Government of South Australia
South Australian Murray-Darling Basin
Natural Resources Management Board

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Water Allocation Plan for the Peake, Roby and Sherlock Prescribed Wells Area

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Prepared by the South Australian Murray-Darling Basin Natural Resources Management Board

2010

Natural Resources Management Act 2004

Water Allocation Plan

for the

Peake, Roby and Sherlock Prescribed Wells Area

I, Paul Caica, Minister Environment and Conservation, hereby adopt this Water Allocation Plan pursuant to section 80(3)(a) of the Natural Resources Management Act 2004

Paul Caica
Minister for Environment and Conservation

Date: 02.03.11

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1 | Peake, Roby and Sherlock Prescribed Wells Area

The Peake, Roby and Sherlock Prescribed Wells Area (PWA) incorporates the underground water within the boundaries of the Hundreds of Peake, Roby and Sherlock. The Peake, Roby and Sherlock PWA is located within the South Australian Murray-Darling Basin Natural Resources Management Board's (the SA MDB NRM Board's) boundaries, approximately 140km south-east of Adelaide. The Peake, Roby and Sherlock PWA is bordered by the Tintinara Coonalpyn PWA to the south and the Mallee PWA to the east (Figure 1, GRO 21/2009). The area covers approximately 1,120km² and falls within the Murray-Darling Basin.

1.1 | Background to the Plan

On 11 March 2004, the Minister for Environment and Conservation declared a notice of intent to prescribe the wells in the Hundreds of Peake, Roby and Sherlock under the *Water Resources Act 1997*. This declaration followed concerns raised about the future sustainability of the underground water resource, with the development of underground water supplies for irrigation.

On 27 October 2005, the wells in the Hundreds of Peake, Roby and Sherlock were prescribed pursuant to section 125 of the *Natural Resources Management Act 2004* (NRM Act), which replaced the Water Resources Act.

The SA MDB NRM Board is required, under the NRM Act, to prepare a water allocation plan (the Plan) for the Peake, Roby and Sherlock PWA. The aim of the Plan is to ensure the sustainable use of the available underground water resources.

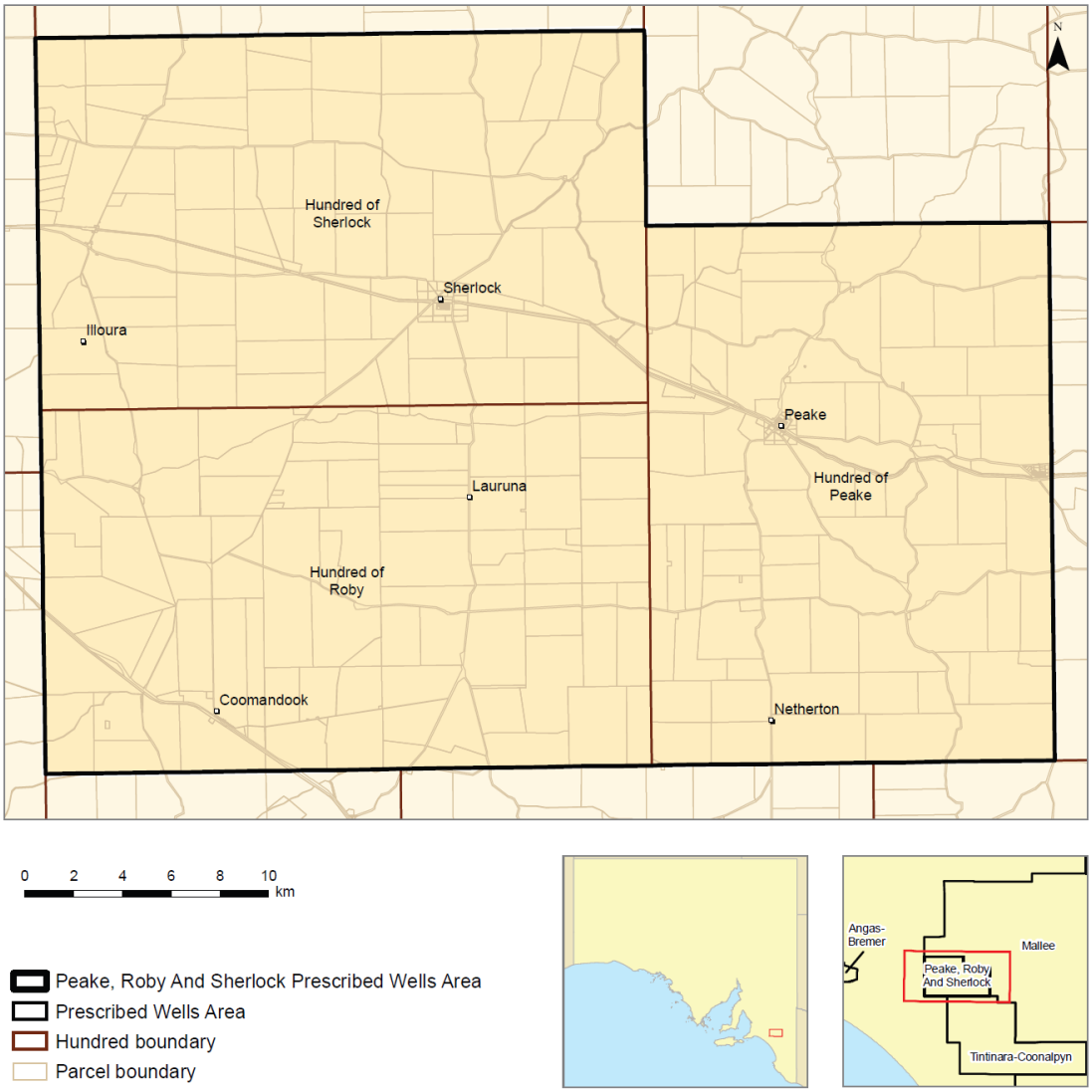
In accordance with section 78 of the NRM Act, the SA MDB NRM Board prepared a concept statement in November 2006. The concept statement proposed a scope for the Plan, and identified issues and topics for community discussion and consultation during the Plan’s development.

In addition to the statutory community consultation, a communication and consultation strategy was developed to ensure the relevant people and organisations were involved to develop, review, consider and advise on policy options.

Feedback on the concept statement from the community was taken into account during the development of this Plan.

Figure 1: Peake, Roby and Sherlock Prescribed Wells Area (GRO 21/2009)

Insets: Location in relation to South Australia; location in relation to the Tintinara Coonalpyn PWA and the Mallee PWA



1.2| Underground water systems

The Peake, Roby and Sherlock PWA is located within the Murray-Darling Basin, a large underground water basin which extends from the Mount Lofty Ranges and eastward to the Great Dividing Range. The Basin's profile consists of layers of sand, clay and limestone sediments.

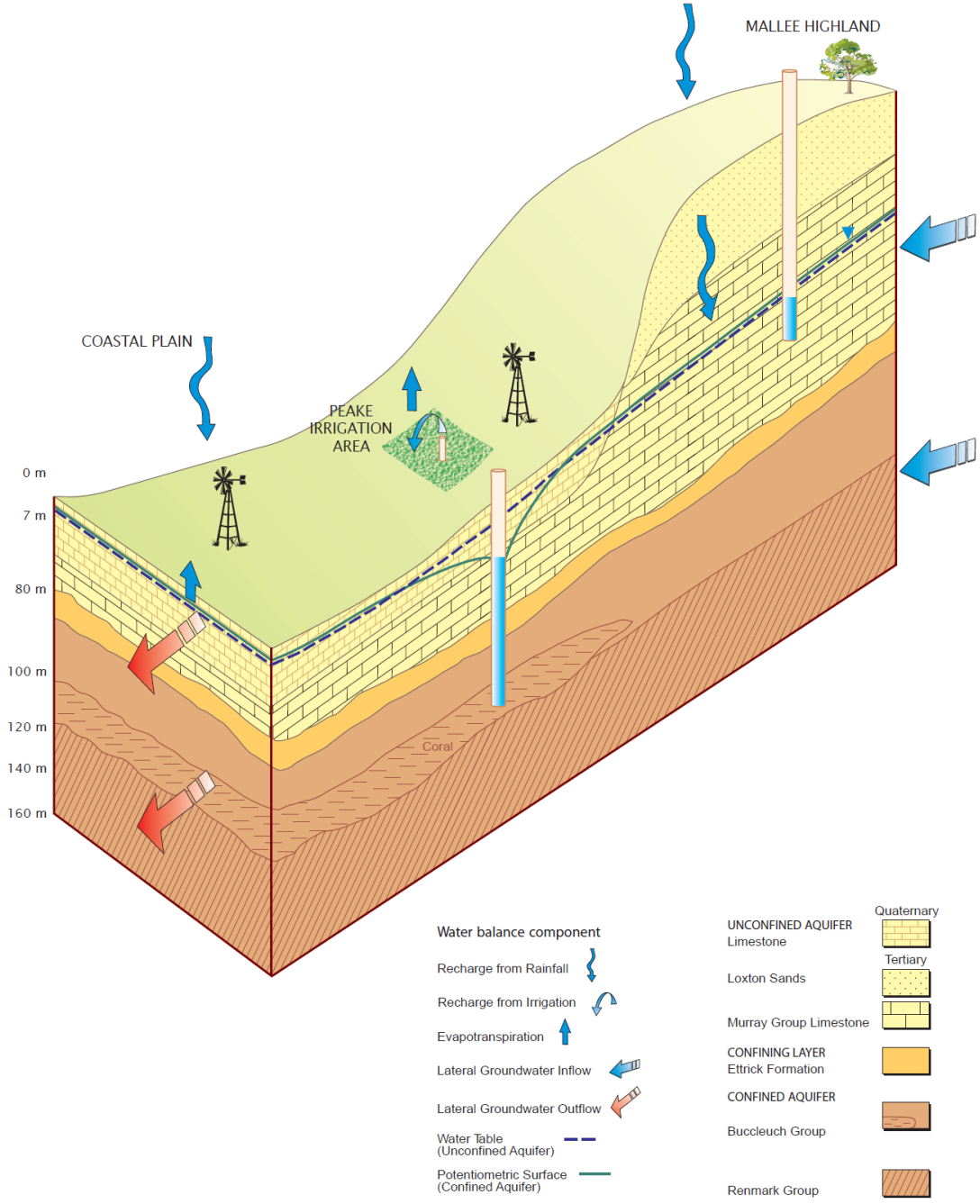
About one million years ago, a marine transgression extended from the coast as far inland as Keith, Tintinara and Peake and is marked by the scarp of the higher Mallee landscape referred to as the Mallee Highlands. This influx of the sea eroded away the Tertiary sands leaving a broad, flat low-lying area that is now referred to as the Coastal Plain.

