

TECHNICAL NOTE 2009/28

Department of Water, Land and Biodiversity Conservation

GROUNDWATER RESOURCE ASSESSMENT OF THE HUNDRED OF LAFFER

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CONTENTS

INTRODUCTION	2
HYDROGEOLOGY.....	3
UNCONFINED AQUIFER SALINITY AND TRENDS.....	3
UNCONFINED AQUIFER WATER LEVELS AND TRENDS	5
GROUNDWATER DEVELOPMENT	6
SUSTAINABILITY ISSUES	7
SUMMARY	8
RECOMMENDATIONS	8

List of Figures

Figure 1. Location of the Hundred of Laffer	2
Figure 2. Observation well salinities in the Hundred of Laffer	4
Figure 3. Salinities trend in observation well LAF 101	4
Figure 4. Unconfined water level trends in the Hundred of Laffer	5
Figure 5. Location of irrigation and selected observation wells in the Hundred of Laffer	6
Figure 6. Watertable elevation contours for October 2007	7
Figure 7. Impacts of extractions from the Hundred of Laffer.	8

INTRODUCTION

The Hundred of Laffer lies immediately to the west of the Tatiara Prescribed Wells Area (Fig. 1). It was not initially included in the Tatiara PWA because it is underlain by groundwater considered too saline for irrigation use. However, up to 20 wells have been established for the flood irrigation of lucerne over the years, and the Southeast NRM Board has recommended the area be prescribed and included in the Tatiara PWA. As such, an assessment of the groundwater resources of Hundred of Laffer is required.

