Peake, Roby and Sherlock Prescribed Wells Area Groundwater Assessment

Department for Environment and Water

February 2021

DEW Technical note 2021/02

Government of South Australia

Department for Environment and Water

Department for Environment and Water
Government of South Australia
November 2020

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ISBN 978-1-925964-95-0

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Preferred way to cite this publication

Department for Environment and Water (DEW) 2021. Peake, Roby and Sherlock Prescribed Wells Area Groundwater Assessment., DEW Technical Note 2021/02, Government of South Australia, Adelaide.

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Foreword

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

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

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

John Schutz
CHIEF EXECUTIVE
DEPARTMENT FOR ENVIRONMENT AND WATER

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1 Introduction

The Peake, Roby and Sherlock Prescribed Wells Area (PWA) is located about 120 km southeast of Adelaide and is underlain by sedimentary aquifers of the Murray Basin (Figure. 1). It is a local-scale groundwater resource with a small number of irrigators. Groundwater is prescribed under Landscape South Australia Act 2019 and a Water Allocation Plan provides for the sustainable management of the groundwater resources (SAMDB NRM Board, 2011).

The Water Allocation Plan defines various groundwater management zones with Figure 1 highlighting the Extraction Management Zone (EMZ) in which the majority of groundwater extractions occur.

This technical note presents an update of the groundwater level and salinity trends which may inform decision-making on management options for the area.

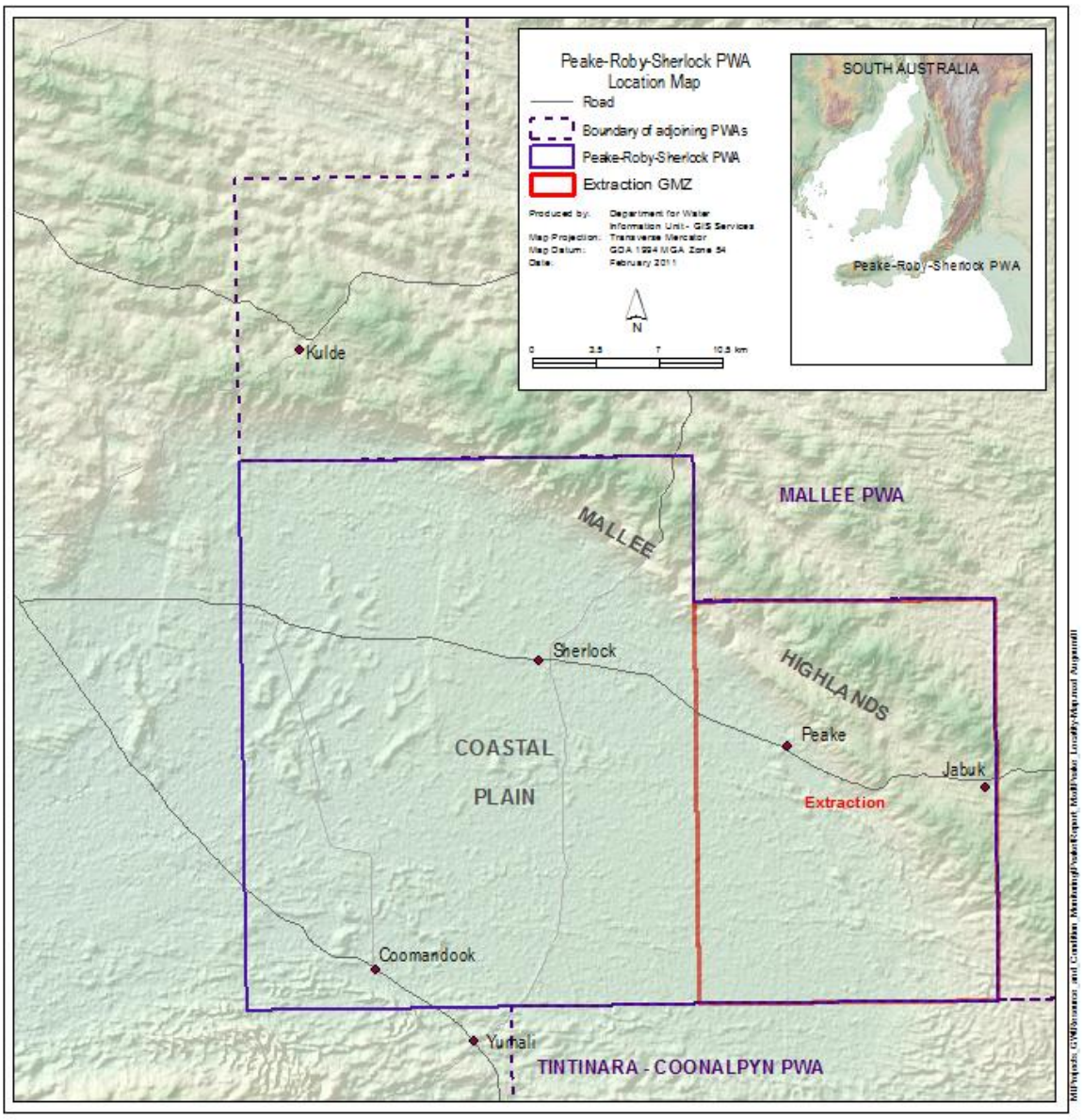

Figure 1. Location of the Peake, Roby and Sherlock Prescribed Wells Area

2 Hydrogeology

The Peake, Roby and Sherlock PWA has two distinct aquifers – an unconfined aquifer and a confined aquifer (Figure 2).

2.1 Unconfined Aquifer

The unconfined aquifer is continuous across the Peake, Roby and Sherlock PWA but can be divided into two main regions, the low-lying Coastal Plain and the Mallee Highlands, each with different hydrogeological characteristics. Recharge to the unconfined aquifer primarily occurs locally via rainfall infiltrating directly into the aquifer through the soil profile.

2.1.1 Coastal Plain

On the low-lying Coastal Plain, groundwater occurs within a Quaternary limestone aquifer at shallow depths ranging between three and eight metres below ground level. Due to high salinities, there are currently no extractions from this resource.