The Peake, Roby and Sherlock PWA is underlain by two main aquifer systems from which underground water is extracted - a shallow Unconfined Aquifer and the underlying Confined Aquifer (Figure 2).

The Unconfined and Confined Aquifers are hydraulically separated by the Ettrick formation. This aquitard, or confining layer of low permeability, is approximately 20m thick and consists of dark-brown carbonaceous clay.

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

Note: Diagram not to scale.



1.2.1 | The Unconfined Aquifer

The Limestone Unconfined Aquifer extends across the entire PWA, and can be sub-divided into two regions: the Mallee Highland in the east and the Coastal Plain in the west (Figure 2). Beneath the Mallee Highland, the aquifer is contained within a calcareous sandstone and Tertiary limestone (approximately 30 million years old) and is known as the Murray Group Limestone Aquifer. The aquifer underlying the flat, low-lying Coastal Plain is contained within the Coomandook and Bridgewater Formations, composed of Quaternary limestone less than 1 million years old.

Recharge

The Unconfined Aquifer is recharged by the following two processes:

- locally recharged from rainfall which infiltrates directly into the aquifer through the soil profile
- recharged from lateral underground water flow through the aquifer system from the Mallee Highland.

The timing of the local vertical recharge varies with depth of underground water. Recharge can occur relatively quickly beneath the Coastal Plain, where the watertable averages 5m below ground level. However, beneath the Mallee Highland areas, where the watertable can be as deep as 50m, rainfall recharge could take several decades to reach the watertable.

Salinity

In the Unconfined Aquifer, high underground water salinities in excess of 15,000 milligrams per litre (mg/L) total dissolved solids (TDS) exist below the Coastal Plain. The underground water occurs at shallow depth ranging between 3–8m below ground level. The high salinity of this underground water makes it unsuitable for general use. Beneath the Mallee Highlands, where the underground water occurs at a depth of about 40–50m below ground level, low-salinity underground water (around 2,000 to 3,000 mg/L TDS) is used for irrigation, stock and domestic purposes (Figure 5).

1.2.2 | The Confined Aquifer

The Confined Aquifer lies underneath the Unconfined Aquifer and contains the Buccleuch Formation (known locally as 'coral'). On the Coastal Plain, most underground water for irrigation, stock and domestic purposes is extracted from this formation.

The Buccleuch Formation sits above the Renmark Group (Figure 2), and is composed of consolidated bryozoal limestone that lies at depths of about 90–100m below the Coastal Plain. The thickness varies, and local experience is that this formation is not laterally extensive. In the Peake area, this layer begins to merge laterally to the east with the more extensive Renmark Group Formation, characterised by interbedded sands and clays.

Recharge and discharge

The Confined Aquifer is recharged by lateral flow of underground water. This water originates in south-western Victoria and flows slowly beneath the Mallee from east to west. It passes beneath the Peake, Roby and Sherlock PWA as it flows towards the River Murray, where it is ultimately discharged (Figure 3).

Underground water extraction for irrigation in the Hundred of Peake has caused the development of localised drawdown in underground water levels, referred to as a cone of depression (Figure 4). The occurrence of the cone of depression, as determined from available time series data from 2002 to 2009, has changed the local underground water flow direction in the Peake, Roby and Sherlock PWA so that a component of the flow has reversed direction moving towards the Peake pumping centre. This has also led to an increase in the rate of lateral in-flow of underground water to the Hundred of Peake.

Salinity

In the Confined Aquifer, low levels of underground water salinity under the Hundred of Peake (1,500– 3,000mg/L TDS) makes it suitable for stock, domestic and irrigation use. Salinity increases in concentration towards the west, and is greater than 7,000 mg/L TDS at the western boundary of the Peake, Roby and Sherlock PWA (Figure 5).

1.3 | Nature and volume of underground water extraction

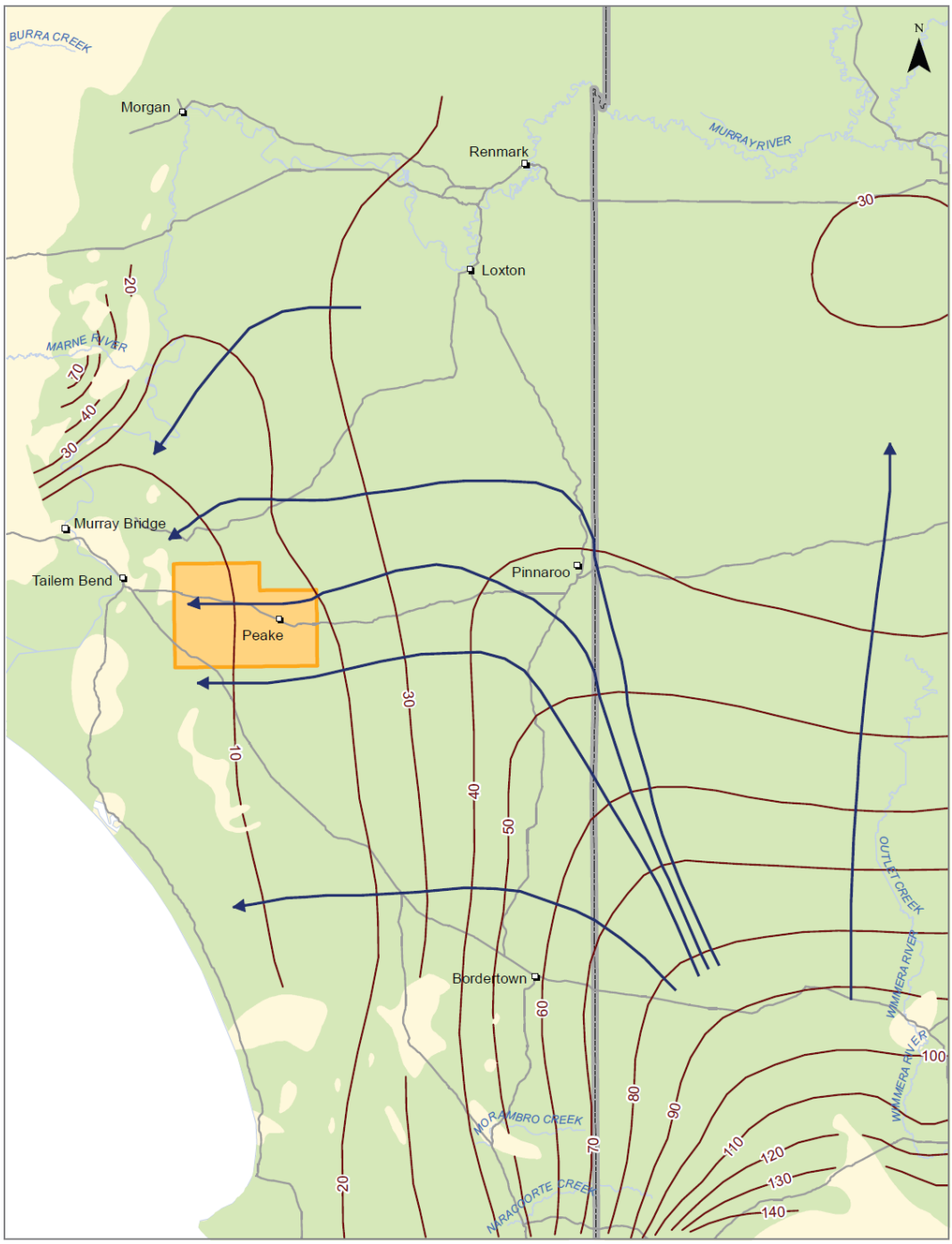
Underground water extraction in the Peake, Roby and Sherlock PWA has historically been limited to minor extraction for stock, domestic and town water supply purposes. However, since 2004, underground water development has expanded for the irrigation of agricultural and horticultural products, which include cereal, hay, pasture, olives and, recently, pistachios. The total metered underground water extraction in the Peake, Roby and Sherlock PWA for the 2008/09 water use year was approximately 1,975.4 megalitres (ML). Stock and domestic use is not metered. A summary of metered extraction is shown in Table 1.

Table 1: Summary of metered extraction

		Metered Extraction (ML/year)			
Hundred	Aquifer	2005/06*	2006/07	2007/08	2008/09
Peake	Confined	1,206.9	1,308.5	1,538.0	1,829.6
	Unconfined	2.1	27.5	2.0††	1.2††
Roby	Confined	0.0†	108.9†	56.9†	144.6†
Sherlock	Confined	0.0†	0.0†	0.0†	0.0†
Total extractions for PWA		**1,209.0**	**1,444.9**	**1,596.9**	**1,975.4**

*Not all meters were installed for the full water use year.
Volumes were estimated based on crop use and crop area
†† Not all meters were installed
† No metered extraction from the Unconfined Aquifer

Figure 3: Underground water level and flow direction in the Renmark Group aquifer



