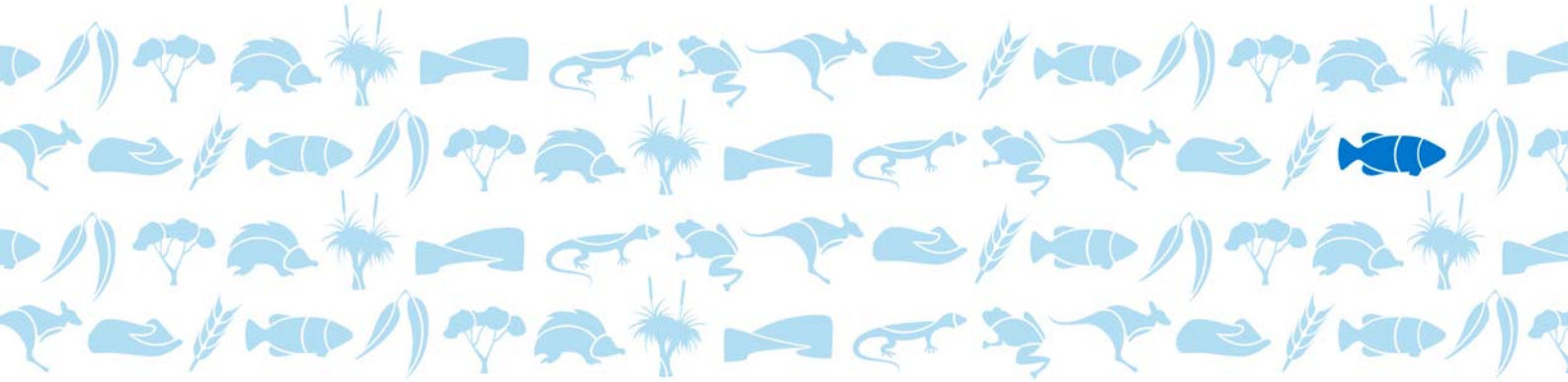
August 2007

South Australian Murray-Darling Basin Natural Resources Management Board

INFORMATION PAPER 1

Hydrogeology of the Peake, Roby and Sherlock Prescribed Wells Area.

(In preparation of the Water Allocation Plan for Peake, Roby and Sherlock Prescribed Wells Area)



