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GROUNDWATER TRENDS IN THE SA MDB NRM BOARD AREA

Steve Barnett

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Knowledge and Information Division

25 Grenfell Street, Adelaide

GPO Box 2834, Adelaide SA 5001

Telephone	National	(08) 8463 6946
	International	+61 8 8463 6946
Fax	National	(08) 8463 6999
	International	+61 8 8463 6999
Website	www.dwlbc.sa.gov.au	

Government of South Australia

Department of Water, Land and Biodiversity Conservation

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INTRODUCTION

In order to facilitate State of the Region reporting for the South Australian Murray-Darling Basin Natural Resources Management Board (SA MDB NRMB), this summary of groundwater levels, salinity and groundwater extraction volumes has been prepared for Prescribed Areas and the Local Action Planning areas. The location of these areas is shown in Figure 1. A number of processes are affecting regional aquifers, ranging from native vegetation clearance, irrigation extractions, interception scheme pumping and irrigation drainage. This analysis includes these regional aquifers but not monitoring networks on the River Murray floodplain.

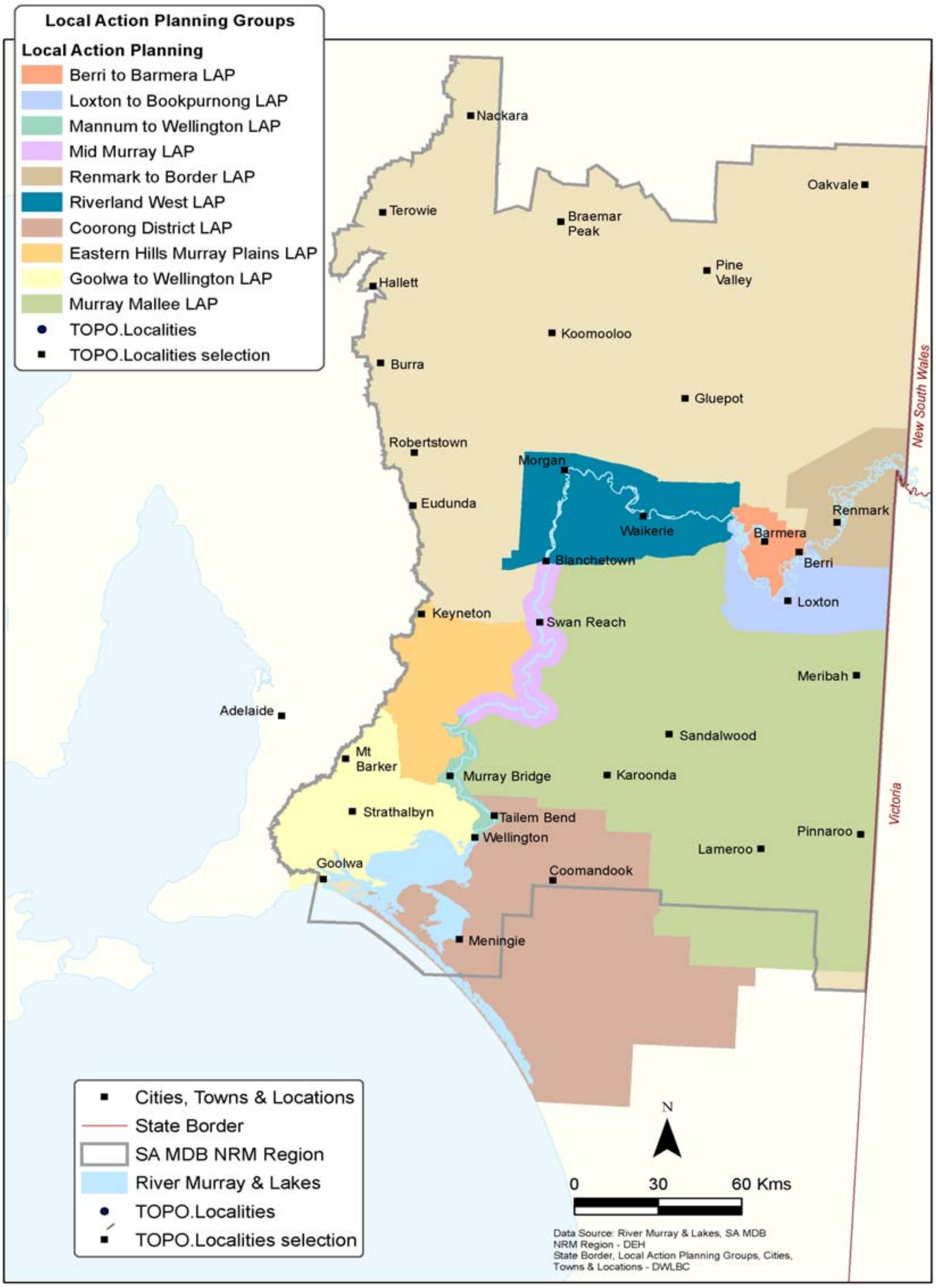

Figure 1. Location plan

Graphs of water levels and salinity are presented from representative observation wells. The names of the networks monitored are also mentioned so that further information can be accessed from the OBSWELL database via the web at this address:

http://applications01.pirsa.sa.gov.au:102/new/obsWell/SearchGroup/startSearch - here

MANNUM TO WELLINGTON

The only observation bores in this LAP area are monitoring the Mypolonga highland irrigation area and the reclaimed swamps at Mypolonga in the 'MYPOLONG' network, and also the Toora and Mobilong reclaimed swamps in the 'MOBILONG' network (Barnett et al, 2003). After some early readings in 1983, monitoring recommenced in 1998 after rehabilitation of the highland delivery system. As shown in Figure 2, trends are downward, not only below highland irrigation (MOB 13), but also in the confined sand aquifer beneath the swamps (MOB 11), indicating positive results from the rehabilitation in reducing accessions to the watertable from leaking infrastructure. The swamp drainage system normally keeps the shallow watertable at a consistent level (MOB 9, 34), however falling river levels and the dramatic reduction in flood irrigation on the swamps have lowered the watertable.