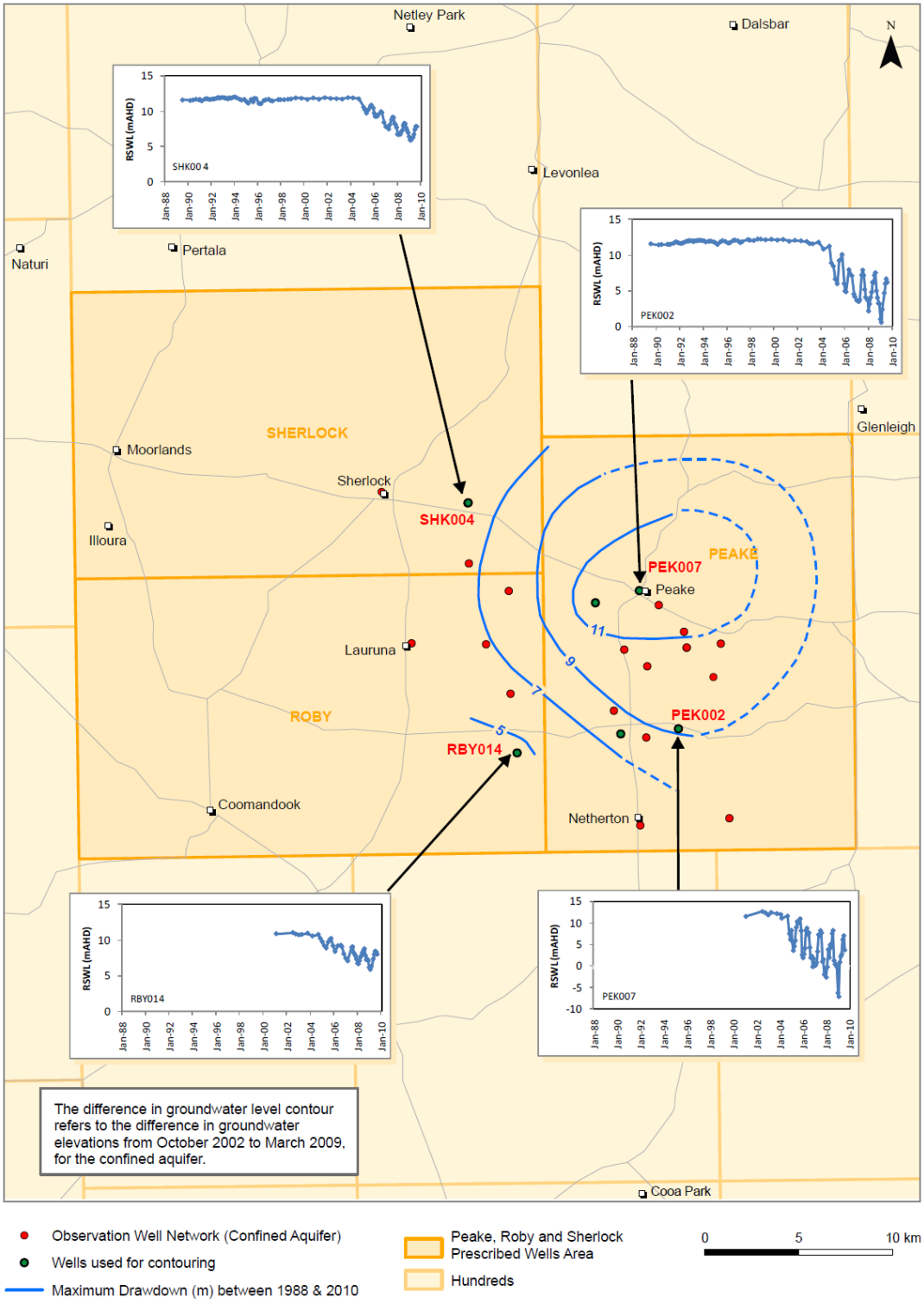
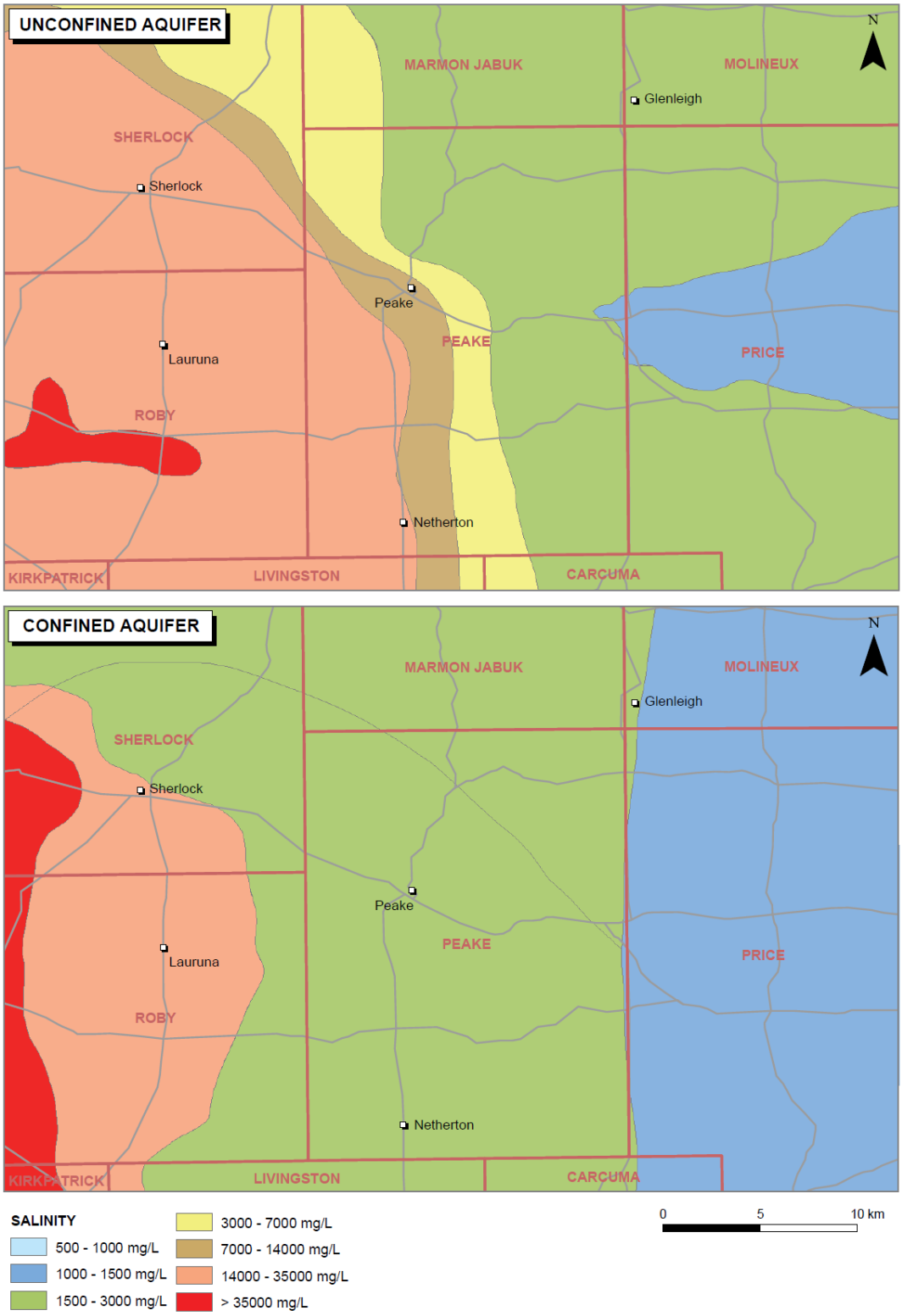


Figure 4: Underground water level trends in the Peake, Roby and Sherlock PWA

Figure 5: Salinity distribution in the Unconfined and Confined Aquifers in the Peake, Roby and Sherlock PWA



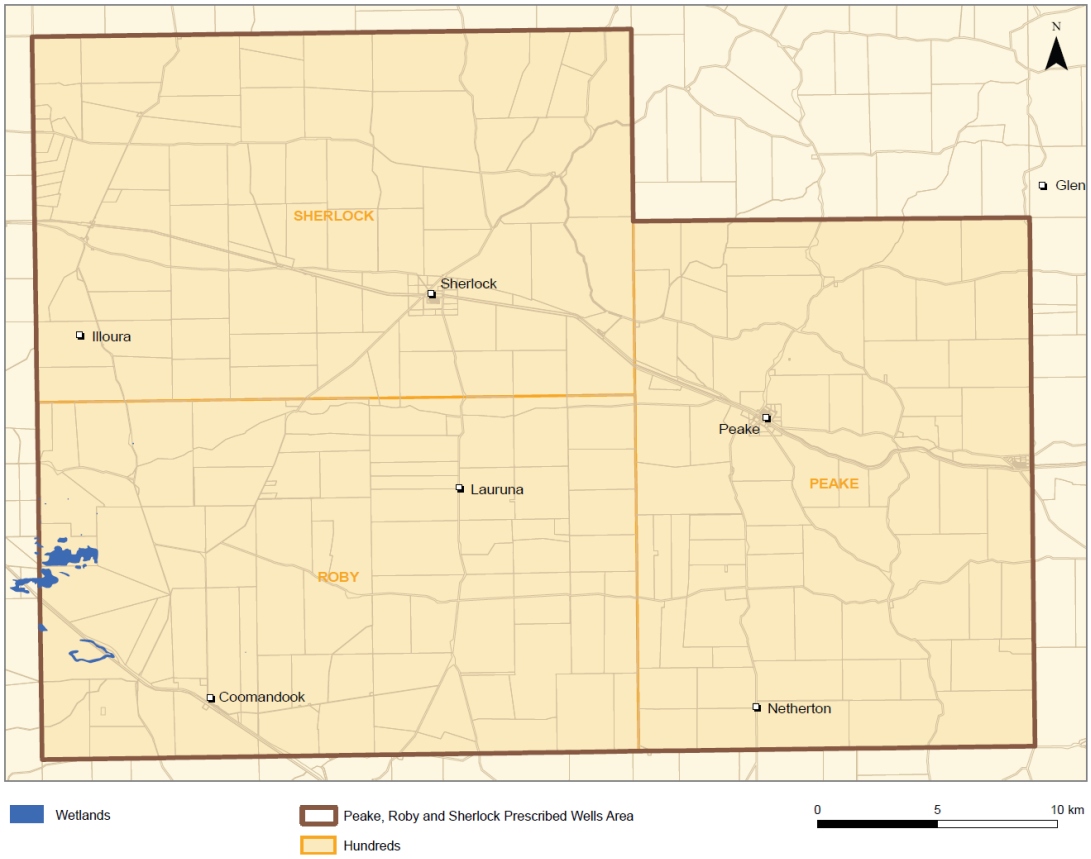
2 | Assessment of the needs of underground water dependent ecosystems

The requirements of underground water dependent ecosystems in the Peake, Roby and Sherlock PWA must be assessed in accordance with section 76(4)(a) (i) of the NRM Act.