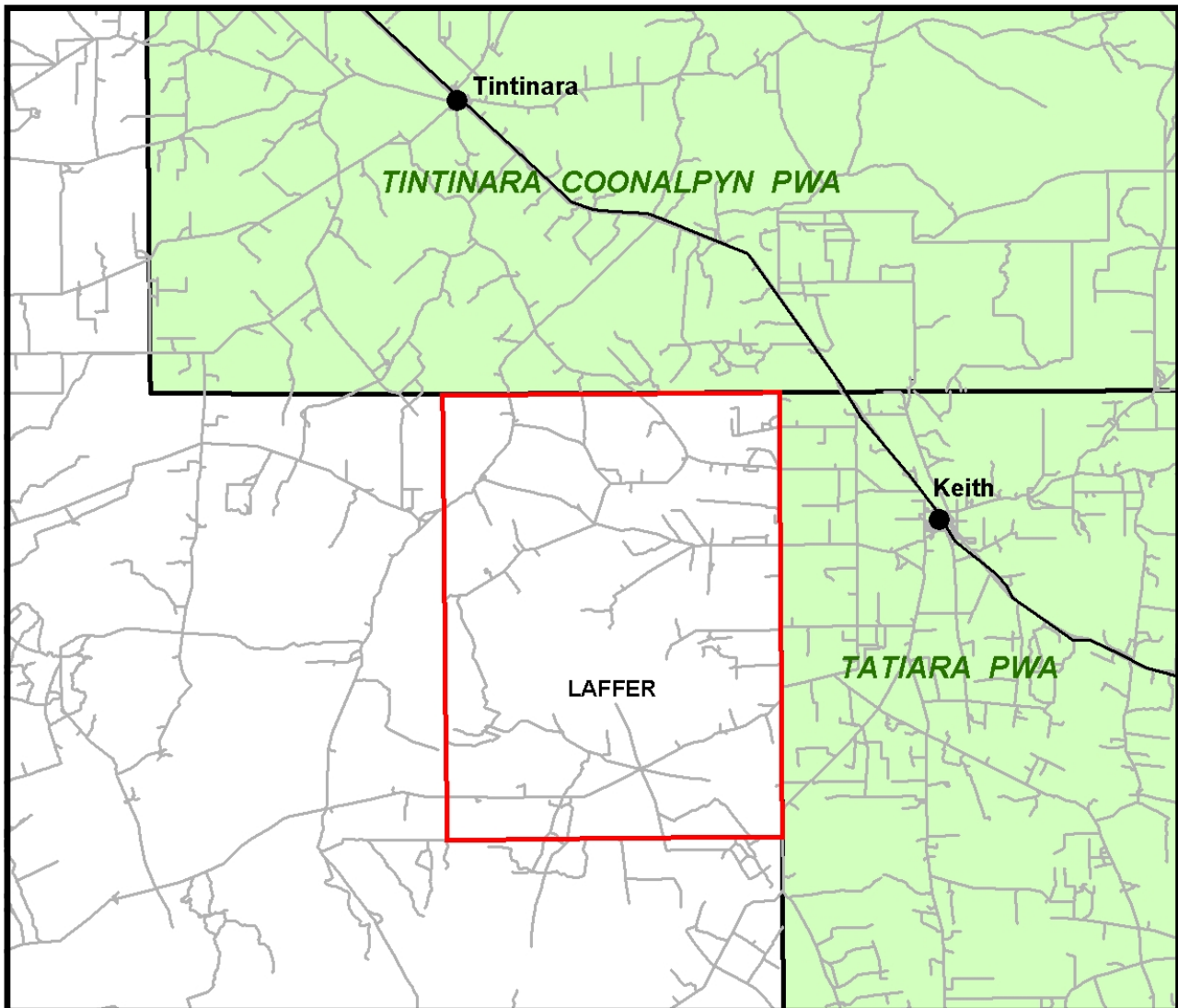


Figure 1. Location of the Hundred of Laffer

SITE DESCRIPTION

The Hundred of Laffer is divided into two portions by northwest trending Black Range, which is the main topographic feature within the area (Fig. 2). The western portion is characterised by low remnant coastal sand dunes interspersed with numerous low-lying saline swamp areas. The eastern portion is dominated by a flat-lying plain that rises gradually towards the Tatiara PWA to the east. The elevation of the ground surface across the Laffer region rises by approximately 8 to 9 metres from west to east.

HYDROGEOLOGY

The Hundred of Laffer is underlain by both the unconfined limestone aquifer and the confined Renmark Group sand aquifer.

The **Renmark Group** confined aquifer consists of interbedded sands and clays, which are intersected about 50 m below ground level. It is relatively thin and has a low permeability, and consequently, yields are usually quite low and unsuitable for irrigation. Only about five wells exist in the northeastern sector of the Hundred where some better quality water for stock supplies is available. Some small artesian flows have been observed during winter. Groundwater flow is generally in a northwesterly direction. This confined aquifer is separated from the overlying unconfined limestone aquifer by clays at the top of the Renmark Group and marls of the Ettrick Formation. Because of the low permeability of these confining beds, and the small head difference between the two aquifers, there is thought to be very little leakage between the aquifers. The Renmark Group confined aquifer will not be discussed further in this Technical Note.

The unconfined limestone aquifer has been developed for irrigation, and is comprised of the **Bridgewater Formation** that generally forms dune ridges, and the **Padthaway Formation**, which is generally found beneath interdunal flats. Because of the generally high permeability of these units, large well yields of up to 200 L/sec are obtainable, often because of the presence of solution features. This aquifer is generally 30 – 40 m thick, with groundwater flow in a westerly direction. The depth to the watertable is less than 5 m.

UNCONFINED AQUIFER SALINITY AND TRENDS

The groundwater in the unconfined aquifer that underlies the Hundred of Laffer increases from moderately saline in the east (5000 mg/L) to highly saline in the west (50 000 mg/L) as shown in Figure 2. Because of these high salinities, there is minimal groundwater use for stock water and there are no known operational wells for domestic purposes. Where the highly saline groundwater occurs in the west, stock and domestic water supplies are provided by reticulated supply from the Murray River.

From drilling records and local knowledge, it is evident that salinity stratification exists within the sandstone and limestone formations of the unconfined limestone aquifer. Some areas in the western portion of the Hundred of Laffer, where the watertable is very shallow, have groundwater with salinities that are extremely high (up to 50 000 mg/L) due to evaporative discharge in the upper part of the aquifer, and that reduce in salinity with depth. Likewise beneath some of the irrigated areas, high salinities have been recorded at the very top of the watertable with some improvement in quality with depth. Well construction, in particular the depth of casing, may influence salinity trends throughout a pumping event if considerable drawdown occurs.

There is very little long term information available to assess salinity trends, however one well (LAF101) on the eastern Hundred boundary showed an increasing trend of 112 mg/L/yr during the 17 year period from 1982 to 1999 (Fig. 3). The last recorded salinity from this well was 5600 mg/L.

