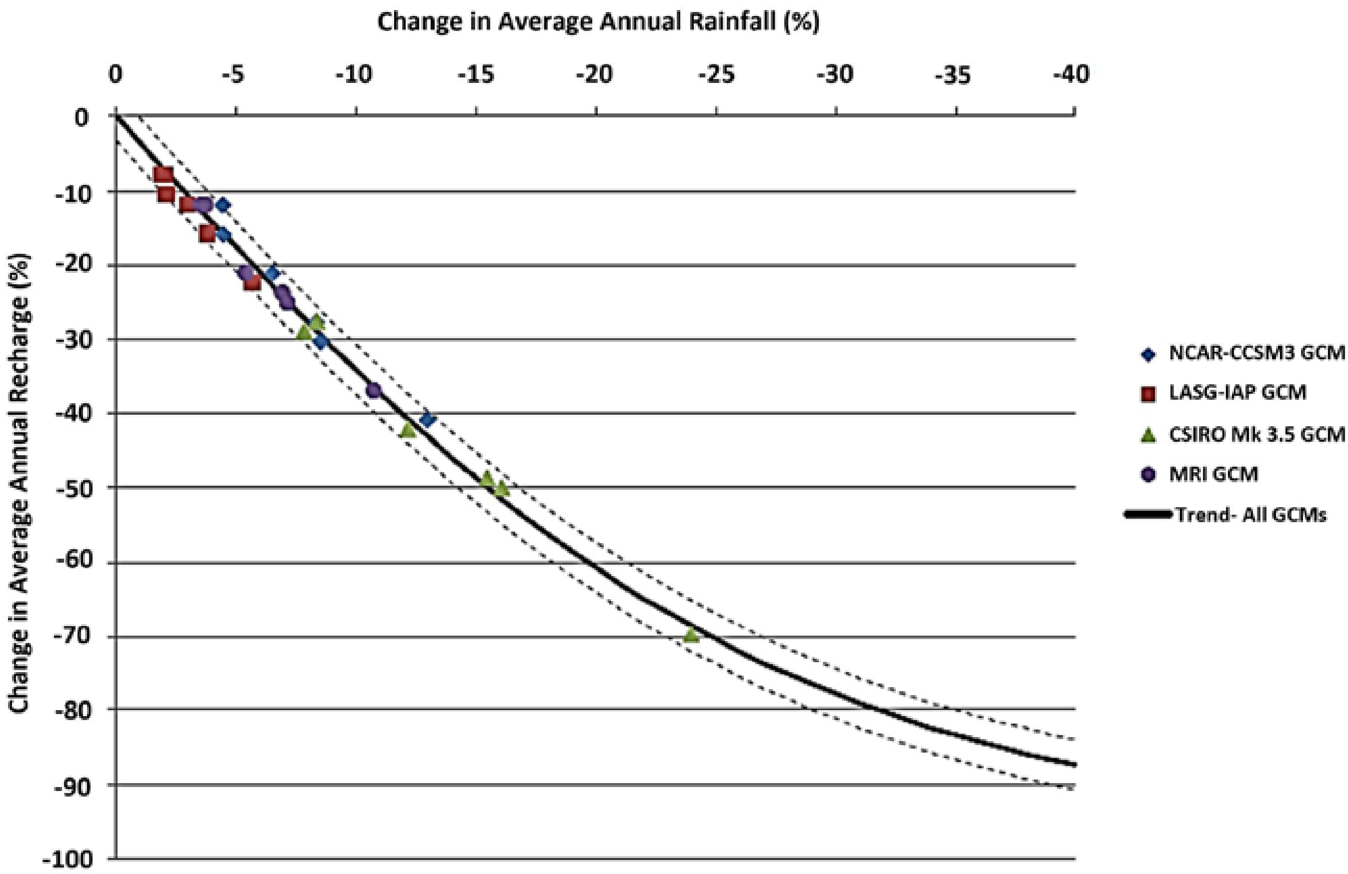

Figure 1-13 Changes in modelled recharge for changes in rainfall in the Musgrave PWA, taken from Green et al. (2012)

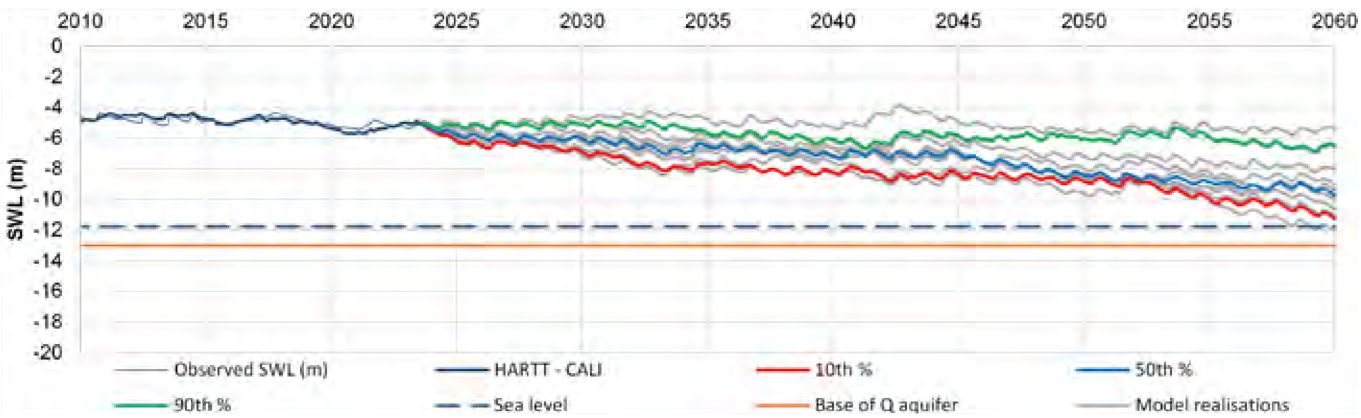

Figure 1-14 Hydrograph projection for monitoring station WAD031 including the 10th, 50th and 90th percentile rainfall datasets, from DEW (2026a)

where SWL is the relative Standing Water Level

1.4. Hydrogeology of the Prescribed Wells Areas

A scientific understanding of the hydrogeology of the PWAs and its application in developing this Plan has been derived from 4 main sources:

- DFW (2011b) *A Literature Review of the Southern Basins and Musgrave Prescribed Wells Area Hydrogeology and Ecology*, Report, Government of South Australia, Department for Water, South Australia.
- Stewart et al. (2012) *Science Support for the Musgrave and Southern Basins Prescribed Wells Areas Water Allocation Plan*, Technical Report 2012/15, Government of South Australia, Department for Water, Adelaide.
- Stewart (2013) *Additional Science Support for the Eyre Peninsula Water Allocation Plan*, Technical Report 2013/19, Government of South Australia, Department of Environment, Water and Natural Resources, Adelaide.
- DEW (2024d) *Groundwater levels and storage capacity of the Southern Basins Prescribed Wells Area – Uley Wanilla and Lincoln South*, Government of South Australia, Department for Environment and Water, Adelaide.
- DEW (2026e) *Supporting science for the review and amendment of the Water Allocation Plan for the Southern Basins and Musgrave PWAs*, Draft, DEW Technical Report 2026 (In press), Government of South Australia, Department of Environment and Water, Adelaide.

1.4.1. 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 1-1), 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 (Twidale et al. 1985).

Table 1-1 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	Wanilla Formation, 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, amphibolite	Hutchison Group, Lincoln Complex
Archean	2,300 to 2,700	Basement	Gneiss, granite gneiss	Sleaford Complex

1.4.2. Aquifers

Groundwater resources within the PWAs of the Eyre Peninsula are primarily hosted in four main aquifer systems: Quaternary Limestone, Tertiary Sands, Jurassic sedimentary and Basement fractured rock aquifers. Among these, the Quaternary Limestone aquifer is the most significant in both the Southern Basins and Musgrave PWAs as it contains low salinity to brackish water as a result 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 Quaternary Limestone aquifer are critical to the long-term water security of the Eyre Peninsula water supply.

1.4.2.1 Quaternary Limestone aquifer

The Quaternary Limestone 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 the formation and karstic features are common. 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 Quaternary Limestone aquifer (see Section 4). Groundwater salinities range between 400 and 1,800 milligrams per litre (mg/L), and well yields are generally high, ranging between 5 and 50 litres per second (L/sec).

Maps of the Quaternary Limestone aquifer watertable elevations indicate two predominant groundwater flow directions within the Southern Basins PWA: a west to north-westerly trend and a west to south-westerly trend (Figure 1-15). In contrast, groundwater in the Musgrave PWA predominantly flows in a west to south-westerly trend (Figure 1-16). In both instances, groundwater ultimately discharges to the sea. Hydrochemical evidence indicates that groundwater in the Quaternary Limestone aquifer in the Uley South Basin is less than 30 years old (Love et al. 1994).

The saturated thickness and porosity of the Quaternary Limestone aquifer, and hence the amount of groundwater stored within the aquifer, varies spatially throughout the prescribed areas. Generally, the saturated thickness is small in the areas of highest elevation, which are furthest inland (for example, the Lincoln North and Polda Basins), but increases toward the coast. There are considerable areas over which the saturated thickness is less than 10 m, which suggests low robustness of these aquifers when compared to many of the groundwater systems across South Australia. The Quaternary Limestone aquifer saturated thickness can also vary rapidly over time as the watertable fluctuates in response to rainfall.

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

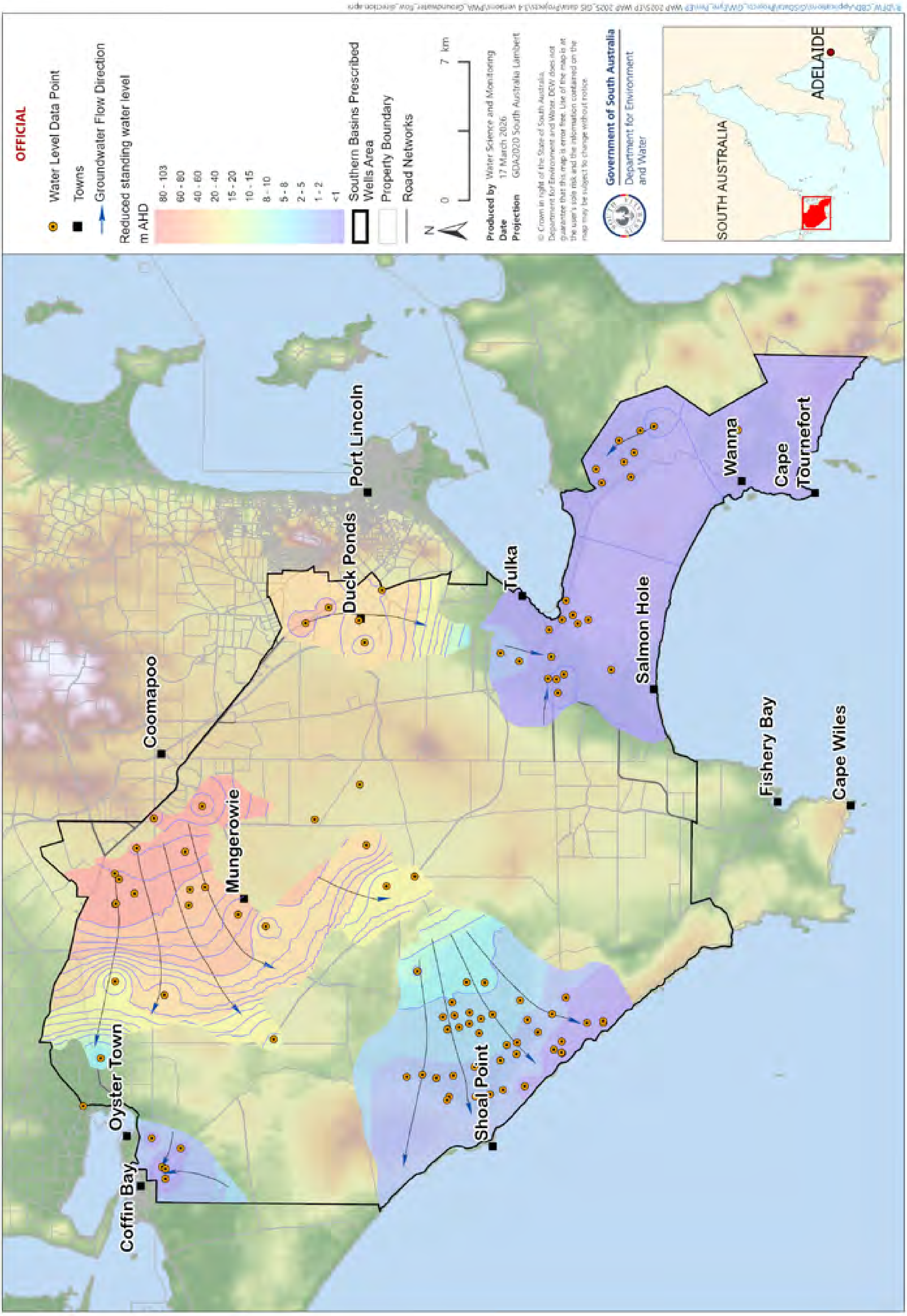

Figure 1-15 Indicative groundwater flow directions (based on Autumn 2024 water levels) for the Quaternary Limestone aquifer in the Southern Basins PWA

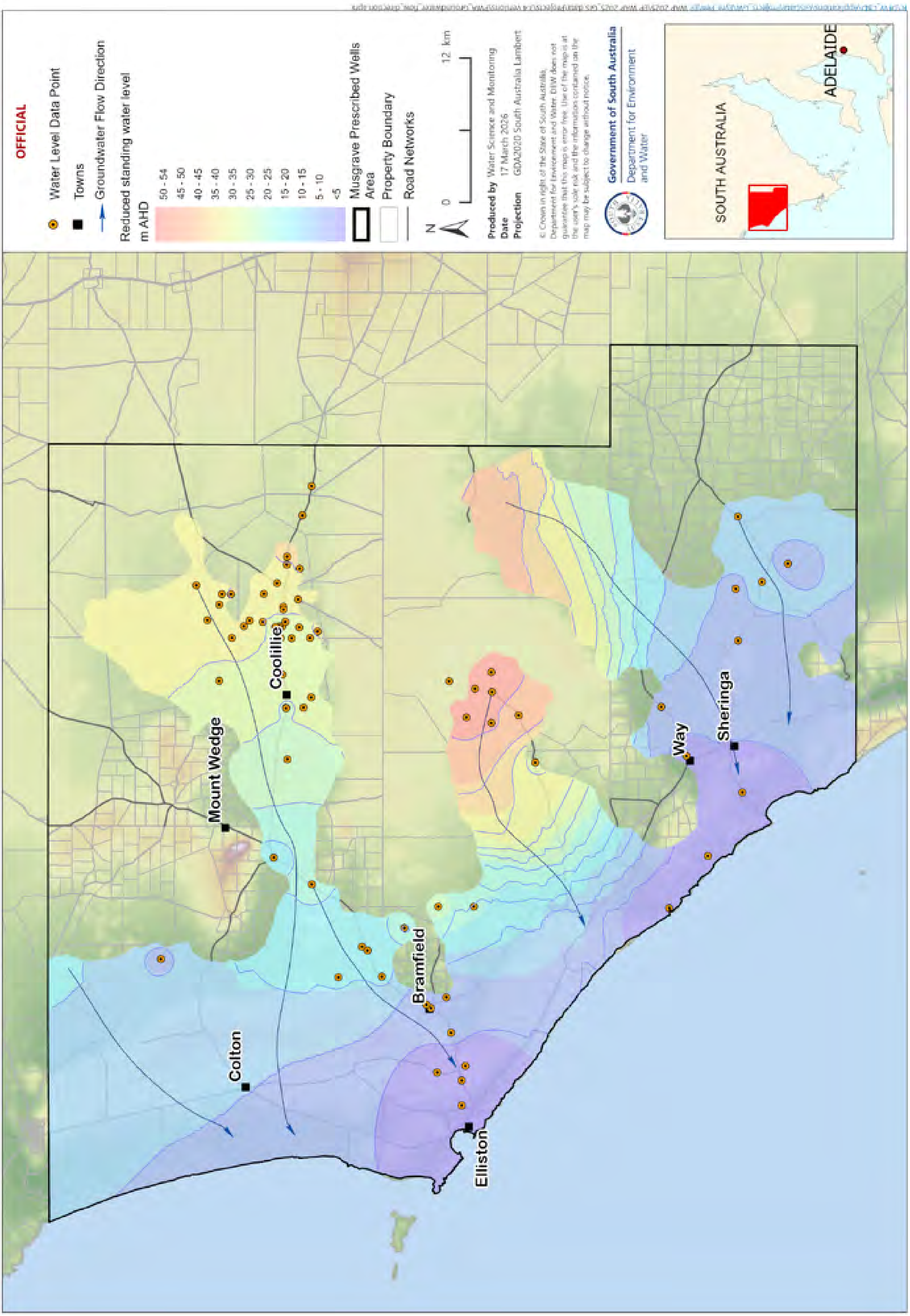

Figure 1-16 Indicative groundwater flow directions (based on Autumn 2024 water levels) for the Quaternary Limestone aquifer in the Musgrave PWA

1.4.2.2 Tertiary Sands aquifer

The Tertiary Sands 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 Tertiary Sands 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/sec.

The Poelpena Formation forms the Tertiary Sands 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/sec.

The Tertiary Sands aquifer is generally separated from the overlying Quaternary Limestone aquifer by low permeability confining layers. Within the Musgrave PWA, clays at the top of the unit act as a confining layer between the sand layers and the overlying Quaternary Limestone 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 Quaternary Limestone aquifer. This formation is observed to be absent in some areas within both PWAs. Where the overlying Quaternary sequence is absent or dry, the Tertiary Sands aquifer can contain the watertable.

Hydrochemical evidence indicates groundwater in the Tertiary Sands 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).

1.4.2.3 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 Polda 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.

1.4.2.4 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 have formed near the surface in some of the carbonate rocks (marble and calcsilicate gneiss).

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

The 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.

1.4.3. 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, and 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 for public water supply).

Natural groundwater discharge processes are ongoing and continuous (Freeze and Cherry 1979), 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. 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 watertable via the root system.

Groundwater level trends give an indication of the state of 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 water levels remain static with only seasonal variations observed). However, within the Quaternary Limestone aquifers of the Southern Basins and Musgrave PWAs, declines in groundwater level are commonly observed in systems where no extraction from wells is occurring, indicating that natural discharge rates exceed the recharge to the system.

1.4.3.1 Quaternary Limestone aquifer recharge

Hydrogeological assessments have shown that the Quaternary Limestone 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 water levels.

1.4.3.2 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 to more than 240 mm/y. 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 Prescribed Wells Area, 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 and the extraction rate of ≈5,700 ML per year (Stewart 2013).

Figure 1-17 shows hydrographs spanning 2009 to 2024 for daily groundwater level trends for observation wells ULE135 and ULE196, alongside monthly rainfall data from the nearby Cooroona water hole pluviometer (Station A5121004), 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 watertable.

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. 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.

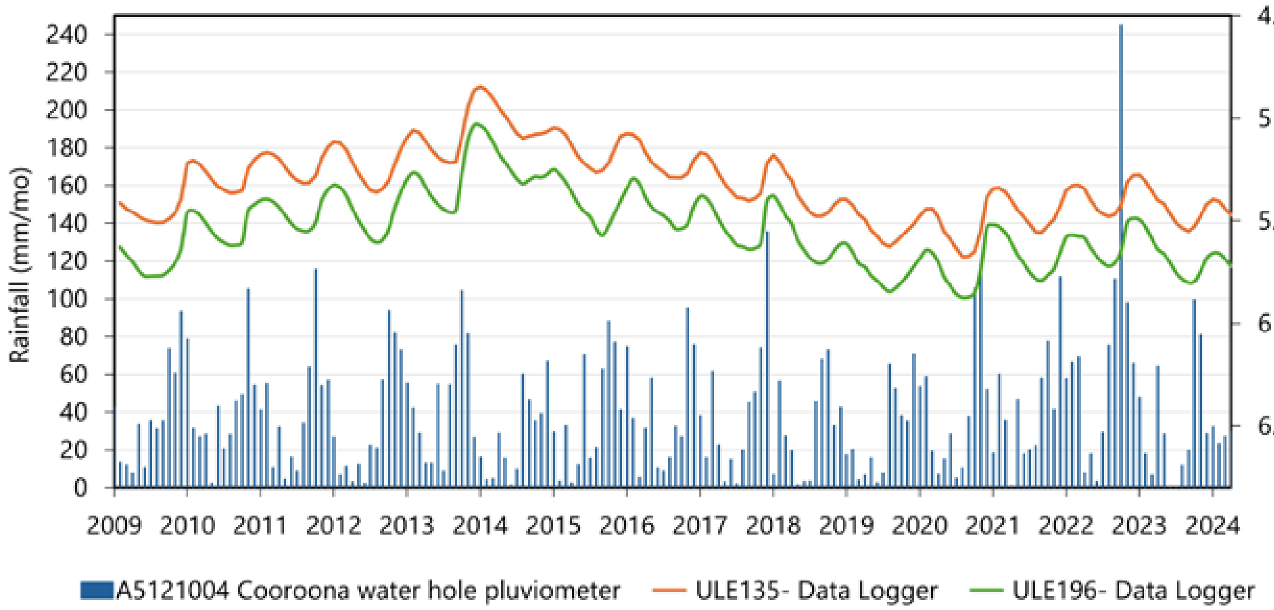

Figure 1-17 Uley South Basin water level and rainfall correlation

where (mm/mo) is millimetres per month, (m bgl) is metres below ground level

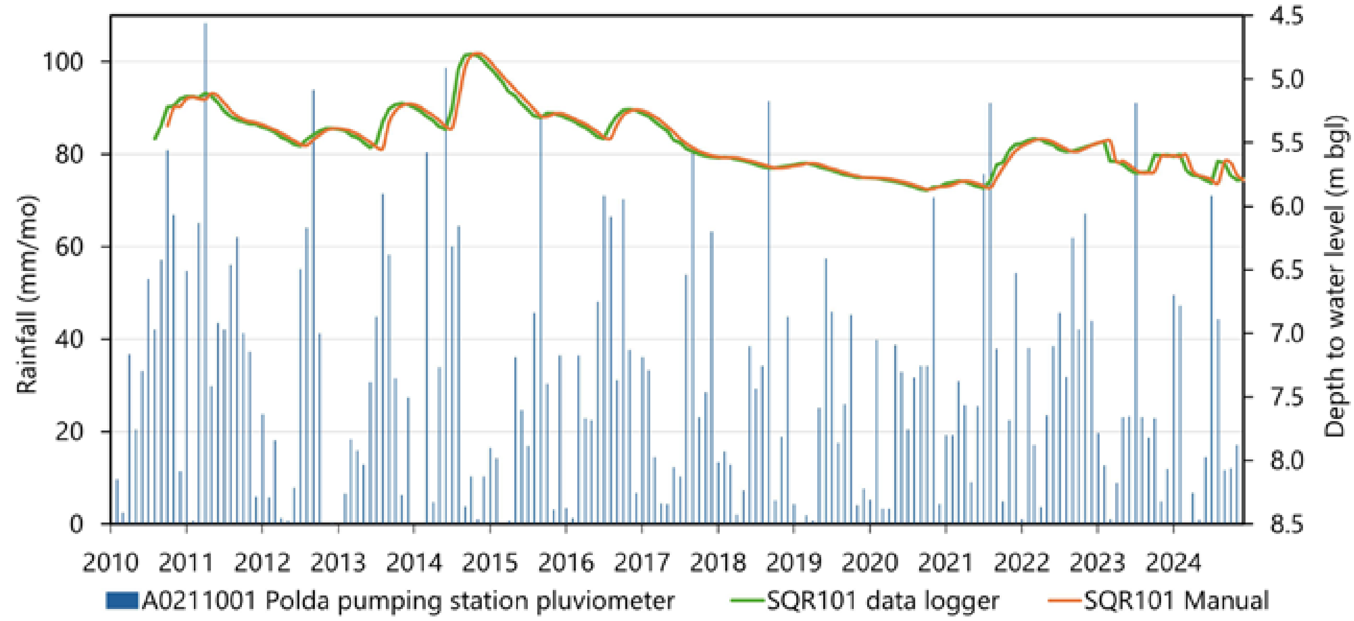

Figure 1-18 Polda Basin water level and rainfall correlation

where (mm/mo) is millimetres per month, (m bgl) is metres below ground level

According to the calibrated transient groundwater model developed by DEW, the long-term average recharge across the model domain from 1961 to 2024 is estimated at 89 mm/y, while the average 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 characterised 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 around 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).

1.4.3.3 Recharge of Polda and Bramfield Basins in the Musgrave Basin PWA

Groundwater recharge in the Musgrave Basin PWA has been investigated through long-term monitoring and modelling. A hydrograph from observation well SQR101, located in Polda Basin, alongside monthly rainfall data from the Polda pumping station pluviometer (Station A0211001), illustrates the aquifer's response to rainfall events (Figure 1-18). 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 monthly rainfall exceeding 60 mm often results in a rise in the groundwater table. However, not all rainfall above 60 mm/month triggers recharge, likely due to low rainfall intensity or rainfall occurring in the hotter months.

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 (average 31 mm/y). Additional estimates using the watertable fluctuation method (with specific yields of 0.1 to 0.3) suggested recharge rates of 130 to 151 mm/y in two wells, though these were considered less reliable. The authors also noted that recharge is most likely when monthly rainfall exceeds 60 mm.

As part of the National Water Grid Fund project into the sustainability of the groundwater resources in the Bramfield Basin, investigations are underway 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. Preliminary results suggest a range of average annual recharge estimates: 15 to 25 mm/y using tritium under saturated flow assumptions, 15 to 65 mm/y under combined unsaturated and saturated flow, 2 to 24 mm/y using CFC12, and 16 to 33 mm/y using chloride mass balance. Stable isotope data also suggest a potential monthly rainfall threshold of around 60 mm for recharge to occur, though this requires further refinement.

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 water, 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 watertable rises are observed.

The average 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 average recharge is 19 mm/y. However, in the most recent decade (2015 to 2024), the average 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 model discussed above 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 Quaternary Limestone aquifer is rainfall recharge. Recharge to the Quaternary Limestone 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.

1.4.3.4 Tertiary Sands aquifer recharge

Recharge to the Tertiary Sands aquifer is limited due to confinement by clay layers. Where the clay is thin or absent, vertical leakage from the overlying Quaternary Limestone aquifer may occur. In the Uley South Basin, recharge to the Tertiary Sands aquifer is inferred to occur primarily via lateral inflow from upgradient areas and downward leakage from the Quaternary Limestone aquifer in the Uley Wanilla lens, supported by groundwater isotope and chemistry data (Evans 1997; Harrington et al. 2006). Groundwater levels in the Tertiary Sands 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 Quaternary Limestone aquifer levels, suggesting reduced recharge from Quaternary Limestone to Tertiary Sands aquifer in that area.

Evidence from Dowie and Love (1996) suggests that improvements in Tertiary Sands 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 Quaternary Limestone-derived recharge to the Tertiary Sands aquifer (DEW 2026b). In addition, stable isotope analysis shows that Quaternary Limestone and Tertiary Sands groundwater types plot near the Adelaide meteoric water line, indicating rapid recharge with minimal evapotranspiration. This supports the idea that Quaternary Limestone aquifer recharge occurs after significant rainfall events and Tertiary Sands aquifer recharge follows via downward leakage.

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

1.4.3.5 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 recharge has occurred to this aquifer in modern times.

1.4.3.6 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.

1.5. Historic 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 north 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 supply system, beginning with the commissioning of the Uley Wanilla Basin in 1948-49 water-use year. Over the next 4 decades, several other basins were developed including: Lincoln Basin (1961-62), Polda 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 1-19 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 1950 due to the wool boom and in the 1970's during a livestock boom, with total water supply peaking at nearly 15 gigalitres (GL). Following water restrictions introduced in 2002 during the Millennium Drought, demand generally declined and then reminded 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 public water supply systems. This water supports industry, primary production and residential customers. While annual demand varies with seasonal conditions, it is trending upward 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 1-20). This increasing demand is placing pressure on existing groundwater sources, which are becoming less sustainable under current extraction rates.

Several sources have since 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.
- 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 Plan introduced an adaptive groundwater management framework for managing the authorised extraction of groundwater, particularly in areas where water resources were under pressure due to declining rainfall and recharge. Through the framework, the volume of water available to be used for consumptive purposes (the consumptive pool) was determined annually based on groundwater storage levels, which were influenced by rainfall and recharge, taking into account the impact of natural and anthropogenic discharges from the system. A reference level (based on 1993 groundwater storage) was used to assess the resource condition. When storage levels fell below defined trigger thresholds, the percentage of water available to be used from the resource was reduced proportionally for each consumptive pool managed via this process.

Since the introduction of the 2016 Plan, groundwater levels in the Bramfield and Sheringa consumptive pools have remained just above the lower storage trigger. The lower storage trigger, if reached, reduces the volume of the consumptive pool to a point where there is no water available for licenced purposes. Low water levels have resulted in the Polda and Uley North consumptive pools remaining below the lower storage trigger for most of the Plan's duration.

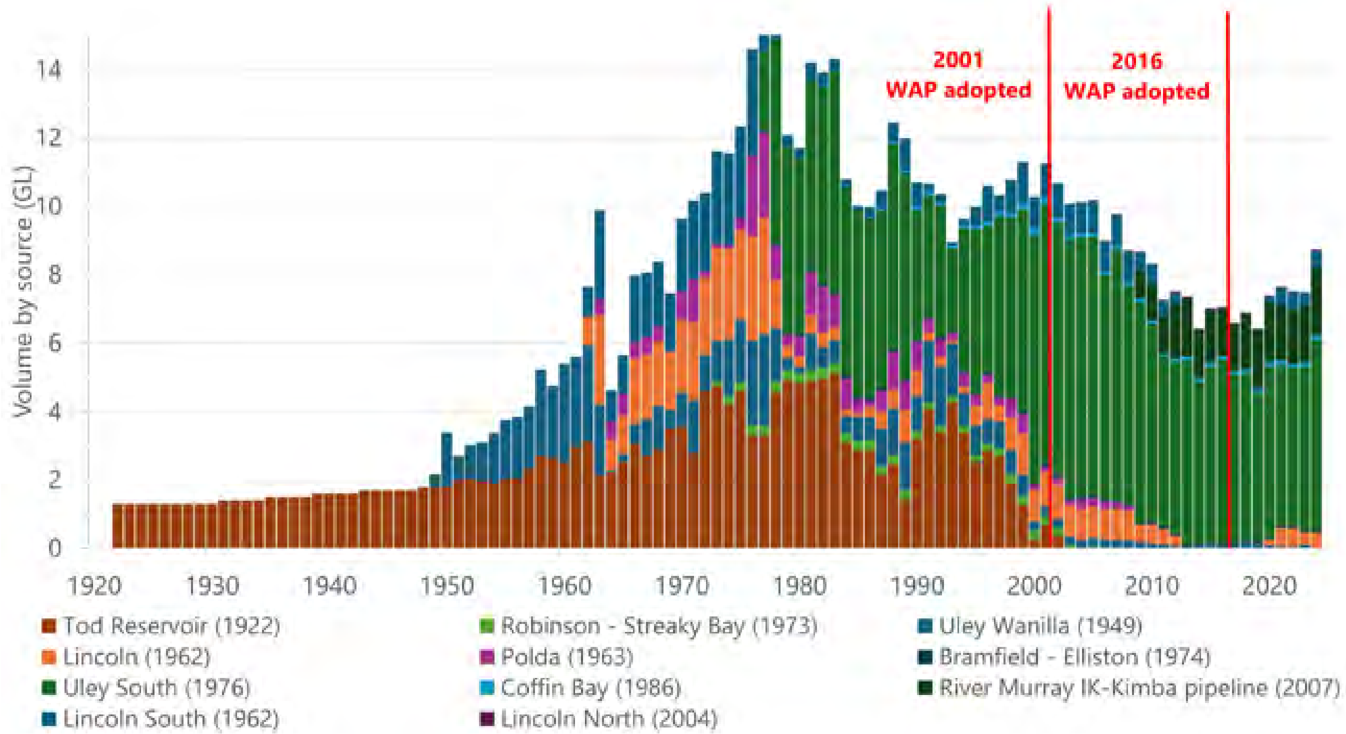

Figure 1-19 Historical use and sources of public water supply for the Eyre Peninsula, including the prescribed water resources

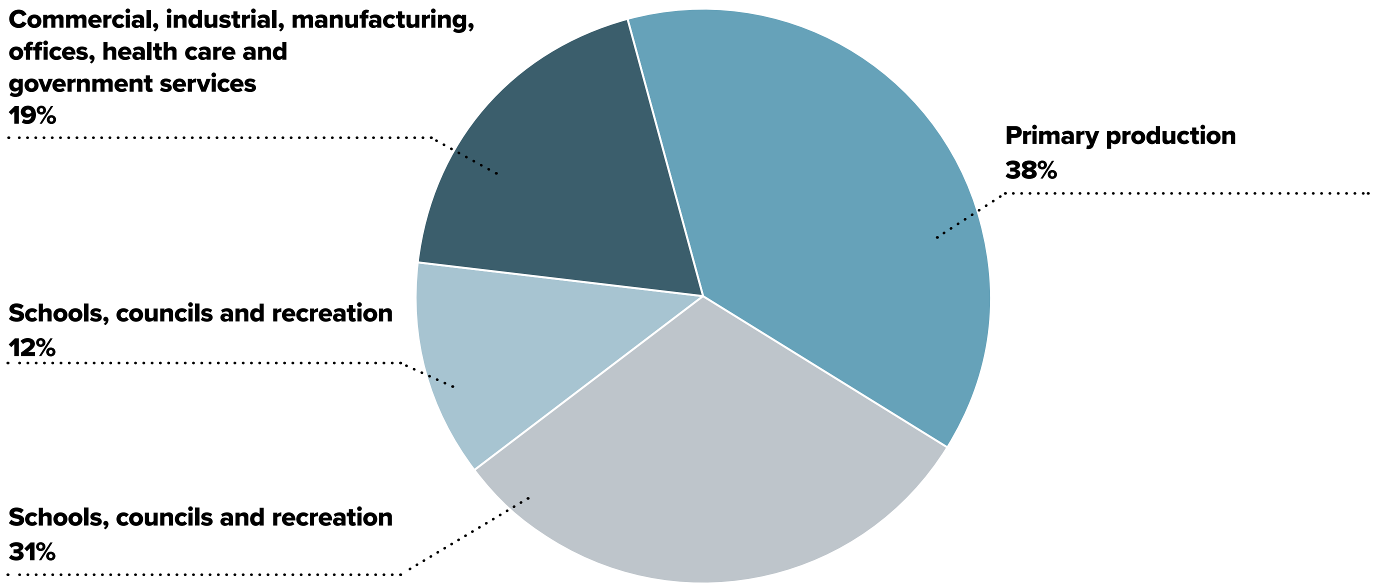

Figure 1-20 Water demand on the Eyre Peninsula by customer segment
(from SA Water 2024)

2. Condition of groundwater resources

Long-term assessment of groundwater resources within the Southern Basins and Musgrave Prescribed Wells Areas 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 the following:

- A multi-model approach was 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 2024a). A recent post-audit (DEW 2024b) 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 was undertaken in 2024 to assess the current state and condition of the fresh groundwater resources that comprise the Uley Wanilla and Lincoln South public water supply consumptive pools. It also evaluated their capacity to sustain GDEs and further groundwater extractions into the future (DEW 2024d).
- Recent geophysical studies in Coffin Bay, including reprocessed airborne electromagnetic (AEM) data (Munday et al. 2024) and surface geophysics conducted in April 2025 (Munday et al. 2025), have provided valuable insights into the extent and dynamics of the freshwater lens within the Quaternary Limestone aquifer.

Below is a summary of trends in rainfall, water levels, salinity and the volumes of water extracted for licenced purposes from the various groundwater resources within the PWAs. Locality maps are included and correspond with each graph which presents correlating 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 average 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 following Sections refer to the groundwater resources of the Quaternary Limestone aquifer across both PWAs as consumptive pools. The term consumptive pool is provided for under the Landscape Act 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 4-1 and Figure 4-2. Further discussion on consumptive pools is provided in Section 9.

2.1. Southern Basins Prescribed Wells Area

2.1.1. Coffin Bay Consumptive Pool

Over the past decade, groundwater levels in the Coffin Bay Consumptive Pool (Figure 2-1) have remained relatively stable, which can be seen in observation wells LKW038 and LKW027. This stability is likely due to the wells' coastal location, where variations in groundwater levels are buffered by proximity to the ocean and are less sensitive to fluctuations in rainfall or extraction volumes (see Figure 2-2).

Groundwater extraction data indicate historical peaks in the late 1990s to early 2000s, followed by a marked reduction in extraction volumes in subsequent years.

While allocation volumes have remained relatively stable, the reduction in recorded extraction primarily reflects changes in water management and water supply arrangement during and following the Millennium Drought. Although water restrictions were rescinded after drought conditions eased, groundwater use did not return to pre-drought levels. In 2019, SA Water constructed a pipeline connecting the Coffin Bay township to the Eyre South system (Uley South, Lincoln South and Uley Wanilla Basins) providing supplementary supply during periods of elevated demand. Licensed groundwater extraction from the Coffin Bay Consumptive Pool in 2023–2024 was 118 ML, which is an increase of 12.4 % compared to 105 ML extracted in 2022–23.

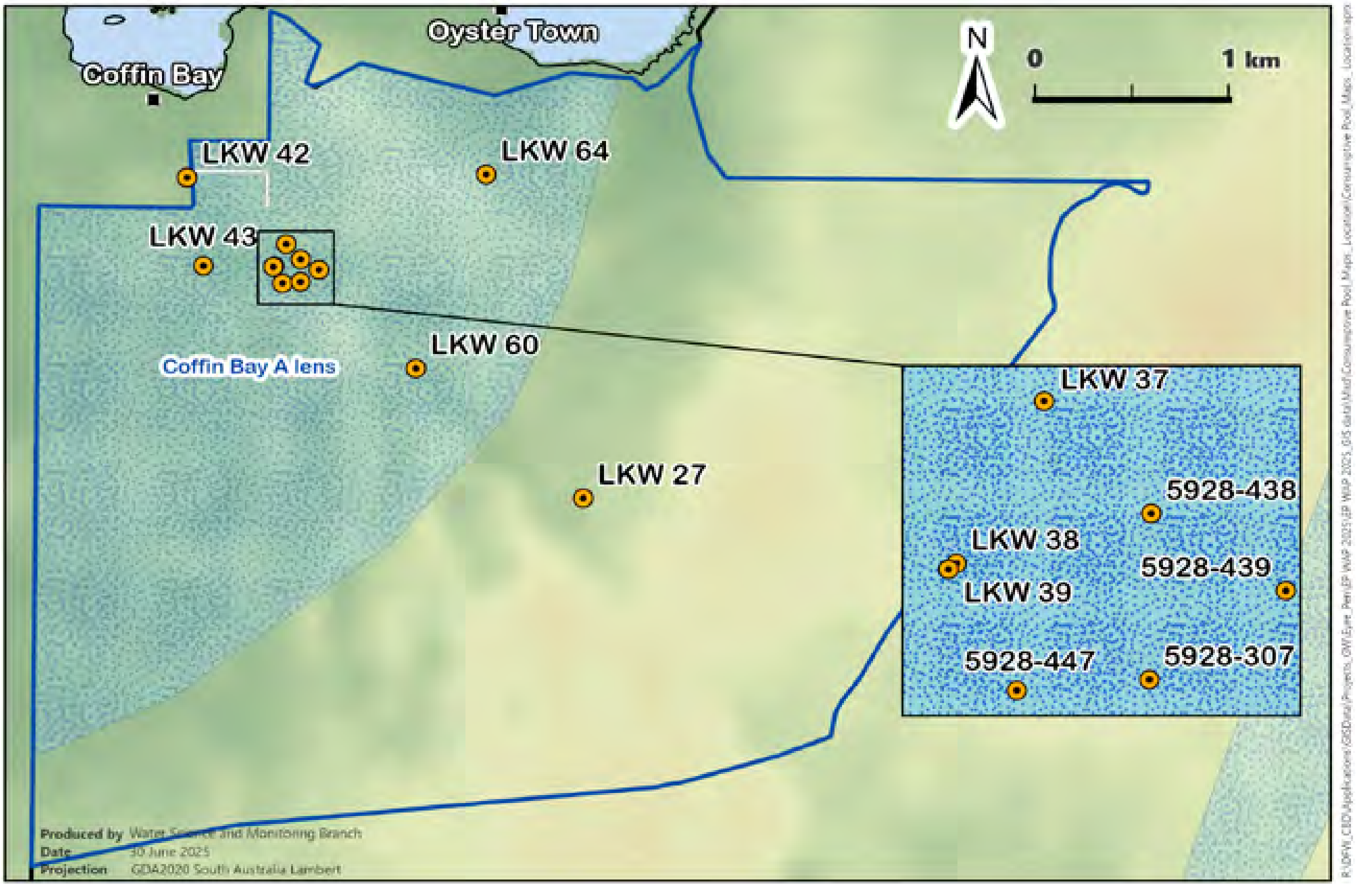

Figure 2-1 Location map for wells and rainfall stations for the Coffin Bay Consumptive Pool

The BoM Coffin Bay station is located approximately 1.3 km west.

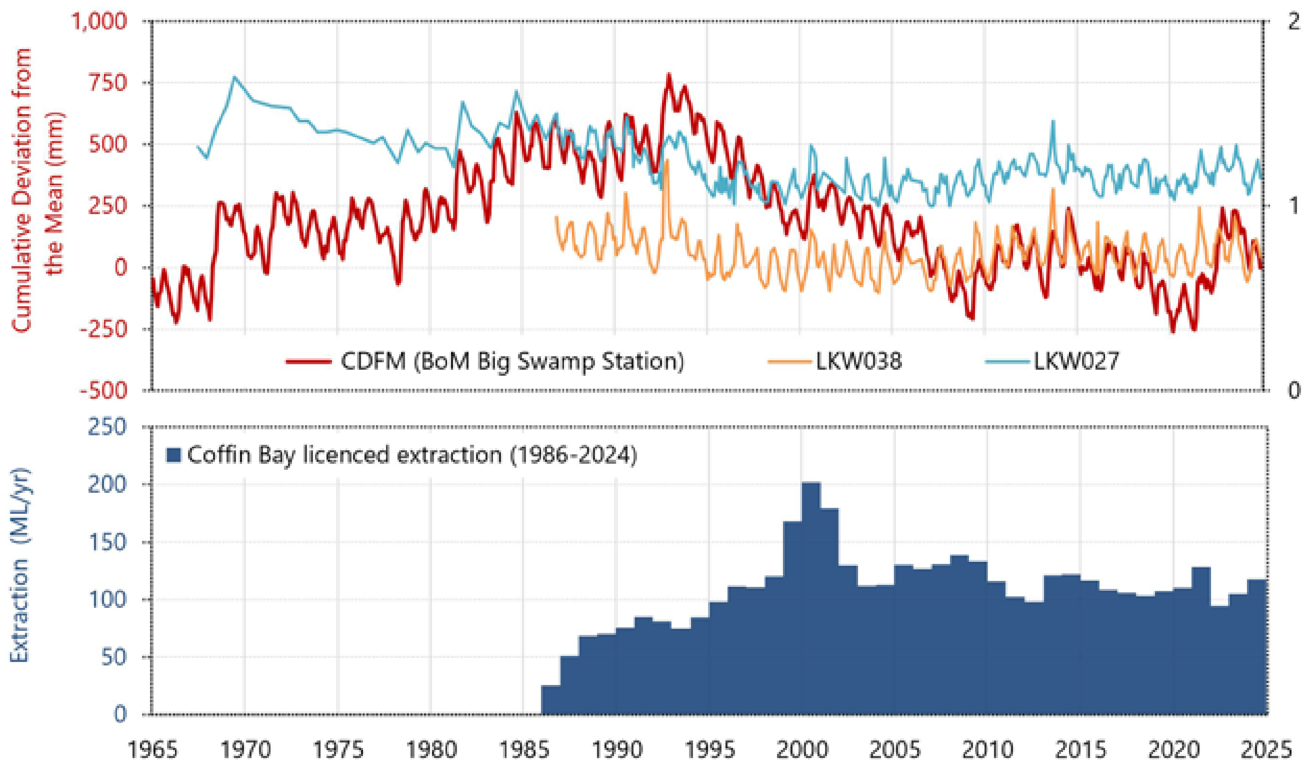

Figure 2-2 Groundwater level, rainfall and extraction trends for the Coffin Bay Consumptive Pool

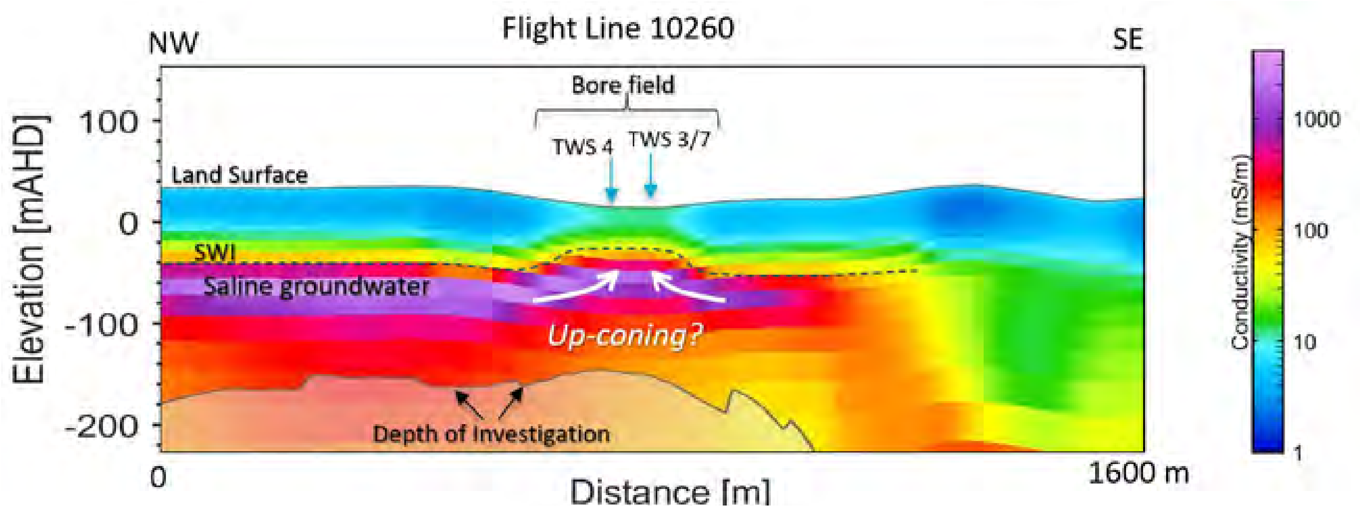

Figure 2-3 Conductivity–depth section for a subset of flightline 10260 which transects the south-western margin of the Coffin Bay wellfield

(from Munday et al. 2024)

Following the 2009 airborne electromagnetic (AEM) investigations commissioned by SA Water, additional wells were drilled and pumping was redistributed to reduce flow rates and mitigate further groundwater level drawdown. Subsequent investigations, including reprocessed AEM data and surface geophysical surveys conducted in 2025 (Munday et al. 2024, 2025), indicate that the saltwater interface rises beneath the public water supply wellfield continue to impose an ongoing risk to the security of the water supply. (Figure 2-3).

Combined evidence from groundwater salinity data, downhole measurements and geophysical investigations indicates that upconing of underlying saltwater is the primary risk to the Coffin Bay resource (Munday et al. 2025). This suggests that salinity increases are being driven by localised intensive extraction rather than broader aquifer-wide impacts. This risk can be mitigated by measures such as expanding the wellfield footprint or extending the time period over which equivalent volumes of groundwater are taken.

2.1.2. Uley North Consumptive Pool

Over the past 20 years, groundwater levels have varied in the Uley North Consumptive Pool (Figure 2-4), 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 2-5). This is particularly evident in the correlation with the cumulative deviation from the mean rainfall trend, where peaks and troughs in water 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 observation wells (Figure 2-6). 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.

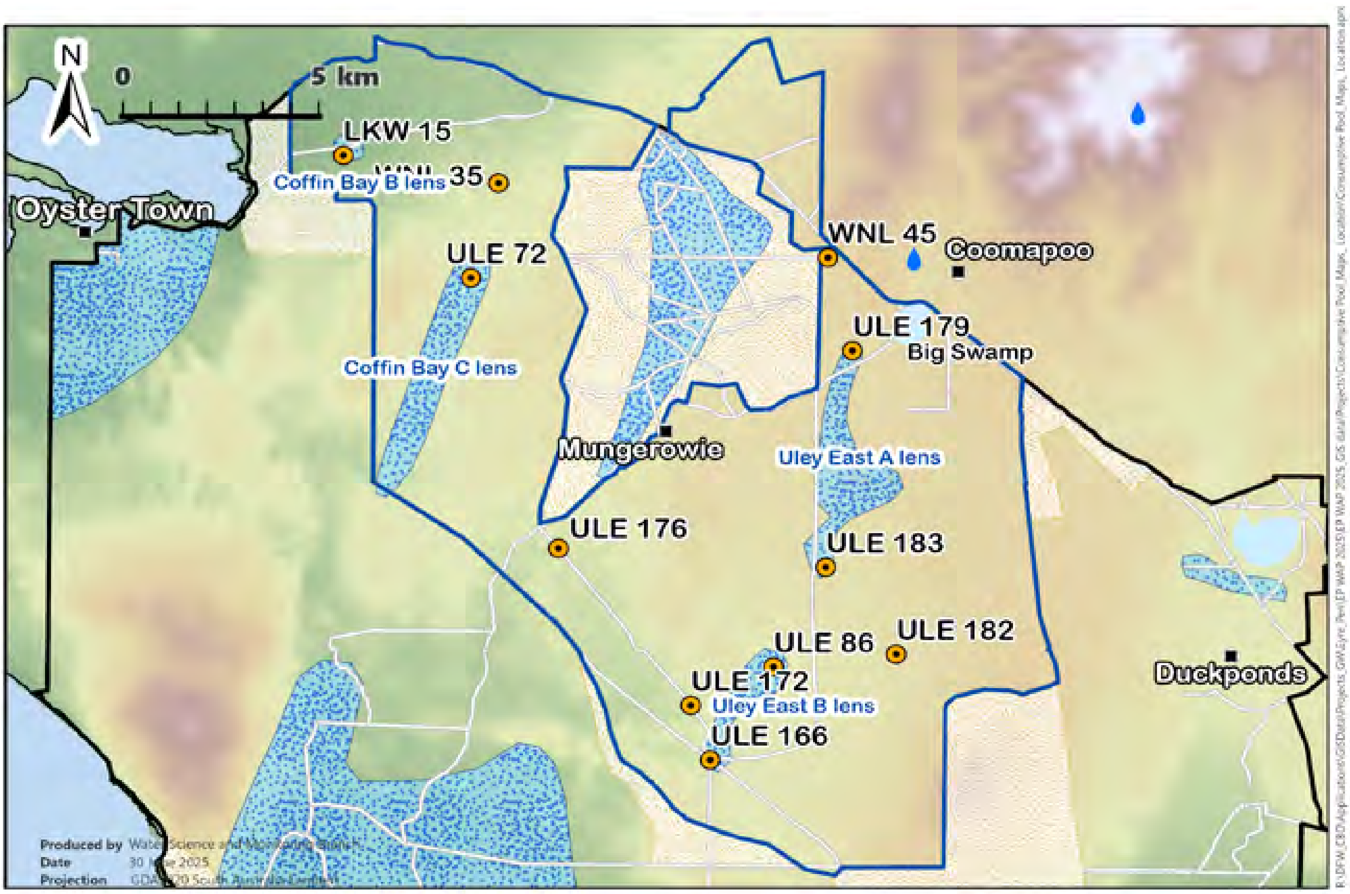

Figure 2-4 Location map for wells and rainfall stations for Uley North Consumptive Pool

The BoM Big Swamp station is located approximately 1.7 km east

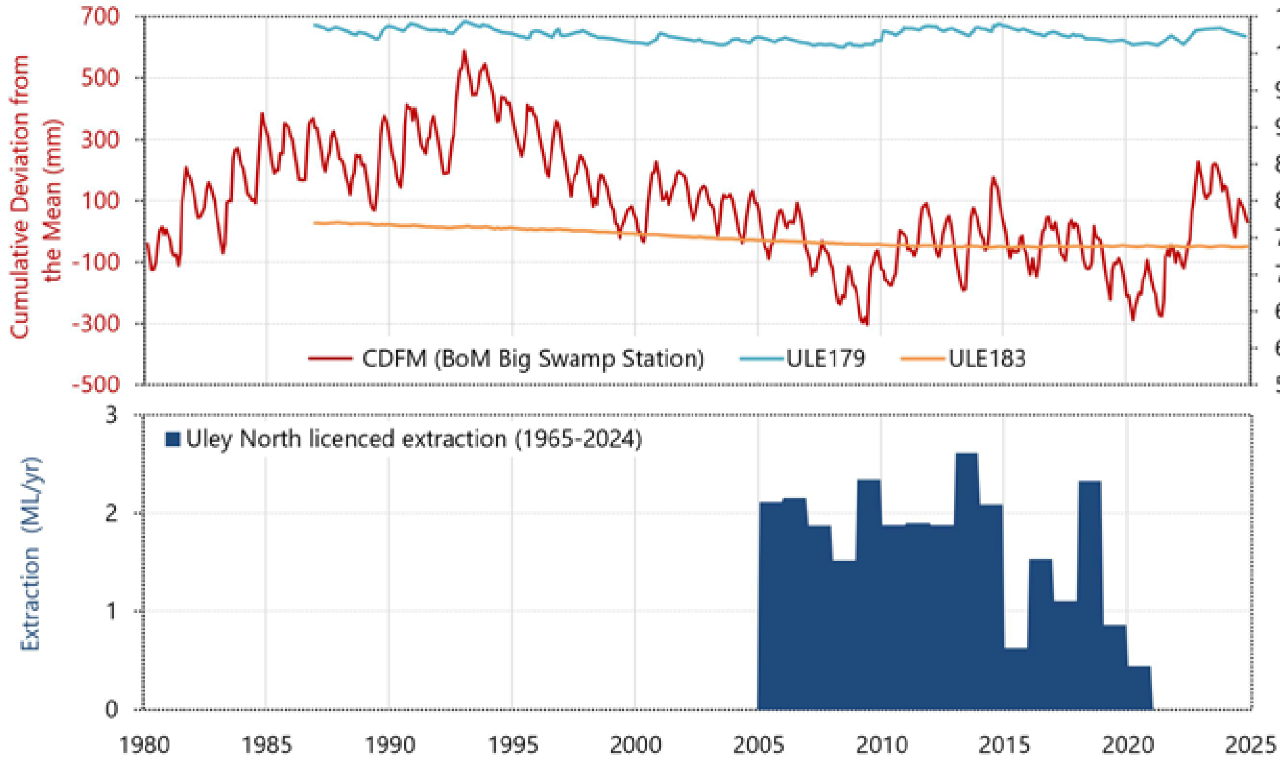

Figure 2-5 Groundwater level, rainfall and extraction trends for the Uley North Consumptive Pool

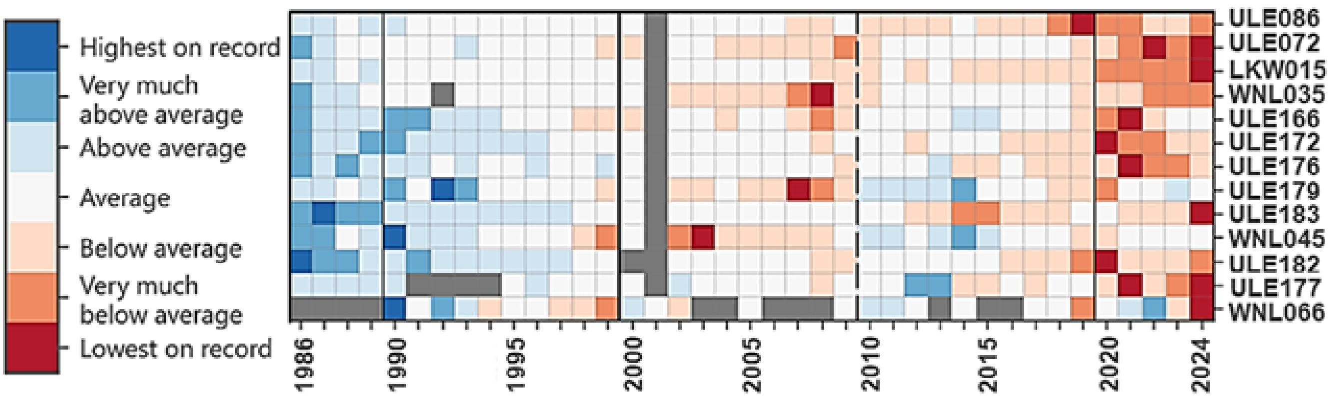

Figure 2-6 Uley North historical water level rankings for selected observation wells with good historical records

Only one well 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. The Uley Wanilla Consumptive Pool, located within the Uley North Consumptive Pool, also exhibits an increasing trend in salinity and is detailed in the next Section 2.1.3.

