Central Adelaide and Northern Adelaide Plains Prescribed Wells Areas 2018-19 water resources assessment

Department for Environment and Water
December, 2020

DEW Technical report 2020/30

Government of South Australia
Department for Environment and Water

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ISBN 978-1-925964-81-3

Preferred way to cite this publication

DEW (2020). *Central Adelaide and Northern Adelaide Plains Prescribed Wells Areas 2018-19 water resources assessment*, DEW Technical report 2020/30, Government of South Australia, Department for Environment and Water, Adelaide.

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Contents

1 Summary

Rainfall

- Rainfall measurements are taken from three relevant stations: Gawler, Smithfield and North Adelaide. Total annual rainfall at these was between 310 mm and 409 mm in 2018–19, which was lower than the average for all three stations.
- Rainfall is relatively consistent across Kangaroo Flat (KF), Northern Adelaide Plains (NAP) and Central Adelaide (CA).
- All months except August 2018, November 2018 and May 2019 (and June 2019 for Smithfield and North Adelaide) experienced lower than average rainfall.
- Long-term data trends indicate a decline in rainfall for Smithfield (NAP) and North Adelaide (CA) and a slight increase for Gawler (KF).

Groundwater

- Groundwater levels observed in 2018–19 in the T2 aquifer (NAP PWA and Kangaroo Flat region) are predominantly at average levels, with the T1 aquifer (NAP and CA PWAs) mainly at above average levels.
- Most wells with long-term records illustrated different recovery levels for the T1 and T2 aquifers in 2019. The T1 aquifer demonstrated above-average or better recovery levels: 59% of wells in the CA PWA and 62% in the NAP PWA. In comparison, the T2 aquifer indicated most wells were at either average levels (53% in the NAP PWA and 50% in the KF region) or lower recovery levels: 39% in the NAP PWA and 50% in the KF region.
- Five-year trends in water level show that most wells have declining water levels in the T2 aquifer and rising in the T1 aquifer.
- Salinity trends remain stable for both the T1 and T2 aquifers with the exception of Kangaroo Flat, where most wells indicate a decrease in salinity.

Water use

- Groundwater extraction is predominantly for irrigation purposes and was higher in 2018–19 than the previous year (2017–18). The increase in groundwater extraction in 2018–19 coincides with lower than average annual rainfall.

1.1 Purpose

The Department for Environment and Water (DEW) has a key responsibility to monitor and report annually on the status of prescribed and other groundwater and surface water resources. To fulfil this responsibility, data on water resources are collected regularly, analysed and reported in a series of annual reports. Three reports are provided to suit a range of audiences and their needs for differing levels of information:

- **Fact sheets**: provide summary information for each resource area with an Annual Resource Status Overview.
- **Technical Notes**: (this document) build on the fact sheets to provide more comprehensive information for each resource area, helping to identify the resource condition in further detail.
- **State-wide summary**: this summarises information for all resources across all regions in a quick-reference format.

This document is the Technical Note for the Central Adelaide and Northern Adelaide Plains Prescribed Wells Areas for 2018-19 and addresses water extraction data collected between July 2018 and June 2019, and groundwater data collected up until December 2019.

1.2 Regional context

The Central Adelaide Prescribed Wells Area (PWA) mostly lies within the Green Adelaide management area, with small areas in the Hills and Fleurieu, and Northern and Yorke Landscape Regions. It encompasses most of the Adelaide metropolitan area, extending from Outer Harbor and Evanston South in the north, to Noarlunga in the south.

The Northern Adelaide Plains (NAP) PWA is located immediately north of the Central Adelaide (CA) PWA, in Green Adelaide and the Northern and Yorke Landscape Region. The Kangaroo Flat area is located in the north-east area of the NAP PWA, encompassing an area of around 80 km^2. Groundwater use in the Kangaroo Flat area was restricted in 2000 and the area was prescribed in 2004 as an addition to the NAP PWA; now under South Australia's *Landscape SA Act 2019*.

Groundwater is a prescribed resource in the Central Adelaide and Northern Adelaide Plains PWAs under South Australia's *Landscape SA Act 2019.* A water allocation plan for the NAP PWA was adopted in 2000 and provides rules for the management of its groundwater resources. Although the Central Adelaide PWA is prescribed, it does not yet have a water allocation plan. A draft Adelaide Plains Water Allocation Plan (WAP) is currently being developed, intended to cover the groundwater of the Central Adelaide, Northern Adelaide Plains and Dry Creek PWAs.

Groundwater occurs in multiple aquifers across this region, however, most groundwater is extracted from the T1 and T2 aquifers of the Adelaide Plains. For this reason, the four areas where the most intensive extraction occurs from these aquifers are reported on here: the T1 aquifer of the Central Adelaide PWA; the T1 and T2 aquifers of the Northern Adelaide Plains PWA; and the T2 aquifer of the Kangaroo Flat region.

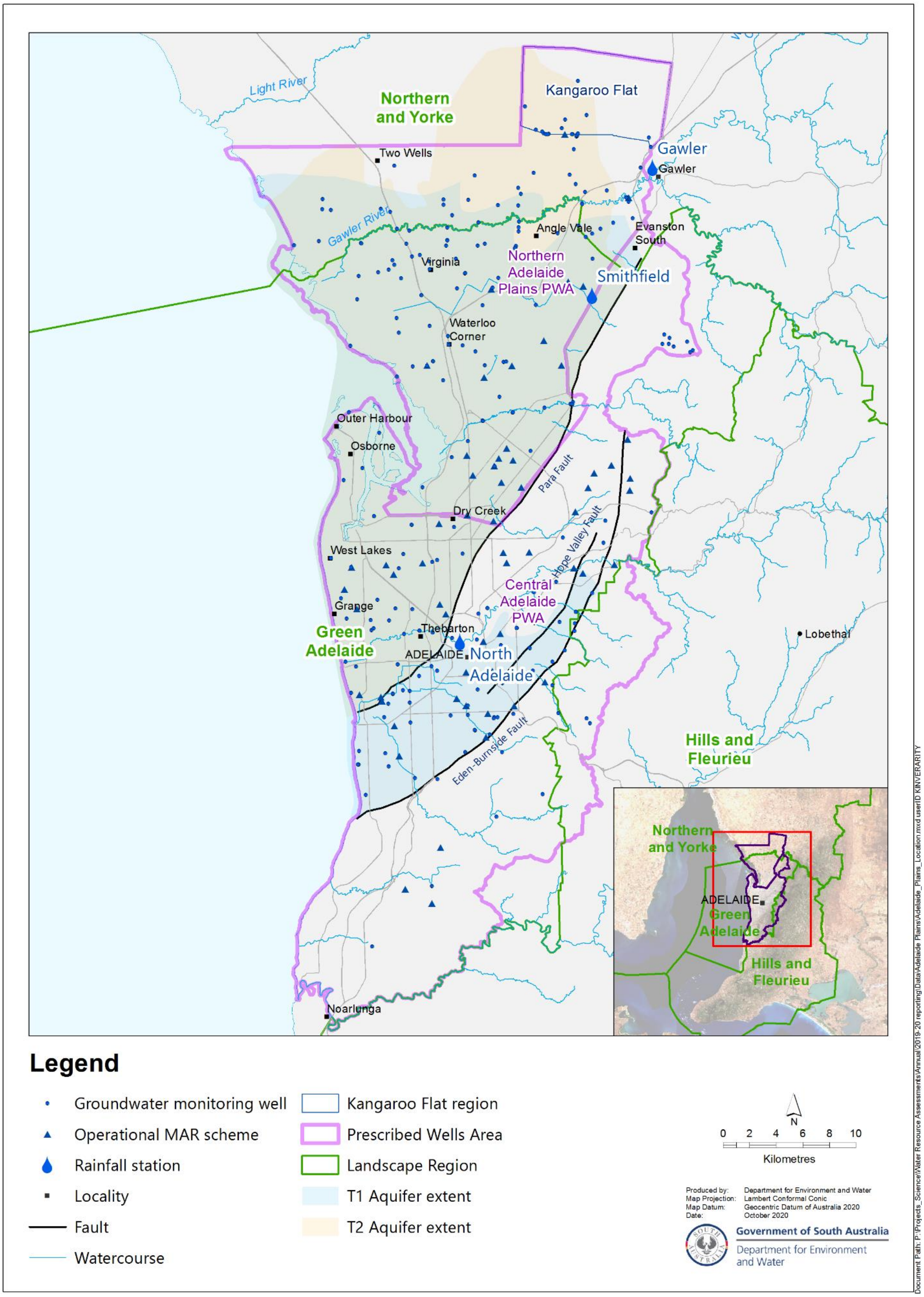

Figure 1.1 Location of the Central Adelaide and Northern Adelaide Plains PWAs

2 Methods and data

This section describes the source of rainfall, surface water, groundwater and extraction data presented in this report, and describes the methods used to analyse and present this data.

2.1 Rainfall

Daily rainfall observations have been used from selected Bureau of Meteorology (BoM) stations in order to calculate monthly and annual totals. The data have been obtained from the SILO Patched Point Dataset service provided by the Queensland Government, which provides interpolated values to fill gaps in observations (see Section 3).

Rainfall maps were compiled using gridded datasets obtained from the BoM (Figure 3.1). The long-term average annual rainfall map was obtained from Climate Data Online. The 2018–19 map of total rainfall was compiled from monthly rainfall grids obtained for the months between July 2018 and June 2019 from the Australian Landscape Water Balance website.

2.2 Groundwater

2.2.1 Water level

Water level data1 were obtained from wells in the monitoring network by both manual and continuous logger observations. All available water level data are verified and reduced to an annual maximum water level for each well for further analysis. The annual maximum level is used as this represents the unstressed or recovered water level following pumping each year for irrigation and other uses. The amount of pumping can vary from year to year, and the proximity of pumping wells to monitoring wells may affect the reliability of trends and historical comparisons. Therefore, the recovered level is used as it is a more reliable indicator of the status of the groundwater resource. In general, the aquifers in the Central Adelaide and Northern Adelaide Plains PWAs return to a recovered maximum level between July and November of the same year.

For those wells with suitable long-term records, the annual recovered water levels were then ranked from lowest to highest and given a description according to their decile range[2] (Table 2.1). The definition of a suitable long-term record varies depending on the history of monitoring activities in different areas; for the Central Adelaide PWA, any well with 20 years or more of recovered water levels is included, while for the Northern Adelaide Plains PWA any well with 10 years or more is included and for the Kangaroo Flat area any well with 3 years or more is included.

The number of wells in each description class for the most recent year is then summarized for each aquifer (for example see Figure 4.1) and hydrographs are shown for a selection of wells to illustrate common or important trends (for example see Figure 4.3). Five-year trends were calculated using annual recovered water levels for those wells that have at least five measurements (i.e. at least one measurement a year). The trend line was calculated by linear regression and the well is given a status of 'declining', 'rising', or 'stable', depending on whether the slope of this trend line is below, above, or within a given tolerance threshold. This threshold and the status of 'stable' is intended

[1] "Water level" in this report refers to both the watertable elevation, as measured in wells completed in unconfined aquifers, and the potentiometric water level elevation, as measured in wells completed in confined aquifers where the water level or pressure in the monitoring well rises above the top of the aquifer. These are collectively referred to as the "reduced standing water level" (RSWL).

[2] Decile: a division of a ranked set of data into ten groups with an equal number of values. In this case e.g. the first decile contains those values below the 10th percentile.

to allow for the demarcation of wells where water levels are changing at very low rates and would normally be considered stable, and also to accommodate very small human or instrument measurement errors. The number of rising, declining and stable wells are then summarized for each aquifer (for example see Figure 4.2).

Regional-scale confined and unconfined sedimentary aquifers such as the T1 and T2 aquifers are given tolerance thresholds of 2 cm/y.

Twenty-year changes in water level were calculated as the difference between the average water level in a three-year period twenty years ago (i.e. 1999–2001) and the average water level in 2019.

Table 2.1. Percentile/decile descriptions*

Decile	Percentile	Description	Colour used
N/A	0	Lowest on record	
1	0 to 10	Very much below average	
2 and 3	10 to 30	Below average	
4, 5, 6, and 7	30 to 70	Average	
8 and 9	70 to 90	Above average	
10	90 to 100	Very much above average	
N/A	100	Highest on record	

* Deciles and descriptions as defined by the Bureau of Meteorology[3]

2.2.2 Salinity

Where more than one salinity sample has been collected in the course of a year, the annual mean salinity is used for analysis. Salinity is measured as total dissolved solids (TDS). The results are shown in Figure 4.4.

Five-year salinity trends are calculated where there are at least five years of salinity data (i.e. at least one measurement per year). The trend line is calculated by linear regression and the percentage change in salinity is calculated through the following formula:

$$\text{Percentage change in salinity (\%)} = \frac{\text{Slope of linear trend line (mg/L/y)} * 5}{\text{Value of trend line at start of period (mg/L)}} * 100$$

If the percentage change is greater than 10% then the well is given a status of 'increasing' or 'decreasing' depending on how the salinity is changing, while if the absolute percentage change is less than 10% it is given a status of 'stable'. The latter is intended to reflect the fact that salinity measurements based on the measurement of the electrical conductivity of a water sample are often subject to small instrument errors. The number of increasing, decreasing and stable wells are then summarized (e.g. Figure 4.5).

2.3 Groundwater extraction

Meter readings are used to estimate licensed extraction volumes for groundwater sources. Where meter readings are not available, licensed or allocated volumes are used (Figure 5.1 and Figure 5.2).

[3] Bureau of Meteorology Annual climate statement 2019

2.4 Further information

Both surface water and groundwater data can be viewed and downloaded using the *Surface Water Data* and *Groundwater Data* pages under the Data Systems tab on WaterConnect. For additional information related to groundwater monitoring well nomenclature, please refer to the Well Details page on WaterConnect.

Other important sources of information on water resources of the Northern Adelaide Plains and Central Adelaide PWAs and Kangaroo Flat region, are:

- Summary reports on the groundwater resources of the Northern Adelaide Plains and Central Adelaide PWAs and Kangaroo Flat region (DEWNR, 2011), and annual groundwater level and salinity status reports (DEW, 2019a-d).
- The Water Allocation Plan for the Northern Adelaide Plains Prescribed Wells Area (NABCWMB, 2000).
- Gerges (2006) provides an overview of the hydrogeology of the Adelaide metropolitan area.

3 Rainfall

The Adelaide Plains PWAs have mild, wet winters and hot, dry summers that are typical of a Mediterranean climate. Annual rainfall for 2018–19 across the PWAs ranged from 310 mm to 409 mm. Rainfall is consistently higher in the south-east portion of the Central Adelaide PWA where topographical changes occur and rainfall is constant across the lower Adelaide Plains. Compared to the average annual rainfall from 1986 to 2015, the rainfall patterns are consistent (Figure 3.1). Overall, the total rainfall for 2018–19 is lower than the annual average rainfall for the 1986–2015 period.