Underground water dependent ecosystems have adapted to a particular quality and quantity of underground water and to receiving it in a particular annual and inter-annual pattern. Changes in the quality and availability of underground water may affect water dependent ecosystems. There are no known underground water dependent ecosystems in the Confined Aquifer.

Saline wetlands have been identified in the Coastal Plain region of the Peake, Roby and Sherlock PWA that are likely to be hydraulically connected to the saline Unconfined Aquifer. These are shown in Figure 6 (GRO 19/2009). There is currently little known of the value of the wetlands and their level of dependence on underground water. Given the limited potential for taking of the saline underground water it is considered that, during the life of this Plan, the level of risk to the wetlands from extraction activity is low.

Figure 6: Peake, Roby and Sherlock Prescribed Wells Area – Areas of ecosystems dependant on groundwater (GRO 19/2009)



3 | Assessment of the effects on other water resources

Section 76(4)(a)(ii) of the NRM Act requires an assessment of the potential effect of this Plan on other water resources.

The assessments of the effect on other water resources were considered for the following situations:

- the impact that taking underground water from both the Unconfined and Confined Aquifers may have on each aquifer
- the impact that taking underground water from both the Unconfined and Confined Aquifers may have on adjacent water resources, prescribed or not
- the impact that taking underground water from adjacent water resources (prescribed or not), may have on the water resources of the Peake, Roby and Sherlock PWA.

In cases where the potential effect of taking underground water is not anticipated, or unlikely to have a significant impact in these situations, monitoring and evaluation will enable a periodic review of the resource condition to identify any unforeseeable impacts throughout the life of the Plan.

3.1 | Impacts of taking from the Unconfined Aquifer

3.1.1 | Confined Aquifer

The low permeability confining layer (Ettrick formation) (Figure 2) hydraulically separates the Unconfined and Confined Aquifers restricting inter-aquifer leakage. An analysis comparing hydrographs from two monitoring wells drilled at the same site, one completed in the Unconfined Aquifer (PEK003) and the other in the Confined Aquifer (PEK002) (Figure 7), indicates that at the 2006/07 rate of taking underground water, there is no significant impact on the Confined Aquifer as a result of extraction from the Unconfined Aquifer. This suggests that the degree of hydraulic connection between the Unconfined and Confined Aquifers is low. The effects on the salinity and the structural integrity of the aquifer are discussed in section 4.3.2 of this Plan.

Taking underground water from the Unconfined Aquifer is unlikely to have a significant impact on the Confined Aquifer.

3.1.2 | Adjacent water resources

There is no evidence that taking underground water from the Unconfined Aquifer within the Peake, Roby and Sherlock PWA will have any impact on adjacent water resources in the Mallee and Tintinara Coonalpyn PWAs.

The long-term effect of taking underground water from the Unconfined Aquifer is unlikely to have a significant impact on adjacent water resources.

3.2 | Impacts of taking from the Confined Aquifer

3.2.1 | Unconfined Aquifer

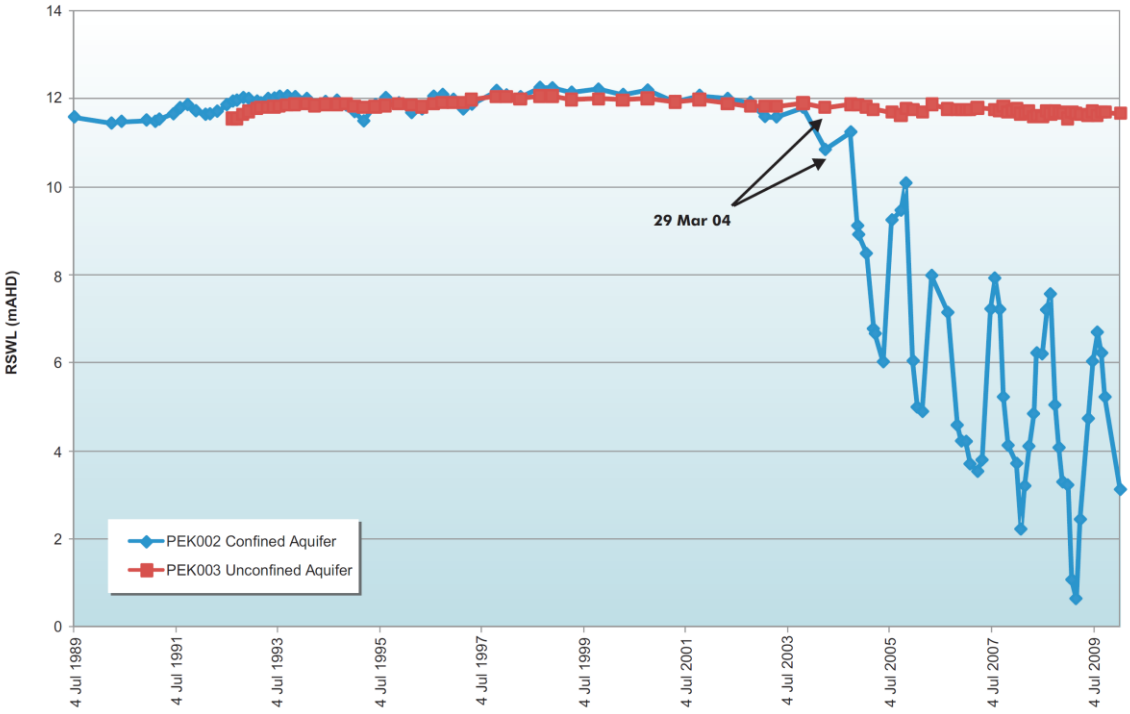
Hydrographs from observation wells indicate that the taking of underground water from the Confined Aquifer at 2006/07 rates does not significantly impact on the Unconfined Aquifer (Figure 7) due to the restriction of inter-aquifer leakage through the separating confining layer.

Taking underground water from the Confined Aquifer is not likely to have a significant long-term impact on the Unconfined Aquifer.

3.2.2 | Adjacent water resources

There is no evidence that any drawdown impacts to the south, in the Tintinara Coonalpyn PWA, can be directly attributed to extractions in the Peake, Roby and Sherlock PWA. There are no irrigation activities or observation wells in the Mallee PWA close enough to the Peake, Roby and Sherlock PWA to cause or detect any impacts.

The long term effect of taking underground water from the Confined Aquifer is unlikely to have a significant impact on adjacent water resources.



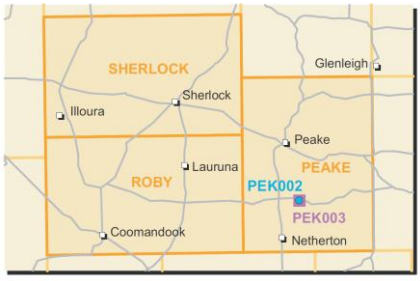


Figure 7:
Hydrographs for monitoring wells completed in the Confined and Unconfined Aquifer at a paired site

see insert for location of paired site

3.3 | Impacts of using adjacent water resources

3.3.1 | Unconfined Aquifer

It is possible that if future extractions in the Mallee and Tintinara Coonalpyn PWAs are concentrated close to the Peake, Roby and Sherlock PWA boundaries, in the east and south respectively, there may be drawdown impacts in the Unconfined Aquifer.

Policies within the Water Allocation Plans for the Mallee and the Tintinara Coonalpyn PWAs seek to minimise concentration of the taking of underground water and therefore impacts from taking are unlikely to occur in the short term.

3.3.2 | Confined Aquifer

Drawdown impacts caused by the taking of underground water from the Confined Aquifer licensed in the Tintinara Coonalpyn PWA may have the potential to extend as far north as the southern boundary of the Peake, Roby and Sherlock PWA. However, policies within the Water Allocation Plan for the Tintinara Coonalpyn PWA seek to minimise concentration of the taking of underground water and therefore, impacts from taking are unlikely to occur in the short term.

Historically there has been no taking of underground water from the Confined Aquifer in the western region of Mallee PWA.

Taking underground water from the adjacent water resources is unlikely to have a significant impact on the Confined Aquifer in the Peake, Roby and Sherlock PWA.

3.4 | Impacts on the River Murray

Although the underground water from the Confined Aquifer travels toward and discharges into the River Murray Prescribed Watercourse, the rate of movement is slow, taking thousands of years. The potential effect of taking underground water from the Confined Aquifer is unlikely to have a significant impact on the River Murray.

4 | Assessment of the capacity of the resource to meet demands

Section 76(4)(d) of the NRM Act requires the Plan to contain an assessment of the capacity of the resource to meet the demand for water on a continuing basis and to provide for regular monitoring of that capacity.

4.1 | Trends in underground water levels

Increased extraction in 2004 caused water levels in the Confined Aquifer to decline, creating a localised cone of depression in an area surrounding the Peake township and altering the underground water flow direction.

Figure 4 highlights the difference in underground water pressure levels in the Confined Aquifer between October 2002 (prior to irrigation expansion) and March 2009. The data displayed in the hydrographs are from observation wells PEK002 and PEK007 situated close to the Peake township, and RBY014 and SHK004 approximately 10km from the Peake township.

The hydrographs show large seasonal variations in underground potentiometric surface levels and a fall in the recovered underground water pressure levels between 2003 and 2006. The recovered underground potentiometric surface level in July 2007 was similar to recovered levels in May 2006 in observation wells PEK002 and PEK007 and later in August 2006 and 2007 in observation wells SHK004 and RBY014. This characteristic suggested stabilisation of underground potentiometric surface levels (i.e. the effects of underground water extraction in the irrigation season and recovery in the winter are beginning to reach equilibrium). However, increases in underground water use in the 2008/09 water use year resulted in further declines in the maximum recovered underground water level relative to previous years. The amount to be allocated will be less than used in 2008/09 so underground potentiometric surface levels will reach a new equilibrium.

4.2 | Present and future needs of water users

Section 76(4)(c) of the NRM Act requires that the Plan must take into account the present and future needs of the occupiers of land in relation to existing requirements and future capacity of the land and the likely effect of those provisions on the value of the land.