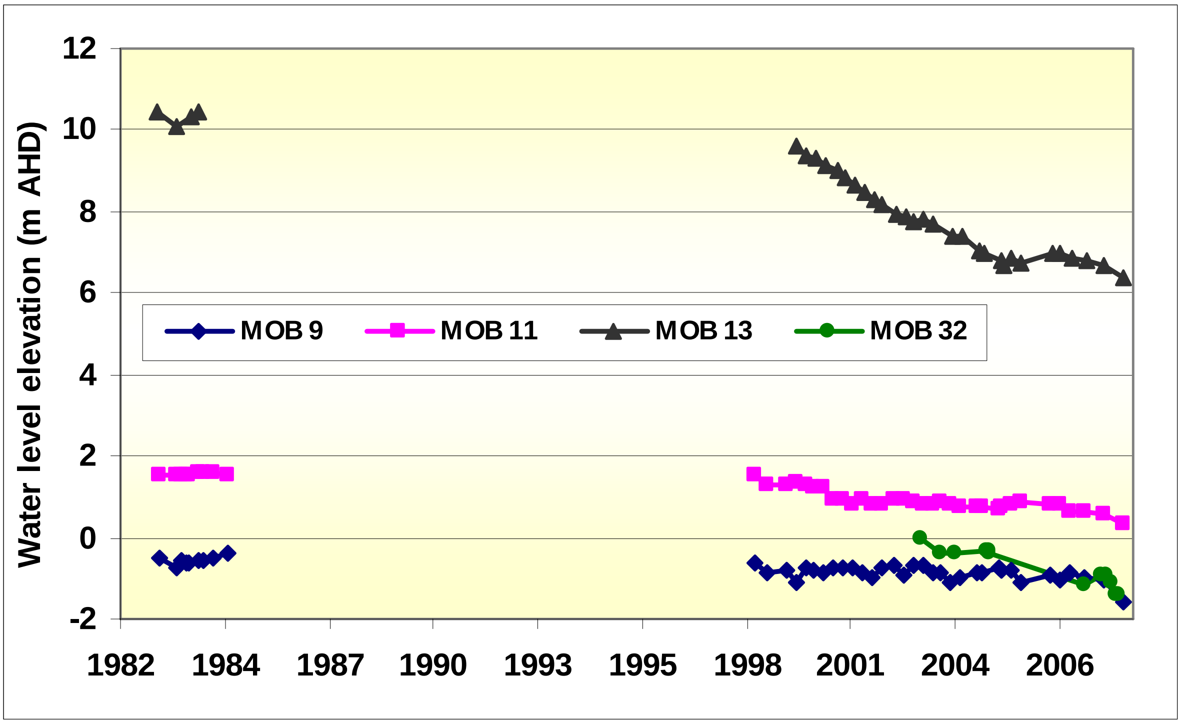

Figure 2. Mannum to Wellington hydrographs

MID MURRAY

There are no observation bores that have been regularly monitored for a long period in this area. However short term monitoring was carried out during 2003 and 2004 to determine the impacts of the lowering of the river level due to low flows, on nearby groundwater levels (Lamontagne et al, 2005). This network (LOWLAKE) extended from Lock 1 to the lower lakes.

RIVERLAND WEST

Several processes affecting groundwater levels are being monitored in this LAP area.

Salt Interception Schemes - About 38 observation wells monitor the performance of the Woolpunda Salt Interception Scheme (WOOLP_IS) which intercepts natural saline groundwater inflows to the River Murray. In Figure 3, PGK 6 gives a representative downward trend watertable levels in response to scheme pumping. The Waikerie Phase 1 SIS intercepts irrigation –induced saline inflows and have 63 observation wells in the WAIK_IS network, with WAK 63 providing a typical trend (Fig. 3). Similarly, the Phase 2 Scheme monitors 55 wells in the WAIK2_IS network and The Sunlands – Qualco groundwater control scheme has 57 bores observation wells (SUNLD_IS), with well 6829-1253 showing the impact of the scheme pumping.