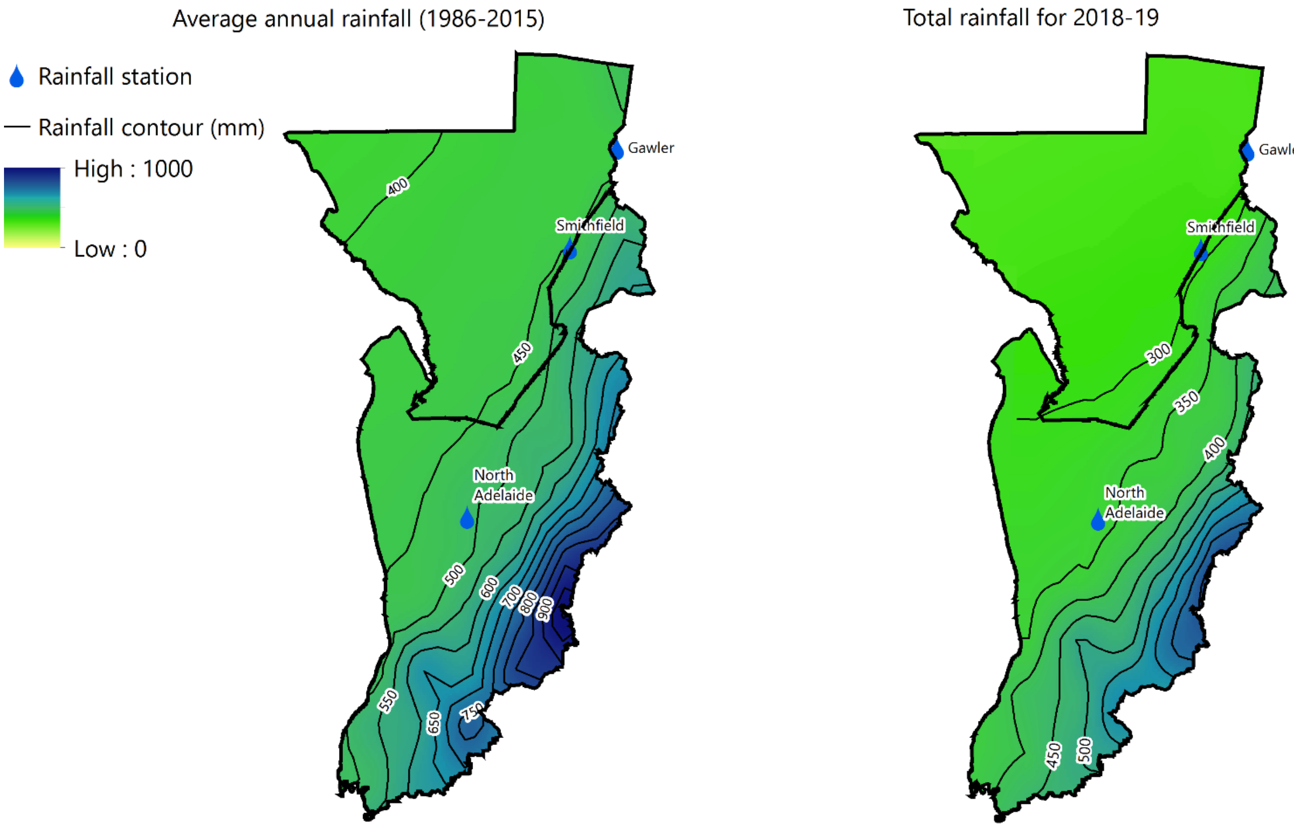

Figure 3.1 Rainfall in the Central Adelaide and Northern Adelaide Plains PWAs compared to the long-term average annual rainfall (1986–2019)

The following rainfall stations have been considered for the respective PWAs and are presented below[4]:

- Gawler (Kangaroo Flat region).
- Smithfield (Northern Adelaide Plains PWA).
- North Adelaide (Central Adelaide PWA).

[4] Some differences may be noticeable between the spatial rainfall maps and the annual rainfall from individual stations. This is due to the use of different data sources and time periods and further detail is provided in Section 2.1.

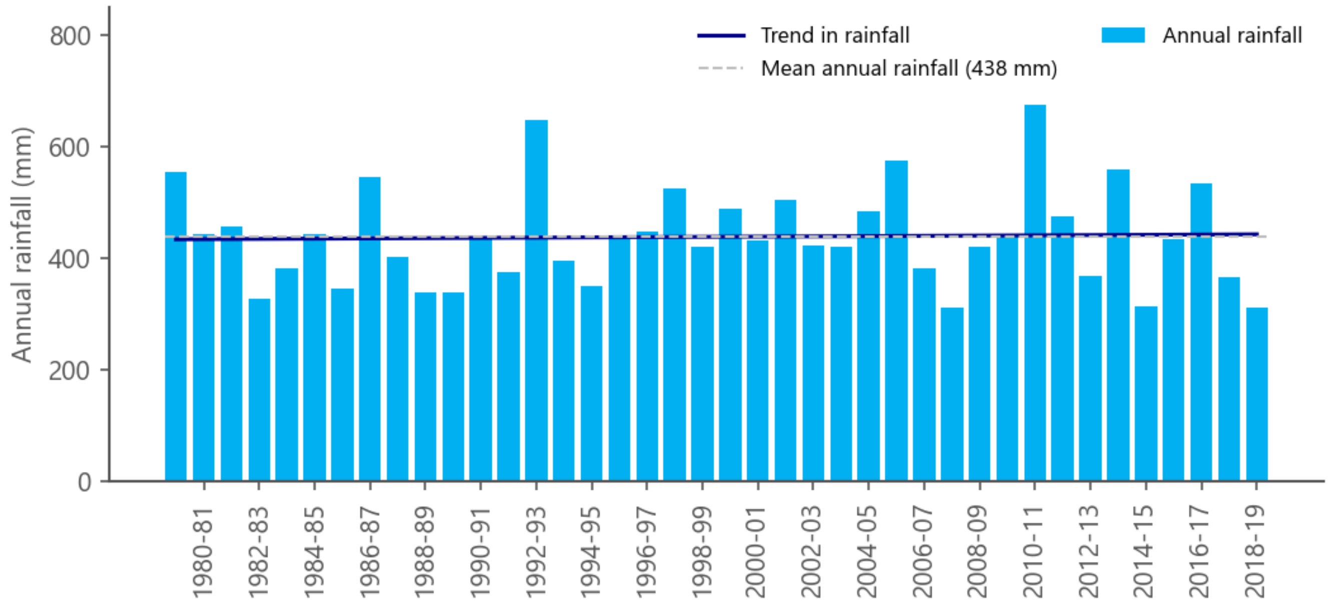

Figure 3.2 Annual rainfall for 1979–80 to 2018–19 at the Gawler rainfall station (23078)

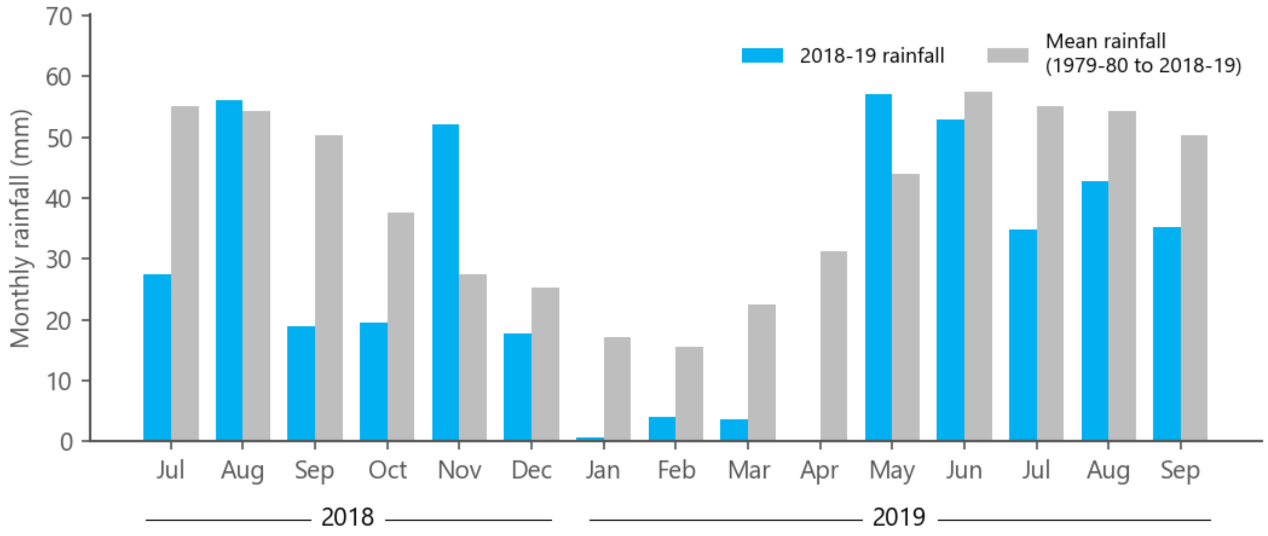

Figure 3.3 Monthly rainfall between July 2018 and September 2019 at the Gawler rainfall station (23078)

- The Gawler rainfall station (BoM station 23078) is used as a representative rainfall station for the Kangaroo Flat region. The annual total recorded for 2018–19 was 310 mm. This was 127 mm lower than the average annual rainfall of 437 mm (1979–80 to 2018–19) and is the lowest annual rainfall over that period. The long-term trend is slightly increasing across this period (Figure 3.2).
- Drier-than-average conditions were observed throughout the 2018–19 period. With the exception of November, the spring–summer months were extremely dry in comparison to the long-term average (Figure 3.3).

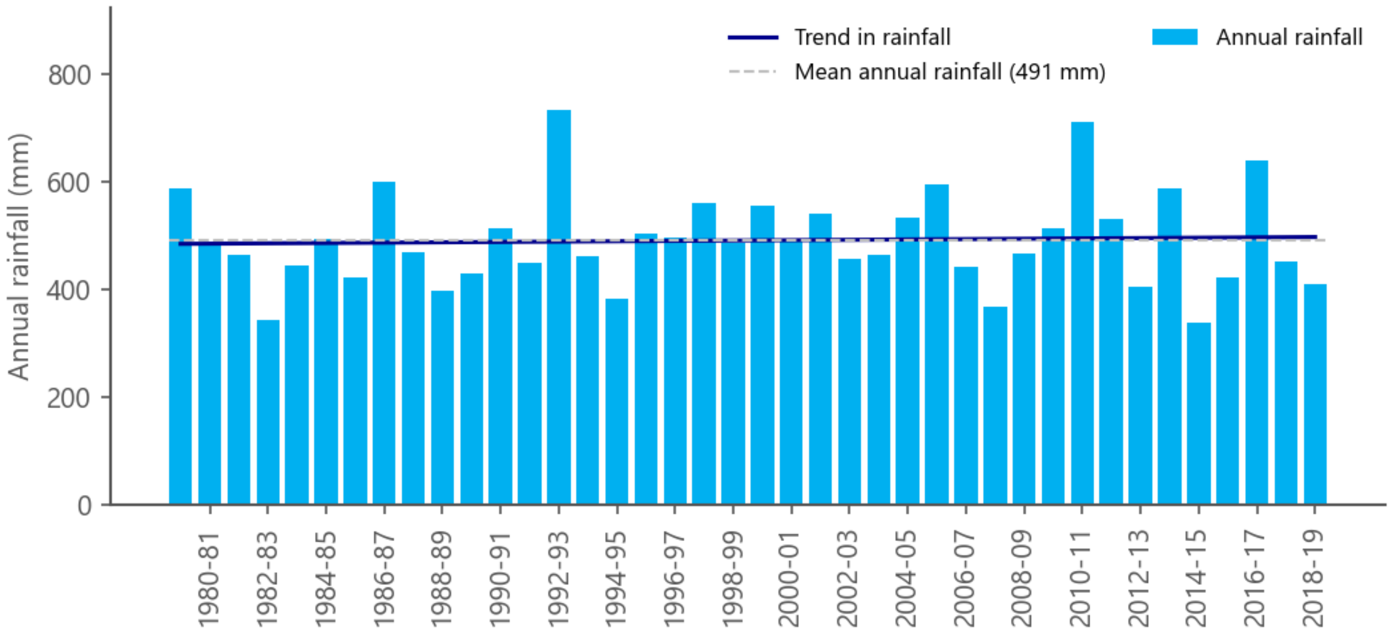

Figure 3.4 Annual rainfall for 1979–80 to 2018–19 at the Smithfield rainfall station (23025)

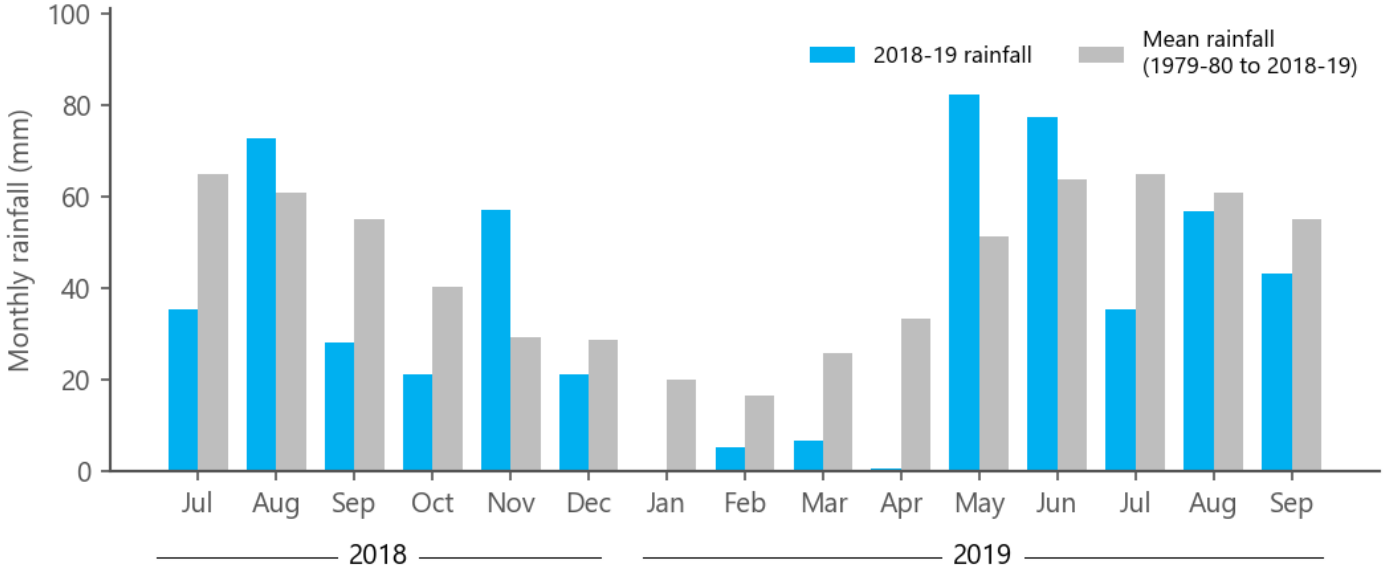

Figure 3.5 Monthly rainfall between July 2018 and September 2019 at the Smithfield rainfall station (23025)

- The Smithfield rainfall station (BoM station 23025) is used as a representative rainfall station for the Northern Adelaide Plains PWA. The annual total recorded for 2018–19 was 409 mm. This was 82 mm lower than the average annual rainfall of 491 mm (1979–80 to 2018–19). The long-term trend is decreasing across this period (Figure 3.4).
- Drier-than-average conditions were observed throughout the period, with the 2019 winter being drier than the 2018 winter. The spring–summer months were also extremely dry in comparison to the long-term average (Figure 3.5).