Underground water use in the Peake, Roby and Sherlock PWA includes irrigation for horticultural production, town water supply, commercial/industrial use, and recreational use as well as stock and domestic use. Table 1 indicates metered extraction volumes for the 2005/06, 2006/07, 2007/08 and 2008/09 water use years.

Stock and domestic underground water use is not required to be licensed in the Peake, Roby and Sherlock PWA and actual use for this purpose is currently unknown. An estimated annual volume for stock and domestic use of 600 ML (190 ML in the Unconfined Aquifer and 410 ML in the Confined Aquifer) was set aside when establishing the annual allocation volumes. Stock and domestic allocations were estimated at 2 ML/year for each active well.

The use of water for stock and domestic purposes is expected to remain stable. Irrigation for horticulture will continue to place the greatest demands on the underground water resource, particularly within the Hundred of Peake. However, the associated drawdown in underground water pressure level may impact stock and domestic users. Excessive taking of underground water from the Confined Aquifer may increase the rate of movement of saline underground water from west to east, towards the township of Peake.

The Peake town water supply, which is operated and maintained by the Coorong District Council, currently uses approximately 10 ML/year of underground water. It is anticipated that the future usage of the town water supply will increase to 12 ML/year.

There will be short-term fluctuations in demand largely linked to variations in climate, horticultural markets and changes to land use.

Imported water is used in the Peake, Roby and Sherlock PWA through the Tailem Bend Pipeline from the River Murray. This water is used for stock and domestic purposes and future demand is expected to remain stable.

Aboriginal business and cultural needs
The traditional owners of the land in the Peake, Roby and Sherlock PWA are the first Peoples of the River Murray & Mallee Region.

Access to, and use of water from prescribed water resources by Aboriginal people is exempt from licensing for the purpose of social, cultural or spiritual use, provided 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 water resources.

The current and future Aboriginal needs for water have not been identified or quantified at this time. The SA MDB NRM Board will be working with the first Peoples of the River Murray and Mallee Region and other Aboriginal groups that assert an interest in the area to identify and quantify these needs.

4.3 | Capacity of the resource to meet demand

4.3.1 | Unconfined Aquifer

Coastal Plain
The salinity of the underground water in the Coastal Plain High Salinity Management Zone is too high for agricultural production and therefore is not currently being utilised. The Annual Allocation Volume has been assessed to be 2,000 ML/year. The potential allocation of this volume allows for future industries such as underground water desalination and aquaculture, and provides for environmental needs of underground water dependent ecosystems. Extraction at 2,000 ML/year is not expected to cause adverse impacts to the underground water resource, or the limited users of that resource.

Mallee Highland
The Mallee Highland Management Zone is located within the Murray Group Limestone. Although this is a Confined Aquifer in the Mallee PWA, it becomes unconfined in the Peake, Roby and Sherlock PWA and is the same underground water resource. The Annual Allocation Volume has been assessed to be 1,215 ML/year. Extraction at 1,215 ML/year is not expected to cause adverse impacts to the underground water resource.

4.3.2 | Confined Aquifer

The capacity of the resource within the Confined Aquifer is limited by the potential for damage to the aquifer by excessive reduction in underground water pressure levels. The Confined Aquifer can be damaged in either or both of the following two ways:

- collapse of the overlying confining layer
- increase in underground water salinity.

The Confined Aquifer can be irreversibly damaged if extraction becomes too excessive and underground water pressure levels are lowered below the overlying confining layer, causing depressurisation. This process can result in the fracturing of the confining layer and consolidation of the sands in the Confined Aquifer. The resultant damage will cause downward leakage of higher salinity underground water from the overlying Unconfined Aquifer and yield reduction. For depressurisation to occur in the Peake, Roby and Sherlock PWA, drawdowns in underground water pressure levels from pre-irrigation levels would need to be beyond 75m.

An increase in underground water salinity can also cause damage to the aquifer. Prior to irrigation, underground water flowed from a region of low salinity in the east to one of high salinity in the west. Underground water pressure level decline caused by extraction within the Hundred of Peake has influenced the local underground water flow direction. Components of flow have reversed direction by moving toward the pumping centre from the south, west and northwest. Flow reversal from the west has the potential to damage the Confined Aquifer by inducing the movement of higher salinity water towards areas of low salinity in the east (Figure 5). The rate of underground water movement depends on the magnitude of the water pressure level decline, which is determined by the rate of extraction.

The capacity of the Confined Aquifer has been assessed to be 2,168 ML/year. The potential effects that extraction from the Confined Aquifer has in relation to collapse of the overlying confining layer, and potential effects on underground water salinity, have been taken into account in setting the Annual Allocation Volume. Extraction at 2,168 ML/year is not expected to cause adverse impacts to the Confined Aquifer underground water resource.

4.4 | Climate change

Climate change presents a significant challenge to South Australia. The effects of climate change are not yet clearly understood and therefore predicting the consequences of climate change on water demand is difficult. The predicted increase in temperatures, together with predictions of low frequency and high intensity rainfall, is likely to lead to an increased demand for water and an associated increased length of irrigation seasons, potentially placing additional demand on underground water.

It is critical that water policy decision makers apply effective risk and adaptive management strategies and planning. Underground water resource condition thresholds for both water level and salinity will enable adaptive management in the event that climate change has an unforeseen adverse impact on the resource. Therefore, ongoing monitoring and technical investigations during the life of this Plan will be critical to reviewing the future sustainability of the underground water resource.

Management may lead to a change in planting seasons for annual crops to adjust and utilise the change in rainfall pattern. There may also be a demand for alternative crops to suit the climatic conditions (including increase in resilience to disease, heat tolerance, and lower water use requirements). The intense rainfall events may assist in leaching salt loads from the crop root zones, which will be a benefit to irrigated crops where increasing salt loads from irrigated soils may become an issue. However, this could also increase the salinity of underground water.

5 | Water allocation criteria

Section 76(4) of the NRM Act requires that the Plan:

- provides for the allocation and use of water so that an equitable balance is achieved between environmental, social and economic needs for the water and the rate of use of the water is sustainable
- takes into account, in providing for the allocation of water, the present and future needs of the occupiers of land in relation to the existing requirements and future capacity of the land and the likely effect of those provisions on the value of the land.

5.1 | Interpretation and definitions

Any terms used in this Plan that are defined in the NRM Act have the definitions set out in that Act, except for those set out in the Glossary of this Plan.

5.2 | Objectives

The objectives of the Plan are to:

- manage the underground water resource of the Unconfined and Confined Aquifers so that they may continue to be available for the social, economic and environmental needs of current and future generations
- provide flexibility in the way in which underground water resources are managed
- maintain reasonable ability to access water in the Peake, Roby and Sherlock PWA
- ensure there are no unacceptable impacts on the underground water resource or the productive capacity of land from the taking and use of water
- promote efficient use of water.

5.3 | Principles

The following principles relate to water allocation in the Peake, Roby and Sherlock PWA.

5.3.1 | Basis of allocation

1. Water shall be allocated from two management zones of the Unconfined Aquifer, and from four management zones of the Confined Aquifer (Table 2). The location of the management zones is shown in Figures 8a (GRO 20/2009) and 8b (GRO 17/2009).

2. Water shall be allocated by volume.

3. Water shall not be allocated within one kilometre of an ecosystem dependent on underground water shown in Figure 6 (GRO 19/2009).

5.3.2 | Volume available for allocation

4. The total maximum Annual Allocation Volume of underground water from the Peake, Roby and Sherlock PWA is 5,383 ML/year.

5. The Annual Allocation Volume of underground water allocated for use in each management zone is shown in Table 2.

6. Water allocations shall be made in accordance with principles 7 to 12.

Table 2: Aquifer management zones and related Annual Allocation Volume

Aquifer	Zones	Annual Allocation Volume (ML)
Confined Aquifer	Coastal Plain High Salinity Management Zone	100
	Coastal Plain Medium Salinity Management Zone	250
	Coastal Plain General Management Zone	100
	Extraction Management Zone	1,718
Unconfined Aquifer	Coastal Plain High Salinity Management Zone	2,000
	Mallee Highland Management Zone	1,215
Total		5,383

5.3.3 | Effects of water use on the productive capacity of the land

7. The take and use of the allocation shall not cause degradation of the land on which the allocation is used, by way of increased soil salinity, soil erosion, perched watertables, or any other means having a negative impact on the productive capacity of the land.

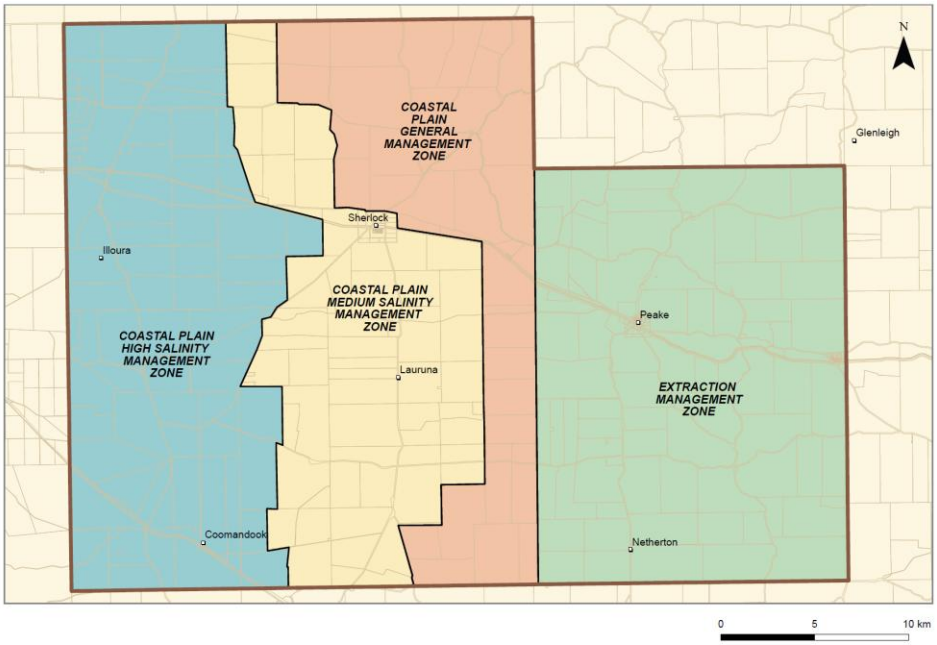


Figure 8a: Management zone boundaries of the Confined Aquifer (GRO 20/2009)