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

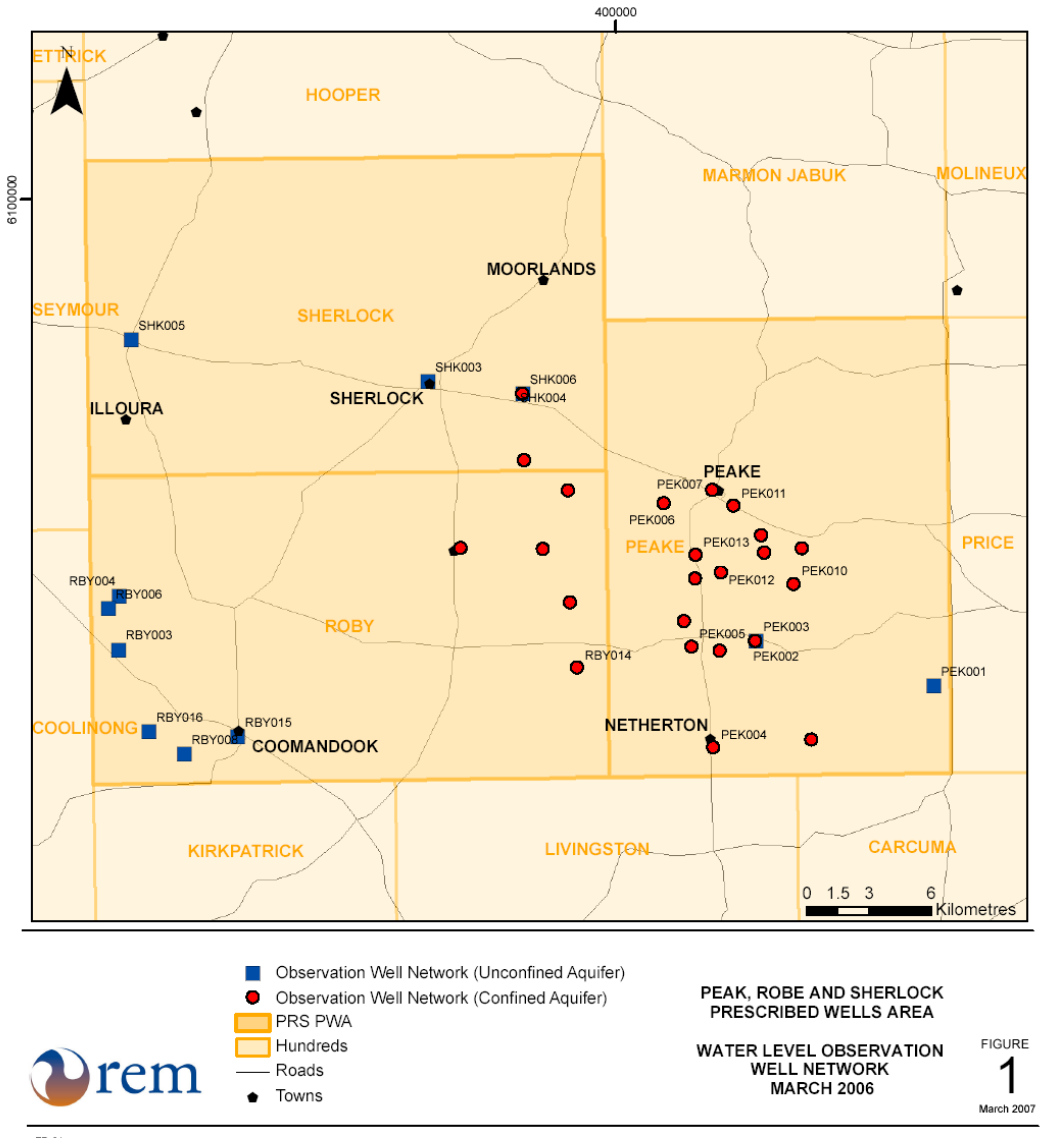
INTRODUCTION

The Natural Resource Management Act 2004 requires the South Australian Murray-Darling Basin Natural Resource Management (SA MDB NRM) Board to prepare a Water Allocation Plan (WAP) for each of the prescribed water resources in its area.

The Peake, Roby and Sherlock Prescribed Wells Area (PRS PWA) was proclaimed on the 27th October 2005. The PRS PWA comprises all lands situated within the Hundreds of Peake, Roby and Sherlock **(Fig. 1)**. The objective of the WAP is to set limits on the amount of groundwater that can be taken for all uses. In setting the limits, the WAP must consider the needs of both the environment and all consumptive water uses and provide secure and equitable access to water for economic, social and environmental users. The WAP is an essential document that seeks to protect the wellbeing of the region's groundwater resource for present and future generations.

This is the first of a series of information papers to be produced during the water allocation planning process for your information. Any questions and comments you may have are welcome. Contact Stuart Richardson at REM on 08 8363 1777.

This paper, *Information Paper 1 'Hydrogeology and of the Peake, Roby and Sherlock Prescribed Wells Area'* provides background information on hydrogeology of the area describing the different aquifer systems, how they are recharged and how they function. This paper also provides information on the current status of the groundwater resource, historic trends and expected future demands.



DISCUSSION

1. Hydrogeology of the Peake, Roby and Sherlock PWA

Two main aquifer systems underlie the PRS PWA. These comprise the unconfined limestone aquifer which is present throughout the area, and the underlying confined aquifer which comprises both the Buccleuch Formation and the underlying Renmark Group **(Fig. 2).** Most groundwater for irrigation and stock and domestic purposes is extracted from the Buccleuch Formation (known locally as the coral).

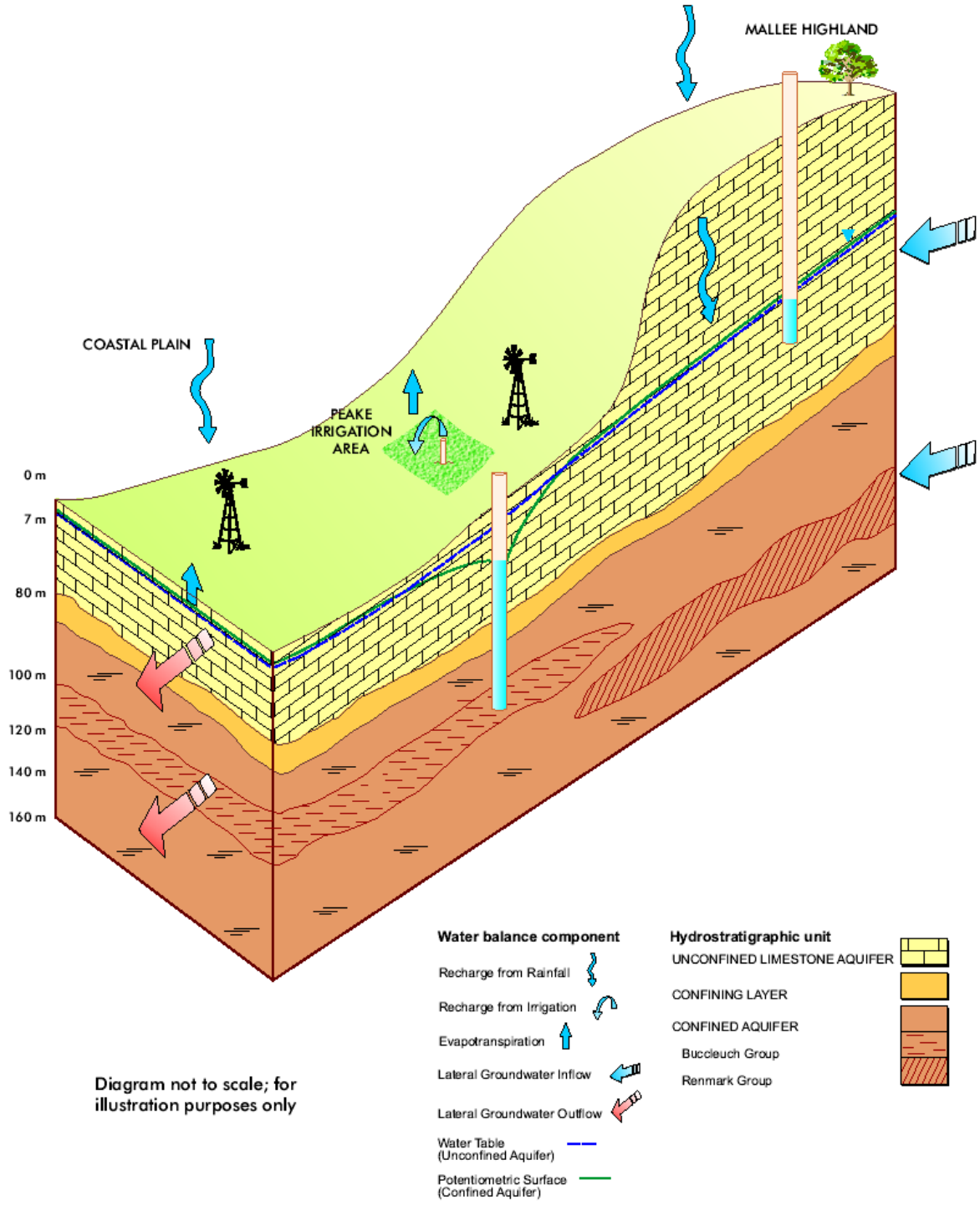


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FIGURE 2

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Schematic Hydrogeological cross-section