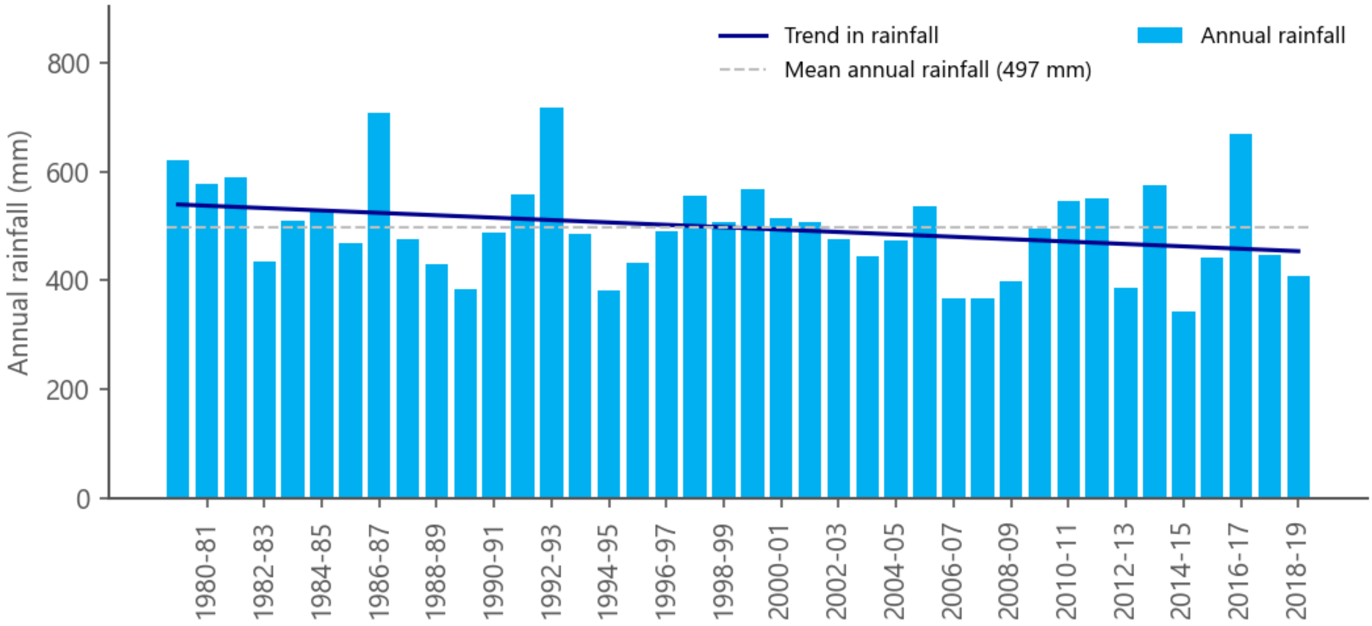

Figure 3.6 Annual rainfall for 1979–80 to 2018–19 at the North Adelaide rainfall station (23011)

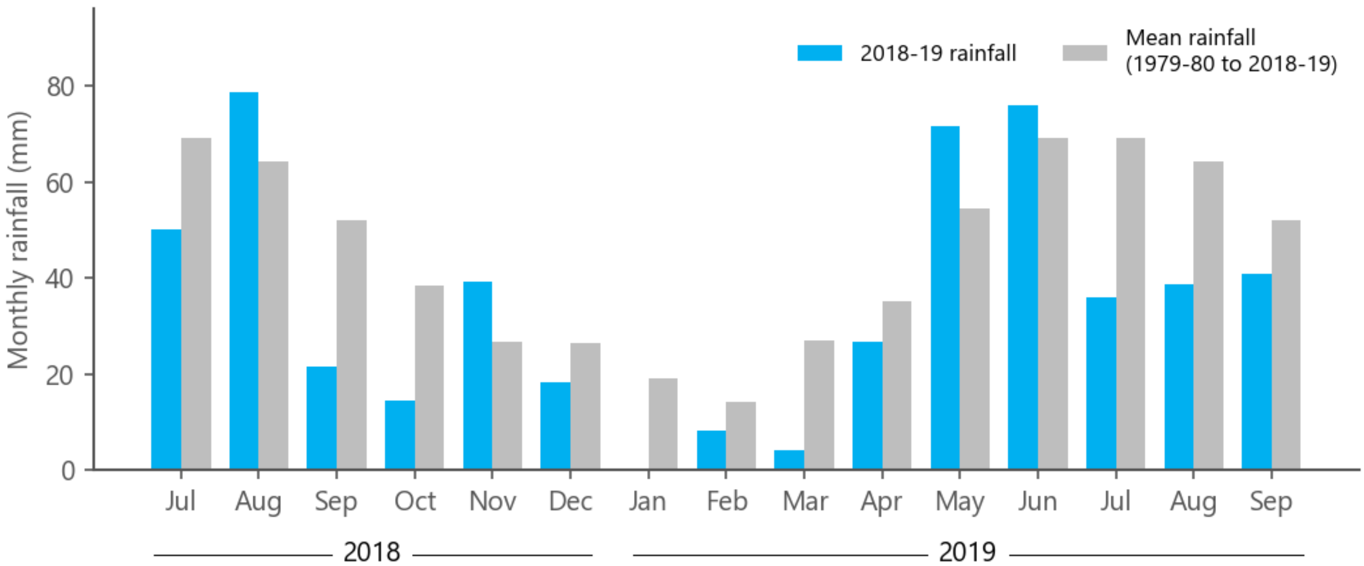

Figure 3.7 Monthly rainfall between July 2018 and September 2019 at the North Adelaide rainfall station (23011)

- The North Adelaide rainfall station (BoM station 23011) is used as a representative rainfall station for the Central Adelaide PWA. The annual total recorded for 2018–19 was 409 mm. This was 88 mm lower than the average annual rainfall of 497 mm (1979–80 to 2018–19). The long-term trend is decreasing across this period (Figure 3.6).

  Drier-than-average conditions were observed throughout the period, with the 2019 winter being drier than the 2018 winter. With the exception of November, the spring–summer months were extremely dry in comparison to the long-term average (Figure 3.7).

4 Groundwater

4.1 Hydrogeology

Most groundwater extraction across the Adelaide Plains occurs from the T1 aquifer in the Central Adelaide PWA, the T1 and T2 aquifers in the Northern Adelaide Plains PWA and the T2 aquifer in the Kangaroo Flat region.

4.1.1 T1 aquifer

The T1 aquifer primarily comprises Hallett Cove Sandstone, Dry Creek Sand and limestone of the upper Port Willunga Formation. Tertiary sands that have been deposited immediately adjacent to the faulted boundary between the basin sediments and the Mount Lofty Ranges, are also considered part of the T1 aquifer. The direction of groundwater flow is generally westward from the ranges to the Gulf St Vincent. The two main sources of recharge are thought to be lateral throughflow from fractured rock aquifers of the ranges and infiltration of surface water from streams that flow onto the plains from the ranges. Outflows from the groundwater system occur through groundwater extraction and discharge to Gulf St Vincent.

The T1 aquifer can be divided into two main areas which are separated by the Para Fault: the Adelaide Plains Sub-basin and the Golden Grove Embayment. The T1 aquifer differs markedly in thickness and extent between these two areas. In the Golden Grove Embayment (east of the Para Fault), the T1 aquifer occurs as a semi-confined or unconfined aquifer and is relatively thin. In the Adelaide Plains Sub-basin (west of the Para Fault), the aquifer is thicker, but also more uniform and continuous in terms of thickness and spatial distribution and consequently, most groundwater extraction from the T1 aquifer occurs in this area. The T1 aquifer is absent in the north-east portion of the NAP PWA.

The T1 aquifer is generally confined, except where it becomes shallow or crops out in the northern Golden Grove Embayment, particularly north of the River Torrens, and near the Eden–Burnside Fault (Figure 1.1). Despite the generally confined nature of the T1 aquifer, the intensity and timing of rainfall (and related variations in rates of groundwater extraction) can have an effect on groundwater levels and salinities. For example, if the Central Adelaide PWA experienced above-average rainfall, this could result in less groundwater being extracted from the T1 aquifer for irrigation purposes, and rises in groundwater levels might result. Summer irrigation extraction causes major seasonal fluctuations, while industrial extractions are continuous throughout the year.

4.1.2 T2 aquifer

The T2 aquifer consists of well-cemented limestones of the lower Port Willunga Formation. The two main sources of groundwater recharge to the T2 aquifer are thought to be lateral inflow from the adjacent fractured rock aquifers of the Mount Lofty Ranges and the infiltration of surface water from streams that flow onto the plains from the ranges. Outflows from the groundwater system occur through groundwater extraction and discharge to Gulf St Vincent. The T2 aquifer occurs extensively across the Adelaide Plains Sub-basin portion of the Central Adelaide PWA and most of the NAP PWA and Kangaroo Flat region.

Although there is no direct recharge from incident rainfall to the confined T2 aquifer, there may be an indirect correlation between groundwater levels and rainfall, as periods of below-average rainfall will likely result in increased rates of groundwater extraction, which may lead to declines in groundwater levels and increases in salinities. Conversely, above-average rainfall may result in increased recharge and decreases in extractions, which can cause groundwater levels to rise and salinities to stabilise or decrease.

4.2 Central Adelaide PWA T1 aquifer water level

Observed recovered water levels in most of the T1 monitoring wells with long-term records (38%) were above-average (Fig. 4.1). These wells are located in the southern extent of the aquifer with most of them located between Adelaide and the coastline. Observed water levels in the northern part of the PWA were generally very much above average or the highest on record (Figure 4.1).

Wells with suitable long-term records show an overall rise in water level over the last 20 years, with changes ranging from a decline of 1.08 m to a rise of 11.07 m (the median change is a rise of 2.71 m).

Five-year trends in water levels are rising in 85% of wells and declining in 15% of wells (Figure 4.2), with rates of rise ranging from 0.11 m/y to 2.67 m/y (the median rate of rise is 0.28 m/y), and rates of decline ranging from 0.04 m/y to 0.85 m/y (the median rate of decline is 0.43 m/y).

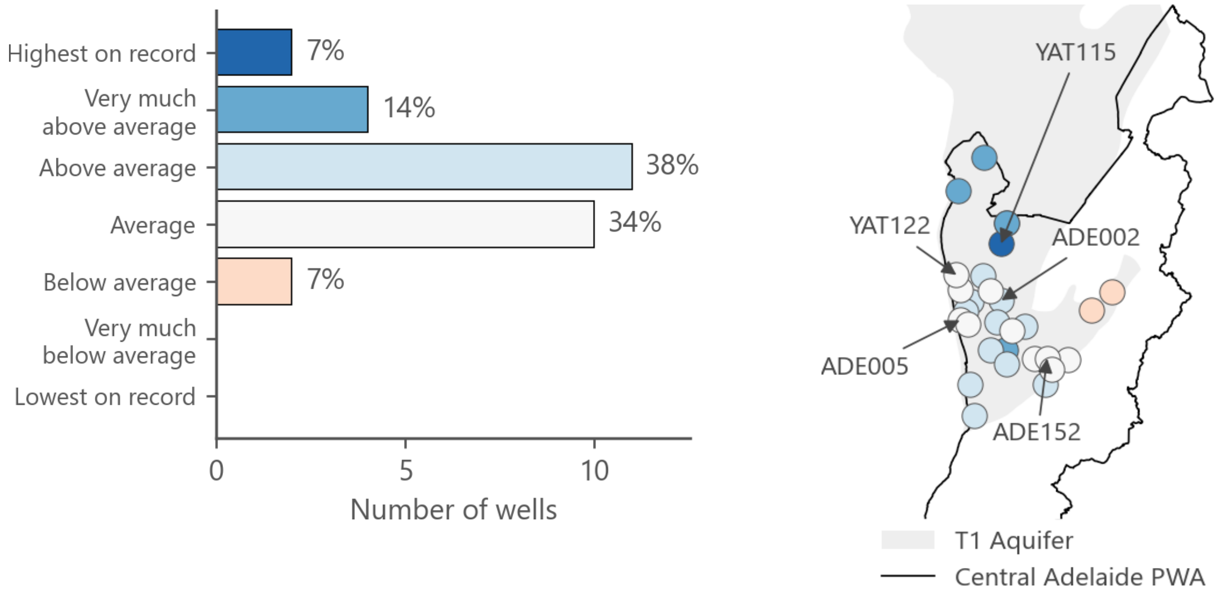

Figure 4.1 2019 recovered water levels for wells in the Central Adelaide T1 aquifer

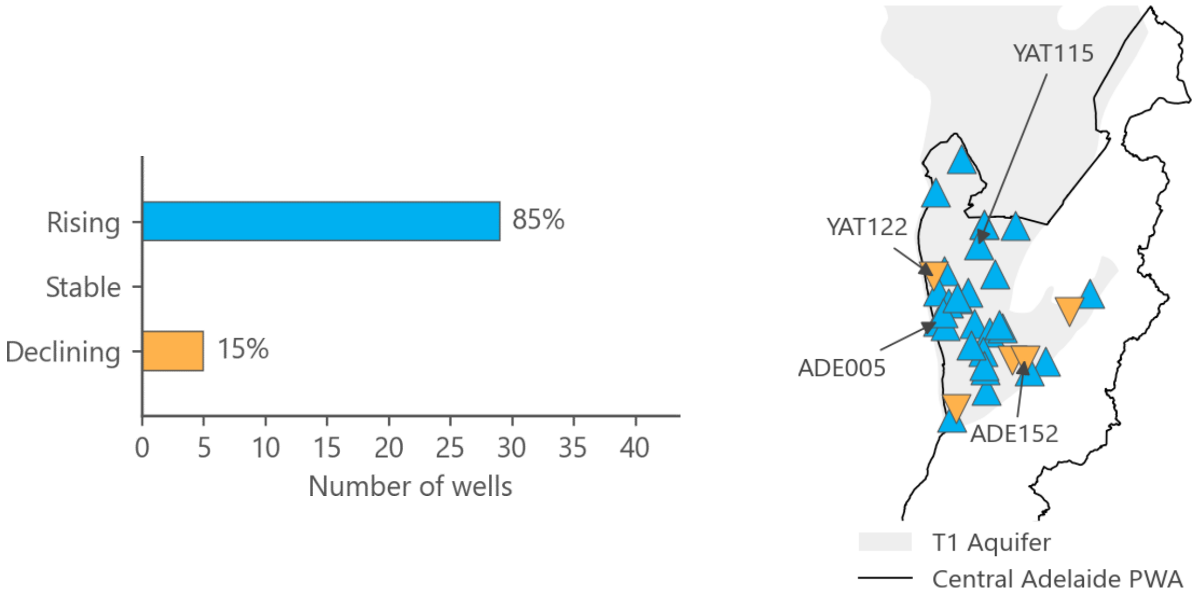

Figure 4.2 2015–19 trend in recovered water levels for wells in the Central Adelaide T1 Aquifer

Figure 4.3 shows hydrographs from a selection of T1 aquifer monitoring wells to illustrate common or important trends. Most of the groundwater extraction from the T1 aquifer occurs between the suburbs of West Lakes and Grange. Long-term water level records for the T1 aquifer in the Central Adelaide PWA illustrate an average rise of 2.06 m since 1990 (e.g. ADE002 and ADE005).