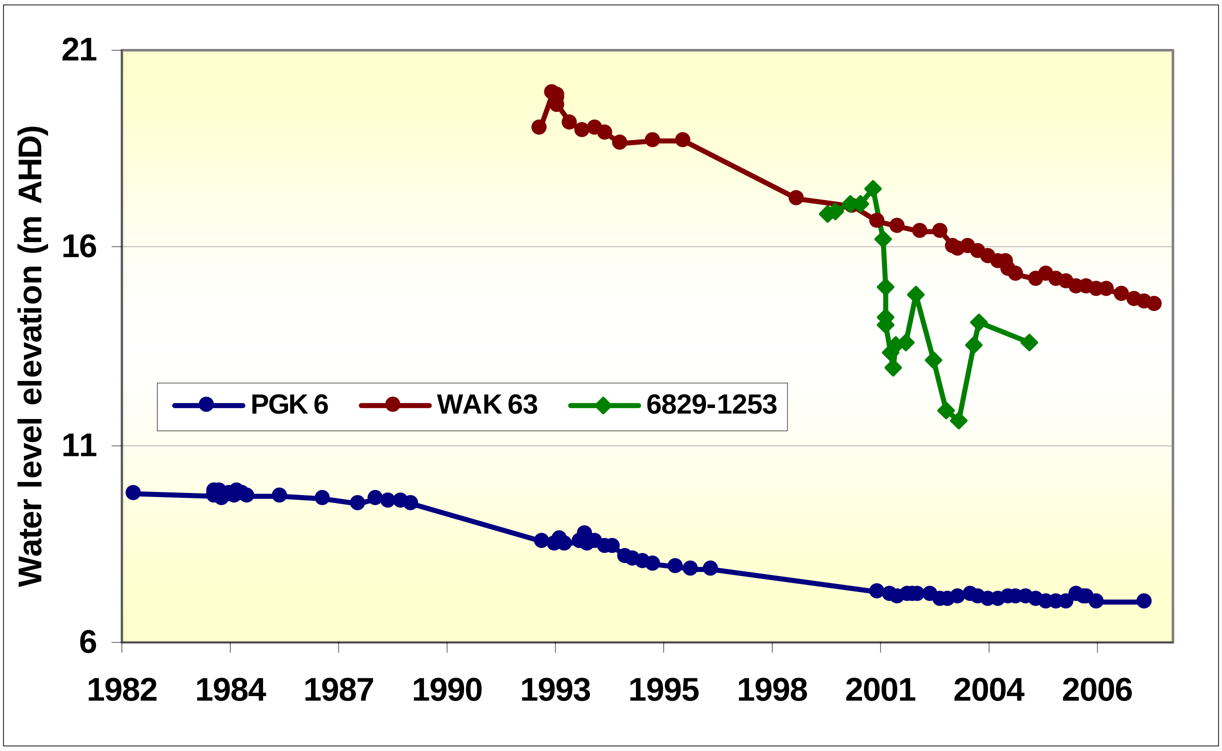

Figure 3. Riverland West hydrographs

Stockyard Plains Disposal Basin – 24 bores are monitoring the impacts of the disposal of groundwater pumped from the above schemes (STOKYARD). WAK 40 shows the significant rise in the regional watertable due to downward leakage from the basin (Fig. 4), while MBK 9 indicates the rise of the shallow perched watertable in direct contact with the basin.

Waikerie Irrigation Area – about 30 bores monitor the condition and extent of the watertable mound caused by drainage beneath the Waikerie irrigation area (WAK-HLD network). WAK 5 shows the impacts of early inefficient irrigation practices (Fig. 5), with later reductions in level due possibly the impact of the interception scheme, or more likely improvements in irrigation efficiency.

Sunlands – Qualco Irrigation Area – in addition to the GCS network, an additional 9 wells monitor the irrigation area, with WAK 46 showing the previous rising trend due to irrigation drainage and the dramatic influence of the groundwater control scheme (Fig. 5).

In some areas to the south of Waikerie, the increase in recharge due to clearing has caused slow rises in the watertable of about 2 cm/year (WAK 32).