2.1.3. Uley Wanilla Basin

The Uley Wanilla Basin (Figure 2-7) 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 2023–24 was 12 ML, lower than the extracted volume in 2022-23.

Representative observation wells illustrate common or important groundwater level trends in Uley Wanilla Basin (Figure 2-8 and Figure 2-9). The dominant driver of groundwater levels in the Uley Wanilla Basin is not known with certainty. By way of example, observation well ULE007 shows a large rise in groundwater levels between 1968 and 1972 that coincides with above-average rainfall and large increases in extraction, whereas a slower decline in groundwater levels observed at this observation well between 1973 and 1978 corresponds with a large increase in extraction and rainfall totals commensurate with the long-term average (DEW 2024d). However, since around 2010, rates of extraction in the Uley Wanilla Basin have been been consistently low (DEW 2024d) allowing for a clearer expression of the relationship between rainfall and the corresponding response in groundwater levels.

Observation wells with long-term records (for example, ULE007, ULE036) show very large groundwater level declines of around 8 m. This increases the risk of detrimental impacts to local groundwater-dependent ecosystems (for example, to Wanilla river red gums). This decline has been increasing with time (EPNRMB 2016). The status of the median groundwater level of all Uley Wanilla groundwater resource observation wells has been classified 'lowest on record' for 4 consecutive years over the period 2018 to 2021 (DEW 2020a, 2021a, 2022a, 2023a) and similar groundwater level trends have been observed in Uley South Basin (DEW 2024d).

From 2010 to 2016, a period of mostly above average rainfall, groundwater level recovery was observed in most Uley Wanilla observation 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 observation wells. These observations of somewhat inconsistent responses suggest there have been changes in the groundwater level response to rainfall that could be attributable to recent changes in the timing and/or intensity of rainfall and consequently, lower rates of rainfall recharge. Further scientific investigations are required to test this hypothesis.

A highly parameterised groundwater model of Uley South (Knowling et al. 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 in 2020. 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.

As recharge is solely from rainfall, any additional extraction will proportionally reduce natural discharge and slightly deplete aquifer storage. This poses a risk to groundwater-dependent ecosystems, which rely on these flows and storage for their health and survival.

The majority of salinity monitoring wells within Uley Wanilla Basin are located within the public water supply wellfield with a salinity ranging between 488 mg/L and 1,086 mg/L with a median of 570 mg/L. The 10-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%.

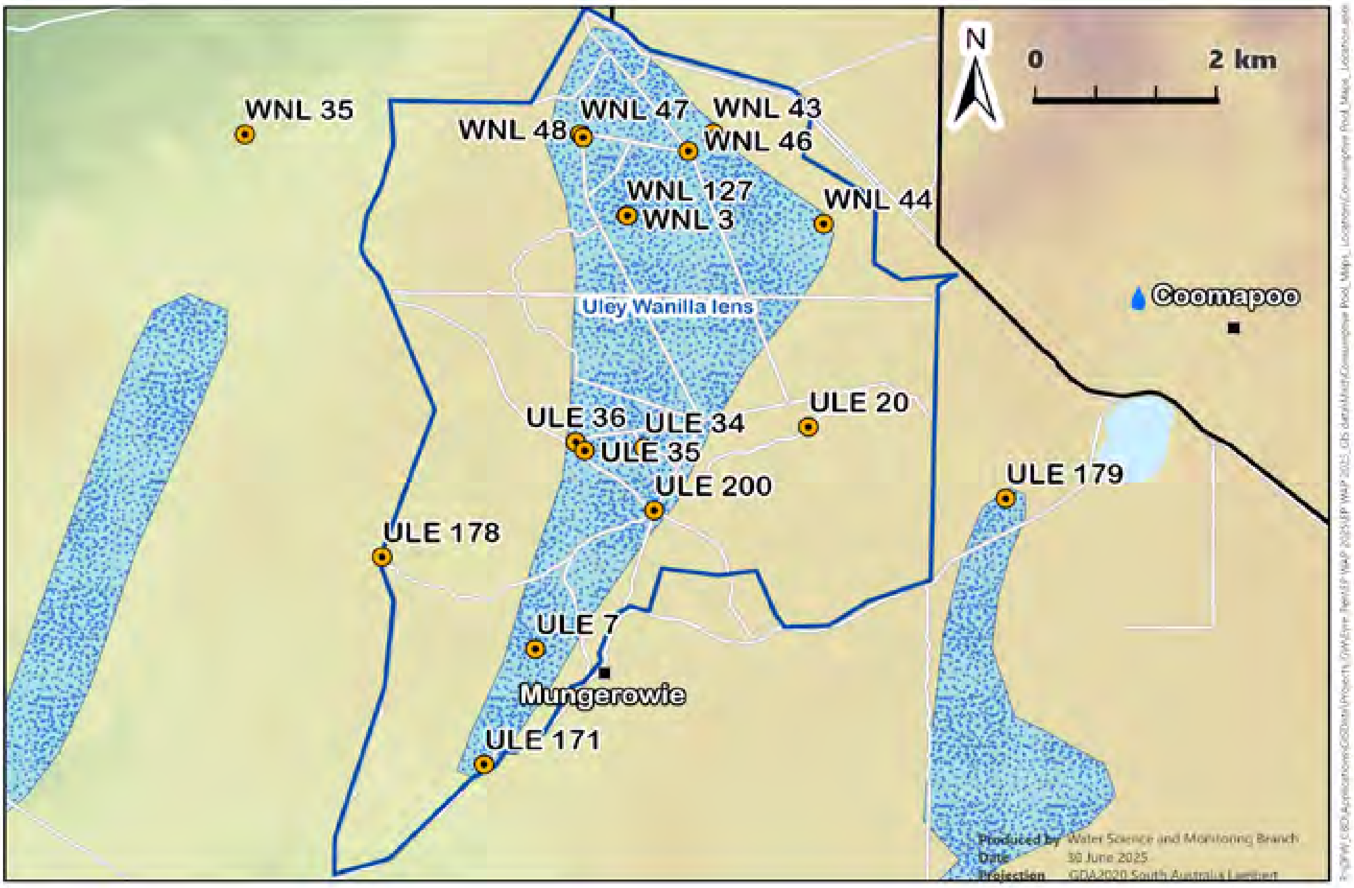

Figure 2-7 Location map for wells and rainfall stations for Uley Wanilla Consumptive Pool

The Port Lincoln (Big Swamp) BoM station is located approximately 2.2 km east.

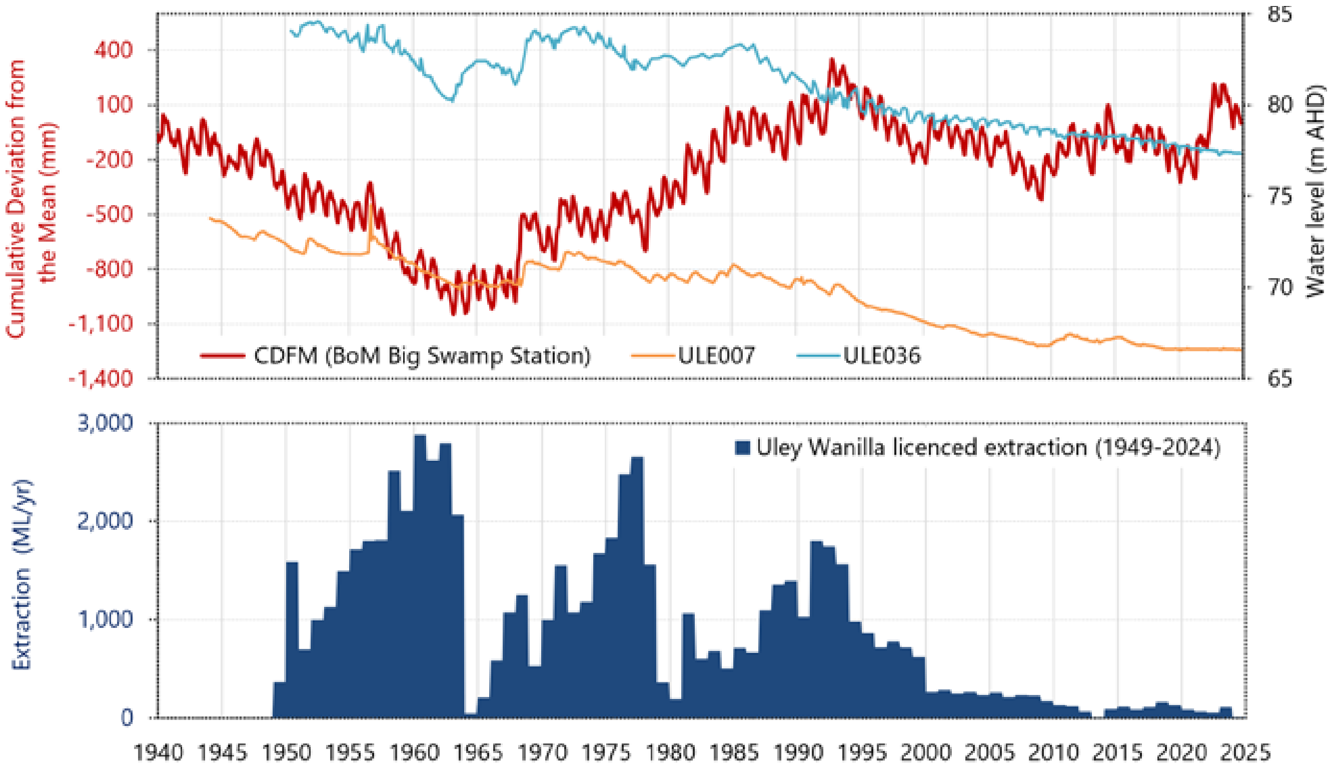

Figure 2-8 Groundwater level, rainfall and extraction trends for Uley Wanilla Consumptive Pool

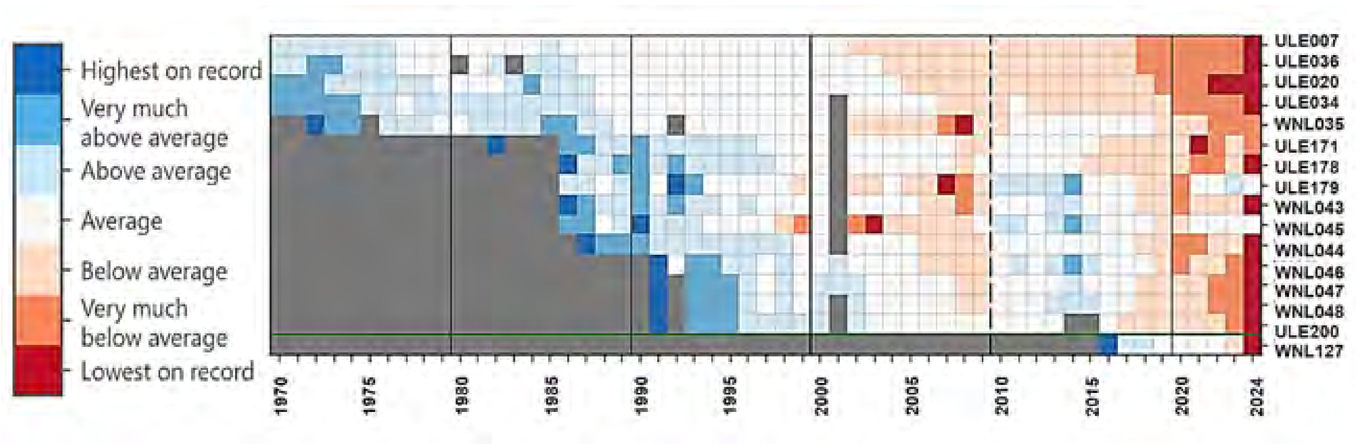

Figure 2-9 Uley Wanilla historical water level rankings for selected observation wells with good historical records

2.1.4. Lincoln North Consumptive Pool

Extraction volumes in the Lincoln North Consumptive Pool (Figure 2-10) generally follow a pattern similar to rainfall variability, suggesting a strong link between climatic conditions and extraction rates. Licenced groundwater extraction at Lincoln North began in the 2004-2005 water-use year, with notable peaks recorded in the period 2012 to 2014 and again in 2024 (Figure 2-11 and Figure 2-12). However, some current licence holders are exempt from reporting their extraction, which will be rectified under this Plan moving forward. 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, 6 monitoring wells were drilled: LNC20, LNC21, LNC22 and LNC25 have screened zones that target the Quaternary Limestone aquifer while LNC23 and LNC24 intersect both the Quaternary Limestone and Tertiary Sands aquifers. Currently, only basic driller's logs are available for these wells, limiting detailed geological and hydrogeological interpretation.

A general decline in groundwater levels is evident across the observation 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 2-11 and Figure 2-12). 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 Quaternary Limestone aquifer have recorded groundwater level declines ranging from 1.36 to 3.46 m, while longer term data indicates an overall decline of approximately 2.0 m. Notably, well LNC020, located within 3 km of historical monitoring well 6028128, 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 now poses a risk of dry wells or reduced yields, particularly during peak demand periods.

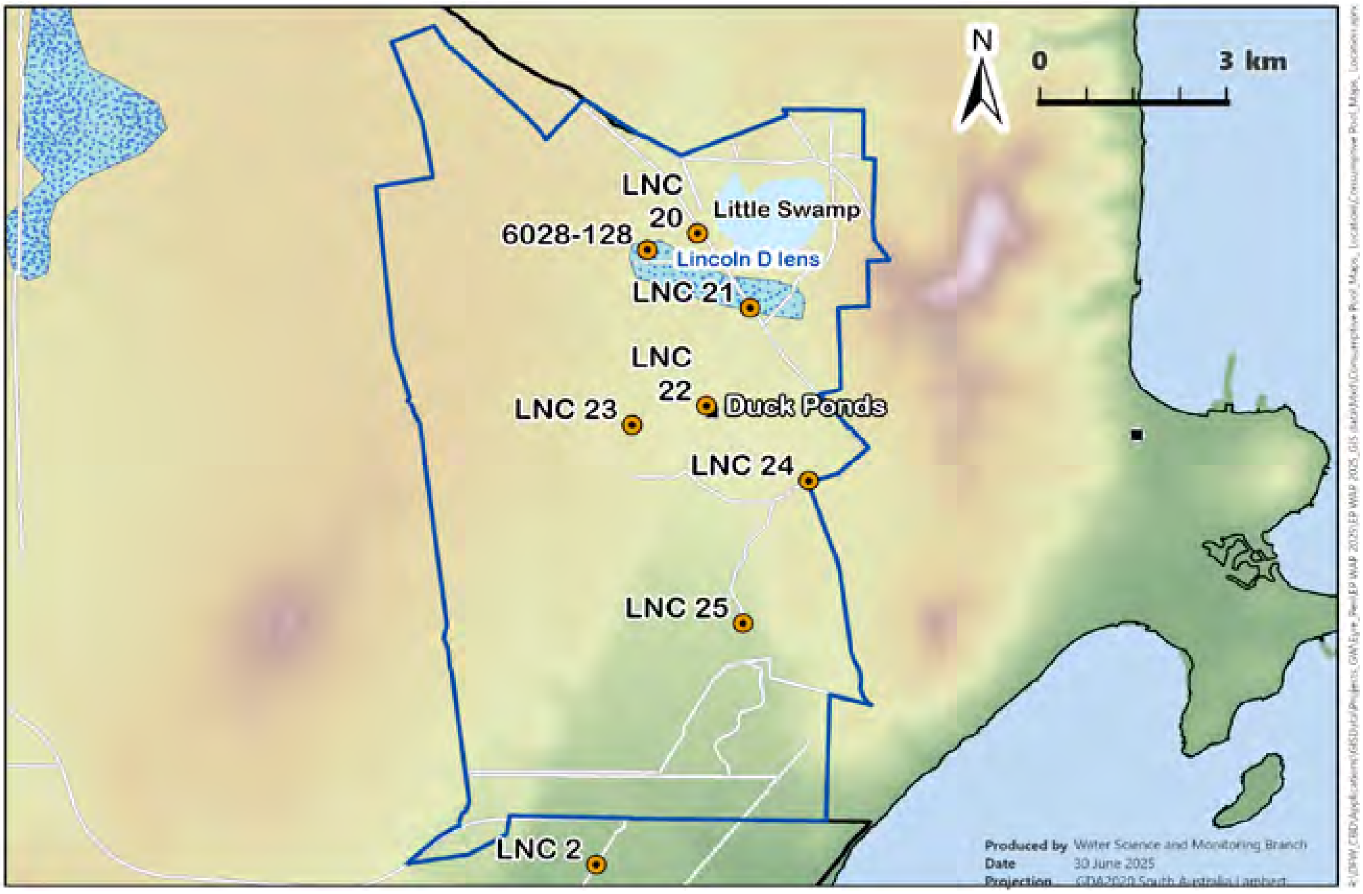

Figure 2-10 Monitoring wells for Lincoln North Consumptive Pool

The Port Lincoln (Big Swamp) BoM station located approximately 5.6 km north-west.

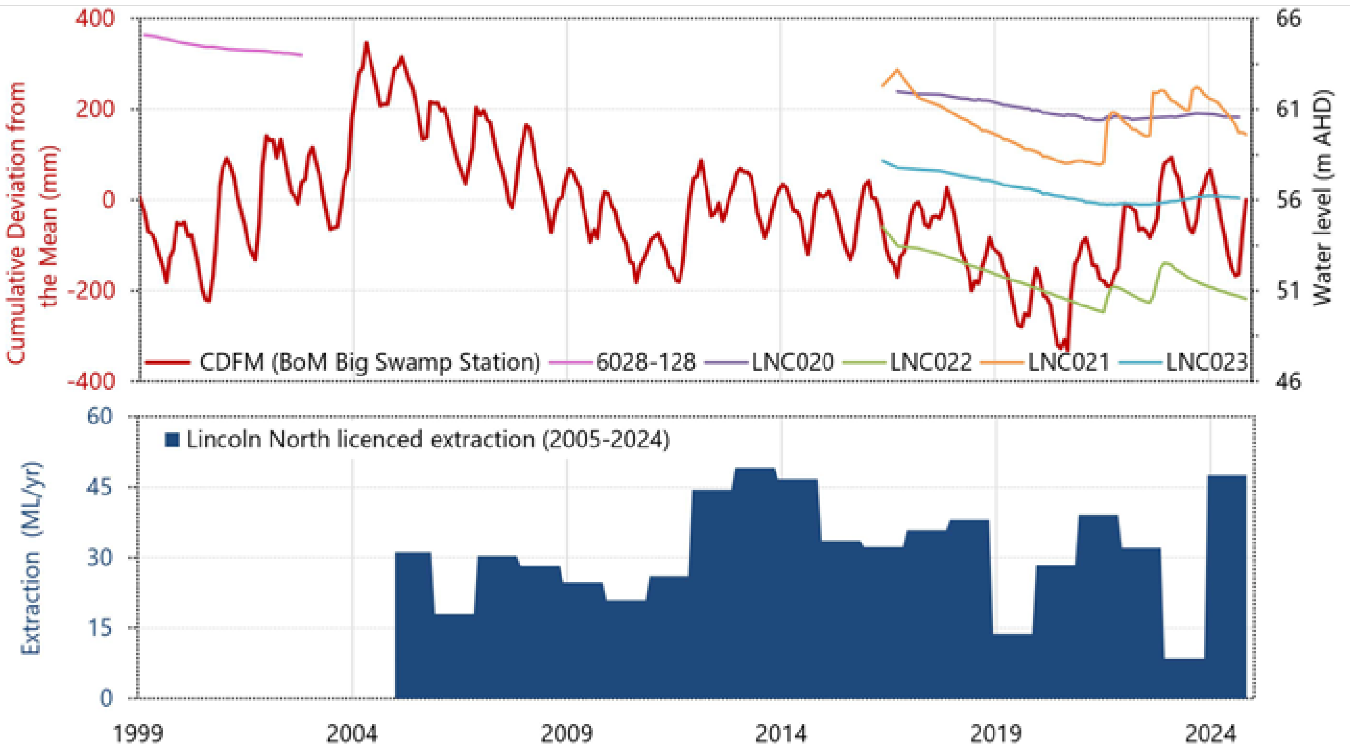

Figure 2-11 Groundwater level, rainfall and extraction trends for Lincoln North Consumptive Pool

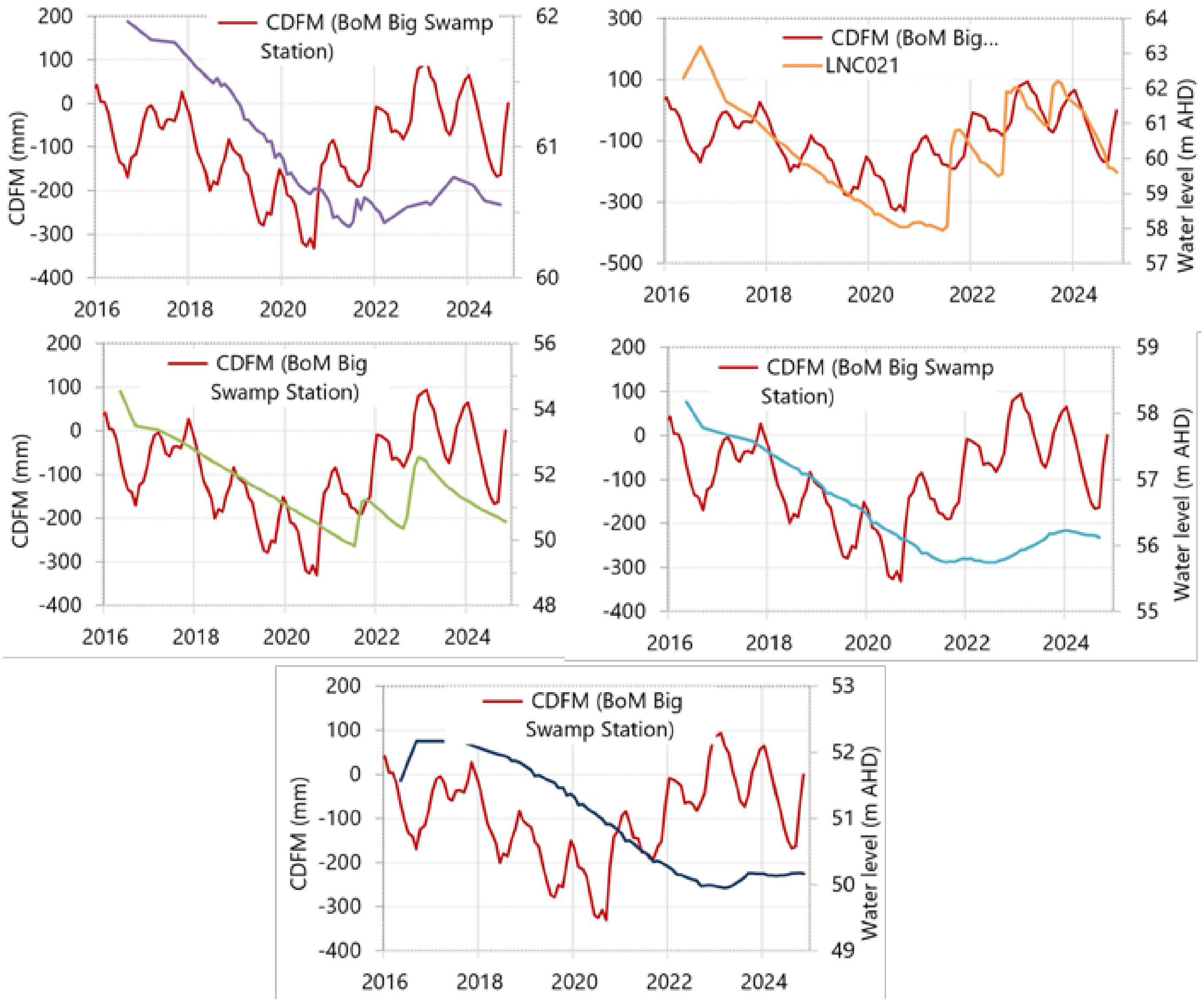

Figure 2-12 Groundwater level hydrographs for selected observation wells in Lincoln North

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. Given the limited extractions in this area, these declines are likely driven by prolonged below-average rainfall and reduced recharge.

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 Quaternary Limestone aquifers, as the streams are predominantly gaining and underlain by Basement aquifers. Little Swamp, Big Swamp and numerous minor surface water bodies are generally ephemeral and rely on rainfall and local 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 Quaternary Limestone 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 watertable.

2.1.5. Uley South Consumptive Pool

Prior to the commencement of groundwater extraction in the 1976-77 water-use year, groundwater levels in the Uley South Consumptive Pool (Figure 2-13) exhibited a gradual long-term decline, with natural fluctuations occurring intermittently in response to seasonal variability (Figure 2-14). 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 water level periods, indicating sufficient recharge. During the Millennium Drought (1997 to 2009), groundwater levels in most observation wells were classified as below average to very low (Figure 2-15). Despite these low levels, groundwater levels remained relatively stable throughout the period. This stability is primarily attributed to the expansion of the public water supply wellfield, which facilitated a more even distribution of extraction across the area, combined with demand management measures that reduced extraction from approximately 7,000 ML/y to around 5,000 ML/y from 2010 onwards.

Over the last decade, changes in groundwater level across 38 observation 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, winter-recovered groundwater levels in 20 out of 38 monitoring wells (53%) within the Quaternary Limestone aquifer of the Uley South Consumptive Pool were classified as below average or lower (DEW 2026c). 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.

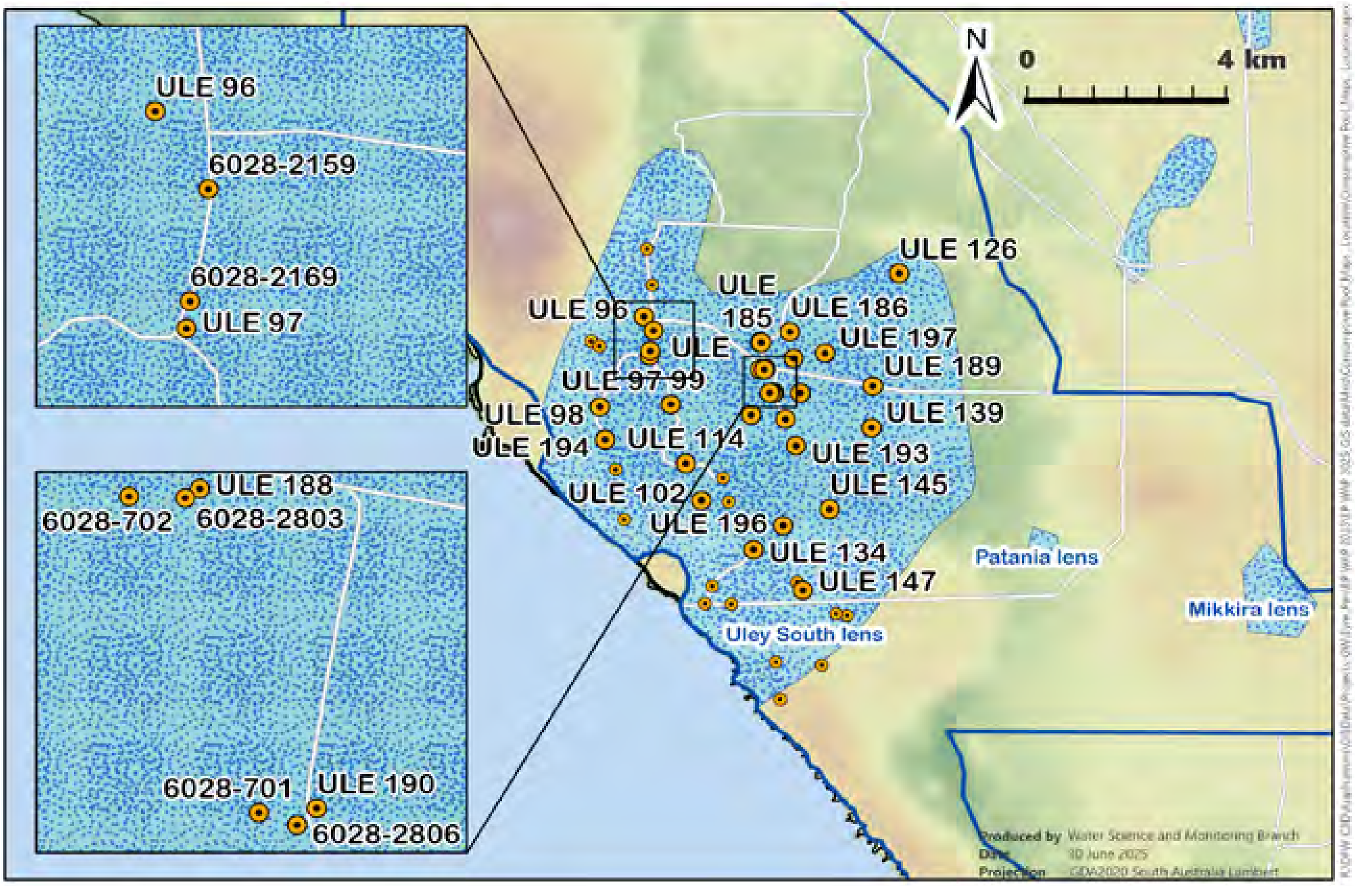

Figure 2-13 Monitoring wells for Uley South Consumptive Pool

The Port Lincoln (Westmere) BoM station is located approximately 0.16 km east.

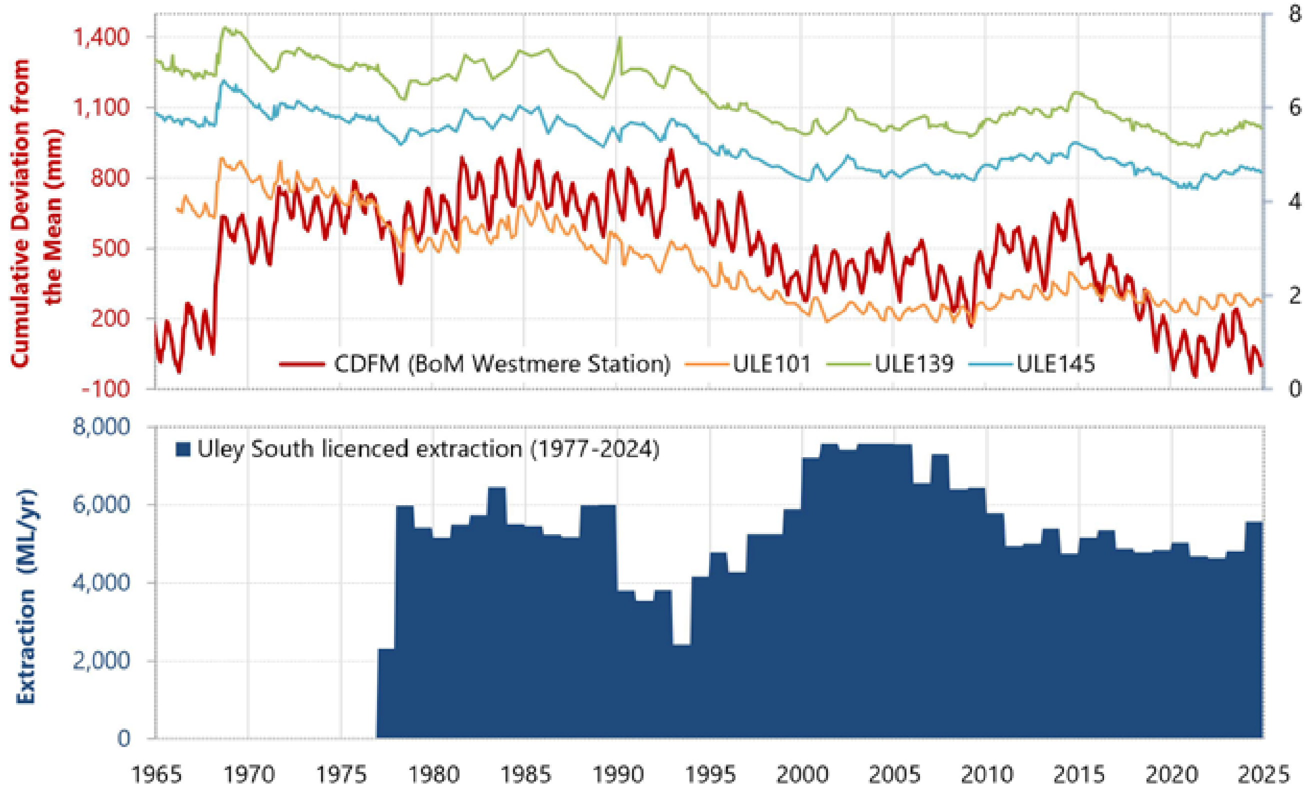

Figure 2-14 Groundwater level, rainfall and extraction trends for the Uley South Consumptive Pool

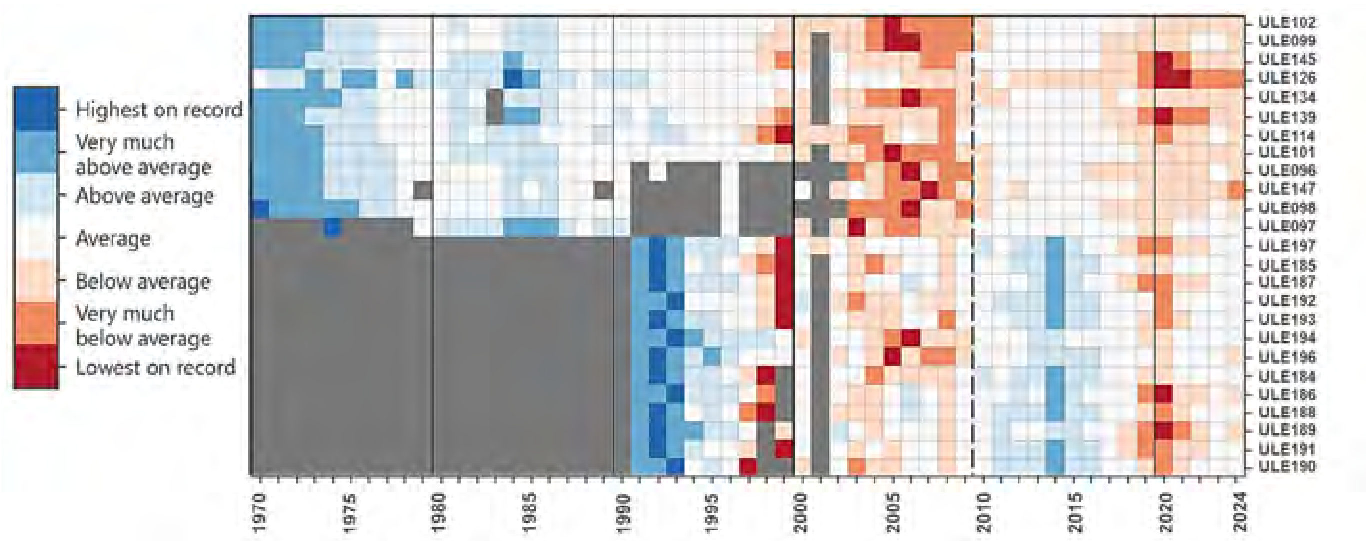

Figure 2-15 Uley South historical water level rankings for selected observation wells with good historical records

Figure 2-16 indicate 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 observation wells within the Quaternary Limestone aquifer varied from 448 to 3,195 mg/L. Salinity samples are obtained from a combination of public water supply production wells and DEW monitoring wells. Historic monitoring of groundwater salinity from public water supply wells, since extraction commenced, indicated generally stable trends until the mid-2000s when salinity started rising.

In 2025, a Risk Management and Monitoring Plan was established by DEW, to manage the risk of seawater intrusion into the Uley South Consumptive Pool, in response to an SA Water request for a higher allocation. The Minister approved a higher allocation with a licence condition requiring strict compliance with the Risk Management and Monitoring Plan, which remains in effect in 2025–26[1]. However, sustained extraction at this higher level was assessed as posing significant risks.

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

1 In accordance with the Landscape Act, non-compliance with the Risk Management and Monitoring Plan may constitute an offence by breaching a prescribed condition of a water management authorisation or could be considered a breach of the water management authorisation (e.g. the water licence) if the holder of a water licence contravenes or fails to comply with a condition of the water licence.

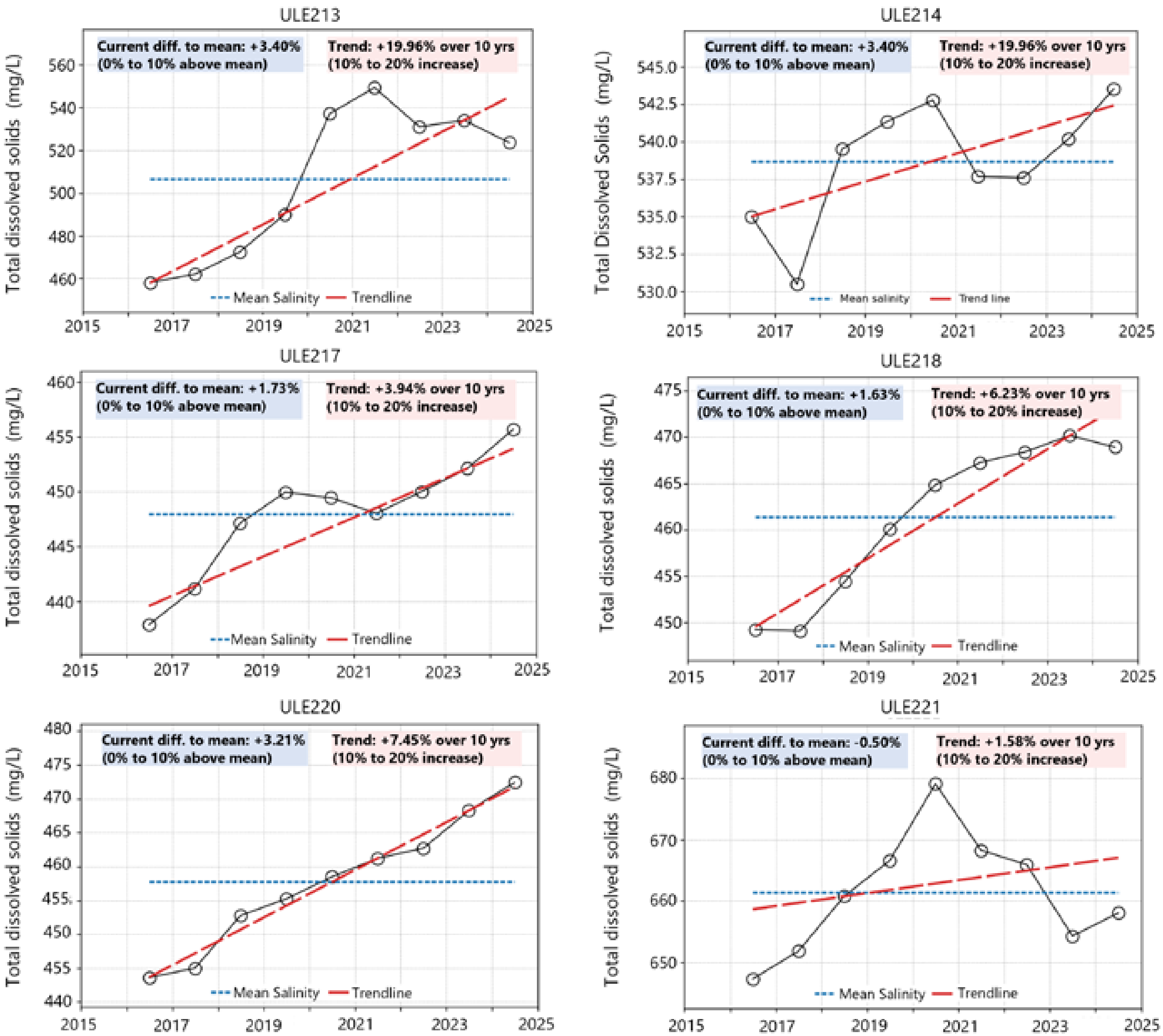

Figure 2-16 Select salinity graphs for wells in the Quaternary Limestone aquifer in the Uley South Consumptive Pool

2.1.6. Lincoln South Basin

Groundwater extraction from the Lincoln South Basin (Figure 2-17) 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 2-18).

Since the 1960s, a long-term decline in rainfall has been reflected by corresponding decreases in groundwater levels across all observation wells in the Lincoln South network (Figure 2-18). 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 the 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 (Figure 2-18). In 2023 and 2024, groundwater levels (measured at their post-winter maximum) in 100% of Lincoln South observation wells were classified 'below average' or lower (Figure 2-19). 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 4-5) are contiguous with the surrounding brackish Quaternary Limestone 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 observation 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 2024d).

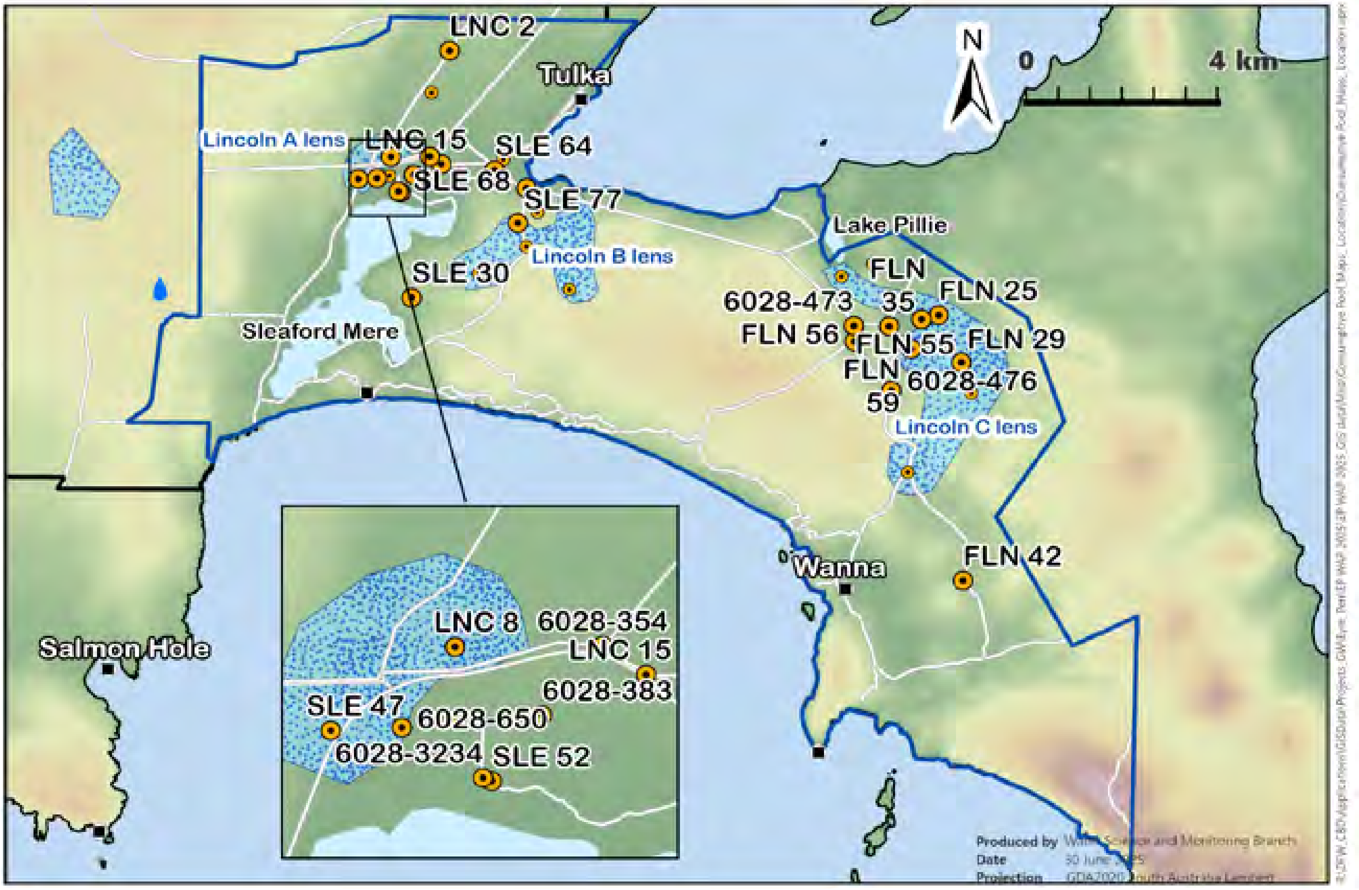

Figure 2-17 Location map for wells and rainfall stations for Lincoln South Consumptive Pool

The Port Lincoln (Westmere) BoM station is located approximately 0.63 km west.

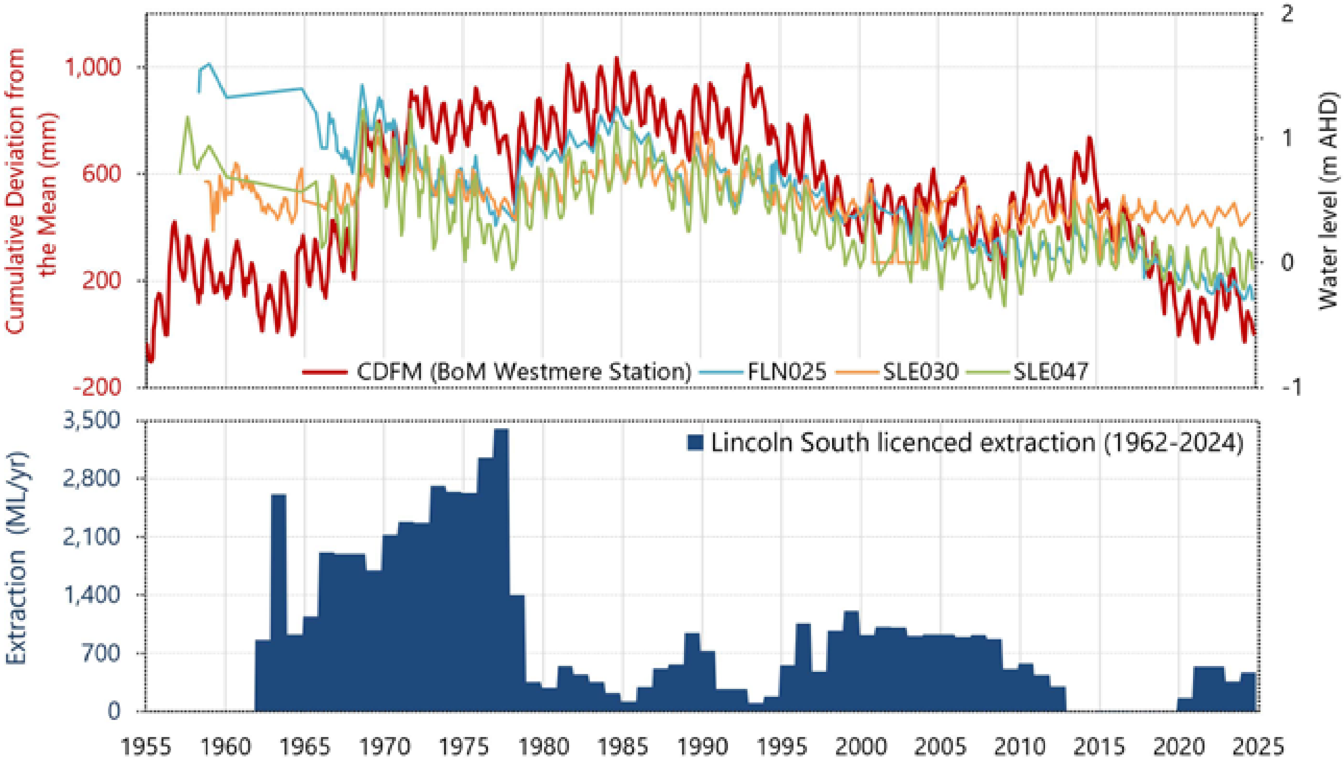

Figure 2-18 Groundwater level, rainfall and extraction trends for the Lincoln South Consumptive Pool

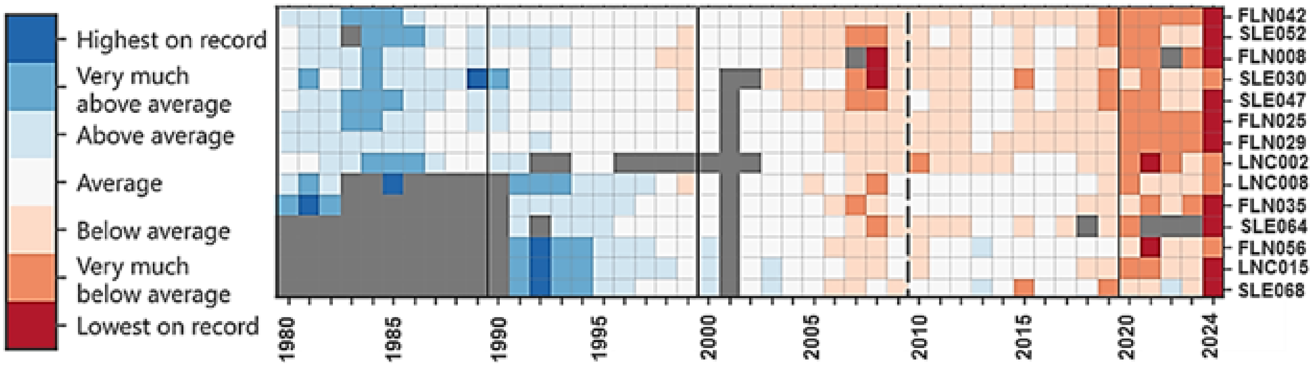

Figure 2-19 Lincoln South historical water level rankings for selected observation wells with good historical records

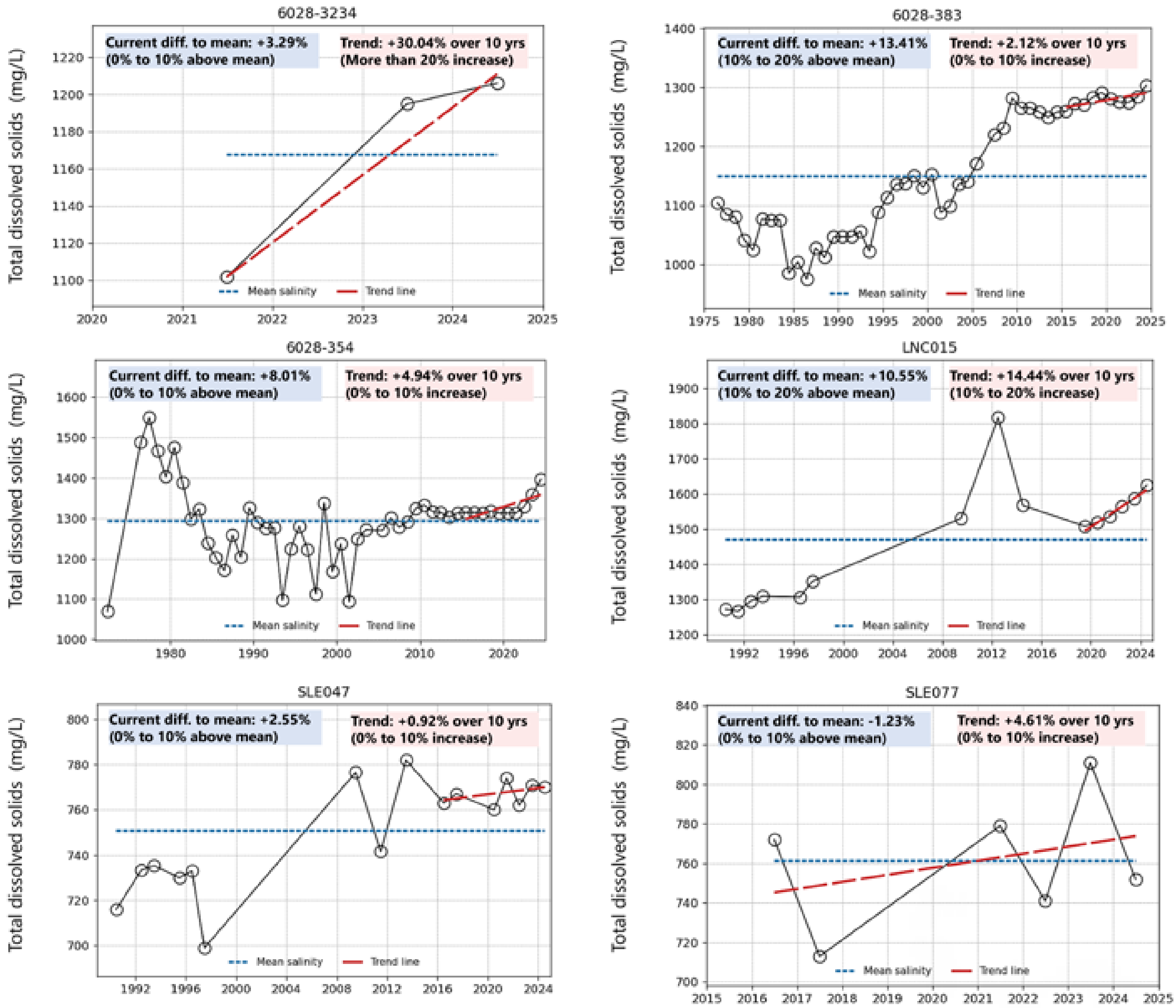

Figure 2-20 Representative salinity graphs for wells in the QL aquifer in the Lincoln South consumptive pool with ten-year salinity trends

The 10-year salinity monitoring in the Lincoln South area has shown increasing concentrations (Figure 2-20). In 2024, sampling results from 16 wells in the Quaternary Limestone 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 2.6% per year and a median rate of 0.5% increase per year.

These trends suggest 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, to induced 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.

Any groundwater extracted from Lincoln South will be offset by a small reduction in storage, with the remainder replaced by induced inflow of saline water. This intrusion of seawater and high-salinity groundwater into the fragile Lincoln South resource poses a serious threat to the health and viability of ecosystems dependent on fresh groundwater.

2.2. Musgrave Prescribed Wells Area

2.2.1. Bramfield Consumptive Pool

Licensed groundwater extraction at Bramfield (Figure 2-21) commenced in the 1973-74 water-use year and steadily increased, peaking during the 1990s and early 2000s (Figure 2-22). While extraction volumes have fluctuated slightly in more recent years, groundwater levels remain at or near their historical lows. In 2023–24, total licensed use from the Bramfield Consumptive Pool was 64 ML, sourced for the purposes of providing public water supply 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 the 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.