Unconfined Aquifer

Groundwater is contained within the regionally extensive unconfined limestone aquifer. Regionally, groundwater flow in the unconfined aquifer is generally in a westerly direction at a very slow rate of several metres per year.

High groundwater salinities in excess of 15 000 mg/L exist below the Coastal Plain. However low salinity groundwater (around 2000 – 3000 mg/L) lies beneath the Mallee Highlands only a few kilometres to the east and is used for stock and domestic purposes. Due to the deep watertable in the Highlands stock and domestic groundwater users generally set pumps at depths between 50 to 100m.

The unconfined aquifer is recharged:

- locally by rainfall which infiltrates directly into the aquifer through the soil profile; and
- regionally from lateral groundwater flow through the aquifer system from the east.

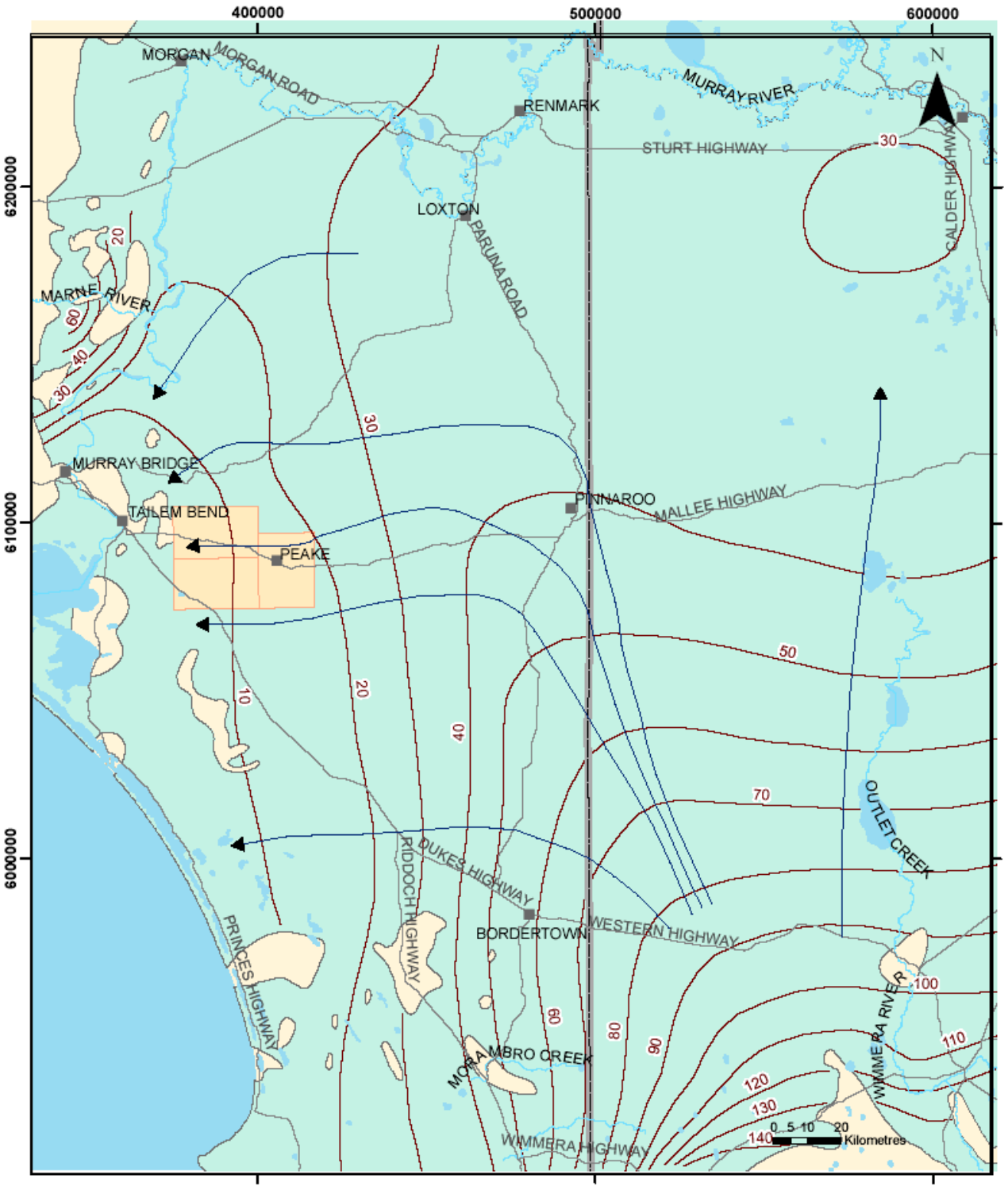
The timing of the local recharge will vary with depth to groundwater. Rapid recharge can occur beneath the Coastal Plain where the watertable averages about 5 metres below ground level. However beneath the Mallee Highland areas, where the water table can be as deep as 50 metres, recharge could take several decades to reach the watertable.