In the adjoining Hundred of Stirling to the east, good long term salinity records exist from private and Departmental observation wells. Considerable variations in annual salinity trends are evident ranging from no significant trend through to increases of greater than 180 mg/L/year.

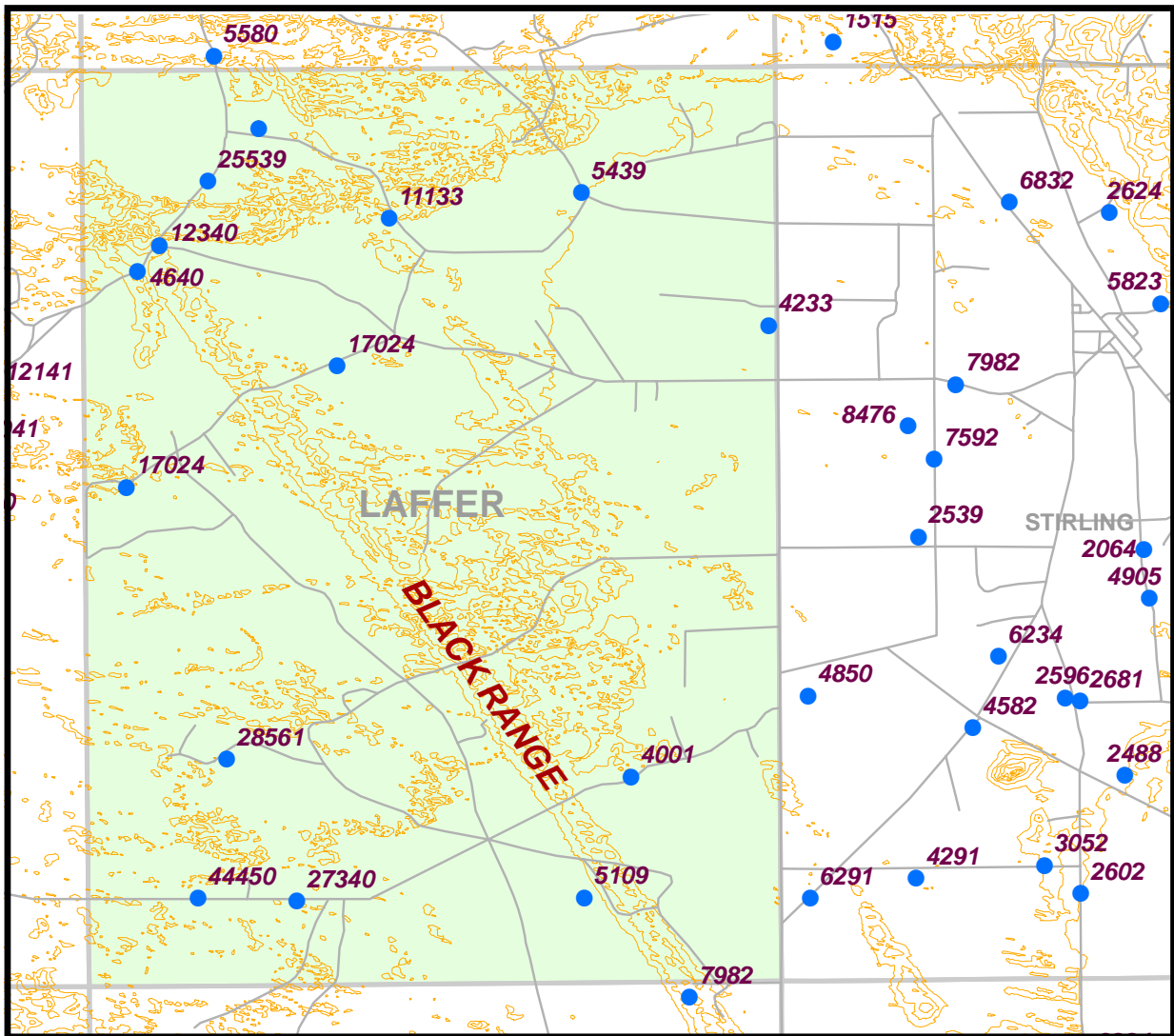


Figure 2. Observation well salinities in the Hundred of Laffer

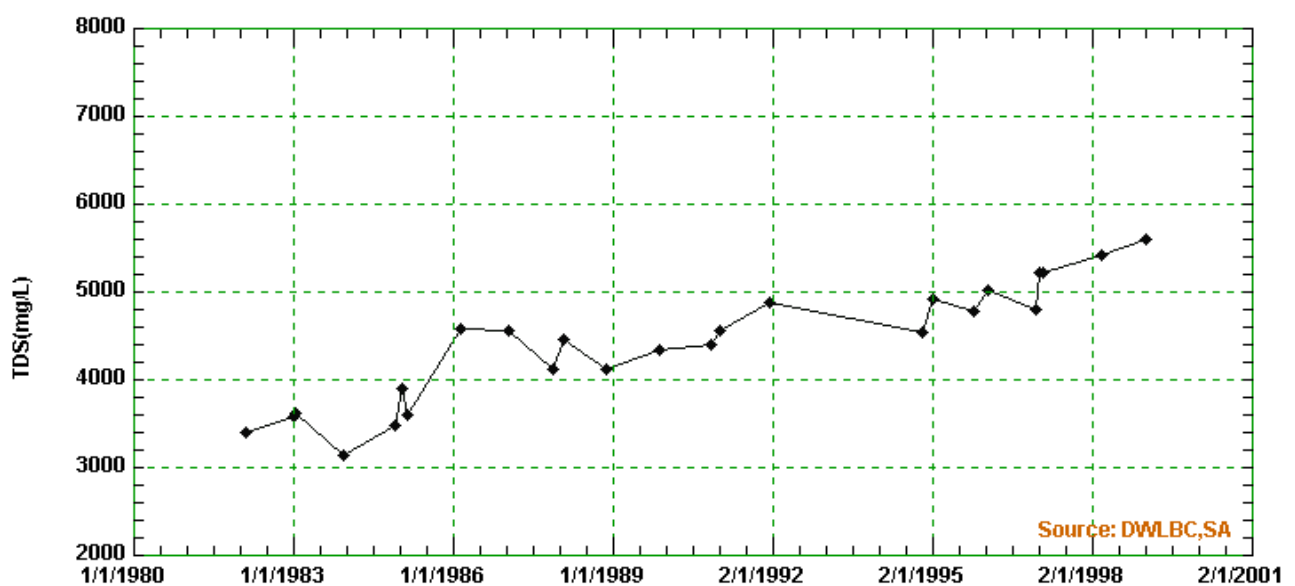


Figure 3. Salinities trend in observation well LAF 101

UNCONFINED AQUIFER WATER LEVELS AND TRENDS

Water level hydrographs are presented in Figure 4, which is divided by those observation wells that lie east and west of Black Range (locations shown in blue in Fig. 5). Both graphs have the same vertical scale and show the cumulative deviation of monthly rainfall shown in dark blue.

East of the Range, the groundwater levels are responding to both below average rainfall since 1996, and irrigation extractions to varying degrees. LAF 1 is surrounded by irrigation and is showing a decreasing trend of 0.2 m/yr since 2000, while LAF 3 is on the margin of irrigation development. LAF 26 has only been affected by below average rainfall. All three wells show that no recharge occurred during the 2006 drought.

Observation wells west of the range are showing no discernible trend because they are mostly located near salinised discharge areas where the watertable is less than 2 m below the ground surface. Although there are seasonal variations due to winter recharge and summer evaporative discharge, these processes tend to balance each other resulting in no overall trend, with the exception of the 2006 drought.