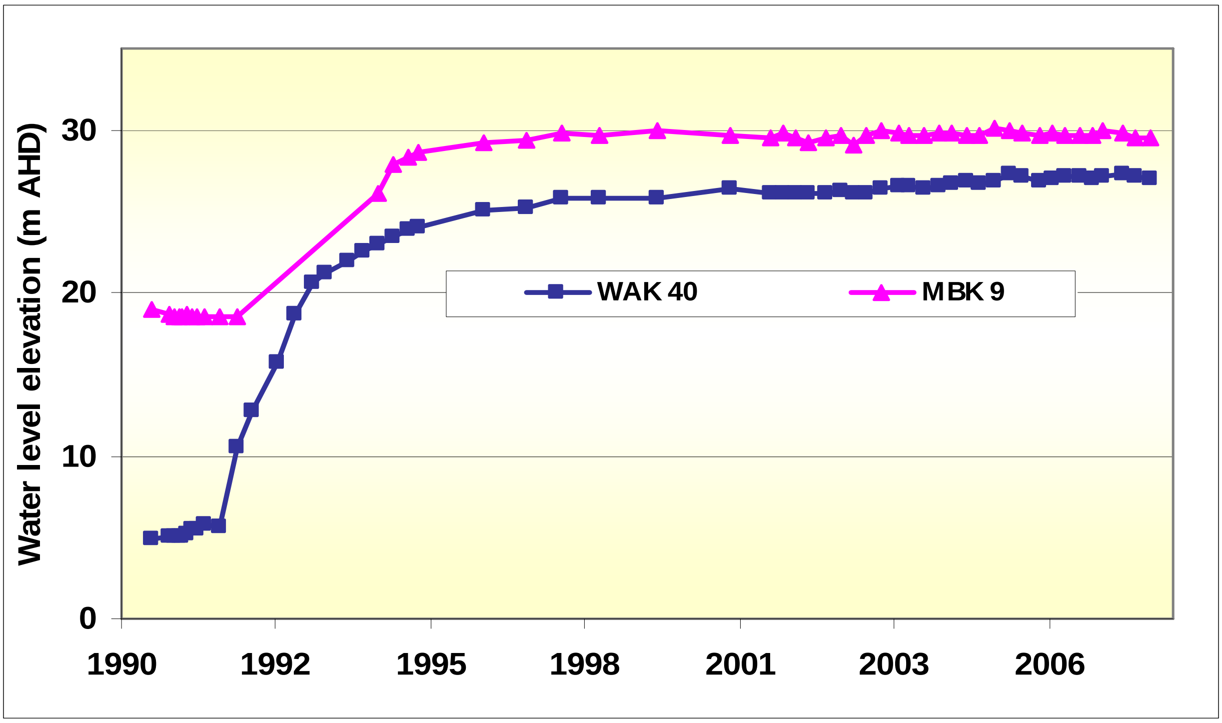

Figure 4. Stockyard Plains hydrographs

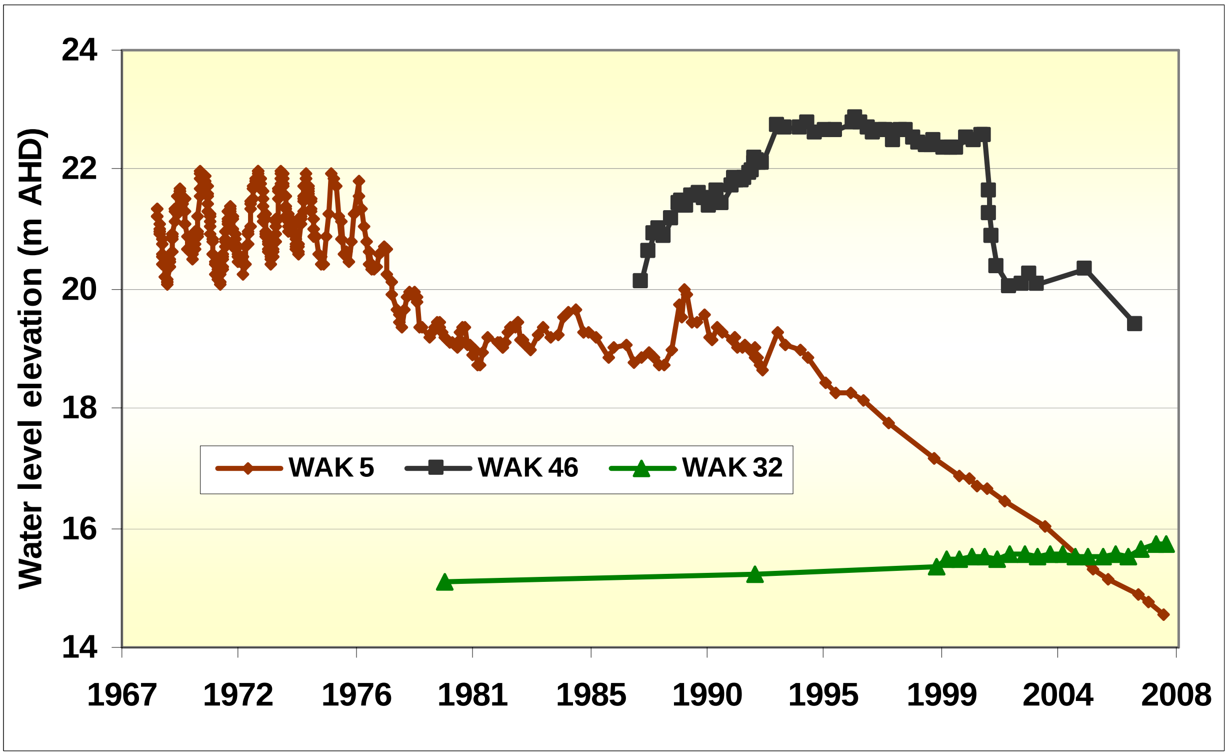

Figure 5. Waikerie and Sunlands irrigation area hydrographs

LOXTON TO BOOKPURNONG

Several groundwater processes are being monitored in this LAP.

Noora Disposal Basin – 51 bores are monitoring the impacts of the disposal of irrigation drainage water pumped to the basin and also regional trends in the Pliocene Sands watertable aquifer and the underlying confined limestone aquifer (NOORA network). GDN 16 shows the obvious rise in the watertable due to disposal to the basin which commenced in 1982 (Fig. 6). The regional watertable rise due to clearing to the south and east of Loxton at a rate of 2 – 3 cm/year is demonstrated by GDN 37. Hydrostatic loading of the deeper confined limestone aquifer by the overlying rising watertable aquifer (more water added to system) which increases the weight bearing down on the elastic confining layer is shown by the rising pressure level of GDN 36.