Above-average water levels are recorded near the River Torrens and central part of the PWA (e.g. ADE002), and average water levels are found proximal to the coast and the River Torrens (e.g. ADE005). These hydrographs may be indicative of the state of the T1 aquifer where there is limited influence of extraction or injection of water by managed aquifer recharge (MAR) schemes (see section 5.2).

In the northern area of the PWA, where there is limited extraction, water levels are currently the highest on record (e.g. YAT115). Similar water level trends have been observed in the southern part of the Northern Adelaide Plains PWA, where the border meets that of the Central Adelaide PWA. This is likely due to a combination of net MAR injection to the T1 aquifer in the southern NAP PWA and the significant reduction in extraction related to the Dry Creek salt fields and closure of the Penrice Soda Plant at Osborne (see Section 4.4).

In the southern portion of the Central Adelaide PWA, the Para Fault and Golden Grove Embayment influences groundwater flow directions and levels. Current water levels are recorded as average with rising trends over the past 30 years with a small localised decline proximal to MAR schemes (e.g. ADE152).

A long-standing cone of depression has developed at Grange due to extraction for irrigation, while the cone of depression that previously existed at Thebarton due to industrial extraction has now largely recovered since the closure of the Coca Cola bottling plant.

High-use areas between West Lakes and Grange show an average current water level and a minor declining trend over the five-year period from 2015–2019 (e.g. YAT122). This high-use area is also proximal to MAR injection and extraction wells, with these schemes typically extracting more than they inject.

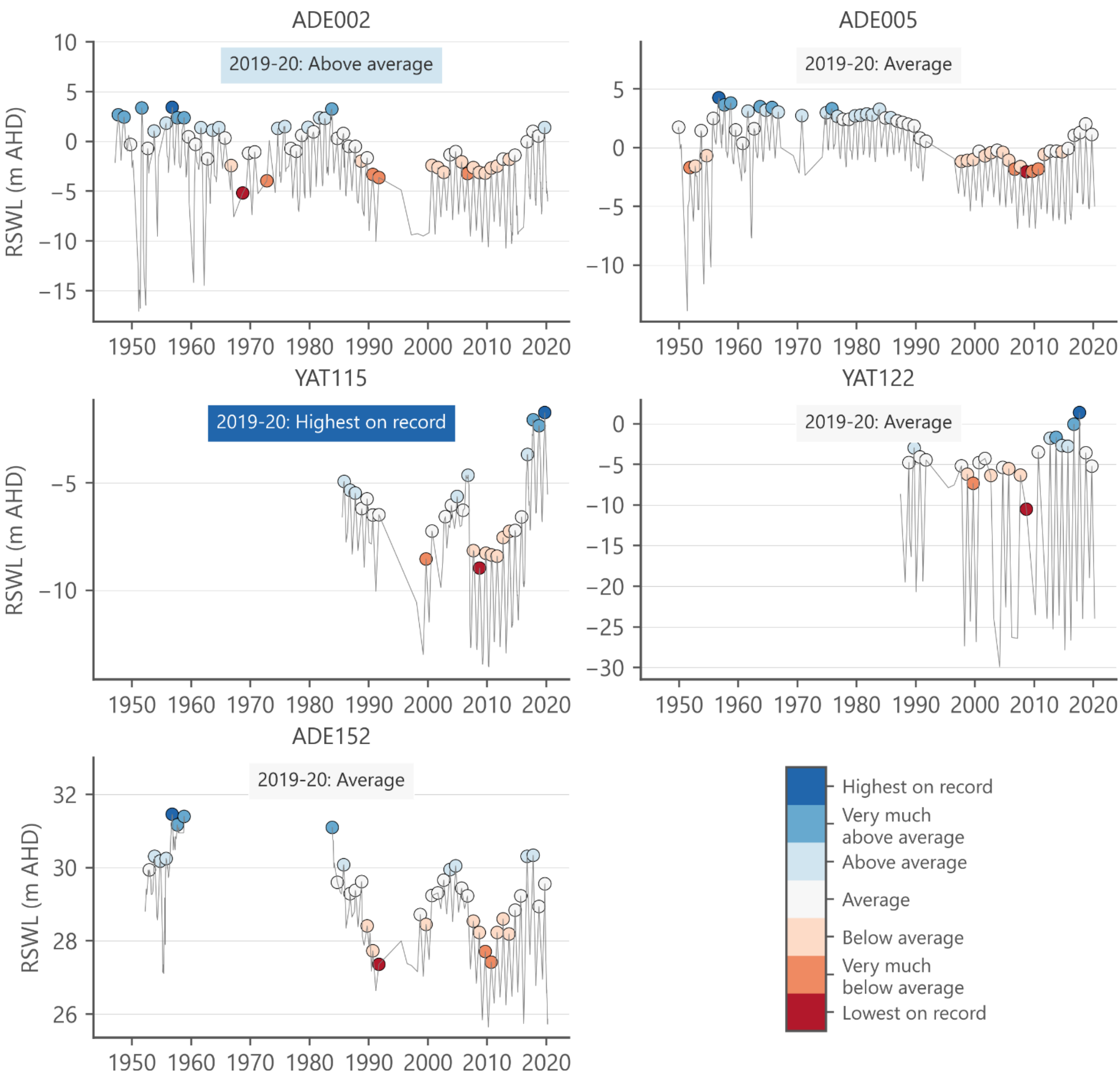

Figure 4.3 Selected Central Adelaide PWA T1 aquifer hydrographs

4.3 Central Adelaide PWA T1 aquifer salinity

In 2019, results from 16 wells in the T1 aquifer show groundwater salinity varies from fresh to brackish, ranging from 822 to 3862 mg/L, with a median of 1353 mg/L. The higher salinities are in the central and northern part of the PWA, with the remainder located throughout the aquifer.

The salinity of the T1 aquifer has remained stable for the 2015–19 period (Figure 4.6).

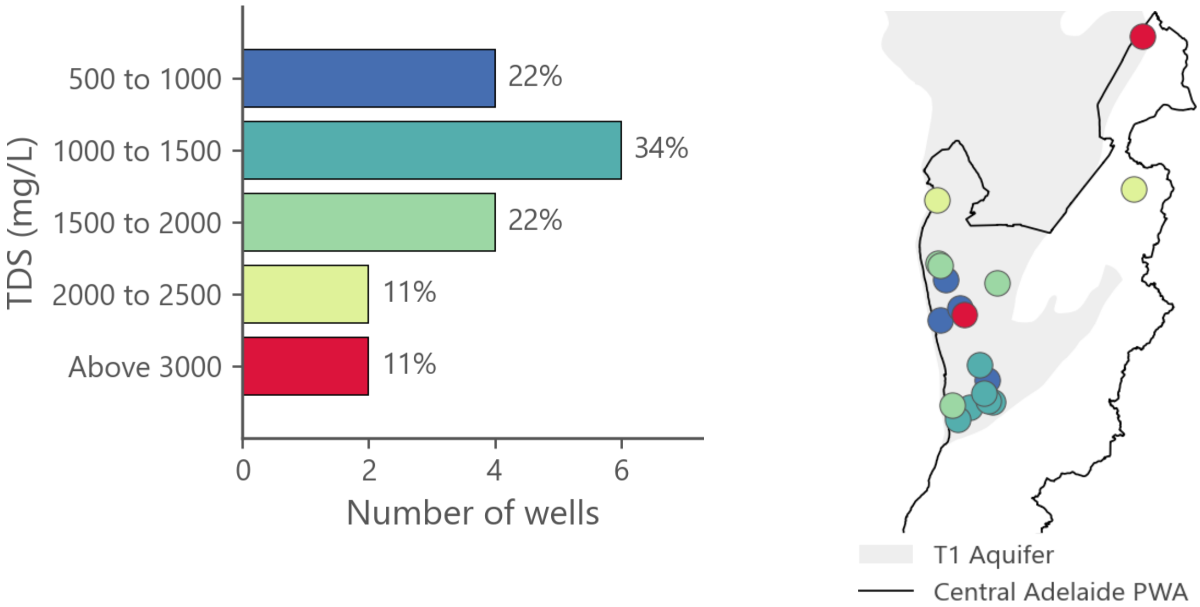

Figure 4.4 2019 salinity observations from wells in the T1 aquifer of the Central Adelaide PWA

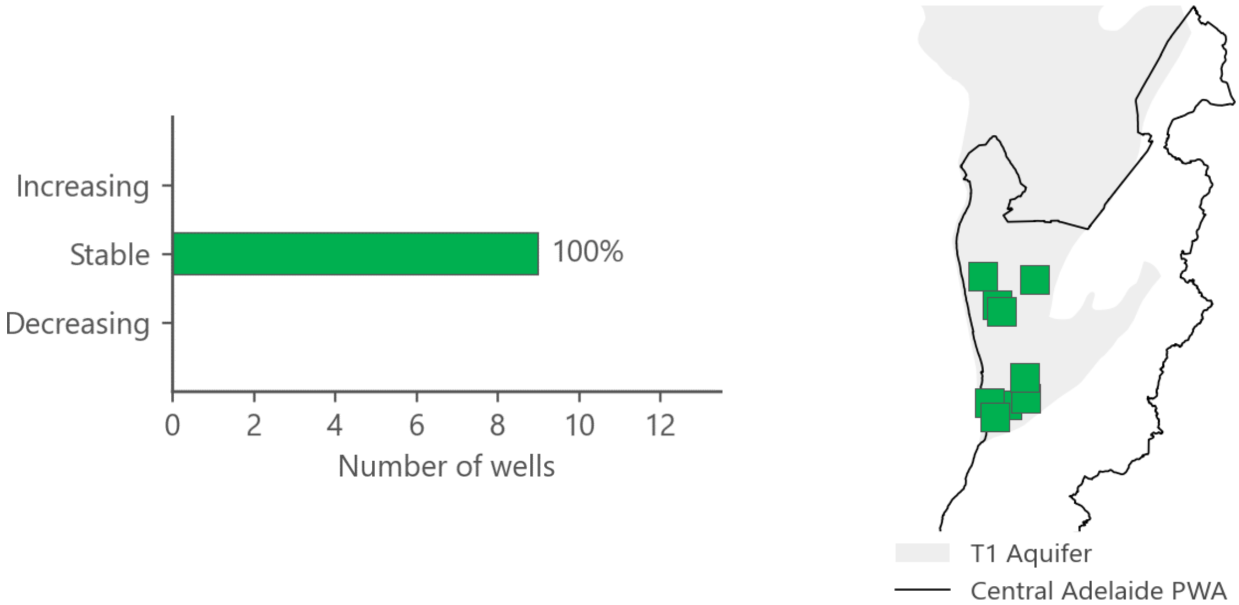

Figure 4.5 2015–19 trend in groundwater salinity for wells in the T1 aquifer of the Central Adelaide PWA

4.4 Northern Adelaide Plains PWA T1 aquifer water level

Observed recovered water levels in most of the NAP PWA T1 aquifer monitoring wells with suitable long-term records reached above-average or higher levels (62% of wells) compared to their historic record. These wells are spread throughout the extent of the T1 aquifer. Water levels in a minority of wells (19%) were below average, very much below average or lowest on record (Figure 4.6).

The change in water level over the last 20 years in wells with suitable long-term records ranged from a decline of 2.58 m to a rise of 7.38 m (the median change is a rise of 2.04 m). Most wells (89%) recorded a rise in water level over this time period.

Five-year trends in water levels are rising in 50% of wells, declining in 45% of wells, and stable in 5% of wells. Rates of rise range from 0.07 m/y to 2.44 m/y (the median rate of rise is 0.38 m/y), and rates of decline range from 0.02 m/y to 0.78 m/y (the median rate of decline is 0.26 m/y) (Figure 4.7).

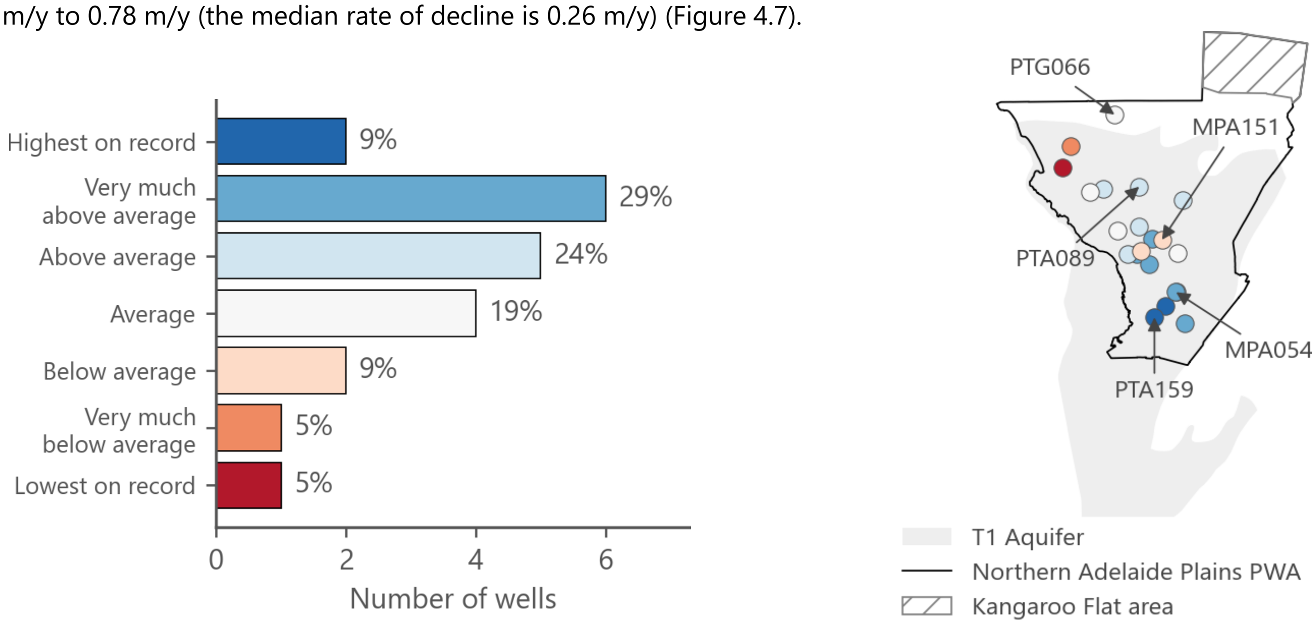

Figure 4.6 2019 recovered water levels for wells in the T1 aquifer of the NAP PWA