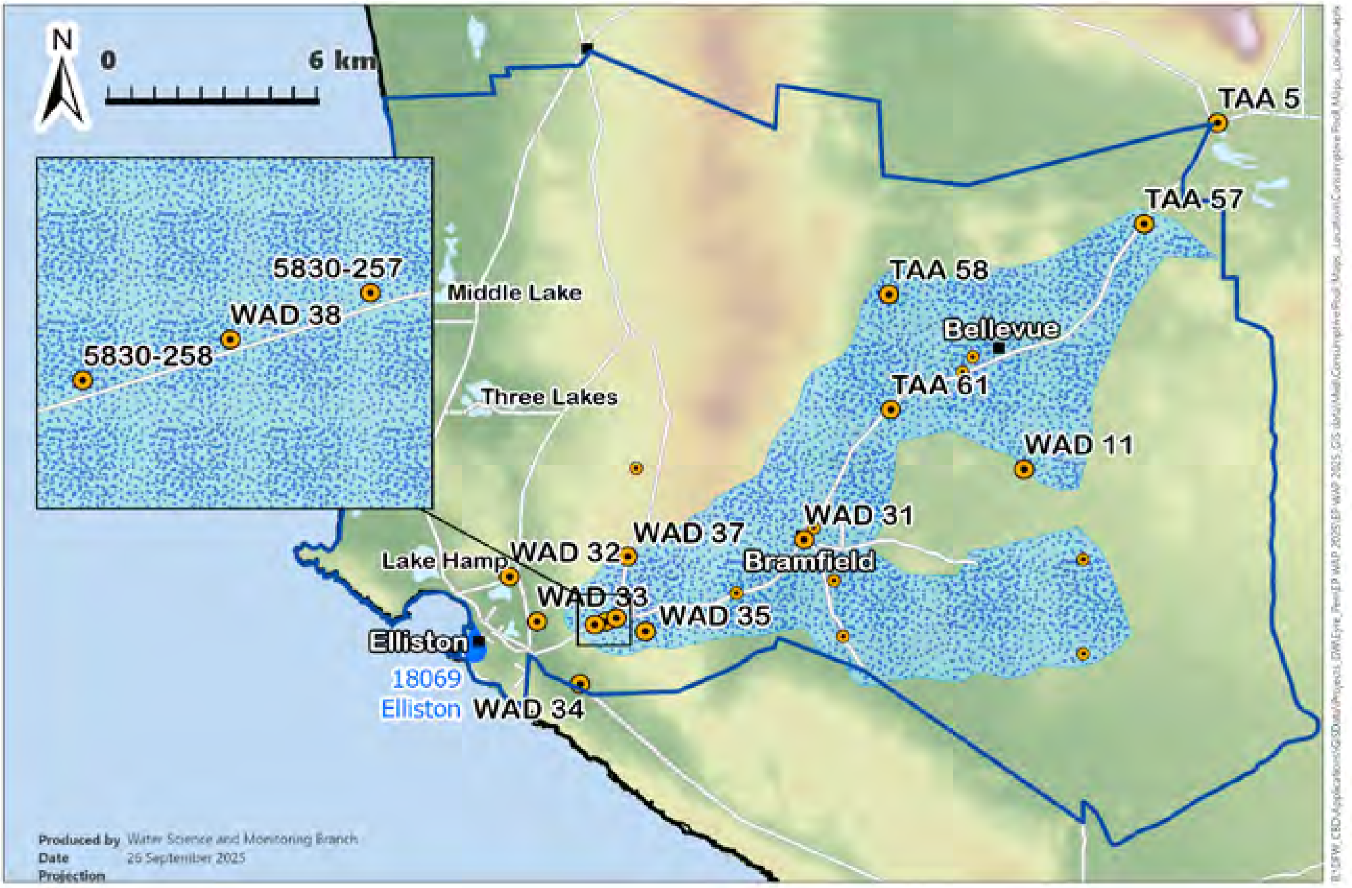

Figure 2-21 Location map for wells and rainfall stations for Bramfield Consumptive Pool.

The Elliston BoM station located approximately 1.7 km northwest

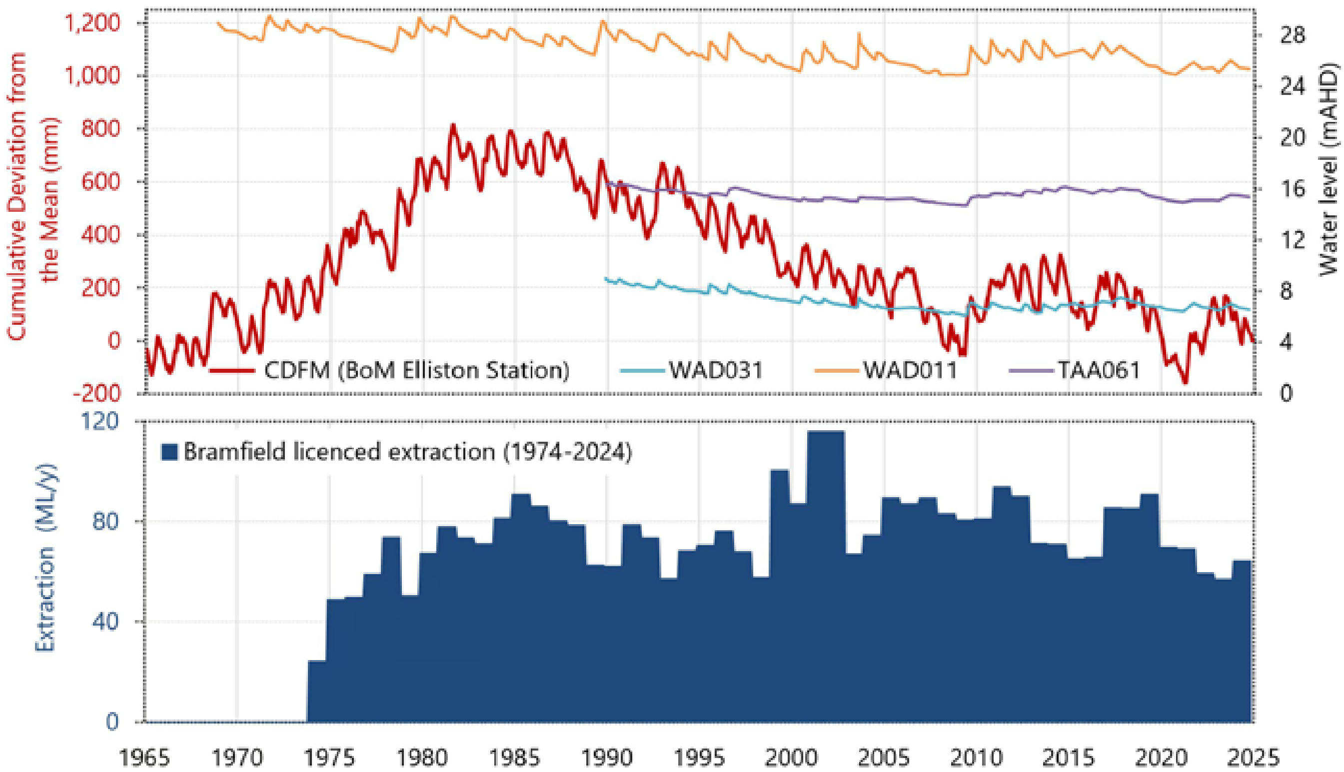

Figure 2-22 Groundwater level, rainfall and extraction trends for the Bramfield Consumptive Pool

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 Quaternary Limestone aquifer of the Bramfield Consumptive Pool were classified as below average or lower for 2023-24 (Figure 2-23).

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 resource toward 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 public water supply wells 5830-257 and 5830-258, monitored since 1999 (Figure 2-24). All public water supply wells show increasing salinity trends, with the highest concentrations recorded in the western-most well, 5830-258. In contrast, well TAA058, located inland, has remained relatively stable between 450 and 550 mg/L since the 1970s, suggesting less influence from coastal or anthropogenic factors.

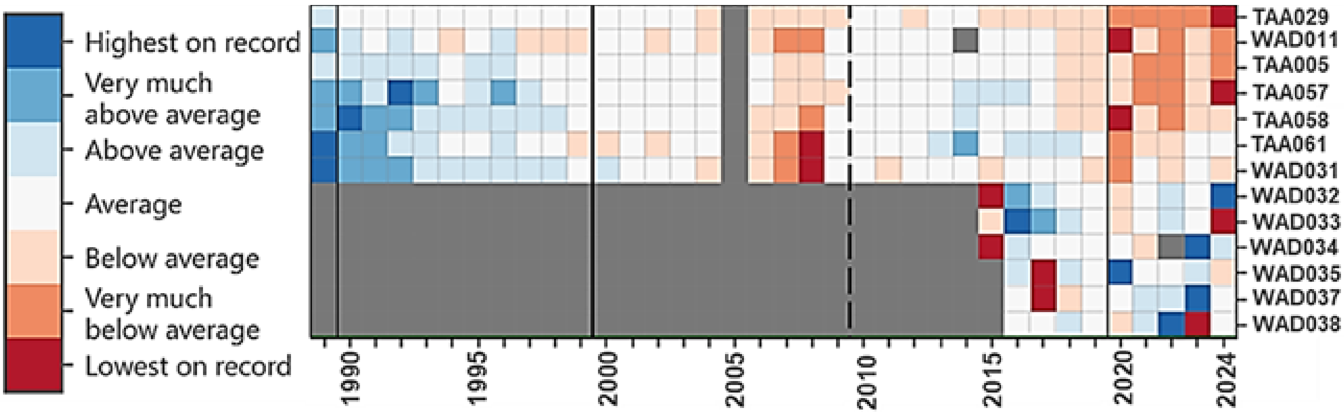

Figure 2-23 Bramfield historical water level rankings for selected observation wells with good historical records

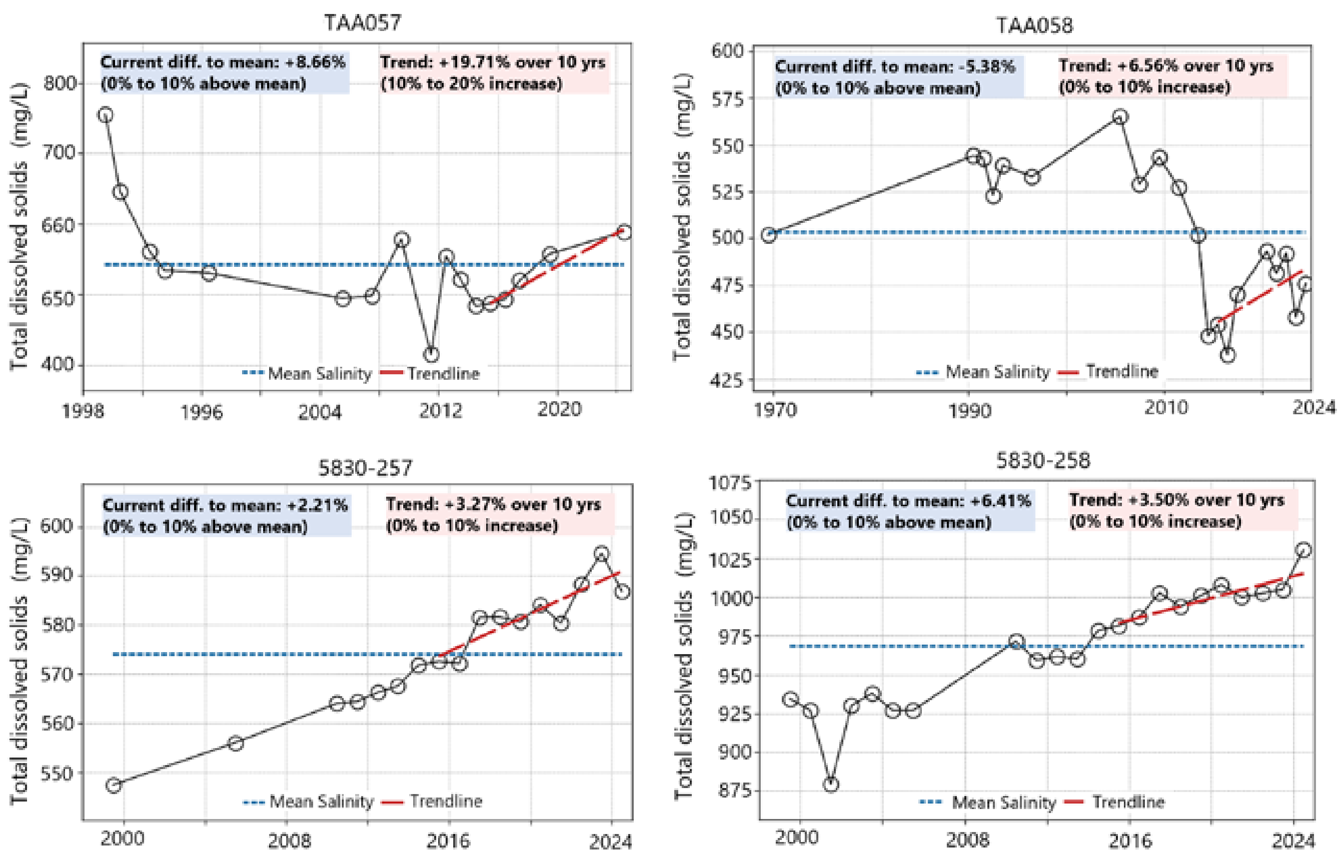

Figure 2-24 Representative salinity graphs for wells in the Quaternary Limestone aquifer in the Bramfield Consumptive Pool with 10-year salinity trends

2.2.2. Polda Consumptive Pool

Extraction from the Polda Consumptive Pool (Figure 2-25) 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 water 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).

Groundwater trends in the Polda Consumptive Pool have been closely linked to rainfall patterns, as shown by data from BoM stations and observation wells (Figure 2-26). Rainfall increases in the 1960s and 1970s corresponded with high groundwater levels, while declines from the 1980s onward led to significant drops in aquifer levels. The Millennium Drought (1997 to 2009) had a particularly severe impact, with below-average to very low groundwater levels recorded across the network.

In the past decade, groundwater levels in 32 wells have declined between 0.49 m and 1.70 m, with a median drop of 0.9 m. 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 (Figure 2-27).

Salinity monitoring between 2014 and 2024 revealed worsening trends in groundwater quality (Figure 2-28). Of the 1 observation wells, 86% showed rising salinity concentrations, with rates ranging from a 0.8% annual decrease to a 3.2% annual increase, and a median increase of 0.6% per year. In 2024, salinity levels within the Quaternary Limestone aquifer ranged from 501 to 3,552 mg/L, with a median of 902 mg/L. Most observation wells show a gradual long-term increase in salinity concentrations.

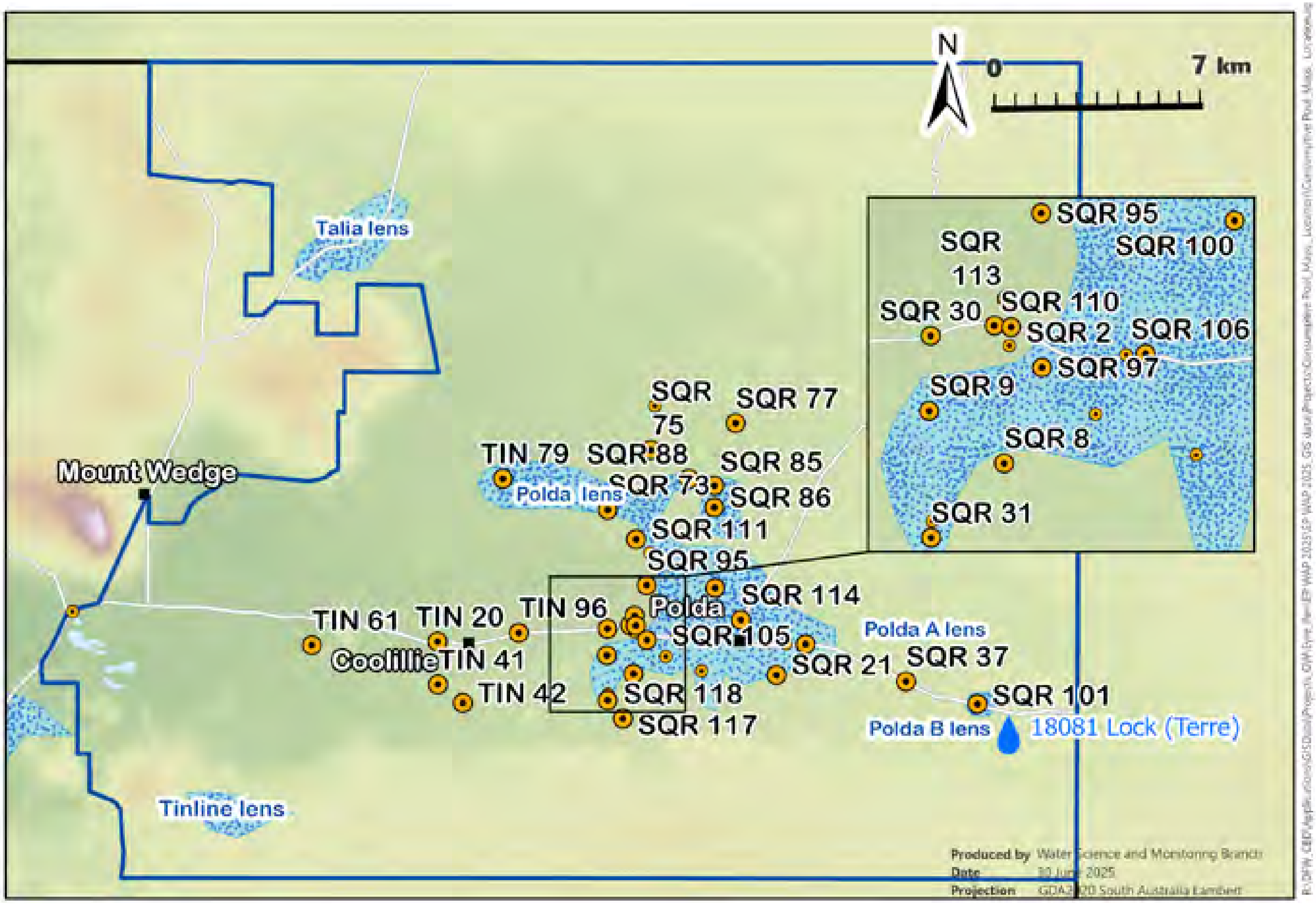

Figure 2-25 Location map for wells and rainfall stations for Polda Consumptive Pool

The Lock (Terre) BoM station is located near the south-east boundary of Polda while the Lock (Terrah Winds) BoM station is located approximately 10.5 km east.

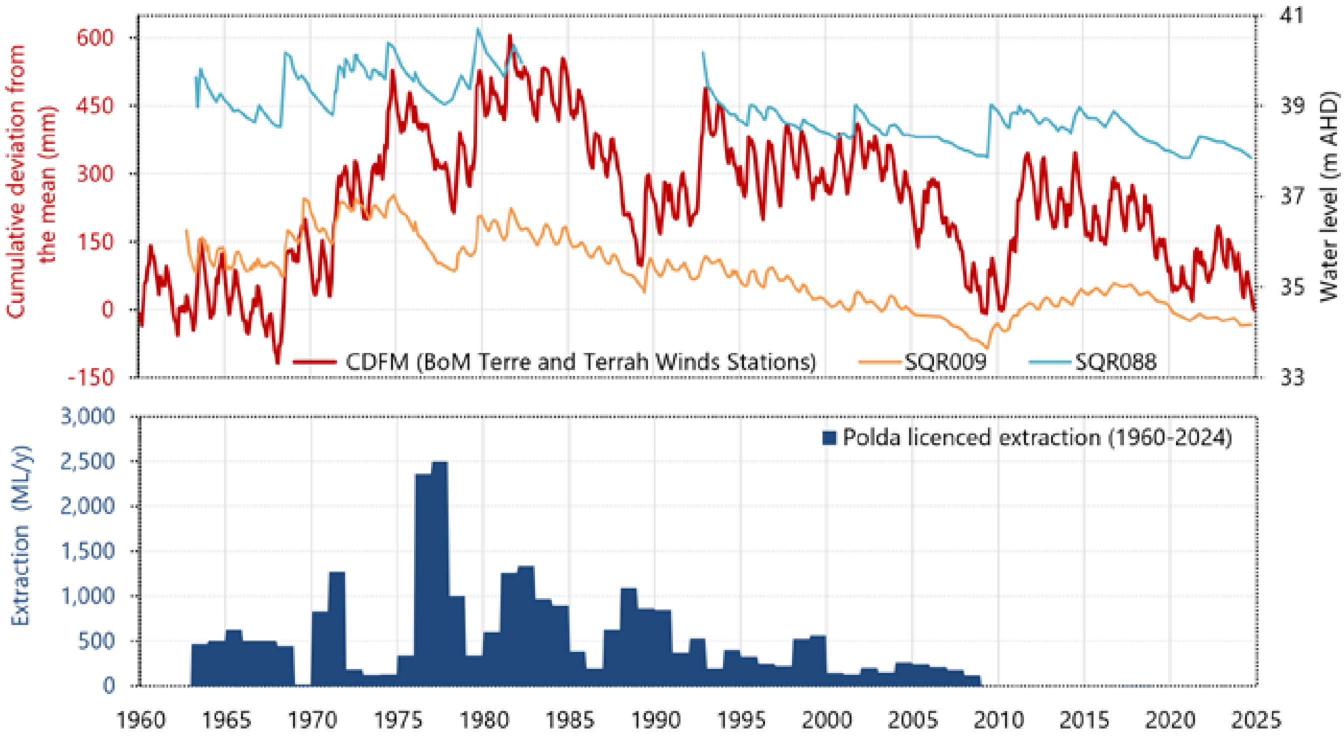

Figure 2-26 Groundwater level, rainfall and extraction trends for the Polda Consumptive Pool

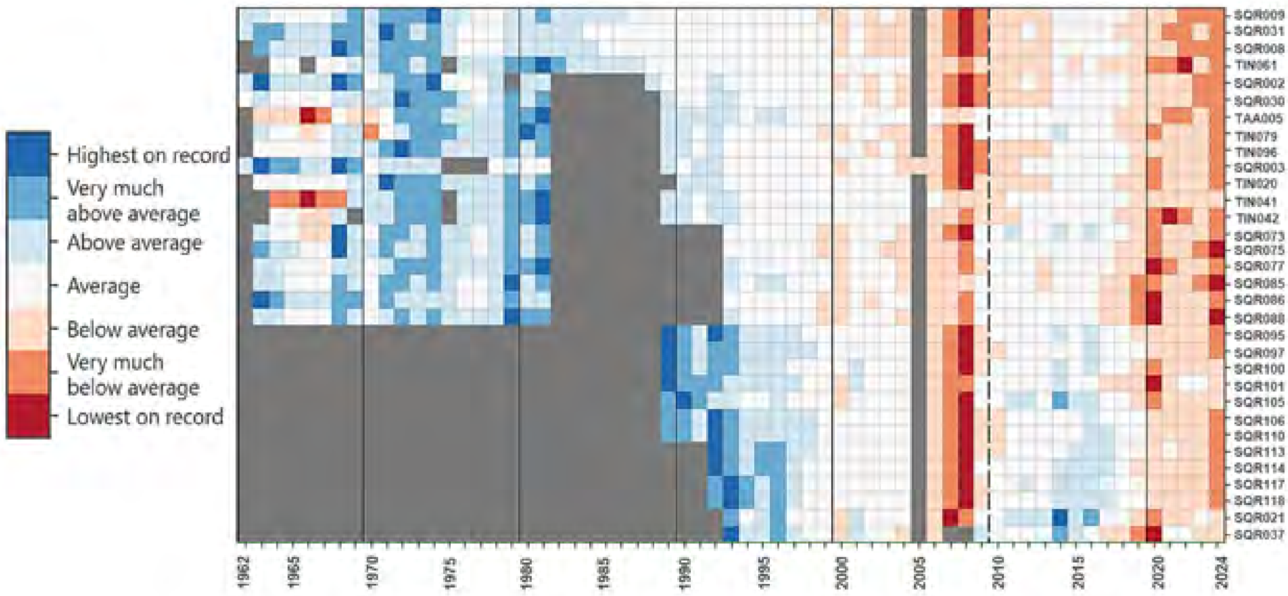

Figure 2-27 Polda historical water level rankings for selected observation wells with good historical records

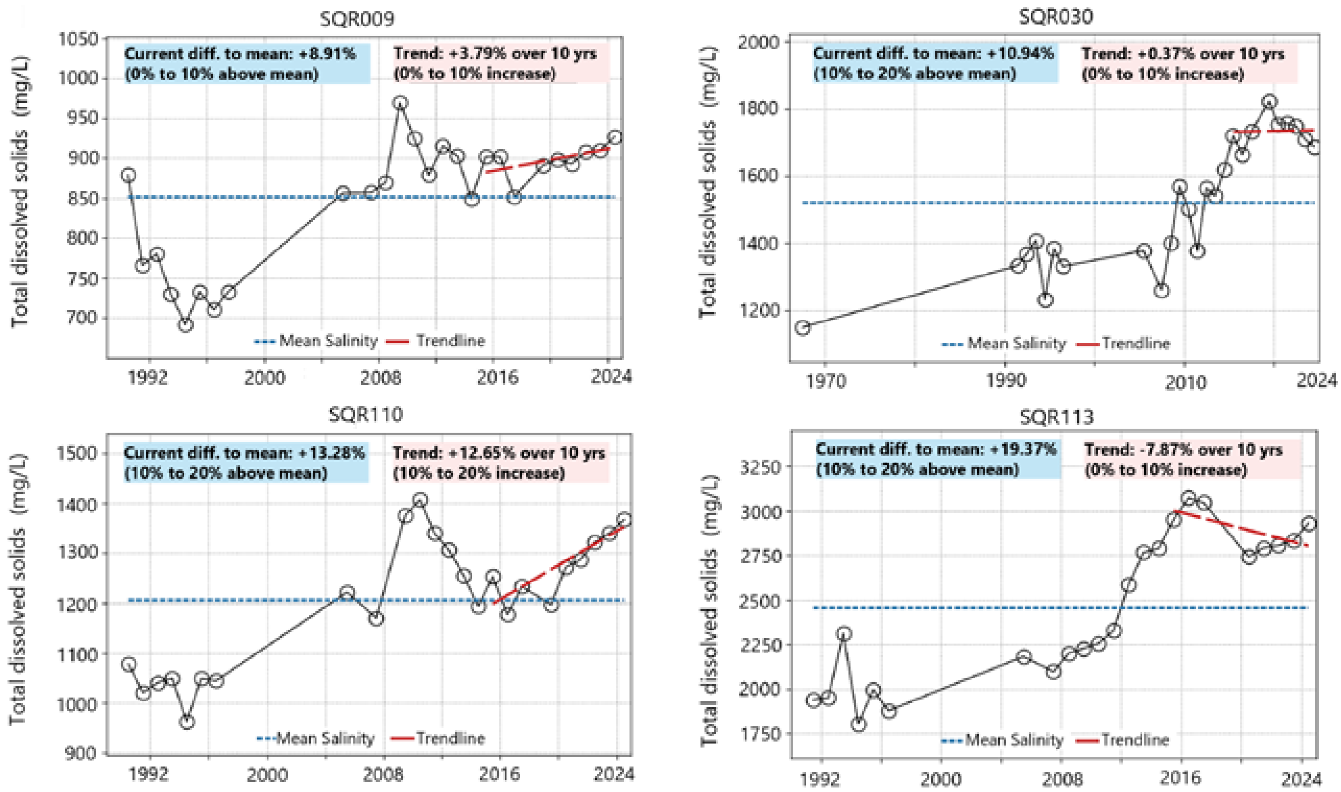

Figure 2-28 Select salinity graphs for wells in the Quaternary Limestone aquifer in the Polda Consumptive Pool with 10-year salinity trends

2.2.3. Sheringa Consumptive Pool

Generally, the trend of groundwater level in the Sheringa Consumptive Pool (Figure 2-29) demonstrates a strong climatic influence, with levels generally reflecting fluctuations in the 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 increase in 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 (Figure 2-30). 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 water levels, followed by a fluctuating yet overall declining trend leading up to the Millennium Drought (1997 to 2009), during which further reductions in water 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.

No significant extraction volumes have been recorded in the Sheringa Consumptive Pool, as the resource primarily functions to support GDEs within the pool and sustain the non-licensed groundwater use for stock and domestic purposes

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 and at PER015 from 696 to 1707 mg/L. In contrast, KPW038 remained relatively stable, ranging between 381 and 599 mg/L (Figure 2-31). Given the limited extractions in this area, these changes in groundwater levels and variation of salinity are likely driven by rainfall and reduced recharge.

Figure 2-29 Location map for wells and rainfall stations for Sheringa Consumptive Pool

The Lock (Terrah Winds) BoM station is located approximately 10.8 km northeast.

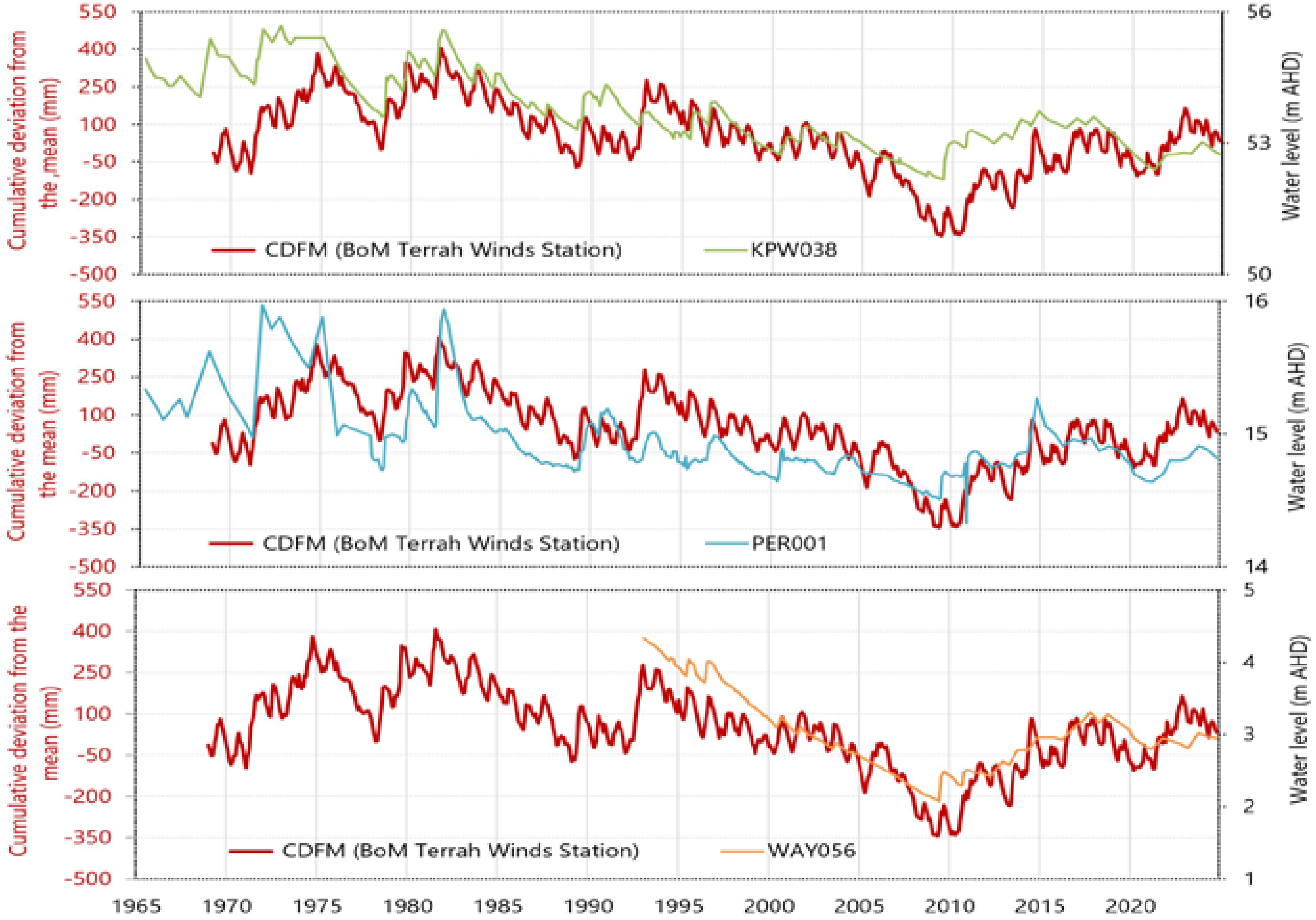

Figure 2-30 Groundwater level and rainfall trends for the Sheringa Consumptive Pool

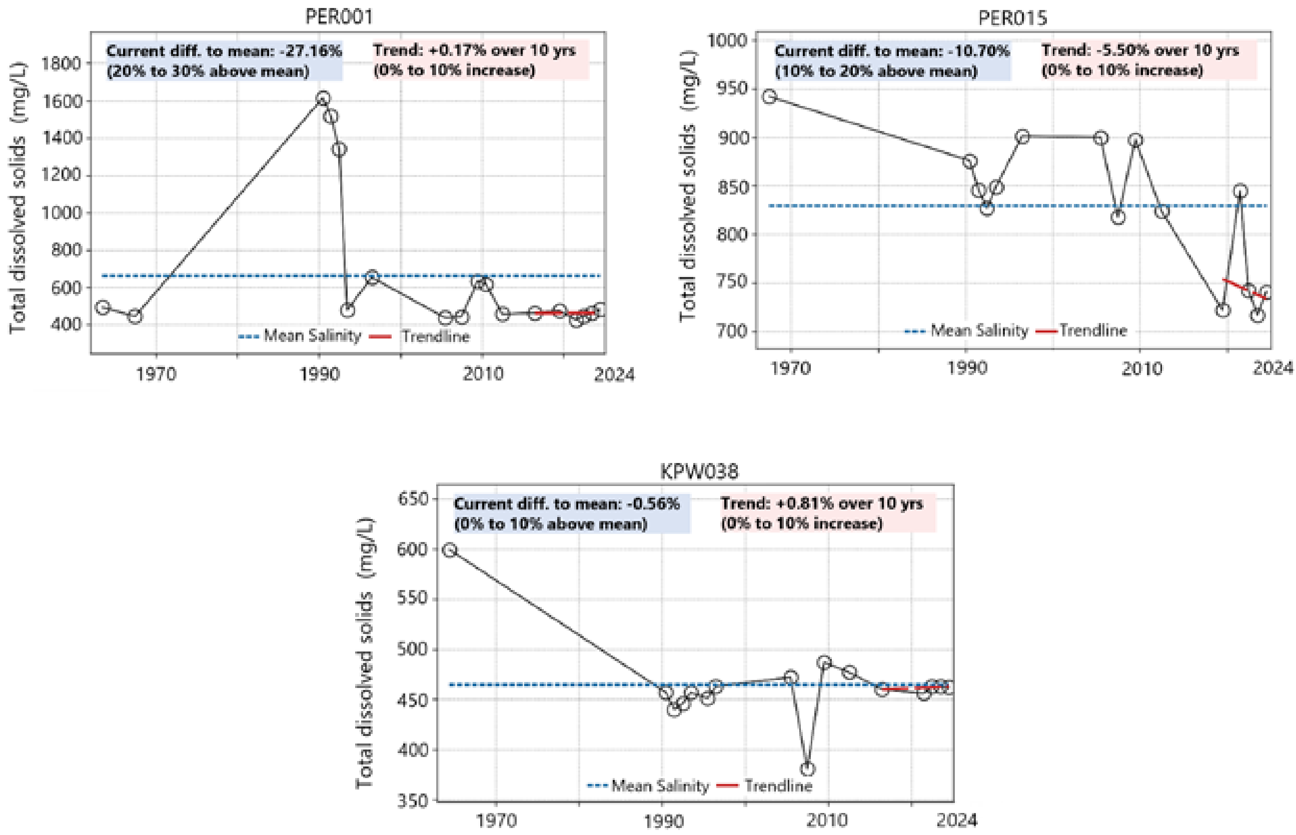

Figure 2-31 Selected salinity graphs for wells in the Quaternary Limestone aquifer in the Sheringa Consumptive Pool with 10-year salinity trends

2.3. Alterations in groundwater-dependent ecosystems in response to historic water level changes

It is thought that up until the 1950s to 1960s (over 20 years prior to formal water management commencing in the region), the groundwater levels were significantly higher in some aquifers, 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 towards a more terrestrial ecosystem. For example, in Uley South there were groundwater-dependent wetlands (waterholes) with permanent surface water bodies, such as Paradise Swamp, that have been dry since the 1960s and by the early 2000s were covered in terrestrial tussock grasslands (J Hyde, personal communication, 2014). There is also anecdotal evidence that Lake Pillie transitioned from a permanent surface water wetland to a basin being colonised by terrestrial plants in the late 1990s and early 2000s (J Hyde, personal communication, 2014).

These recollections by long term community members and landholders are consistent with the historically higher water levels measured in the Quaternary Limestone aquifer of Uley Wanilla and Uley South. The period of high rainfall and high watertables in the 1950s and 1960s 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. This Plan 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 groundwater-dependent ecosystems as they occurred in the 2007 to 2012 baseline period for groundwater-dependent ecosystem observations and analysis during which groundwater-dependent ecosystem environmental water requirements were determined (Semeniuk and Semeniuk 2007, Doeg et al. 2012).

3. Management approaches

The management approaches adopted by this Plan must take into account the unique characteristics of the groundwater resources on Eyre Peninsula, which can be summarised as highly dependent on recent rainfall recharge (see Section 2) and, in some areas, as having a low aquifer robustness where the saturated thickness of the aquifer is relatively thin.

3.1. Adaptive management consumptive pool approach

3.1.1. Uley North, Bramfield, Sheringa and Polda resources

The variability and lack of robustness of the Quaternary Limestone resources in Uley North, Sheringa, Polda and Bramfield Basins are suited to an adaptive management approach whereby the volume of the consumptive pool may vary annually depending on the condition of the resource (see Section 9.4.1).

This approach is consistent with Principle 25(iv) of the National Water Initiative (NWI) to create planning frameworks which '*provide for adaptive management of … groundwater systems in order to meet productive, environmental and other public benefit outcomes*' and is considered the most appropriate way to deal with the uncertainties in how and when climate is predicted to change in the future.

Although this adaptive approach represents a continuation of the overarching philosophy adopted in the previous plans, this Plan uses specified water levels within the aquifer as a basis for varying the volume of the consumptive pool. This provides a more responsive and transparent methodology than the 10-year moving average of recharge estimates used in the inaugural plans and is easier to implement and more transparent for the community than the storage assessments used in the previous Plan.

3.2. Non-adaptive consumptive pool approach

Due to local considerations, a range of management approaches are being applied in Coffin Bay, Uley South, Lincoln North, Southern Basins Tertiary, Southern Basins Basement, Aquaculture Elliston, Musgrave Tertiary and Musgrave Basement (Section 9.4.2).

3.2.1. Coffin Bay

The Coffin Bay resource had an adaptive management approach enacted for the previous Plan (EPNRMB 2016). However, given its proximity to the coast any changes in storage levels due to reduced recharge or extraction were 'buffered' by the ocean and as such the storage did not drop below the upper storage trigger throughout the life of the previous Plan. For this reason, adaptive management is not effective for the Coffin Bay resource. Upconing of saltwater which underlies the fresh groundwater is the highest risk to this resource, which can be mitigated by reducing extraction intensity and taking water from a larger well field. As this is an operational matter for licensees, it is not appropriate to continue an adaptive management approach for this resource at this time.

3.2.2. Uley South

A numerical groundwater model based on available data has been developed for the Uley South resource, which has provided robust assessments of the long-term water availability. The volume of the consumptive pool for Uley South will, therefore, not be recalculated annually[2] from the 2027–28 Water Year onwards[3], based on the long-term sustainability of the resource under a changing climate.

2 The Minister may enact Sections 109 (Restrictions in case of inadequate supply or overuse of water) or 130 (Reduction of water allocation) of the Landscape Act to restrict water take from these areas should adverse impacts be observed.

3 See Section 10.1.

3.2.3. Lincoln North

The Lincoln North resource did not have appropriate monitoring before the previous Plan and therefore could not previously adopt an adaptive management approach. Despite now having 10 years of water level data, there are significant gaps in water extraction data over this period. As such there is not sufficient information upon which to identify water level triggers for determining the volume of the consumptive pool annually. Rather this Plan requires that all licensed water users in this area implement metering immediately so the impacts of extraction in relation to climate impacts can more robustly be considered and adaptive management options can be investigated further during the life of this Plan.

3.2.4. Aquaculture Elliston

Aquaculture Elliston is a specific consumptive pool created through the life of the previous Plan. To be issued a licence, the applicant demonstrated through a robust assessment that the taking of the specified volume of water from the specified location would not adversely impact groundwater-dependent ecosystems, other users of the resource or the aquifer itself over long-term extraction scenarios. As such, like Uley South, the volume of volume of the consumptive pool will not be recalculated annually.

3.2.5. Southern Basins and Musgrave Tertiary and Basement

The deeper resources, namely: Southern Basins Tertiary, Southern Basins Basement, Musgrave Tertiary and Musgrave Basement, are disconnected from direct rainfall and therefore show little response to rainfall variations and as such are not adaptively managed.

3.3. No licensed extraction approach

3.3.1. Uley Wanilla and Lincoln South

The previous Plan had two additional resources available for licenced use: Uley Wanilla and Lincoln South. Evidence has shown that ongoing extractions from these resources are not sustainable in the long-term. As such, these resources are no longer able to be used for licensed purposes; however, water can still be extracted from these areas for stock and domestic purposes which does not require a licence.

Historically, 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 1.3 and 2.1), persisting beyond the end of the Millennium Drought, have significantly impacted these resources and the groundwater-dependent ecosystems that rely on them.

As a result, these resources no longer possess the capacity to support any ongoing licenced extraction for any purpose, including public water supply. Investigations into groundwater levels and storage capacity within these consumptive pools support this conclusion (DEW 2024d).

4. Capacity of groundwater resources

Section 53(1)(f) of the Landscape Act requires a water allocation plan to *'assess the capacity of the resource to meet the demands for water on a continuing basis…'*.

This Section of the Plan defines the geographic locations (referred to as management areas) used to determine the volumetric capacity of the resource, and a sub-set 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 this Plan, the volume of the consumptive pool, in some instances, will be re-calculated annually, as detailed in Section 9.4.

The capacity of the resource, which is expressed as a volume, represents the upper limit of water available for all uses (i.e. consumptive and non-consumptive uses). Consumptive use includes licensed water use (irrigation, industrial, recreational, mining and public water supply) and non-licensed water use such as water for stock or domestic use or water authorised by the Minister under Section 105 of the Landscape Act. Non-consumptive use includes water for maintaining natural processes such as aquifer throughflow and discharge, and water for groundwater-dependent ecosystems where they are present.

Given the fragile nature of the Quaternary Limestone 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 South East 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.

As described previously, the Quaternary Limestone aquifer on the Eyre Peninsula is highly dependent on rainfall recharge and is fragile in some areas where the aquifer is quite thin. The water levels and consequently the amount of water stored in the aquifer, are strongly controlled by rainfall patterns which can be variable. These characteristics require the capacity of the groundwater resources to be determined by a methodology unique to Eyre Peninsula. For this Plan, the process for determining the capacity of the groundwater resources has therefore been combined with another requirement of the Landscape Act, namely the determination of consumptive pools.

Sections 53(1)(c) of the Landscape Act requires a Plan to "*determine or provide a mechanism for determining, from time to time, a consumptive pool or pools for the water resource*". Additionally, Section 3 of the Act defines consumptive pool to mean:

> "*The water that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource…, as determined –*
>
> > *(a) by or under a water allocation plan for that water resource or*
> >
> > *(b) in prescribed circumstances – by the Minister*".

For the Musgrave and Southern Basins PWAs, resource capacities and the volume of the consumptive pools have been calculated using the methods outlined below (and detailed in DEW 2026e). The following Sections explain how these volumes were obtained.

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 purposes. 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 2, the Quaternary Limestone 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 the resource condition limit framework (Richardson et al. 2011).

Data availability varies across aquifers. The Quaternary Limestone aquifer is well-characterised due to its widespread use for public water supply, irrigation, industry, recreation and stock and domestic purposes. In contrast, the deeper Tertiary Sands and Basement aquifers are less understood. Consequently, resource capacity estimates and consumptive pool volumes for the following five consumptive pool groupings have been derived using different methodologies.

This Section defines the consumptive pools by way of geography and Section 10 defines the consumptive pools by way of volume.

4.1. Management areas used to determine consumptive pools

Consumptive pools are delineated based on 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 Quaternary Limestone aquifers (excluding Uley South, Bramfield and Aquaculture Elliston)
- Licensed Quaternary Limestone aquifers – Uley South and Bramfield
- Aquaculture Elliston
- Non-licensed Quaternary Limestone aquifers
- Tertiary Sand 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 4-1. The Quaternary Limestone aquifer management areas are displayed in Figure 4-1 for the Southern Basins and in Figure 4-2 for the Musgrave PWA. The management areas for the Tertiary Sands and Basement aquifers of the Southern Basins PWA (Figure 4-3) and the Musgrave PWA (Figure 4-4) 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 Quaternary Limestone 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 from the previous Plan to focus on the area of greatest interest – where the freshwater occurs, and the current licence 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.

Table 4-1 Management areas within the Southern Basins and Musgrave PWAs

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

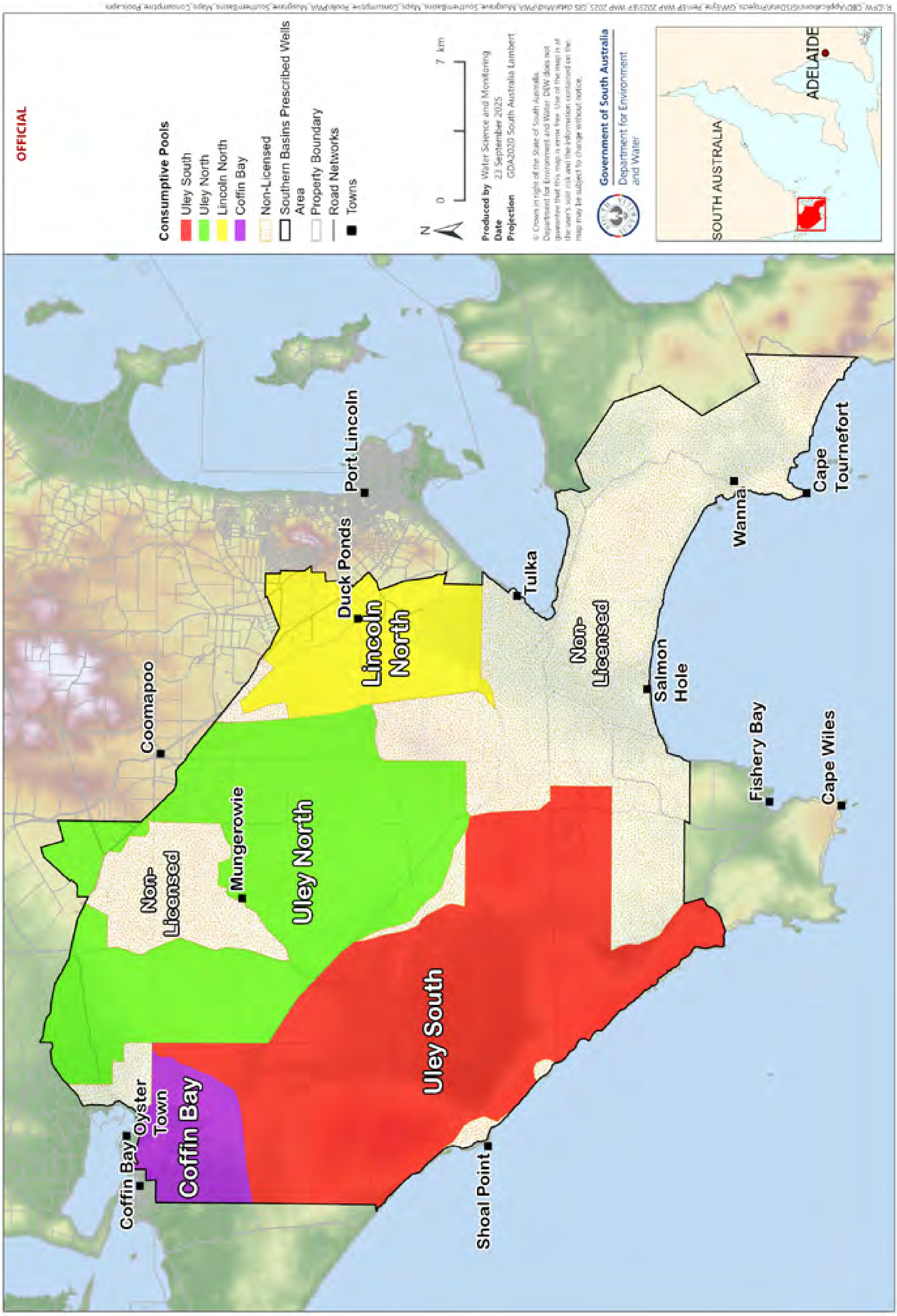

Figure 4-1 Management areas for the Quaternary Limestone aquifer of the Southern Basins PWA

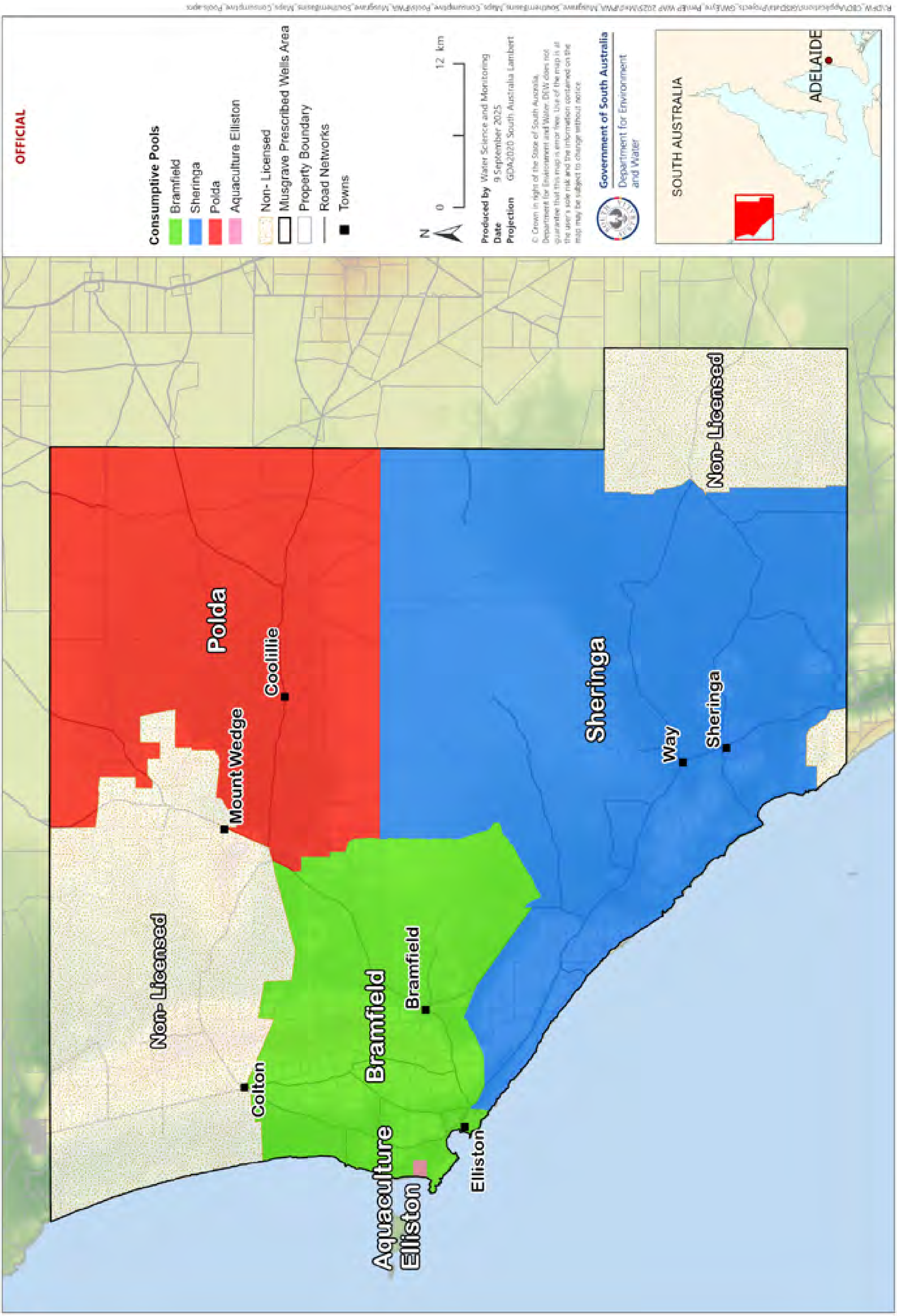

Figure 4-2 Management areas for the Quaternary Limestone aquifer of the Musgrave PWA

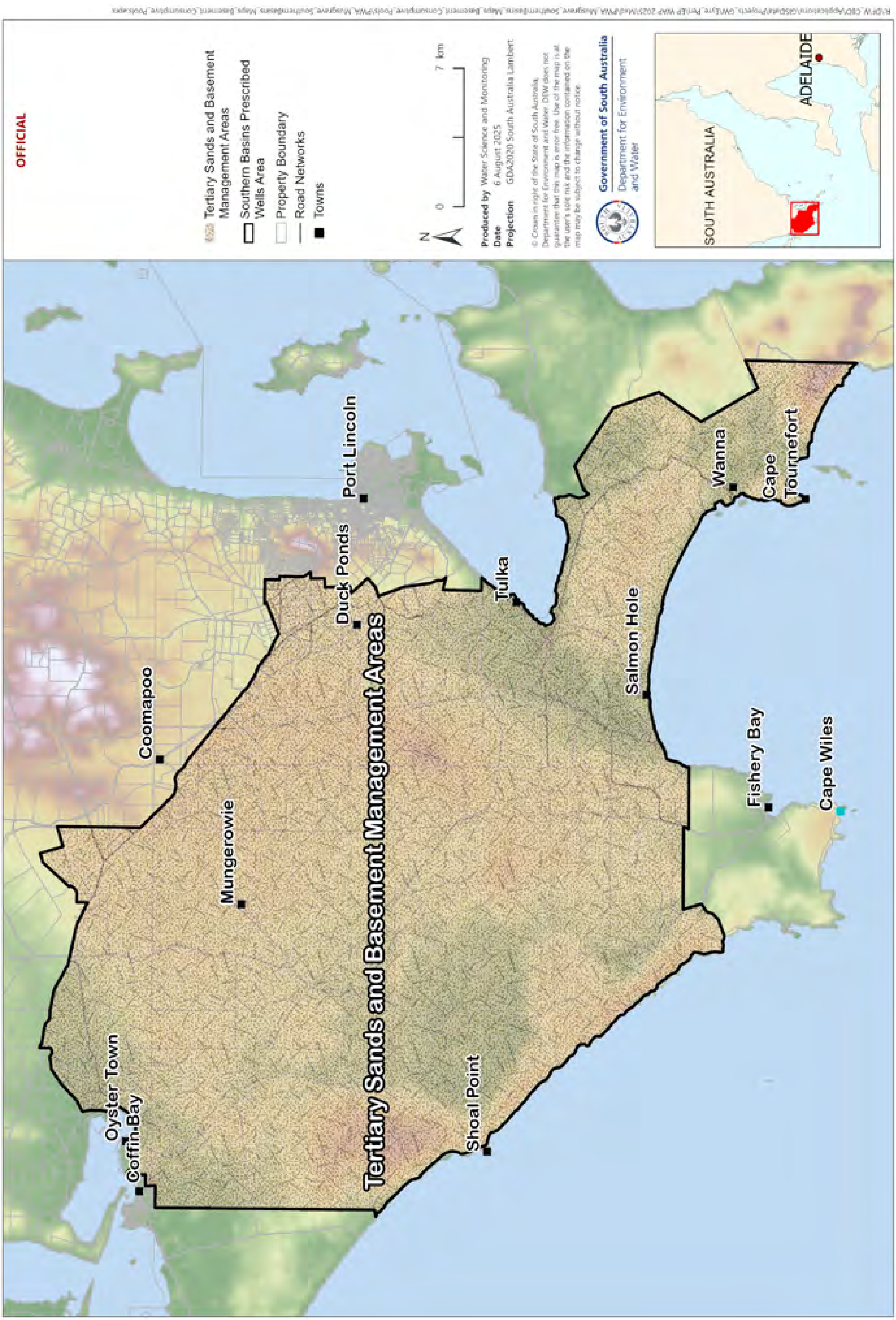

Figure 4-3 Management areas for the Tertiary Sands and Basement aquifers of the Southern Basins PWA

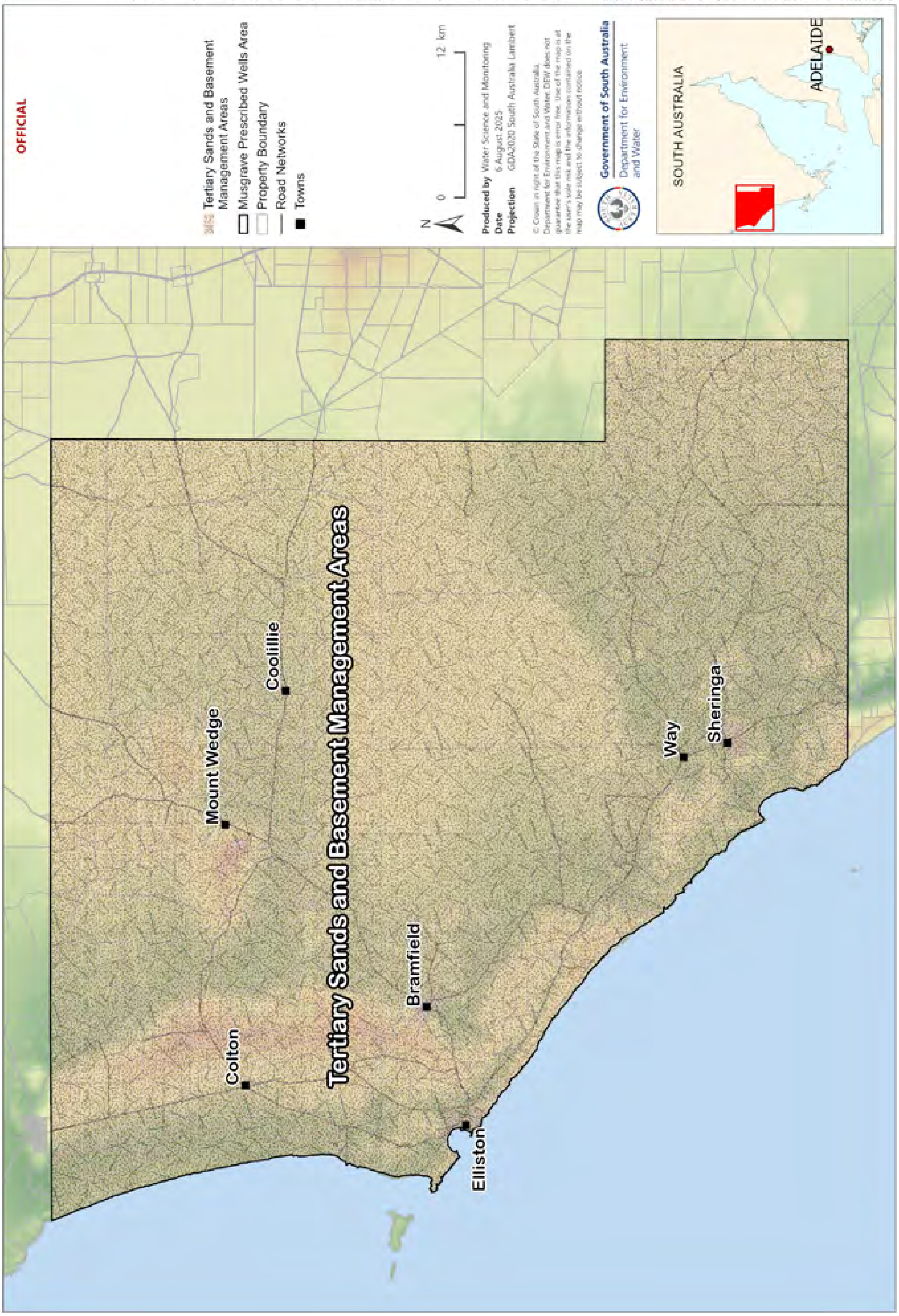

Figure 4-4 Management areas for the Tertiary Sands and Basement aquifers of the Musgrave PWA

4.2. Licensed Quaternary Limestone aquifer management areas

The capacities of the Coffin Bay, Uley North, Lincoln North, Polda and Sheringa management areas are defined as the recharge zone areas multiplied by the recharge rates. The resource capacity of the licensed Quaternary Limestone aquifer management areas represent 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.