2.1.2 Mallee Highlands

Beneath the Mallee Highlands, groundwater is found in the Tertiary age Murray Group Limestone aquifer at a depth of about 40–50 m below the ground. Groundwater is mostly used for stock and domestic purposes with a small amount allocated for irrigation. Further to the east, in the adjoining Mallee PWA, this aquifer is used extensively for irrigation.

2.2 Confined Aquifer

The confined aquifer comprises both the Buccleuch Group and the underlying Renmark Group. The most widely used aquifer is the Buccleuch Group, which consists of a consolidated bryozoal limestone or "coral" that lies at a depth of 90–100 m below the ground and varies in thickness from 5–25 m. The Ettrick Formation occurs between the confined aquifer and the overlying Murray Group Limestone aquifer and comprises a layer of black carbonaceous clay up to 20 m thick.

The coral layer thins out towards the east, coincidentally where the terrain rises toward the Mallee Highland. Below this coral, sand layers within the Renmark Group lie at a depth of about 130 m and may be developed for supplies, with wells requiring sand screens.

As the Buccleuch and Renmark Group aquifers are confined, they are not recharged by local rainfall. The primary recharge source is the lateral inflow of groundwater into the Peake, Roby and Sherlock PWA from southwestern Victoria.

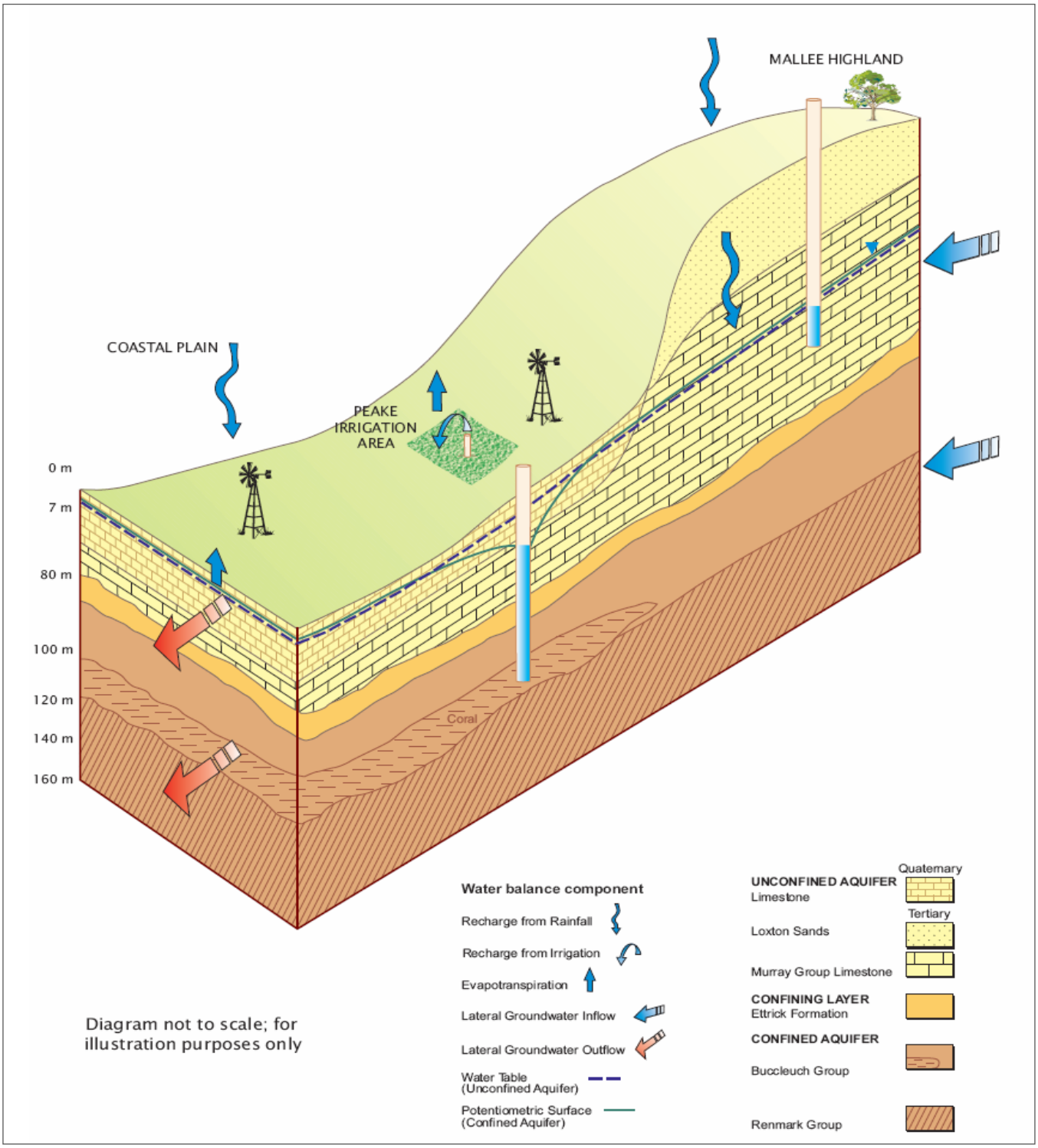

Figure 2. Schematic cross-section of the Peake, Roby and Sherlock PWA

3 Extractions and allocation

Groundwater extracted within the Peak-Roby-Sherlock PWA is used predominantly for irrigation, with metered extractions commencing in 2004. For the 2019-20 water use year, groundwater extractions totalled 731 ML, an increase of 13% from the previous year (Figure 3). Nearly all of this extraction occurred from the confined aquifer, with only 0.01 ML taken from the unconfined aquifer. The marked increase in extraction in 2008–09 coincided with the revocation of a Notice of Prohibition.