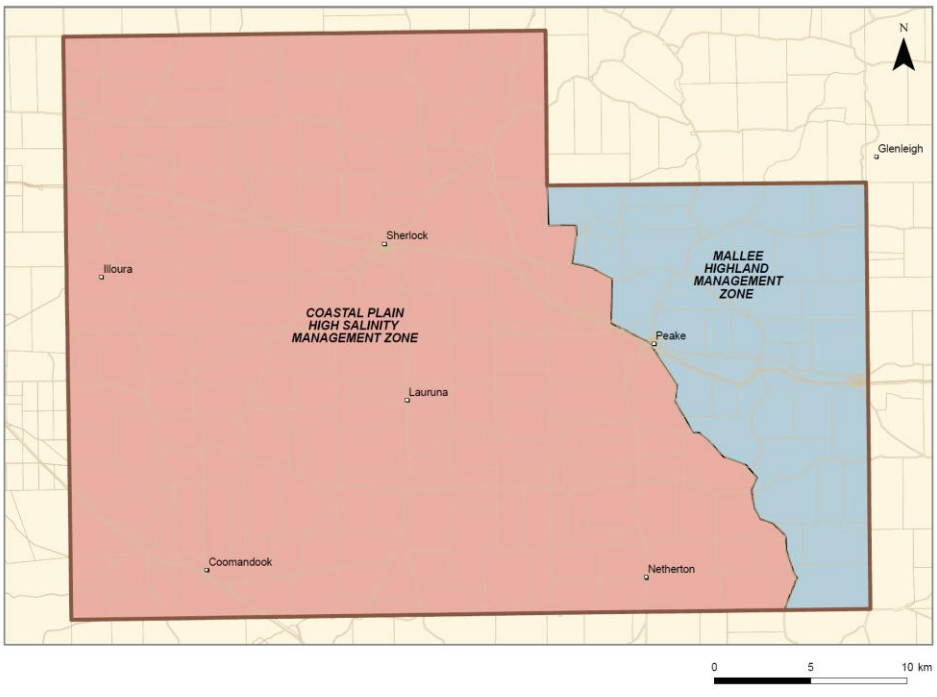


Figure 8b: Management zone boundaries of the Unconfined Aquifer (GRO 17/2009)

5.3.4 | Effects of water taking on the underground water resource

8. The taking of underground water must not cause or have the potential to cause:

   i. adverse changes to the structural integrity of the aquifers and aquitards including, but not limited to, dewatering the aquitard that lies between the Unconfined and Confined Aquifers
   ii. the rolling three-year average of the annual maximum or minimum measured water level elevations, measured by the Minister in at least 50% of the wells listed in Table 3 and shown on Figure 9 (GRO 18/2009), to fall below the maximum or minimum water elevation thresholds listed in Table 3
   iii. 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 rise by more than 5%

   then the consequences set out in principle 29 will apply.

9. For the purposes of principle 8(ii):

   i. the annual maximum underground water elevation is the highest underground water elevation measured in a calendar year
   ii. the annual minimum underground water elevation is the lowest water level measured in a calendar year.

10. For the purposes of principle 8(iii), the annual maximum underground water salinity is the highest underground water salinity measured in each calendar year.

11. Should a well listed in Table 3 or Table 4 become inoperable for underground water level and/or salinity measurements for the purpose of principle 8 (that is samples are not representative of regional underground water conditions and/or the well(s) water column cannot be accessed) the Minister may select suitable replacement well(s).

Table 3

Underground water level observation wells, threshold water levels and corresponding static water levels				
Well	Maximum measured water level elevation		Minimum measured water level elevation	
	mAHD*	SWL(m)**	mAHD*	SWL(m)**
SHK004	6.5	12	4.4	14.1
PEK007	5.3	15.4	10.0	30.0
PEK005	5.4	13.1	0.4	18.1
RBY014	5.0	10.5	3.2	12.3
RBY017	4.7	16.0	1.7	19.0

**mAHD stands for 'metres above the Australian Height Datum (AHD)*
AHD is approximately mean sea level
***SWL stands for 'static (or standing) water level', or the distance from ground surface to the static water level*

Table 4

Underground water salinity observation wells and corresponding baseline salinity levels	
Well	Baseline salinity levels (mg/L)
PEK006	1980
RBY017	3570
RBY020	4740
RBY024	4023
RBY027	3194

5.3.5 | New allocations

12. If there is water available within the Annual Allocation Volumes of the respective management zones, payment will be required for new allocations in accordance with section 147(2) of the NRM Act.

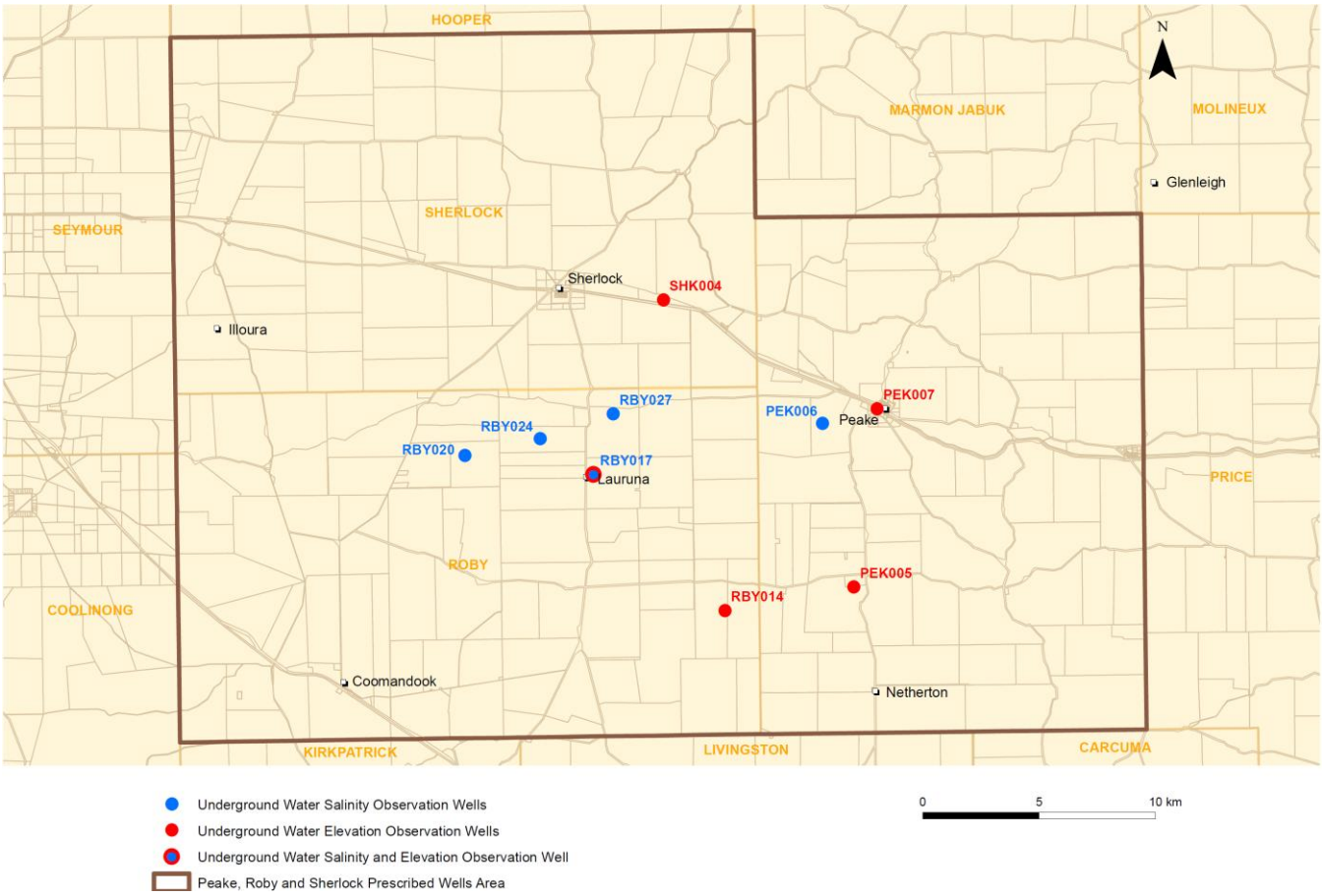


Figure 9 Location of observation wells measuring threshold limits (GRO 18/2009)

5.3.6 | Divided allotments

13. Where two or more adjoining allotments are held by the same owner, and are divided by a management zone, and the water allocation is held in only one of the management zones, the water allocation may be taken and used anywhere within the allotment(s) provided that:

i. the taking and use of water meets the requirements of principles 1–12
ii. the point of taking does not move more than two kilometres into the Confined Aquifer Extraction Management Zone or more than two kilometres into the Unconfined Aquifer Mallee Highland Management Zone.

6 | Transfer criteria

6.1 | Objectives

The objectives for the transfer of licences and allocations in the Peake, Roby and Sherlock PWA are to:

- manage the impact of taking underground water by preventing transfer of an allocation to high use areas
- maintain the integrity of the aquifers
- protect the resource locally, throughout each management area and the entire Peake, Roby and Sherlock PWA
- promote the efficient and sustainable use of underground water resources.
- ensure that the taking of underground water from the proposed new point of taking does not have the potential to:
    - increase the stress in the aquifer (relative to the original point of taking)
    - adversely impact on the structural integrity of the aquifers and aquitards
    - adversely impact on the quantity and quality of underground water in the aquifer
    - detrimentally affect the ability of other persons to lawfully take from the underground water
    - detrimentally affect any ecosystems that depend on the underground water
    - detrimentally affect the productive capacity of the land

6.2 | Principles

All transfers of water allocations are subject to the allocation principles set out in section 5 of the Plan. Principles that relate to the transfer of licences and allocations in the Peake, Roby and Sherlock PWA are listed below:

14. Permanent and/or temporary transfers of allocations shall be permitted within, and between, management zones as specified in Table 5 and subject to principles 15–21.