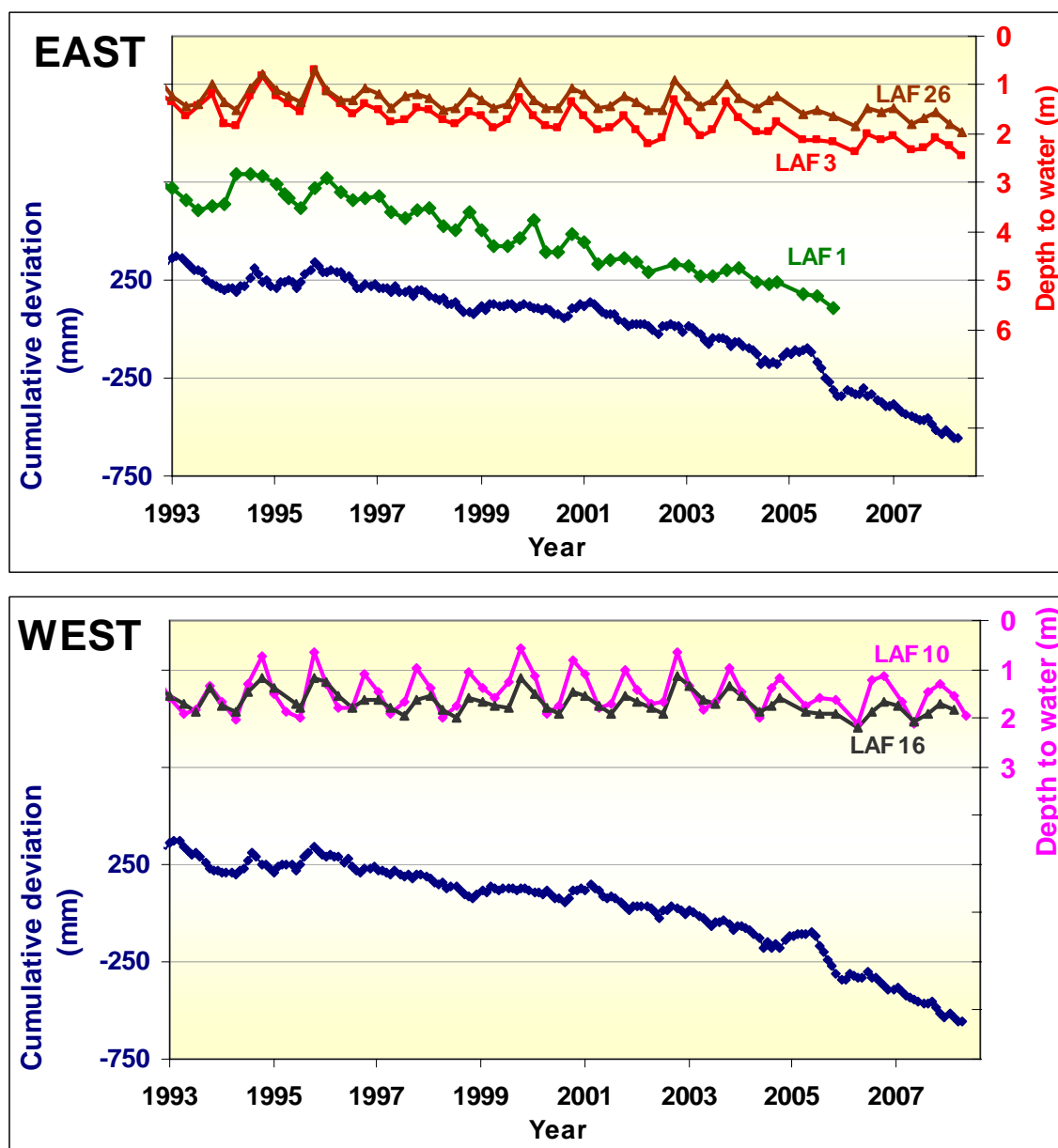


Figure 4. Unconfined water level trends in the Hundred of Laffer

GROUNDWATER DEVELOPMENT

The current development of flood irrigation of lucerne for pasture or seed production is limited to the northeastern portion of the Hundred where moderately saline groundwater occurs. Approximately 45 wells have been drilled for irrigation purposes and the locations of these wells are shown in Figure 5 (yellow dots) together with the most recent salinity reading (recorded in mg/L). This plan uses infra-red aerial photography which shows the irrigated areas in red. Potential for further irrigation expansion from the existing area is very limited due to high groundwater salinities.

The range of salinities recorded from these irrigation wells is 3400 to 13 100 mg/L, with an average of 6200 mg/L. The number of operational irrigation wells in 2006 is estimated to be less than 20, and a field survey would need to be undertaken to confirm this number. The average salinity of 11 wells that have been sampled at least once within 2005/06 is 5400 mg/L.

By using the 2008 aerial photography of the area and the theoretical crop requirements, an estimate of 12 700 ML has been obtained for the current annual extraction.