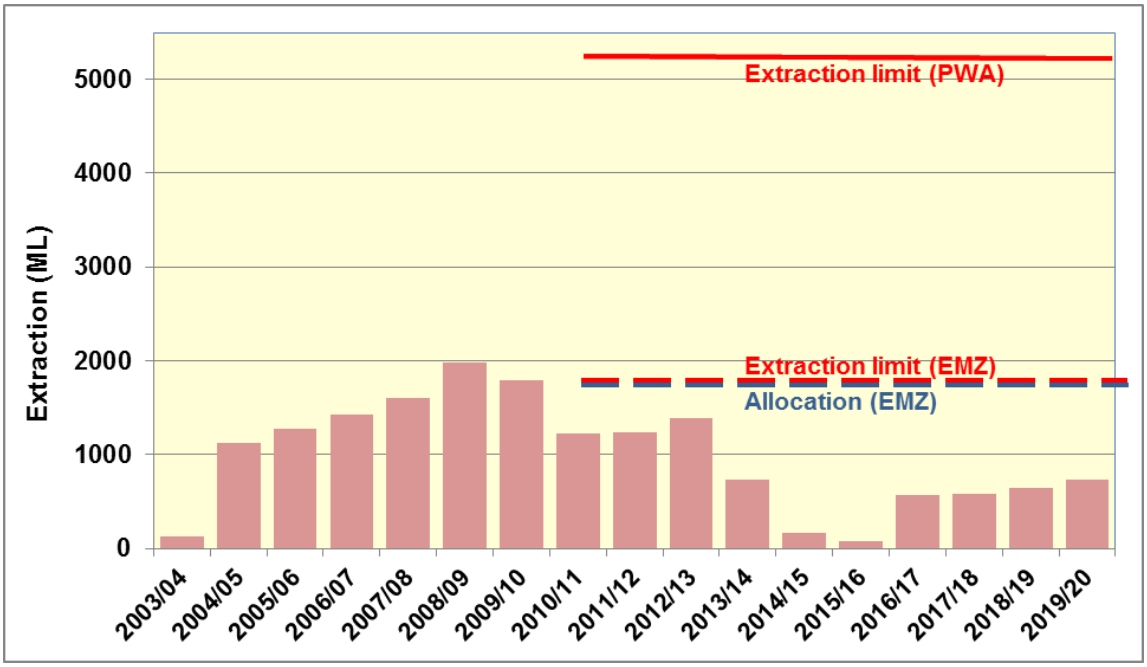

Figure 3. Historic metered groundwater use in the Peake, Roby and Sherlock PWA

Overall, extractions are considerably below the extraction limit for the whole of the PWA. However, virtually all extractions occur from the area of low salinity groundwater in the confined aquifer within the Extraction MZ (EMZ). Figure 3 shows that this zone is fully allocated and that extractions have been below the extraction limit since 2009-10.

4 Water level monitoring

The monitoring of groundwater levels in the Peake, Roby and Sherlock PWA began in 1989 when concerns were expressed about rising watertables in the southwest of the area. Initially, the network was established on a local scale, but when interest in establishing irrigation in the Peake area first became apparent in 2000, the network was expanded. The large increase in irrigation development in 2004 prompted an intensification of the network and commencement of salinity monitoring.

4.1 Unconfined Aquifer

There are currently 13 observation wells within the Peake, Roby and Sherlock PWA which monitor the unconfined aquifer (Figure 4). Most of these were established in 1987 to monitor rising watertables on the low-lying Coastal Plain due to the clearance of native vegetation.