15. The transfer of water into any management zone shall not cause the Annual Allocated Volumes to be exceeded as listed in Table 2.

16. In the case of a temporary transfer, the allocation shall be accounted for in both the originating and receiving management zones. A permanent transfer of water will allow for new allocations to become available within the respective zones' Annual Allocation Volume limit.

17. A water allocation shall not be transferred for any purpose where the proposed point of extraction is within a one kilometre radius of a well completed within the same aquifer that is:

    a. endorsed on a licence; or
    b. used as a source of domestic water; or
    c. used as a source of stock water

    unless the transferee has lawful access to the well(s).

18. A water allocation within the Coastal Plain High Salinity Management Zone shall not be transferred to a well which is within one kilometre of an ecosystem dependent on underground water.

6.2.1 | Extraction Management Zone

19. Transfers of allocations within the Confined Aquifer Extraction Management Zone shall not be permitted where the transferred allocation is from an area of higher underground water level to an area of lower underground water level unless the proponent can provide hydrogeological evidence to the satisfaction of the Minister, demonstrating that any negative impact on the underground water resource is acceptable.

20. For the purpose of principle 19, the underground water level is that water level measured immediately following the completion of the previous irrigation season (generally April/May). The Minister's Department will measure the underground water levels.

6.2.2 | Transfers where the point of extraction does not change

21. Principles 14–20 do not apply to the transfer of underground water allocations where there is no change to the location of the point of taking, the volume of water allocated or the conditions on the licence.

6.2.3 | Exceptions

22. Notwithstanding principles 14–21, the transfer of water may be approved where the proponent can demonstrate to the satisfaction of the Minister that the taking of underground water from the new point of taking, has no potential to interfere with the quality and quantity of water supply from existing wells operated by other licensees or stock and domestic users, or for ecosystems dependant on underground water.

Table 5: Principles for the permanent and temporary transfer of licences and/or allocations between management zones

		Transfer to					
		Unconfined Aquifer		Confined Aquifer			
	Management zone	Mallee Highland	Coastal Plain High Salinity	Coastal Plain High Salinity	Coastal Plain Medium Salinity	Extraction	Coastal Plain General
Transfer from: Unconfined Aquifer	Mallee Highland	Transfer within area permitted	Permitted	Permitted	Not permitted	Not permitted	Not permitted
Transfer from: Unconfined Aquifer	Coastal Plain High Salinity	Not permitted	Transfer within area permitted	Not permitted	Not permitted	Not permitted	Not permitted
Transfer from: Confined Aquifer	Coastal Plain High Salinity	Not permitted	Not permitted	Transfer within area permitted	Not permitted	Not permitted	Not permitted
Transfer from: Confined Aquifer	Coastal Plain Medium Salinity	Not permitted	Permitted	Permitted	Transfer within area permitted	Not Permitted	Not Permitted
Transfer from: Confined Aquifer	Extraction	Permitted	Permitted	Permitted	Permitted	Transfer within area permitted subject to principle 19	Permitted
Transfer from: Confined Aquifer	Coastal Plain General	Permitted	Permitted	Permitted	Permitted	Permitted	Transfer within area permitted

7 | Permits

7.1 | Well construction

The following objectives and principles apply to permits for activities in relation to wells under section 127(3)(a) and (b) of the NRM Act comprising the drilling, plugging, backfilling or sealing of a well and the repairing, replacing or altering the casing, lining or screen of a well.

A person can only undertake any of the activities listed in this section if authorised to do so by a permit granted by the relevant authority. Permits will only be granted if the activity complies with the relevant objectives and principles of this section. For the purpose of these water affecting activities, the relevant authority is the Minister.

All wells have to be drilled in accordance with the general specifications for water well drilling as defined in Minimum Construction Requirements For Water Bores In Australia Edition 2. Land and Water Biodiversity Committee, 2003.

7.1.1 | Objectives

The objectives of well construction principles are to:

- minimise the effect of well location on water levels, and ensure wells are located to minimise extraction interference with other users and the environment
- maintain the integrity of aquifers
- maintain the quality of water drawn from wells, protecting the water supplies from future salinisation
- minimise pollution of the aquifer.

All new bores are to be constructed to maintain hydraulic separation between the Unconfined and Confined Aquifers.

7.1.2 | Principles

Minimum distance for the construction of wells for a licensed purpose

23. A well for a licensed purpose may only be constructed in the Peake, Roby and Sherlock PWA where the proposed extraction point is more than one kilometre from a well used for taking underground water from the same aquifer for stock and/or domestic purposes or a licensed purpose.

24. Principle 23 does not apply if:

(a)(i)the well for a licensed purpose is proposed to replace an original well for a licensed purpose where the proposed extraction point is within a 100 m radius of the original well; or
(ii) the owner of the stock and domestic well is also the proponent of the proposed well; and
(b) it can be shown, to the satisfaction of the Minister, that the proposed extraction will not have an impact on the underground water levels or salinity.

25. Within the Coastal Plain High Salinity Management Zone a well for a licensed purpose may only be constructed if it is not located within one kilometre of an ecosystem dependent on underground water.

8 | Monitoring, evaluation and reporting

8.1 | objectives

The objectives of monitoring, evaluation and reporting are to:

- provide sufficient data and information to implement the policies contained within this Plan
- provide sufficient information to enable an on-going evaluation of the condition of the underground water resource
- provide sufficient information to enable the evaluation of the impact of taking underground water on users.

Table 6: Summary of monitoring requirements

What	Where	When	Analysed by	Data Custodian
An underground water sample to be collected by the licence holder from each well and submitted for salinity analysis	All wells used by licensed underground water users	Collected in the last week of February and submitted to the Minister by the end of March, annually	Minister's Department	Minister's Department
Underground water levels will be monitored by DENR and/or the SA MDB NRM Board	Full network of observation wells completed in the Unconfined and Confined Aquifers	Monthly or at least once every three months (approximately February, May, August and November)	Minister's Department and the SA MDB NRM Board	Minister's Department
Underground water salinity will be monitored by DENR and/or the SA MDB NRM Board	Observation wells outlined in Table 4	Six monthly collection (immediately after the completion of the irrigation season), every year	Minister's Department	Minister's Department
Read and record meter readings from all meters	All meters	At least once each year	Minister's Department and the SA MDB NRM Board	Minister's Department

8.2 | Principles

8.2.1 | General monitoring, evaluation and reporting

26. Monitoring of the resources will be undertaken by either licence holders, the SA MDB NRM Board and/or the Minister's Department and these responsibilities are outlined in Table 6.
27. Monitoring methods are to be undertaken in a manner that is consistent with best-practice. Sufficient documentation will be maintained to demonstrate that representative samples were collected, chain of custody maintained and sufficient quality assurance was achieved.
28. Once each year, the Minister's Department will prepare a summary of the patterns in use of underground water trends in underground water levels and underground water salinity levels. The summary of trends will place the annual data in the context of the full record of trends in underground water levels and salinity and be used to assess the performance of this Plan. The summary will be placed on the SA MDB NRM Board's website.
29. Where the underground water level or underground water salinity specified in principle 8 is exceeded or may potentially be exceeded, the SA MDB NRM Board and the Minister's Department must:

    i. immediately investigate the cause
    ii. determine whether the exceedance is a threat to the condition of the resource and/or users of the resource
    iii. determine whether changes to the allocation and taking regime are required
    iv. notify the community.

8.2.2 | Annual water use report

30. An annual water use report for the Prescribed Resource is to be submitted by the licensee to the Minister or his/her delegate by 31 July of each year and will provide information pertaining to the following:

i. the volume of water used by the licensee and recorded for each meter during the water use year
ii. water use efficiency and irrigation scheduling
iii. the area of each crop type irrigated
iv. total volume of water used by the licensee on each crop type
v. irrigation rate for each crop type
vi. problems with water quality, water logging, perched watertables or dryland salinity
vii. the nature of any soil moisture monitoring devices used on the relevant land
viii. future plans for water use developments
ix. detail of allocation transfers
x. any other information as requested by the SA MDB NRM Board.

8.2.3 | Plan review

31. The SA MDB NRM Board will review the Plan within 5 years of the Minister adopting the Plan, as the recommended timeframe for review of plans.

Appendix A | Consistency with other plans or legislation

Figure 10: Legislation and other plans that have guided the development of the Water Allocation Plan for the Peake, Roby and Sherlock Prescribed Wells Area

Commonwealth
Intergovernmental Agreement on a National Water Initiative, 2004
Wilderness Protection Act 1992
Environment Protection and Biodiversity Conservation Act 1999
Water Act 2008

State
Natural Resources Management Act 2004
State Natural Resources Management Plan, 2006
South Australia'a Strategic Plan 2007
River Murray Act 2003
Development Act 1993
Environment Protection Act 1993, and related polices and relevant management plans under the *National Parks and Wildlife Act 1972*
Native Vegetation Act 1991
Native Title Act 1994
Environment Protection (Water Quality) Policy 2003
South Australian Murray Darling Basin Initial Natural Resources Management Plan

Regional
South Australian Murray Darling Basin Regional NRM Plan
South Australian Murray Darling Basin Natural Resources Management Board's Strategic Framework, 2007
Water Allocation Plan for the Mallee Prescribed Wells Area, 2000
Water Allocation Plan for the Tintinara Coonalpyn Prescribed Wells Areas, 2003
Coorong Local Action Plan, 1997
Coorong District Council Development Plan, 2003
DENR's Guidelines for the Preparation of Water Allocation Plans, 2005

Local
Land and Water Management Plans

Appendix B | Glossary

Active well: for the purpose of salinity monitoring, a source (well) endorsed on a licence that is actively being used at that point in time and has necessary operating pumping equipment attached to enable a water sample to be taken.

Adaptive management: a management approach often used in natural resource management where there is little information and/or a lot of complexity, and there is a need to implement some management changes sooner rather than later.

Adjoins or adjoining: in relation to an allotment or management area, the allotment or management area (or any part of it) is contiguous with another allotment or management area, and includes allotments or management areas that are separated only by a road, street, footpath, railway or thoroughfare.

Adoption date or date of adoption: the date that the Minister adopts this Plan.