Confined aquifer

The confined aquifer is contained within the Buccleuch and Renmark Group Formations. The Buccleuch Formation is comprised of consolidated bryozoal limestone or 'coral' that lies at depths of about 90 to 100m below ground. In the Peake area, this coral layer begins to merge laterally to the east with the more regionally extensive Renmark Group Formation **(Fig 2)**. The Renmark Group is made up of interbedded sands and clays, and there are very few bores which extract from this aquifer in the PRS PWA.

Figure 3 shows the extent of groundwater flow in the Renmark Group aquifer over South Australia and the western part of Victoria. Unlike the unconfined aquifer, the confined aquifer is not recharged by local rainfall in the PRS PWA. The main recharge source is from groundwater that flows laterally through the aquifer from south western Victoria. It is here in Victoria, where the aquifer is recharged and flows into South Australia moving in the direction of high to low aquifer pressures (**Fig 3**).

On the Coastal Plain, most of the water for stock, domestic and irrigation use is sourced from the Buccleuch Formation. A combination of low groundwater salinity (1,500mg/L to 3,000mg/L) and good well yields (5-30L/s) has led to a concentration of groundwater development in the Peake area.



Legend

- Peak, Roby and Sherlock Prescribed Wells Area
- Renmark Subsystem Extent
- Potentiometric Surface Contours (mAHD) (Ife,D. &Skelt, K. 2004)
- Inferred Groundwater Flowpaths
- Towns
- Major Roads
- Rivers
- SA Border
- Lakes

FIGURE

3

June - 2007

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RENMARK SYSTEM POTENTIOMETRIC SURFACE CONTOURS

Ife,D &Skelt, K. 2004 Murray-Darling basin Groundwater Status 1990-2000: Summary Report, Murray -Darling Basin Commission, Canberra.

Leakage between the unconfined aquifer and the confined aquifer

The unconfined limestone and the deeper Renmark and Buccleuch Group aquifers are separated by a 20m thick confining layer comprised of dark-brown carbonaceous clay **(Fig. 2)**. This low permeability confining layer hydraulically separates the two aquifers which behave independently of each other. The confining layer also restricts inter-aquifer leakage. The following hydrograph **(Fig 4)** compares the water level of the unconfined limestone aquifer monitored in observation well PEK003, with the pressure level of the Buccleuch Formation confined aquifer monitored in PEK002, located 10 m away.