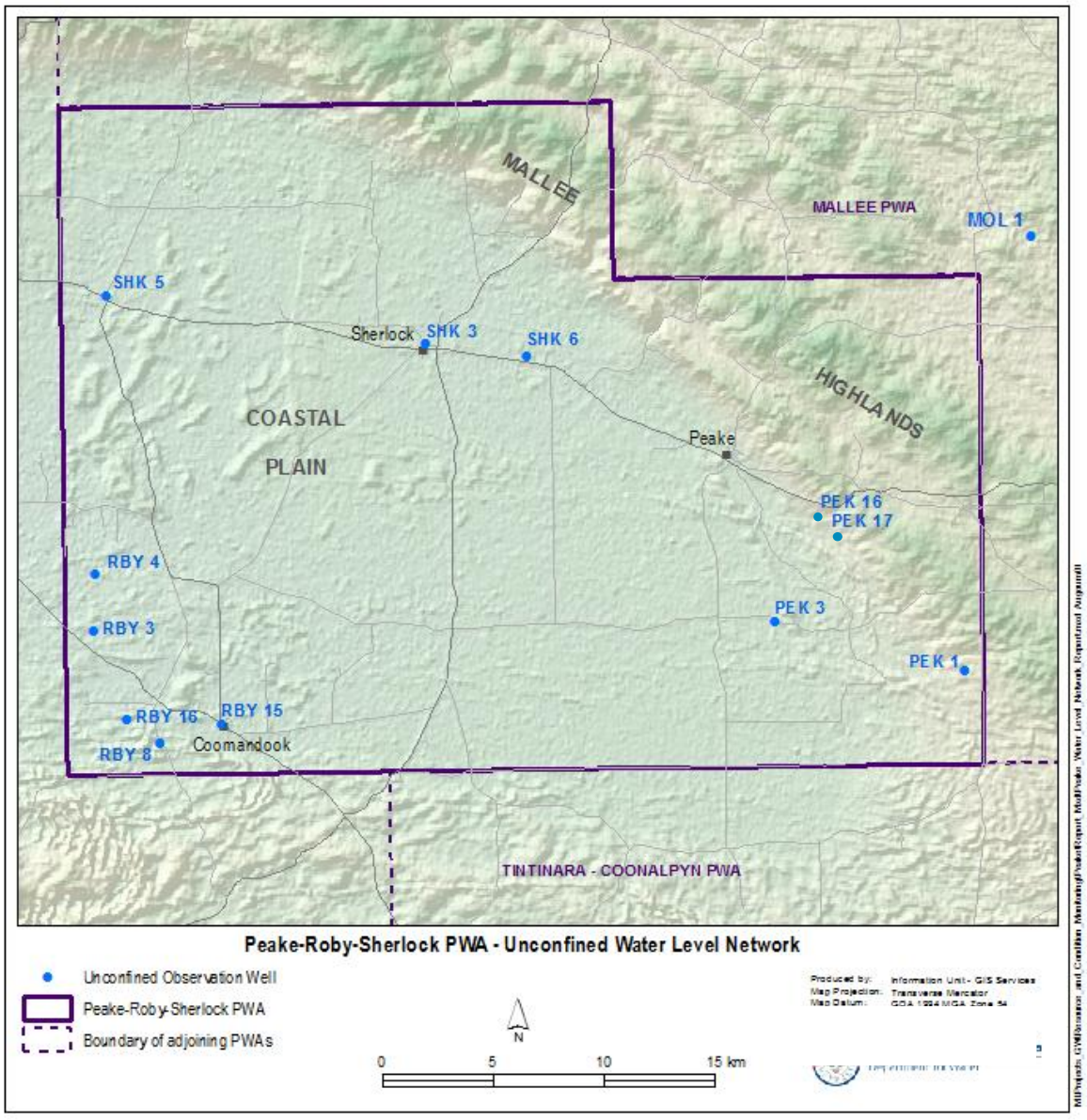

Figure 4. Location of unconfined water level observation wells in the Peake, Roby and Sherlock PWA

4.1.1 Coastal Plain

Prior to 1993, regional watertables recorded a rising long-term trend of 5–10 cm/y due to an increase in recharge following extensive clearing of native vegetation. This watertable rise had resulted in dryland salinity affecting hundreds of hectares in the Cooke Plains area (Figure. 1) found to the west of the Peake, Roby and Sherlock PWA. Since 1993, there have been significant periods of below-average rainfall which has resulted in a slow decline in watertable levels. However, when compared to the cumulative deviation from mean monthly rainfall, the shallow watertable can be seen rising in response to episodic wet years such as 1992-1993, 1996, 2010 and 2016 (Figure. 5).

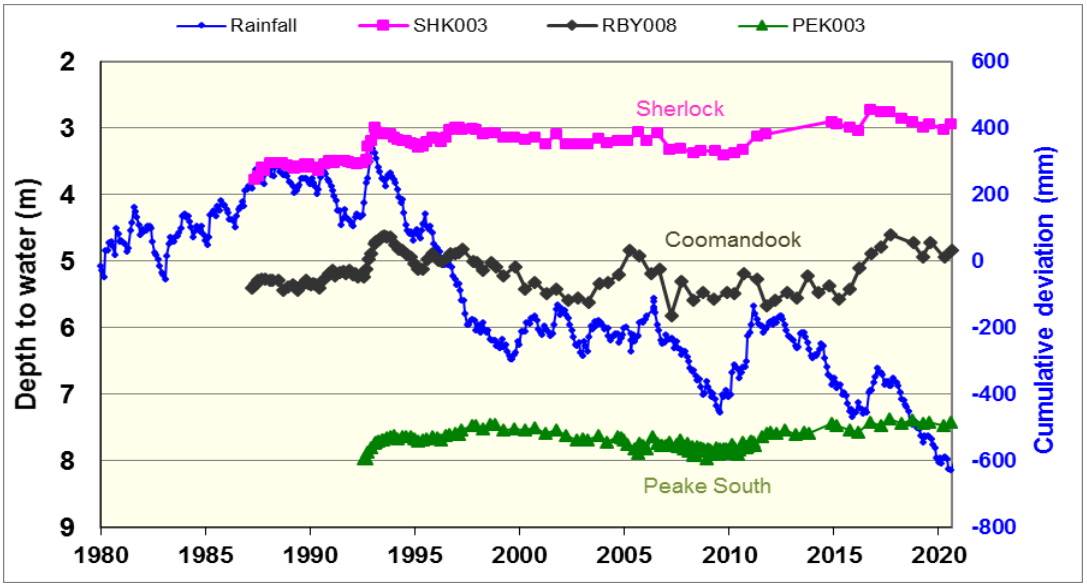

Figure 5. Groundwater level trends of the Coastal Plain unconfined aquifer

4.1.2 Mallee Highlands

Hydrographs for observation wells in the Mallee Highlands (Figure 6) show a very gradual rising trend of 1-5 cm/y due to vegetation clearance, despite the below-average rainfall discussed earlier and the considerable depth to the watertable. Vegetation clearance generally also causes a long-term increase in groundwater salinity as salt previously stored in the root zone of the Mallee vegetation is flushed down to the watertable by the increased recharge.

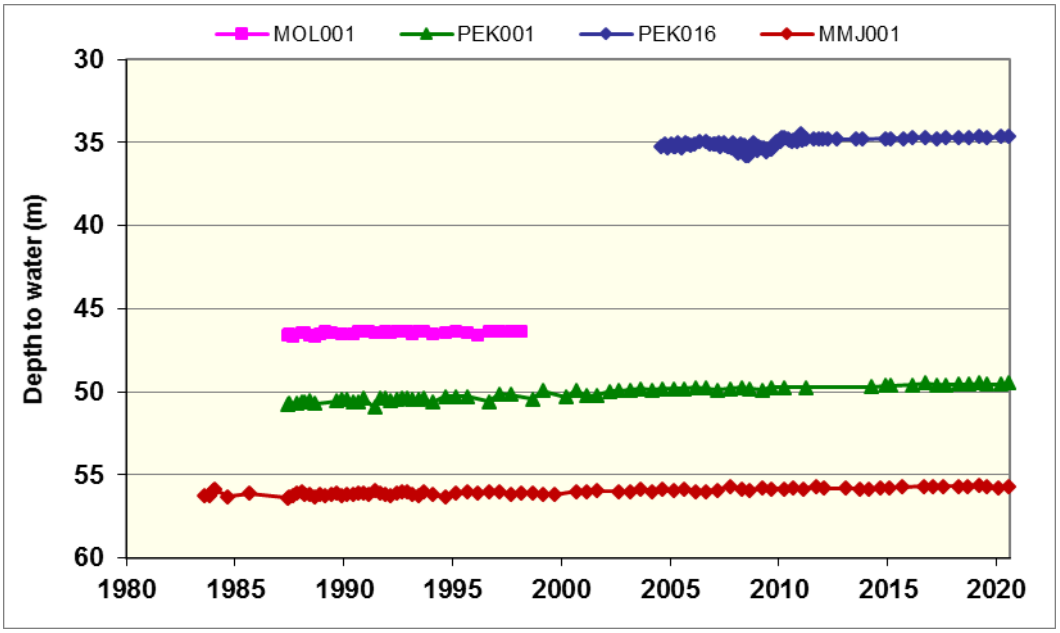

Figure 6. Groundwater level trends of the Mallee Highlands unconfined aquifer

4.2 Confined Aquifer

There are currently 14 observation wells monitoring pressure levels in the confined aquifer in the Peake, Roby and Sherlock PWA (Figure 7).