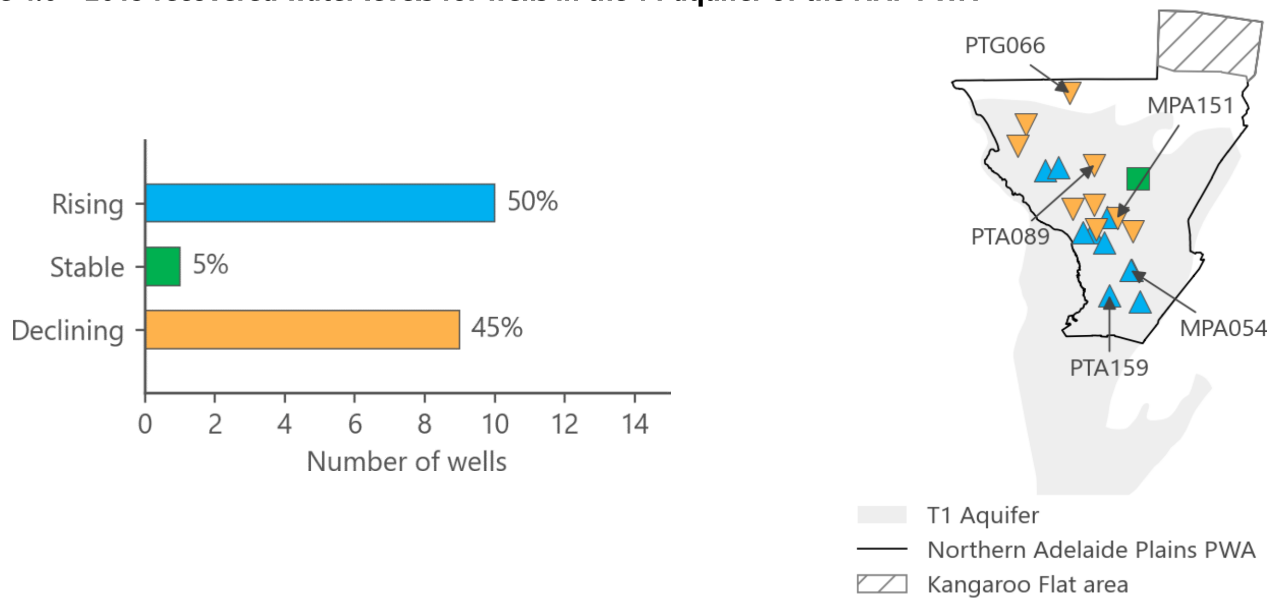

Figure 4.7 2015–19 trend in recovered water levels for wells in the T1 aquifer of the NAP PWA

Figure 4.8 shows hydrographs from a selection of monitoring wells completed in the T1 aquifer of the Northern Adelaide Plains PWA. Groundwater is extracted from this aquifer across the PWA, with numerous users in the vicinity of Waterloo Corner and east of St Kilda. The water levels recorded in this area of high use, are noted as currently below average (e.g. MPA151).

Another area of high use is in the southern area of the PWA (e.g. PTA159). Despite high volumes of extraction (see Section 5), this area benefits from positive net injection from the nearby Greenfields Wetlands MAR scheme and the significant reduction in extraction from the Dry Creek salt fields, with current data indicating water levels are the highest on record. There has been a marked rise in water levels since 2017, which is when extraction reduced significantly at the salt fields.

Areas in the PWA that have low to no metered extraction for 2018–19 show water levels that are either very much above average (near the Little Para River in the south of the PWA, e.g. MPA054) or water levels that are average (proximal to Two Wells in the north of the PWA, e.g. PTG066). Similarly, water levels are shown to be above average at Virginia (e.g. PTA089) where there is limited to no metered extraction from the T1 aquifer. This is, conversely, a high-use area for the T2 aquifer, which emphasises the differences between the T1 and T2 aquifers in this region.

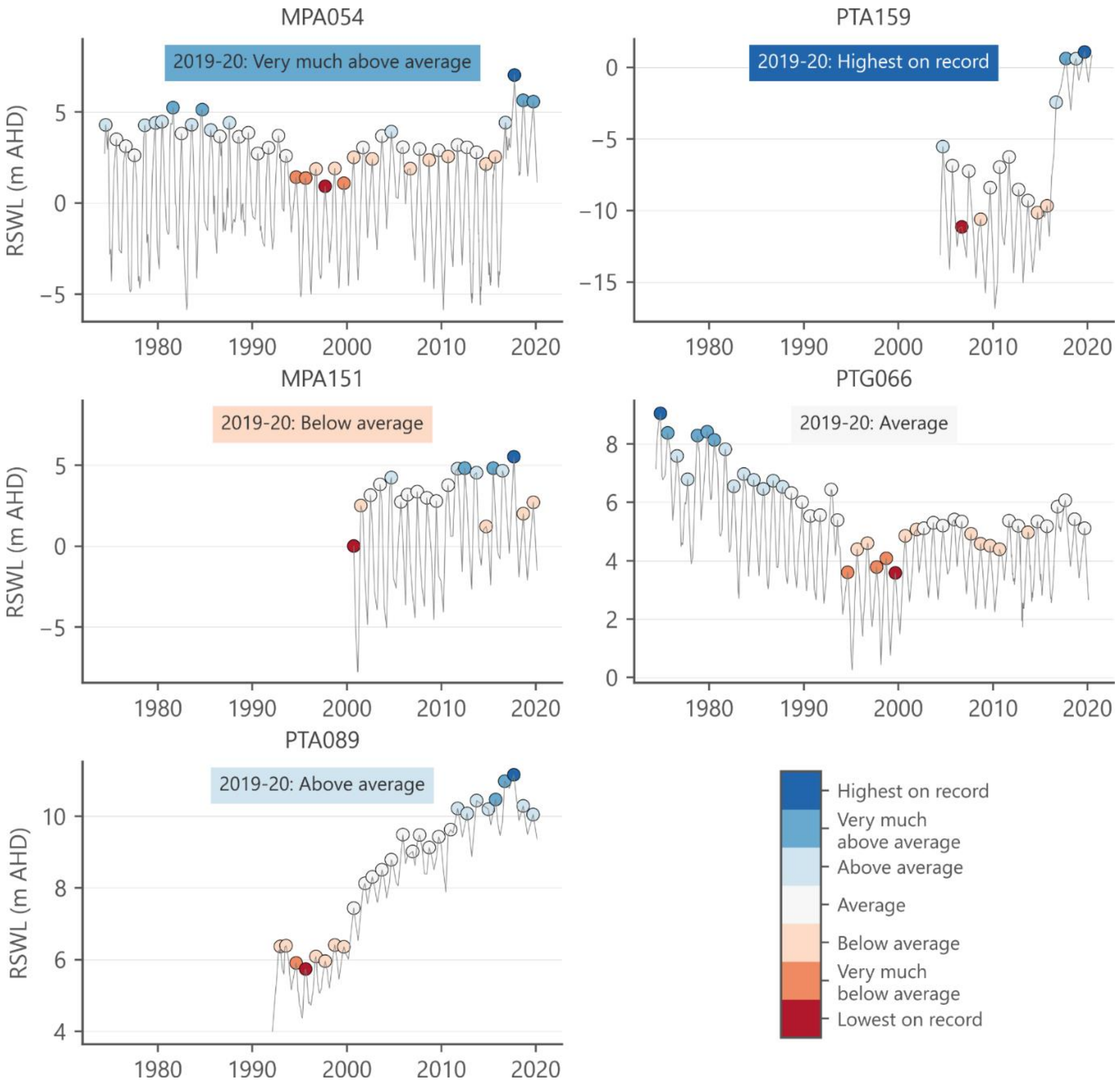

Figure 4.8 Selected NAP T1 Aquifer hydrographs

4.5 Northern Adelaide Plains PWA T1 aquifer salinity

In 2019, salinity results from 81 wells in the T1 aquifer ranged between 562 mg/L and 2802 mg/L, with a median of 847 mg/L. Most wells (62%) are less than 1000 mg/L and occur along the Little Para River and the central eastern area of the aquifer (Figure 4.9).

For the five-year period between 2015 and 2019, salinity of the T1 aquifer was predominantly stable (Figure 4.10).

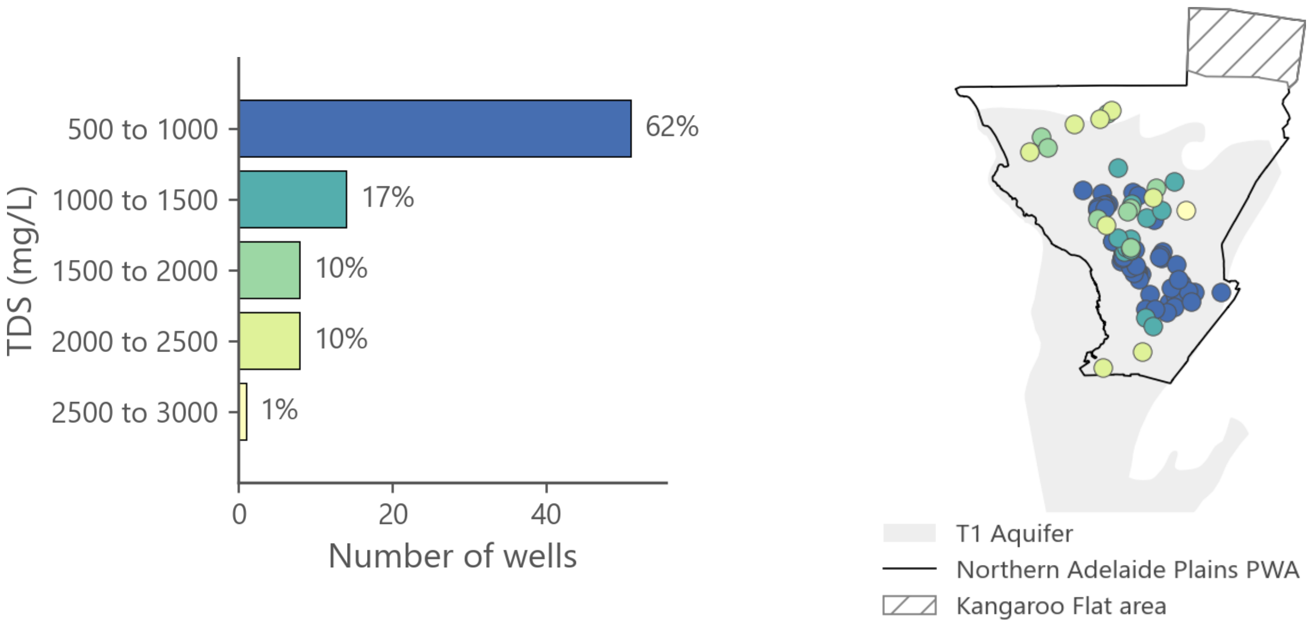

Figure 4.9 2019 salinity observations in the T1 aquifer of the NAP PWA

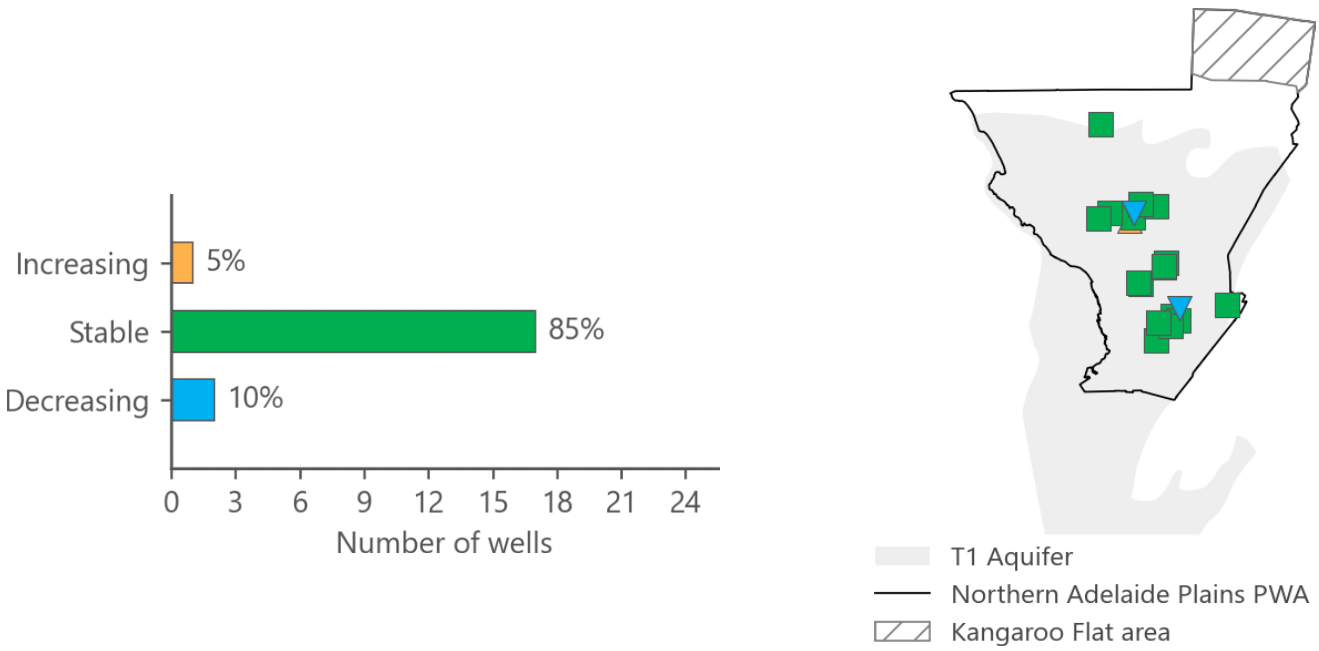

Figure 4.10 2015–19 trend in groundwater salinity for wells in the T1 aquifer of the NAP PWA

4.6 Northern Adelaide Plains PWA T2 aquifer water level

The observed recovered water levels in 53% of monitoring wells recovered to the average level on record. 39% of monitoring wells showed levels that were below average or lowest on record (Figure 4.11).

The change in water level over the last 20 years in wells with suitable long-term records ranged from a decline of 3.75 m to a rise of 12.18 m (the median change is a rise of 1.04 m). Most wells (72%) recorded a rise in water level over this time period.

Five-year trends in water levels are declining in 79% of wells, with rates ranging from a decline of 2.08 m/y to a rise of 0.25 m/y (the median rate is a declining trend of 0.32 m/y) (Figure 4.12).