4.2.1. Recharge zones

Recharge zones within the management areas (Figure 4-5 and Figure 4-6) are delineated based on two criteria:

- the extent of fresh groundwater lenses (defined as <1,000 mg/L Total Dissolved Solids)
- the saturated extent of the remaining brackish Quaternary Limestone aquifer.

The saturated extent of the Quaternary Limestone 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 watertable – 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 during the development of the previous Plan, except for Bramfield where additional groundwater monitoring was undertaken in 2023 and 2024.

To determine the areas which are saturated in both the Musgrave and Southern Basins PWAs, a geographic information system program (ArcGIS) was used to overlay a layer representing the 2024 water level on a layer representing the top of the Tertiary Clay aquitard. The program was then used to identify areas where the water level lies above the aquitard surface, indicating zones where the Quaternary Limestone aquifer is saturated with either fresh or brackish groundwater.

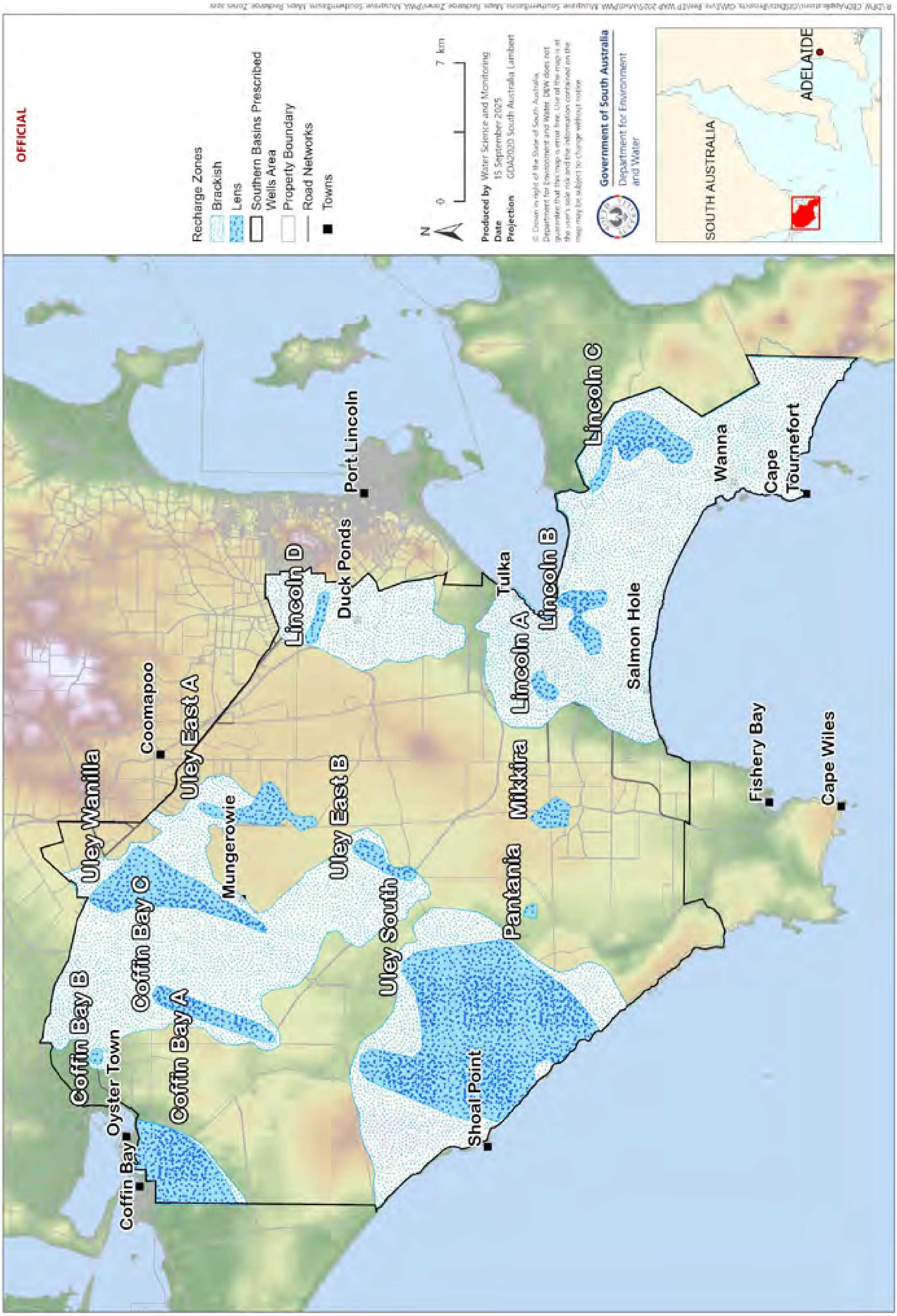

Figure 4-5 Recharge zones for the saturated Quaternary Limestone aquifer of the Southern Basins PWA

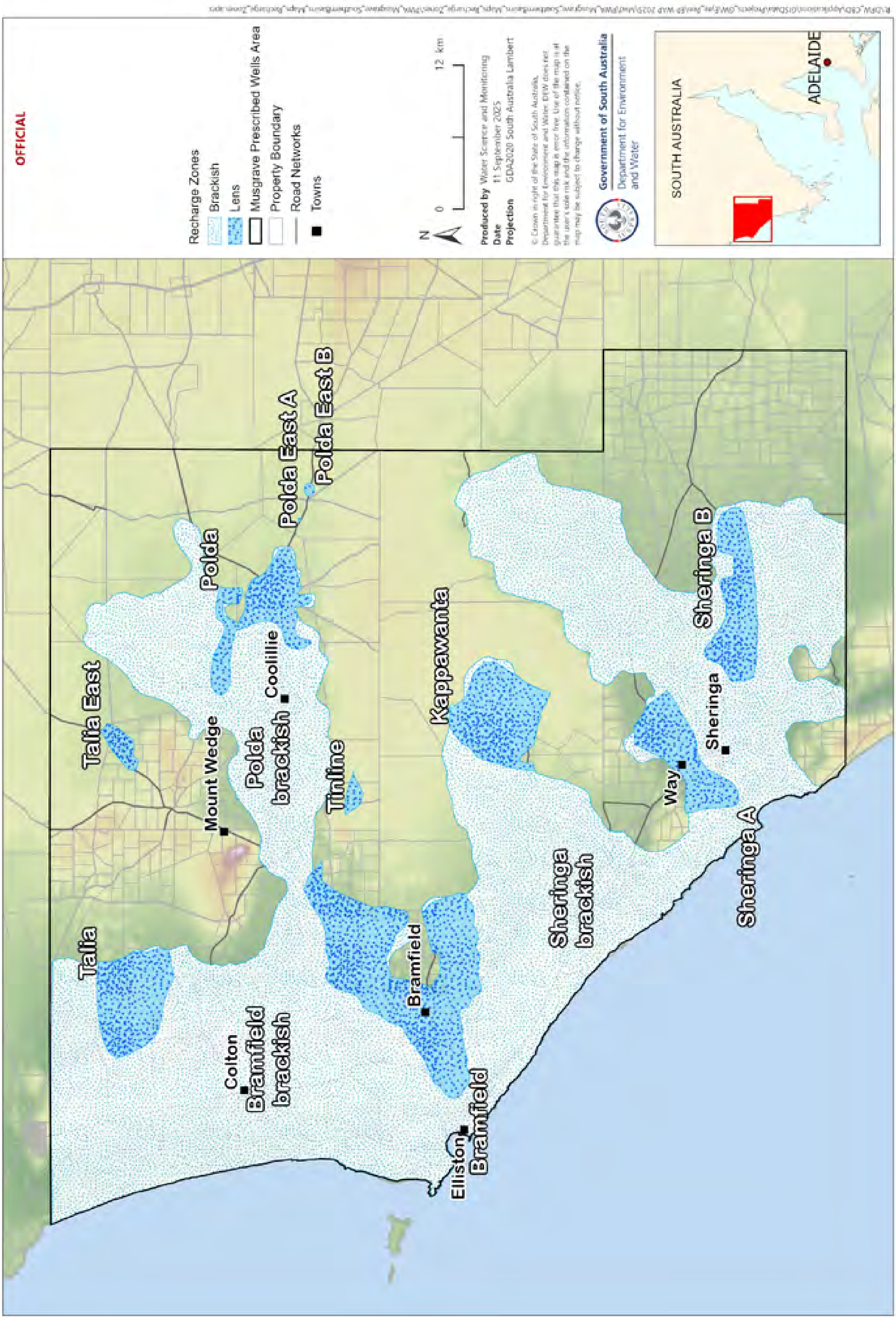

Figure 4-6 Recharge zones for the saturated Quaternary Limestone aquifer of the Musgrave PWA

4.2.2. Recharge rate

To determine the resource capacity of the Licenced Quaternary Limestone management areas, the recharge rates for the individual recharge zones needed to be determined. This Section presents the results of several methodologies employed to evaluate changes in recharge rates following the implementation of the previous Plan, including aquifer storage analysis, transient groundwater modelling and the water table fluctuation method. The use of multiple methods was necessitated by differences 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 4-7). 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 include:

- There was 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.
- Combined analysis of recharge and storage trends indicates a reduction in resource capacity of 4 to 24% across the Southern Basins.

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

- Uley South: The average recharge across the model domain decreased from 90 mm/y during the 2005 to 2014 period to 58 mm/y for 2015 to 2024, representing a 36% reduction. The long-term average recharge rate for Uley South over the full modelling period (1961 to 2024) is 90 mm/y.
- Bramfield: Recharge estimates declined from 19.6 mm/y (2005 to 2014) to 7.0 mm/y (2015 to 2024), indicating a 65% reduction. The long-term average recharge rate for Bramfield over the modelling period (1965 to 2024) is 19 mm/y.

In addition to aquifer storage analysis, recharge rates for the Quaternary Limestone aquifers within the Southern Basins PWAs were estimated using the water table fluctuation 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 watertable (Healy and Cook 2002). The detailed methodology is outlined in Stewart 2015 and DEW 2026e. The water table fluctuation method was applied in the Coffin Bay and Uley North management areas.

To assess recharge since the previous Plan's implementation, rainfall and groundwater level data from 2016 to 2024 were analysed using the same water table fluctuation 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.

The lowest recharge estimates from 2008 were compared to the lowest recharge rates observed between 2015 and 2024 (Figure 4-8). Key findings from the water table fluctuation evaluation include:

- Coffin Bay A freshwater lens, recharge declined from 25 mm/y in 2008 to 22 mm/y in 2015, representing a 12% reduction.
- 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.

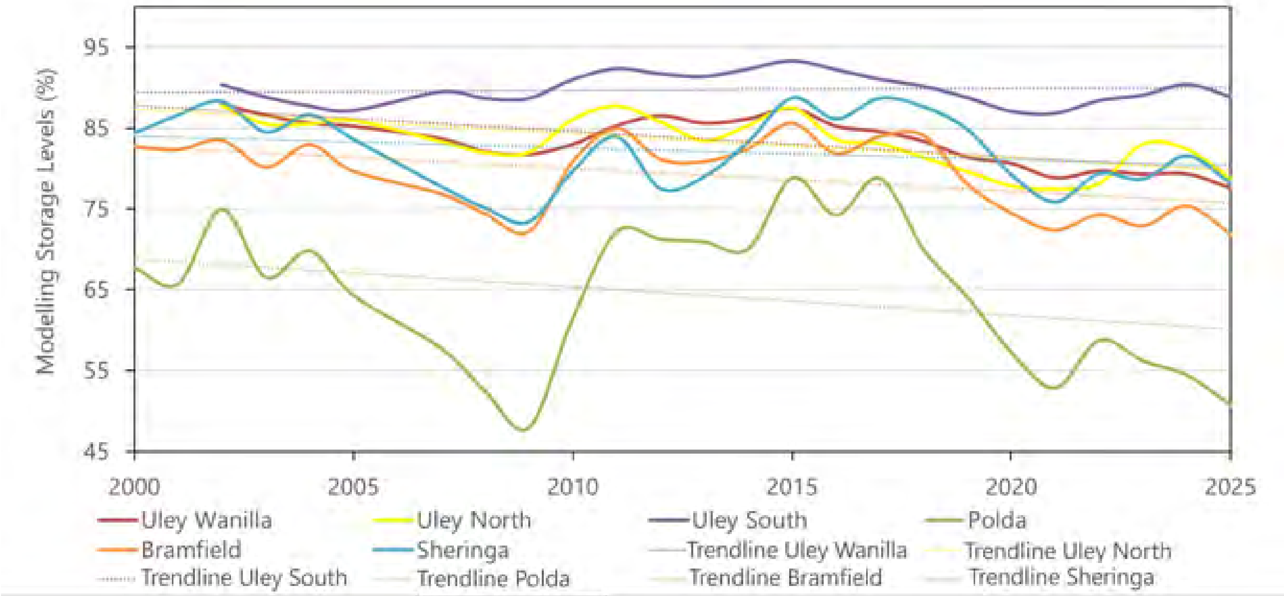

Figure 4-7 Modelled aquifer storage levels from 2000 to 2025 –for the Uley North, Polda, Bramfield and Sheringa consumptive pools

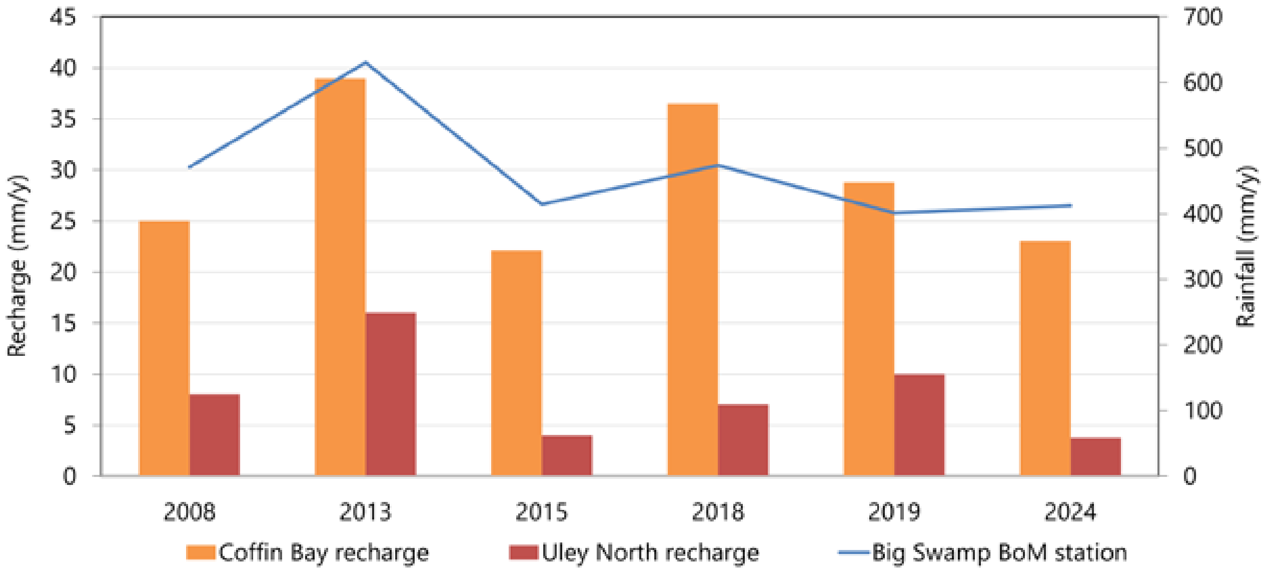

Figure 4-8 Recharge rates for the Coffin Bay and Uley North consumptive pools using the water table fluctuation method

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 water table fluctuation method in the 2008 assessment for the previous Plan. The saturated extent and recharge area have been based on the 2024 water 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 Quaternary Limestone aquifer recharge rates, relative to the already conservative recharge-based estimates in the previous Plan. This recommendation is supported by multiple lines of evidence, including:

- 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 Basins, which revealed reductions in recharge rates between 2005 to 2014 and 2015 to 2024
- water table fluctuation analysis, indicating reduced recharge over time
- 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
- provide a precautionary buffer against further climate-driven declines.

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

4.2.3. Resource capacity estimates

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

Resource capacity (ML) = Recharge area (km^2) x Recharge rate (mm)

The revised resource capacity estimates for the Southern Basins and Musgrave PWA licensed Quaternary water resources are shown in Table 4-2 and Table 4-3 respectively.

Table 4-2 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 (ML)
Coffin Bay	Coffin Bay A	**22.5***	**15.340**	**345.2**
Uley North	Coffin Bay B Lens	0.0	0.418	0.0
	Coffin Bay C Lens	1.7*	5.471	9.3
	Uley East A Lens	66.2	5.476	362.5
	Uley East B Lens	0.0	2.418	0.0
	Uley North Brackish	6.8	92.967	632.2
	Uley North Total			**1,004.0**
Lincoln North	All zones	7.0	34.820	**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 4-3 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 (km2)	Resource capacity (ML)
Polda	Polda Lens	5.0	37.208	186.0
	Polda East Lens A	0.0	0.072	0.0
	Polda East Lens B	0.0	0.724	0.0
	Polda Brackish	10.1	273.840	2,765.8
	Tinline Lens	0.0	3.125	0.0
	Talia East Lens	0.0	6.148	0.0
	Polda Total			**2,951.8**
Sheringa	Sheringa A Lens	0.0	37.208	0.00
	Sheringa B Lens	0.6	38.986	23.4
	Kappawanta Lens	10.1	48.856	493.4
	Sheringa Brackish	5.3	519.818	2,755.0
	Sheringa Total			**3,271.9**

4.3. Uley South and Bramfield Quaternary Limestone aquifer management areas

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 Quaternary Limestone aquifer management areas was not considered appropriate for these aquifer systems.

4.3.1. 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 and the inflow of high-salinity water from deeper aquifers into inland wells, both driven by groundwater extraction. This process poses 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), with several external reviews (Middlemis 2019; Cook and Post 2021a, 2021b; 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 extraction rates of 5.5 GL/y – SA Water's highest extraction rate since the adoption of the previous Plan in 2016 – 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 Plan 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 may continue to decline 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 consumptive pool volume is adopted:

- 3,508 ML/y[4] to stabilise groundwater levels, minimise the risk of saline intrusion into coastal and inland production wells and protect long-term resource integrity.

The total volume of the consumptive pool for the Uley South management area, including both licensed and non-licensed users, is detailed in Table 4-4.

4 The consumptive pool description in Section 10.1 and the transitional licensing arrangements in Section 10.7 acknowledge that in the 2026–27 water-use year, the desalination plant may not be running at peak capacity. This Plan therefore enables the take of up to 6,300 ML from the Uley South resource in the 2026–27 water-use year. As soon as the desalination plant is producing water, the public water supply demand shall be transitioned to this source to minimise the pressures on the groundwater resource. In future years only 3,500 ML will be enabled for licensed extraction.

Table 4-4 Non-licenced and licensed use for Uley South Quaternary Limestone aquifer

Management area	Domestic use (ML)	Stock use (ML)	Minister's authorisation (ML)	Licensed (ML)	Consumptive Pool volume (ML)
Uley South	0.0	3.1	5.0	3500.0	3508.1

4.3.2. Bramfield groundwater modelling results

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 groundwater-dependent ecosystems, 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 inter-annual fluctuations related to groundwater extraction and 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. The model results compare well with the limited information that is available on the position of the seawater interface, much of which (geophysics and drilling) was collected during the model build. The modelling study also highlights several areas where further data could be collected to help confirm model conceptualisation and reduce uncertainty.

The model is considered fit for purpose to inform short- to medium-term water security planning for the Bramfield Consumptive Pool.

The numerical groundwater model was used to simulate three scenarios incorporating variations in pumping and climate projections through to 2050. Across all scenarios, groundwater levels are projected to continue declining, primarily due to ongoing reductions in rainfall recharge. While potential increases in groundwater extraction may contribute to this decline, extraction at current rates represents a relatively minor component of the overall water balance and has limited influence at the scale of the Bramfield Basin.

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 the intrusion distance ranging from 200 to 600 m across different parts of the study area by 2050.

Model results suggest that the interface is unlikely to reach public water supply wells by 2050. However, surface geophysics combined with the current rising trend in salinity in these wells indicate that dispersive mixing has occurred on the inland side of this 50:50 isohaline. Consequently, increases in salinity in the public water supply wells are expected to continue if current operations are maintained across the life of this Plan.

Based on the outcomes of transient modelling, projected climate and rainfall trends, and observed increases in salinity at the public water supply wells, a risk assessment is critical to support the continued extraction of groundwater for town water supply. This assessment will define the necessary monitoring and adaptation measures to manage the resource sustainably.

This approach reflects a balanced response – ensuring ongoing access to groundwater while prioritising the protection of aquifer integrity in a changing climate. The volume of the consumptive pool for the Bramfield management area, including both licensed and non-licensed users is provided in Table 4-5.

Table 4-5 Non-licensed and licensed use for Bramfield Quaternary Limestone aquifer

Management area	Domestic use (ML)	Stock use (ML)	Minister's authorisation (ML)	Licensed (ML)	Consumptive pool volume (ML)
Bramfield	18.2	77.0	5.0	476.75	576.95

4.4. Aquaculture Elliston management area

The Aquaculture Elliston management area consists of a brackish to saline Quaternary Limestone 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 action in response to any emerging risks or environmental changes. The volume of the consumptive pool (Table 4-6) for this management area will not be re-calculated annually.

4.5. Non-licenced Quaternary aquifer management areas

The Non-Licensed Quaternary management area is comprised of the unsaturated portion of the Quaternary Limestone aquifer, along with the Lincoln South and Uley Wanilla management areas. As discussed in Section 3.3.1 Lincoln South and Uley Wanilla no longer have the capacity to support any ongoing licensed extraction, including for public water supply. While these areas may not be subject to volumetric licensing under the Plan, they remain critical for understanding broader aquifer dynamics and regional water resource conditions.

The unsaturated portion of the Quaternary Limestone 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 consumptive pool limit is required for the non-licensed Quaternary management area. Due to the absence of reliable groundwater level and recharge data across the unsaturated Quaternary Limestone, its resource capacity (and hence consumptive pool limit) cannot be calculated using the standard methodology applied to other Quaternary Limestone management areas. Instead, the consumptive pool volume is estimated based on projected non-licensed demand within the area (Table 4-6). This volume will not be re-calculated annually.

4.6. Tertiary Sands and Basement aquifer management areas

Detailed information on groundwater level trends and recharge rates for the deeper Tertiary Sands and Basement aquifers is lacking due to the limited data available. 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 Quaternary Limestone aquifer 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.

4.6.1. Tertiary Sands aquifer management areas

There is currently no licensed extraction from the Tertiary Sands consumptive pool in either the Southern Basins or Musgrave PWAs. Given the depth and confined nature of the Tertiary Sands aquifer, it is unlikely to contribute to, or be hydraulically connected with, any known groundwater-dependent ecosystems. 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 consumptive pool volume of the Tertiary Sands management area, with an additional nominal allowance to accommodate potential future extractions authorised by the Minister. This volume will not be re-calculated annually (Table 4-6).

4.6.2. Basement aquifer management areas

Whilst there is some licensed extraction from the Basement management area in the Southern Basins PWA, no licensed extraction 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 groundwater-dependent ecosystems. 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 Tertiary Sands aquifer, current extractions are considered to have no observed adverse impacts on other water resources. Therefore, these volumes are deemed appropriate for defining the volume of the consumptive pool of the Basement aquifer management area. This volume will not be re-calculated annually (Table 4-6).

Table 4-6 Estimated resource capacities of the Aquaculture Elliston, non-licensed Quaternary, Tertiary Sands and Basement management areas

PWA	Management area	Domestic use (ML)	Stock use (ML)	Minister's authorisation (ML)	Licensed use (ML)	Consumptive Pool volume (ML)
Southern Basins	Non-licenced Quaternary	4.8	1.4	5.0	0.0	11.2
	Tertiary Sands	1.1	23.0	5.0	0.0	29.1
	Basement	0.3	23.0	5.0	462.2	490.5
Musgrave	Aquaculture Elliston	0.0	0.0	0.0^	10.0	10.0
	Non-licenced Quaternary	13.0	76.0	5.0	0.0	94.0
	Tertiary Sands	1.1	62.3	5.0	0.0	68.4
	Basement	0.0	62.3	5.0	0.0	67.3

^Note: Minister's authorisation is not enabled for this purpose-based consumptive pool created under the previous Plan

4.7. Annual calculation of the resource capacity for variable consumptive pools

As previously mentioned, in the case of the Uley North, Polda, Sheringa and Bramfield consumptive pools, there is sufficient monitoring information to support an adaptive management approach to allocating water from these resources. Therefore, this Plan provides for the adaptive management of the dynamic saturated Quaternary Limestone aquifer which responds quickly to climatic variations. The abovementioned consumptive pools will be defined by way of volume determined annually. These variable consumptive pool volumes will reflect the condition of the groundwater resource and will greatly assist in ensuring that 'the rate of the taking and use of the water is sustainable', as required by Section 53(1)(d)(ii) of the Landscape Act. The methodology for determining the annual consumptive pool volume is discussed in Section 9.4.1 of this Plan.

5. Needs of groundwater-dependent ecosystems

5.1. Environmental water requirements and provisions

Section 53(1)(a)(i) of the Landscape Act requires a water allocation plan to complete '*an assessment of the quantity and quality of water needed by the ecosystems that depend on the water resource and the times at which, or periods during which, those ecosystems will need that water*'.

Section 53(1)(b) of the Landscape Act also requires that a water allocation plan includes:

1. an assessment of the capacity of the water resource to meet environmental water requirements
2. information about the water that is to be set aside for the environment including, insofar as is reasonably practicable, information about the quantity and quality of water, the time when that water is expected to be made available and the type and extent of the ecosystems to which it is to be provided
3. a statement of the environmental outcomes expected to be delivered on account of the provision of environmental water under the Plan.

Whilst the Plan defines optimal water requirements for the environment (environmental water requirements, defined in Section 5.4) these may be different to what is provided (environmental water provisions, defined in Section 5.5) under the Plan in order to achieve an equitable balance between cultural, environmental, social and economic needs.

5.1.1. Environmental water requirements

Section 53(12) of the Landscape Act defines environmental water requirements (EWRs) to mean 'those water requirements that must be met in order to sustain the ecological values of ecosystems that depend on the water resource, including their processes and biodiversity, at a low level of risk'.

The EWRs of ecosystems that depend on the groundwater resources being managed in the PWAs through this Plan are discussed in Section 5.4. These ecosystems rely on there being sufficient water in the aquifer to maintain natural discharge processes, including discharge to wetlands and other groundwater-dependent ecosystems (GDEs).

5.1.2. Environmental water provisions

A water allocation plan must achieve an equitable balance between environmental, social and economic needs for water under Section 53(1)(d)(i) of the Landscape Act. For the purposes of this Plan 'environmental water provisions' mean those parts of environmental water requirements that can be met at any given time, with consideration to existing users' rights and social and economic impacts.

Environmental water provisions (EWPs) for the PWAs are described in Section 5.5. It should be noted that these EWPs do not aim to return the groundwater-dependent ecosystems within the PWAs to a 'pristine', pre-European or historic condition, but rather they aim to maintain the condition and distribution in their 2007 condition (Doeg et al. 2012), at a low level of risk in a changing climate, by managing consumptive allocations.

It is not the role of this Plan to address historic adverse impacts on environmental values that depend on groundwater. The groundwater extraction limits in this Plan have been set at levels that are expected to maintain current environmental values identified within the PWAs that may be affected by higher unsustainable groundwater extraction levels.

5.2. Groundwater-dependent ecosystems

Groundwater-dependent ecosystems (GDEs) contain a diverse range of complex ecological communities of plants, animals, fungi and microbes whose functions depend on water. In general, GDEs include waterholes, springs, watercourses, riparian zones, wetlands, floodplains, salt lakes and estuaries, as well as ecosystems dependent on near-shore marine groundwater discharges and hyporheic (underground stream) and aquifer ecosystems.

Within the PWAs GDEs are often dominated by plants such as red gums (*Eucalyptus camaldulensis*), tea tree (*Melaleuca spp.*), cutting grass (*Gahnia filum*) or stands of mixed reeds and rushes. These plants have relatively high water needs that cannot be provided for by rainfall alone. They typically occur in riparian areas on the edges of wetlands, springs or watercourses. There are also terrestrial ecosystems that occur away from recognised water bodies, which depend on groundwater for some, or all, their water needs and thus would be considered GDEs. Examples include grasslands and dense shrublands. Animals such as emus and kangaroos can also be considered part of the GDE, especially in areas where other freshwater supplies are limited.

GDEs have a highly complex dependence on their water regime, that is on the extent, duration, frequency, timing and depth of standing water (inundation) or soil saturation. The influence of the water regime is so fundamental that the very occurrence of these ecosystems in the landscape is a clear indicator of their dependence on groundwater and the water regime they have historically experienced. This is especially true on the Eyre Peninsula where water sources other than groundwater may be unreliable (for example, rainfall) or largely non-existent (for example, permanent watercourses) and thus wetland plants and animals have no alternate aquatic habitats to rely on if groundwater wetlands are adversely affected. It is important to note that it is not just the total volume of water these ecosystems receive in a given period that determines their ecological functionality, but also how, when and where that water is delivered and whether the quality of that water is suitable to support the full range of life stages for the full complement of water dependent life (biota).

In the case of this Plan, the prescribed water resource is the groundwater contained in the Quaternary Limestone and the deeper Tertiary Sands and Basement aquifers within the Southern Basins and Musgrave PWAs. It does not directly include transient water in overlying soil strata (recharge areas), or perched systems disconnected from the regional Quaternary Limestone aquifer. As such, the GDEs that this Plan needs to provide for, are those dependent on the groundwater in the Quaternary Limestone, the deeper Tertiary Sands and the Basement aquifers within the PWAs.

As defined above, ecosystems that rely on groundwater for some, or all, their water requirements are classified as GDEs. Not all GDEs draw on groundwater directly, however, and not all are solely reliant on groundwater. Regardless, groundwater provides a vital and reliable source of water to all GDEs because of the generally low rainfall environment and the lack of watercourses in the PWAs and the broader Eyre Peninsula region.

It is understood that groundwater availability is the main factor controlling the distribution of these GDE types within the PWA landscape given the dry and drying background climate. Changes in groundwater quantity (for example, depth, extent, duration) and quality (for example, salinity, pH), therefore are likely to affect the condition and survival of these GDEs, depending on the degree and nature of their groundwater dependency. Some GDEs may have an 'obligate' groundwater dependence where the ecosystem or key species or functional groups within the ecosystem would be lost if groundwater was no longer available in a suitable regime and/or quality. Other GDEs are likely to have 'facultative' groundwater dependence – where other sources of water (for example, rainfall, runoff or recharge) are used when and where available, but groundwater will be used if it is fresher or if no other water is available, particularly during low rainfall periods. Groundwater may be a significant source of water for GDE persistence between other watering events such as between infrequent periods of high rainfall. It is likely that if the environmental water provisions (EWPs) to the GDEs present in the PWAs decline further, whole ecosystems will be lost and will either transition to bare, saline ground or terrestrial systems, depending on the salt load and rate of drying.

5.3. Groundwater-dependent ecosystems within the PWAs

The following list of GDEs have been identified and mapped (Figure 5-1 to Figure 5-4) with respect to their condition and spatial extent in 2007 when most of the investigations were undertaken in the PWAs and the majority of the research and investigations were undertaken (Semeniuk and Semeniuk 2007; Doeg et al. 2012). GDEs in the PWAs have been characterised into 5 distinct groups based on ecosystem type and will be used as the environmental values that may be affected by groundwater extraction for the purposes of this Plan. Terrestrial fauna that drink from groundwater can also be considered a separate GDE component, but for the purposes of this Plan it is assumed that their water needs will be provided by providing water to the GDEs listed below. Therefore, they have not been considered as a separate environmental value.

While places of cultural significance are not limited to the GDEs identified in this Plan, many of the groundwater-dependent ecosystems discussed in this Section are of particular cultural significance to Aboriginal people. As such, Native Title determination areas (discussed further in Section 6) are provided on Figure 5-1 and Figure 5-3.

Figure 5-1 Groundwater-dependent ecosystems of the Southern Basins PWA showing Native Title Determination areas

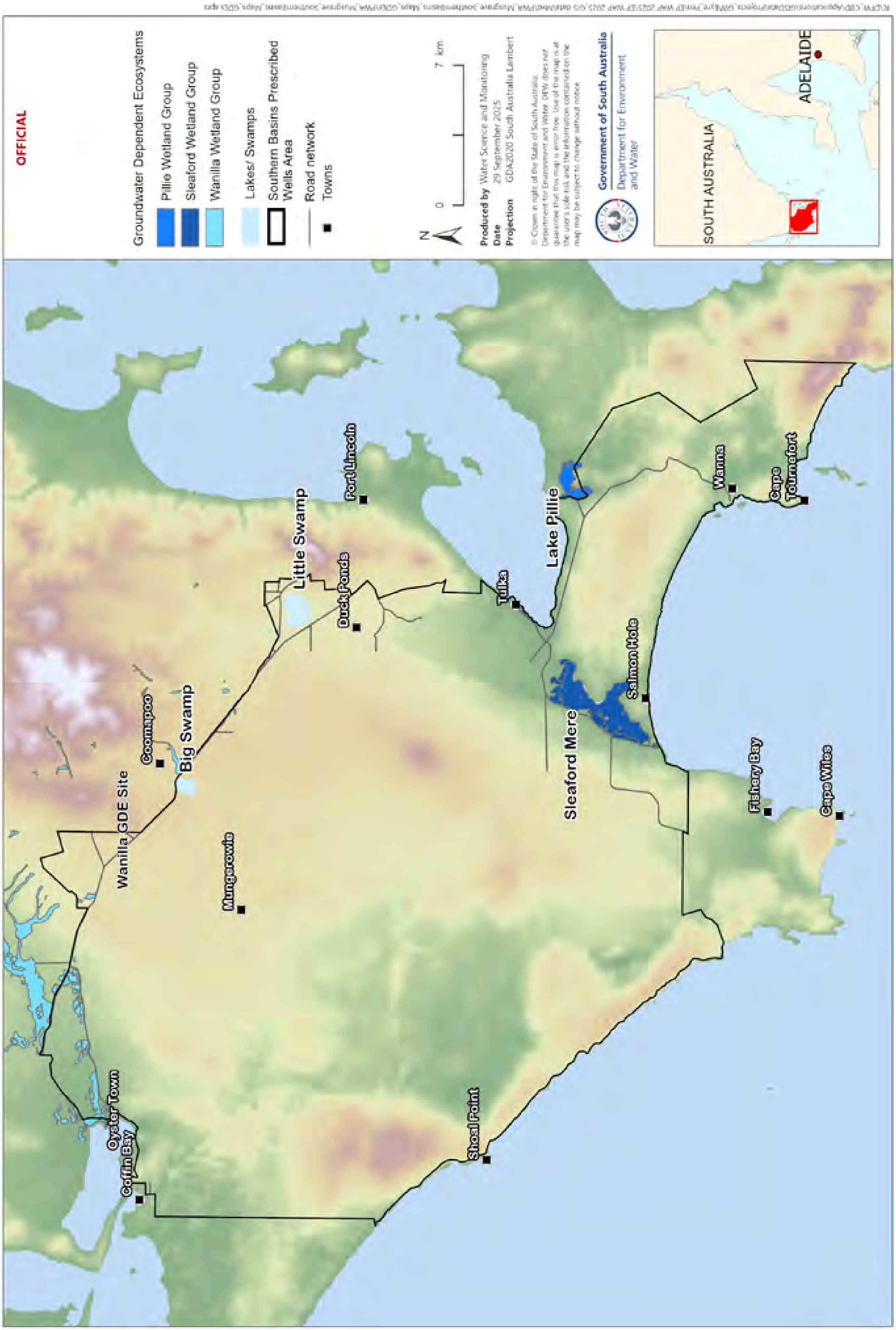

Figure 5-2 Wetland groundwater-dependent ecosystems of the Southern Basins PWA showing wetland groups

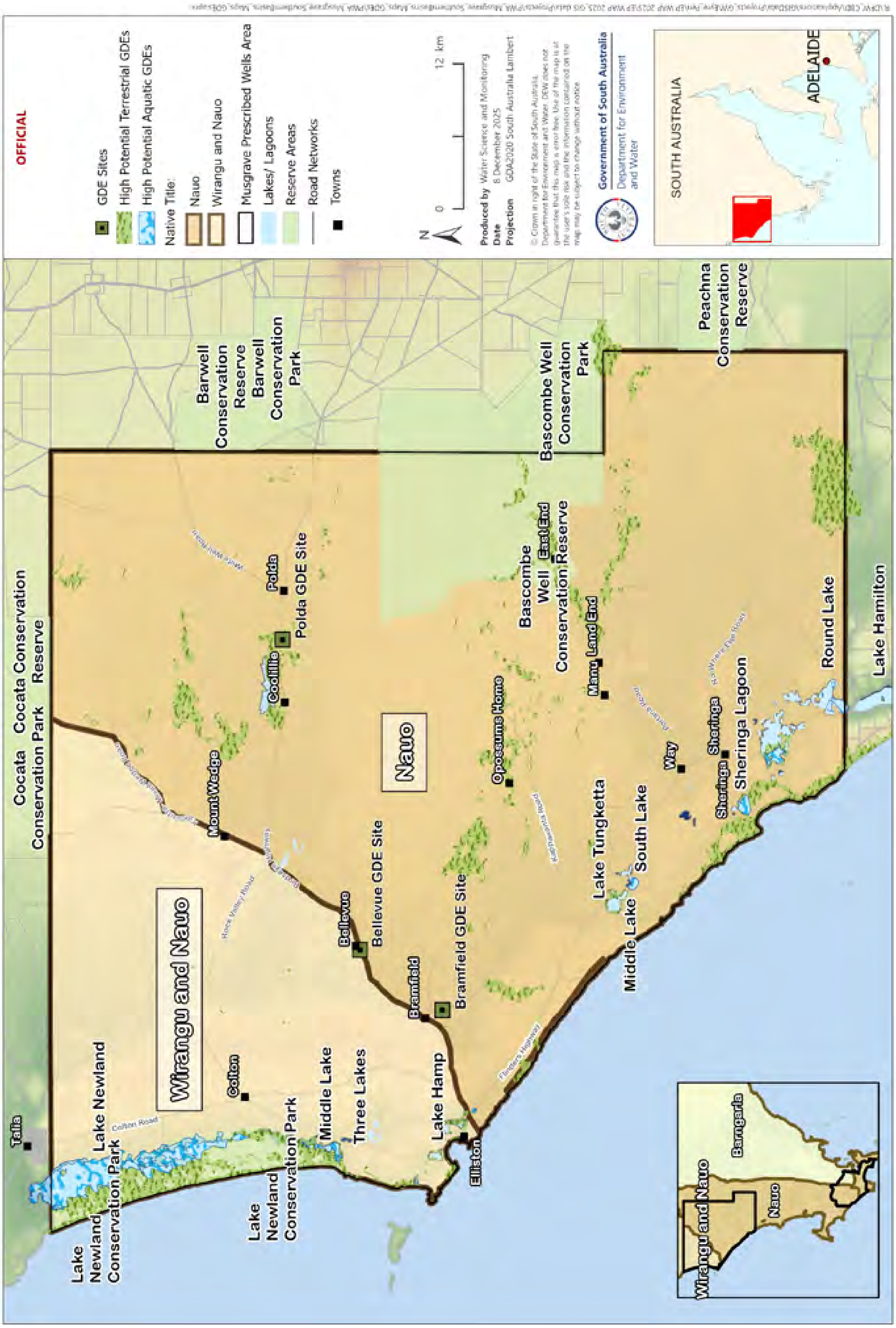

Figure 5-3 Groundwater-dependent ecosystems of the Musgrave PWA showing Native Title Determination areas

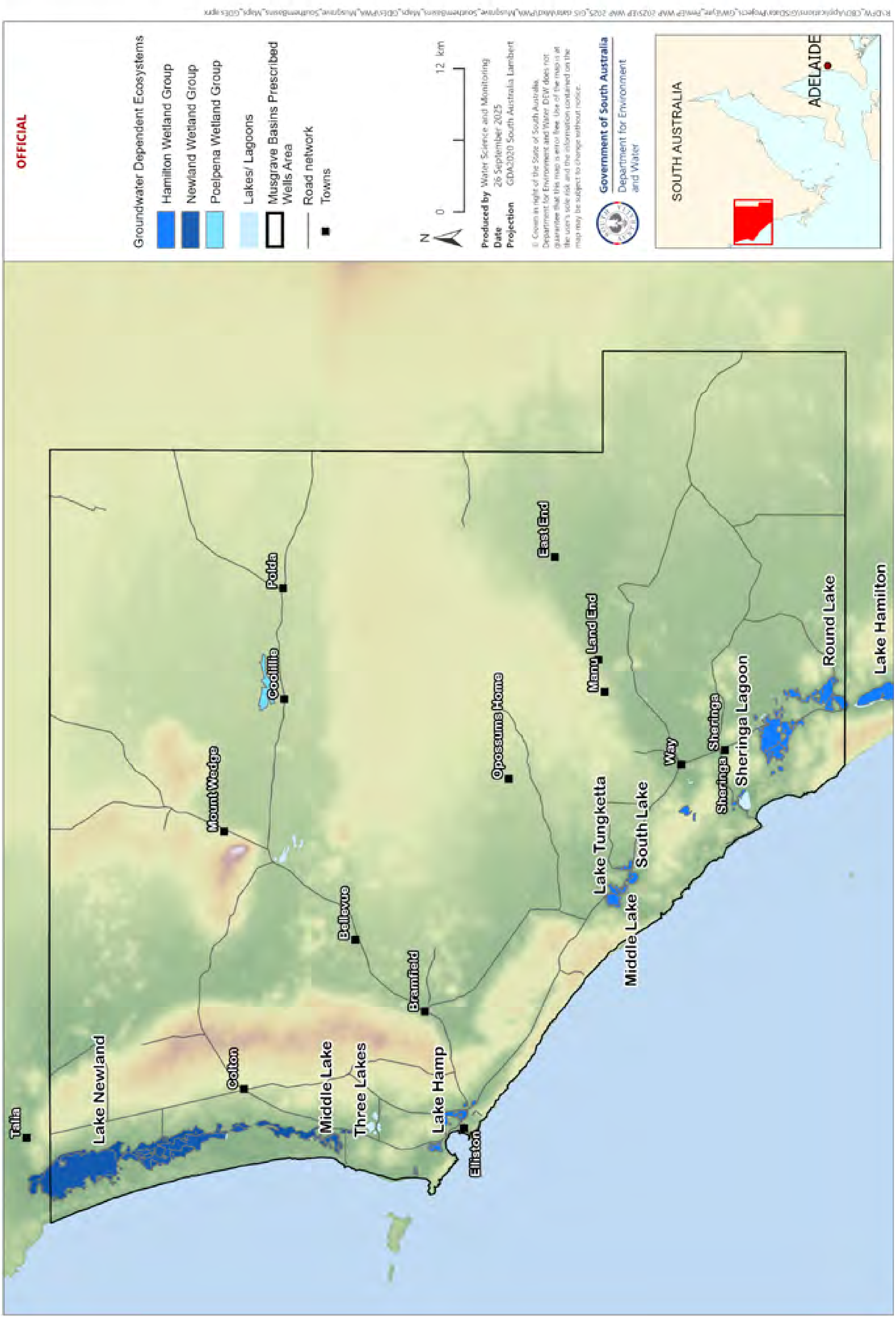

Figure 5-4 Wetland groundwater-dependent ecosystems of the Musgrave PWA showing wetland groups

5.3.1. Wetlands

Wetland systems within the PWAs that receive ephemeral, seasonal or continuous groundwater contribution, including lakes, damplands and springs, are considered to be GDEs and constitute environmental values to be provided for by this Plan. These wetland GDEs include saline wetlands (for example, Lake Newland and Sleaford Mere) and freshwater-brackish wetlands (for example, Myrtle Swamp, near Elliston, and Lake Hamilton), as well as springs such as the Weepra Spring at Lake Newland.

Those wetlands that depend on catchment water and have not been shown to be connected to the Quaternary aquifer, such as Big and Little Swamp (SKM 2009) were not considered to be GDEs and thus are not considered to be current groundwater-dependent environmental values for the purposes of determining the non-consumptive portion of the resource capacity for this Plan (Section 8.1.1.4). However, environmental protection zones have been placed around Big and Little Swamps to protect these wetlands and their surrounding red gums from possible adverse impacts from adjacent groundwater extractions (Section 7.2). It is likely that these red gum swamps enhance groundwater recharge at times and that at other times the red gums are facultative GDEs. The red gums may rely on groundwater to maintain good health in periods when surface water flows to Big and Little Swamp are persistently low. Studies into the isotope signature of plants in and around these wetlands, similar to those conducted on GDE red gums at other regional sites (see, for example, Banks and Shanafield 2023), could determine their GDE status.

Groundwater contributions to a given GDE wetland are determined by the bathymetry or shape of the wetland basin (that is, deep or shallow), its surface water catchment characteristics and how the shape of the basin intersects with groundwater levels over time and space. Direct rainfall, inflows from run-off (if the GDE wetland catches surface flows) combined with the minimum and maximum depths to groundwater relative to the depth of the wetland basin, will determine the frequency, extent, timing, depth and duration of wetland inundation (that is, its water regime – surface and subsurface). When the groundwater level is higher than the base of the wetland, the wetland will be inundated to the depth and extent that the groundwater level exceeds the wetland base. When groundwater levels drop below the base of the wetland, groundwater will not be expressed at the surface but the soil below the groundwater level will remain saturated. Rainfall that lands directly on the wetland and run-off from the surface water catchment of the basin will contribute to the overall water regime and resultant variations in water depth and inundation extent. However, it is likely that these water source contributions are very low compared to that of groundwater given the dry regional climate and flat topography in many areas.

Generally, the wetland GDEs within the PWAs are shallow and can dry out completely with only small changes in groundwater levels, much less than that observed in the PWA aquifers. This means that they are vulnerable to relatively small changes in groundwater level that may not significantly affect other water users. As such, they are susceptible to groundwater development and/or periods of low recharge that result in lowered groundwater levels and/or increased salinity.

Semeniuk and Semeniuk (2007) grouped wetlands on the Eyre Peninsula based on their topographical, hydrological and ecological character. The wetland groups that are known to have groundwater dependency are described below and displayed in Figure 5-2 and Figure 5-4 for Southern Basins and Musgrave PWAs, respectively.

Sleaford wetland group: Located on the south-eastern tip of the Southern Basins PWA (Figure 5-2) and consisting of 2 basins, Sleaford Mere and Little Sleaford Mere. Sleaford Mere is a shallow, saline, permanent wetland and a site of national and international importance for shorebirds (Environment Australia 2001). Little Sleaford Mere is ephemeral. Together these basins provide important habitat for a wide range of fauna including waders, shorebirds, other waterbirds and frogs. The water regime appears to be dependent on direct rainfall and groundwater recharge from the supporting Quaternary Limestone aquifer (Lincoln South management area). Permanent freshwater soaks occur at the northern end of Sleaford Mere, although the extent of their influence on freshening the overall salinity of the wetland is highly constrained to a narrow band (<2m) immediately adjacent to the spring discharge point (Doeg et al. 2012).

Wanilla wetland group: Consists of a number of short channels originating in the Lincoln Hills that flow into waterlogged flats in the northern Section of the Southern Basins PWA (Figure 5-2). These channels have flow periods of approximately 5 months (Semeniuk and Semeniuk 2007). The 2 main wetlands are Merintha Creek and Wanilla. They appear to be recharged by direct rainfall and runoff from Lincoln Hills and lose water to the groundwater

(Uley North management area). However, changes in regional groundwater levels may affect flow and thus they are included as environmental values.

Pillie wetland group: Consists of a number of small elongated dampland basins on the south-eastern tip of the Southern Basins PWA (Figure 5-2). The selected representative site is Lake Pillie, although there is anecdotal evidence that it has become more terrestrial in character in the late 1990s and early 2000s (J Hyde, personal communication, 2014). The water regime appears to be dependent on direct rainfall and groundwater recharge from the supporting Quaternary Limestone aquifer (Lincoln South management area).

Hamilton wetland group: Includes a single large elongate basin (Lake Hamilton) and a number of smaller associated basins along the coastal edge of the Musgrave PWA (Figure 5-4). All are seasonally inundated. The selected representative sites are Lake Hamilton and Round Lake. Lake Hamilton is listed as a nationally important wetland in the *Directory of Important Wetlands in Australia* (Environment Australia 2001) and is a good example of a wetland type occurring within a biogeographic region in Australia. The water regime for Lake Hamilton is dependent on several pathways. Fresh surface water from the eastern and western limestone ridges discharges into the lake from multiple sources, predominantly at the northern end. There is saline surface water on the western side of the lake with salinities in the order of 2 to 3 times seawater concentration. It is thought that this may be due to saline springs discharging into the lake (W Nosworthy, personal communication, April 2015) or tidal channel connections (Semeniuk and Semeniuk 2007). The water regime of Round Lake appears to be dependent on direct rainfall and groundwater discharge from the supporting Quaternary Limestone aquifer (Sheringa management area).

Newland wetland group: Consists of a complex of large wetland basins within the Musgrave PWA (Figure 5-4), with the main body of water, Lake Newland, being a relatively permanent salt lake with freshwater springs. Parts of the lake system dry over the summer period. Lake Newland is one of the most ecologically important wetlands on the Eyre Peninsula. According to Wainwright (2008) it attracts bird species considered vulnerable in South Australia and has an important role as a drought refuge for waterfowl. Wainwright (2008) considered Lake Newland to be of 'international importance for banded stilt' and of 'national importance' as a summer feeding habitat for the vulnerable hooded plover. It is also listed as a nationally important wetland in the *Directory of Important Wetlands in Australia* (Environment Australia 2001). Fresh water is delivered into the Newland Lake by rainfall and groundwater (Semeniuk and Semeniuk 2007) from the supporting Quaternary Limestone aquifer (Bramfield management area). The saline lakes become shallower and more saline in summer but are freshened by winter rain and a number of fresh (ground) water springs and seepages, which enter the lakes at their edges.

Poelpena wetland group: Consists of a single large elongate basin to the east of the Musgrave PWA (Figure 5-4) that is likely to be intermittently inundated. Poelpena Swamp is the representative site. Recharge to the wetland appears to be via direct rainfall and groundwater discharge from the supporting Quaternary Limestone aquifer (Polda management area).

It should be noted that the GDE wetlands cannot be differentiated into those that may be impacted by the Plan and those that can act as control due to:

- the complex responses of all GDE wetlands to the historic declines in regional groundwater levels
- the lack of paired wetlands (control and impact) within the boundaries of the PWAs
- differences in soil types and topography
- the lack of detectable change in vegetation communities due to those being left being the most tolerant.

Furthermore, the most vulnerable GDE wetland plant communities that are likely to respond to changes (for example, those in springs at Sleaford Mere) are fragile and may be threatened by repeated on-ground survey techniques, whilst drone footage does not have the spatial resolution to detect change at the required scale.

This will be considered in the revision of the Monitoring, Evaluation and Reporting Plan (MERI) that accompanies this Plan.

5.3.2. Phreatophytes (especially red gum forests and woodlands)

Vegetation communities that use groundwater to meet some or all of their water requirements are referred to as phreatophytes. Eucalyptus forests and woodlands are considered to be the only obligate groundwater-dependent vegetation community within the PWAs (SKM 2009). There may be other facultative phreatophytes, but these were not readily identified by SKM (2009) and are not included as environmental values in this Plan (Doeg et al. 2012).

Phreatophytic eucalypts include *Eucalyptus camaldulensis* (red gums) and *E. petiolaris* (Eyre Peninsula blue gum or water gum). *E. petiolaris* only occurs on the Eyre Peninsula (Nicolle 2013) and these trees are listed as Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999.* Very little is known about the ecophysiology of Eyre Peninsula blue gums. Given this, for the purposes of this Plan, they are assumed to have similar water requirements to the better studied *E. camaldulensis*.

Regardless of species, phreatophytic eucalypts use deep root systems to access groundwater that is brought into the unsaturated soil layers via capillary rise. The typical water use requirements of red gums are greater than that provided by the average annual rainfall on Eyre Peninsula and thus their survival is dependent on additional water supplies (e.g. catchment run-off after summer storms or regional groundwater). They cannot, however, withstand periods of inundation longer than 18 months, which is not likely to occur on Eyre Peninsula due to dropping groundwater tables and the lack of surface watercourses or impoundment. Red gum stands in the region that are suffering extensive loss of leaves and significant dieback are most likely experiencing a loss of reliable, fresh groundwater supplies in their root zones.

Recruitment processes for red gums and blue gums within the PWAs are unclear but it appears that new trees germinate and establish when depressions are inundated for a prolonged period. This seems to be linked to pooling of water on the soil surface after large, infrequent rainfall events rather than to groundwater levels rising above ground level for extended periods (Muller, unpublished observations made at Bramfield in 2014).

The critical components of the water regime for phreatophytes are the frequency and duration of groundwater levels at a depth that intersect with their active root system (Doeg et al. 2012). Representative stands of red gums across the Eyre Peninsula occur at Polda, Bramfield, Bellevue, Coulta and Wanilla.