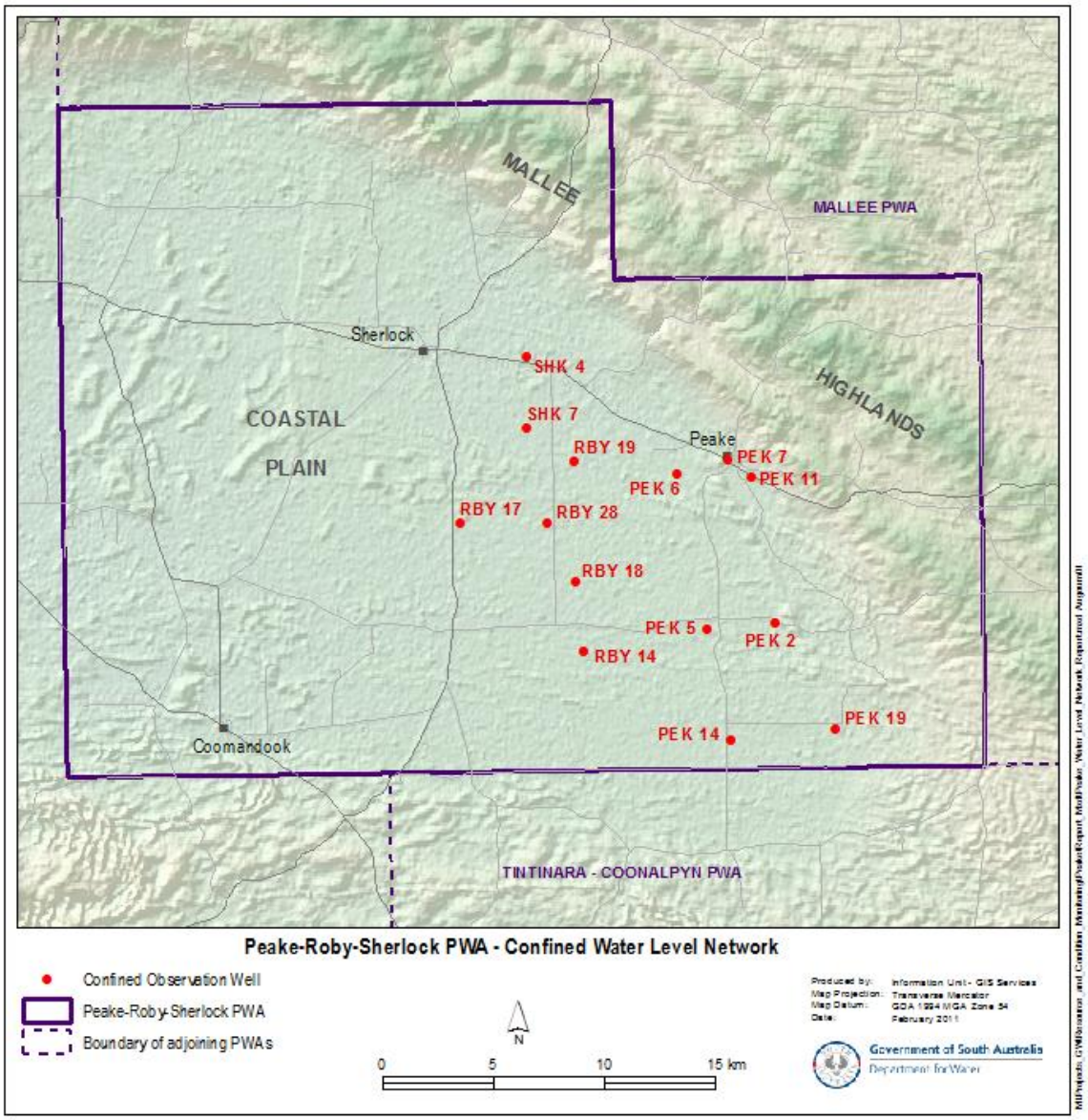

Figure 7. Location of confined water level observation wells in the Peake, Roby and Sherlock PWA

As most of the groundwater extractions come from the confined aquifer, there is little direct correlation between groundwater levels and variations in rainfall. However, there could be an indirect correlation in that dry years (such as 2002 and 2006) will result in increased groundwater pumping that may lead to a lowering of groundwater levels. In particular, a dry winter could lead to an earlier start to pumping for the irrigation season which may prevent water levels from recovering to their normal levels in spring. Conversely, a wet spring might delay the start of irrigation, leading to a higher than normal recovery in groundwater levels.

Observation well PEK007 is the Peake town water supply well located at a distance of three kilometres from the area of concentrated pumping for irrigation; observation well PEK002 is located four kilometres away and SHK004 is at a distance of 15 km.

Large seasonal variations in pressure levels developed when large-scale irrigation commenced in 2004, with the seasonal drawdowns decreasing with distance from the areas of irrigation (Figure 8). Drawdowns increased every year until 2009–10. Drawdowns then stabilised and decreased in magnitude, reaching a new equilibrium after 2014-15 following the substantial reduction in groundwater extractions (Figure 3).