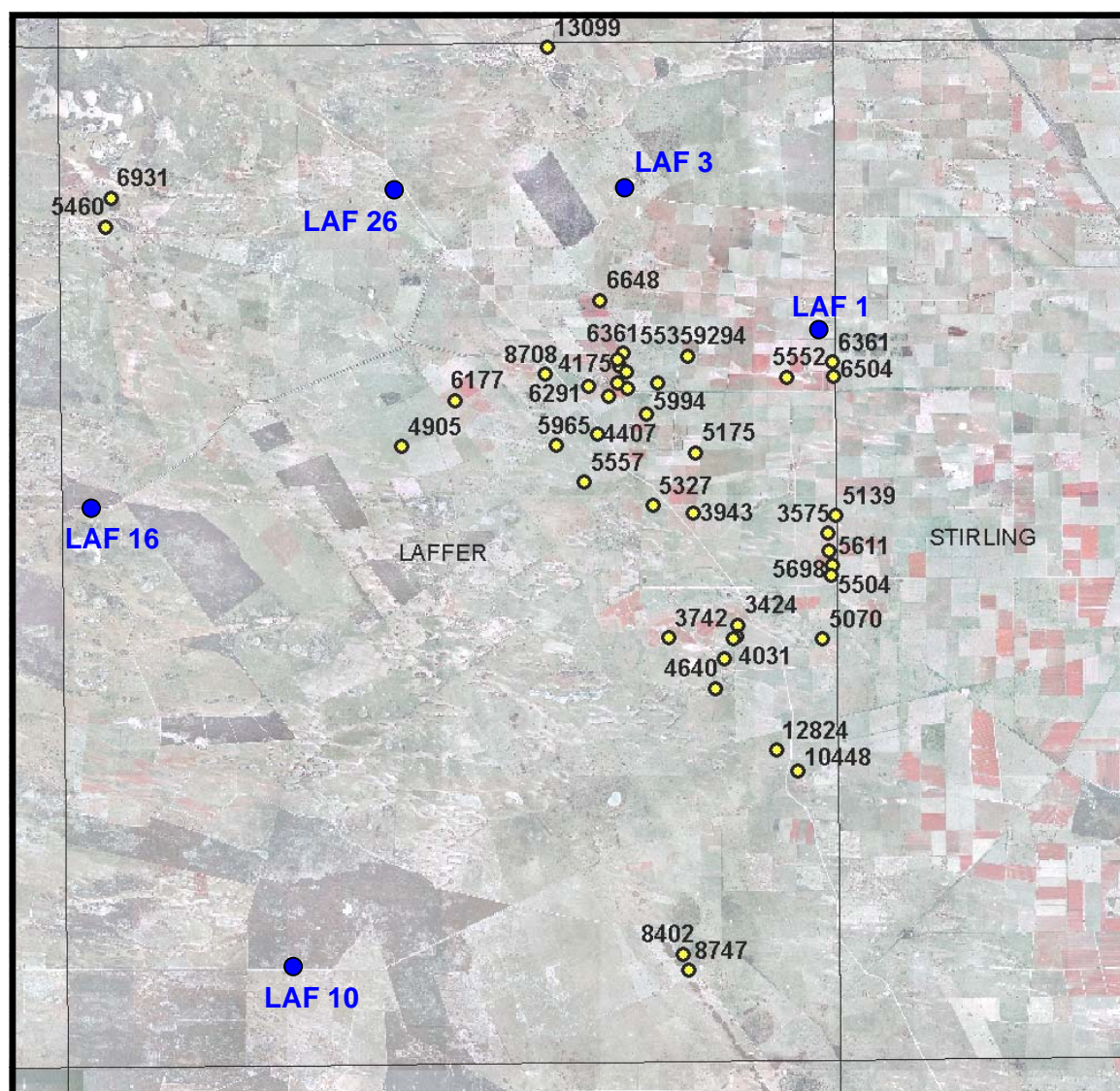


Figure 5. Location of irrigation and selected observation wells in the Hundred of Laffer

SUSTAINABILITY ISSUES

Irrigators in the Hundred of Laffer are using groundwater of marginal quality for flood irrigation of lucerne, which is the highest value use of this groundwater. This development is the last opportunity for economic use of this groundwater before it flows westward where it will be salinised naturally by evaporative concentration where watertables are shallow. Potential for further irrigation development within the Hundred is very limited due to poor water quality and lack of suitable soils.

Significant increases in salinity are likely to occur in existing irrigation wells due to recycling of irrigation drainage water (eg LAF 101 in Fig. 3).