For the purposes of evaluating the previous Plan, the condition of the red gums at Wanilla and Coulta were used as the impact and control sites for the Southern Basins PWA. Bellevue was used as the control site and Bramfield the impact site for the Musgrave PWA.

Groundwater use by red gums at three of these sites was confirmed through direct measurements of stable isotopes of the groundwater and the water in the trees (xylem water), and the levels of water stress experienced by the tree (Banks and Shanafield 2023). Studies were conducted in March 2023 when groundwater levels were relatively low following an extended period of low rainfall. Red gums at three GDE sites (Wanilla, Coulta and Bramfield) were found to be reliant on groundwater where the depth to groundwater was 6.5m at Wanilla, 6.2 to 7.2 m at Coulta and 4.9m at Bramfield.

Over the time of monitoring (2012 to 2025), there has been an overall decline in red gum condition across both PWAs. The red gums at the Wanilla site, which was the impact monitoring site for the Southern Basin PWA (Uley Wanilla basin) were in the poorest condition of all four GDE monitoring sites. GDE red gums at Bramfield (Impact site Musgrave PWA), Bellevue (Control site Musgrave PWA) and Coulta (Control site Southern Basins PWA) have shown generally better condition and were in relatively better health in August 2025, with signs of vigour following recent rains including new leaf growth or flowering.

The GDE red gum monitoring method used for the previous plan was based on River Murray monitoring methods which have proven to not be directly applicable to Eyre Peninsula red gums. The lack of applicability is most likely due to the very different responses of trees dependent on groundwater and heavy rainfall events (Eyre Peninsula) and those dependent on watercourse flows, wetland water regimes and flooding (River Murray). Alternative approaches to GDE monitoring may be explored in the new MERI Plan.

5.3.3. Baseflow and groundwater soaks

Ephemeral or permanent streams can occur where there is a continuous or seasonal groundwater discharge into watercourses. Ecosystems that rely on these streams are known as baseflow GDEs because the groundwater typically provides the baseflows to the systems upon which rainfall or surface water run-off is added in wetter periods. Groundwater soaks are surface water expressions of groundwater and occur where the groundwater intersects with the surface and the pressure of the groundwater is sufficient to move water to the surface. Therefore, soaks only occur where and when the groundwater rises to the surface. Soaks like those entering Sleaford

Mere provide a source of water much fresher than the surrounding saline water and form a stream within the wetland that supports plants with lower salinity tolerances (e.g. *Hydrocotyle* sp.) and that facilitates processes such as frog breeding (Doeg et al. 2012).

Baseflow and groundwater soaks may be permanent in areas where the groundwater is in constant contact with the surface providing a permanent water source, or they may be only temporary with flow ceasing when the groundwater level drops below the surface and/or evapotranspiration is greater than the groundwater pressure (i.e. evapotranspiration is greater than discharge rate). Also, the distance that the expressed groundwater travels before it infiltrates below land surface and therefore the area affected by the discharge, is a function of the flux and pressure of the groundwater (determining the discharge rate) and the porosity of the down-slope soils (determining the rate of loss back into the ground). Therefore, the critical components of the water regime for baseflow and groundwater soaks are the difference between the minimum and maximum levels of groundwater local to the discharge, which determines the frequency and duration that the springs are active and the groundwater flux and pressure which determine the rate at which groundwater is expressed.

There are no baseflow or groundwater soak GDEs known within the PWAs that are not associated with one of the identified GDE wetlands (for example, Weepra springs in Lake Newland); thus they have not been identified as a separate environmental value.

5.3.4. Hypogean, hyporheic and collapsed sinkhole ecosystems

Aquifer and/or cave habitat ecosystems that depend on groundwater interaction are another suite of GDEs. Little is known about the microbes, plants and animals that use these systems on the Eyre Peninsula, although some records of stygofauna have been identified from sampling of select observation wells and caves (Doeg et al. 2012). Hypogean and hyporheic ecosystems occur beneath the surface of the ground in saturated pore spaces, in cracks or fractures in consolidated material, or in caves formed below the surface. Hyporheic systems generally occur closer to the surface where there can be mixing of surface and groundwater, while hypogean systems occur deeper in the ground.

These systems provide habitat for a diverse group of micro-organisms and invertebrates, and even fish species can be found in caves. The biota of these systems are obligate groundwater users that are isolated by physical and hydrological barriers to migration. Therefore, the critical components of the water regime for hypogean and hyporheic systems are the difference between the minimum and maximum levels of the watertable determining the amount of available habitat, particularly in cave systems. It is still uncertain what role water quality plays in maintaining these systems (Doeg et al. 2012).

5.3.5. Marine discharges

Marine discharges are surface expressions of groundwater that occur under the ocean or in near-shore marine environments. These can only occur where the terrestrial groundwater intersects with the marine bed and the pressure of the groundwater is sufficient to discharge water against the head of the seawater. The introduction of fresher water (depending on the salinity of the groundwater) into the marine environment creates a localised habitat with different water chemistry to the surrounding areas and can therefore lead to a distinct biotic community adapted to that chemical regime. The critical components of the water regime for marine discharges are the difference between the minimum and maximum levels of the groundwater and the relative hydraulic pressures of the groundwater system and the adjacent marine environment, determining whether groundwater can exceed the head of the seawater above it.

Anecdotal reports suggest that the occurrence of marine discharges was once very common and has declined over time along the coastline, which may be an impact of groundwater extraction and/or low (rainfall-driven) recharge rates. In Kellidie Bay and Coffin Bay, groundwater discharge is readily visible in the shallow coastal waters, particularly at low tide. These are representative sites.

Coffin and Kellidie Bays are part of the same inverse estuary: a long and narrow marine inlet whose waters become hypersaline each summer (with saltier waters occurring nearer to land than to the open ocean). Inverse estuaries typically occur in hot arid climates without large freshwater inputs, such as the South Australian gulfs (Kämpf and Ellis 2015). Modelling by Kämpf and Ellis (2015) showed that despite the existence of strong tidal flows (more than 1 m/s) in passages within Coffin Bay, there was little connection between tidal stirring zones and therefore water could remain in the bay for 80 to 100 days. However, the increased salinity from the long residence time was less than expected compared to 2 local, large inverse estuaries: Spencer Gulf and Gulf St. Vincent (Kämpf and Ellis 2015). This indicates that there are freshwater inputs to Coffin and Kellidie Bays in the form of rainfall on the surface of the bays and groundwater discharge from the Coffin Bay A lens. Observations of the near shore upwellings in Kellidie Bay suggest that the groundwater inputs fluctuate but persist through summer and autumn each year, independent of rainfall (BG Saunders, personal communication, April 2015).

Coffin and Kellidie Bays have a range of marine habitats historically including mangroves, saltmarsh, reef, sandflats, biogenic rock, algal pools, seagrass meadows (2 species), mussel beds, tidal flats and rocky shorelines (Miller et al. 2009; Saunders 2012). It is a multi-species breeding and feeding ground for commercial and recreational finfish, a nursery for Western king prawn and a drought refuge for shorebirds and waterfowl. Kellidie Bay and the 2 creeks that connect with it, Merintha and Minniribbie Creeks, form essential environments for diadromous fish to complete their life cycles in fresh and saline waters, such as Galaxiids and Hardyheads (BG Saunders, personal communication, April 2015). The bays also support commercial oyster farms. The unique ecosystems of Kellidie Bay are considered to be a High Conservation Value Aquatic Ecosystem and the eastern end is a sanctuary within the Thorny Passage Marine Park.

5.3.6. Aquifer maintenance

Whilst aquifer maintenance is not technically a GDE, there is a need to maintain natural flows through the aquifer, including natural discharge. If too much water is made available for consumptive purposes, there may be impacts on the water balance in other areas, such as reducing natural discharges or altering flow directions. These natural discharges occur not only to marine environments, but also to groundwater-dependent ecosystems. Therefore, the environmental water requirements and provisions should have some consideration toward the need for water to maintain the aquifers' natural flow regime.

5.3.7. Management areas with no known groundwater-dependent ecosystems

Groundwater that discharges into wetland GDEs is typically shallow, that is, the watertable is within the top 2 m of the soil profile and as such, the deeper Tertiary and Basement aquifers are unlikely to provide water to any GDEs within the PWAs. On this basis it was assumed that the following management areas contain no wetland GDEs:

- Tertiary Sands
- Basement.

It is acknowledged that stygofauna or other subterranean ecosystems may be present within these areas that are not yet mapped or studied.

5.4. Environmental water requirements

The environmental water requirements (EWRs) of the GDEs within the PWAs, were determined by Doeg et al. (2012) using the following ecological approach:

- All relevant information on identified GDEs was collated and analysed in terms of identification, classification and mapping of the wetlands and describing the associated biota and ecological processes (environmental values)
- Ecological objectives for the maintenance of these environmental values were set to define the scope and guide the determination of the EWRs
- The relationship between the environmental values used in the ecological objectives and their water requirements were described using conceptual models (that is, how the GDE system 'works') formulated through literature research and application of expert opinion, which were used to identify the critical characteristics of the water regime
- The water regimes that fulfil all of the objectives set for the different GDEs were determined.

It is recognised that wetlands on the Eyre Peninsula that have surface water for some or all the time have been relatively well-mapped, but the dependence of some of them on groundwater sources has not been well demonstrated (see Doeg et al. 2012 for discussion). It is assumed here that all wetland groups within the PWAs, except where stated otherwise, are dependent on regional groundwater and may be susceptible to impacts from groundwater development (for example, decreased water availability and/or increased salinity). The exception as stated above (see Section 5.3.1) is the Greenly Wetland Group (including Big and Little Swamps), which have not been shown to be groundwater dependent (Doeg et al. 2012). Surface water entering these wetlands is managed through the Water Affecting Activities Control Policy (Eyre Peninsula Landscape Board 2022). Groundwater-dependent ecosystems other than wetlands have not been as well mapped within the PWAs. For these ecosystems it is assumed that the generic EWRs that have been applied to well-studied GDEs that support similar vegetation associations will apply if they are mapped in the future.

The environmental values employed for this Plan are limited to those GDEs that have been identified and mapped with respect to 2007 condition and spatial extent within the PWAs (Semeniuk and Semeniuk 2007; Doeg et al. 2012). It is acknowledged that there may be other unknown GDEs that are at risk from groundwater extraction in the PWAs and that there are significant gaps in knowledge about groundwater reliance for some identified GDEs (for example, the importance of baseflows to the Wanilla Wetland Group), which should be explored for future versions of this Plan.

The determination of EWRs was guided by the following objectives (Doeg et al. 2012):

1. The watering regime will promote self-sustaining populations of groundwater-dependent flora and fauna that currently exist within the area.
2. The watering regime will reduce the likelihood of future degradation of assets and increase their resilience to future low rainfall periods.
3. The current spatial distribution of groundwater-dependent flora and fauna will be maintained.

Note that these objectives are for the environmental water requirements (EWRs). The environmental water provisions (EWPs) adopted for this Plan (see Section 5.5) have taken these EWR objectives, as well as cultural, social and economic factors relevant to other groundwater users into consideration.

The EWRs presented below were based on maintaining the 2007 'baseline' environmental values at a low level of risk. It is recognised that during dry periods, the quantity and quality of groundwater available to support the identified environmental values may not always meet the recommended regime. This is seen as a natural part of climate variability, albeit one that may be exacerbated by climate change. The biota have adapted to survive some periods where water availability is lower than optimal, but the combination of future climate change impacts and groundwater extraction may exceed their tolerances if too much groundwater is extracted and/or if groundwater is extracted too close to the groundwater-dependent ecosystems to maintain them at a low level of risk. Therefore, environmental protection zones and consumptive use limits exist to minimise this risk.

5.4.1. Environmental water requirements for groundwater-dependent plants

Most of the available biological data relevant to the Eyre Peninsula GDEs is for plant species. This is due to plants in the GDEs being readily observable over time and space; in fact, most GDEs are identified because of their distinct plant assemblages and because plants are widely recognised as robust indicators of both short- and long-term changes in water availability and thus attract scientific attention. Relatively few studies have been conducted on more mobile or cryptic biota such as aquatic macro-invertebrates, fish, birds and other vertebrates (Doeg et al. 2012). Therefore, the EWRs for all GDEs within the PWAs that contain plants were primarily determined by the EWRs of the current plant communities.

It should be noted however, that many of the wetlands on the Eyre Peninsula were in sub-optimal condition before the end of the 20th Century, particularly the more aquatic plant species (that is, those that demand more permanent, deeper or more frequent inundation) or the less salt-tolerant plant species. Where they still occurred in 2012, they were likely to be persisting at their limits of their tolerance under the extant water availability and quality conditions, which may have deteriorated since.

The majority of wetlands identified were dominated by more terrestrial and highly resilient vegetation, with the more aquatic species inhabiting smaller and more marginal niches. This means that the more aquatic or less salt-tolerant plant species and their associated fauna (for example, freshwater plants and frogs at Sleaford Mere) are highly susceptible to the impacts of groundwater extraction, increasing groundwater salinity and/or periods of low recharge. Those near to the coast are also highly susceptible to sea level rise, particularly if it leads to changes in the hydraulic gradient as well as an increase in the salinity of the standing water or groundwater available to these GDEs.

To classify plants in terms of susceptibility to changes in groundwater quality and quantity, plant species that occur in the GDEs can be assigned to various functional groups based upon our understanding of their water requirements and their tolerances for duration and depth of inundation and desiccation (dryness). Plant functional groups can be visualised as a theoretical zonation of sometimes overlapping plant communities along an elevation gradient. In a permanent freshwater-brackish wetland there is often a larger range of functional groups along the elevation gradient (Figure 5-5) than in saline, temporary wetlands that tend to support only limited functional groups, that is saline and desiccation-tolerant ones (Figure 5-6). The functional groups can also be depicted as a relationship between the duration of inundation and the depth of inundation at a particular site (Figure 5-7). The degree of overlap in functional group zonation within a given wetland GDE at different times may indicate the degree of variability in water levels and/or water quality within that GDE.

Terrestrial damp taxa (e.g. *Wilsonia backhousei*) are typically found higher on the banks of permanent wetlands, above the high-water mark (Figure 5-6). Only in exceptionally wet years will the water inundate that zone and then only for a short time. However, the plants there depend in part on the saturated soil beneath as a source of water. In temporary wetlands, terrestrial damp taxa may occupy niches on the wetland basin if the periods of inundation are not too extensive for their waterlogging tolerance (Figure 5-7). Most of the identified wetland GDEs did not have plant communities dominated by terrestrial dry or floodplain taxa and thus these functional groups were not used for EWR determination.

Further down gradient in permanent wetlands, amphibious species, for example coastal saw-sedge (*Gahnia trifida)* and tea tree (*Melaleuca halmaturorum*)) occur (Figure 5-6). They are more regularly flooded by increased wetland depth but remain out of the water for the majority of the time. Again, the plants there depend on the saturated soil beneath as a source of water between inundation periods. Fluctuation-tolerant amphibious plants (for example, samphires) may occur right across the basin of temporary wetlands (Figure 5-7).

At the edge of a permanent wetland basin (or alongside a permanent creek like Merintha Creek near Coffin Bay), where soils remain permanently wet and inundation is common, emergent species (for example, reeds and sedges) can form a narrow to wide band, depending on the slope of the shoreline, which determines the width of the shoreline between the minimum and maximum water marks (Figure 5-5). It is unlikely that emergent plants will be supported by the water regime in temporary wetlands (Figure 5-6).

In the basin of a permanent wetland, standing water is always available and provides habitat for floating or submergent species (for example, *Ruppia megacarpa*) (Figure 5-5). In temporary wetlands, different submergent species (for example, *Chara* and *Ruppia tuberosa*) may be found during periods when surface water is present (Figure 5-6).

Therefore, the critical components of the water regime for wetlands are the:

- difference between the minimum and maximum levels of the watertable (determines the persistence of water and the functional groups present)
- frequency and duration of water levels that intersect with the wetland surface (determines the regularity of surface water and the time for evaporation to reduce surface water levels)
- water chemistry, particularly salinity.

Monitoring and evaluation of any changes in the location and/or condition of plants from the different functional groups can be used to indicate if significant changes in water regime have occurred.

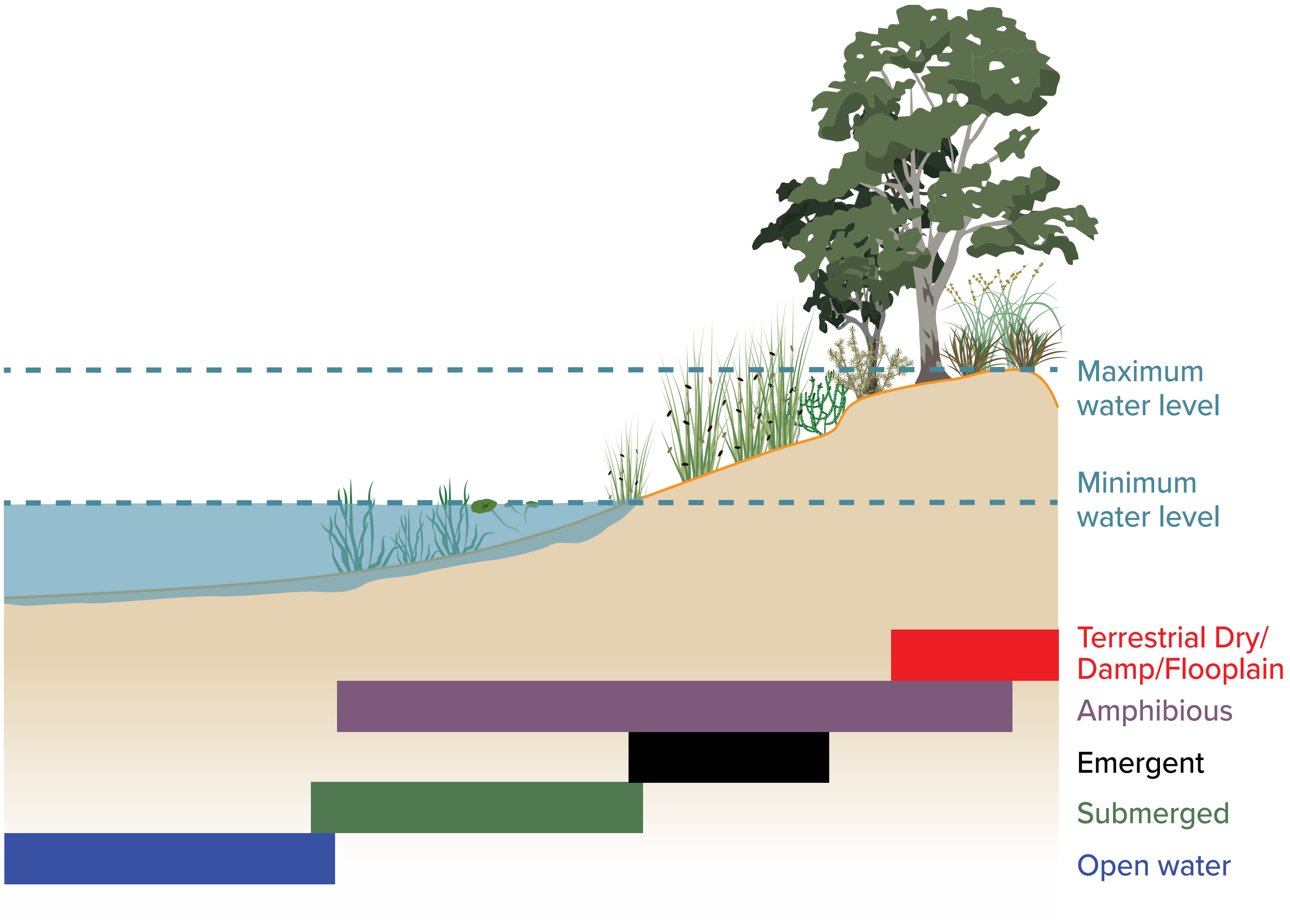

Figure 5-5 Plant functional groups in relation to elevation in a permanent, freshwater-brackish wetland

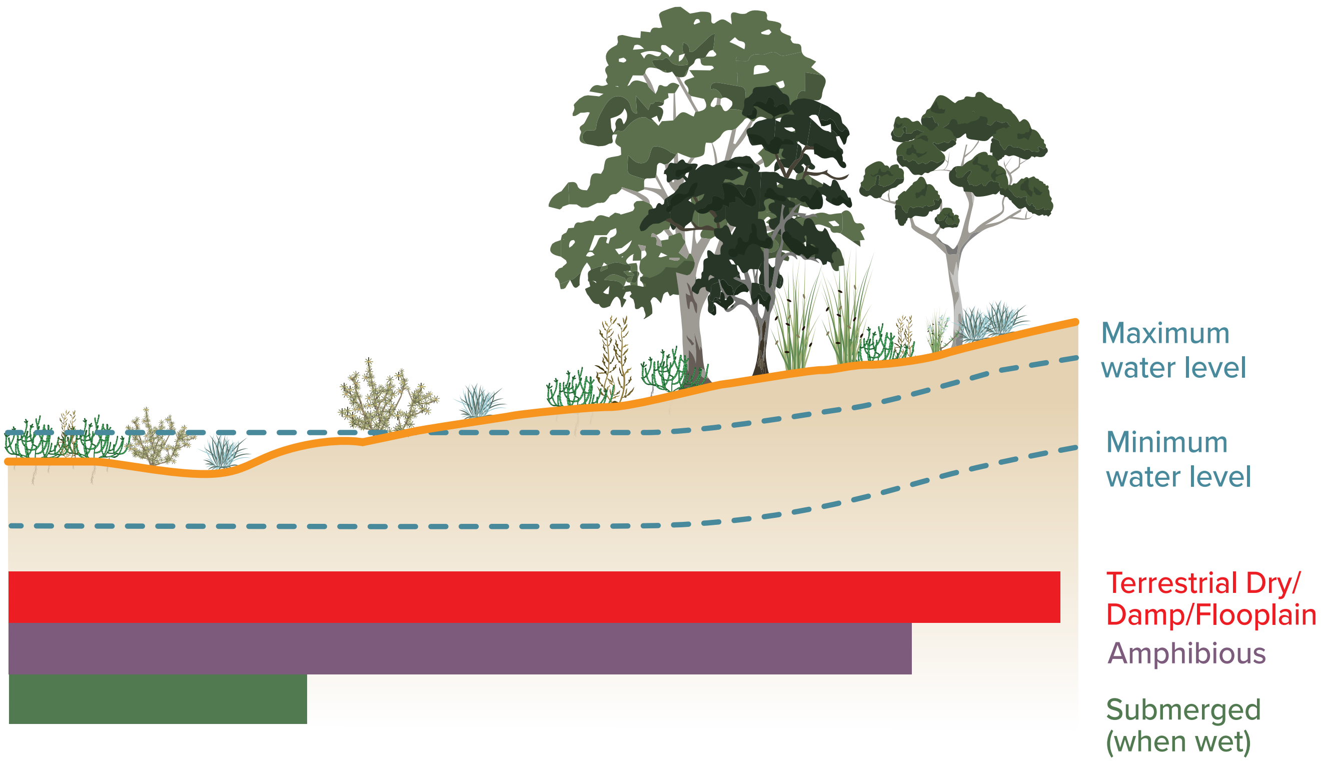

Figure 5-6 Plant functional groups in relation to elevation in a temporary, saline wetland

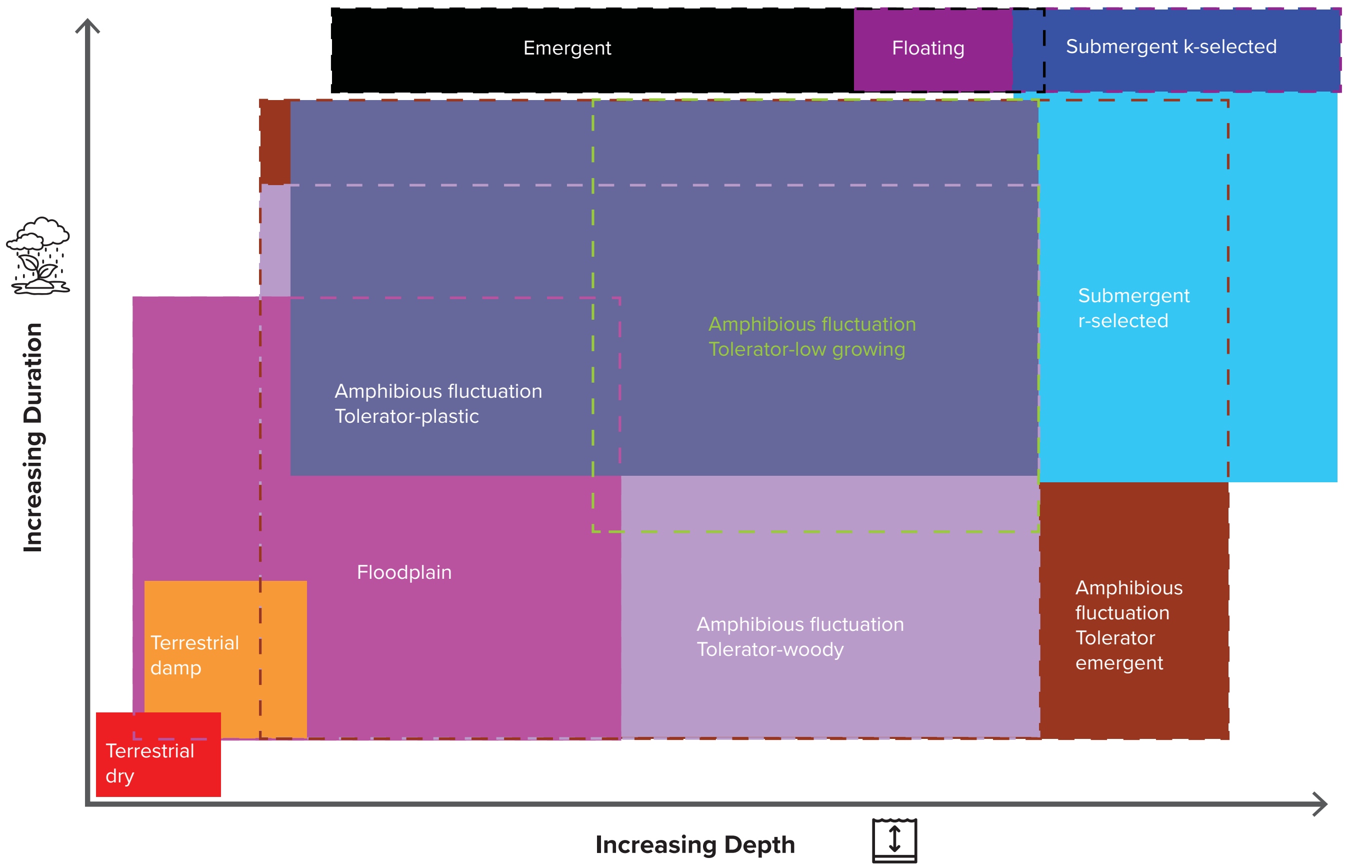

Figure 5-7 Plant functional groups in relation to depth and duration of inundation

A subset of common plants found on the Eyre Peninsula were selected as surrogate or indicator plants for monitoring conditions over time for each functional group (Table 5-1) in order to determine the EWRs for the identified GDEs (as discussed in Section 5.4). It is assumed that providing an adequate water regime for these surrogate or indicator plants (Table 5-2) will adequately provide for other plants in the same functional group that are less common and/or less well understood. It is further assumed that provision of water for these surrogate or indicator plants will also provide for their dependent fauna, which is especially true for species dependent on small patches of fresher water such as amphibious plants and animals (for example, *Hydrocotyle sp.* and frogs) that depend on groundwater soaks at Sleaford Mere.

Table 5-1 Selected plant taxa, with functional groups and water requirements, used as surrogates or indicators for determining the EWRs of GDEs

(from Doeg et al. 2012)

Taxon*	Common name	Functional group	Water requirements
Wilsonia backhousei	Narrow leaf Wilsonia	Terrestrial Damp	Indicative of the highest elevation that retains damp soil
Melaleuca halmaturorum	Tea tree or Swamp paperbark	Amphibious fluctuation tolerator woody	Dominant tree species Decline suggests change from wetland to terrestrial
Gahnia spp.	Cutting sedge or saw sedge	Amphibious fluctuation tolerator emergent	Indicates periodic waterlogging in the root zone (surface to ≈3 m).
Machaerina juncea	Bare twigrush	Amphibious fluctuation tolerator emergent	Most sensitive of the emergent plants to water source variations
Sarcocornia quinqueflora & Tecticornia pruinosa	Samphires	Amphibious fluctuation tolerator emergent	Dominant shrub species Only vegetation in most saline wetlands Indicative of wet, saline areas Decline suggests change from wetland to terrestrial conditions
Triglochin striatum	Short arrow grass	Amphibious fluctuation tolerator emergent	Indicative of areas of permanently damp brackish conditions
Hydrocotyle spp.	Pennywort	Amphibious fluctuation responder plastic	Desiccation and salt intolerant Indicative of fresher and permanent habitats (e.g. freshwater soaks at Sleaford Mere)
Phragmites australis	Common reed	Emergent	Indicative of fresher and permanently wet or damp habitats (e.g. Merintha Creek)
Ruppia spp.	Seatassels	Submerged r-selected	Indicative of periodic inundation Significant food resource for birds and other fauna
Chara spp.	Stoneworts	Submerged r-selected	Indicative of periodic inundation Significant food resource for birds and other fauna

*Note scientific name change from *Baumea juncea* to *Machaerina juncea*

Table 5-2 EWRs of surrogate or indicator taxa
(from Doeg et al. 2012)

Taxa and process*	Water Level requirement (Surface or groundwater)	Minimum Duration	Timing	Frequency
Wilsonia backhousei or *W. humilis*	Groundwater within 25 cm of surface leading to damp soil (no surface water)	3 months	Any time	Annual
Melaleuca halmaturorum Persistence & growth	Groundwater within 2 to 3 m of surface based on assumed root depth	3 months	Any time	Annual
Melaleuca halmaturorum Recruitment	Groundwater within 25 cm of surface leading to damp soil (no surface water)	3 months without drying	Spring	Once every 10-25 years
Gahnia trifida Persistence & growth	Groundwater within 3 to 4 m of surface based on assumed root depth	2 months	Any time	Annual
Machaerina juncea Persistence & growth	Groundwater within 1 m of surface based on assumed root depth	3 months	Any time	Annual No rarer than once every 3 years
Machaerina juncea Recruitment	Groundwater within 25 cm of surface leading to damp soil (no surface water)	3 months	Spring to early summer (optimal)	Once every 3 years; No rarer than once every 5 to 10 years
Samphires Persistence & growth	Surface water depth <50 cm	6 to 9 months	Any time	Annual
Sarcocornia quinqueflora & *Tecticornia pruinosa* Recruitment	Groundwater within 25 cm of surface leading to damp soil (no surface water)	3 months	Any time	1 in 3 years
Triglochin striatum Persistence & growth	Wetland margins with damp soil to shallow water (2 to 10 cm)	3 months	Any time	Annual No rarer than once every 3 years
Triglochin striatum Recruitment	Freshening of saline soils by inundation	3 months	Spring to early summer (optimal)	Once every 2 years; No rarer than once every 3 to 5 years
Hydrocotyle spp.	Permanent shallow (2 to 10 cm) fresh water	12 months	Continuous	Annual
Phragmites spp. Persistence & growth	Permanent shallow water (20 to 45 cm) or saturated soils	12 months	Continuous	Annual
Phragmites spp. Recruitment	No surface water	<4 weeks inundation of seedlings	Any time	1 in 7 years

Taxa and process*	Water Level requirement (Surface or groundwater)	Minimum Duration	Timing	Frequency
Ruppia tuberosa. Persistence, growth and recruitment	Surface water depth 2 to 3 cm	6 months	Any time	1 in 3 years
Chara spp.	Surface water depth >25 cm	>16 weeks	Any time	Annual

*Note scientific name change from *Baumea juncea* to *Machaerina juncea*

5.4.2. Environmental water requirements for groundwater-dependent wetlands

The wetland GDEs within the PWAs are relatively well mapped and understood compared with some of the other GDE types. Most of the wetland GDEs are shallow and are thus vulnerable to small changes in groundwater level and/or quality that may not significantly affect other GDEs. Some of the wetlands have international or national conservation ratings (Environment Australia 2001) and all of them are considered important habitats and water sources for their dependent flora and fauna. Therefore, the wetland GDEs could be used as indicators of the success of this Plan in maintaining and/or improving the current environmental values. However, this would require the ability to distinguish between extractions or climate induced changes in groundwater levels or quality as well as an ability to effectively monitor change in wetland vegetation zonation as an indicator of change in groundwater contribution.

Doeg et al. (2012) developed the EWRs for the wetland GDEs presented in Table 5-3 based on the presence of different vegetation components and the persistence of water. It should be noted that Wanilla Group EWRs apply only if future investigations show dependence upon the groundwater in the Quaternary aquifer for these ecosystems.

Table 5-3 The environmental water requirements (EWRs) adopted for each wetland group

Wetland group	Adopted environmental water requirements
Sleaford wetland group	For the entire year, the groundwater level needs to be in direct contact with the sources of the freshwater soaks. The watertable needs to maintain the surface water to a depth of 10 to 20 cm throughout the year. For at least 3 months of the year (at any time), the watertable needs to be maintained within 1 m of the *Machaerina* zone. For at least 3 months of the year (at any time), the watertable needs to be maintained within 2 to 3 m of the *Melaleuca* zone. For at least 2 months of the year (at any time), the watertable needs to be maintained within 3 to 4 m of the *Gahnia* zone. For at least 3 months of the year over spring (at least once every 3 years) the watertable needs to be maintained within 25 cm of the *Machaerina* zone.
Wanilla wetland group	For the entire year, the watertable needs to maintain damp soil throughout the creek line for *Phragmites*. For at least 3 months of the year (at any time), the watertable needs to be maintained within 2 to 3 m of the *Melaleuca* zone. For at least 3 months of the year over spring (at least once in 10 years) the watertable needs to be maintained within 25 cm of the *Melaleuca* zone.
Pillie wetland group	For at least 6 to 9 months of the year, a water depth of up to 50 cm needs to be maintained in the basin for *Sarcocornia*. Where present, a surface water depth >25 cm needs to be present for at least 16 weeks for *Chara* each year. For at least 3 months of the year (at least once in every 3 years), no surface water should be present, but the watertable needs to maintain damp soil within the parts of the basin where *Sarcocornia* is located. For at least 3 months of the year (at any time), the watertable needs to be maintained within 2 to 3 m of the *Melaleuca* zone. For at least 2 months of the year (at any time), the watertable needs to be maintained within 3 to 4 m of the *Gahnia* zone. For at least 3 months of the year over spring (at least once in 10 years) the watertable needs to be maintained within 25 cm of the *Melaleuca* zone.

Wetland group	Adopted environmental water requirements
Hamilton wetland group	For the entire year, the groundwater level needs to be in direct contact with the spring source. For at least 6 to 9 months of the year, a water depth of up to 50 cm needs to be maintained in the basin for *Tecticornia* and *Sarcocornia*. For 6 months of the year, a water depth of 2 to 3 cm needs to be maintained in the basin for *Ruppia*. For at least 3 months of the year (one in 3 years), no surface water should be present, but the watertable needs to maintain damp soil within the parts of the basin where *Tecticornia* and *Sarcocornia* are located (for recruitment). Where present, a surface water depth >25 cm needs to be present for at least 16 weeks for *Chara* each year. For at least 3 months of the year (at any time), the watertable needs to be maintained within 2 to 3 m of the *Melaleuca* zone. For at least 2 months of the year (at any time), the watertable needs to be maintained within 3 to 4 m of the *Gahnia* zone. For at least 3 months of the year over spring (at least once in 10 years) the watertable needs to be maintained within 25 cm of the *Melaleuca* zone.
Round Lake –Hamilton wetland group	For at least 6 to 9 months of the year, a water depth of up to 50 cm needs to be maintained in the basin for *Tecticornia* and *Sarcocornia*. For at least 3 months of the year (at least once in every 3 years), no surface water should be present, but the watertable needs to maintain damp soil within the parts of the basin where *Tecticornia* and *Sarcocornia* are located (for recruitment). For at least 3 months of the year (at any time), the watertable needs to be maintained within 1 m of the *Machaerina* zone. For 3 months of the year over spring (at least once in every 3 years) the watertable needs to be maintained within 25 cm of the *Machaerina* zone. For at least 3 months of the year (at any time), the watertable needs to be maintained within 2 to 3 m of the *Melaleuca* zone. For at least 2 months of the year (at any time), the watertable needs to be maintained within 3 to 4 m of the *Gahnia* zone. For at least 3 months of the year over spring (at least once in 10 years) the watertable needs to be maintained within 25 cm of the *Melaleuca* zone.

Wetland group	Adopted environmental water requirements
Newland wetland group	For the entire year, the groundwater level needs to be in direct contact with the spring source. For at least 6 to 9 months of the year, a water depth of up to 50 cm needs to be maintained in the basin for *Tecticornia* and *Sarcocornia*. For 6 months of the year, a water depth of 2 to 3 cm needs to be maintained in the basin for *Ruppia*. Where present, a surface water depth >25 cm needs to be present for at least 16 weeks for *Chara* each year. For at least 3 months of the year (at least once in every 3 years), no surface water should be present, but the watertable needs to maintain damp soil within the parts of the basin where *Tecticornia* and *Sarcocornia* are located. For at least 3 months of the year (at any time), the watertable needs to be maintained within 1 m of the *Baumea* zone. For at least 3 months of the year (at any time), the watertable needs to be maintained within 2 to 3 m of the *Melaleuca* zone. For at least 2 months of the year (at any time), the watertable needs to be maintained within 3 to 4 m of the *Gahnia* zone. For at least 3 months of the year over spring (at least once in every 3 years) the watertable needs to be maintained within 25 cm of the *Machaerina* zone. For at least 3 months of the year over spring (at least once in 10 years) the watertable needs to be maintained within 25 cm of the *Melaleuca* zone.
Poelpena wetland group	For 3 to 6 months of the year, saturated soil or surface water depth <200 mm needs to be maintained in the basin for *Tecticornia*. For at least 3 months of the year (at least once in every 3 years), no surface water should be present, but the watertable needs to maintain damp soil within the parts of the basin where *Tecticornia* is located (for recruitment). For at least 3 months of the year (at any time), the watertable needs to be maintained within 2 to 3 m of the *Melaleuca* zone. For at least 2 months of the year (at any time), the watertable needs to be maintained within 3 to 4 m of the *Gahnia* zone. For at least 3 months of the year over spring (at least once in 10 years) the watertable needs to be maintained within 250 mm of the *Melaleuca* zone. For red gum stands, the water regime needs to be maintained within the limits of red gum adaptability (as indicated by the historic groundwater regime).

5.4.3. Environmental water requirements for other groundwater-dependent ecosystems

The following sub-sections discuss the environmental water requirements for phreatophytes, baseflow and groundwater soaks, hypogean, hyporheic and collapsed sinkhole ecosystems and marine discharges.

5.4.3.1 Phreatophytes (especially red gum forests and woodlands)

The EWR for red gum and the Eyre Peninsula blue gum or water gums is to maintain the water regime within the limits of their capacity to adapt to changes in water regime (that is, the ability to change morphological and physiological characteristics). Further research into the water sources used by phreatophytic eucalypts within the PWAs and their ability to switch water sources is needed to further refine this EWR for particular stands of gums (for example, those occurring near to or over the Polda lens).

5.4.3.2 Baseflow and groundwater soaks

Environmental water requirements for these systems are guided by the need to maintain groundwater discharge to support associated vegetation communities, which in turn are assumed to support a wider diversity of other aquatic biota.

5.4.3.3 Hypogean, hyporheic and collapsed sinkhole ecosystems

There is inadequate data to determine the location and groundwater dependency of environmental values of hypogean and hyporheic ecosystems, and therefore generic EWRs for these systems could not be developed.

5.4.3.4 Marine discharges

Environmental water requirements for these systems predicate that the associated aquifer system needs to maintain a pressure at least sufficient to prevent seawater intrusion. Improved mapping of near-shore discharges is required to identify the discharge points and their dependent environmental values and hydraulic processes.

5.4.3.5 Aquifer maintenance

Environmental water requirements for these systems are guided by the need to maintain groundwater discharge to support associated vegetation communities and maintain a pressure at least sufficient to prevent sea water intrusion. Additionally, there is also a need to provide a buffer of suitable aquifer storage for extended periods of below-average rainfall and recharge.

5.5. Assessment of environmental water provisions

Environmental water provisions (EWPs) are those portions of the EWRs presented above that can be met at any given time within this Plan. In this case, the EWPs are equal to the EWRs because the relatively shallow groundwater levels that dictate current GDE water availability are highly responsive to, and primarily driven by, rainfall. The levels of consumptive use in this Plan, even at full usage of water on licence, are unlikely to significantly impact on water availability or water quality for identified GDEs, which is consistent with the objectives of this Plan. Therefore, this Plan seeks to provide adequate water to meet the EWRs of identified GDEs stated in Section 5.4 with due consideration of existing users' rights, as well as social and economic impacts under permissible levels of resource development.

As stated above, water made available for consumptive use within this Plan is not expected to impact groundwater levels or behaviour sufficiently enough to prevent EWPs from being met. However, there is some uncertainty inherent in the technical investigations that inform this expectation. This uncertainty will be considered via the monitoring, evaluation, reporting and improvement processes that support this Plan, with regard to trends in GDE condition (Eyre Peninsula Landscape Board 2025).

By its nature, a water allocation plan requires an equitable balance between consumptive uses and environmental water requirements. This Plan is intended to maintain GDEs at a low level of risk and allow for the use of the water resources for human needs.

The Plan seeks to provide an adequate water regime to maintain the identified GDEs. It achieves this by using a combination of the following methods:

- ensuring a proportion of recharge is set aside for the environment when determining the water available for consumptive use (Section 8.1.1.4)
- providing for the adaptive management of the variable saturated Quaternary Limestone aquifer (Section 9.4.1)
- using buffers and exclusion zones to protect environmental assets/values and promote natural groundwater flow processes by preventing the construction of new wells and setting conditions on replacement wells (Section 7.2)
- considering the presence or absence of GDEs within management areas when determining the methodology for varying consumptive pool volumes (Section 5.3).

Using this approach, EWPs will be available to GDEs in a way that mirrors rainfall patterns as would naturally occur. The principles included in this Plan are not expected to alter the timing of EWPs because the timing of environmental water availability is largely driven by rainfall, recharge and discharge processes that are unlikely to be modified significantly by the permissible extraction levels.

This Plan is limited in its ability to prevent the degradation of the GDEs that may be caused by drought (or extended periods of below average rainfall) and the subsequent lowering of groundwater below tolerance levels.

6. Aboriginal water interests

This Aboriginal water interests Section of the Plan has been developed in consultation with representatives of the Aboriginal Corporations holding Native Title over the PWAs, namely the Nauo Aboriginal Corporation Registered Native Title Body Corporate (RNTBC), the Wirangu and Nauo Aboriginal Corporation RNTBC, and the Barngarla Determination Aboriginal Corporation RNTBC. Information set out in this Section was informed directly through the Aboriginal Water Interests Work Group, established to ensure that the traditional knowledge of Aboriginal people helped to inform the development of the Plan.

The consultation undertaken in the preparation of this Section marks the beginning of conversations with Native Title groups in the region on water issues. It was not possible, within the necessary time limits, to obtain consent to the information set out in this Section from all the Registered Native Title Body Corporates. The content of this Section, therefore, only reflects the views of those working group members involved in the co-authoring, and the organisations that they represented.

6.1. Cultural importance of groundwater to Aboriginal Peoples

The connection of Aboriginal people to the land and waters covered by this Plan is expressed through customs, lores, songlines, stories, spirituality, kinship with flora and fauna and cultural care for Country. These cultural connections relate strongly to springs, soaks, rock holes, creeks, rivers, caves, waterholes and marine discharge springs, including those with hydrogeological connection to the groundwater resources covered by this Plan.

The Board understands that for Aboriginal people, water is life, nothing survives without it. Water across this landscape is understood as a living system whose deep interconnections must be preserved through wise stewardship, ensuring it continues to sustain life into the future. As such, cultural significance extends far beyond designated groundwaterdependent ecosystems, encompassing all places where water reveals itself regardless of administrative boundaries or whether the source is surface or subterranean. There is a fundamental and ancient connection between life and the fresh groundwater that sustains it. This refers to all life that uses groundwater – aquatic, terrestrial, marine, human and non-human – and all parts of groundwater holding Country.

On Eyre Peninsula, the quality and quantity of groundwater is a particularly important water source for supporting spiritual, cultural, environmental, social and economic life because of the relatively low supplies of surface water and low rainfall. Numerous stories and songlines relate to groundwater, especially the springs that occur across the landscape and within major lake systems. It is essential that the cultural values of this Country, especially those supported by fresh groundwater, are protected for the benefits of all people and all life, now and into the future.

Aboriginal people believe that all water in these regions and across the whole landscape must be managed to allow it to maintain, and restore where possible, the connected elements of this Country. Wise management will enable our precious fresh water supplies to continue to support life for many more thousands of years.

For the purposes of this Section, places of cultural significance are not limited to the groundwater-dependent ecosystems nominated in this Plan (Section 5), but also include other places where groundwater comes to the surface in springs, soaks, waterholes, caves, creeks, rivers and marine springs, that are all of particular cultural significance to Aboriginal people, regardless of whether they are in the PWAs, or entirely dependent on groundwater, or not. This includes, but is not limited to, the following:

- Lake Newland
- Lake Greenly
- Sheringa Lake
- Bascombe Well
- Lake Hamilton
- Lake Wangary
- Sleaford Mere and Little Sleaford
- Lake Damascus
- Happy Valley Springs (Port Lincoln)
- Big and Little Swamps
- Pillie Lake
- Lake Hope
- Wandala
- Lake Malata
- Lake Tungketta and South Lake
- Round Lake
- Minniribbie Creek
- Merintha Creek
- Wanilla Wetlands
- Glengyle Creek.

6.2. Aboriginal water rights and interests

6.2.1. Commonwealth legislation and commitment

During the 10 years since the adoption of the previous Plan (2016), there have been legal determinations approved under the federal *Native Title Act 1993* (Native Title Act) that cover both water resource areas regulated by this Plan. The Native Title Act recognises and protects Native Title[5], defining 'Native Title' as the communal, group or individual rights and interests of Aboriginal peoples or Torres Strait Islanders in relation to land or waters[6]. The definition of 'waters' in the Native Title Act includes 'subterranean waters'[7], that is, groundwater.

This Plan acknowledges Aboriginal water interests in the Southern Basins and Musgrave PWAs as held by the following Registered Native Title Body Corporates (Figure 6-1):

- Nauo Aboriginal Corporation RNTBC
- Wirangu and Nauo Aboriginal Corporation RNTBC
- Barngarla Determination Aboriginal Corporation RNTBC.

Nauo Aboriginal Corporation RNTBC

Native Title determinations for the Nauo People were achieved in stages: Nauo 1 in 2023, Nauo 2 in 2024, and Nauo 3 in 2025. The third determination was resolved alongside Wirangu claims, reflecting overlapping custodial responsibilities in coastal and marine environments. These determinations formally recognised that both groups hold rights and responsibilities over shared waters, where cultural, spiritual, and practical connections are deeply intertwined.

Wirangu and Nauo Aboriginal Corporation RNTBC

The governance arrangements between Wirangu and Nauo embody the profound interconnection of their estates and waters. This shared structure is not simply a response to geographic overlap, but a recognition of enduring cultural relationships and the necessity of coordinated stewardship. Joint management of water rights ensures inclusive decision making, sustainable use, and protection of cultural heritage, while a shared board promotes efficiency, unity, and a stronger collective voice in engagements with governments, industry, and communities.

5 Section 3(a) of the *Native Title Act 1993*

6 Section 223(1) of the *Native Title Act 1993*

7 Section 253 of the *Native Title Act 1993*

In this way, the staged Nauo determinations culminated in Nauo 3, affirming shared custodial responsibilities for water and establishing a cooperative framework through which the Wirangu and Nauo Peoples exercise their Native Title rights with coherence, authority, and respect for the integrity of Country. To give effect to these responsibilities, the Wirangu Nauo Aboriginal Corporation was established as the Prescribed Body Corporate, providing the formal governance structure through which both groups jointly manage their recognised rights and interests. This corporation embodies their shared stewardship of land and waters, ensuring that cultural values, custodial obligations, and sustainable practices are upheld in a unified and authoritative manner.

Barngarla Determination Aboriginal Corporation RNTBC

Barngarla's Native Title was determined in two separate proceedings. The Native Title determination that includes part of the Southern Basins PWA was the 'Barngarla Native Title Claim', determined on 23 June 2016.

Barngarla's Native Title determinations set out the rights that Barngarla have to use and enjoy the land and waters of the Native Title area, in accordance with traditional laws and customs, including:

- The right to live on, use and enjoy the land and waters
- The right to make decisions about the use and enjoyment of the land and waters by those Aboriginal people who recognise themselves to be governed by the traditional laws and customs acknowledged by the Native Title Holders
- The right of access to the land and waters
- The right to control the access of other Aboriginal people who recognise themselves to be governed by the traditional laws and customs acknowledged by the Native Title holders to the land and waters
- The right to use and enjoy resources of the land and waters
- The right to control the use and enjoyment of resources on the land and waters by other Aboriginal people who recognise themselves to be governed by the traditional laws and customs acknowledged by the Native Title holders
- The right to maintain and protect places of importance under traditional laws, customs and practices on the land and waters
- The right to conduct burial ceremonies on the land and waters.

The Commonwealth Government has made a commitment to the National Agreement on Closing the Gap which seeks to 'overcome the entrenched inequality faced by too many Aboriginal and Torres Strait Islander people so that their life outcomes are equal to all Australians' and includes a target for progressing towards securing Aboriginal rights for inland waters.

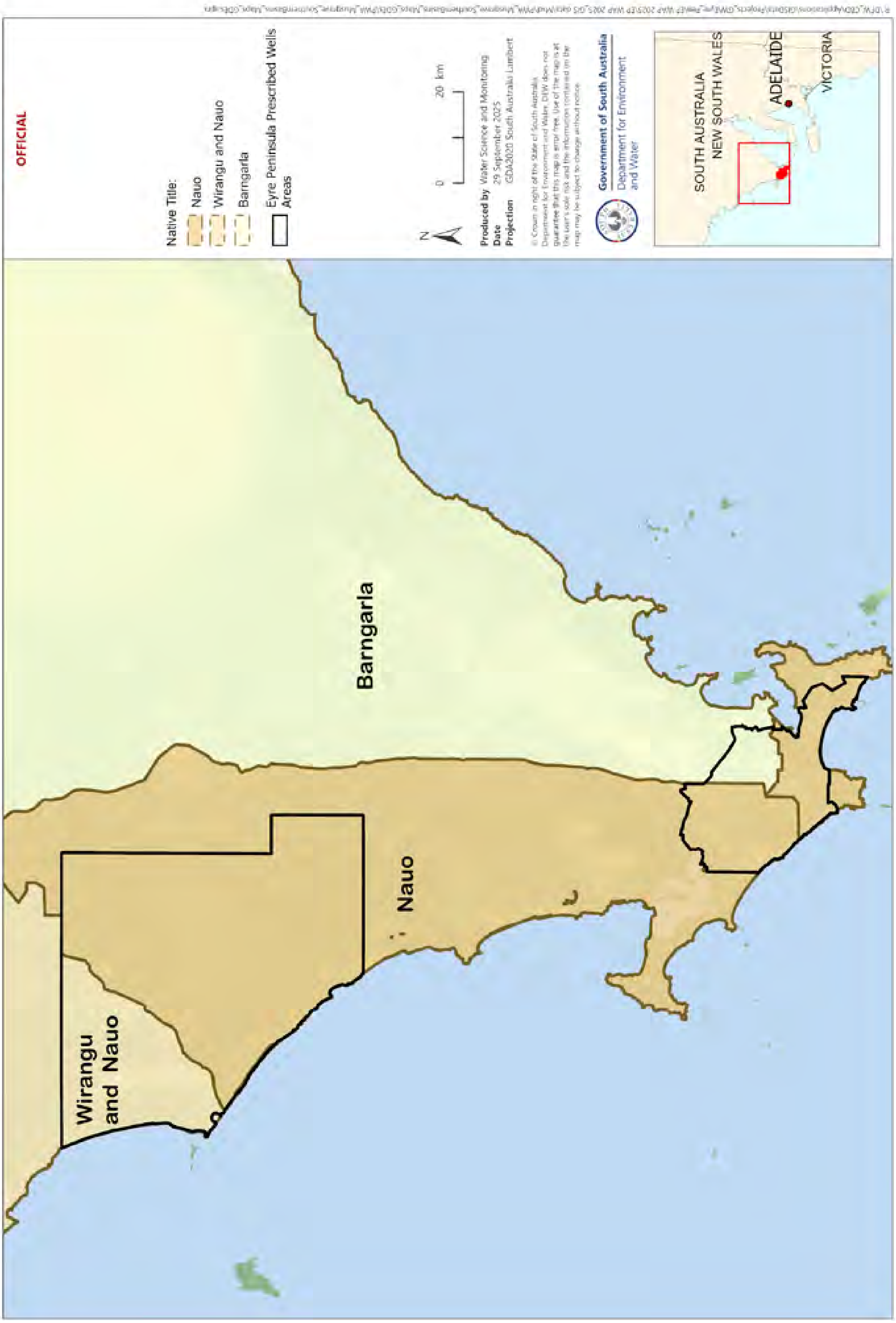

Figure 6-1 Boundaries of Prescribed Wells Areas and approved Native Title determinations for the Nauo, Wirangu and Nauo, and Barngarla Determination Aboriginal corporations

6.2.2. State legislation and commitment

The Landscape Act includes several Sections relating to the inclusion of Aboriginal water interests in the planning processes, including:

- Section 7(1)(b) – seeking to support and enhance ecologically sustainable development in an integrated manner that includes supporting the interests of Aboriginal peoples
- Section 7(3)(a) – recognition should be given to the spiritual, social, customary and economic significance of landscapes, and especially natural resources, to Aboriginal people
- Section 7(3)(e) – the requirement that decision making be informed by traditional Aboriginal knowledge
- Section 25(4)(c) – a regional landscape board should seek to work collaboratively with Aboriginal people.

Furthermore, an authorisation issued under Section 105(1) of the Landscape Act – which enables the Minister to authorise the taking (use) of water from prescribed wells for a particular purpose, via a notice published in the SA Government gazette – was published on 13 September 2012 authorising Native Title holders to take (use) water from prescribed wells '*for the purpose of satisfying that person's personal, domestic, cultural, spiritual or non-commercial communal needs where they are doing so in the exercise or enjoyment of their native title rights and interests*'.

State legislation reflects the Aboriginal rights and interests in groundwater recognised in the federal legislation and reinforces the need to incorporate Aboriginal water interests in this Plan.

Additionally, South Australia is a signatory to the National Agreement on Closing the Gap which seeks to '*overcome the entrenched inequality faced by too many Aboriginal and Torres Strait Islander people so that their life outcomes are equal to all Australians*' and includes a target for progressing towards securing Aboriginal rights for inland waters[8].

DEW is currently working with Aboriginal peoples and peak bodies to co-design a 'South Australian Framework to Advance First Nations Water Interests', to support the SA government's commitment, and to identify actions to secure Aboriginal access to water for spiritual, cultural, social, environmental and economic purposes.

The framework will identify actions to:

- strengthen recognition of cultural authority in water planning and management
- secure access to water for economic, social, environmental, spiritual and cultural purposes
- increase Aboriginal ownership of water entitlements
- ensure there is a consistent approach to Aboriginal water interests within the state, while allowing for flexibility to meet individual group needs.

A draft of the Framework, co-designed by many of the Aboriginal Prescribed Body Corporates from across the state including Eyre Peninsula, and by DEW, has identified the key priorities, objectives and outcomes as being:

- Cultural authority
- Self-determination
- Healthy Country
- Cultural economies
- Healthy People.

During the life of this Plan, state policies and programs will continue to seek ways to better address Aboriginal water interests, including increased Aboriginal ownership of commercial water access entitlements. These state policies are still under development, via the abovementioned framework, and therefore cannot be enacted by this Plan at this stage. However, the Landscape Act allows any aspect of this Plan to be reviewed at any time[9], therefore, the implementation of any state policies may be incorporated into a mid-term review of this Plan.