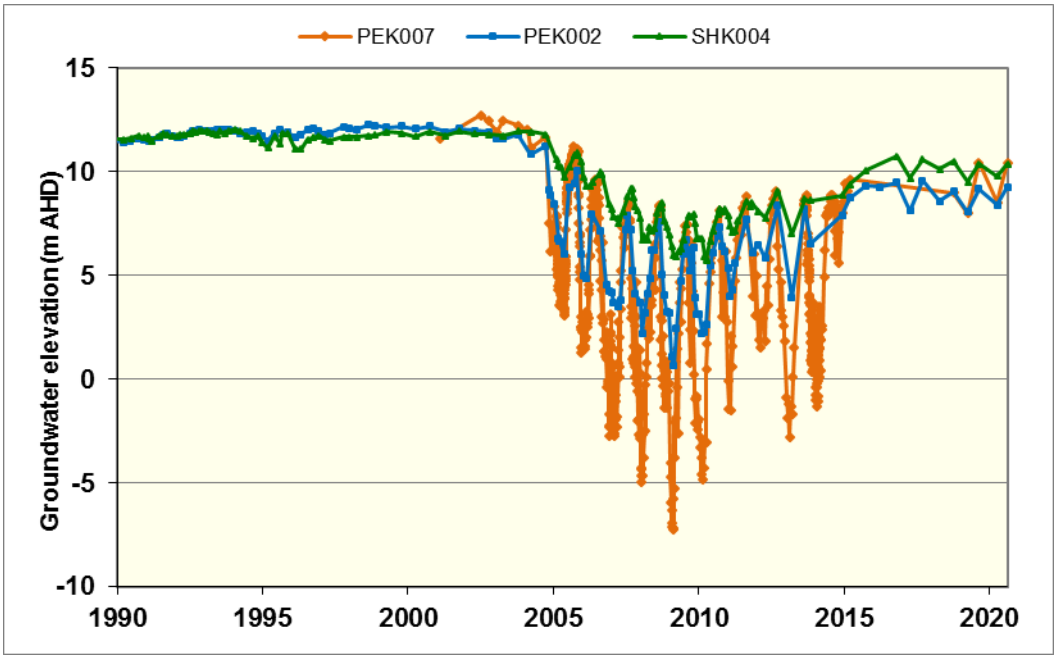

Figure 8. Groundwater levels trends of the confined aquifer

Figure 9 shows a comparison between the potentiometric surface contours for September 2010 and August 2020. The substantial cone of depression developed near the township of Peake caused by the increased groundwater extraction during the period between 2005 and 2013 has now dissipated in response to the reduction in groundwater extraction from 2013-14 onwards (Figure 3).

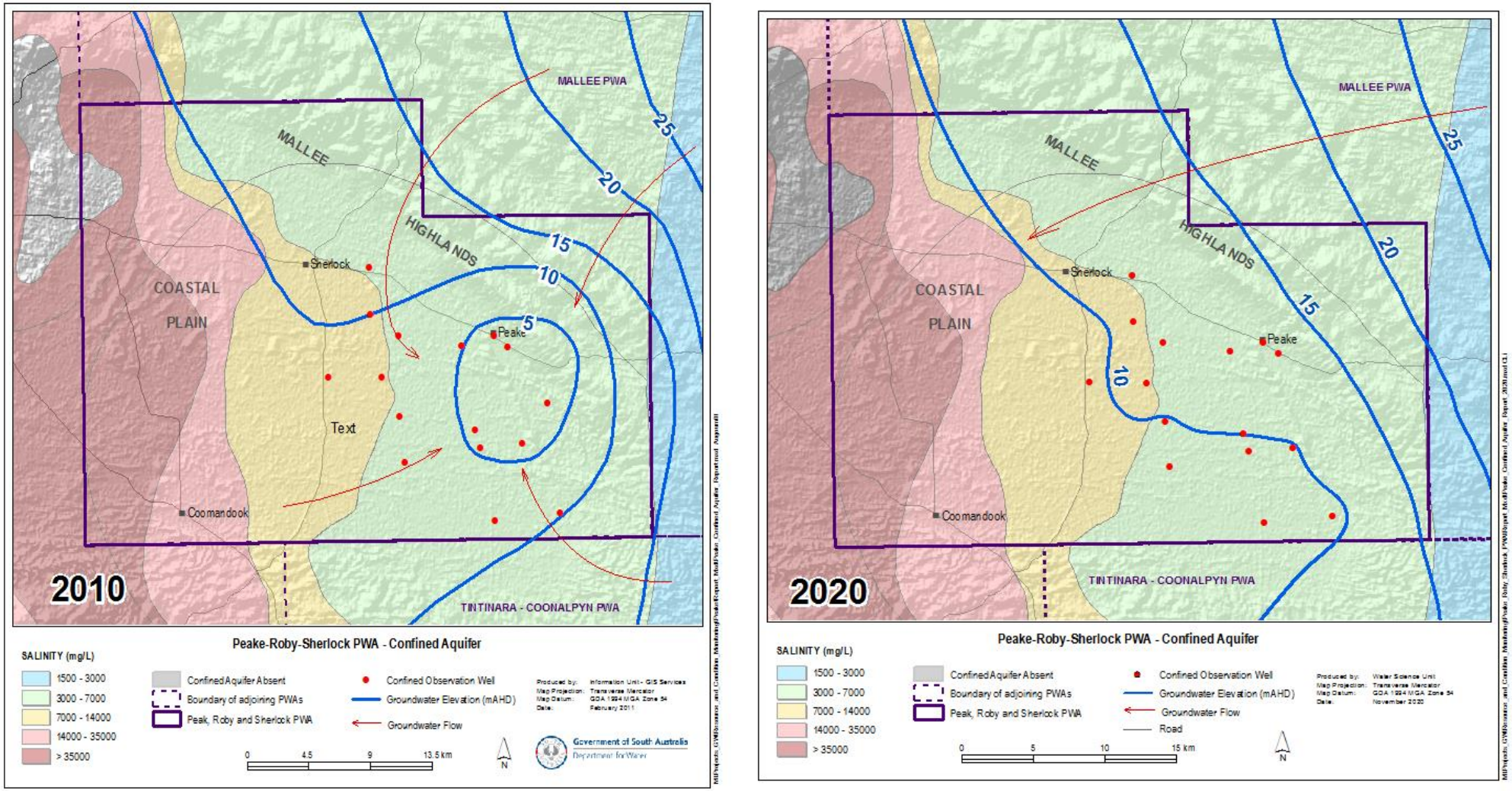

Figure 9. Salinity distribution and potentiometric surface contours for September 2010 and August 2020

5 Salinity monitoring

There are 13 wells within the confined aquifer salinity observation network (Figure 7). These private stock and domestic wells are concentrated to the west of the main extraction area where the risk of salinity increases due to flow reversal is highest. They are sampled annually.