Figure 6 displays the watertable elevation contours for October 2007 for the Hundreds of Laffer and Stirling. It shows that water levels have recovered following the 2006 drought and there is no evidence of permanent flow reversal during the non-irrigation season. The October 2008 levels show a similar pattern, although 30-50 cm lower throughout the area.

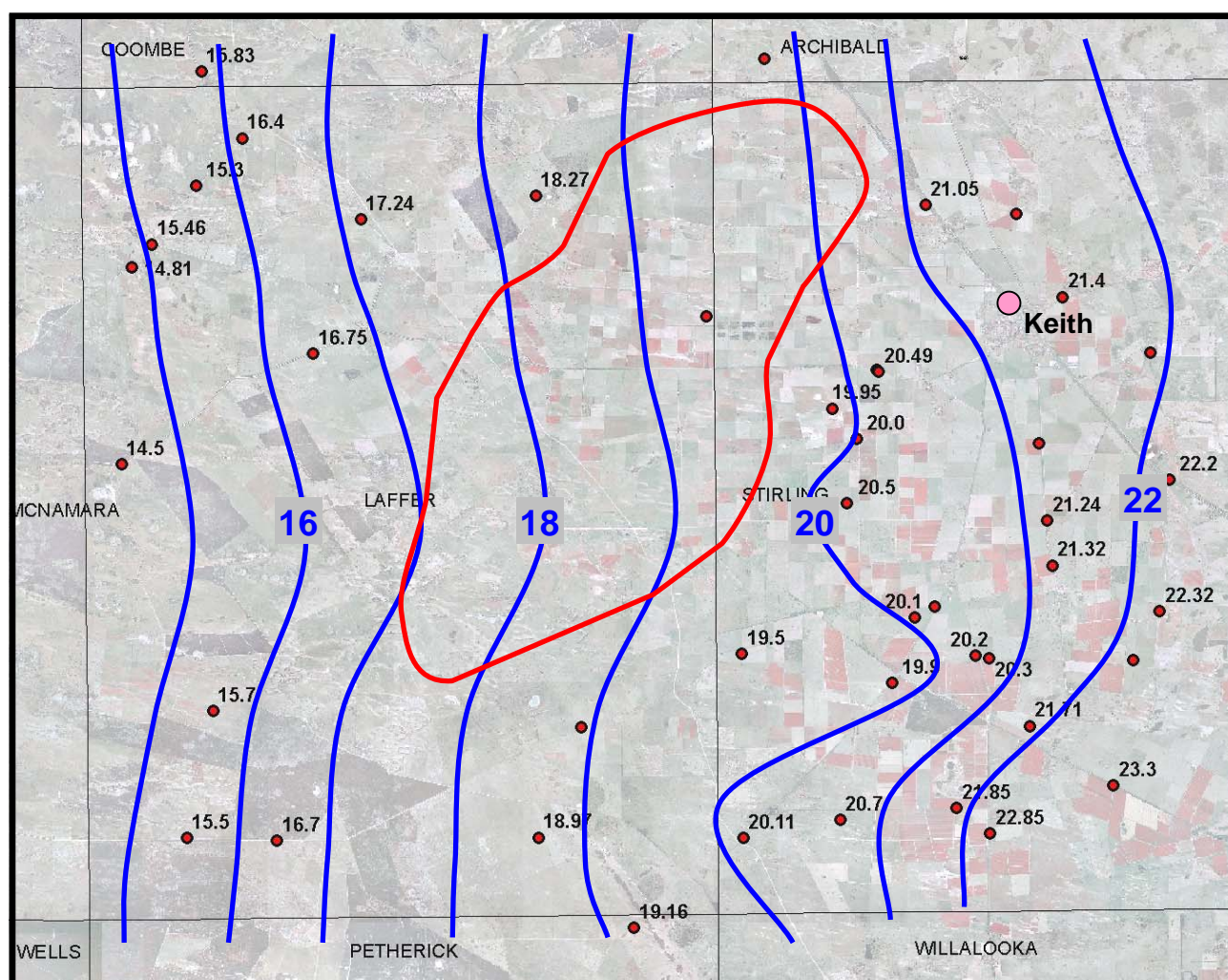


Figure 6. Watertable elevation contours for October 2007.