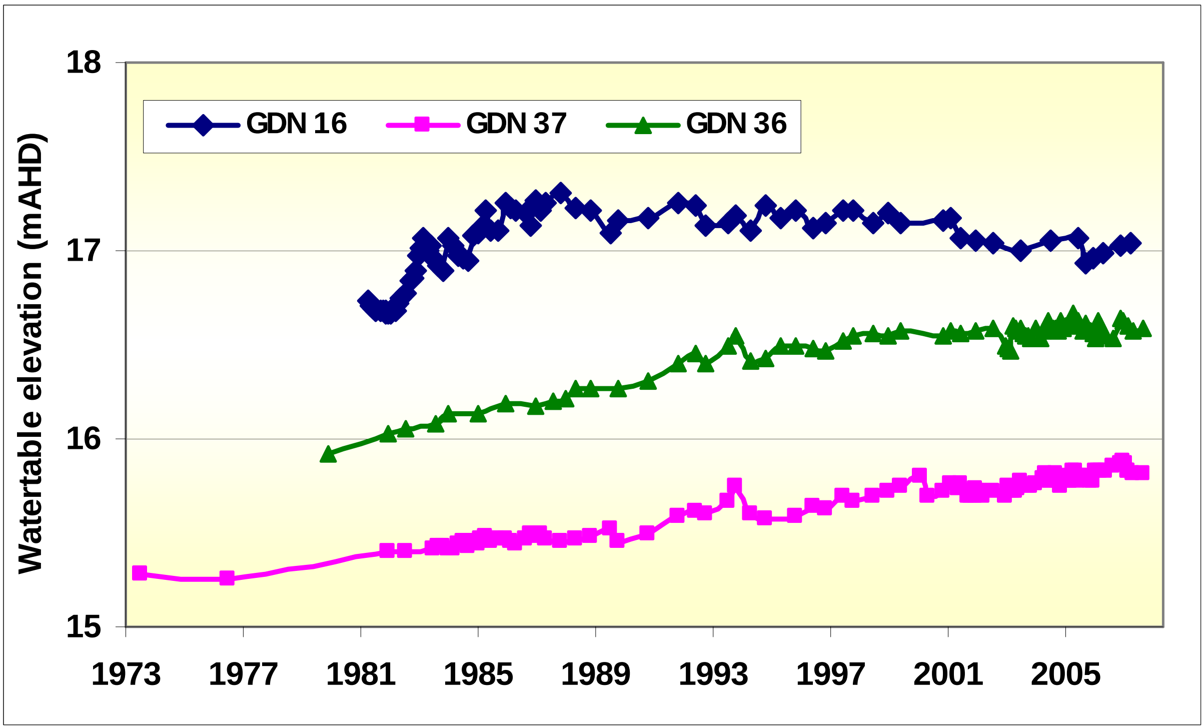

Figure 6. Noora area hydrographs

Loxton Irrigation Area – about 100 wells monitor the condition and extent of the watertable mound (LOXTON_SIS network) caused by drainage from the irrigation area, as well as the partially completed Loxton SIS. BKP 2 and GDN 7 (Fig. 7) shows the rising trend due to irrigation drainage that has stabilised and begun to fall in recent years in response to the rehabilitation of the delivery system and more efficient irrigation practices, and possibly pumping from the SIS which is currently operating on the floodplain. BKP 16 continues to rise slowly on the southern edge of the mound, indicating the mound is slowly expanding laterally, despite decreasing in elevation.

Bookpurnong Irrigation Area – monitoring began in 1987 with two observation wells (GDN 51 and 52). A further eleven were drilled by 1998. Currently, a total of 35 wells monitor the highland and floodplain to observe the watertable mound and the impacts of the Bookpurnong SIS which has been operational since 2006 (BOOKY_SIS network). On the northwestern margin of the irrigation area, wells GDN 52 and 69 are exhibiting a falling trend, most likely as a result of interception scheme pumping and possible improved irrigation practices (Fig. 8). Those located in the center of the mound are stable (GDN 51 and 67). Rising trends occur on the southern side of the irrigated area due to the coalescing of both the Bookpurnong and Loxton watertable mounds (GDN 68).