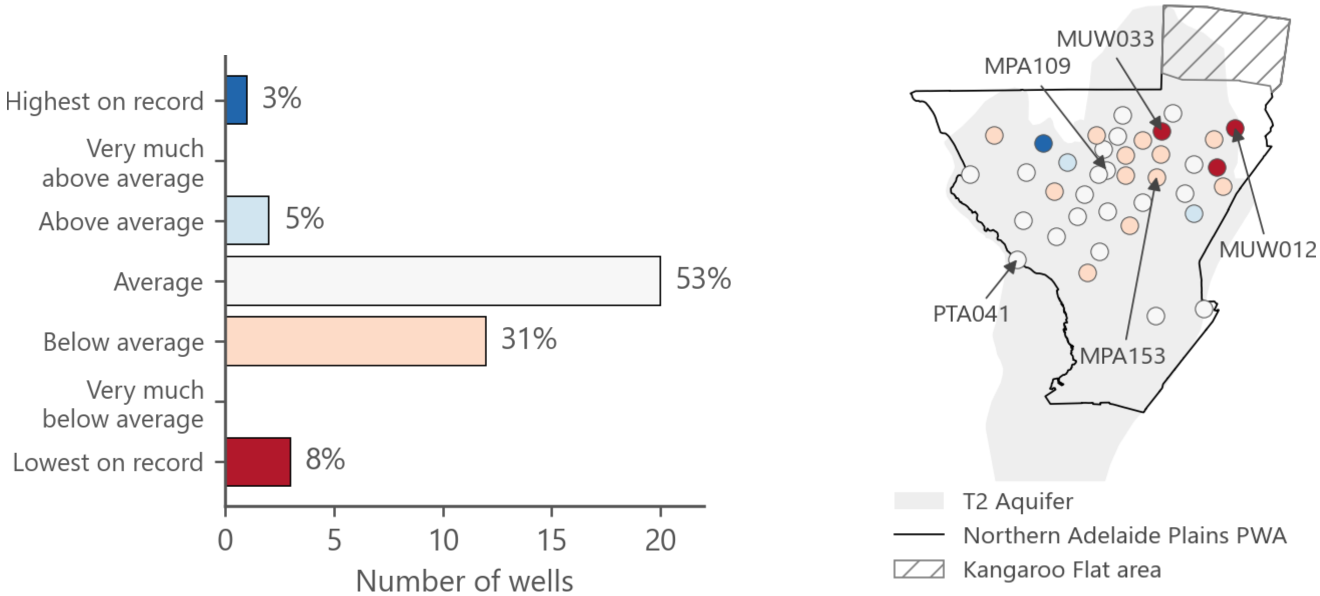

Figure 4.11 2019 recovered water levels for the T2 aquifer of the NAP PWA

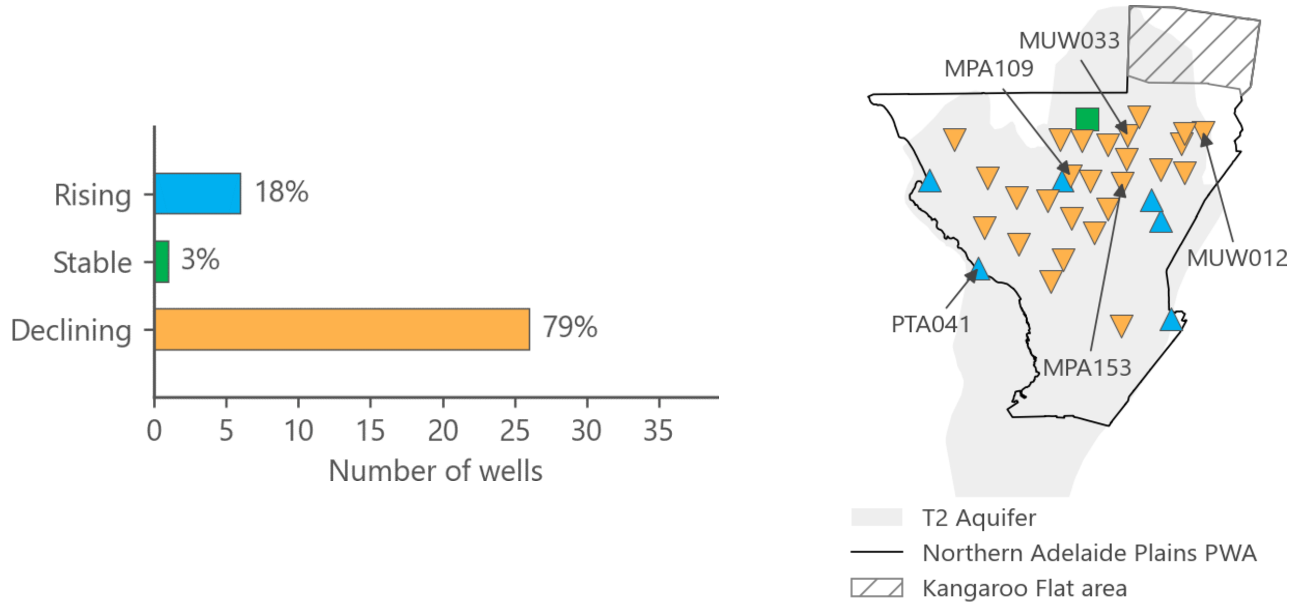

Figure 4.12 2015–19 trend in recovered water levels for wells in the T2 aquifer of the NAP PWA

Figure 4.13 shows hydrographs from a selection of monitoring wells completed in the T2 aquifer of the Northern Adelaide Plains PWA. Groundwater is extracted from this aquifer across the PWA, with numerous users in the vicinity of Angle Vale and Virginia (e.g. MPA109).

Water levels in most of the wells in the PWA have declined over the last five-year period with four wells east of Angle Vale showing lowest on record water levels (e.g. MUW033, MUW012). This may be due to below-average rainfall resulting in high extraction.

Localised higher extraction volumes near Virginia and Angle Vale are due to the local horticultural industry (e.g. market gardens). Worth noting, in 2016–17 rainfall data (see Section 3), there is a marked increase in rainfall; this correlates to a rise in water levels in typically high extraction areas (e.g. MPA153 and MPA109). It is likely that the higher than average rainfall reduced the irrigation requirement. This is reflected in the overall five-year declining trend in water levels since a relative peak in 2016 records.

The sustained decline of groundwater levels could cause movement of higher salinity groundwater to the area.

Locations along the coast indicate a five-year trend of rising water levels (e.g. PTA041); these coastal wells are located in an area of less intensive groundwater use more than nine kilometres west of Virginia and may be more indicative of the 10 and 20 year rising trend of the aquifer.

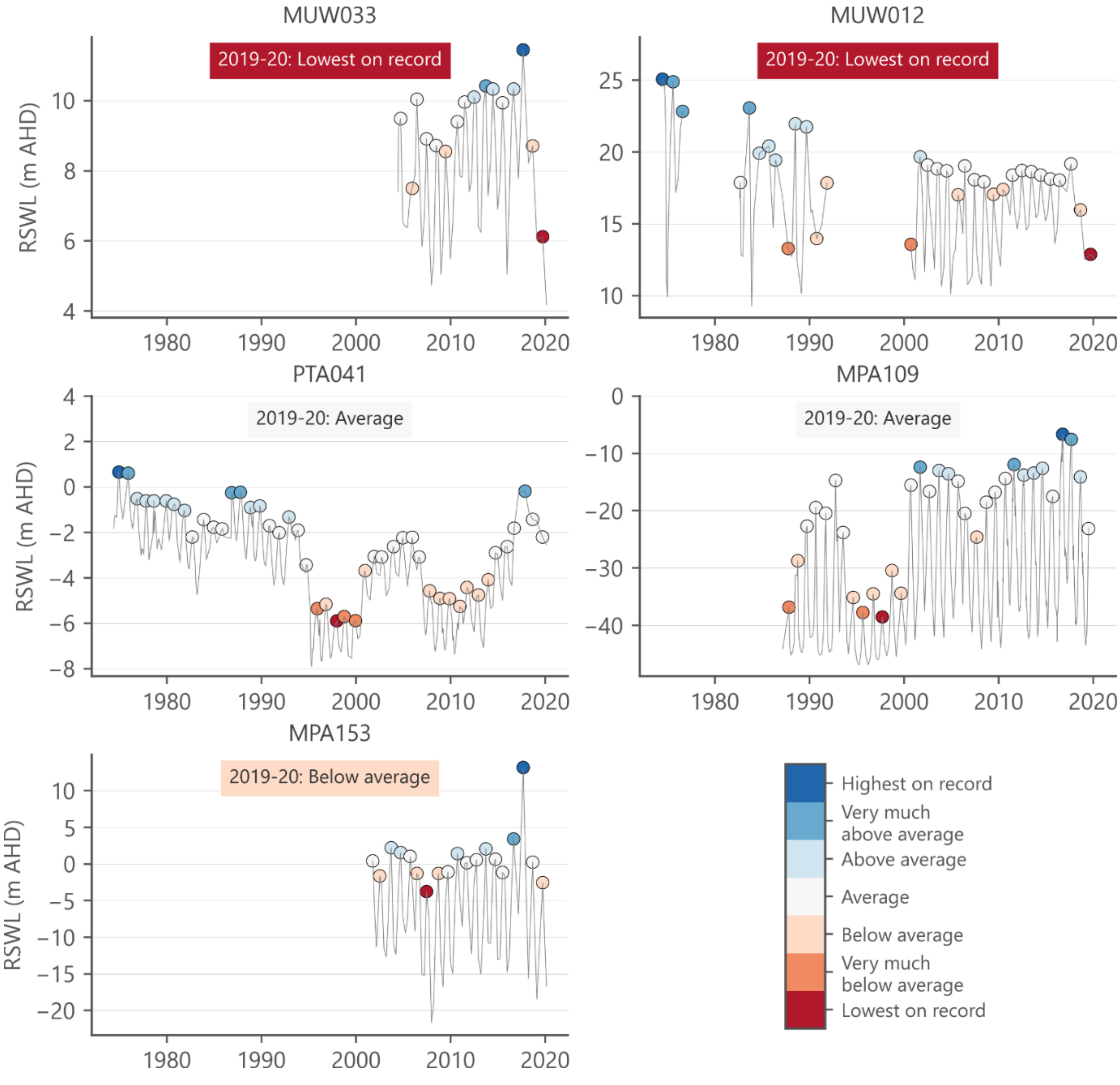

Figure 4.13 Selected hydrographs for wells in NAP T2 Aquifer

4.7 Northern Adelaide Plains PWA T2 aquifer salinity

In 2019, salinity results from 285 wells in the T2 aquifer ranged between 570 mg/L and 4315 mg/L, with a median of 990 mg/L. The salinity of most wells (79%) is below 1500 mg/L, with these wells distributed through the central north section of the PWA (Figure 4.14).

The five-year trends (2015–19) show salinity is stable for most wells in the T2 aquifer (83%), with some locations (11%) scattered throughout the PWA indicating a decrease in salinity (Figure 4.15).

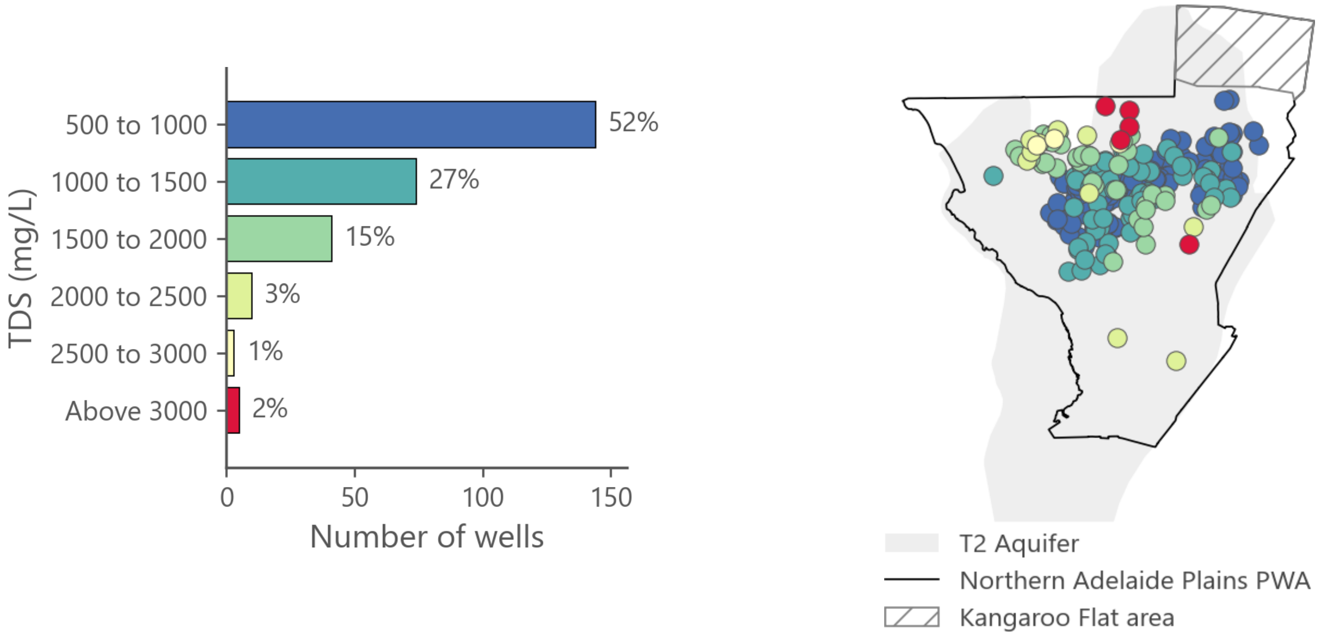

Figure 4.14 2019 salinity observations in the T2 aquifer of the NAP PWA

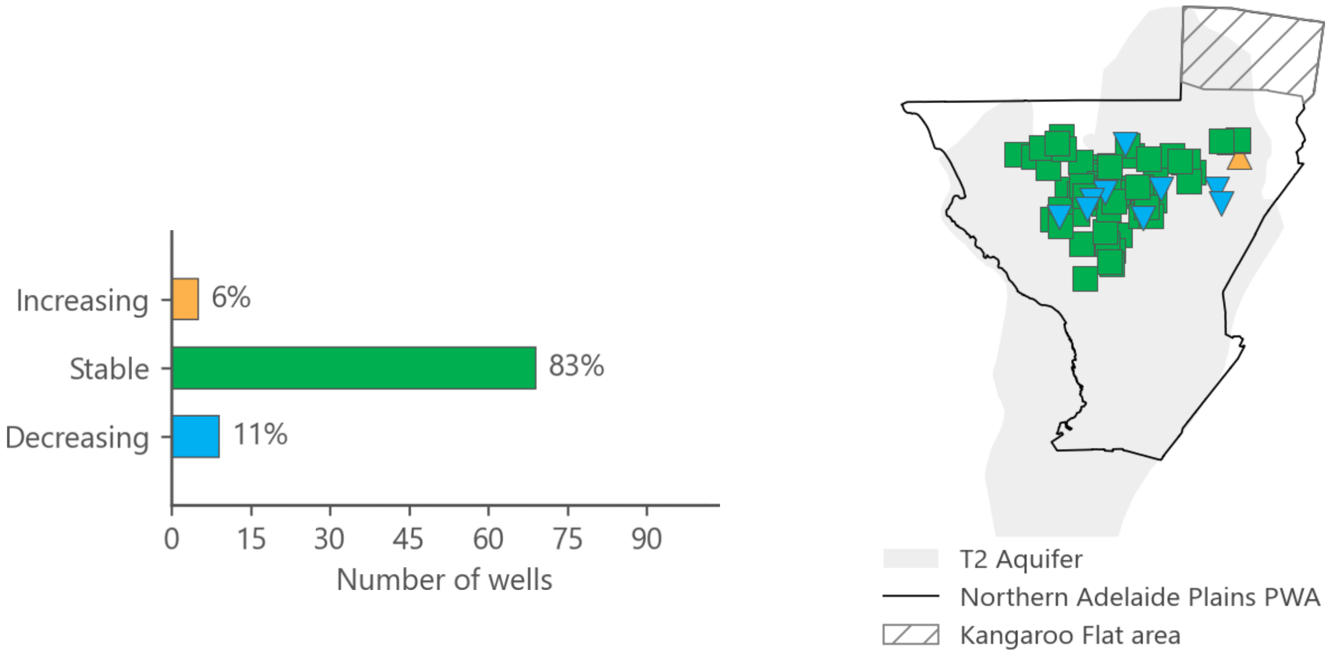

Figure 4.15 2015–19 trend in groundwater salinity for wells in the T2 aquifer of the NAP PWA

4.8 Kangaroo Flat T2 aquifer water level

There are only four monitoring wells in the T2 aquifer in the Kangaroo Flat area with observed recovered water level data for 2018–19. Average water levels were observed in two of these wells and the other two wells had levels that were the lowest on record (Figure 4.16).