Figure 7 shows how any water level declines in Laffer will help prevent such flow reversal and ensure groundwater throughflow from Stirling. If above average rainfall returns to the area in the future, water level declines due to irrigation in Laffer may protect land from dryland salinisation caused by rising watertables to the east of Black Range.

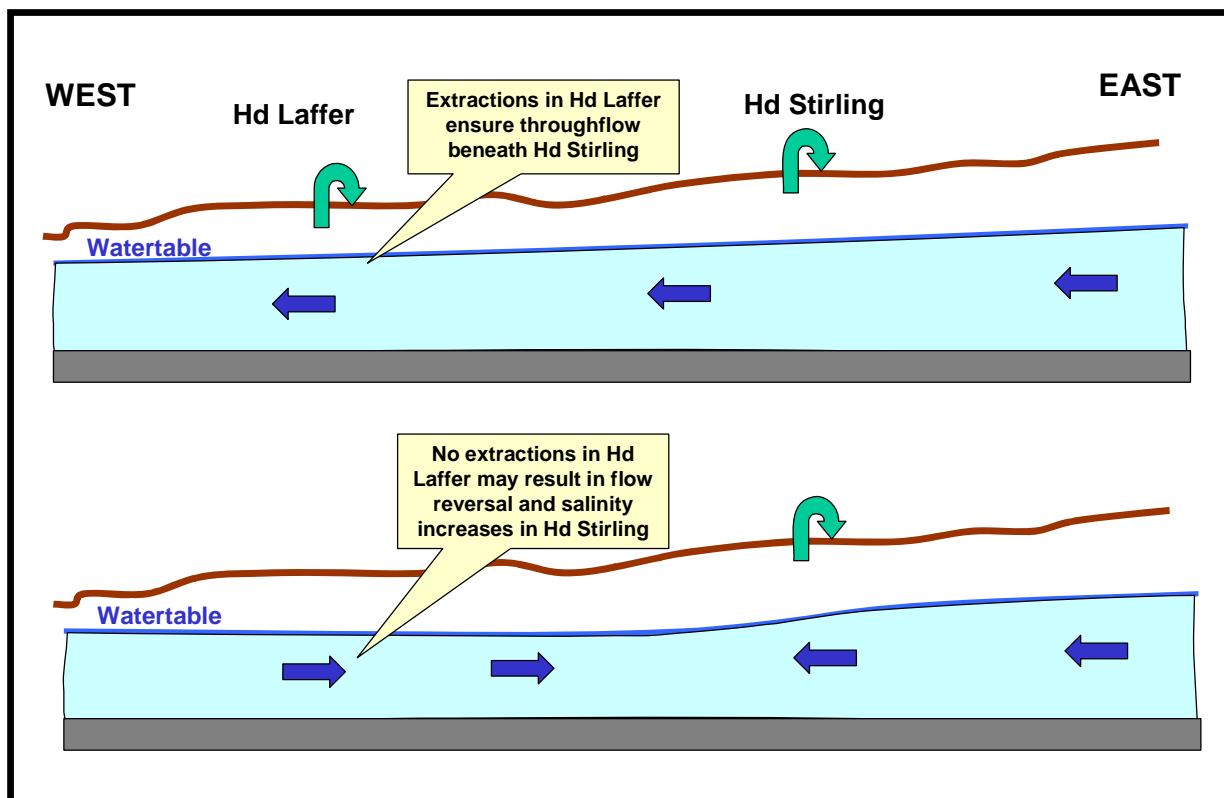


Figure 7. Impacts of extractions from the Hundred of Laffer.

SUMMARY

Because of the inevitable rise in salinity, the potential benefits of watertable lowering, and the limited potential for further development, the current extractions estimated to be about 12 700 ML/yr should be allowed to continue if the Hundred of Laffer is prescribed. There should be no expectation that management intervention will prevent the decline in the quality of the resource, unless irrigation is prohibited altogether.

RECOMMENDATIONS

1. Field surveys need to be undertaken to confirm the status of all wells that have been drilled for irrigation purposes within the Hundred.
2. A PAV should be set at the current level of use of the resource.
3. If prescribed, no transfer of allocations out of the Hundred to the existing Tatiara PWA should be allowed. In addition, no allocations for extraction from the Renmark Group confined aquifer should be issued.
4. New water level and salinity observation wells are required in the area outlined in red in Figure 6.
5. If licences are issued, a condition requiring annual samples from irrigation wells should be applied.