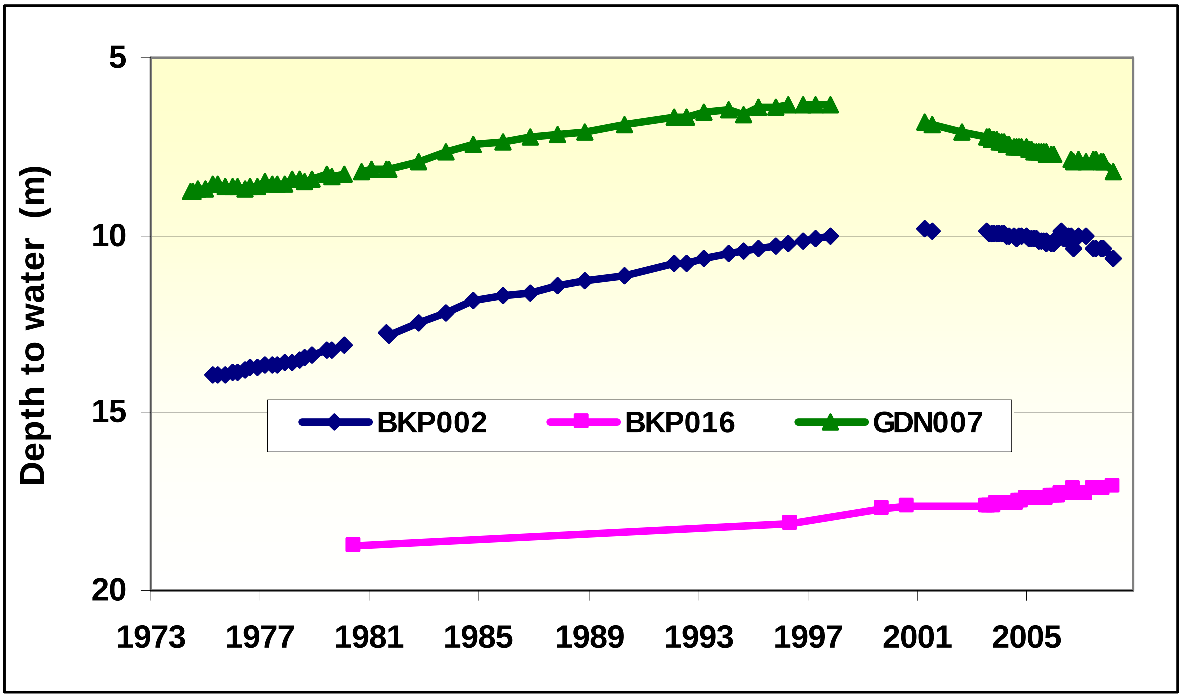

Figure 7. Loxton Irrigation Area hydrographs

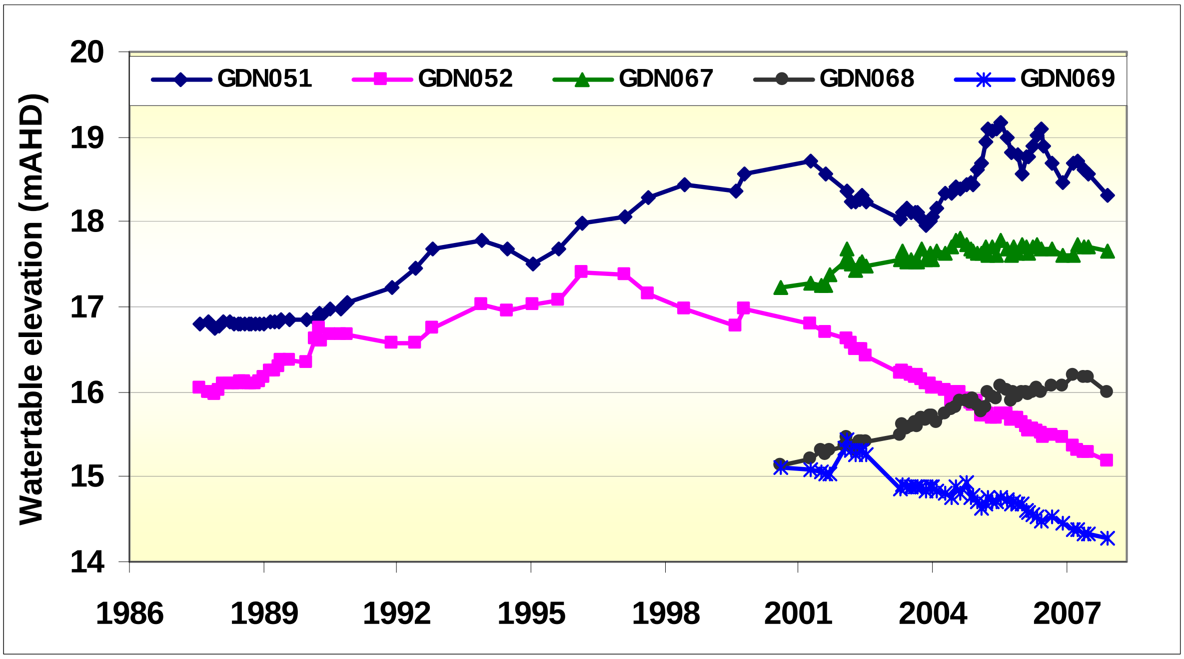

Figure 8. Bookpurnong Irrigation Area hydrographs

Moorook – New Residence Irrigation Areas – about 27 bores monitor the condition and extent of the watertable mounds caused by drainage from the irrigation areas between Kingston and Pyap (MOORNEWR network). MRK 12 shows the rising trend due to irrigation drainage which has reversed since 1993 by rehabilitation of the highland delivery system at Moorook (Fig. 9). PYP 15 shows a typical declining trend due to more efficient irrigation practices in the Pyap area, while PYP 22 shows a rare slowly rising trend due to irrigation drainage. MNT 4 at the western boundary of the LAP area displays a slow rising trend due to vegetation clearance.

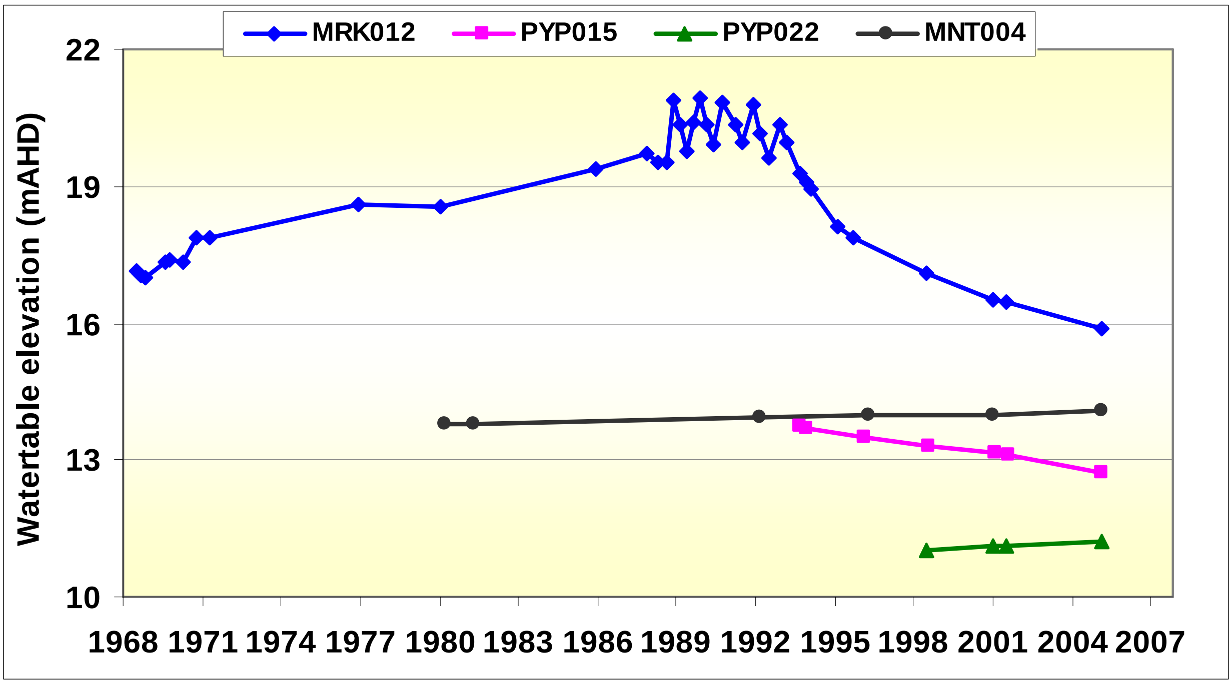

Figure 9. Moorook – New Residence Irrigation Area hydrographs

BERRI TO BARMERA

Monitoring in this LAP is concentrated mainly on the Berri - Barmera Irrigation Areas – about 38 wells monitor the condition and extent of the watertable mound caused by drainage from the irrigation areas between Cobdogla and Berri (BERIBARM network). LVD 4 and RMK 21 (Fig.10) shows the rising trend due to irrigation drainage that has reversed recently by rehabilitation of the highland delivery system and reduced irrigation due to drought. RMK 275 shows the hydrostatic loading of the confined limestone aquifer that mirrors the trend of the overlying watertable aquifer.

