AQUIFER SALINISATION, LOWER MURRUMBIDGEE, AUSTRALIA.

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INTRODUCTION

Water management must incorporate both quality and quantity aspects. It is important to understand the effects of changing groundwater levels and irrigation activities on groundwater quality. Where shallow groundwater is saline or contaminated, downwards leakage to fresh water aquifers must be minimised.

On the Lower Murrumbidgee alluvial fan, shallow groundwater within the Upper Shepparton aquifer is frequently saline (Fig. 1), and high nitrate concentrations have been detected at some sites. Fresh groundwater from deep aquifers (Lower Shepparton, Calivil and Renmark aquifers) is abstracted for drinking water, stock watering and irrigation purposes.

AIMS

- To determine whether significant groundwater quality changes have occurred since development of the resource (medium term).
- To examine the relationship between groundwater pumping and chemical changes near an irrigation bore during a pumping season (short term).

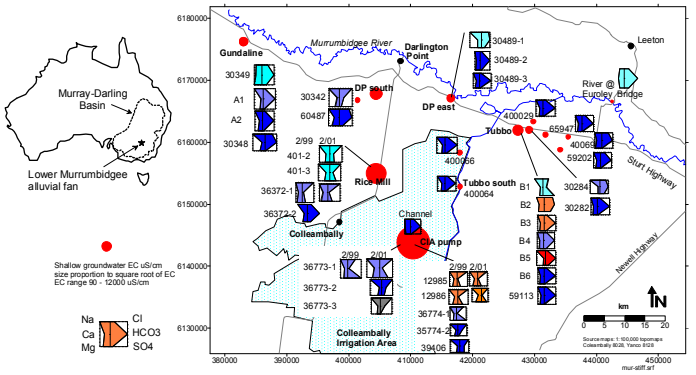

Fig 1. Groundwater chemistry and shallow aquifer salinity, 1999-2001.

AQUIFER SALINISATION SINCE THE MID 1980s

Increasing aquifer salinity was evident at several selected sites since the mid 1980s (Fig 2). Prior to this time, shallow groundwater quality at all sites was of potable quality, and suitable for irrigating even the most sensitive crops such as clover. However, by 1995 shallow groundwater at some sites were no longer potable and were limited to irrigating more salt tolerant crops.

There was no evidence of aquifer salinisation below 50 m depth at these sites, and at sites close to the river minor freshening had occurred. However, downwards leakage of saline groundwater dominated lateral inflow of fresh recharge water over the medium term, thus increasing the risk of impacting the deep aquifers.

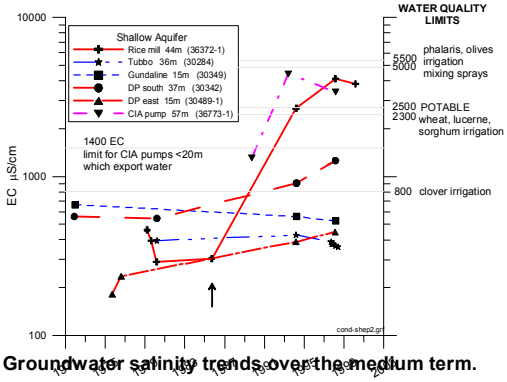

Fig. 2 Groundwater salinity trends over the medium term.

Detailed hydrochemical analysis, revealed that salinisation was initially buffered by cation exchange reactions with clay which removed excess sodium from groundwater (Fig. 3). However, by 1995, the natural cation exchange capacity of clay was exhausted, and Na-Cl type groundwaters dominated.

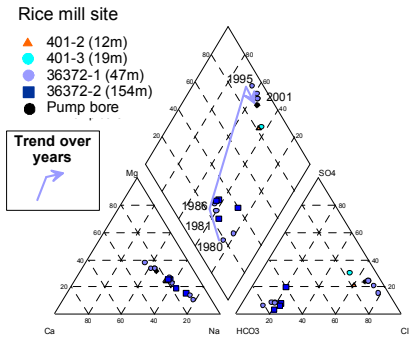

Fig 3. Hydrochemical trends revealing buffering of sodium by ion exchange.

INDUCED LEAKAGE DURING AN IRRIGATION SEASON

Groundwater was sampled from purpose built piezometers before, at several stages during, and after an irrigation season. These piezometers were installed near an irrigation bore, in 4 aquifers ranging from 22 to 88 m depth, and 2 interlayer aquitards.

Increasing salinity that was observed in the shallow aquifer (+170 mg/L) was attributed to leakage of saline porewater from the unsaturated zone.

A small, but significant increase in total dissolved salts (TDS) was observed at depth (Fig. 4) indicating that fingers of saline groundwater moved downwards in response to groundwater pumping from the deep aquifer. TDS increased in the Lower Shepparton aquifer by 39% (+4.3 mg/L), and in the Calivil aquifer by 13% (+1.5 mg/L). Saline leakage was diluted by lateral inflow of fresh groundwater by the end of the irrigation season.

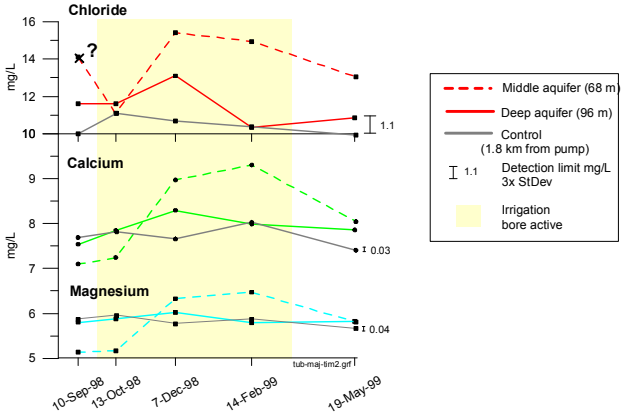

Fig 4. Hydrochemical changes observed in a layered aquifer system, near an irrigation bore, 1998-99 irrigation season.

CONCLUSIONS

Aquifer salinisation has occurred on the Lower Murrumbidgee alluvial fan in response to pumping stresses that have induced downwards movement of shallow saline groundwater over the short and medium term. Further investigation, including frequent hydrochemical sampling at key sites, is required to assess the spatial distribution of aquifer salinisation. Sustainable groundwater pumping strategies should be assessed for those areas identified to be at risk.

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FURTHER INFORMATION: www.wrl.unsw.edu.au **APRIL 2002**