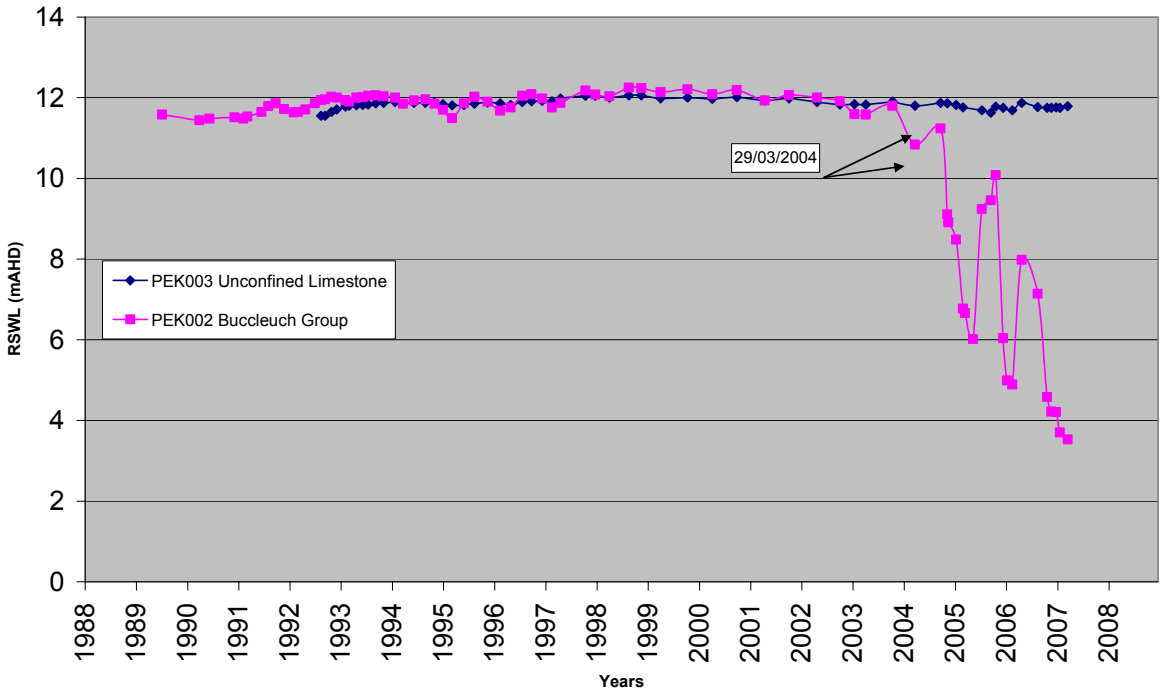
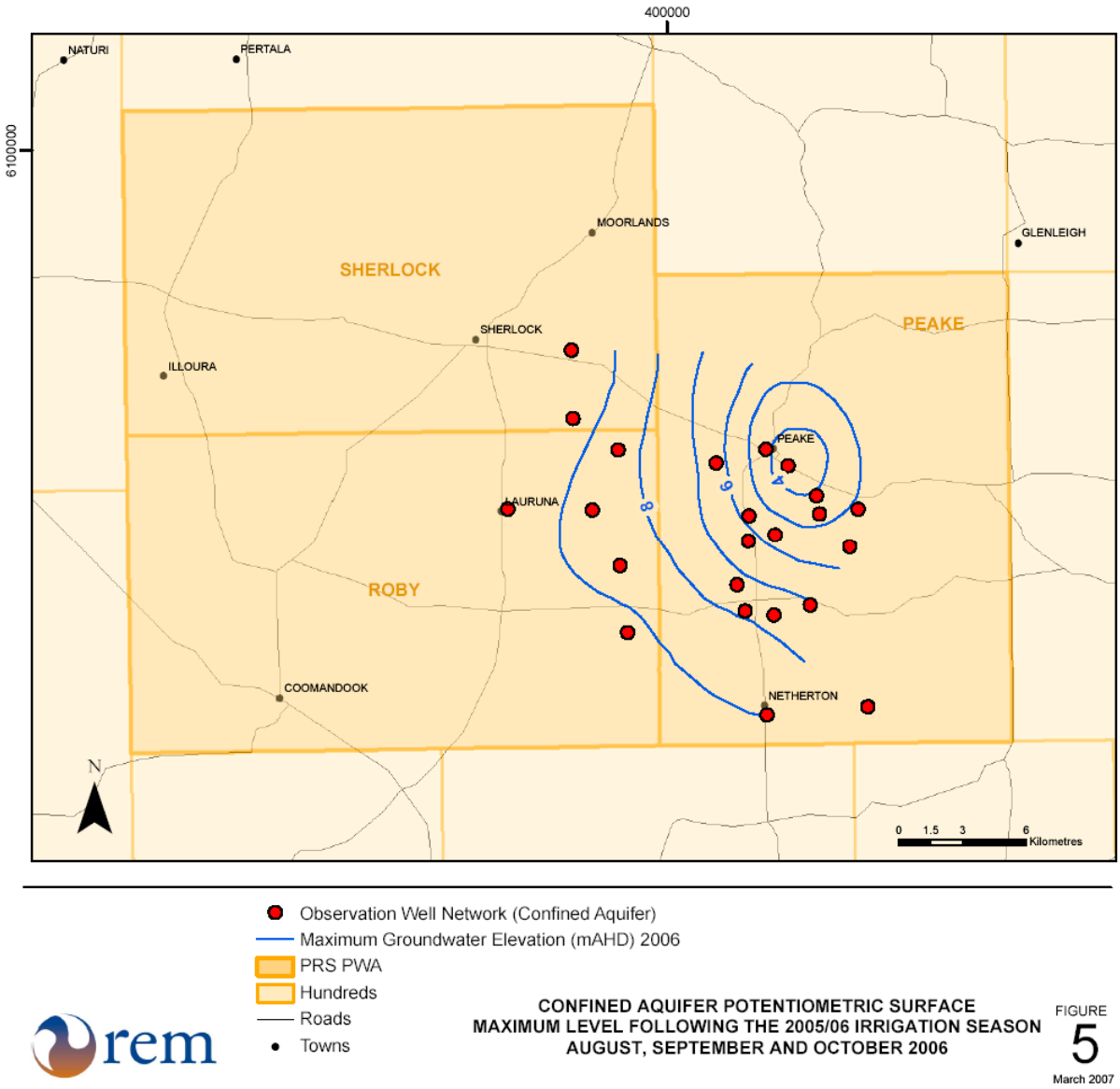


Fig 4 Example of Hydraulic Separation Between the Confined and Unconfined Aquifer Confined Aquifer

As can be seen from the hydrographs, the expansion of irrigation in 2004 has caused groundwater pressure to fall significantly in the confined aquifer, however the water levels in the unconfined aquifer have remained stable throughout this period. This indicates that downward leakage may not be significant.