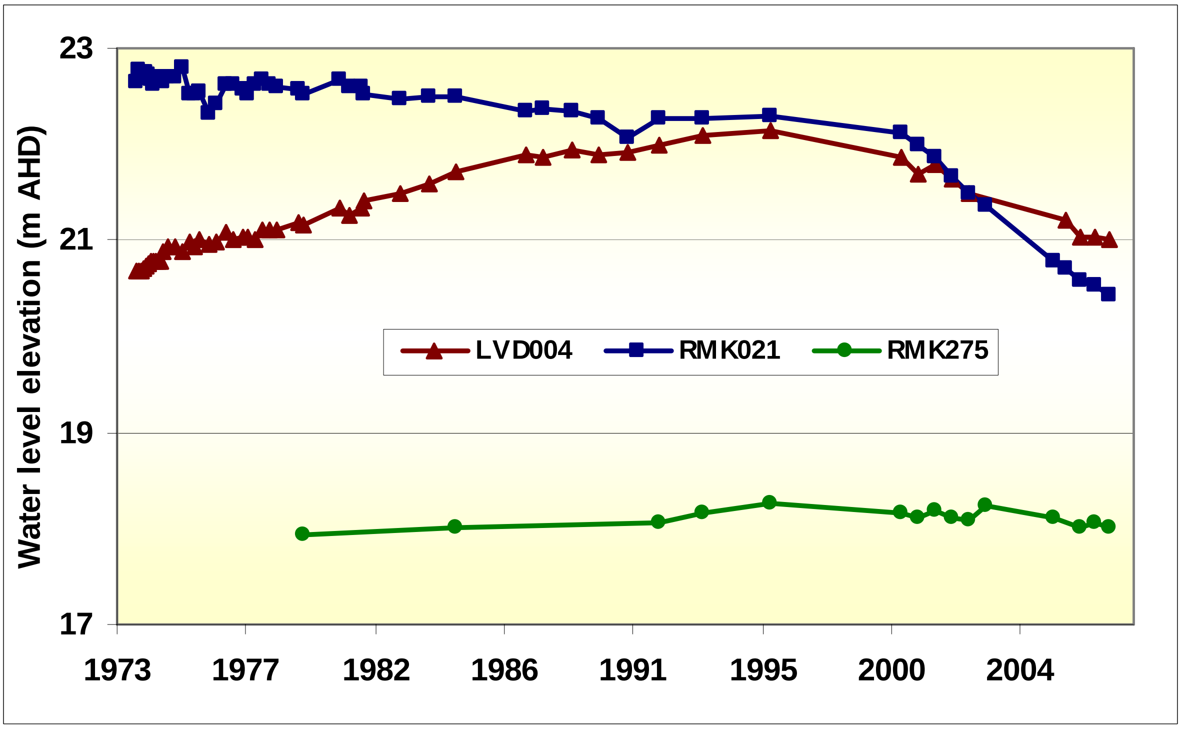

Figure 10. Berri - Barmera Irrigation Area hydrographs

RENMARK TO BORDER

Several irrigation areas are monitored.

Renmark – Cooltong Irrigation Area – about 30 wells monitor this area (RMK-COOL). The watertable beneath the floodplain irrigation area is controlled by drainage and was stable until the early 1990s (RMK 65). Since then, levels have fallen by about two metres due to a combination of reasons – changing crop types and more efficient irrigation practices, reduced applications, and possibly extraction of groundwater by drainage caissons (Fig. 11). However to the west beneath higher ground, the watertable was rising at about 1.5 cm/year (RMK 213) until 2002 when it stabilised and started to decline slowly.

Murtho Irrigation Area – eight wells have been monitoring a small watertable mound beneath the private irrigation along this reach in the MURTHO network which was rising at about 2 cm/year until 2000 (Fig. 11) when it stabilised and started to decline slowly (MTH 1). Since 2000, a further 11 wells have been drilled, most associated with the Murtho SIS which is soon to be constructed.

Pike – Mundic Irrigation Area – about 62 bores monitor the watertable mound beneath this irrigation area (PIKEMURTHO). PAG 44 shows that the rising trend (2 5 cm/year) continued until some parts of the area (Fig. 11).