8 Section 87(b) of the National Agreement on Closing the Gap states 'The inland waters target will measure progress towards securing Aboriginal and Torres Strait Islander interests in water bodies inland from the coastal zone under state and territory water rights regimes. This will include data development to identify a nationally consistent measure for inland waters encompassing, for example, water licenses, water rights and water allocation plans'.

9 Section 54(3) of the Landscape Act

6.3. Aboriginal water interests objective

The objective for this Water Allocation Plan relating to Aboriginal water interests is to:

Support the water interests of Aboriginal people relating to:

- the traditional and cultural importance of groundwater, including access to the water resources
- the taking of water from a particular location to avoid damage, disturbance or interference with any site of cultural significance
- legal rights to take water arising from Native Title determinations
- possible economic benefits from entitlements to groundwater in the future.

This Plan does not identify or quantify current and future water needs of Aboriginal people. Instead, the drafting process of this Plan was used to start conversations with Aboriginal people to begin to understand cultural objectives for the prescribed water resources and prepare for future water ownership. However, a significant barrier to the capacity of Aboriginal people to exercise their cultural responsibilities and obligations is the lack of access to Country and particularly sites of cultural significance on private land.

6.4. Providing access to groundwater for Aboriginal people

Supporting water interests of Aboriginal people through the provision of access to the water resources

In consultation with Aboriginal people, the following preliminary objectives in relation to the provision of access to the water resource were identified:

1. an ability to take water in the future for any purpose
2. an ability to take water for amenities at sites of cultural significance to ensure more Aboriginal people will visit, and care for, these sites
3. an ability to take water for the maintenance of cultural sites including springs and red gums (including not taking the water but leaving the water in the ground to assist in preserving these sites for cultural purposes).

This Plan contributes to meeting these objectives as follows:

1. An ability to take water in the future for any purpose – The ability to take water for economic development may be met through the principles outlined in this Plan. The taking of water by Aboriginal people for economic/commercial purposes is subject to the same requirements as any other prospective licensee, these being:

a. issuance of a water access entitlement, authorising access to a portion of the resource, and
b. issuance of a permit to authorise the drilling and construction of a water well.

It is acknowledged that while Aboriginal people have the same rights to take water for economic/commercial purposes as other prospective licensees, there are still barriers for Aboriginal people in achieving economic/ commercial water use, for example ownership of land upon which to use water. While this Plan is an enabler for water related business, continued conversations with Native Title holders to both clarify barriers and consider options to reduce these barriers is necessary to aid in progressing economic/commercial use of the water resources by Aboriginal people in the areas.

2. An ability to take water for amenities at sites of cultural significance to ensure more Aboriginal people will visit, and care for, these sites – Pursuant to Section 105 of the Landscape Act, a notice of authorisation to take water for native title purposes was published in the South Australian Government Gazette on 13 September 2012, page 4437. This authorisation allows for "*the taking of water from any prescribed watercourse, lake or well, or surface water prescribed area within the*

State of South Australia by a person who is a native title holder in relation to the land or waters on or in which that watercourse, lake, well, or surface water prescribed area is situated and the taking is for the purpose of satisfying that person's personal, domestic, cultural, spiritual or non-commercial communal needs where they are doing so in the exercise or enjoyment of their native title rights and interests, providing that the taking does not involve stopping, impeding or diverting the flow of water for the purpose of collecting the water or diverting the flow of water from a watercourse."

Native Title holders therefore have the right to take and use water within a particular area in relation to satisfying their personal, domestic, cultural, spiritual or non-commercial communal water needs.

If the intention is to access groundwater via a well in order to supply water for amenities such as toilets at the ceremonial site, the principles in this Plan are relevant as they manage the location and construction specifications for drilling a well. Other legislation, such as the *Planning, Infrastructure and Development Act 2016*, may be applicable in providing for the permits to undertake construction of the amenities.

Native Title holders may also want to access groundwater for cultural management of Country, including meeting the specific needs of flora and fauna to ensure cultural, ecological and spiritual health. In some cases, this may involve the co-ordinated management of surface and groundwater resources to provide water for cultural water needs, noting that the surface waters of the region are not prescribed.

Depending on the volume of water being used and the purpose of use, this water may be defined under the Landscape Act as being utilised for a domestic purpose, that being the taking of water which does not include–

(a) taking water for the purpose of watering or irrigating land, other than land used solely in connection with a dwelling; or

(ab) without limiting paragraph (a)—taking water for the purpose of watering or irrigating more than 0.4 of a hectare of land; or

(b) taking water to be used in carrying on a business (except for the personal use of persons employed in the business).

Under the Landscape Act, water for domestic purposes is exempt from being charged a levy.

3. An ability to take water for the maintenance of cultural sites including nominated groundwater-dependent ecosystems and other sites of cultural significance (including not taking the water but leaving the water in the ground to assist in preserving these sites for cultural purposes). This objective relates to maintaining the current groundwater-dependent sites of cultural significance within the landscape, which is consistent with a high-level objective of this Plan to minimise the impact of the authorised taking of water on groundwater-dependent ecosystems. However, this objective 3 extends that approach to culturally significant sites other than groundwater-dependent ecosystems nominated by this Plan.

6.5. Incorporating traditional knowledge in groundwater management

Recognising and incorporating the traditional knowledge of Aboriginal people in the management of the take and use of water from the groundwater resources

Incorporating the traditional knowledge of Aboriginal people in the management of the take and use of water from the groundwater resource is integral in achieving successful water planning outcomes. Collaboration with Aboriginal people in relation to water management will take time and whilst the drafting of this Plan commenced conversations with Native Title holders, there is still significant work to be undertaken to truly incorporate the traditional knowledge of Aboriginal people in the water planning framework.

6.6. Protecting sites of cultural significance

Ensuring the taking of water will not damage, disturb or interfere with any site of cultural significance

There is an existing opportunity for Native Title holder input into the decision-making process in relation to where new wells can be drilled. In line with existing practices, in instances where a permit falls within an area where a Native Title Determination exists, or Native Title has not been extinguished, DEW refers the application to the relevant Native Title holder (for example the Registered Native Title Body Corporate or the South Australian Native Title Services) to provide the opportunity for comment. The relevant Native Title holder has 60 days to respond to the request (Section 10.11). In cases where an Indigenous Land Use Agreement (ILUA) exists which refers to matters relating to water, this will be consulted prior to referring the application.

If the Native Title holders respond to the Department identifying that a site of cultural significance may be affected by the proposed well drilling, the Department will work with the Native Title holders and the applicant for the well drilling permit to address the concerns, guided by any ILUA that applies, the SA *Aboriginal Heritage Act 1988*, the *Landscape South Australia Act 2019*, and by this Plan.

Where groundwater resource development is proposed as part of a larger development proposal, the proponent should not rely on referral for comment for individual well drilling permits. Early and effective engagement with the relevant Prescribed Body Corporate will be more effective in determining if the taking of water is likely to damage, disturb or interfere with culturally significant sites.

Identifying the Aboriginal people, communities and representative organisations relevant to a proposal is a crucial element to ensure an engagement process is effective. This is especially important in situations where there is more than one relevant Aboriginal community or Traditional Owner group (Commonwealth of Australia 2016).

Aboriginal input into the decision-making process on applications for large new groundwater extractions, where an application for more than 50 ML/y triggers the requirement for a Risk Management and Monitoring Plan (RMMP, see Section 10.8), would strengthen the different components of the risk assessment processes. The current DEW process requires the applicant to demonstrate that the taking of water would not result in impacts on the groundwater resource, groundwater-dependent ecosystems or existing users. If that is demonstrated, a risk assessment is then undertaken by DEW to inform water licence conditions via the RMMP. Aboriginal input into the decision-making process would inform both of those risk assessment components, seeking to ensure that the large extraction will not damage, disturb or interfere with any site of cultural significance, or diminish the cultural value of a groundwater-dependent ecosystem or site of cultural significance. The inclusion of cultural assessment into decision-making would acknowledge that whilst an impact to a spring or site of ecological significance may be assessed as acceptable from an environmental perspective, the impact may diminish the cultural value of the site.

7. Assessment of the effects on other water resources

Section 53(1)(a)(ii) of the Landscape Act requires a water allocation plan to include '*an assessment as to whether the taking or use of water from the resource will have a detrimental effect on the quantity or quality of water that is available from any other water resource*'. This includes water resources in neighbouring prescribed and non-prescribed areas.

An aquifer may have a hydraulic connection to other nearby aquifers, but the rate of flow and the volumes that flow between them are controlled by the permeability of the geological materials and the differences in their groundwater levels (that is, does a hydraulic gradient exist between them?).

It must be recognised that climatic factors will affect water resources throughout the Eyre Peninsula and care should be taken such that influences are not confused with any effects on the water resources attributed to the taking of water.

7.1. Impacts from aquifer use

The extraction of groundwater is likely to have an impact on the groundwater resource, and it is the role of this Plan to ensure that these potential impacts, as well as impacts on other groundwater users and groundwater-dependent ecosystems, are within acceptable limits.

Around each point of extraction, there will be a zone of influence where drawdown (or a decline in water level, often referred to as a 'cone of depression') will be observed. Outside of this zone, the impact on water levels and groundwater flow will be insignificant, not only within the same aquifer from which the extraction is occurring but also in nearby aquifers that may or may not have a hydraulic connection.

7.1.1. Seawater–fresh groundwater interface

Under natural conditions, coastal aquifers with hydraulic connection to the sea typically form a seawater–fresh groundwater interface. The interface is the underground zone where seawater and lower-salinity groundwater encounter one another. The shape and location of this interface is governed by natural processes including density differences between seawater and groundwater, tidal action and climate-driven seasonal or annual changes in aquifer discharge to the sea.

Disruption of this natural balance can lead to landward migration of the seawater–groundwater interface, a process known as seawater intrusion. This can occur due to:

- groundwater extraction lowering the groundwater level close to the sea level
- reduced groundwater recharge because of lower rainfall (as projected by some future climate change scenarios), causing a lowering the fresh groundwater level and reduce discharge to the ocean
- rising sea level due to climate change.

The rate and extent of seawater intrusion is complex and difficult to predict and once salinisation occurs, it is often irreversible. Therefore, maintaining adequate aquifer discharge to the sea is critical to protecting freshwater resources.

The risk of seawater intrusion is particularly uncertain in Eyre Peninsula's coastal aquifers due to the karstic nature of the limestone formations. These aquifers often exhibit preferential flow through solution features with extremely high transmissivity, increasing vulnerability.

Over the past decade, groundwater levels have declined across coastal aquifers in Uley South, Lincoln South and Bramfield Basins, driven by reduced rainfall, altered recharge patterns and sustained extraction. If levels fall below sea level, seawater intrusion could permanently degrade water quality. Recent investigations into seawater intrusion under current extraction rates have been conducted for the Uley South, Bramfield and Lincoln South Basins.

In Uley South, long-term numerical groundwater models have been developed. Model 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.

In Bramfield, modelling indicates continued inland movement of the seawater interface. Although the modelling shows that the sharp interface (defined by the 50:50 freshwater-seawater isohaline) is unlikely to reach public water supply wells by 2050, rising salinity trends and geophysical data suggest dispersive mixing is already occurring and salinity levels in these wells are expected to continue increasing throughout the life of the Plan.

In Lincoln South, multiple lines of evidence confirm a reversal in the hydraulic gradient has occurred. This has resulted in seawater ingress from the ocean and saline water ingress from Sleaford Mere. Such intrusions pose a serious threat to the fragile Lincoln South lens and the ecosystems dependent on fresh groundwater.

7.1.2. Saltwater upconing

Some aquifer systems exhibit vertical salinity stratification, in which layers of different salinity groundwater overlie one another. This is different to seawater intrusion and can occur away from the ocean, where differences in historical groundwater recharge quantity and quality have caused there to be higher-density brackish or saline groundwater underlaying lower-density, fresher groundwater.

This layering can be unbalanced when extraction from the upper fresh zones causes a local reduction in hydrostatic pressure, resulting in the upward movement of the underlying saline groundwater at or around the point of extraction – a process known as upconing. If pumping rates are reduced or extraction ceases, this process may be mitigated or even reversed.

Recent investigations in Coffin Bay have identified upconing of underlying saltwater as the primary risk to the groundwater resource (Munday et al. 2025). This conclusion is supported by a combination of groundwater salinity data, downhole measurements and geophysical studies. Unlike seawater intrusion, upconing can generally be mitigated through operational adjustments, such as modifying extraction rates and implementing trigger-level management strategies. These approaches help minimise the risk to groundwater resources and maintain the integrity of freshwater lenses.

7.2. Impact of taking from one resource on another

There are no perennial watercourses within the Southern Basins or Musgrave PWAs. Consequently, all watercourses flow predominantly under losing stream conditions, meaning that the streams generally lose water to the aquifer and so are not reliant on groundwater discharge as their source of water.

Sleaford Mere, Sheringa Lagoon (Lake Hamilton Wetland complex) and Lake Newland are the only perennial surface water bodies within the PWAs. These water bodies are essentially back-dunal saline lakes and are recipients of groundwater discharge. The taking of water from connected aquifers is not likely to impact on water quantity or general water quality of these surface water bodies. However local fresh-to-brackish groundwater discharges are known to be of ecological significance and therefore warrant protection from groundwater extraction.

Little Swamp, Big Swamp and numerous minor surface water bodies are generally ephemeral and rely on rainfall and local 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 Quaternary Limestone aquifers of the Lincoln and Uley Basins respectively (Harrington et al. 2006; Evans et al. 2009). The taking of water from adjacent management areas are unlikely to impact these surface water bodies as they are disconnected and lie at a higher elevation than the watertable.

Even if there is hydraulic connectivity between two adjacent management areas within the Quaternary Limestone aquifer, the taking of water from one area is likely to only have an impact if the zone of influence from extraction extends to the other area. Such impacts will be restricted to the area near the management area boundary. The majority of inflow to each of these management areas is predominately from infiltration of local rainfall (both rapid and diffuse) and not lateral inflow.

7.2.1. Protection for public water supply resources

A groundwater protection zone (GWPZ) is applied in this Plan to constrain the taking of water in order to maintain the integrity of the Quaternary Limestone aquifer Uley South Consumptive Pool, which is solely used for public water supply. In order to protect any impacts to the public water supply resource, a GWPZ has been assigned to both the Tertiary Sands and Basement management areas of the Southern Basins PWA (Figure 7-1) where the aquifers are overlain by publicly owned land that falls within the Uley South management area. Within these GWPZs, the construction of new wells and the taking of water will be subject to Principle 42.c in Section 10 of the Plan to ensure that pumping from the deeper aquifers does not cause downward leakage and losses from the Quaternary Limestone aquifer into the Tertiary Sands or Basement aquifers. Where the management area extends to privately owned land the GWPZs do not exist, thereby allowing landholders to access water from the deeper aquifers.

7.2.2. Protecting the Quaternary aquifer where the Tertiary clay aquitard is absent

In locations where the Tertiary clay aquitard is absent, there is the potential for the Quaternary Limestone aquifer to be connected to the underlying Tertiary Sands or Basement aquifers. In these cases, the construction of new wells and the taking of water for licensed purposes from the Tertiary Sands or Basement aquifers is limited to protect the overlying Quaternary Limestone aquifer. This is to minimise the potential for downward leakage in these areas if the hydraulic head gradients are varied.

As a way of protecting the Quaternary Limestone aquifer from this downward leakage, buffer zones have been established around areas where the Tertiary clay aquitard is absent (based on the best science currently available (Stewart 2013)). Figure 7-2 and Figure 7-3 outline the areas of clay absence, as well as the buffer distances required to protect the Quaternary resource in the Southern Basins and Musgrave PWAs, respectively. Details on how the buffer distances have been determined are outlined in Stewart (2013: 48–51).

The setting of buffer zones limiting the location of new licensed wells will protect the Quaternary Limestone aquifer from indirect stress associated with taking water from a connected aquifer system.

Table 7-1 outlines the distance from the clay absent area within which new wells for the purposes of extraction from the Tertiary Sands or Basement aquifers will be prohibited.

Table 7-1 Adopted buffer distances around areas where the Tertiary clay is absent

Location	Buffer distance (m)
Talia area	5,059
Remaining areas in Musgrave PWA	1,417
Uley South area	163
Remaining areas in Southern Basins PWA	1,417

Data presented in Figure 7-2 and Figure 7-3 are based on the best science available at the time of producing this Plan (Stewart 2013) and it is acknowledged that there may be additional areas of Tertiary clay absence where there is no drillhole data currently available.

Additionally, there may be areas where, although the Tertiary clay aquitard is absent, there is a similar low-permeability confining layer present which separates the Quaternary Limestone aquifer from the underlying aquifers. In these situations, it may be possible for new or additional extractions to be taken from the Tertiary Sands or Basement aquifers provided it can be proven (to the satisfaction of the Minister) that either:

- the Quaternary Limestone is unsaturated, and a management regime exists which can adequately manage all aquifers should it become saturated, or
- a similar confining layer to the Tertiary clay aquitard is present and will protect the Quaternary Limestone aquifer from downward leakage should water be taken from the underlying aquifers.

Section 10.12 of this Plan provides the rules for the siting of wells and the taking of groundwater where the Tertiary clay aquitard is absent.

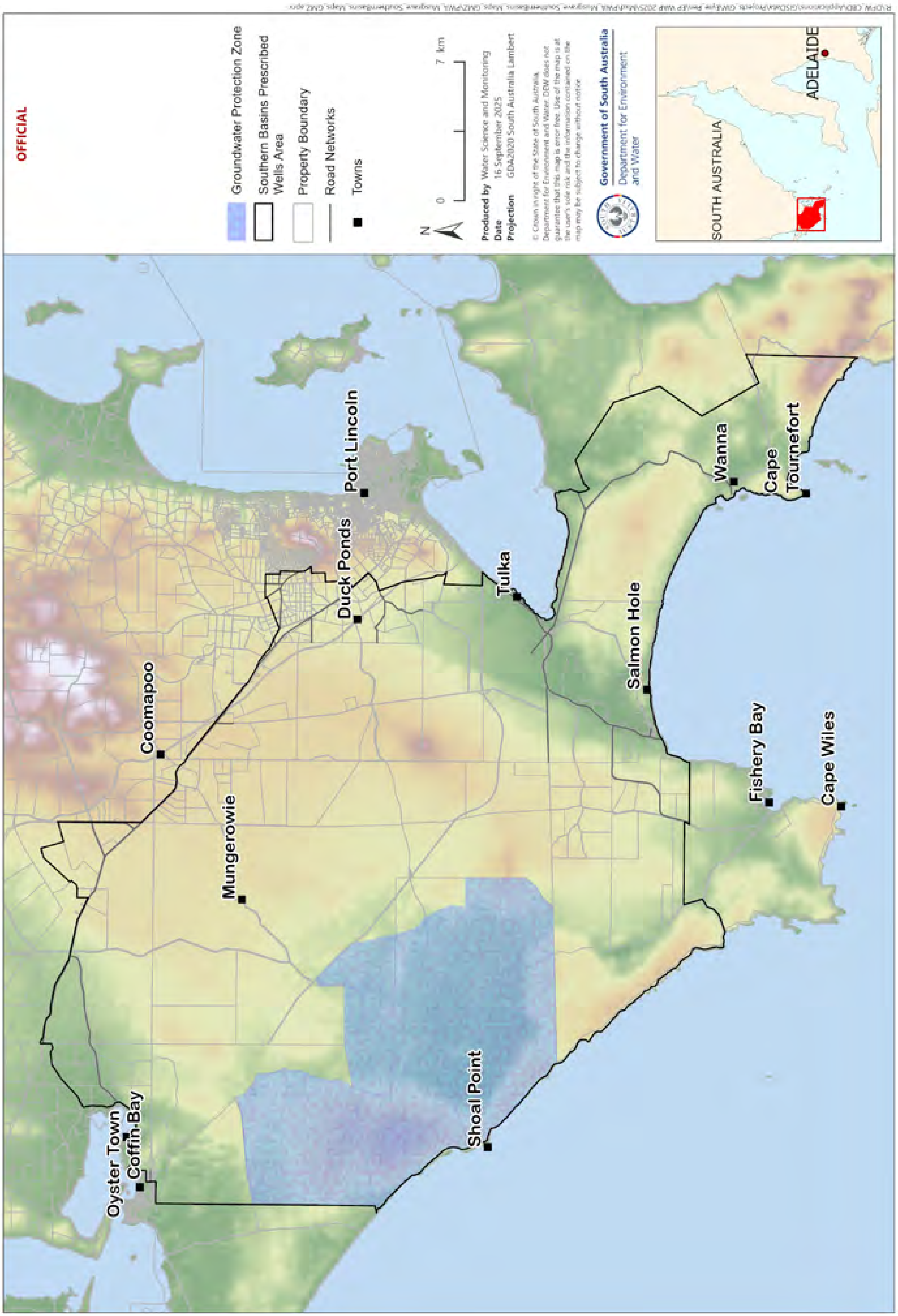

Figure 7-1 Groundwater protection zones for the Tertiary Sands and Basement aquifers of the Southern Basins PWA

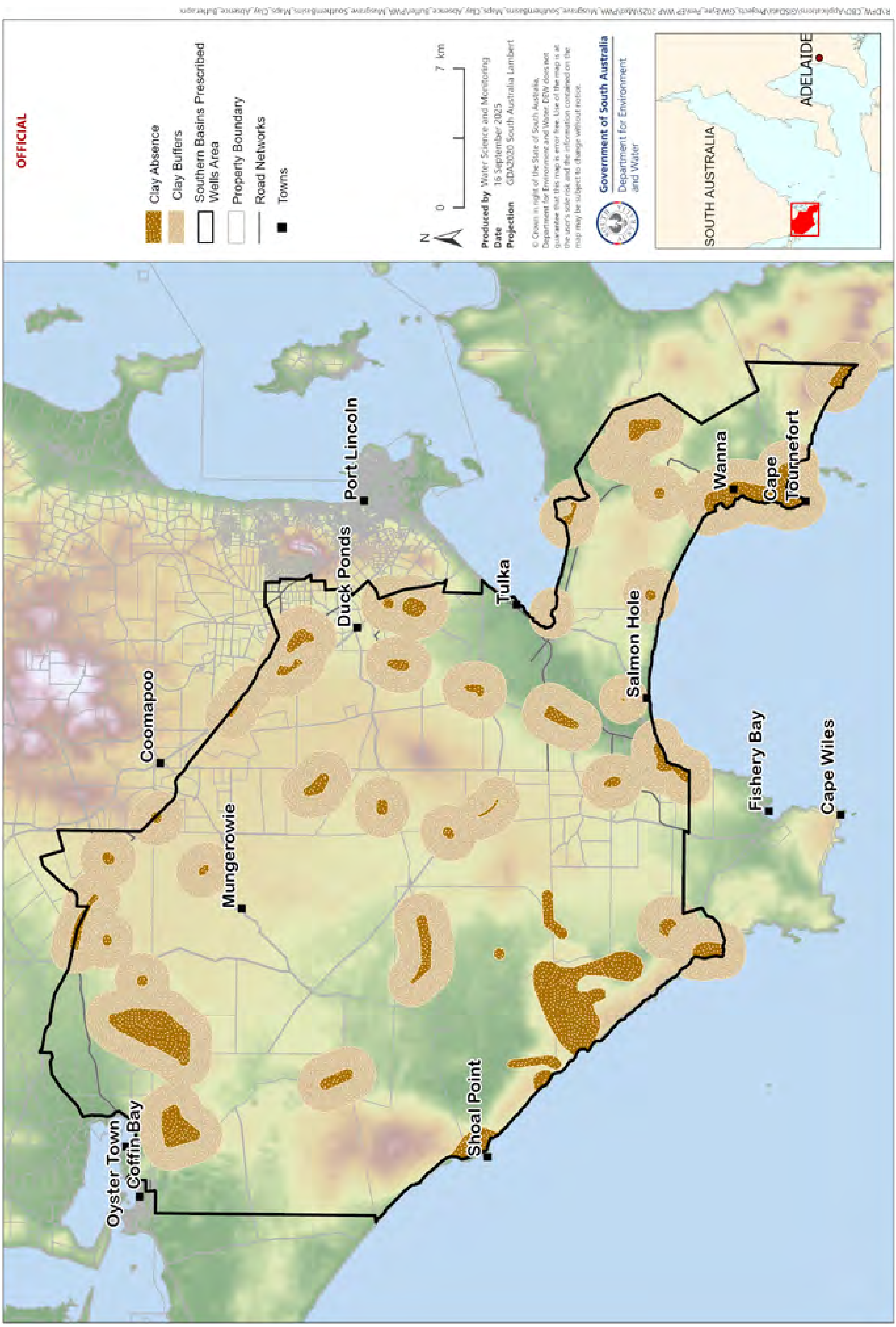

Figure 7-2 Spatial extent and adopted buffer areas where the Tertiary clay aquitard is absent within the Southern Basins PWA

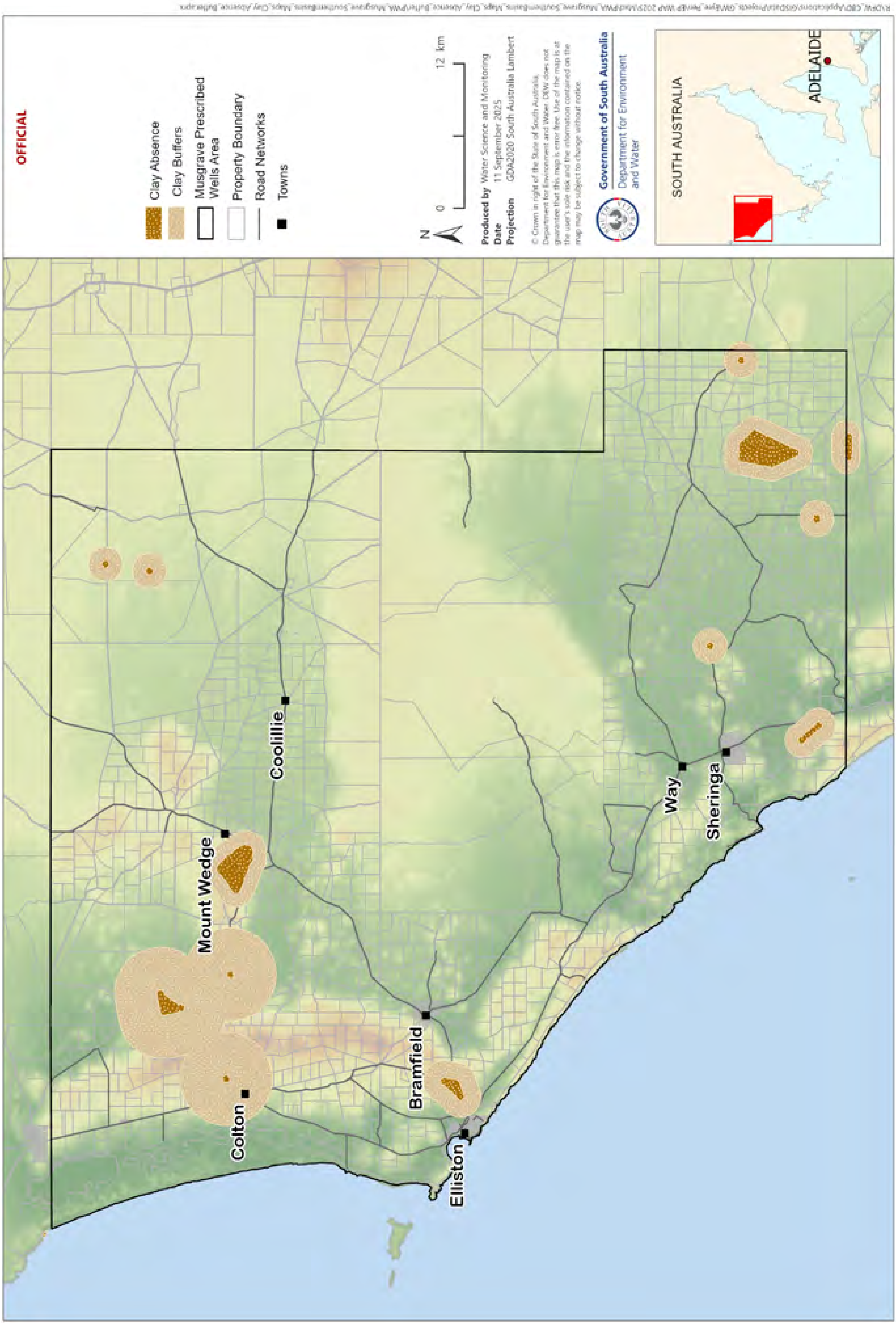

Figure 7-3 Spatial extent and adopted buffer areas where Tertiary clay aquitard is absent within the Musgrave PWA

7.2.3. Protection around wetland groundwater-dependent ecosystems

Wetland groundwater-dependent ecosystems are at risk from groundwater extraction if that extraction leads to a reduction in the surface expression of groundwater levels or periodicity of inundation that, in turn, adversely affects wetland biota or changes the ecological character of the wetland groundwater-dependent ecosystem. This is illustrated in Figure 7-4 (a), (b) and (c). A natural, undeveloped landscape containing a wetland groundwater-dependent ecosystem is shown in (a). The seasonal maximum and minimum water levels are displayed and indicate that this would be a permanent wetland (e.g. Sleaford Mere). If unmanaged groundwater pumping occurred close to this wetland groundwater-dependent ecosystem, it may generate a localised cone of depression that could reverse the groundwater flow direction and deprive the wetland groundwater-dependent ecosystem of water, as shown in (b). In this case, unmanaged pumping would convert the permanent wetland into a temporary one with a lower maximum water level. This would lead to the sedges and tea trees fringing the wetland no longer being inundated which would then lead to degradation of these environmental values.

Implementation of Environmental Protection Zones that require wells to be placed at a set-back distance from the groundwater-dependent ecosystem wetland will mitigate the impacts of pumping. This, coupled with implementation of consumptive limits that manage the level of take, effectively protects the wetland groundwater-dependent ecosystem by generating a much smaller cone of depression further away from the wetland groundwater-dependent ecosystem, as in (c). This will also protect the water resource by preventing excessive take.

Environmental protection zones (shown in Figure 7-6, Figure 7-7 and in Table 7-2) are set around the known wetland groundwater-dependent ecosystems within the Southern Basins and Musgrave PWAs (see Stewart 2013: 42–47). Within these groundwater-dependent ecosystems and environmental protection zones, the construction of new wells for the taking of water from the Quaternary Limestone aquifer for licensed purposes will not be permitted (see Section 10.12) unless it can be proven (to the satisfaction of the Minister) that take from within these groundwater-dependent ecosystems and environmental protection zones will not detrimentally affect the groundwater-dependent ecosystem.

This restriction will protect the known wetland groundwater-dependent ecosystems from the impacts of extraction which could lower groundwater levels and reduce the availability of water for these groundwater-dependent ecosystems. This prohibition will not however protect the wetland groundwater-dependent ecosystems against the impacts of drought-induced declines in groundwater level.

Whilst analysis of regional geology, lithological logs and depth to groundwater (SKM 2009) suggest that both Big and Little Swamp are disconnected from the Quaternary Limestone aquifer, consensus from the community is that these wetlands should also have environmental protection zones given that Big Swamp is listed on the register of nationally important wetlands. It is considered that the environmental protection zones may act to protect the vegetation reliant on groundwater in the vicinity of the swamps from any extraction from the Quaternary Limestone aquifer.

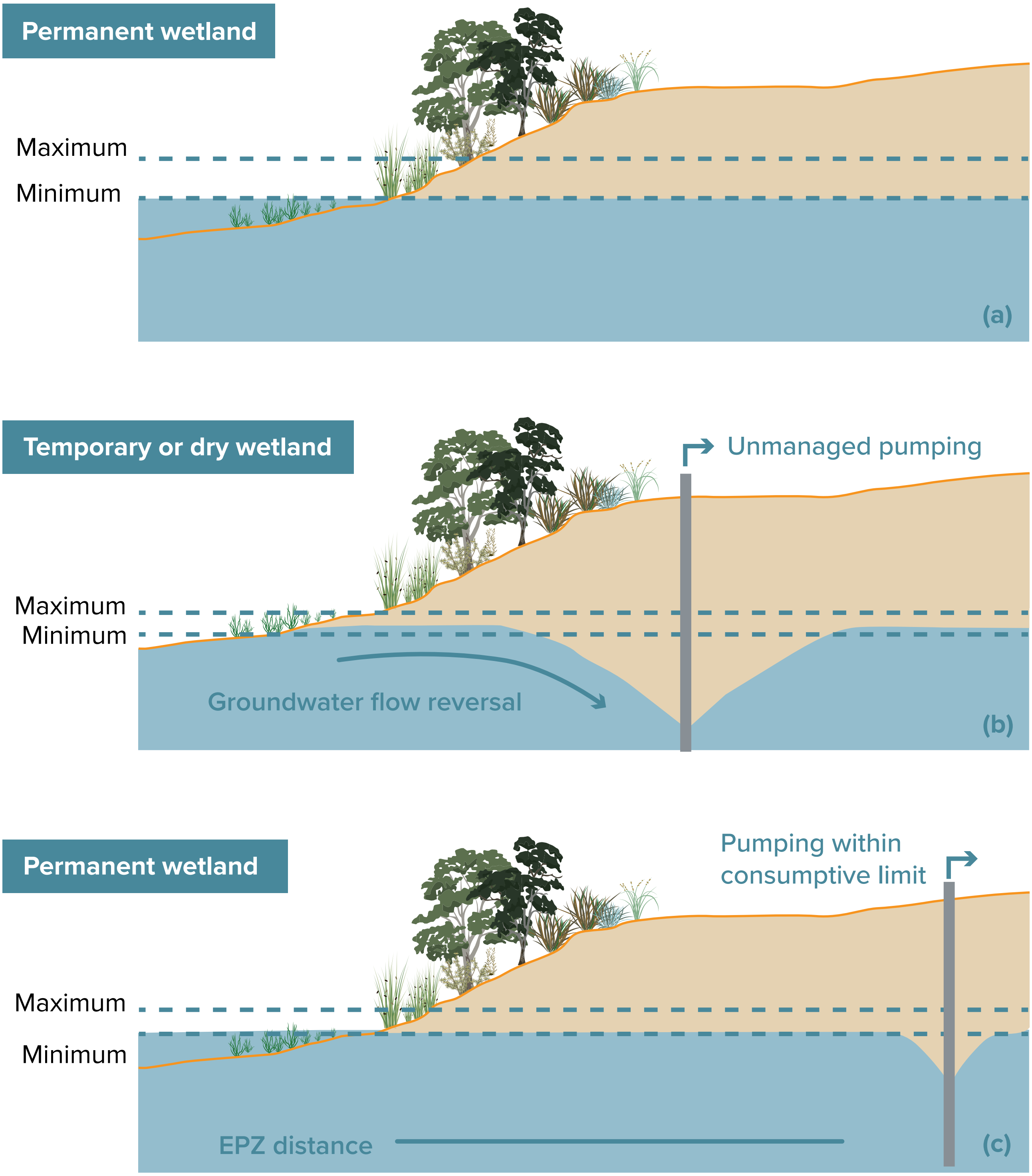

Figure 7-4 Conceptual diagram of how the use of environmental protection zones and consumptive limits protect wetland GDEs

a = permanent wetland groundwater-dependent ecosystem with no development showing groundwater maximum and minimum levels

b = unmanaged pumping leading to cone of depression and drying of the wetland and surrounding vegetation

c = managed pumping outside of an environmental protection zone and within consumptive limits showing mitigation of the effects of pumping on the wetland groundwater-dependent ecosystem

Environmental protection zones for the Quaternary Limestone aquifer have been determined from the range of transmissivity and specific yield values stated in Table 1-2 in Stewart (2013:43), assuming a pumping rate of 133 kL/d (that is, an annual allocation of 10 ML, used in its entirety and extracted continuously over an irrigation season of 75 days). This is likely to be a conservative estimate, as the majority of users on the Eyre Peninsula will extract their allocations over a longer period of time resulting in smaller zones of impact. The maximum allowable drawdown of water within the wetland is 1 cm. Due to the exponential nature of the equation used to calculate the environmental protection zone distances in cases where the aquifer properties (specific yield or transmissivity) were very low, the resultant environmental protection zone was unrealistically large. Therefore, in these cases the environmental protection zone has been limited to a maximum extent of 5 km (Stewart 2015).

Table 7-2 Adopted environmental protection zone (EPZ) distances around identified GDEs

PWA	Groundwater-dependent ecosystem	EPZ Distance (m)
Southern Basins	Pillie Wetland Group	2,187
	Sleaford Wetland Group	2,187
	Wanilla Wetland Group	1,294
	Big Swamp	1,294
	Little Swamp	1,294
	Duck Ponds Creek	1,294
	Black Swan Lane	1,294
Musgrave	Hamilton Wetland Group	3,530
	Newland Wetland Group	5,000
	Poelpena Wetland	5,000

7.2.4. Protection of red gum communities

Phreatophytic red gums on the Eyre Peninsula are dependent on groundwater when mature, for survival, and require access to significant soil moisture when growing from a seedling into a mature tree (Figure 7-5). They do not seem to be dependent on groundwater for germination. Instead, they appear to germinate following infrequent heavy rainfall when rainwater ponds around mature red gums for a period of weeks. This ponding then simulates flood conditions suitable for the germination of fallen seeds (Doeg et al. 2012). There is limited scope for management to protect these red gums and ensure recruitment of new trees into the population. Groundwater management through the implementation of environmental protection zones around red gums as well as groundwater level triggers in relevant consumptive pools are the main options for protecting the red gums. The other key management strategy would be to exclude stock from areas where red gums are germinating and growing, but this type of land management is outside the scope of this Plan.

Given that the distribution of phreatophytes such as red gums is regionally widespread and any inferred mapping such as by using the Normalised Differential Vegetation Index or aerial photography has yet to be ground-truthed, there is currently insufficient information to apply environmental protection zones to individual red gum standings. However, based on community input, significant red gum communities will be protected from the authorised taking of water through environmental protection zones around these communities.

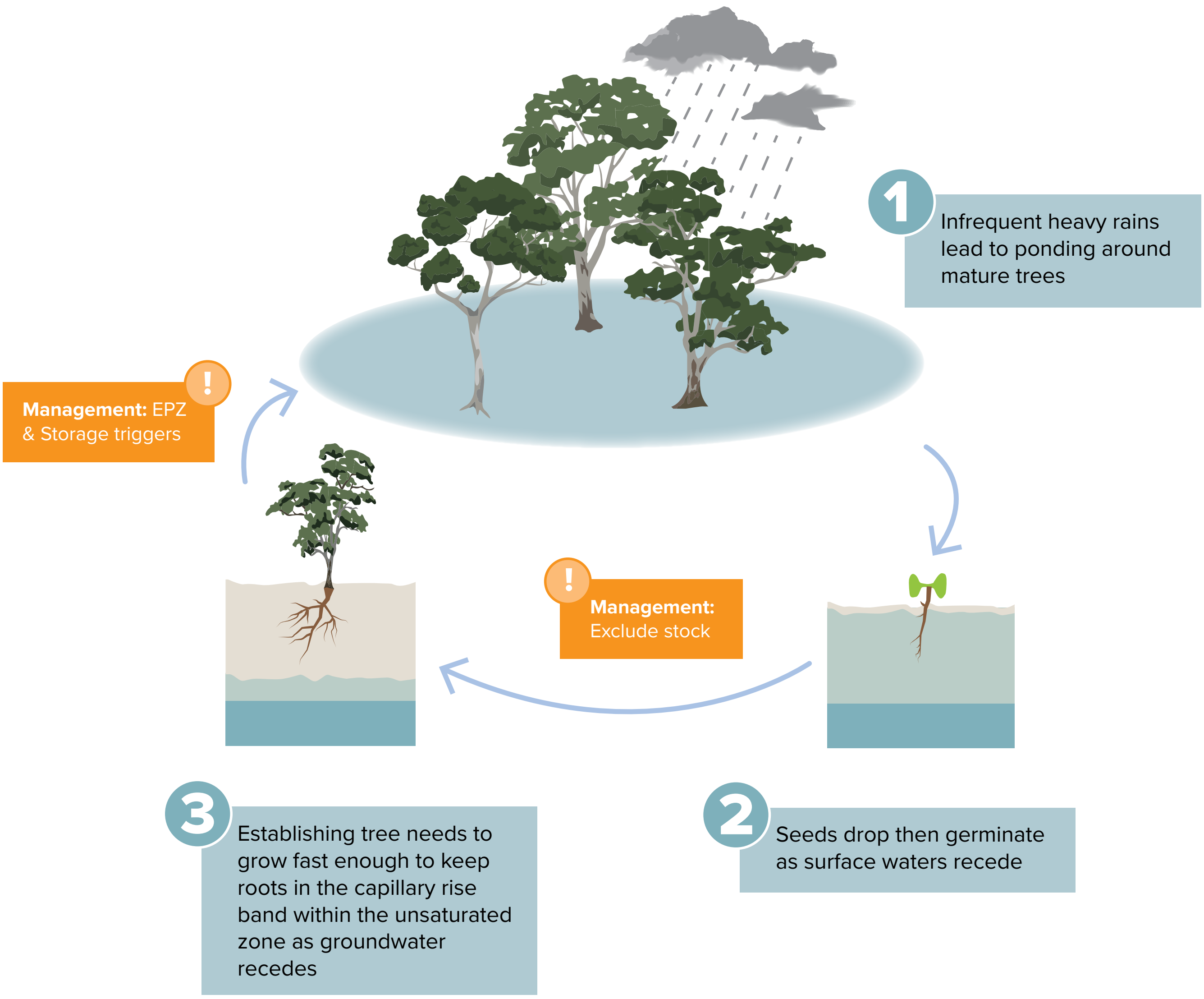

Figure 7-5 Conceptual model showing the phreatophytic red gum life cycle, roles of different water sources and management influences

Significant red gum communities were identified through community consultation and are presented in Figure 7-6 and Figure 7-7. Environmental protection zones have been calculated from the maximum transmissivity and specific yield values stated in Table 1-2 in Stewart (2013:43), assuming a pumping rate of 1.33 KL/d (that is, an annual allocation of 10 ML, used in its entirety and extracted continuously over an irrigation season of 75 days). The maximum allowable watertable drawdown at the full extent of the zone is 10 cm as this is considered to be within the red gums' tolerance to changes in water level. The resultant environmental protection zone distance for all red gum communities is 1,894 m (Stewart 2015).

7.2.5. Protection of marine discharges

The maintenance of groundwater discharge to the sea to prevent sea water intrusion will have the added benefit of providing on-going fresh groundwater discharge to estuarine systems (for example, Kellidie Bay). This is important for some ecosystems that have at least some dependence on such groundwater discharge.

To protect such groundwater discharges, a setback distance from the coast (in the form of an environmental protection zone) has been calculated to restrict the taking of water near the shore.

Environmental protection zones have been determined from the range of transmissivity and specific yield values stated in Table 12 in Stewart (2013:43), assuming a pumping rate of 1.33 KL/d (that is, an annual allocation of 10 ML, used in its entirety and extracted continuously over an irrigation season of 75 days). The maximum allowable watertable drawdown at the full extent of the zone is 10 cm (Stewart 2015). The resultant environmental protection zones for marine discharges can be seen in Table 7-3 and Figure 7-6 and Figure 7-7.

Table 7-3 Adopted buffer distances around identified marine discharges

PWA	Marine discharge location	EPZ distance (m)
Southern Basins	Kellidie Bay	444
	Tulka	751
Musgrave	Elliston	147

7.3. Water resources in adjacent non-prescribed wells areas

The groundwater resources in the adjacent non-prescribed areas are generally of poor quality and are low yielding. The taking and use of water from the Quaternary, Tertiary Sands and Basement aquifers in the Southern Basins PWA or Musgrave PWA are not expected to detrimentally affect these resources. Minor impacts could occur in areas near the PWA boundary if the resultant zone of influence of water extraction (that is, cone of depression) extends beyond the PWA. Coffin Bay is the exception - drilling found goodquality water in the National Park to the northwest of the PWA, if large volumes of water were to be taken from this area, it may result in declining water levels within Coffin Bay or increased upconing to compensate for the loss of fresh water.

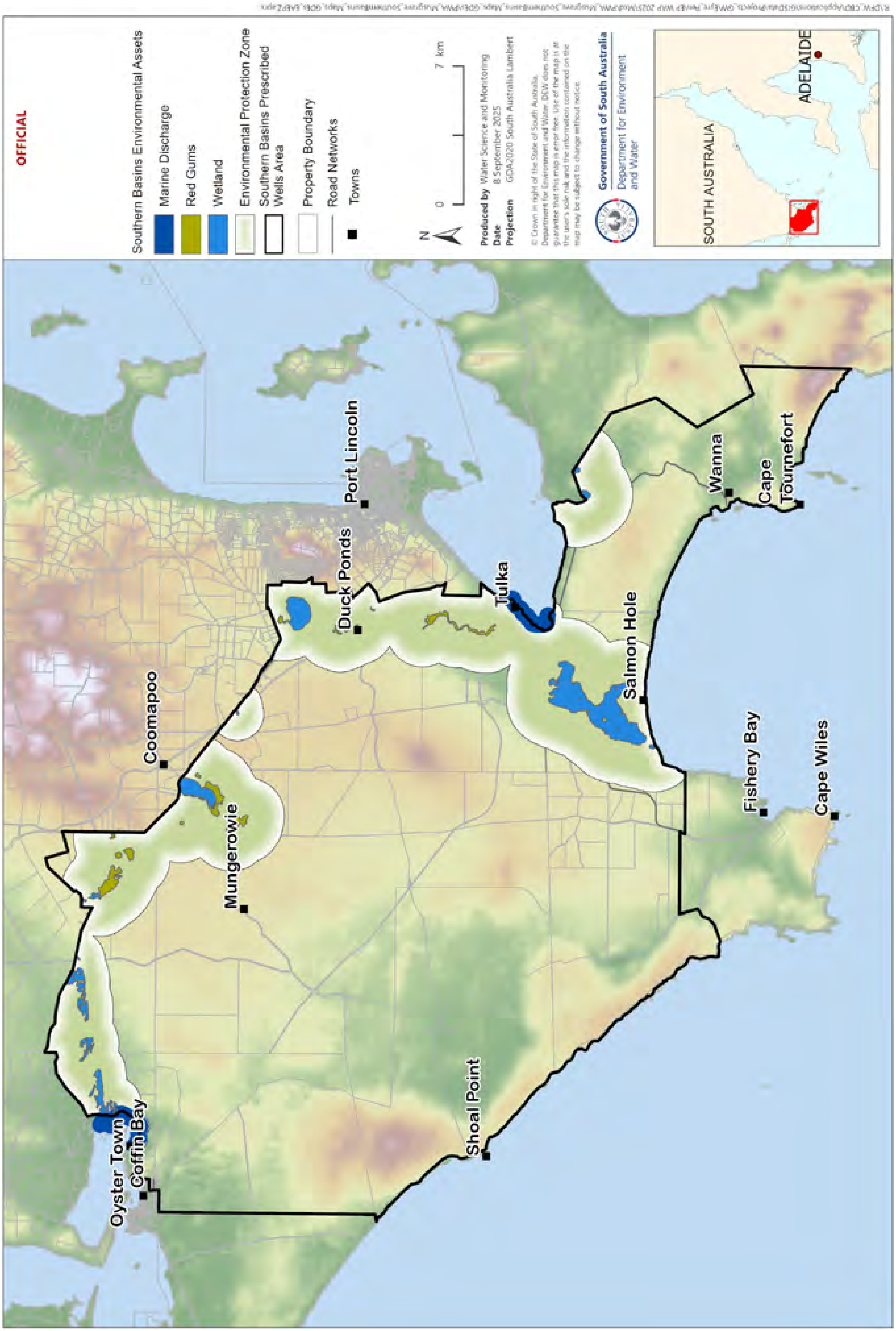

Figure 7-6 Spatial distribution of environmental assets and environmental protection zones within the Southern Basins PWA

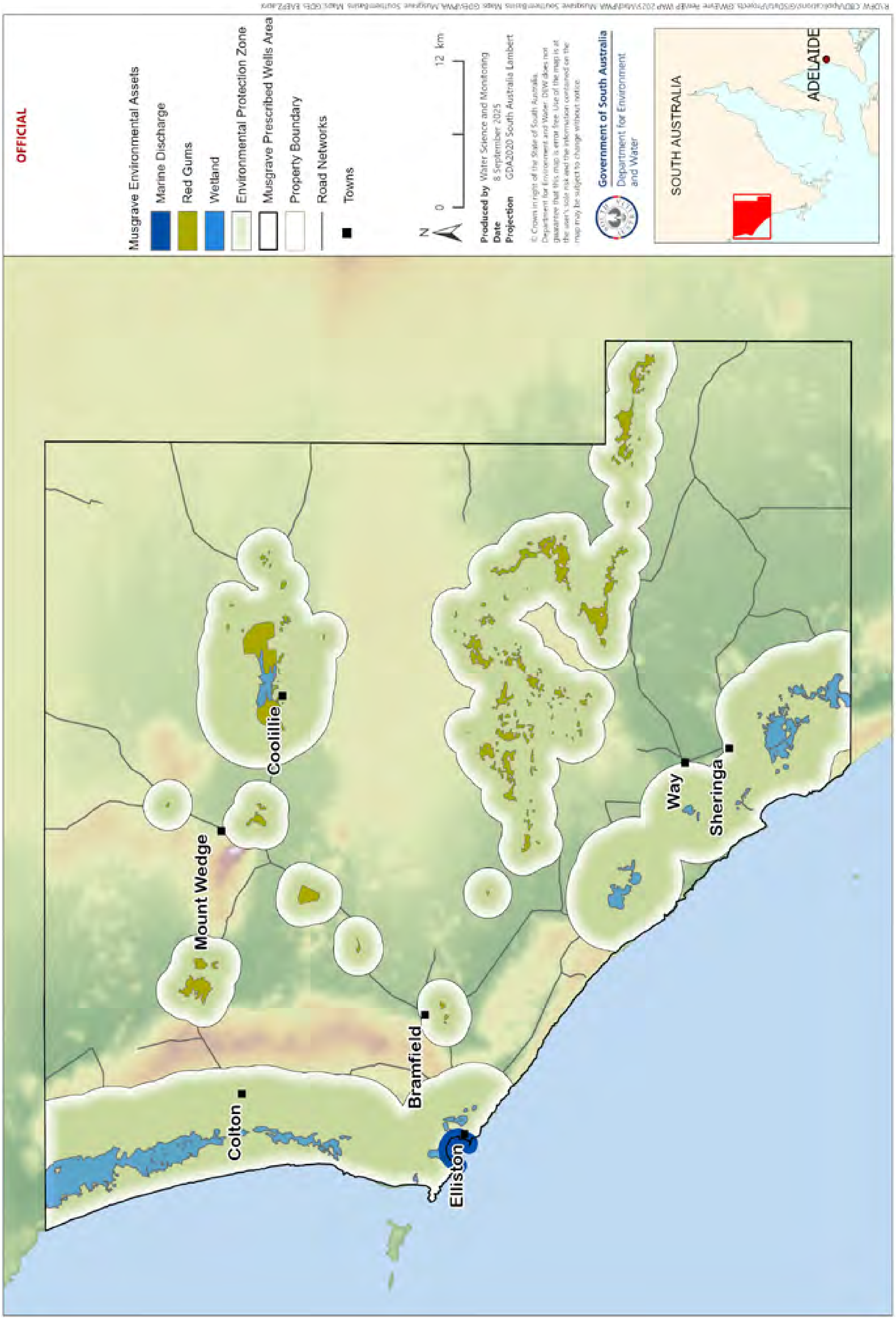

Figure 7-7 Spatial distribution of environmental assets and environmental protection zones within the Musgrave PWA

8. Assessment of demands on the water resources

Section 53(1)(f) of the Landscape Act requires a water allocation plan to '*assess the capacity of the resource to meet the demands for water on a continuing basis…*'. The demands on the resource include water for both consumptive and non-consumptive purposes. Consumptive demands include licensed water use, for example water for commercial irrigation and public water supply. Non-licensed consumptive water use includes water for stock or domestic use, and water take authorised by the Minister under Section 105 of the Landscape Act, such as water for emergency firefighting and water used in the making of public roads. Non-consumptive demands include water required to maintain natural groundwater processes such as aquifer throughflow and groundwater discharges that assist in the provision of water for the environment.

8.1. Licensed Quaternary Limestone aquifer management areas

The resource capacity for the Licensed Quaternary Limestone aquifer management areas (excluding Uley South and Bramfield) was calculated as outlined in Section 4.2.3 of this Plan. This resource capacity is required to meet non-consumptive demands (groundwater-dependent ecosystems and aquifer maintenance) and consumptive demands (water for licensed and non-licensed purposes).

8.1.1. Non-consumptive demands

The non-consumptive demand is important for several reasons. If too much water is made available for licensed and consumptive purposes, there may be impacts on the water balance in other areas, such as reducing natural discharges and altering flow directions. For example, maintaining groundwater flow gradients toward the sea is particularly important in coastal areas to minimise the risk of sea water intrusion. There is also a need to provide a buffer of sufficient aquifer storage for extended periods of below average rainfall and recharge, as well as maintaining natural discharge to provide sufficient water for groundwater-dependent ecosystems. To maintain the processes which, constitute the non-consumptive demand, not all of the recharge to the aquifer can be made available for extraction for consumptive purposes.

Ultimately, the percentage of water set aside for aquifer maintenance and groundwater-dependent ecosystems depends on a balance between the various management objectives from a resource perspective and social and economic considerations. The percentage of the recharge that is set aside for non-consumptive purposes for the various Licensed Quaternary Limestone aquifer management areas has been determined through a risk assessment undertaken in accordance with the approach used for the previous Plan and developed by Sinclair Knight Merz (SKM 2013). The risk assessment approach was consistent with the Risk Management Policy and Guidelines for Water Allocation Plans (DEWNR 2012). While the risk assessment approach has been followed, the risk levels for some resources have changed over time resulting in different risk levels from the previous Plan.

The risk assessment took into consideration:

- accessibility risk – the risks to users (licensed and non-licensed) of restricting water for consumptive use, that is risks to the social, cultural and economic values of not being able to access groundwater
- environmental risk – the risks to the aquifer and environment of extracting water for consumptive use.

Risk assessment was built into the modelling for Bramfield and Uley South consumptive pools and therefore the following Section does not apply to these consumptive pools. For risks associated with Bramfield and Uley South see Section 4.3.

For the Polda Consumptive Pool, the risk assessment method was refined during community consultation in 2014 to be more conservative than the 60% result from application of the risk assessment as determined in SKM (2013). The approach to changing the percentage was discussed in the previous Plan and has been followed through to this Plan.

8.1.1.1 Defining accessibility risk

Groundwater is used widely across the PWAs of Eyre Peninsula and provides a critical source of water for domestic, stock, recreation, irrigation and industrial use. There are potentially severe social and economic impacts if there is not sufficient access to groundwater to meet these demands.

Two types of risk factors were used to assess the accessibility risk:

- users are not allocated sufficient groundwater to meet their consumptive needs
- there is no alternate water supply available to meet user needs.

The likelihood and consequence of these factors occurring is based on several criteria. For example, the likelihood of there being insufficient groundwater available for consumptive demand depends partly on the amount of extraction (number of users and the volumes taken) compared with the resource capacity. The likelihood is low for under-developed systems and higher for more developed systems.

The potential availability of a cost-effective alternative water supply is also considered. The lowest risk ranking is given in areas where there are existing lower cost alternatives to groundwater, such as access to an SA Water pipeline. The highest ranking was applied where accessing an alternative water supply would be expensive, such as where desalination is the only alternative.

This risk ranking was influenced by the ease of access to alternative water supplies for all users including water utilities, irrigators, recreational and stock and domestic users.

8.1.1.2 Defining environmental risk

The groundwater resources support many types of ecosystems across Eyre Peninsula including wetlands, estuaries and vegetation. If there is too much extraction of groundwater, then less will be available to sustain these ecosystems, possibly leading to degradation.

Three types of risk factors were used to assess the environmental risk:

- the presence of groundwater-dependent ecosystems in an area where there is extraction
- aquifer integrity (based on salinity), which could be impacted by extraction
- aquifer integrity (based on groundwater levels), which could be impacted by extraction.

The likelihood and consequence of these factors occurring is based on several criteria. For example, groundwater-dependent ecosystems are assessed on whether they are present, how sensitive they are to changes in groundwater salinity or levels, and whether there is licensed extraction nearby.