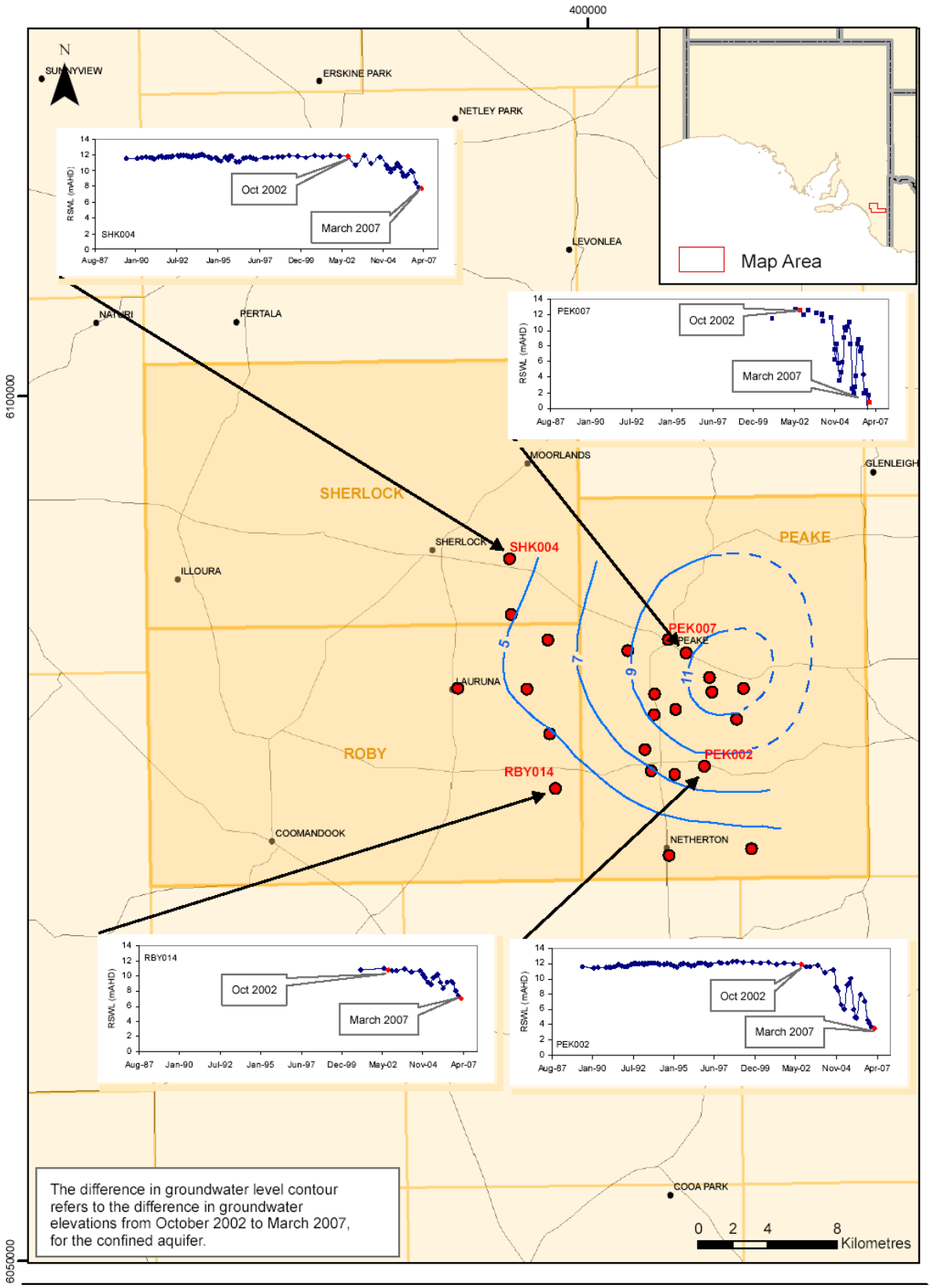
The pressure surface contours in **Figure 5** represent maximum groundwater pressure following the 2005/06 irrigation season. This figure illustrates that the expansion of irrigation in 2004 has caused groundwater pressures to fall, creating a localised drawdown in the Peake area and thereby altering local groundwater flow direction and creating what is known as a 'cone of depression'.



Groundwater pressure trends

A network of 34 observation bores monitor groundwater pressures levels and salinity periodically from both the unconfined aquifer (11 bores) and confined aquifer (23 bores). These are generally concentrated in areas of groundwater development **(Fig. 1)**.

Contours of the difference in groundwater pressures in the confined aquifer between 2002 (prior to irrigation expansion) and March 2007 is shown in **Figure 6**. During this period, the maximum decline in groundwater pressures ranged up to 12 metres.