A decline in water level over the last 20 years was recorded in the three wells with suitable long-term records with declines of 1.94 m, 1.68 m and 1.35 m.

Five-year trends in water levels are declining in three of the four wells, with rates ranging from a decline of 0.21 m/y to a rise of 0.14 m/y (the median change is declining at 0.10 m/y) (Figure 4.17).

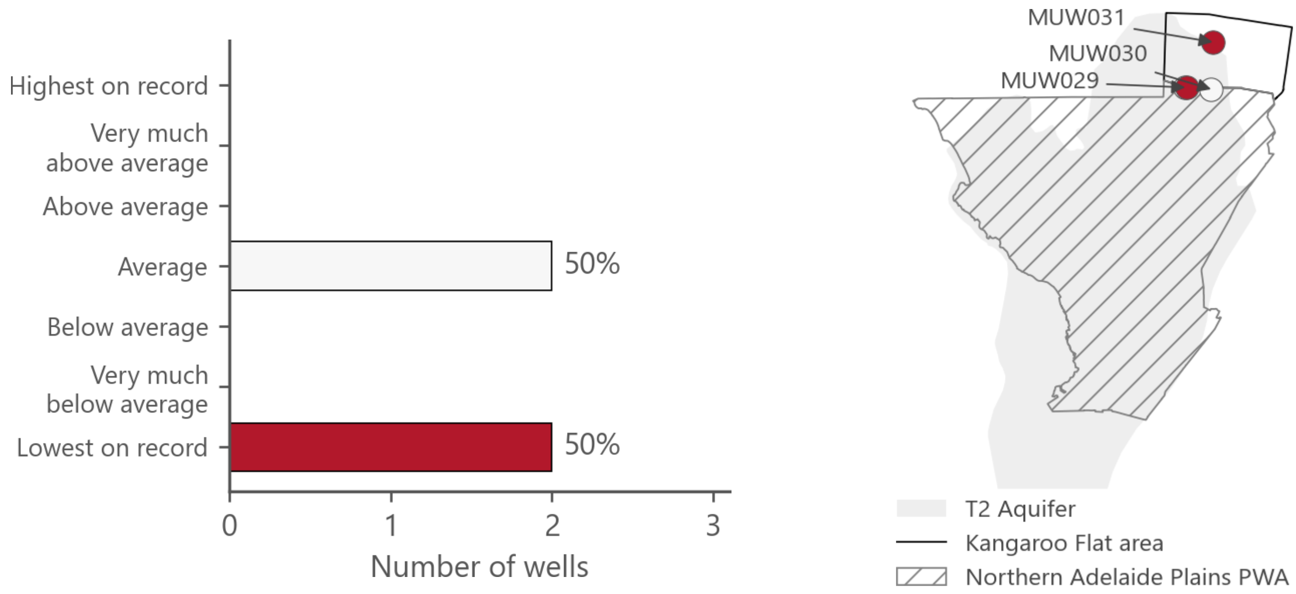

Figure 4.16 2019 recovered water levels for the T2 aquifer of the Kangaroo Flat region

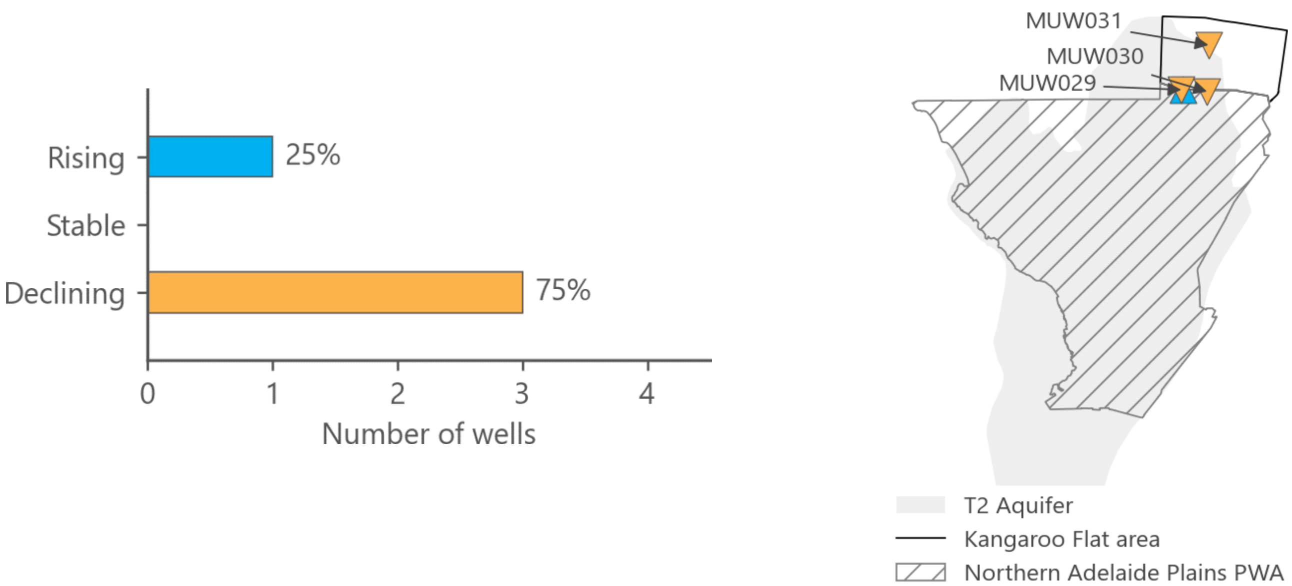

Figure 4.17 2015–19 trend in recovered water levels for wells in the T2 aquifer of the Kangaroo Flat region

Figure 4.18 shows hydrographs from the three T2 aquifer monitoring wells with long-term records completed in the Kangaroo Flat region. Groundwater is extracted from this aquifer predominantly at the southern extent of the region, with water levels showing a slight decline over the past five years (e.g. MUW029 and MUW030). The relationship between extraction volumes and salinity in this aquifer has prompted a staged reduction to allocations since 2017. These reductions may be why the decline in water levels has only been 0.07 m/y over the past five years, despite a reduction in average rainfall over the same period.

A localised cone of depression in the T2 aquifer, centred in the south-western corner of the region, has been observed on a seasonal basis since 2011 as the result of the intensive spring/early-summer extraction regime (DEW 2019b).

A consistent decline is noted in the northern area of the region (e.g. MUW031) which is most likely due to the gradual expansion of the cone of depression (Barnett 2013).

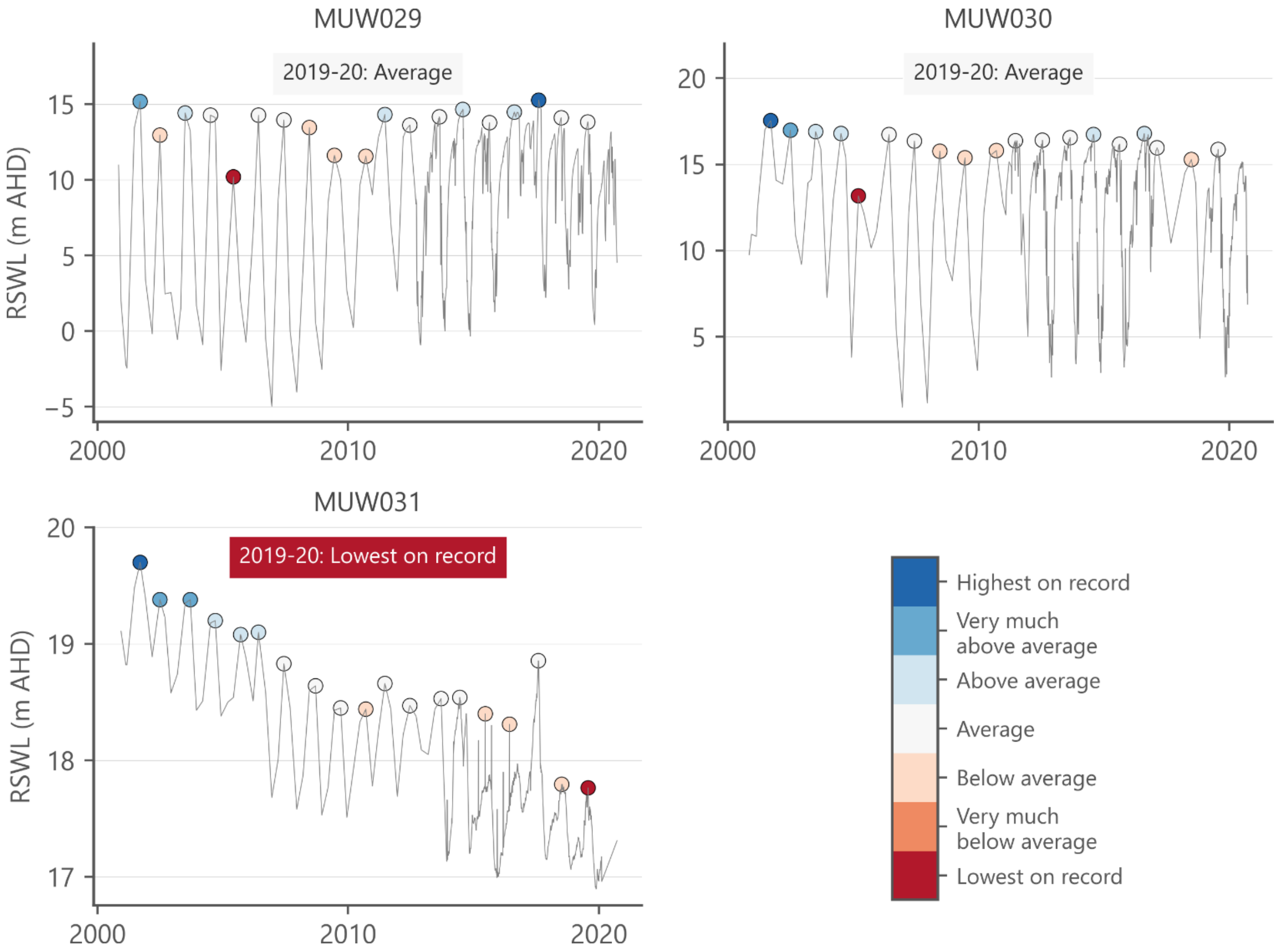

Figure 4.18 Selected hydrographs for wells in the T2 aquifer of the Kangaroo Flat region

4.9 Kangaroo Flat T2 aquifer salinity

Kangaroo Flat is a farming area where there is a strong relationship between extraction volumes and salinity. In 2019, salinity results from 11 wells in the T2 aquifer ranged between 1272 mg/L and 4513 mg/L, with a median of 1647 mg/L. Most wells (82%) recorded a salinity between 1000 mg/L and 2500 mg/L (Figure 4.19).

Salinity has been decreasing in four of the six wells for which the salinity trend for the past five years (2015–19) for the T2 aquifer in Kangaroo Flat could be calculated. The salinity trend in two of the wells remained stable while the remaining two wells indicated an increase in salinity (Figure 4.20).