Allotment/parcel:

1. the whole of the land comprised in a certificate of title including a community or development lot or common property within the meaning of the *Community Titles Act 1996* or a unit or common property within the meaning of the *Strata Titles Act 1988*; or
2. the whole of the land comprised in a registered conveyance of land that has not been brought under the provisions of the *Real Property Act 1886*; or
3. a separately defined piece of land that is delineated on a public map and separately identified by a number or letter (not being a piece of land that is identified in a treasury receipt, certificate or other document or instrument of title as being part only of an allotment);
4. two or more separately defined pieces of land that are delineated on a public map and that are identified in a treasury receipt, certificate or other document or instrument of title as forming one allotment for the purposes of the *Real Property Act 1886*; or
5. a separately defined piece of land delineated on a plan of division for the purpose of enabling the separate ownership in fee simple of that land;
6. a separately defined piece of land identified as an allotment for the purposes of the *Real Property Act 1886* in a plan prepared by the Registrar-General and accepted for filing in the lands titles Registration office; or
7. where a primary plan of community division has been cancelled under Part 7 Division 3 of the *Community Titles Act 1996* or a strata plan has been cancelled under Part 2 Division 7 of the *Strata Titles Act 1988*— the land comprising the former community parcel or site shown on the plan.

Annual Allocation Volume: the maximum volume of water able to be taken for licensed purposes in a water use year.

Annual water use report: a report produced by a licensee and submitted to the Minister or his/her delegate by 5pm on 31 July each year, in accordance with section 8 (Monitoring, evaluation and reporting) of this Plan.

Aquifer: an underground layer of rock or sediment that holds water and allows water to percolate through.

Aquitard: a layer in the geological profile that separates two aquifers and restricts the flow of water between them.

Artificial recharge: the process of artificially diverting water from the surface to an aquifer (see also ‘aquifer’ and ‘recharge’).

Basin: the area drained by a major river and its tributaries.

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

Catchment water management board: a statutory body established under the *Water Resources Act 1997* whose prime function was to implement a catchment water management plan for its area. Now, under the *Natural Resources Management Act 2004*, these boards are known as natural resources management boards.

Coastal Plain: a broad, flat low-lying area in the Peake, Roby and Sherlock PWA.

Cone of depression: an inverted cone-shaped space within an aquifer caused by a rate of underground water extraction that exceeds the rate of recharge.

Confined Aquifer: the aquifer in the Peake, Roby and Sherlock Prescribed Wells Area in which the upper surface is impervious (see 'confining layer') and the water is held at greater than atmospheric pressure so that water in a penetrating well will rise above the surface of the aquifer.

Confining layer: a rock unit impervious to water, which forms the upper bound of a Confined Aquifer; a body of impermeable material adjacent to an aquifer (see also 'Confined Aquifer').

Domestic purpose or use: the taking of water for ordinary household purposes, including taking water for the purpose of watering or irrigation up to 0.4ha or 1 acre of land.

Drawdown: the occasional, seasonal or permanent lowering of the watertable or reduction in pressure (head) of an aquifer resulting from the extraction of underground water.

Dryland salinity: the process whereby salts stored below the surface of the ground are brought close to the surface by the rising watertable. The accumulation of salt degrades the upper soil profile, with impacts on agriculture, infrastructure and the environment.

Ecosystem: any system in which there is an interdependence upon, and interaction between, living organisms and their immediate physical, chemical and biological environment.

Farm: a place being used solely or predominantly for the business of agriculture, pasturage, horticulture, viticulture, animal farming or any other business consisting of the cultivation of soils, the gathering in of crops or the rearing of livestock.

Imported water: water which has been brought into a management area from another management area by means of a pipe or other channel, and the water (including surface water) has been extracted and piped, or directed into a channel, under licence or permit under the NRM Act.

Impact: a change in the chemical, physical, or biological quality or condition of a water body caused by internal or external sources.

Intensive farming: a method of keeping animals in the course of carrying on the business of primary production where the animals are usually confined to a small space or area and usually fed by hand or by 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.

Land: whether under water or not, and includes an interest in land and any building or structure fixed to the land.

Land capability: the ability of the land to accept a type and intensity of use without sustaining long-term damage.

Leaching: removal of material in solution such as minerals, nutrients and salts from soil.

Licence: a licence to take water in accordance with the NRM Act (see also 'water licence').

Licensee: a person or company who holds a water licence.

Mallee Highland: the scarp of the higher Mallee landscape formed by a marine transgression about one million years ago which extended from the coast as far inland as Keith, Tintinara and Peake.

Management zone: a policy tool, where each zone has specific rules to manage the impact that may occur from underground water extraction.

Megalitre (ML): one million (1,000,000) litres. An Olympic size swimming pool contains approximately one and a half megalitres.

Monitoring:

1. the repeated measurement of parameters to assess the current status and changes over time of the parameters measured; or

2. periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements or pollutant levels in various media or in humans, animals, and other living things.

Native vegetation: any plant species indigenous to South Australia including a plant or plants growing in or under waters of the sea.

Natural resources: soil, water resources, geological features and landscapes, native vegetation, native animals and other native organisms and ecosystems.

Natural resources management (NRM): all activities that involve the use or development of natural resources such as soil, water, geological features and landscapes, native vegetation, native animals, other native organisms and ecosystems or that impact on the state and condition of natural resources, whether positively or negatively.

Observation well: a narrow well or piezometer used for water level measurements.

Pasture: grassland used for the production of grazing animals such as sheep and cattle.

Permeability: a measure of the ease with which water flows through an aquifer or aquitard, measured in square metres per day (m^2/day).

Potentiometric surface: the level to which water rises in a well due to water pressure in the aquifer, measured in metres (m). May also be referred to as the 'potentiometric surface', potentiometric level or 'piezometric surface '.

Prescribed well: a well or future well declared to be a prescribed well under the NRM Act.

Proponent: the person or persons (who may be a body corporate) seeking approval to take water from the Prescribed Wells Area.

Recharge: the infiltration of water into an aquifer from the surface (rainfall, streamflow, irrigation etc.). See also 'recharge area' and 'artificial recharge'.

Recharge area: the area of land from which water from the surface (rainfall, streamflow, irrigation etc.) infiltrates into an aquifer. See also 'artificial recharge' and 'recharge'.

Standing underground water level: the distance, in metres, from the reference point to the water surface (that is not affected by pumping).

Stock: animals not used for intensive farming.

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

Stressed underground water resource: an underground water resource that is being overused resulting in unsustainable impacts.

Surface water:

1. water flowing over land (except in a watercourse), after having fallen as rain or hail or having precipitated in any other manner, or after rising to the surface naturally from underground; or
2. water of the kind referred to in (1) that has been collected in a dam, reservoir or contained in any stormwater infrastructure.

Sustainability: the ability of an ecosystem to maintain ecological processes and functions, biological diversity, and productivity over time.

Transfer: transfer of a licence (including its water allocation) to another person, or the whole or part of the water allocation of a licence to another licensee or the Minister under Part 3, Division 2, Section 157 of the NRM Act. The transfer may be absolute or for a limited period.

Unconfined Aquifer: the aquifer in the Peake, Roby and Sherlock Prescribed Wells Area in which the upper surface has free connection to the ground surface and the water surface is at atmospheric pressure.

Underground water: water occurring naturally below ground level or water pumped, diverted or released into a well for storage underground.

Underground water dependent ecosystems: an ecosystem that relies either wholly or partially on underground water to sustain it continuously, seasonally or episodically.

Water affecting activities: activities referred to in section 127 of the NRM Act.

Water allocation:

1. in respect to a water licence, the water allocation or the water allocation endorsed on the licence; or

2. in respect to water taken pursuant to an authorisation under section 128 of the NRM Act, the maximum quantity of water that can be taken and used pursuant to the authorisation.

Water allocation plan: a plan prepared by a NRM Board and adopted by the Minister in accordance with the NRM Act.

Water licence: a licence granted under the NRM Act authorising the holder to take water from a prescribed watercourse, lake or well or to take surface water from a prescribed surface water area.

Water resource monitoring: an integrated activity for evaluating the physical, chemical, and biological character of water resources, including:

- surface water, underground water, estuaries, and near-coastal water; and
- associated aquatic communities and physical habitats, which include wetlands.

Watertable: the upper surface of saturation in the Unconfined Aquifer.

Water use year: the period from 1 July in any given year to 30 June the following year.

Well:

1. an opening in the ground excavated for the purpose of obtaining access to underground water; or
2. an opening in the ground excavated for some other purpose but gives access to underground water; or
3. a natural opening in the ground that gives access to underground water.

Wetlands: defined by the NRM Act as a swamp or marsh and includes any land that is seasonally inundated with water. This definition encompasses a number of concepts that are more specifically described in the definition used in the Ramsar Convention's list of Wetlands of International Importance. This describes wetlands as areas of permanent or periodic to intermittent inundation, whether natural or artificial, permanent or temporary, with water that is standing or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tides does not exceed six metres.

Appendix C | Abbreviations

For the purposes of the Water Allocation Plan for the Peake, Roby and Sherlock PWA, the following abbreviations shall have the meanings set out below:

AHD: Australian Height Datum, or approximate mean sea level, measured in metres (m).

ANZECC (2000): Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

GRO Plan: General Registry Office Plan, being a plan or map registered and held at the Lands Title Office.

The Minister: the Minister responsible for the administration of the NRM Act.

NRM Act: the *Natural Resources Management Act 2004*, which supersedes the *Water Resources Act 1997*.

The Plan: the Water Allocation Plan for the Peake, Roby and Sherlock Prescribed Wells Area.

PWA: prescribed wells area

The PWA: the Peake, Roby and Sherlock Prescribed Wells Area.

The SA MDB NRM Board: the SA Murray-Darling Basin Natural Resources Management Board.

TDS: total dissolved solids, a measure of water salinity, measured in milligrams per litre (mg/L).

Measurements

ha	hectare
km	kilometre(s)
km²	square kilometre(s)
m	metre(s)
m²	square metre(s)
mg/L	milligram(s) per litre
ML	megalitre(s)
ML/year	megalitres per year

For more information
For more information about this publication please contact:

SA MDB NRM Board
P.O. Box 2343
Murray Bridge SA 5253
Phone: (08) 8532 1432