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DIFFERENCE IN GROUNDWATER LEVELS BETWEEN 2002 AND 2007

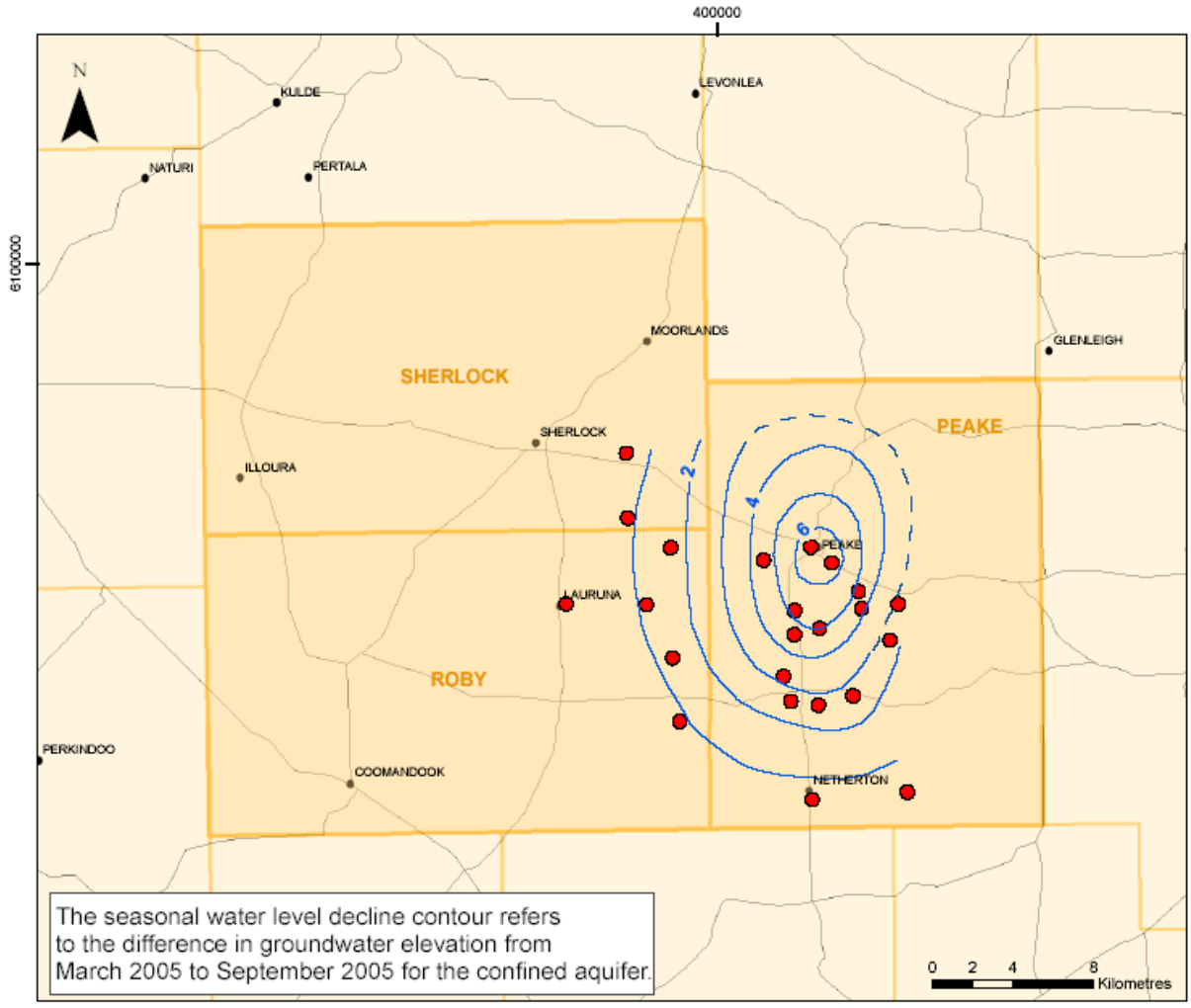
FIGURE 6

March 2007

Hydrographs for observation bores PEK002 and PEK007 illustrate this decline. Declines of up to 4 metres are noticed in observation bores RBY004 and SHK004 towards the eastern margin in the Hundreds of Roby and Sherlock for the same period. The fall in groundwater pressures in the Hundreds of Roby and Sherlock is due to an expansion of the cone of depression associated with the irrigation areas in the Hundred of Peake.

The hydrographs also show that since 2002, aquifer pressures measured in September of each year have not recovered to pre-development levels, indicating that the aquifer continues to experience incomplete recovery following each irrigation season.

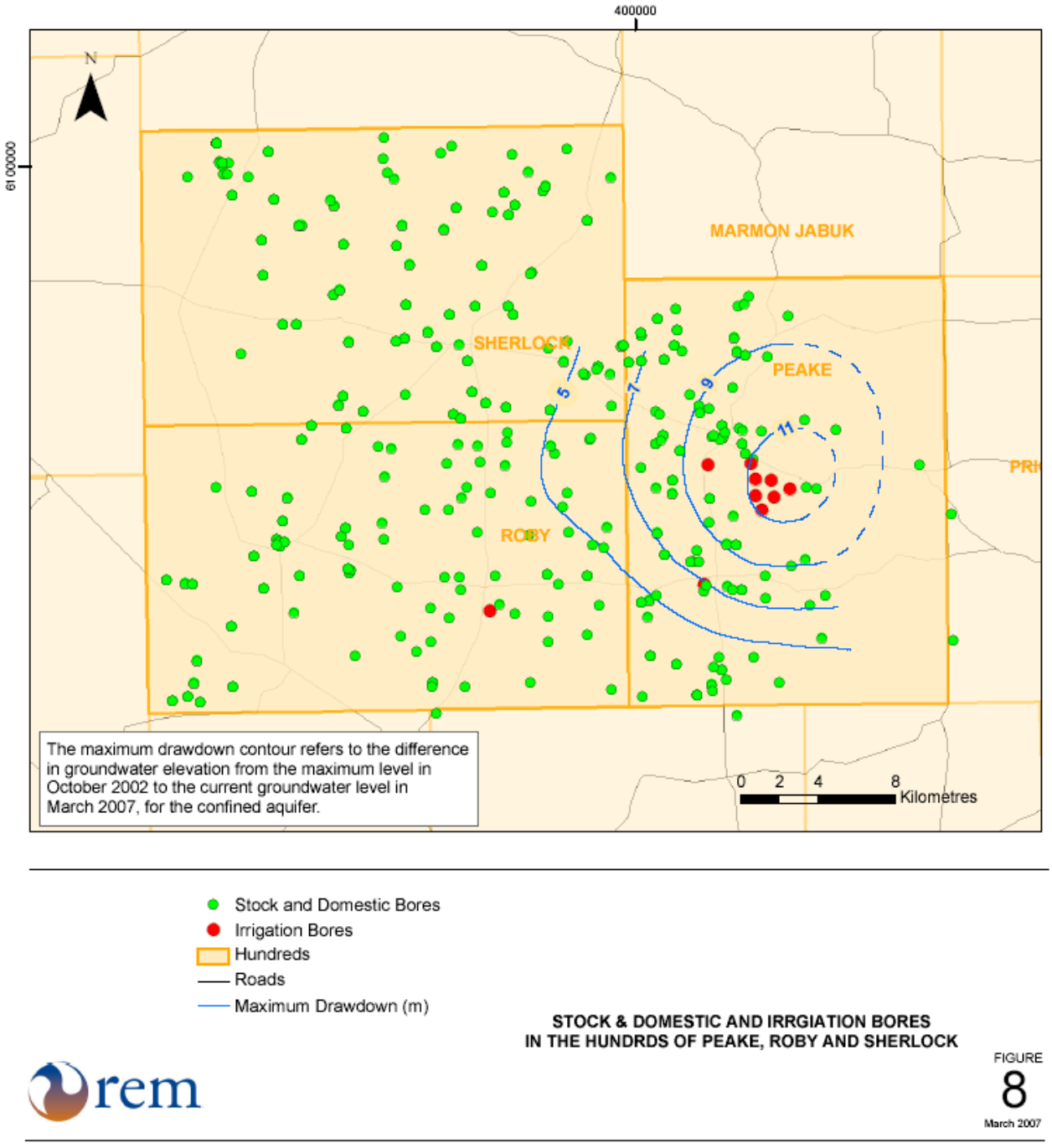
A comparison of the groundwater pressures for March 2005 and September 2005 enables an assessment to be made of seasonal difference in groundwater pressures from groundwater extraction through the irrigation season. In the areas affected by pumping around Peake, seasonal drawdown ranging up to 6 metres occurred **(Fig. 7).**



2. Groundwater Demand

Present groundwater extraction

Groundwater extraction in the PRS PWA has historically been limited to minor extraction for stock, domestic use, town water supply, crop spraying and irrigation of recreational areas. The location of current stock, domestic and irrigation bores is shown in **Fig 8**.