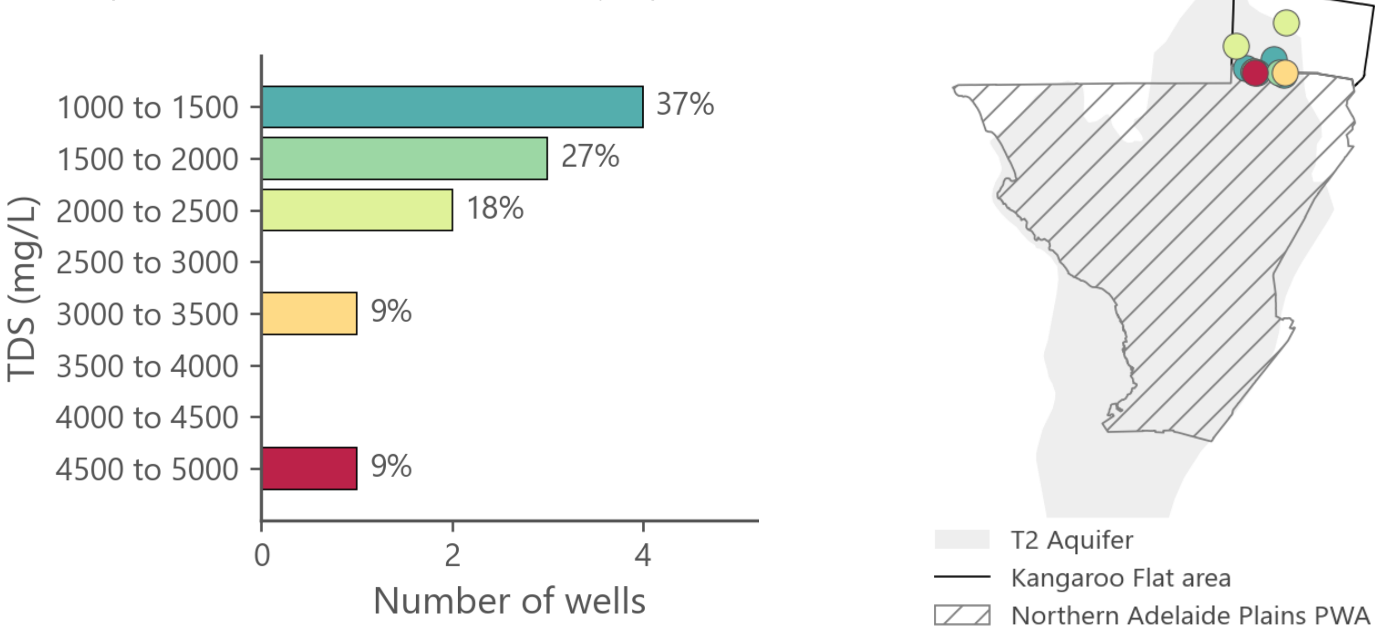

Figure 4.19 2019 salinity observations in the T2 aquifer of the Kangaroo Flat region

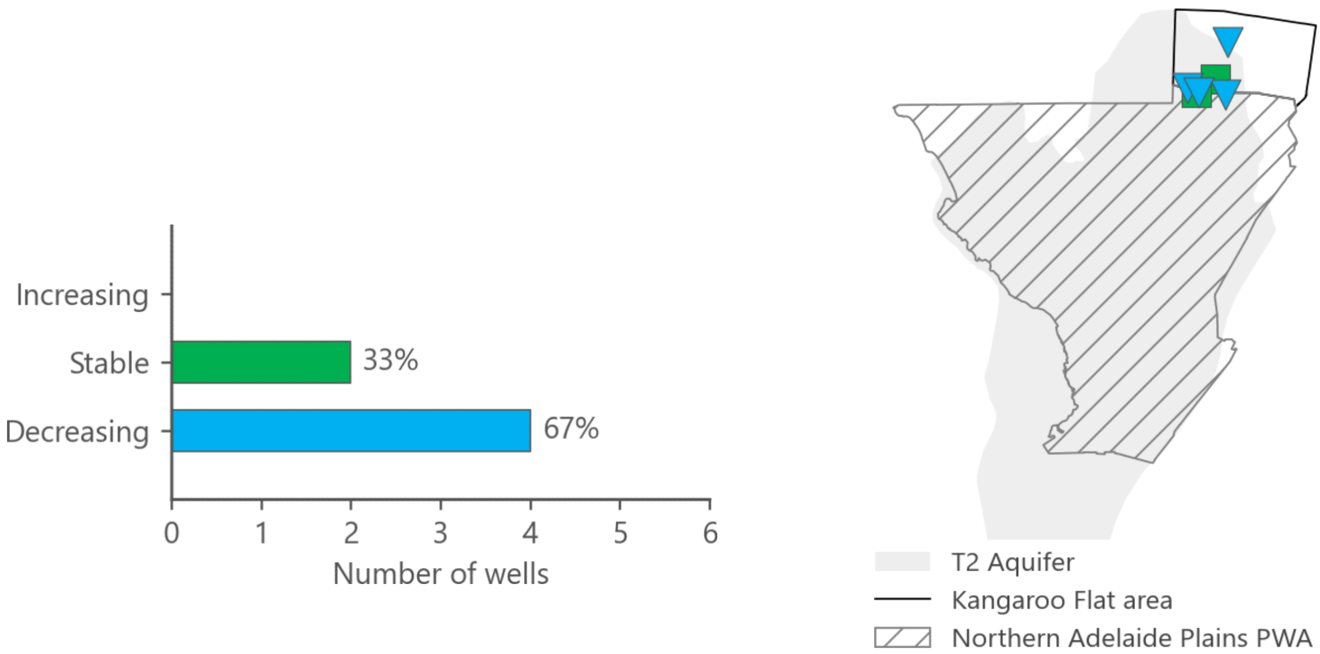

Figure 4.20 2015–19 trend in groundwater salinity for wells in the T2 aquifer of the Kangaroo Flat region

5 Water use

Water use data in this status report considers groundwater extracted from licensed wells and water extracted and injected into the T1 and T2 aquifer from MAR schemes. In comparison to the previous 10 years, water extraction in the 2018–19 water-use year has increased. The year of lowest extraction volumes (2016–17) correlates with a marked increase in water injection volumes and an increase in regional rainfall. Conversely, a relative decrease in rainfall since 2016 correlates to a relative increase in extraction volumes.

Within the Central Adelaide PWA, comprehensive metering of extractions for existing users is progressing and should be complete in several years. However, there is data available for the MAR schemes that operate in both the T1 and T2 aquifers.

5.1 Groundwater extraction

In 2018–19, licensed groundwater extractions (from the T1 and T2 aquifers of the Kangaroo Flat region and NAP PWA) were 14 025 ML compared to 12 270 ML in 2017–18, and 9920 ML in 2016–17 (Figure 5.1).

The relatively low groundwater extraction volume in 2016–17 coincides with a higher than average annual rainfall (see Section 3). The increase in groundwater extraction in 2018–19 coincides with a lower than average annual rainfall. As expected, a dry year results in higher extraction and vice versa.

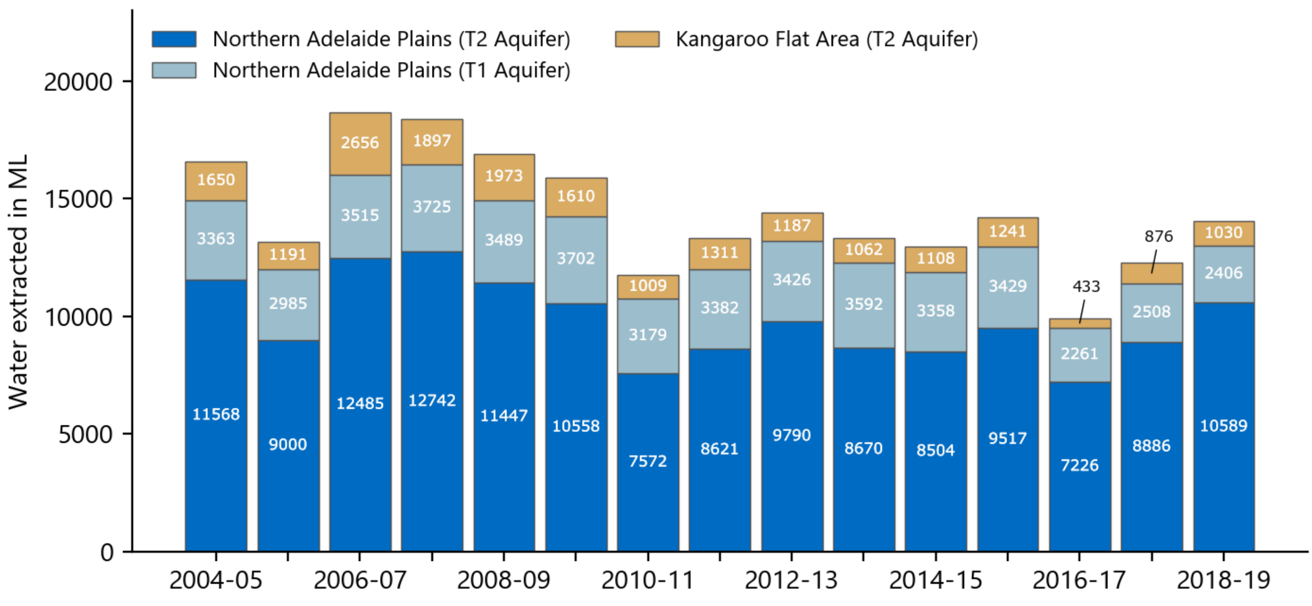

Figure 5.1 Metered groundwater extraction in aquifers of the Northern Adelaide Plains PWA, including the Kangaroo Flat region from 2004–05 to 2018–19

5.1 Managed aquifer recharge

5.1.1 Central Adelaide PWA

In 2018–19, licensed groundwater injections to the T1 aquifer of the Central Adelaide PWA totalled 645 ML, a decrease from 704 ML in the previous reporting period (2017–18) (Figure 5.2). Injections into the T2 aquifer were also higher in 2018–19 at 776 ML, compared to the previous water-use year (599 ML).

Extraction from the T1 aquifer has exceeded injection since 2009–10. Predominantly, these MAR schemes are associated with golf course and racecourse maintenance. Conversely, injection has exceeded extraction in the T2 aquifer of the Central Adelaide PWA since 2010–11, resulting in a net gain to the T2 aquifer in the order of 1.7 GL.

5.1.2 Northern Adelaide Plains PWA

In 2018–19, licensed groundwater injections to the T1 aquifer of the Northern Adelaide Plains PWA increased slightly to 342 ML from 315 ML in 2017–18. Injection volumes for the T2 aquifer also slightly increased, with 2788 ML recorded for 2018–19 and 2771 ML for the 2017–18 reporting period (Figure 5.3). Both of these injection volumes were a marked decrease from 491 ML (T1) and 5636 ML (T2) in 2016–17, which coincided with higher than average annual rainfall that allowed the schemes to harvest large volumes of stormwater for injection.

Injection typically exceeds extraction in the T1 and T2 aquifers in the NAP PWA. This has resulted in a net gain to the T1 aquifer of just over 3.5 GL and 9.7 GL in the T2 aquifer, since 2004–05.

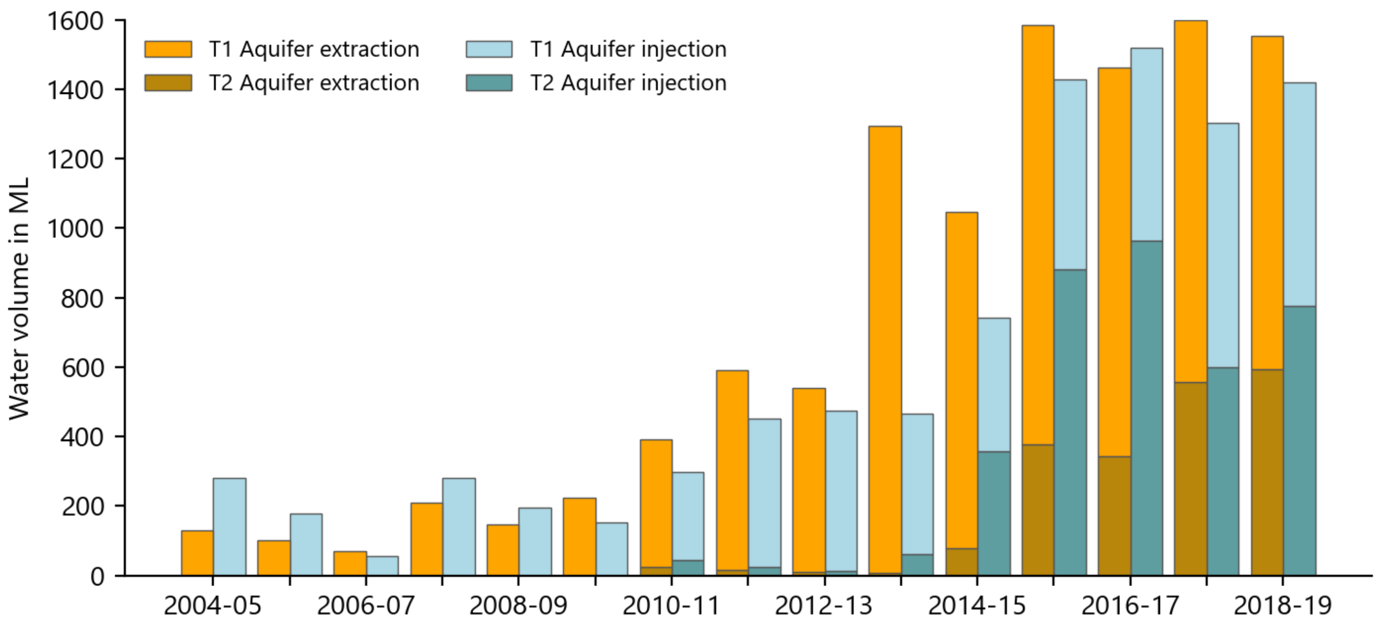

Figure 5.2 Metered water injection and extraction volumes for MAR schemes in the T1 and T2 aquifers of the Central Adelaide PWA from 2004–05 to 2018–19

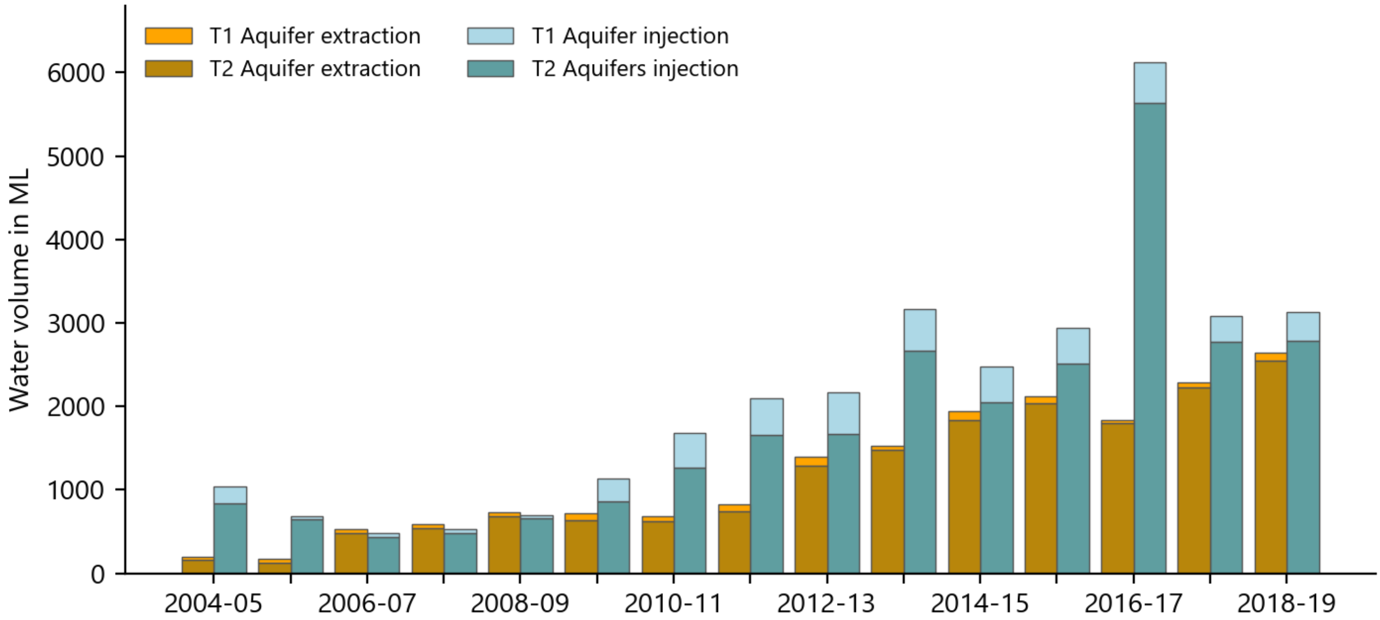

Figure 5.3 Metered water injection and extraction volumes for MAR schemes in the T1 and T2 aquifers of the Northern Adelaide Plains PWA from 2004–05 to 2018–19

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