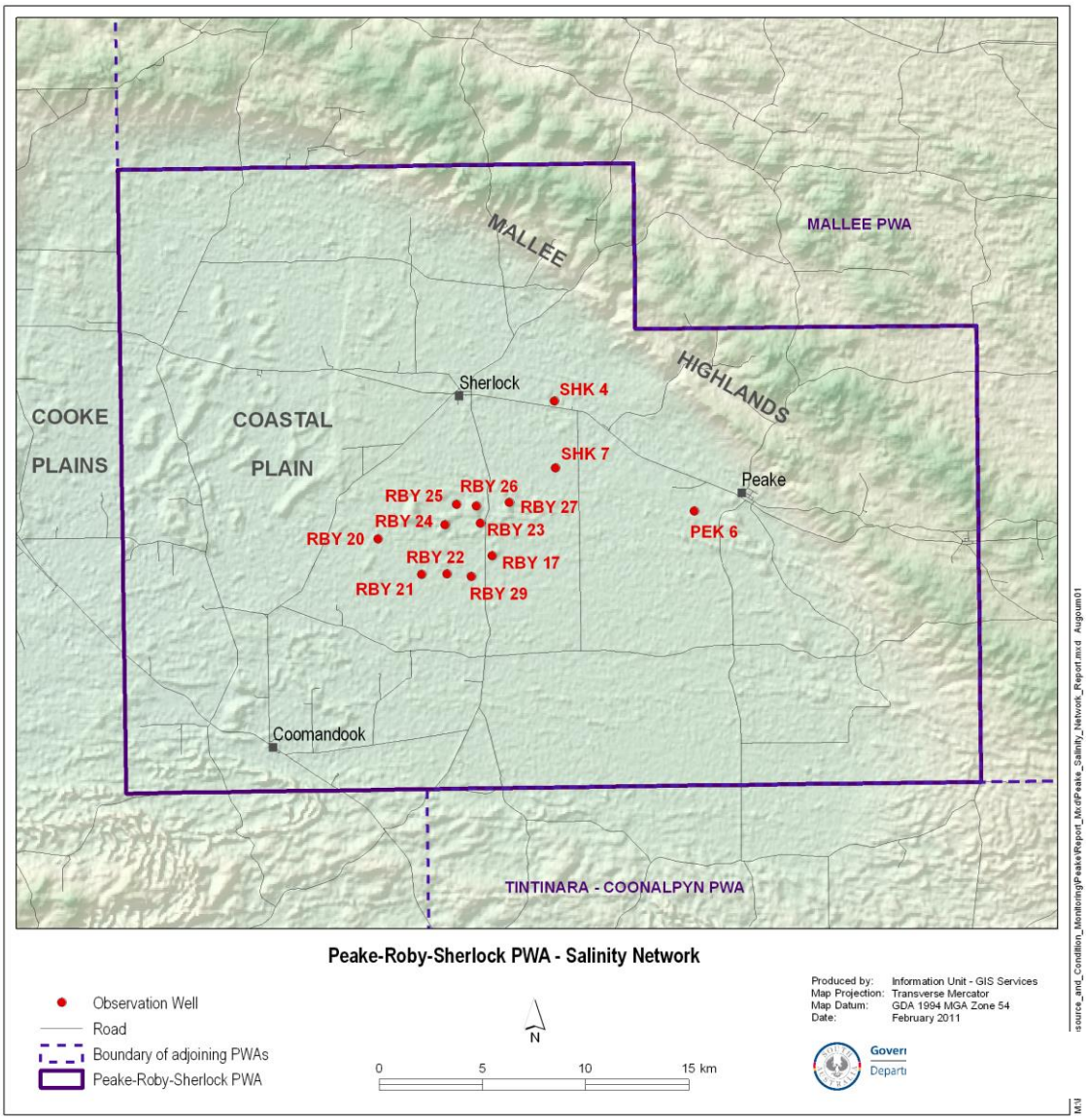

Figure 7. Location of groundwater salinity observation wells in the Peake, Roby and Sherlock PWA

Figure 11 presents the salinity trends from selected wells together with the salinity values at the time of drilling some years ago. The trends are predominantly stable, although the wells show some variability from year to year. There is no widespread gradual rising trend which would have been evident if flow reversal of more saline groundwater from the west was initiated. This is not surprising given the large drawdowns that could have caused flow reversal only existed for ten years.