Aquifer integrity is assessed using groundwater monitoring records, beneficial use criteria (that is, what is the groundwater used/needed for) and how robust the aquifer is considered to be. The robustness of the groundwater resource (each consumptive pool) is assessed by comparing the storage capacity within the aquifer with the estimated amount of recharge (that is, how much water enters the aquifer).

The overall environmental risk ranking is decided by taking into account all these factors.

8.1.1.3 Risk matrix

By considering the likelihood and consequence of the different risk factors, scores for individual management areas were able to be determined by ranking the accessibility and environmental risks as either ‘High’, ‘Moderate’ or ‘Low’ (Table 8-1).

Table 8-1 Risk assessment matrix with management areas

Composite rankings		Accessibility risk: Low	Moderate	High
Environmental risk	Low	Lincoln North		
	Moderate	Sheringa	Uley North	
	High			Coffin Bay Polda

The split between water that is made available to the environment (non-consumptive portion) and users (consumptive portion) is determined based upon where each management area fits in the risk matrix. Management areas with high accessibility risk and low environmental risk require a high proportion allocated to users (consumptive demand) to mitigate risk. Management areas with higher environmental risk and lower accessibility risk required a high proportion allocated to aquifer maintenance (Table 8-2 and Table 8-3). The amount provided to each management area is dependent on which is more at risk from lack of groundwater. It was acknowledged that a management area with a high environmental risk requires a higher proportion for aquifer maintenance even if there was a high accessibility risk. This recognises that even if there is a high risk to users if consumptive use is restricted, if the aquifer storage or salinity is affected (environmental risk) the aquifer may not be able to provide suitable water (volume or quality) to meet consumptive demands.

Table 8-2 Risk assessment matrix with environmental and accessibility split

Composite rankings		Accessibility risk: Low	Moderate	High
Environmental risk	Low	More even split		Larger consumptive demand portion and smaller aquifer maintenance portion
	Moderate		More even split	
	High	Smaller consumptive demand portion and larger aquifer maintenance portion		More even split

8.1.1.4 Consumptive to non-consumptive ratios

Each management area has different aquifer properties and supports different levels of extraction. Some contain and maintain more groundwater-dependent ecosystems than others and there is some variation in the availability of feasible or cost-effective water sources other than groundwater. This variety means that users within each management area may be at lower or higher risk from insufficient water supply and that an aquifer or the environment is at greater risk from extraction in some management areas compared to others. Under the previous Plan, the results of the risk assessment for all management areas of the Quaternary Limestone aquifer across the Southern Basins and Musgrave PWAs provided the preliminary resource capacity for non-consumptive and consumptive demand (Table 8-4).

Table 8-3 Risk assessment matrix ratios

Composite rankings		Accessibility risk		
		Low	Moderate	High
Environmental risk	Low	50% consumptive	60% consumptive	70% consumptive
		50% non-consumptive	40% non-consumptive	30% non-consumptive
	Moderate	40% consumptive	50% consumptive	60% consumptive
		60% non-consumptive	50% non-consumptive	40% non-consumptive
	High	20% consumptive	30% consumptive	40% consumptive
		80% non-consumptive	70% non-consumptive	60% non-consumptive

Table 8-4 Preliminary resource capacity for non-consumptive and consumptive demand

PWA	Management area	Non-consumptive demands (%)	Consumptive demands (%)
Southern Basins	Coffin Bay	60	40
	Uley North	50	50
	Lincoln North	50	50
Musgrave	Polda	60	40
	Sheringa	60	40

Based on the most recent assessment of resource conditions, and taking into consideration the current water access entitlements held on water licences in each consumptive pool, the percentage of water set aside for non-consumptive demands will be set as displayed below in Table 8-5. High accuracy (multiple decimal points) is required to reduce the excess water for each consumptive pool to be equal to zero. This is to improve water security for existing water users under a changing climate.

Table 8-5 Resource capacity reserved for non-consumptive and consumptive demand

PWA	Management area	Non-consumptive demands (%)	Consumptive demands (%)
Southern Basins	Coffin Bay	59.89	40.11
	Uley North	92.20	7.80
	Lincoln North	50.01	49.99
Musgrave	Polda	98.05	1.95
	Sheringa	92.74	7.26

8.1.2. Consumptive demands

The resource capacity for the majority of the Licensed Quaternary Limestone aquifer management areas was defined by the equation in Section 4.2.3 as:

Resource capacity (ML) = Recharge area (km^2) x Recharge rate (mm)

The resource capacity is the total amount of water available for consumptive demand and non-consumptive demand, that is, total demand. Thus:

Resource capacity = Total demand

Where:

Total demand = Consumptive demand + Non-consumptive demand.

Therefore, consumptive demand can be calculated as:

Consumptive demand = Total demand – Non-consumptive demand

Consumptive demand includes water available for non-licensed demand, water available for licensed demand and excess water where:

- Non-licensed demand includes stock and domestic requirements and Minister's authorisations
- Licensed demand is water for any purpose that requires a licence
- Excess water is water that may be granted on account of a new water access entitlement under a water licence, or additional water that may be granted on account of an existing water access entitlement, but which is yet to be granted.

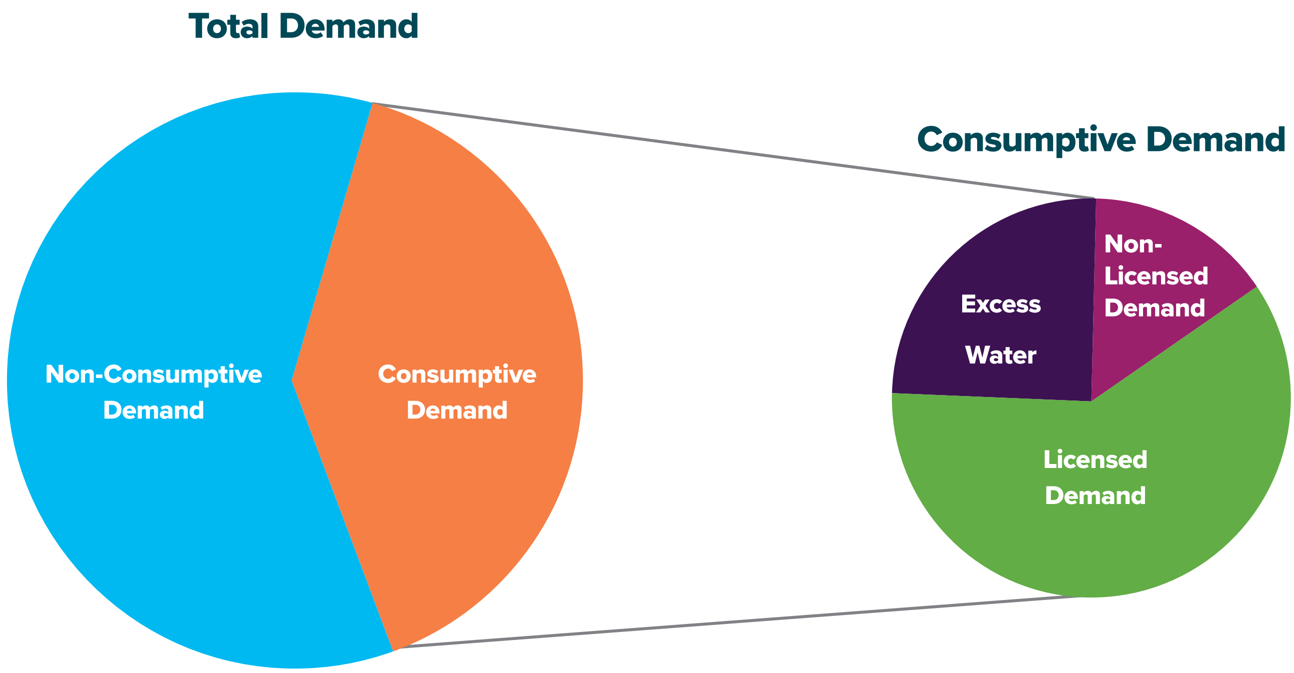

Figure 8-1 Diagrammatic representation of total demand and consumptive demands of the saturated Quaternary Limestone management areas

8.1.2.1 Non-licensed demand

Non-licensed water use includes water for stock and domestic use and water authorised by the Minister under Section 105 of the Landscape Act, for example water for firefighting and public road making. The estimation of non-licensed demand was robustly established in the previous Plan. Community consultation during the development of this Plan confirmed that stock and domestic water use has remained largely unchanged. Consequently, a full recalculation of these demands was not undertaken; however, adjustments were made where necessary to align with the revised consumptive pool boundaries.

It is considered unlikely that the estimates of stock and domestic water use outlined in the Sections below will vary significantly throughout the life of this Plan. However, these estimates are based on past data and are subject to change in response to market conditions. A standard 5 ML per management area has been assumed to be sufficient to meet future authorisations by the Minister.

8.1.2.1.1. Method for estimating stock water use

The number of stock held on any given parcel of land can be normalised to a standard unit – the Dry Sheep Equivalent (DSE). The DSE is a standard unit used to estimate feed requirements of different classes of stock or to assess the carrying capacity and potential productivity of a given area of land. Normalising absolute stock numbers to DSEs enables water demand estimates to be calculated based on estimated water consumption per unit DSE.

The Eyre Peninsula Demand and Supply Statement (DFW 2011a) estimated the rate of water use of sheep located on the Eyre Peninsula to be 10 L/sheep/d (or 7.14 L/DSE/d). This estimate of water use is based on advice from Primary Industries and Regions South Australia (PIRSA) (Mary Chirgwin, PIRSA Biosecurity, personal communication, September 2010) and includes an allowance for on-farm losses.

PIRSA collects information from properties with current registrations under the *Livestock Act 1997*. The Primary Industries Information Management System (PIIMS) provides a spatially referenced data set of stock numbers for the PWAs. The spatial nature of the dataset allows water to be assigned to management areas or aquifers.

Stock water use was estimated by overlying the spatially referenced PIIMS parcel data on the recharge zones and assigning stock numbers to each zone. These stock numbers were multiplied by the DSE for the relevant stock and the DSE was then converted into a water use consumption by multiplying by 7.14 L/d (Stewart 2013:28–30).

The distribution of estimated stock water use across Licensed Quaternary Limestone aquifer management areas is indicated in Table 8-9 and Table 8-10.

8.1.2.1.2. Method for estimating domestic water use

The method used to estimate domestic water use was to multiply the number of domestic wells by the average water consumption per household. The SA Geodata database records the intended purpose of wells when they are permitted; those wells that have been ascribed the purpose 'domestic use' have been used in this assessment.

Water for Good (DWLBC 2009), reported that average household mains water consumption in the greater Adelaide region, prior to water restrictions, was 280 kL/y. For the purposes of this Plan domestic groundwater consumption is conservatively estimated to be 280 kL/y per well (Stewart 2013) as it is likely that additional water supplies such as mains and rainwater would be available to complement the groundwater supply.

The distribution of estimated domestic water use across the Licensed Quaternary Limestone aquifer management areas is indicated in Table 8-9 and Table 8-10.

8.1.2.2 Licensed demand

DEW keeps a record of the licensed groundwater extractions for the Southern Basins and Musgrave PWAs in mywater, DEW's water licensing system. This data record details historic licensed groundwater extraction and allocation limits on an annual basis since the 2004–05 water-use year. The portion of water access entitlements used for differing purposes, for all consumptive pools is shown in Figure 8-2.

Extractions from the Licenced Quaternary Limestone aquifer management areas for 2024–25 are shown in Table 8-6. The majority of extractions are from the Uley South management area, which accounts for around 99% of the total extractions from the Southern Basins.

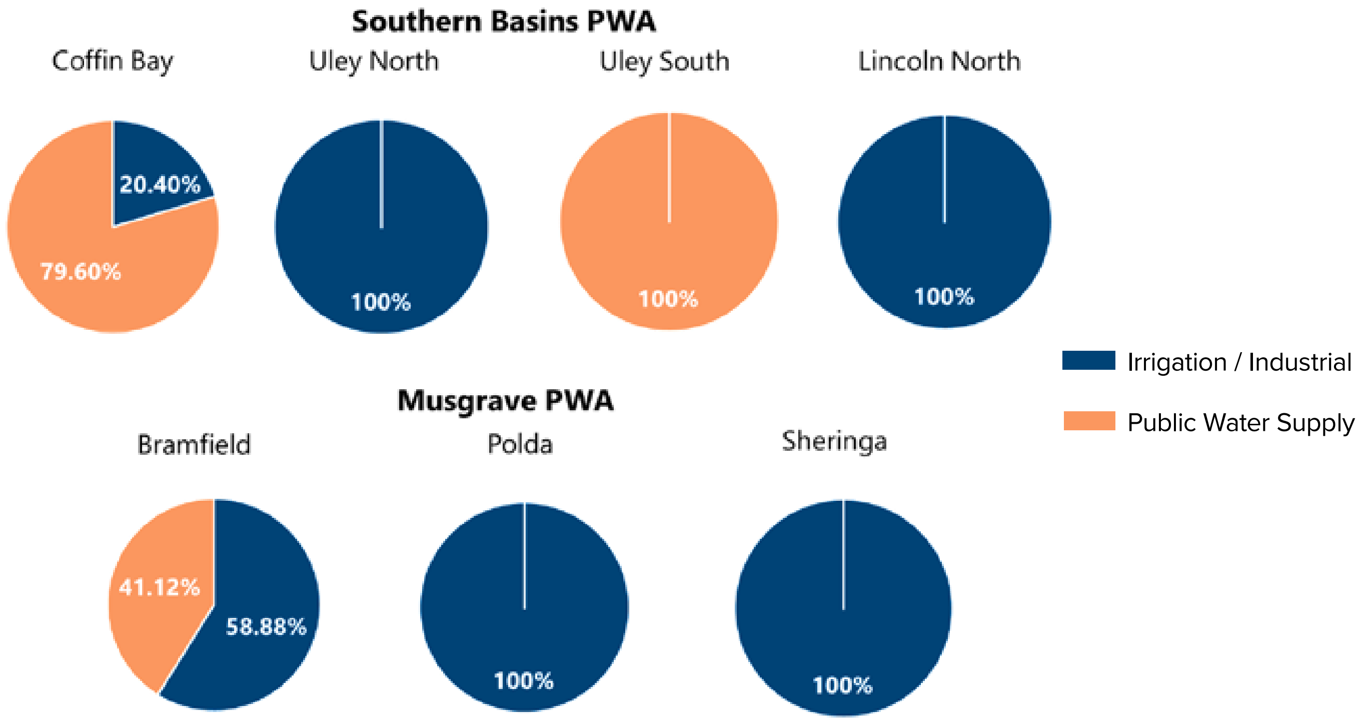

Figure 8-2 Portion of water access entitlements used for differing purposes for all Quaternary Limestone consumptive pools in the Southern Basins and Musgrave PWAs

Table 8-6 Southern Basins and Musgrave PWAs Quaternary aquifer metered usage, 2024-25 water-use year

PWA	Irrigation and industrial 2024–25 (ML)	Public water supply 2024-25 (ML)	Total use 2024–25 (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

Total annual groundwater extractions for the Licenced Quaternary Limestone aquifer management areas of the PWA's from 2015–16 to 2024–25 are presented in Table 8-7. Annual use solely for the purpose of public water supply for the period 2015–16 to 2024-25 is shown in Table 8-8 and Figure 8-3. The demand on SA Water to extract water for public water supply has been steady over recent years; however, there was as significant increase of 15% from 2023–24 to 2024–25.

Table 8-7 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 8-8 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	5,433.4	5,583.0	5,148.6	5,115.8	5,144.7	5,421.3	5,442.3	5,344.2	5,418.3	6,216.7

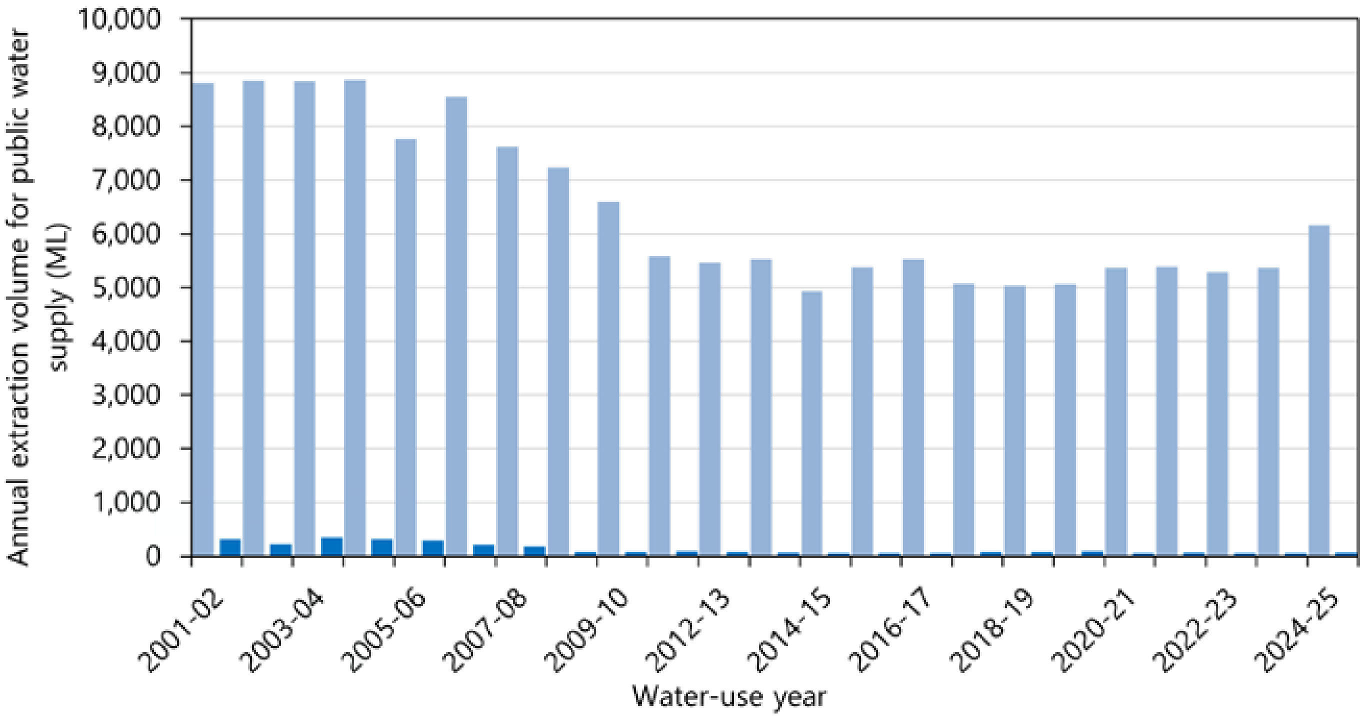

Figure 8-3 Metered usage for public water supply from 2001–02 to 2024–25 from the Southern Basins and Musgrave PWAs

8.1.2.2.1. Southern Basins PWA – existing licensed demand

Public water supply

Of the water allocated in 2024–25 from the Quaternary Limestone groundwater resource of the Southern Basins PWA, SA Water held 98% of the total water available on licence for the purpose of public water supply.

Irrigation and industrial

At the date of approval of this Plan, within the Quaternary Limestone groundwater resource of the Southern Basins PWA there are 12 existing water licences issued for the purposes of accessing groundwater for irrigation and other minor industry and recreational uses. Of these uses, golf course irrigation is the dominant activity.

Mining industry

There is currently no licensed demand for mining industry activities from the Quaternary Limestone management areas of the Southern Basins PWA.

8.1.2.2.2. Musgrave PWA – existing licensed demand

Public water supply

Of the water allocated in 2024–25 from the Quaternary Limestone groundwater resource of the Musgrave PWA, SA Water held 26% of the total water available on licence for the purpose of public water supply.

Irrigation and industrial

At the date of approval of this Plan, within the Quaternary Limestone groundwater resource of the Musgrave PWA, there are 7 existing water licences issued for the purposes of accessing groundwater for irrigation, and other minor industry, recreational and aquaculture uses. Of these uses, fruit and nut tree irrigation is the dominant activity.

Mining industry

There is currently no licensed demand for mining industry activities from the Quaternary Limestone management areas of the Musgrave PWA.

8.1.2.3 Excess water

If the total volume of water available for licensed demand in any management area exceeds current demand, a resultant excess water volume may exist. The excess water may be made available for use, subject to the Minister's discretion. Section 10 outlines the principles of how to manage the release of excess water.

8.2. Non-licensed Quaternary Limestone management areas

Based on current knowledge, there is unlikely to be any significant volumes of water available for consumptive purposes on an ongoing basis from the non-licensed Quaternary Limestone management areas in either the Southern Basins or Musgrave PWAs. Any such supplies are likely to be highly unreliable. The only demands for water are potentially for the purposes of stock and/or domestic supply and Ministerial authorisations.

8.3. Tertiary Sands and Basement management areas

The demands on the Tertiary Sands and Basement management areas are outlined below in Sections 8.3.1 and 8.3.2.

8.3.1. Non-consumptive demands

The non-consumptive demands for each of the management areas associated with the Tertiary Sands and Basement aquifers were unable to be determined due to limited knowledge of these aquifers.

8.3.2. Consumptive demands

The water available for consumptive demand in the Tertiary Sands and Basement management areas is calculated as the sum of the licensed and non-licensed demands.

8.3.2.1 Non-licensed demand

Non-licensed water use includes water for stock and domestic use and water use authorised by the Minister under Section 105 of the Landscape Act, such as water for firefighting and for the making of public roads. A standard 5 ML per consumptive pool has been assumed to be sufficient to meet future authorisations by the Minister.

8.3.2.1.1. Method for estimating stock water use

The methodology (refer to Section 8.1.2.1.1) for determining the stock demands for the deeper management areas assumes that if the Quaternary Limestone aquifer is dry, then any stock water use must come from either the underlying Tertiary Sands or Basement management areas. As there is no information available to determine the proportion of water being accessed for stock purposes from each management area, the volume of water apportioned to parcels overlying the unsaturated Quaternary Limestone (Non-Licenced Quaternary Limestone management zone) have been split evenly between the Tertiary Sands and Basement management areas.

The distribution of estimated stock water use across the Tertiary Sands and Basement management areas is indicated in Table 8-9 and Table 8-10.

8.3.2.1.2. Method for estimating domestic water use

The method for estimating domestic water allowance in the Tertiary Sands and Basement management areas follows that outlined in Section 8.1.2.1.2.

The distribution of estimated domestic water use across the Tertiary Sands and Basement is indicated in Table 8-9 and Table 8-10.

8.3.2.2 Licensed demand

Extraction for the Southern Basins and Musgrave PWAs has been recorded by DEW in mywater since 2024-25. It details historic licensed groundwater extraction and allocation limits on an annual basis since the 2004-05 water-use year.

The distribution of licensed water use across the Tertiary Sands and Basement management areas is indicated in Table 8-9 and Table 8-10.

8.3.2.2.1. Southern Basins PWA – existing licensed demand

Public water supply

At the date of approval of this Plan, there was no licensed demand for public water supply from the Tertiary Sands or Basement management areas of the Southern Basins PWA.

Irrigation and industrial

At the date of approval of this Plan, within the Tertiary Sands and Basement management areas of the Southern Basins PWA there were 7 existing water licences issued for the purposes of accessing groundwater for irrigation, including for agricultural and recreational (golf course) purposes.

Mining industry

At the date of approval of this Plan, within the Tertiary Sands and Basement management areas of the Southern Basins PWA, there was one small water licence issued for the purposes of mineral exploration.

8.3.2.2.2. Musgrave PWA – existing licensed demand

Public water supply

At the date of approval of this Plan, there was no licensed demand for public water supply from the Tertiary Sands or Basement management areas of the Musgrave PWA.

Irrigation and industrial

At the date of approval of this Plan, there was no licensed demand for irrigation or industrial supply from the Tertiary Sands or Basement management areas of the Musgrave PWA.

Mining industry

At the date of approval of this Plan, there was no licensed demand for mining industry activities from the Tertiary Sands or Basement management areas of the Musgrave PWA.

Table 8-9 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: Domestic demands (ML)	Non-licensed demand: Stock demands (ML)	Non-licensed demand: Minister authorisations (ML)	Maximum volume of water available for licensed use (ML)*	Licensed demand (ML)*	Excess water (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[10]	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

* at the date of approval of this Plan

Table 8-10 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: Domestic demands (ML)	Non-licensed demand: Stock demands (ML)	Non-licensed demand: Minister authorisations (ML)	Maximum volume of water available for licensed use (ML)*	Licensed demand (ML) *	Excess water (ML)*
Bramfield	NA	NA	577.0	18.2	77.0	5.0	476.8	476.8	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

*at the date of approval of this Plan

Resource Capacity = Recharge Area x Recharge Rate

Resource Capacity = Non-Consumptive Demand + Consumptive Demand which is (Non-Licensed Demand + Licensed Demand + Excess Water)

10 Note 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.

8.4. Future demand for water

The content of this Section has been informed by the Water Security Statement: Water for Sustainable Growth *(*DEW 2022b), which was prepared to meet the water planning requirements of the *Water Industry Act 2012*. The statement includes overviews of regional water supplies and demands and strategic priorities for ensuring long-term water security. It seeks to prepare for future climate risks and allow communities to make the most of all available sources of water as the climate changes and demand for water increases. The Water Security Statement replaced the function of the Eyre Peninsula Demand and Supply Statement (DFW 2011a) that informed the previous Plan.

8.4.1. Public water supply

The water security planning process (DEW 2022b) identified a gap in the available supply of water on the Eyre Peninsula compared to demands. In addition, this Plan reduces the volume of the consumptive pool for Uley South from 7.3 GL to 3.5 GL (Section 4.3.1), with no water to be extracted from Lincoln South and the Uley Wanilla Basins, which previously enabled peak demands to be met during summer months. To address these water security issues across the Eyre Peninsula and protect the long-term viability of groundwater resources in the Uley South Basin, SA Water is constructing a 5.3 GL/y seawater desalination plant, with potential future expansion to 8 GL/y, to supply potable water to assist with meeting public water supply demands.

SA Water developed and implemented the Water Security Response Plan Eyre Peninsula (SA Water 2025), designed to manage demand until the climate-independent desalination source becomes operational. The plan includes four response levels. As of December 2025, the region was at Level 2 – Save Water, indicating that resources meet current demand but cannot support growth. The response plan included an Eyre Peninsula Farm Water Security program aimed at the primary industries sector, which uses 38% of the mains water on Eyre Peninsula.

Public water supply for the township of Elliston is sourced from the groundwater of the Bramfield Basin, where the water level has also been slowly declining in recent years (Section 2.2.1). SA Water is considering options to secure a long-term water supply, including the potential to extend the existing Lock to Polda trunk main to Elliston, to source water from either the River Murray or the Uley South Basin for Elliston.

Recent regional public water supply trends indicate that consumption has been relatively stable over the last 10 years, although water demand has increased by 15% in the 2024–25 water-use year (Section 8.1.2.2). This additional demand will be met by the seawater desalination plant once operational. Future trends in stock water use provided by mains water are uncertain given the possibility that stock numbers may increase intermittently or may decrease if alternate income streams are pursued (for example, carbon farming). The greatly increased water demands associated with COVID overseas travel restrictions demonstrated that external factors could affect water demands on the public water supply system associated with fluctuations in tourism activity.

The development of mining operations could lead to an increase in regional employment opportunities resulting in a possible increase in the public water supply demand as more people are drawn to the region. There is also a significant lack of affordable housing in South Australia and therefore urban growth is expanding in most towns. Mining operations and other development may also source some of their water needs from the public water supply.

8.4.2. Water for stock and domestic use

Future demand for stock water and domestic water use will be driven by a range of factors that include, but are not limited to, land carrying capacity, commodity prices and local climatic conditions.

There is evidence of expanding or increasing urban development within some areas of the PWAs. Where public water supply is not provided to these newly developed areas, it is likely that there will be increased demand for groundwater for domestic purposes with potential local influences on the groundwater resource.

Future water requirements for increasing stock numbers are extremely difficult to predict. Analysis of land carrying capacity found that most of the Southern Basins and Musgrave PWAs have low grazing potential. The results of this analysis suggest that it is unlikely that stock numbers will increase markedly in the near future (Stewart et al. 2012). Long-term landholders have observed that stock numbers in both the Southern Basins and Musgrave PWAs have been largely static, and they believe a significant increase in stock numbers in the future is highly unlikely.

Estimates of stock and domestic use were based on available information and are calculated based on current conditions. However, there is the potential for stock numbers to increase if grain prices decrease. The take of water to support additional stock will be limited to access to reasonable groundwater quality water or access to the mains water system.

8.4.3. Recreational and industrial use

Tourism and aquaculture industry activities are identified as areas of potential development in the PWAs. It is anticipated that in the most part, these activities will use the public water supply for water requirements. Where public water supply is not available, aquaculture developments will need to acquire a water access entitlement to take water from the groundwater resources within the PWAs. It is difficult to estimate the demand for these uses.

8.4.4. Mining industry use

Demand for water from the mining sector in Eyre Peninsula is expected to increase in the future and mining operations can require significant volumes of water. Future production of hydrogen energy, in particular, is a potential driver of significantly increased demand for water. Energy and mining were identified as priority sectors in the Water Security Statement (DEW 2022b) because of their strong potential to meet increasing interstate and global demand, attract investors and leverage comparative advantages.

Typically, activities such as mineral processing and dust suppression can be undertaken using water of lower quality than is required for stock or irrigation. It is important that associated water resource demands are considered, planned for and managed, while balancing this against environmental and social requirements. Potential impacts from mining can include issues associated with aquifer dewatering and aquifer interference.

In accordance with State Government policy (DWLBC 2009), mining ventures must source their own water supplies within the sustainable framework of natural resources management planning. Within PWAs, the taking of water for mine development and operational activities is subject to the same licensing requirements as any other water use. As a general principle, mining companies would be required to hold a water access entitlement to take water in any circumstance where other water users would also be required to hold a water access entitlement. Mine water supplies reliant on the public water supply system would operate within the licensing limits held by the public water supply water access entitlement and associated water allocations.

Within the Southern Basins, future mining prospects currently include graphite and iron ore. Operational water supply, dewatering requirements and any other groundwater-related issues will need to be addressed within the water allocation and licensing frameworks.

8.4.5. Land values

The Plan has taken into account the present and future needs of the occupiers of the land and is not expected to adversely affect land values.

Generous provisions for stock and domestic water have been retained from the previous Plan.

Water security for private licensed water users has been improved by removing the adaptive management approach for some consumptive pools and by implementing a staged approach to determining the volume the consumptive pool in those resources which remain adaptively managed.

9. Water management strategy

Within the Southern Basins and Musgrave PWAs, a person may only lawfully take water from the prescribed water resources:

1. pursuant to a water allocation that relates to the water resource, or
2. for stock and domestic purposes[11], or
3. pursuant to an authorisation under Section 105 of the Landscape Act[12] which allows for water to be taken for certain purposes, or

The Landscape Act requires that a water allocation plan be prepared for each prescribed water resource and further specifies that a water allocation plan can relate to more than one water resource. As such the principles in Section 10 of this Plan relate to the Southern Basins and the Musgrave PWAs.

9.1. Water licensing regime

A key aspect of a water allocation plan is that it establishes a water licensing regime to regulate the taking of water from the resource. The first step in establishing this licensing regime is the determination of a consumptive pool or pools.

The Landscape Act requires that a water allocation plan must '*determine, or provide a mechanism for determining, from time to time, a consumptive pool, or consumptive pools for the water resource*'.[13]

A consumptive pool is defined as the water '*that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Part 8…*'.[14] This Plan must therefore determine a consumptive pool or pools, so as to account for all of the water that may be lawfully taken from the prescribed water resources, which excludes water required to maintain cultural and environmental values. The consumptive pools determined for this Plan are outlined in Section 10.1 and are based on a fixed geographic boundary and aquifer, with the exception of the Managed Aquifer Recharge Consumptive Pool, which is based on purpose of water use. This consumptive pool extends across the entire area managed by this Plan.

A water licence provides a water access entitlement to the holder of the licence to gain access to a share of the water available in the consumptive pool to which the licence relates.[15] A water access entitlement is a specified number of water access entitlement shares (entitlement shares) within the consumptive pool. The Minister will, from time to time, determine the volume of water that is to be made available for allocation from a consumptive pool.[16] Meaning that, the volume of water may vary depending on the value of the entitlement shares.

While a water access entitlement represents the licence holder's right to a share of the resource, a water allocation will relate to a specified period

11 This includes water for the purposes of drinking or cooking if the rate of taking does not exceed the rate prescribed by regulation, namely 100 litres a day (Section 100(7) of the Landscape Act and regulation 17 of the Landscape South Australia (Water Management) Regulations 2020)

12 Authorisations under Section 105 of the Landscape Act or these prescribed areas include the ability to take water for the following purposes without a water licence: firefighting, road making, cultural purposes for native title holders, and the application of chemicals to non-irrigated crops and non-irrigated pasture, and for the control of pest plants and animals

13 Section 53(1)(c) of the Landscape Act

14 Sections 53(1)(c) and 3(1) of the Landscape Act

15 Section 121(2) of the Landscape Act

16 Section 121(4) of the Landscape Act

of no more than 12 months[17] and is the volume of water that may be taken during the specified period. The water allocation is determined based on the value of the entitlement share (Figure 9-1).

Therefore, this Plan provides a framework for how the volume of consumptive pools will be determined annually (Section 9.4). The consumptive pools are separated into those which are adaptively managed – the consumptive pool volume is determined annually – and those which are not adaptively managed – the consumptive pool volume will remain fixed for the life of the Plan.

There are four consumptive pools which will be adaptively managed, where the volume of the consumptive pool will be determined annually and consequently the value of the entitlement shares may vary annually. This may result in the allocation being issued at a reduced volume in some water-use years. The determination of the consumptive pool volumes for the adaptively managed consumptive pools is discussed further in Section 9.4.1.

For most consumptive pools the Plan does not specify a mechanism for determining the volume of the consumptive pool each year (i.e. not adaptively managed). Therefore, the value of the entitlement shares is likely to remain consistent for the life of this Plan (that is 1 share = 1 kL) and the allocation issued each water-use year will generally be for the same volume. However, it is important to note that despite this Plan identifying that the consumptive pool volume will remain consistent for the life of the Plan, the Minister has discretion under Section 121(4) of the Landscape Act to determine the volume of water that is to be made available from a consumptive pool for allocation. The Minister's discretion is to operate within the capacity of the resource, that is, the consumptive pool volume.

The availability of water from the Managed Aquifer Recharge Consumptive Pool is managed via an alternative mechanism discussed below in Section 9.3.

Groundwater may only be taken from within the Southern Basins and Musgrave PWAs in accordance with a water licence issued under this Plan or through an authorisation issued under the Act. The water licence will list the wells through which the water allocation may be taken, prior to any water being extracted in relation to the licence and therefore a water resource works approval is not required to authorise the taking of water under any circumstances.[18]

Further, the Landscape Act states[19] that a person must not use water taken from a prescribed water resource unless authorised to do so by a site use approval.[20] A site-use approval is not required if the water allocation plan for the prescribed resource provides the specified circumstances or situations in which no site use approval is required.[21] For the purposes of this Plan, a site use approval is not required under any circumstances.

The Minister may grant new water licences with respect to the wells in the prescribed areas in accordance with this Plan and the Landscape Act. The taking and use of such water will be subject to the principles in this Plan to ensure the taking of water will not cause undesired impacts to existing users of the resource, groundwater-dependent ecosystems or the aquifers themselves.

17 Section 127(8) of the Landscape Act

18 Section 104(6)(a) of the Landscape Act and regulation 19(1) of the Landscape South Australia (Water Management) Regulations 2020

19 Section 104(5)(b) of the Landscape Act

20 A site use approval specifies the purposes for which the water is proposed to be used, the place at which the water is proposed to be used and prescribed information about the proposed extent, manner and rate of use of the water as per Section 141(1)(a) of the Landscape Act

21 Section 104(6)(b) of the Landscape Act and regulation 19(2) of the Landscape South Australia (Water Management) Regulations 2020

Water Licence

- Is personal property
- Relates to a particular consumptive pool
- Lists the wells through which water can be taken
- May contain conditions
- Provides a Water Access Entitlements (WAE) to the holder and specifies on the basis on which the WAE is determined

Water Access Entitlement

- Authorisation issued under the Water Licence
- Mortgageable component
- Subject to the conditions on the Water Licence (such as the consumptive pool and the wells)
- For the Managed Aquifer Recharge Consumptive Pool it relates to the "Available Balance"
- For the other consumptive pools it's comprised of a number of Entitlement Shares (e.g. 100 shares)

Value of the Entitlement Share

- Value of the Entitlement Share
- Consistent from one year to the next for most consumptive pools
- Number and value of entitlement shares determines water allocation
- Based on the resource condition and determined in accordance with the adaptive trigger management approach specified in the Plan for the following consumptive pools:
  - Uley North
  - Polda
  - Sheringa
  - Bramfield

Water Allocation

- Issued under a Water Access Entitlement
- Lasts for 12 months
- Subject to the conditions on the Water Licence (such as the consumptive pool and the wells)
- For the Managed Aquifer Recharge Consumptive Pool is equivalent to the "Available Balance"
- For the other consumptive pools is issued based on the value of the Entitlement Share (e.g. 1 share= 1kL)

^See Glossary for definition

Figure 9-1 Water licence, water access entitlement, value of entitlement share and water allocation

9.2. Water affecting activities

Generally, water affecting activities are managed by the objectives and principles set out in the Water Affecting Activities Control Policy formulated by the relevant Landscape Board. The Water Affecting Activities Control Policy sets out the matters that the relevant authority will take into account when exercising a power to grant or refuse a permit for a water affecting activity,[22], such as a permit to erect, construct or place any building or structure in a watercourse or on the floodplain of a watercourse.

However, in particular circumstances, the Minister is the relevant authority for certain water affecting activity permits, such as the granting of permits for the drilling, decommissioning, sealing, repairing, replacing or altering the casing, lining or screen of a well; or the draining or discharging of water directly or indirectly into a well.

This Plan sets out the matters that the Minister must consider when deciding whether to grant or refuse a permit with respect to the above matters within the Southern Basins and Musgrave PWAs.

9.3. Management of Managed Aquifer Recharge Schemes

Managed Aquifer Recharge refers to the intentional draining or discharging of water to aquifers for subsequent use or environmental benefit. Managed Aquifer Recharge offers numerous benefits, including storage to improve security of water supply; natural water treatment;[23] a low-cost, low-energy water supply option; a freshening of regional aquifer salinity; and replenishing over-exploited aquifers. At the date of approval of this Plan, there are no active Managed Aquifer Recharge schemes that drain or discharge water into aquifers for subsequent recovery. Should there be a desire to undertake Managed Aquifer Recharge into the future, this Plan sets out the provisions for the draining or discharging of water into an aquifer and the recovery of water in relation to the water previously drained or discharged.

Operators of Managed Aquifer Recharge schemes will be required to work in accordance with a risk management and monitoring plan to protect the resource from any adverse impacts from draining or discharging of water into the resource. As these risk management and monitoring plans will be the key document to which the Managed Aquifer Recharge operators will align their activities, the water licence will be subject to working in accordance with the risk management and monitoring plan and will require updating as the scheme operation changes.

A permit is required under Section 104(3)(c) of the Landscape Act for the draining or discharging of water directly or indirectly into a well. However, if the water to be drained or discharged has undergone antibiotic or chemical water treatment with a discharge volume greater than 50 kL per day, the person draining or discharging water into the aquifer is required to hold a licence for an 'activity of environmental significance' under Section 36 of the *Environment Protection Act 1993*. The permit is granted by the Environment Protection Authority under Section 40(1) of the *Environment Protection Act 1993*.

The water drained or discharged into the aquifer and used in relation to Managed Aquifer Recharge schemes constitutes a single consumptive pool for the purposes of this Plan. This consumptive pool is a separate administrative consumptive pool to the 'native groundwater' consumptive pools and is not volumetrically constrained (that is, has no maximum capacity).

The volume of water in the Managed Aquifer Recharge Consumptive Pool will change over time in relation to scheme operator activities. Individual water access entitlements within this consumptive pool are based on the available balance for the Managed Aquifer Recharge scheme. The available balance takes into account the total volume of water drained or discharged (under a permit issued pursuant to either Section 104(3)(c) of the Landscape Act or an environmental authorisation

22 Section 102(3)(c) of the Act

23 The intentional discharge of surface water, can for example, reduce the localised groundwater salinity or concentration of other minerals, leading to the availability of higher quality water for subsequent extraction.

issued under Section 40(1) of the *Environment Protection Act 1993*) in the previous water-use year, which is available for recovery in the following water-use year (that is, the available balance). The total volume that can be recovered in a single water-use year will be limited to 80% of the water drained or discharged in the previous water-use year or a specified percentage of the water drained and discharged in the previous water-use year if the proponent can demonstrate to the satisfaction of the Minister that the taking of up to 100% of the water drained or discharged into the well(s) would not contravene the principles of this Plan.

Note that the water is to be recovered from well(s) located within 1 km of the injection well and within the same spatial extent as the corresponding native groundwater consumptive pool that aligns with the location and aquifer within which the water was previously drained or discharged. If the scheme operator requires more water than the available balance they must acquire additional access to water. Additional access to water may be acquired by applying for a water licence and allocation in the spatially relevant native groundwater consumptive pool. The water licence for the native groundwater consumptive pool will be separate to the licence in relation to the Managed Aquifer Recharge Consumptive Pool and will be managed separately. If a scheme operator has both a licence in relation to the Managed Aquifer Recharge Consumptive Pool and a licence in relation to a native groundwater consumptive pool and the water is to be taken from the same well(s), the allocation in relation to the native groundwater consumptive pool will be considered to be extracted first.

A scheme operator with a licence in the Managed Aquifer Recharge Consumptive Pool cannot transfer the allocation, or part of the allocation, which arises in a particular water-use year to another user of the resource.

9.4. Consumptive pool management

The management approach adopted by this Plan must consider the unique characteristics of the groundwater resources on Eyre Peninsula. These resources are highly dependent on rainfall recharge and, in some areas, exhibit low aquifer robustness due to limited saturated thickness. As such, some consumptive pools require a management approach which adaptively responds to the condition of the resource, as discussed further in Section 9.4.1, while for the remaining consumptive pools, adaptive management is not required for reasons specified in Section 9.4.2.

9.4.1. Adaptively managed consumptive pools

This groundwater level-based adaptive management approach applies specifically to the Uley North, Bramfield, Sheringa and Polda management areas.

For these management areas, this Plan defines consumptive pools in two ways:

- by geography, using the management areas which are fixed for the life of the Plan (shown in Figure 4-1 and Figure 4-2.), and
- as a volume of water determined annually, which is referred to as 'the consumptive pool volume'.

The Landscape Act defines a consumptive pool as '*the water that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Part 8'* of the Landscape Act. A consumptive pool, therefore, is the resource for the purposes of:

1. water available for licensed purposes
2. water for stock and domestic use
3. water authorised for use by the Minister under Section 105 of the Landscape Act

As there is unlikely to be any change in the volume of water for stock and domestic use and water authorised by the Minister under Section 105 of the Landscape Act (non-licensed demand) for each management area (for reasons that have been described in Section 8.1.2.1), the volume required for non-licensed demand has been fixed for the life of this Plan. The fixed volumes of water for non-licensed demand are included in the consumptive pool volume which is calculated annually. These volumes are shown in Table 8-9 and Table 8-10 in the columns marked 'non-licensed demand'.

The volume of water stored within the saturated Quaternary Limestone aquifer within both PWAs is known to vary annually in response to changes in recharge to the aquifer. Therefore, it is reasonable to use the condition of the groundwater resource as a trigger to determine the consumptive pool volume on an annual basis. This enables the adaptive management of the resource in response to the changes in recharge due to impacts of climate variability in the short term and climate change in the long term. This ability to respond with a variable consumptive pool is consistent with the adaptive management clauses in the National Water Initiative (NWI) (COAG 2004) and the unbundled licence provisions in the Landscape Act. Therefore, a variable component of the consumptive pool volume will be determined in accordance with the method set out in this Section.

Accordingly, the consumptive pool volume shall be the sum of:

> **fixed volume (stock and domestic use)**
> **+ fixed volume (Section 105 authorisations)**
> **+ variable component ([a portion of the] maximum volume of water available for licensed use).**

The variable component of the consumptive pool volume is determined by reference to the 'maximum volume of water available for licensed use' for each management area as defined in Table 8-9 and Table 8-10 of this Plan. The variable component of the consumptive pool volume cannot exceed that maximum volume. However, the variable component of the consumptive pool volume may be less than the defined maximum volume with a reduction determined based on groundwater condition within each consumptive pool.

The method for determining the variable component of the consumptive pool volume is based on scientific technical reports (Stewart et al. 2012, Stewart 2013) and the updated methodology (DEW 2026e) as discussed in this Section.

The determination of the volume of water which comprises the variable component of the consumptive pool volume for each adaptively managed consumptive pool will be undertaken after groundwater level monitoring is carried out in autumn (March – April) each year, which will then determine the 'maximum volume available for licensed use' for the next water-use year commencing on 1 July.

It is important to note that under Section 121(4) of the Landscape Act, the Minister has a discretion to determine the volume of water that is to be made available for licensed use (allocation) from a consumptive pool. The Minister's discretion is to operate within the capacity of the resource, that is, the consumptive pool volume. As such, the annual calculation of the variable component of the consumptive pool volume will, for the Uley North, Bramfield, Polda and Sheringa management areas, result in a redetermination of the volume of water available for allocation by the Minister. This will come into effect through Notice in the *South Australian Government Gazette* informing of the value of the entitlement share for the abovementioned consumptive pools.

9.4.1.1 Previous Framework

Under the previous Plan, water licences provided a fixed share of the consumptive pool to licensees through the entitlement shares they held, but the actual volume available each year depended on aquifer condition. The determination of the variable component of the consumptive pool volume was based on aquifer storage trigger levels, calculated as a percentage of aquifer storage to a reference level from 1993. Calculations of the aquifer storage in Autumn were used because they represented post-irrigation lows and pre-recharge conditions.

The previously used storage triggers are presented schematically in Figure 9-2, and are discussed below:

- **Upper Storage Trigger**: When storage was above this level, the aquifer was considered to be in a good condition, and the volume of water available for the variable component of the consumptive pool volume was 100% of the total available (i.e. 100% of the 'maximum volume of water available for licensed use' as defined for the management area in Tables 20 and 21 of the previous Plan).
- **Mid Storage Trigger**: When the level of storage fells below the Upper Storage Trigger but remained higher than the Mid Storage Trigger, the resource was considered to be at low risk and the volume of water available for the variable component of the consumptive pool volume was varied at a rate similar to the change in the level of storage.

  When the storage level fells below the Mid Storage Trigger but remained higher than the Lower Storage Trigger, the resource was considered to be at moderate risk and the volume of water available for the variable component of the consumptive pool volume was varied at a greater rate than the change in the level of storage.
- **Lower Storage Trigger**: When the storage level was assessed to be equal to or less than the Lower Storage Trigger, the resource was considered to be at high risk and no water was available for the variable component of the consumptive pool volume.

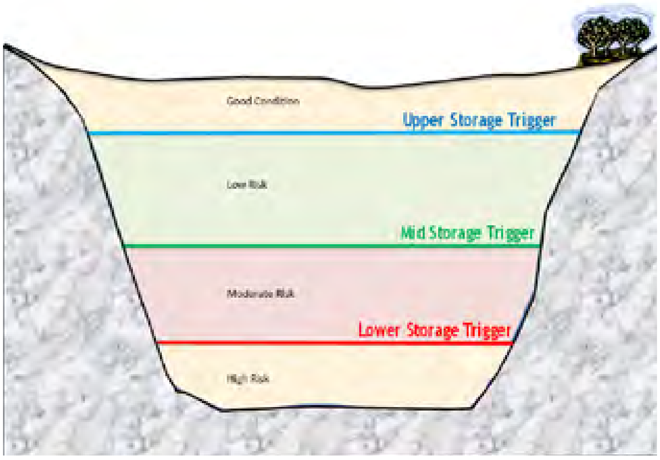

Figure 9-2 Schematic representation of trigger levels in a typical aquifer

Annual variations in aquifer storage were assessed using groundwater monitoring data and the Aquaveo™ Arc Hydro Groundwater model, which incorporated both saturated thickness and aerial extent of the aquifer. This comprehensive approach ensured sustainable management by identifying risk levels and informing adjustments to the variable component of the consumptive pool volume for each water-use year.

9.4.1.2 New Framework

The revised adaptive management framework retains the scientific basis of the original approach of the previous Plan while introducing a more practical, transparent, and efficient method for determining the variable component of the consumptive pool volume. This framework aims to improve consistency in implementation and simplify stakeholder understanding of the volume of water available within the Uley North, Bramfield, Polda, and Sheringa consumptive pools. This approach removes the need to undertake model-based storage calculations.

The revised framework introduces the following key changes:

- Direct groundwater level triggers:
  Trigger levels are expressed as groundwater level triggers at individual observation wells, eliminating the need for annual storage modelling.
- A simplified groundwater level trigger structure:
  The previous Lower Storage Trigger has been removed. The former Mid Storage Trigger now functions as the new Lower Trigger Level.
- A three-tiered framework for determining the variable component of the consumptive pool volume:
  a. The variable component of the consumptive pool volume will equate to **100%** of the 'maximum volume of water available for licensed use' as defined for the management area in Table 8-9 and Table 8-10 when groundwater levels are above the Upper Trigger Level.
  b. The variable component of the consumptive pool volume will equate to **65%** of the 'maximum volume of water available for licensed use' as defined for the management area in Table 8-9 and Table 8-10 when groundwater levels fall between the Upper and Lower Trigger Levels.
  c. The variable component of the consumptive pool volume will equate to **35%** of the 'maximum volume of water available for licensed use' as defined for the management area in Table 8-9 and Table 8-10 when groundwater levels fall below the Lower Trigger Level.
- A minimum variable component of the consumptive pool volume safeguard:
  A minimum volume of the variable component of the consumptive pool volume of 35% is maintained under high-risk operating conditions improving water supply reliability for users.

Historical groundwater data (2002–2024) were analysed to convert the storage-based triggers, as determined under the previous Plan, into equivalent groundwater level triggers under this Plan (DEW 2026e). To assess the consistency of the revised approach with the original approach, the calculated volume of the consumptive pool using the revised groundwater level–based framework were compared with those derived from the original storage-based modelling approach for the period 2002 to 2024. This comparison indicated a high level of consistency between the two approaches across all management areas (DEW 2026e). Therefore, the storage-based trigger approach under the previous Plan has been converted to a groundwater level trigger approach under this Plan.

For each water-use year, groundwater levels from all trigger observation wells within a management area are assessed against the Upper and Lower Trigger Levels (Table 9-1). The determination of volume of the variable component of the consumptive pool volume is calculated using the *mode*, representing the most frequently occurring trigger category across all wells for the management area.

The calculation is set as follows:

- When the modal category exceeds the Upper Trigger Level, the variable component of the consumptive pool volume will equate to **100%** of the ‘maximum volume of water available for licensed use’ for the management area as specified in Table 8-9 and Table 8-10.
- When the modal category falls between the Upper and Lower Trigger Levels, the variable component of the consumptive pool volume will equate to **65%** of the ‘maximum volume of water available for licensed use’ for the management area as specified in Table 8-9 and Table 8-10.
- When the modal category falls below the Lower Trigger Level, the variable component of the consumptive pool volume will equate to **35%** of the ‘maximum volume of water available for licensed use’ for the management area as specified in Table 8-9 and Table 8-10.

This approach ensures that decisions regarding the variable component of the consumptive pool volume reflect overall aquifer condition rather than isolated or anomalous groundwater level responses. Groundwater level triggers for each well are presented in Table 9-1.

If any trigger observation well becomes unavailable for monitoring, a suitable replacement will be identified to ensure continued monitoring of trigger levels.

If, for unforeseen reasons, an observation well cannot be monitored in autumn and a replacement cannot be arranged in a timely manner, an assessment will be undertaken in consultation with DEW Water Science. The assessment will determine of volume of the variable component of the consumptive pool volume. The outcome of this assessment will be appropriately documented.

Table 9-1 Observation wells to be used in the monitoring of groundwater trigger levels

Consumptive Pool	Well No-Obs name.	Upper trigger level (RSWL mAHD)	Lower trigger level (RSWL mAHD)
Uley North	6028-872 - ULE172	31.1	30.8
	6028-910 - ULE077	19.8	19.7
	6028-854 - ULE086	58.8	58.6
	6028-1607 - ULE179	102.7	101.9
	6028-1610 - ULE183	74.2	73.8
	6028-1159 -WNL35	30.9	30.6
	6028-1612 - ULE182	75.8	75.3
Bramfield	5930-57 - TAA005	19.7	19.4
	5930-1063 - TAA057	22.6	22.1
	5930-27 - TAA058	15.2	14.9
	5930-1542 - WAD040	3.2	2.8
	5830-235 - WAD031	6.7	6.4
	5931-297 - TAA029	10.3	10.0
Sheringa	5930-253 - HUD018	35.3	32.8
	5930-754 - KPW037	54.3	54.0
	5930-753 - KPW038	53.2	52.8
	5930-755 - KPW055	51.0	50.6
	5930-757 - KPW068	54.3	54.1
	5930-546 - PER001	14.4	14.2
	5930-535 - PER015	6.2	5.7
	5930-550 - PER030	9.3	9.0
	5930-453 - WAY015	6.8	6.4
	5930-361 - WAY031	1.3	1.1
	5930-315 - WAY056	3.1	2.7
Polda	5930-1000 - SQR008	35.6	35.3
	5930-1001 - SQR009	35.1	34.8
	5930-912 - SQR021	41.3	41.0
	5930-1005 - SQR031	35.4	35.2
	5931-128 - SQR085	40.1	39.8
	5931-123 - SQR086	42.1	41.9
	5930-1050 - SQR097	35.3	35.0
	5930-1046 - SQR105	37.2	36.7
	5930-1059 - SQR106	37.0	36.6
	5930-1073 - SQR114	38.6	38.2
	5931-200 - TIN079	33.5	33.3

9.4.2. Non-adaptively managed consumptive pools

For the Coffin Bay, Uley South, Lincoln North, Aquaculture Elliston, Southern Basins Tertiary, Southern Basins Basement, Musgrave Tertiary and Musgrave Basement management areas, this Plan defines the consumptive pools in two ways:

- by geography, using the management areas which are fixed for the life of the Plan (shown in Figure 4-1, Figure 4-3 and Figure 4-4)
- as a volume of water fixed for the life of this Plan, which is referred to as the consumptive pool volume.

The fixed consumptive pool volumes are the sum of 'non-licensed demand' + 'maximum volume of water available for licensed use' as defined in Table 8-9 and Table 8-10 of this Plan for each management area.

While it is intended that the consumptive pool volume for these management areas remains fixed for the life of this Plan, the Minister retains the discretion under Section 121(4) of the Landscape Act to, by notice in the *South Australian Government Gazette*, determine the volume of water that is to be made available for allocation from the consumptive pool which may be less than the 'maximum volume of water available for licensed use' as defined in Table 8-9 and Table 8-10 of this Plan.

For the fixed consumptive pools, adaptive management is not applied for reasons outlined in the following Sections.

9.4.2.1 Coffin Bay

Although the Coffin Bay management area was previously managed adaptively, its proximity to the coast provides a buffering effect on aquifer storage and water levels through oceanic influence, preventing the activation of triggers. The primary risk to groundwater sustainability in this area is saltwater upconing, which is more effectively mitigated through operational strategies such as reducing extraction intensity, expanding wellfield distribution and implementing ongoing targeted salinity monitoring. These measures form part of the current management framework to ensure long-term resource protection and adaptive response to emerging risks.

9.4.2.2 Uley South

Robust numerical groundwater models have been developed over a number of years for the Uley South management area, providing reliable long-term assessments of aquifer behaviour (refer to Section 4.3.1). As SA Water is the sole licensed user in this area and the resource is critical for ongoing public water supply on the Eyre Peninsula, a fixed consumptive pool volume will be maintained throughout the life of the Plan.

Note that the volume of the consumptive pool will be significantly reduced compared to the previous Plan. Instead of the detailed adaptive management approach, ongoing targeted monitoring of groundwater levels and salinity is required to support sustainable extraction and mitigate risks such as seawater intrusion.

The Uley South management area has been reserved for public water supply purposes to secure fresh groundwater resources for now and into the future for critical human needs.