Before the area was prescribed, the groundwater resource was open to unregulated and unrestricted groundwater extraction. Until November 2003, there had only been minor groundwater extraction in the PRS PWA, apart from the irrigation of 124 ha of olives in the Hundred (Hd) of Peake, and 24 hectares (ha) of cereals in the Hd of Roby. In 2003, further expansion of irrigation occurred in the Hd of Peake and currently irrigation in this area is by far the largest user of groundwater in the PRS PWA, where there are four irrigators with a combined metered extraction over the 2005/06 season of about 1,250 megalitres per year (ML/yr). This volume includes an allowance for some non-metered use (non S & D). In addition, approximately 10 ML/yr of

water is extracted from the confined aquifer for the Peake town water supply. The current authorised groundwater extraction is approximately 2,233ML/yr.

Approximately 50 ML/yr of groundwater is extracted for irrigation in the Hd of Roby. There is currently no intensive irrigation activity in the Hd of Sherlock.

The total groundwater extraction (excluding stock and domestic) for the PRS PWA to 1,310 ML/yr

Future groundwater demand

Irrigation is expected to be the largest growing water user, however irrigation potential may be limited, particularly towards the west where groundwater salinity in the confined aquifer is higher **(Fig 9)**.

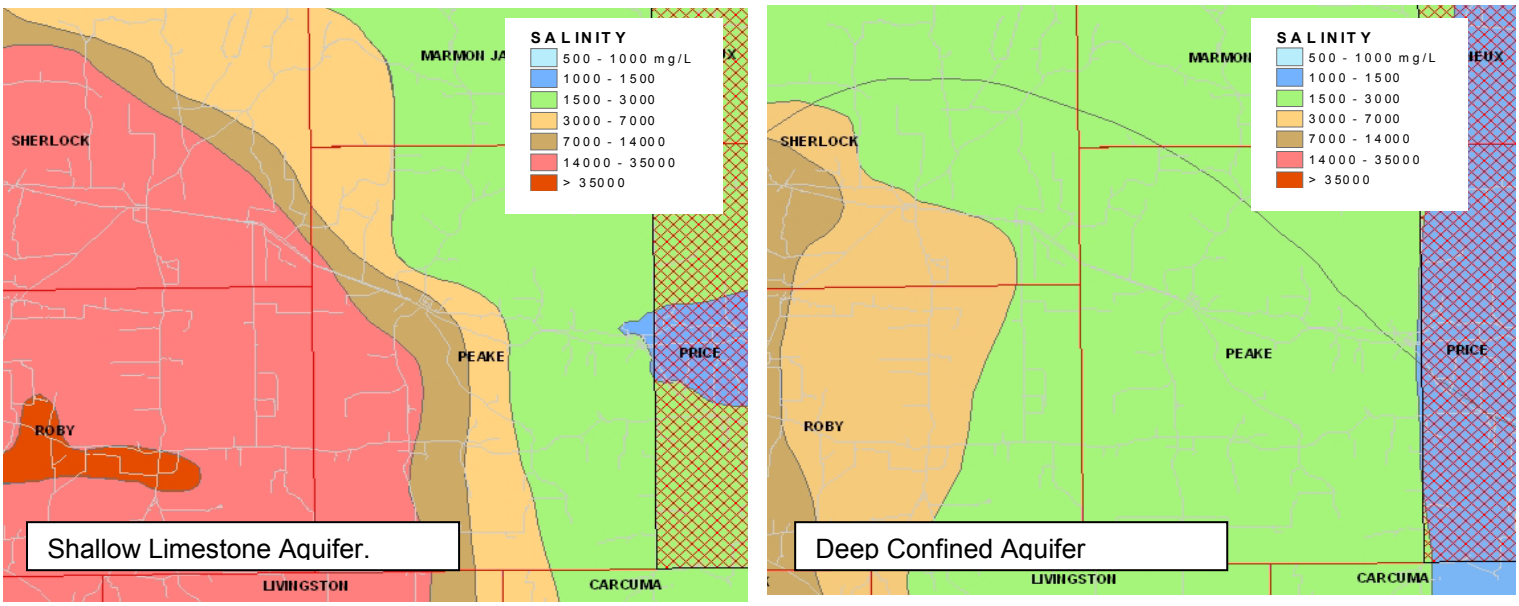


Fig. 9 Salinity distribution in the shallow limestone aquifer and deep confined aquifer
(source DWLBC paper 'Hydrogeology of the Peake Region' October 2006)

Therefore, irrigation development will tend to concentrate in Peake region, where there is good quality water and high groundwater yields. With this in mind, there are two main groundwater issues which need to be considered to ensure long-term sustainable use of the groundwater resource. These are:

- Drawdown in groundwater pressures and associated impacts on stock and domestic groundwater users; and

- Ensuring groundwater extraction is sustainable from the perspective of protection of the water resource itself.

The issue of sustainable use of groundwater is explored in more detail in the next Information Paper.