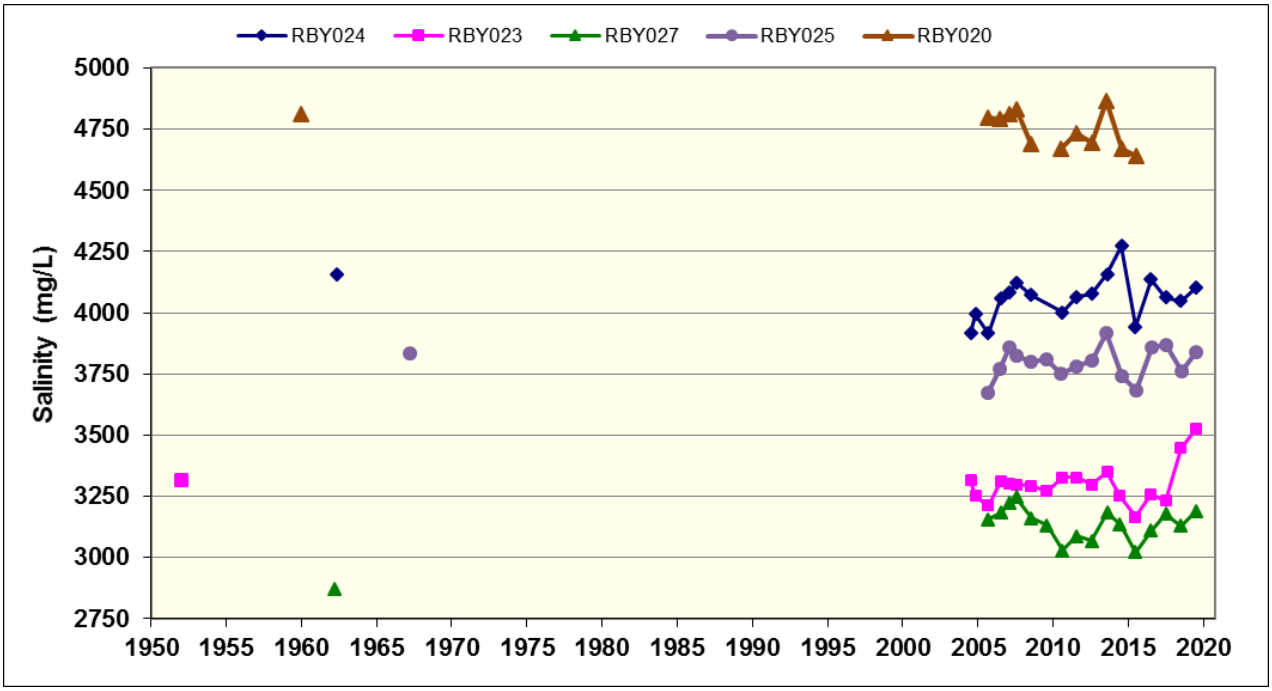

Figure 8. Groundwater salinity trends of the confined aquifer in the Peake, Roby and Sherlock PWA

6 Summary

The previous assessment of the groundwater resources of the Peake, Roby and Sherlock Prescribed Wells Area (Barnett and Yan, 2008) identified salinity increases due to potential groundwater flow reversal of saline groundwater in the west of area, to be the main sustainability risk for the resource. Salinity monitoring and the significant reduction in extraction indicate that this risk is now minimal and will remain so while the current extraction regime exists.

Since the adoption of the Water Allocation Plan (WAP), there have been no exceedances of any of the water level or salinity RCLs and there is little likelihood of any exceedances occurring in the near future because of the siginificant reduction in extractions. The current extraction limit was determined using a groundwater model that considered the salinity impacts of extraction and there is no evidence to suggest a change in the limit is required. The current management settings and extraction limits are considered to be appropriate.

The current monitoring regime provides sufficient data to satisfy the monitoring requirements of the WAP (Section 8.1). The monitoring trends observed within the Peake, Roby and Sherlock Prescribed Wells Area and the adjacent Mallee and the Tintinara Coonalpyn PWAs have not indicated any adverse impacts on the respective groundwater resources and consequently, no changes to Section 3 of the WAP (relating to impacts of using adjacent water resources) are required.

7 Recommendations

7.1 Resource condition limits

Section 5.3.4 of the WAP outlines water level resource condition indicators which if exceeded, trigger an investigation into the cause of the exceedance and to determine whether it is a threat to the condition of the resource. These limits were based on static water levels (SWL; being the depth below ground level) as listed in Table 3 in the WAP. However, some of the reduced standing water level (RSWL; being the height of water level above sea level) values in Table 3 do not correspond to the same SWL value due to incorrect or outdated surveys of the elevation of the observation well. Table 1 indicates the corrections (highlighted in yellow) that need to be made. To avoid confusion, consideration should be given to removing the RSWL values altogether from Table 3 in the WAP.

Table1. Corrections required for Table 3 in the WAP

Well	Maximum measured water level		Minimum measured water level	
	mAHD (RSWL)	SWL (m)	mAHD (RSWL)	SWL (m)
SHK004	2.0	12	-0.1	14.1
PEK007	5.3	15.4	-9.3	30
PEK005	5.4	13.1	0.4	18.1
RBY014	4.8	10.5	3.0	12.3
RBY017	4.6	16	1.6	19

With regard to the salinity condition limits, it is recommended that principle 8 iii be clarified by adopting the following wording (the changes are italicised):

> "the rolling three-year average of the maximum underground water salinity, measured by the Minister in at least 50% of the wells listed in Table 4, *to be* more than 5% *above the baseline salinity level listed for each well in Table 4*"

Under the provision of Section 5.3.4, principle 11 of the WAP, it is recommended that the following changes are made to the salinity indicator wells listed in Table 4 of the WAP:

1. The pump at RBY020 is no longer operational, and the well should be replaced with RBY034, with a baseline salinity level of 5100 mg/L.
2. The windmill at PEK006 is infrequently operational and water samples have been taken from a tank, which is not as reliable a sampling method as taking from an operating pump. The well should be replaced by the nearby SA Water town water supply bore PEK007, with a baseline salinity level of 1625 mg/L.

7.2 Monitoring requirements

It is recommended that the underground water level monitoring requirement in Table 6 in the WAP be changed from "monthly or at least every three months" to "at least six monthly" to reflect the current monitoring frequency which adequately fulfills the monitoring objectives outlined in Section 8.1 of the WAP.

It is recommended that the underground water salinity monitoring requirement in Table 6 in the WAP be changed from "six monthly" to "annual collection" to reflect the current monitoring frequency which adequately fulfills the monitoring objectives outlined in Section 8.1 of the WAP. Given the consistency in monitoring trends and the current very low risk to the resource, consideration should be given to reducing the salinity network from the current 13 wells to the five wells listed in the corrected Table 4 of the WAP. Monitoring of the 13 wells can be reinstated at any time if the risk to the resource increases due to increased extraction.

8 References

Barnett S, and Yan W, 2008. Assessment of the groundwater resource capacity of the Peake–Roby–Sherlock Prescribed Wells Area, DWLBC Report 2008/16, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide.

South Australian Murray-Darling Basin Natural Resources Management Board, 2012. The Water Allocation Plan for the Mallee Prescribed Wells Area. SAMDB NRM Board, Government of South Australia.