9.4.2.3 Lincoln North

Due to insufficient historical monitoring and gaps in extraction data, adaptive management is not currently feasible. Immediate implementation of metering for all licensed users is required to enable future consideration of adaptive strategies.

9.4.2.4 Aquaculture Elliston

This specific consumptive pool was established following a rigorous assessment that confirmed an appropriate ongoing sustainable extraction rate. As with Uley South, a fixed consumptive pool volume is appropriate as there is one licensed user with ongoing monitoring and reporting requirements, under a groundwater management plan, to ensure sustainable use and to inform action in response to any emerging risks or environmental change.

9.4.2.5 Deeper groundwater resources

Southern Basins Tertiary, Southern Basins Basement, Musgrave Tertiary and Musgrave Basement management areas are largely disconnected from direct rainfall and therefore show little response to rainfall variations. As such they are not adaptively managed.

10. Principles

The principles (1 to 51) in Sections 10.1 to 10.14 of this Plan apply to all applications for new water management authorisations and to all applications to vary existing water management authorisations (water licence, water access entitlement or water allocation) made after this Plan becomes operational. The transitional arrangements in Section 10.7 of this Plan discuss how holders of existing water licences will be issued water management authorisations under this Plan.

There are principles within this Plan which require the provision of information to support an application for a water management authorisation, in some circumstances. This information allows the Minister to consider the application against the requirements of this Plan and informs any decision to grant or refuse an application.

Where a proponent is required to demonstrate a matter to the satisfaction of the Minister, the responsibility for undertaking the relevant hydrogeological or other investigation and the associated costs, lies with the proponent and not with the Minister or the Government of South Australia. It should be noted that reference to the Minister throughout this Plan refers to the Minister or the Minister's delegate, where a function or power assigned to the Minister under the Landscape Act has been delegated to another body or person.[24]

10.1. Consumptive pools

1. For the purposes of this Plan, the consumptive pools shall be determined by way of a fixed geographic boundary, volume, or purpose, resulting in 15 consumptive pools defined as:

    a. **Coffin Bay Consumptive Pool**, being the fixed consumptive pool volume of 138.45 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 132.89 ML/y) available to be taken for non-licensed and public water supply and general purposes, from the Quaternary Bridgewater Formation aquifer in the Southern Basins PWA, within the area coloured purple in Figure 4-1

    b. **Uley North Consumptive Pool**, being the consumptive pool volume determined annually with a total maximum volume of 78.34 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 50.49 ML/y) available to be taken for non-licensed and general purposes, from the Quaternary Bridgewater Formation aquifer in the Southern Basins PWA, within the area coloured green in Figure 4-1

    c. **Uley South Consumptive Pool**, being:

        i. For the 2026–27 water-use year, the fixed consumptive pool volume of 6,308.14 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 6,300 ML/y)[25]

        ii. From the 2027-28 water-use year onwards, the fixed consumptive pool volume of 3,508.14 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 3,500 ML/y) available to be taken for non-licensed and public water supply purposes, from the Quaternary Bridgewater Formation aquifer in the Southern Basins PWA, within the area coloured red in Figure 4-1

    d. **Lincoln North Consumptive Pool**, being the fixed consumptive pool volume of 121.85 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 83.10 ML/y) available to be taken for non-licensed and general purposes, from the Quaternary Bridgewater Formation

24 Section 10(1) of the Act

25 A desalination plant is currently being built to augment the public water supply system. This is proposed to be completed within the 2026-27 water-use year. As such, 3,500 ML will be the ongoing volume of water available from this resource. Therefore, additional water has been made available for the 2026-27 water-use year only, while the plant becomes operational. As soon as the desalination plant is producing water, the public water supply demand shall be transitioned to this source to minimise pressures on the groundwater resource.

aquifer in the Southern Basins PWA, within the area coloured yellow in Figure 4-1

e. **Southern Basins Non-Licensed Quaternary Consumptive Pool,** being the fixed consumptive pool volume of 11.22 ML/y available to be taken for non-licensed purposes, from the Quaternary Bridgewater Formation aquifer in the Southern Basins PWA, within the transparent areas in Figure 4-1

f. **Southern Basins Tertiary Consumptive Pool** being the fixed consumptive pool volume of 29.14 ML/y available to be taken for non-licensed purposes, from the Tertiary Wanilla Formation aquifer in the Southern Basins PWA, within the area coloured beige in Figure 4-3

g. **Southern Basins Basement Consumptive Pool** being the fixed consumptive pool volume of 490.52 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 462.22 ML/y) available to be taken for non-licensed and general purposes, from the Basement aquifer in the Southern Basins PWA, within the area coloured beige in Figure 4-3

h. **Bramfield Consumptive Pool**, being the consumptive pool volume determined annually, with a total maximum volume of 576.95 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 476.75 ML/y) available to be taken for non-licensed, public water supply and general purposes, from the Quaternary Bridgewater Formation aquifer in the Musgrave PWA, within the area coloured green in Figure 4-2

i. **Polda Consumptive Pool**, being the consumptive pool volume determined annually, with a total maximum volume of 57.65 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 22.95 ML/y) available to be taken for non-licensed and general purposes, from the Quaternary Bridgewater Formation aquifer in the Musgrave PWA, within the area coloured red in Figure 4-2

j. **Sheringa Consumptive Pool**, being the consumptive pool volume determined annually, with a total maximum volume of 237.43 ML/y (with a maximum value of all entitlement shares available for allocation within the pool being equal to 182.88 ML/y) available to be taken for non-licensed and general purposes, from the Quaternary Bridgewater Formation aquifer in the Musgrave PWA, within the area coloured blue in Figure 4-2

k. **Aquaculture Elliston Consumptive Pool**, being the fixed consumptive pool volume of 10 ML/y available to be taken for authorised aquaculture purposes, from the Quaternary Bridgewater Formation aquifer in the Musgrave PWA, within the area coloured pink in Figure 4-2

l. **Musgrave Non-Licensed Quaternary Consumptive Pool**, being the fixed consumptive pool volume of 94 ML/y available to be taken for non-licensed purposes, from the Quaternary Bridgewater Formation aquifer in the Musgrave PWA, within the transparent areas in Figure 4-2

m. **Musgrave Tertiary Consumptive Pool**, being the fixed consumptive pool volume of 68.39 ML/y available to be taken for non-licensed purposes, from the Tertiary Poelpena Formation aquifer in the Musgrave PWA, within the area coloured beige in Figure 4-4

n. **Musgrave Basement Consumptive Pool**, being the fixed consumptive pool volume of 67.3 ML/y available to be taken for non-licensed purposes, from the Basement aquifer in the Musgrave PWA, within the area coloured beige in Figure 4-4

o. **Managed Aquifer Recharge Consumptive Pool**, being the water available for allocation as a result of metered drain or discharge activities undertaken within the prescribed areas managed by this Plan, in accordance with a permit issued pursuant to either Section 104(3)(c) of the Landscape Act in accordance with Section 10.13 of this Plan, or an environmental authorisation issued under Section 40(1) of the *Environment Protection Act 1993*.

10.2. Water licences

2. Subject to Principle 3, the Minister may grant a new water licence in respect of a consumptive pool listed in Principle 1. A water licence provides a water access entitlement to the holder of the licence to gain access to a share of the water available in the consumptive pool that is available for licensed purposes.
3. The water licence shall list the wells through which the water is authorised to be taken. The proposed wells for the taking of water are required to meet the Assessment criteria in Section 10.12 of this Plan to ensure the taking of water will not cause undesired impacts to groundwater-dependent ecosystems, aquifers or existing users of the resource. The water access entitlement which is provided for under the water licence is subject to the conditions attached to the licence.[26]
4. The Minister may grant a water licence for the recovery of water previously drained or discharged into a well (recharge water licence) in accordance with a permit issued pursuant to either Section 104(3)(c) of the Landscape Act in accordance with Section 10.13 of this Plan, or an environmental authorisation issued under Section 40(1) of the *Environment Protection Act 1993*. The licence will relate to the Managed Aquifer Recharge Consumptive Pool.
5. Where water from a prescribed water resource is used in the conduct of activities subject to a mining or petroleum lease or licence pursuant to the *Mining Act 1971* or the *Petroleum and Geothermal Energy Act 2000*, the Minister may grant a water licence for the purposes of those activities, subject to the provisions of this Plan.
6. Further to Principle 5, a separate water licence is required for each lease or licence issued pursuant to the *Mining Act 1971* or the *Petroleum and Geothermal Energy Act 2000*, including but not limited to exploration licences, retention licences and production licences.
7. Where a water licence has been issued subject to Principles 5 and 6, that licence shall include terms that ensure its expiration on 30 June following the relinquishment of the associated mining or petroleum lease or licence.
8. A water licence (and therefore a water allocation) is not required for the taking of water for:
    a. watering stock (other than stock subject to intensive farming);
    b. domestic purposes as defined by the Landscape Act;
    c. the purpose of using it during any operation or activity reasonably necessary for, or incidental to, the drilling or construction of wells; or
    d. aquifer testing where the proponent can prove to the satisfaction of the Minister that the water required to be taken will not adversely affect the reliability of supply or the quality of water accessed by existing users of water from the same or any other consumptive pool and will only present a low level of risk to the present and future health and maintenance of ecosystems that depend on water from these aquifers.

10.3. Water access entitlements

9. The Minister may grant a new water access entitlement to provide access to a share of a consumptive pool listed in Principle 1.
10. A water access entitlement issued on account of a water licence in relation to the consumptive pools listed in Principles 1a to 1n shall be a specified share of the water available for licensed use, as determined from time to time by the Minister under Section 121(4) of the Landscape Act, expressed as a number of entitlement shares within the consumptive pool.
11. A water access entitlement issued on account of a recharge water licence in relation to the Managed Aquifer Recharge Consumptive Pool listed at Principle 1o, known as a recharge water access entitlement, will be calculated as:
    a. 80% of the total volume of water drained or discharged to a particular aquifer at a particular location under a permit issued pursuant to either Section 104(3)(c) of the Landscape Act or an environmental authorisation under Section

26 Section 121(3)(c) of the Landscape Act

40(1) of the *Environment Protection Act 1993* throughout the previous water-use year; or

b. a specified percentage of the water drained or discharged to a particular aquifer at a particular location under a permit issued pursuant to either Section 104(3)(c) of the Landscape Act or an environmental authorisation under Section 40(1) of the *Environment Protection Act 1993* throughout the previous water-use year, if the proponent can demonstrate to the satisfaction of the Minister that the taking of up to 100% of the water drained or discharged into the well(s) would not contravene the Assessment criteria in Section 10.12 of this Plan to ensure the taking of water will not cause undesired impacts to groundwater-dependent ecosystems, aquifers or existing users of the resource.

12. The granting of new entitlement shares shall not cause the total volume of water able to be allocated in relation to the entitlement shares for each consumptive pool to exceed the maximum value of all entitlement shares available for allocation specified in Principles 1a to 1n and Table 10-1 for the relevant consumptive pool, which are valid at the date of approval of this Plan. The proposed wells for the taking of water in relation to the entitlement shares are required to meet the Assessment criteria in Section 10.12 of this Plan.

13. For the purpose of this Plan, any entitlement shares that have not yet been granted on a water access entitlement or are returned to the consumptive pool through the future surrender of an existing water access entitlement, will be known as excess water.

14. The Minister may issue a water access entitlement or increase the number of entitlement shares on an existing water access entitlement in relation to excess water, based on applications submitted to the Minister under procedures determined by the Minister as being appropriate in the relevant circumstances.[27] A water access entitlement will only be granted or amended if the proposed wells for the taking of water meet the Assessment criteria in Section 10.12 of this Plan.

10.4. Water allocations

15. A water allocation is issued annually on account of a water access entitlement under a water licence, on the basis that the water allocation is being issued by the Minister under the terms of the water licence and will relate to a period not exceeding 12 months.

16. Subject to Principle 17 and 19, for the purposes of allocation, consumptive pools have been established on the nominal basis that 1 entitlement share = 1 kilolitre of water allocation. However, the actual volume of water allocated in any given water-use year is subject to the Minister's determination of the volume of water that is to be made available from a consumptive pool for allocation under Section 121(4) of the Landscape Act.

17. Principle 16 does not apply to a water allocation in relation to a recharge water access entitlement.

18. A recharge water allocation may be obtained on account of a recharge water access entitlement. The volume of water allocated in any given water-use year shall be the 'available balance' being the percentage of the volume of water drained or discharged to a particular aquifer at a particular location throughout the previous water-use year, permitted to be taken in accordance with Principle 11.

10.5. Adaptive management

The Minister may, from time to time, determine the volume of water that is to be made available for allocation in accordance with Section 121(4) of the Landscape Act. In doing so, the Minister may take into consideration the consumptive pool management approaches as outlined in Section 9.4 of this Plan.

19. With respect to the consumptive pools listed in Principle 1a to 1n, the Minister may, by notice in the *South Australian Government Gazette,* published on or about 30 June of the preceding water-use year, determine:

a. the value of an individual entitlement share of a water access entitlement from each of these consumptive pools as determined by the means set out in this Plan; and

b. the volume of water that is to be made available for allocation from each consumptive pool under Section 121(4) of the Landscape Act.

27 Section 122(2) of the Act

Table 10-1 Consumptive pool water access entitlement shares at the date of approval of this Plan

Consumptive pools	Non-licensed demand (kL)	Licensed demand (kL)	Excess water (kL)	Maximum volume of water available for allocation (kL)	Water access entitlement (in shares)		
					Licensed demand	Excess water	Total
Coffin Bay	5,560	132,890	0	132,890	132,890	0	132,890
Uley North	27,860	50,488	0	50,488	50,488	0	50,488
Uley South[28]	8,140	3,500,000	0	3,500,000	3,500,000	0	3,500,000
Lincoln North	38,750	83,100	0	83,100	83,100	0	83,100
Southern Basins Non-Licensed Quaternary	11,220	0	0	0	0	0	0
Southern Basins Tertiary	29,140	0	0	0	0	0	0
Southern Basins Basement	28,300	462,218	0	462,218	462,218	0	462,218
Bramfield	100,200	476,750	0	476,750	476,750	0	476,750
Polda	34,730	22,952	0	22,952	22,952	0	22,952
Sheringa	54,550	182,882	0	182,882	182,882	0	182,882
Aquaculture Elliston	0	10,000	0	10,000	10,000	0	10,000
Musgrave Non-Licensed Quaternary	94,000	0	0	0	0	0	0
Musgrave Tertiary	68,390	0	0	0	0	0	0
Musgrave Basement	67,300	0	0	0	0	0	0

28 A desalination plant is currently being built to augment the public water supply system. This is proposed to be completed within the 2026-27 water-use year. As such, 3,500 ML will be the ongoing volume of water available from this resource. Additional water, as specified in Principle 1ci has been made available for the 2026-27 water-use year only, while the plant becomes operational.

10.6. Carry-over of unused water allocation

20. The carry-over of any unused water allocation is not authorised in relation to any consumptive pool.

10.7. Transitional arrangements

21. From the date of approval of this Plan, the holder of an existing water licence will be provided with a water licence and therefore a water access entitlement under this Plan. Subject to Principle 22, the water licence shall list the wells through which the water is authorised to be taken. The number of entitlement shares issued to the water access entitlement holder shall be equivalent to the number of entitlement shares authorised under the previous Plan, limited to the 'maximum value of all entitlement shares available for allocation within the pool', stated in Principles 1a to 1n[29]. If the issuance of these licences does not align with the date that this Plan comes into operation, administration of this Plan will, until these licences are issued, be undertaken with existing licences operating as if they were authorisations issued under this Plan.

22. Notwithstanding Principle 21, a water licence may be issued to a holder of an existing water licence without a listing of the wells through which the water is to be taken, but in this case the licence must relate to a specific consumptive pool and any allocation issued in relation to the licence cannot be taken until the licence is varied to include the wells through which the water will be taken. The proposed wells for the taking of water are required to meet the Assessment criteria in Section 10.12 of this Plan.

23. A water licence provided under the transitional arrangements in Principles 21 and 22 is subject to the conditions outlined in Section 10.8 of this Plan.

10.8. Terms and conditions for consideration for a water licence or water allocation

The Landscape Act allows for a water licence or water allocation to be subject to conditions endorsed on the water management authorisation by the Minister[30]. A water access entitlement is subject to the conditions attached to the licence[31]. The licence remains in force unless it expires under the terms of the licence[32].

24. When issuing, varying or transferring a water management authorisation, the Minister may consider endorsing conditions on the authorisation to the effect that:

    a. water must only be taken from the well(s) listed on the authorisation;

    b. any well(s) listed on the authorisation must be metered;

    c. the take of water from the well(s) listed on the authorisation must not exceed the allocation issued to be taken from the well(s);

    d. the infrastructure through which water can be taken pursuant to a water management authorisation must be maintained and constructed so that the volume of water taken from the well can be metered without interference;

29 Note a licence in relation to the Uley South Consumptive Pool will vary from water-use year 2026-27 to 2027-28 in relation to the change in size of the consumptive pool as described in principle 1c.

30 Section 123(c)(ii) and Section 127(6)(b) of the Landscape Act

31 Section 121(3)(c) of the Landscape Act

32 Section 123(e)(ii) of the Landscape Act

e. the authorisation holder must report the volume of water taken through a water meter during the water-use year (that is, closing readings) to the Department by the specified date;

f. the conditions listed on the authorisation may be varied by the Minister at annual intervals if, in the opinion of the Minister, the variation is desirable to more effectively regulate the use of water from the resource in accordance with this Plan; and

g. if the water access entitlement relates to 50,000 entitlement shares or more and the licence lists the specific well/s through which the entitlement shares are to be taken:

   i. the Department will undertake a risk assessment and develop a risk management and monitoring plan, based on the findings of the risk assessment;

   ii. the licensee will, in collaboration with the Department, incorporate in the risk management and monitoring plan, the operational procedures and risk mitigation strategies to be put in place to avoid any negative consequences identified through the risk assessment;

   iii. the licensee will operate in accordance with the risk management and monitoring plan, as approved by the Minister;

   iv. the licensee will update the risk management and monitoring plan as requested from time to time by the Minister; and

   v. the licensee will report compliance with the risk management and monitoring plan in a manner approved by the Minister.

25. When issuing or varying a water management authorisation for the recovery of water previously drained or discharged into a well, the Minister may endorse conditions on the authorisation to the effect that:

    a. the water taken pursuant to the authorisation must only be taken from the aquifer into which the water was drained or discharged;

    b. the water taken pursuant to the authorisation must only be taken from well(s) located within the same spatial extent as the corresponding native groundwater consumptive pool that aligns with the location and aquifer within which the drain or discharge activities occurred;

    c. the water taken pursuant to the authorisation must only be taken from well(s) located within 1 km of the drain or discharge activities and must be accessing the same native groundwater consumptive pool and aquifer, in which the drain or discharge activities occurred;

    c. the volume of water taken in a single water-use year must not exceed the available balance;

    d. the licensee must operate in accordance with a risk management and monitoring plan approved by the Minister;

    e. the risk management and monitoring plan must be updated as the Managed Aquifer Recharge scheme's operations change, and as requested from time to time by the Minister;

    d. the licensee must report the drained or discharged and recovered volumes in a manner approved by the Minister; and

    g. the water taken pursuant to the authorisation will be deemed to have been taken after any other allocation authorised for extraction from the same well(s).

26. The conditions specified in Principles 24 and 25 are additional to, and subject to the conditions endorsed on a water management authorisation issued pursuant to Section 10.7 of this Plan and any other conditions endorsed by the Minister or as may be prescribed from time to time by the Regulations.

10.9. Transfers of water licences, access entitlements or entitlement shares

27. Subject to the succeeding provisions of this Section and the Landscape Act[33], the holder of a water licence may apply to transfer to another person:
    a. the water licence;
    b. a water access entitlement;
    c. one or more entitlement shares under the licence; or
    d. a water allocation issued on account of a water access entitlement.
28. The application for the transfer of a water licence, water access entitlement or entitlement shares may be permanent or for a temporary period.
29. Principle 27 does not apply to a water licence, water access entitlement, or water allocation issued pursuant to the Managed Aquifer Recharge Consumptive Pool, unless the transfer is in relation to a change in ownership of the scheme.
30. A water licence, water access entitlement or an entitlement share may only be transferred, temporarily or permanently, to another person where it remains a water licence, water access entitlement or an entitlement share for the consumptive pool from which it was initially granted.
31. Subject to the provisions of this Plan and the Landscape Act[34], the holder of a water allocation may apply to transfer the water allocation in part or in full, to another person for the period for which the allocation is current (up to 12 months).
32. A water allocation may only be transferred to another person where it remains a water allocation for the consumptive pool from which it was initially granted.
33. The transfer of a water licence, water access entitlement, entitlement share, or water allocation will only be approved if it meets the Assessment criteria as specified in Section 10.12.
34. Notwithstanding Principle 33, the Minister may authorise the transfer of a water licence, water access entitlement, entitlement share, or water allocation to enable water to be taken from a particular well, where the applicant has demonstrated to the satisfaction of the Minister that the issuing or varying of the authorisation to take water would not result in any undesirable impacts to water resources, water-dependent ecosystems, existing users (including any future return of currently transferred entitlement shares), or Managed Aquifer Recharge operators.

10.10. Variation of a water licence or water allocation

The Landscape Act allows for a water licence or water allocation to be varied by the Minister[35]. The Minister's decision to vary such a water management authorisation, must be consistent with the relevant water allocation plan[36].

35. The variation of a water licence or water allocation will only be approved if it meets the Assessment criteria as specified in Section 10.12 of this Plan.
36. An application to vary the conditions of a water management authorisation, to be inconsistent with the conditions listed in Section 10.8, will be considered seriously at variance with this Plan.

10.11. Management of wells

Wells may only be constructed, maintained and operated and water may only be taken, in circumstances where the Minister is satisfied that the taking of water and the proposed manner of

33 Section 125 of the Landscape Act
34 Section 132 of the Landscape Act
35 Section 124 and Section 131 of the Landscape Act
36 Section 124(3)(a)(i) of the Landscape Act

taking will have no significant detrimental impact on the water resource, groundwater-dependent ecosystems or existing water users of the resource.

A permit is required for the drilling, plugging, backfilling or sealing of a well and the repairing, replacing or altering of the casing, lining or screen of a well pursuant to Section 104(3)(a) and (b) of the Landscape Act.

For the purpose of this Plan, 'well' has the same definition as stated in the Landscape Act:

- an opening in the ground excavated for the purpose of obtaining access to groundwater
- an opening in the ground excavated for some other purpose but that gives access to groundwater
- a natural opening in the ground that gives access to groundwater.

The occupier of the land on which a well is situated is subject to a general obligation to ensure that the well, including the casing, lining and screen of the well, the headworks of the well and the mechanism (if any) used to cap the well, are properly maintained[37].

37. A permit to drill a well in the prescribed areas managed by this Plan may only be granted if the Minister is satisfied that the proposed well will be installed in accordance with the *General Specifications for Well Drilling Operations Affecting Water in South Australia* and constructed in accordance with the most current edition of the *Minimum Construction Requirements for Water Bores in Australia*. These documents are available from the Department.

38. A permit to drill a well in the prescribed areas may only be granted if the Minister is satisfied that the proposed location of the well (coordinates) will meet the Assessment criteria as specified in Section 10.12 of this Plan.

39. Principle 38 does not apply if the well is:

    a. for the taking of water authorised under Section 105 of the Landscape Act for purposes that do not require a licence and the rate of groundwater extraction from the well will not exceed 1.0 L/sec;

    b. to be used for scientific purposes including but not limited to the monitoring of the groundwater resource where the total volume to be extracted from the well does not exceed 2 ML/y; or

    c. a replacement well that will:

        i. replace an existing production well owned by the existing owner or another party, that is authorised for the purpose of taking a water allocation or for stock and domestic water supply;

        ii. be located no further than 50 m from the well being replaced;

        iii. be constructed in the same consumptive pool as the well being replaced;

        iv. be used for the same purpose as the existing well;

        v. if located within an environmental protection zone or a buffer zone surrounding an area of clay absence, not be located closer to the environmental asset or area of clay absence protected by those zones, and

        vi. have a volume proposed to be extracted from the well is equal to, or less than, that from the existing production well.

40. Notwithstanding Principles 37 to 39, where the Minister reasonably suspects that groundwater within the proposed drilling area may be contaminated, the proponent will be required to submit, to the satisfaction of the Minister, credible evidence demonstrating that:

    a. The groundwater to be accessed is safe for its intended use; and

    b. The proposed drilling and operation of the well will not cause, contribute to, spread, or exacerbate the contamination.

    Failure to provide such evidence to the satisfaction of the Minister may result in refusal to grant a permit for the construction of the well[38].

37 Section 119 of the Landscape Act

38 Section 114 of the Landscape Act

A permit to drill a well within a Native Title determination area, or an area where Native Title has not been extinguished is subject to referral for comment. The referral recipient has 60 days to respond to the request. In cases where an Indigenous Land Use Agreement (ILUA) exists which refers to matters relating to water and the drilling of wells, this will be consulted prior to referring the application. Native Title determination areas current at the date of approval of this Plan are displayed in Figure 6-1.

10.12. Assessment criteria

41. For the purposes of this Section:

    a. A well buffer zone is a circular area centred upon the site of a new or existing operational well located within the listed consumptive pool from which new or additional water is proposed to be taken, with a radius in relation to the listed consumptive pool being determined in accordance with Table 10-2.

    b. An environmental protection zone is a set-back distance from identified groundwater-dependent ecosystem or marine discharge sites, related to the taking of water from the Quaternary Limestone aquifer as determined in accordance with Table 10-3, Figure 7-6 and Figure 7-7.

    c. A clay buffer zone is a buffer area surrounding an area of clay absence, related to the taking of water from the Tertiary or Basement aquifers as determined in accordance with Table 10-4, Figure 7-2 and Figure 7-3.

    d. A groundwater protection zone is an area related to the Uley South Consumptive Pool, aligned with the publicly owned land, to protect the Quaternary Limestone public water supply resource from the taking of water from the Tertiary or Basement aquifers, as determined in accordance with Figure 7-1.

    e. An existing operational well is defined as a well that is used, or can be used, to supply water for irrigation, stock, domestic or commercial use and is known to the Department.

42. Subject to Principle 45 and the transitional arrangements in Section 10.7 of this Plan, the taking of water from a new well or an increase in water to be taken from an existing operational well will not be granted where any of the following apply:

    a. the well buffer zone for the proposed location of take, determined in accordance with Table 10-2, would overlap with an existing operational well in the same consumptive pool;

    b. the proposed location of take is from the Quaternary Limestone aquifer and falls within an environmental asset or an environmental protection zone, as determined in accordance with Table 10-3, Figure 7-6 and Figure 7-7;

    c. the proposed location of take is from the Tertiary or Basement aquifers in the zones identified as areas of clay absence or the buffer zones surrounding the areas of clay absence, as determined in accordance with Table 10-4, Figure 7-2 and Figure 7-3;

    d. the proposed location of take is from the Tertiary or Basement aquifers in the zone identified as a groundwater protection zone, as determined in accordance with Figure 7-1; or

    e. the taking of water is equal to or greater than a total volume[39] of 50,000 kL/y.

43. Principle 42.a does not apply where the proposed location of take is an existing well, or a new well to be drilled, on land owned by the applicant, including land that is contiguous and the proponent's properties are too small to enable the minimum distance as specified in Table 10-2.

44. Principle 42.c may not apply where it can be proven to the satisfaction of the Minister that:

    a. although the Tertiary clay layer is absent in a specific location, a similar confining layer is present that limits the connection between the Quaternary Limestone aquifer and the underlying Tertiary or Basement aquifers such that downward leakage is restricted should water be taken from the Tertiary or Basement aquifers;

39 In cases where the applicant holds an existing licence, the total volume means the volume listed on the existing authorisation plus any additionally proposed volume.

b. the Quaternary Limestone aquifer is unsaturated, and a management regime exists that can adequately manage all aquifers should the Quaternary Limestone aquifer become saturated; or

c. the siting of the well within an area of clay absence or within the buffer zone surrounding an area of clay absence and the subsequent taking of water from that well, will not cause or lead to the downward movement of water from the Quaternary Limestone aquifer to the underlying aquifers.

45. Notwithstanding Principle 42, the Minister may issue or vary a water management authorisation that authorises a new or increased volume of water to be taken from a particular well, where the applicant has demonstrated to the satisfaction of the Minister that the issuing or varying of the authorisation to take water would not result in any undesirable impacts on water resources, water-dependent ecosystems, existing users (including any future return of currently transferred entitlement shares), or Managed Aquifer Recharge operators.

Table 10-2 Well buffer zone

<table>
<tr><th>Consumptive pool</th><th>Proposed new or additional volume of extraction (kL)</th><th>Radius (m)</th></tr>
<tr><td rowspan="5">Coffin Bay
Uley North
Uley South
Lincoln North
Polda
Bramfield
Sheringa</td><td>0 to 5,000</td><td>300</td></tr>
<tr><td>5,001 to 10,000</td><td>350</td></tr>
<tr><td>10, 001 to 25,000</td><td>400</td></tr>
<tr><td>25,001 to 50,000</td><td>450</td></tr>
<tr><td>>50,001</td><td>500</td></tr>
<tr><td>Southern Basins Non-Licensed Quaternary
Southern Basins Tertiary
Southern Basins Basement
Aquaculture Elliston
Musgrave Non-Licensed Quaternary
Musgrave Tertiary
Musgrave Basement</td><td>Any</td><td>300</td></tr>
</table>

Table 10-3 Environmental protection zone set-back distances

PWA	Groundwater-dependent ecosystem	Marine discharge location	EPZ set-back distance (m)
Southern Basins	Pillie Wetland Group		2,187
	Sleaford Wetland Group		2,187
	Wanilla Wetland Group		1,294
	Big Swamp		1,294
	Little Swamp		1,294
	Duck Ponds Creek		1,294
	Black Swan Lane		1,294
		Kellidie Bay	444
		Tulka	751
Musgrave	Hamilton Wetland Group		3,530
	Newland Wetland Group		5,000
	Poelpena Wetland		5,000
		Elliston	147

Table 10-4 Clay buffer zone

PWA	Location	Buffer zone (m)
Southern Basins	Uley South area	163
	Remaining areas in Southern Basins PWA	1,417
Musgrave	Talia area	5,059
	Remaining areas in Musgrave PWA	1,417

10.13. Draining or discharging water into a well

A permit is required for the draining or discharging of water directly or indirectly into a well[40] and the following Principles apply. However, if the water to be drained or discharged has undergone antibiotic or chemical water treatment with a discharge volume greater than 50 kL/d, an authorisation issued by the Environment Protection Authority under Section 40(1) of the *Environment Protection Act 1993* is required instead. In issuing the authorisation, the Environment Protection Authority may take into account the Principles listed below.

46. Prior to the granting of a permit to drain or discharge water into a well the following is required to be undertaken by the applicant to the satisfaction of the Minister:

    a. a risk assessment that is consistent with the *National Water Quality Management Strategy – Australian Guidelines for Water Recycling: Managing Health & Environmental Risks, Phase 2 – Managed Aquifer Recharge*

40 Section 104(3)(c) of the Act

(2009), as amended from time to time, or any subsequent guidelines current at the time;

b. a risk management and monitoring plan, based on the findings of the risk assessment, which demonstrates that operational procedures and risk mitigation strategies are in place to avoid any negative consequences identified through the risk assessment; and

c. any other investigations or documentation required by the Minister.

47. Principle 46 does not apply to water drained or discharged into a well by means of gravity, or roof runoff (surface water), which is proposed to be drained or discharged into a well via a closed system of capture and transport, provided that the system is equipped with a mechanism to divert first flush water and is drained under gravity.

48. A permit may only be granted for the draining or discharging of water to an aquifer where the applicant can demonstrate to the satisfaction of the Minister that such draining or discharging will only present a low level of risk to:

a. the quality of the water in the receiving aquifer;

b. the integrity of the receiving aquifer (for example, it must not cause the overlying confining beds to hydraulically fracture or fail);

c. groundwater-dependent ecosystems or native vegetation;

d. the ability of another water licence holder to access water through an existing operational production well;

e. surface and near-surface drainage including, but not limited to, waterlogging of soils, creating perched watertables or excessive increase in the height of watertables; and

f. buildings, roads and infrastructure due to direct or indirect damage.

49. If the intent is to recover the drained or discharged water a permit may only be granted where:

a. the water taken pursuant to the recharge water allocation will only be taken from the aquifer into which the water was drained or discharged; and

b. the water taken pursuant to the recharge water allocation will only be taken from well(s) located within 1 km of the drain or discharge activities and must be accessing the same native groundwater consumptive pool and aquifer, in which the drain or discharge activities occurred.

50. When issuing a permit to drain or discharge water into a well the Minister may endorse a condition on the permit that requires the permit holder to provide an annual draining or discharge report that includes the following information:

a. the total amount of water drained or discharged into a well, as measured by each meter, in the water-use year and at any period as determined by the Minister;

b. the groundwater level/pressure for the relevant aquifer accessed by the well(s) through which water was drained or discharged, as measured by wells specified on the permit, at intervals specified on the permit (where applicable); and

c. the salinity and other specified chemical components of the water drained or discharged into a well, as well as the receiving native groundwater (as determined on a case-by-case basis).

Additional authorisations may be required under the *Environment Protection Act 1993*.

10.14. Conversion of a mineral well to a water well

51. A mineral well may be converted to a water well in accordance with approved water well construction standards. For the purpose of this Plan, the conversion of a mineral well to a water well is regarded as a new well and is subject to the Principles contained in Section 10.11 of this Plan.

11. Monitoring and evaluation

Section 53(1)(f) of the Landscape Act requires a water allocation plan to '*assess the capacity of the resource to meet the demands for water on a continuing basis and provide for regular monitoring of the capacity of the resource to meet those demands*'.

This includes ensuring that the demands on the resource can be met, without impacting on the ecological sustainability of the resource. Additionally, monitoring assists in the review of the Plan to consider if the Plan is achieving the set objectives.

This Plan will be accompanied by a Monitoring, Evaluation, Reporting and Improvement (MERI) Plan that outlines a comprehensive program aimed at measuring and assessing hydrogeological, ecological and water use parameters.

11.1. Monitoring strategy

The monitoring strategy set out in this Plan aims to ensure sufficient data are available to:

- assess changes in the condition of priority groundwater resources and environmental assets
- determine groundwater levels in relation to specified groundwater level triggers for the Uley North, Bramfield, Polda and Sheringa consumptive pools on an annual basis
- monitor demands placed on the groundwater resource (licensed extractions)
- ensure compliance with conditions on water licences and permits
- inform the evaluation of the effectiveness of the Plan in meeting its objectives.

11.2. Assessment of changes in condition of priority groundwater resources and environmental assets

11.2.1. Groundwater monitoring network

A network of monitoring wells will be maintained and monitored on a temporal and spatial scale sufficient to enable the assessment of the change in condition of water levels and salinities in priority groundwater aquifers within the PWAs. This network will be outlined in the MERI Plan.

A selection of wells (Table 9-1) will be monitored for water level annually in autumn to determine the groundwater level in relation to the water level triggers in the adaptively managed consumptive pools.

Additionally, when indicated as a condition on a water licence, a Risk Management and Monitoring Plan (RMMP) must be prepared, as indicated in Principles 24.g and 46.b of Section 10 of this Plan, which may require the licensee to monitor water level and salinity at selected wells on the basis specified in the RMMP.

11.2.2. Environmental asset monitoring

The water needs of groundwater-dependent ecosystems are described in Section 5 and the principles for the maintenance and protection of environmental assets are included in Section 10. To evaluate the success of these provisions, a program targeting priority environmental assets in management areas where extraction is occurring may be implemented in the MERI Plan.

11.3. Annual assessment of level of storage of the saturated Quaternary Limestone management areas

To determine whether a water level trigger has been reached, DEW's monitoring network must record groundwater levels between March and May (autumn) each year for specific wells. Although monitoring occurs biannually, autumn data is critical as it reflects post-irrigation season lows and provides an accurate snapshot of aquifer condition.

Table 9-1 outlines the wells used for adaptive management, along with their corresponding upper and lower water level triggers.

For the Uley North, Bramfield, Sheringa and Polda consumptive pools, the water level collected in autumn will be compared with the specified trigger levels to determine if the triggered condition has been met and if a change to the variable component of the consumptive pool volume for the following water-use year is required.

11.4. Monitoring of demands placed on the groundwater resource

DEW keeps a record of the licensed groundwater extractions for the Southern Basins and Musgrave PWAs in mywater. Metering of licensed groundwater extractions will continue for both PWAs.

Additionally, when indicated as a condition on a water licence, a RMMP must be prepared, as indicated in Principles 24.g and 46.b of Section 10 of this Plan, which may require the licensee to monitor extraction from production wells on the basis determined in the RMMP.

11.5. Compliance with conditions on authorisations

The monitoring data obtained in Sections 11.2 to 11.4 will assist in determining compliance with any conditions placed on a water management authorisation or relevant permit.

11.6. Evaluation

Evaluation is required at different stages to assess changes in the condition of groundwater resources and dependent ecosystems, determine water levels in relation to resource condition triggers, periodically assess the effectiveness of the Plan in meeting objectives and inform future reviews.

Evaluation of monitoring data will be undertaken in a manner that considers the groundwater and environmental asset condition trends, primarily in relation to the proximity of water affecting activities in the vicinity of environmental assets but also recognising that other factors such as climate variability and land management may be contributing to observed environmental asset condition. Further detail regarding the content, timing and responsibility for evaluation activities will be defined in the MERI Plan.

The MERI Plan will aim to identify knowledge gaps and research required to improve the science that underpins the Plan and provide for continual improvement.

11.7. Evaluating the success and appropriateness of this Plan

This Section outlines a MERI framework to inform a comprehensive review of the success and appropriateness of this Plan as required by Section 54 of the Landscape Act. This framework is intended to inform the development of the detailed MERI Plan which will cover:

- a framework to measure and evaluate the success of this Plan at achieving its objectives
- a framework for assessing whether this Plan remains appropriate or requires amendment.

11.7.1. Review of this Plan

A comprehensive review of this Plan must occur at least once in the 10 years following approval. Under normal circumstances it is proposed that the review should occur towards the end of the 10-year period.

A review may be undertaken earlier in response to observed changes in resource condition or changes in legislation or for any other reason. An early review may be targeted to address any specific issues that have been identified.

The review aims to evaluate the effectiveness and appropriateness of this Plan consistent with the requirements of the Landscape Act. The outputs of the review are decisions regarding the need for amendments. The key evaluation questions to be addressed by the review include:

1. To what extent has this Plan been successful in achieving its objectives?
2. To what extent has the implementation of the policies and principles in this Plan been effective in contributing to the objectives?
3. To what extent does this Plan remain appropriate or require amendment?

The evaluation of the appropriateness of this Plan (key evaluation question 3) should be informed by the evaluation of the success and effectiveness of this Plan (key evaluation questions 1 and 2). Therefore, the review will be undertaken in 2 stages, with the first stage focused on effectiveness and success and the second stage addressing the appropriateness of this Plan and the need for amendment. The MERI Plan will set out how these evaluation questions will be addressed.

11.7.1.1 Stage 1 evaluation – success and effectiveness of this Plan

A MERI Plan to address the success of this Plan and the effectiveness of its principles should include:

- a program logic showing the rationale for how this Plan is anticipated to succeed in achieving its objectives
- the assumptions that underpin the achievement of the objectives
- the suggested lines of evidence, including monitoring
- the evaluation method.

Program logic and assumptions inform the scope of the evaluation process and the evidence required.

11.7.1.2 Stage 2 evaluation – appropriateness and need for amendment

Evaluation to address key evaluation question 3 (appropriateness) will be based on a forward-looking assessment as it must have regard for potential future scenarios regarding use and resource capacity. Therefore, a risk-based approach is appropriate. To implement such an approach, the MERI Plan will cover the following steps consistent with the Department's guidelines for a risk-based review of water allocation plans as follows:

- establish context
- risk assessment:
  - risk identification
  - risk analysis
  - risk evaluation
- risk treatment.

Criteria for the risk assessment will be based on the likelihood and consequences of deviation from the objectives for groundwater resource management. The risk assessment should measure the risks associated with a continuation of the existing, un-amended Plan, that is a ‘business as usual’ scenario. In this way, it provides an argument for amendments based on the level of risk identified at the time.

The risk treatment step considers the question of whether amendments are needed to ensure that risks to groundwater resources and community and environmental values are managed at an acceptable or tolerable level.

The MERI Plan will establish a framework for determining the need to amend this Plan based on the level of risk. The framework is likely to specify that high risks must be treated, while the decision to treat other risks (medium and low) should have regard for the benefits relative to the costs of treatment. Benefits of treatment can be ascertained by assessment of residual risk, which considers the anticipated effectiveness of the proposed Plan amendment for treating risk.

The review of this Plan (Stage 1 and 2 evaluations) should be documented in a public report and, if deemed necessary, this Plan will be amended following the risk assessment.

12. Consistency with other plans and legislation

This Plan was developed having regard to:

- the *Mining Act 1971*
- the *Native Vegetation Act 1991*
- the *Environment Protection Act 1993* and related policies
- the *Planning, Development and Infrastructure Act 2016*
- the *Petroleum and Geothermal Energy Act 2000*
- the *Biodiversity Act 2025*
- the *Native Title Act 1993 (Australia)*
- the Intergovernmental Agreement on a National Water Initiative, Council of Australian Governments 2004
- the Water Security Statement 2022, Water for Sustainable Growth
- the Eyre Peninsula Water Security Response Plan 2024
- the Eyre Peninsula Regional Landscape Plan 2021–2026 (2021)
- the Eyre Peninsula Landscape Board Water Affecting Activity Control Policy, Landscape South Australia, Eyre Peninsula.

13. Units of measurement

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
hectare	ha	10^4 m^2	area
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
milligram	mg	10^{-3} g	mass
second	s	base unit	time interval
year	y	365 or 366 days	time interval

14. Shortened forms

Shortened forms	Meaning
AEM	Airborne Electromagnetic
AHD	Australian Height Datum
Board	Eyre Peninsula Landscape Board
BoM	Bureau of Meteorology
CDFM	Cumulative deviation from the mean
CFC-12	Dichlorodifluoromethane; Chlorofluorocarbon
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEW	Department for Environment and Water
DFW	Department for Water
DSE	Dry Sheep Equivalent
DSEs	Dry Sheep Equivalents
DWLBC	Department of Water, Land and Biodiversity Conservation
EP	Eyre Peninsula
EPNRMB	Eyre Peninsula Natural Resources Management Board (now Eyre Peninsula Landscape Board)
EPZ	Environmental Protection Zone
EWP	Environmental Water Provision
EWR	Environmental Water Requirement
GDE	Groundwater-Dependent Ecosystem
GWPZ	Groundwater Protection Zone
HARTT	Hydrograph Analysis: Rainfall and Time-Trends (HARTT) model
Ma	Million years ago
mAHD	Metres Australian Height Datum
MERI	Monitoring, Evaluation, Reporting and Improvement
mywater	Department for Environment and Water's licensing system
NARCliM	New South Wales and Australian Regional Climate Modelling
NCGRT	National Centre for Groundwater Research and Training
PIIMS	Primary Industries Information Management System
PIRSA	Department of Primary Industries and Regions South Australia
Plan	This Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas
PWA	Prescribed Wells Area
RSWL	Reduced standing water level

15. Glossary

Adaptive management: A management approach often used in groundwater management of modifying the volume of the consumptive pool in response to changes in the condition of the groundwater resource.

Allocation: See Water allocation.

ArcGIS: A geographic information system (GIS) for working with maps and geographic information.

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 layer in the geological profile that separates two aquifers and restricts the flow between them.

Australian Height Datum (AHD): The datum adopted for vertical control, measured in metres. Zero metres AHD is approximately mean sea level.

Baseflow: The water in a stream that results from groundwater discharge to the stream. This discharge often maintains flows during seasonal dry periods and has important ecological functions.

Bathymetry: The underwater depth of lake or ocean floors (i.e. the underwater equivalent to topography).

Biodiversity: (1) The number and variety of organisms found within a specified geographic region. (2) The variability among living organisms on the earth, including the variability within and between species and within and between ecosystems.

Biota: All of the organisms at a particular locality.

Bore: See ‘Well’

Brackish water: Water of intermediate salt content between fresh and saline.

Buffer zone: An area within which certain management objective exists to protect a specific water resource or groundwater-dependent ecosystem.

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

Confining layer: The aquitard (that is, a soil/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: The water that will from time to time be taken to constitute the resource within a particular part of a prescribed water resource for the purposes of Part 8 of the Landscape Act, as determined by this Plan.

Consumptive use: Licensed and non-licensed water use that are in accordance with Part 8 of the Landscape Act.

Critical human needs: The estimated minimum amount of water to meet core human consumption requirements in urban and rural areas.

Dampland: A seasonally waterlogged basin.

Date of approval: The date that the Minister approves this Plan.

Department: The administrative unit designated from time to time, by the Minister, by notice in the Gazette as being the department primarily responsible for assisting the Minister in the administration of the Landscape Act.

Discharge (natural) or **natural discharge:** The process whereby groundwater leaves the aquifer, either through groundwater leakage to surface water bodies (e.g. baseflow), or spring seepage.

Domestic purpose: In relation to the taking of water, domestic purpose includes house and garden usage, but does not include: (a) taking water for the purpose of watering or irrigating land, other than land used solely in connection with a dwelling (garden); or (b) without limiting paragraph (a), taking water for the purpose of watering or irrigating more than 0.4 of a hectare of land; or (c) taking water to be used in carrying on a business (except for the personal use of persons employed in the business).

Draining or discharging (not Discharge as defined above): The act of injecting water directly or indirectly into a well, either under pressure or gravity.

Drawdown: The reduction in piezometric head due to pumping or gravitational drainage, especially relating to reservoirs and groundwater. A large drawdown can be caused by low transmissivity or low well efficiency, or both.

Drillhole: A drilled hole in the ground. Most hydrogeological data is obtained from drillholes.

Dry sheep equivalent (DSE): A unit to compare the feed requirements of different classes of stock or to assess the carrying capacity and potential productivity of a given farm or area of grazing land, considering district practices and climatic conditions.

Ecosystem: A dynamic complex of plant, animal, fungal and microorganism communities and the associated non-living environment interacting as an ecological unit.

Ecosystem services: Those processes and attributes of an ecosystem (or part of an ecosystem) that benefit humans.

Entitlement shares: The individual shares which comprise a water access entitlement within a particular consumptive pool.

Environmental protection zones: An environmental buffer defined as the desirable set-back distance that any water affecting activity must be from an environmental asset to mitigate the effect of groundwater use on the environmental asset.

Environmental water provisions (EWP): Those parts of environmental water requirements that can be met at any given time with consideration to existing users' rights and social and economic impacts.

Environmental water requirements (EWR): Those water requirements that must be met in to sustain the environmental values of ecosystems that depend on the water resource, including their processes and biodiversity, at a low level of risk.

Estuaries: Semi-enclosed water bodies at the lower end of a freshwater stream that are subject to marine, freshwater and terrestrial influences and experience periodic fluctuations and gradients in salinity.

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

Excess water: Excess water is water that may be granted on account of a new water access entitlement under a water licence, or additional water that may be granted on account of an existing water access entitlement, but which is yet to be granted.

Existing user: A person who holds a water licence under the previous Southern Basins and Musgrave Water Allocation Plan.

GIS — Geographic Information System: Computer software linking geographic data (for example land parcels) to textual data (soil type, land value, ownership). It allows for a range of features, from simple map production to complex data analysis.

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

Groundwater-dependent ecosystem (GDE): An ecosystem that require access to groundwater, on a permanent or intermittent basis, to meet all or some of its water requirements to maintain the community of plants and animals and the ecological processes and ecosystem services they provide.

Groundwater extraction: The process of taking water from an underground source, either temporarily or permanently.

Groundwater soaks: Surface water expressions of groundwater that occur where the groundwater intersects with the surface and the pressure of the groundwater is sufficient to move water to the surface. Groundwater soaks may be permanent where the groundwater is in constant contact with the surface providing a permanent water source or may only be temporary with flow ceasing when the groundwater level drops below the surface.

Habitat: The natural place or type of site in which an animal or plant, or communities of animals and plants, live.

Hydraulic connection: The presence of a physical path allowing for the flow of groundwater and the transmission of changes in water pressure between different groundwater bodies or between groundwater and surface systems.

Hydraulic gradient: In unconfined groundwater, the mean watertable gradient in the direction of groundwater flow. In confined aquifers, the pressure gradient in the direction of flow.

Hydrogeology: The study of groundwater, which includes its occurrence, recharge and discharge processes and the properties of aquifers.

Hydrostatic pressure: The pressure exerted by gravity at a given point within a fluid that is at equilibrium.

Hypogean or hyporheic: Hypogean and hyporheic ecosystems occur beneath the surface of the ground in saturated pore spaces, in cracks or fractures in consolidated material, or in caves formed below the surface. Hyporheic systems generally occur closer to the surface where there can be mixing of surface and groundwater, while hypogean systems occur deeper in the ground.

Intensive farming: A method of keeping animals while carrying on the business of primary production in which the animals are usually confined to a small space or area and are usually fed by hand or mechanical means.

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

Irrigation season: The period in which major irrigation diversions occur, usually starting in August–September and ending in April–May.

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

Land: According to the context, (a) land as a physical entity, including land under water; or (b) any legal estate or interest in, or right in respect of, land; and includes any building or structure fixed to the land.

Landscape Act (the): the *Landscape South Australia Act 2019.*

Landward: In a direction moving toward the land.

Lens: A discrete occurrence of relatively fresh groundwater, where groundwater salinity is less than 1,000 mg/L.

Licence: see 'Water licence'.

Licensee: A person or entity who holds a water licence pursuant to Section 121 of the Act.

Low level of risk: the combination of the likelihood and consequences of an event such that the probability of not meeting the environmental objectives is deemed acceptably low, according to set risk criteria.

Macro-invertebrates: Aquatic invertebrates visible to the naked eye including insects, crustaceans, molluscs and worms that inhabit a river channel, pond, lake, wetland or ocean.

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

Managed aquifer recharge (draining or discharging): The intentional draining or discharging of water to aquifers for subsequent recovery or environmental benefit.

Megalitre (ML): One million litres, or one thousand kilolitres.

Minister: The Minister responsible for the administration of the Landscape Act.

Model: A conceptual or mathematical means of understanding elements of the real world that allows for the assessment of certain conditions.

Monitoring: (1) The repeated measurement of parameters to assess the current 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 etc). See also Recharge area.

Non-consumptive: Water used for maintaining natural processes, including but not limited to aquifer throughflow and discharge, and water for groundwater-dependent ecosystems.

Obligate groundwater dependence: Refers to groundwater-dependent ecosystems where the system would be lost if groundwater was no longer available in a suitable regime.

Observation well: A narrow well whose sole function is to permit water level measurements.

Permeability: A measure of the ease with which water flows through an aquifer or aquitard, measured in metres/day.

Phreatophyte: A type of plant that exhibits a high rate of transpiration by virtue of a taproot that extends down to the watertable.

Potable water: Water suitable for human consumption such as drinking or cooking water.

Prescribed: Prescribed means that a rule or a specific set of rules to manage a resource has been officially set by an authority.

Prescribed well: A well declared to be a prescribed well under Section 101 of the Landscape Act.

Prescribed Wells Area (PWA): An area of land within which wells are prescribed.

Production well: The pumped well in an aquifer test, as opposed to observation wells; a wide diameter well, fully developed and screened for water supply.

Proponent: An applicant for a licence, a permit or approval, or a person who puts forward a proposition or proposal.

Public water supply: Potable water that is distributed to residential and commercial customers by a water utility via a reticulated system.

Public water supply well: A groundwater well used for the purpose of providing public water supply.

Recharge: Recharge is the process whereby groundwater is replenished by water draining into the groundwater system. Recharge does not include water held in the soil in the unsaturated zone that may be evaporated, taken up by plants, or discharged at topographic lows. Groundwater can be recharged from rainfall, irrigation infiltration or leakage from surface water bodies (e.g. stream, channel, lake). Recharge to unconfined aquifers occurs over a wide area directly above the aquifer.

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

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

Resource capacity: The capacity of a groundwater resource, calculated by multiplying the recharge area (km^2) by the recharge rate (mm/y). Also known as the total amount of water available for consumptive demand and non-consumptive demand, that is, total demand.

Riparian zone: That part of the landscape that is adjacent to, that influences and is influenced by watercourse processes. This can include landform, hydrological or vegetation definitions. It is commonly used to include the in-stream habitats, beds, banks and sometimes floodplains of watercourses.

SA Geodata database: A collection of linked databases storing geological and hydrogeological data, which the public can access through the offices of Department for Energy and Mining (DEM). Custodianship of data related to minerals and petroleum and groundwater, is vested in DEM and DEW, respectively.

Secondary porosity: Secondary porosity refers to voids within rocks which are formed after sedimentary deposition, e.g. solution features (i.e. sink holes or caves) occurring within limestone formations.

Site use approval: An approval which permits the use of water at a specific site for a particular purpose.

Specific yield (Sy): The volume ratio of water that drains by gravity, to that of total volume of the porous medium. It is dimensionless.

Stock water use: The taking of water to provide drinking water for stock other than stock subject to intensive farming.

Stygofauna: Aquifer fauna or the term encompassing all non-microbial organisms inhabiting underground water.

Surface water: (a) water flowing over land (except in a watercourse), (i) after having fallen as rain or hail or having precipitated in any another manner or, (ii) after rising to the surface naturally from underground; (b) water of the kind referred to in paragraph (a) that has been collected in a dam or reservoir.

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

Taxa: General term given to a group identified by taxonomy. Taxonomy being the science of describing, naming and classifying organisms.

Throughflow: Shallow groundwater flow through a soil sub-parallel to a hillside. If the underlying rock is reasonably permeable, then the infiltrated water percolates vertically and there is no throughflow.

Tertiary Sands aquifer: A term used to describe a water-bearing-sand 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: a parameter indicating the ease of groundwater flow through a metre width of aquifer section (taken perpendicular to the direction of flow), measured in m^2/d.

Unconfined aquifer: An aquifer in which the upper surface has free connection to the ground surface and the water surface is at atmospheric pressure.

Underground water: see Groundwater

Upconing: In a stratified aquifer, especially a coastal aquifer with fresh water overlying sea water, upconing is the upward migration of the saline interface in hydrostatic compensation for a falling watertable in and around a pumped well.

Water access entitlement: An entitlement to the holder of a water licence to gain access to a share of water available in the consumptive pool or pools to which the licence relates, as specified by the licence and after considering any factors specified by the relevant water allocation plan or prescribed by the regulations.

Water allocation: (1) In respect of a water licence means the quantity of water that the licensee is entitled to take and use pursuant to the licence. (2) In respect of water taken pursuant to an authorisation under Section 105 of the Landscape Act means the maximum quantity of water that can be taken and used pursuant to the authorisation.

Water allocation plan: A plan prepared by a designated entity and approved by the Minister in accordance with the Landscape Act.

Water resource works approval: An approval which permits the construction, operation and maintenance of works for the purpose of taking water from a prescribed water resource at a specific location and in a particular manner.

Watercourse: A river, stream, creek or other natural watercourse (whether modified or not) in which water is contained or flows whether permanently or from time to time and includes a dam or reservoir that collects water flowing in a watercourse, a lake through which water flows, a channel (but not a channel declared by regulation to be excluded from the ambit of this definition) into which the water of a watercourse has been diverted, part of a watercourse, an estuary through which water flows, or any other natural resources, or class of natural resources, designated as a watercourse for the purpose of the Landscape Act by a Regional Landscape Plan.

Water licence: A licence granted by the Minister under Section 121 of the Landscape Act.

Water quality: The physical, chemical and biological characteristics of water.

Water regime: The extent, duration, frequency, timing and depth of inundation or soil saturation.

Water-use year: A water-use year runs from 1 July to 30 June in the following calendar year.

Well: As defined by the Landscape Act means: (a) an opening in the ground excavated for the purpose of obtaining access to underground water; (b) an opening in the ground excavated for some other purpose but that gives access to underground water; and/or (c) a natural opening in the ground that gives access to underground water.

Wetland: An area that comprises land that is permanently or periodically inundated with water (whether through a natural or artificial process) where the water may be static or flowing and may range from fresh water to saline water and where the inundation with water influences the biota or ecological processes (whether permanently or from time to time).

Zone of influence: The area around a pumped well, tile drain, quarry, foundation, etc., in which there is detectable drawdown.

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