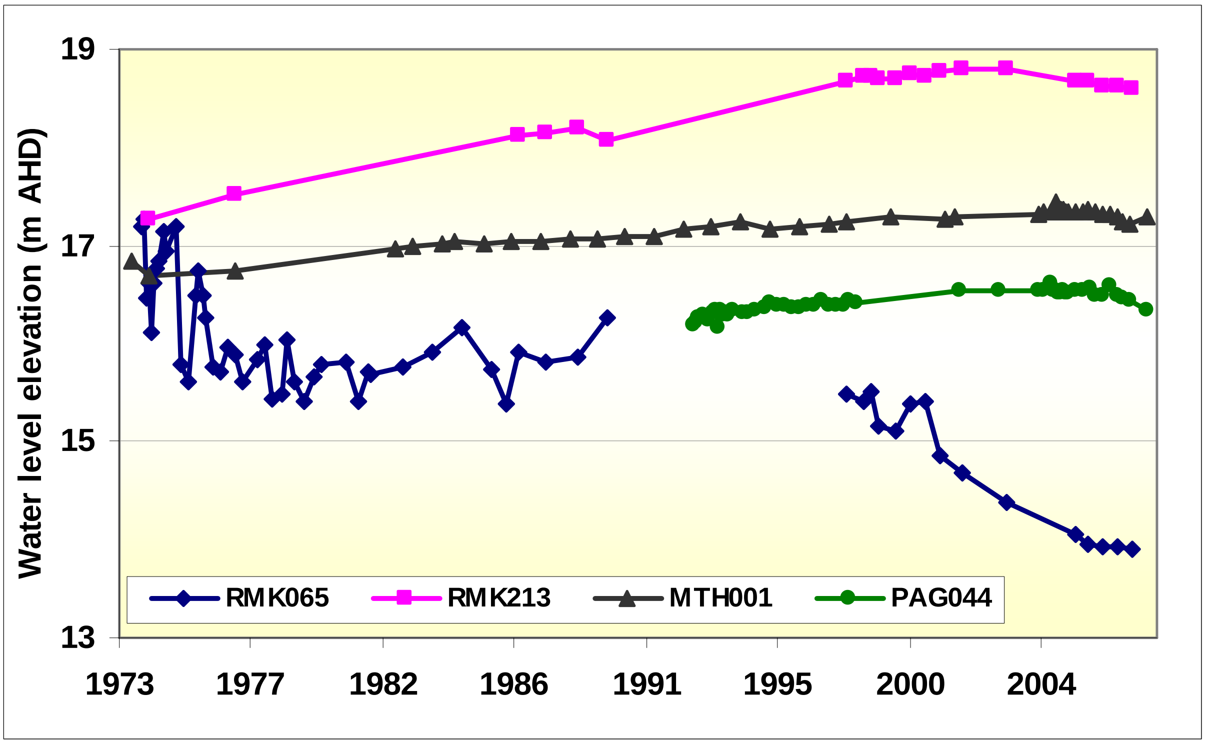

Figure 11. Renmark to Border Irrigation Area hydrographs

MURRAY MALLEE

Monitoring here has been carried out since 1982 in the MALLEE network. The latest monitoring status report (Barnett, 2006), presented water level and salinity trends together with metered extraction data. It found no major adverse impacts due to irrigation extractions from the Murray Group Limestone aquifer, and has continued to confirm the robustness of the groundwater resource. Figure 12 shows some representative water level trends.

Most wells located away from the irrigation areas are showing no trends because of the small recharge rates and deep watertable (KKW 1). However some small rises of 1 – 2 cm/year have been detected between Karoonda and Waikerie as a result of native vegetation clearing (MMJ 1). In the Parilla – Pinnaroo – Peebinga area of the Mallee PWA, irrigation has caused seasonal drawdowns of up to 16 m (PEB 24, 25). Where the pumping volumes have remained relatively constant, the drawdowns have stabilised. The sudden increase in drawdown during the 2007/08 season is being investigated and may be a compliance issue.

Salinity trends are stable (Fig. 13), or decreasing in some areas where drawdown is accelerating the inflow of lower salinity groundwater from the south.

The monitoring status report can accessed at the following link ;

http://www.dwlbc.sa.gov.au/assets/files/dwlbc_report_2006_28_web.pdf

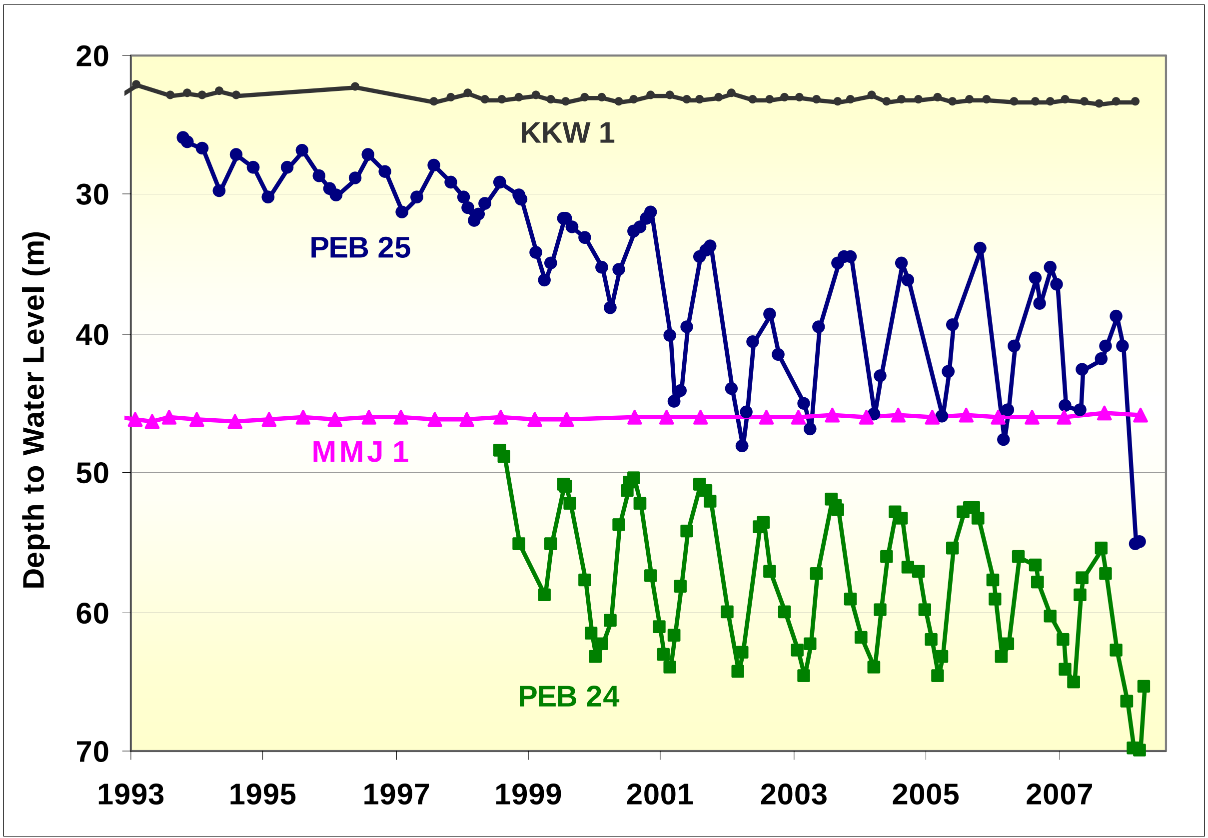

Figure 12. Mallee PWA hydrographs

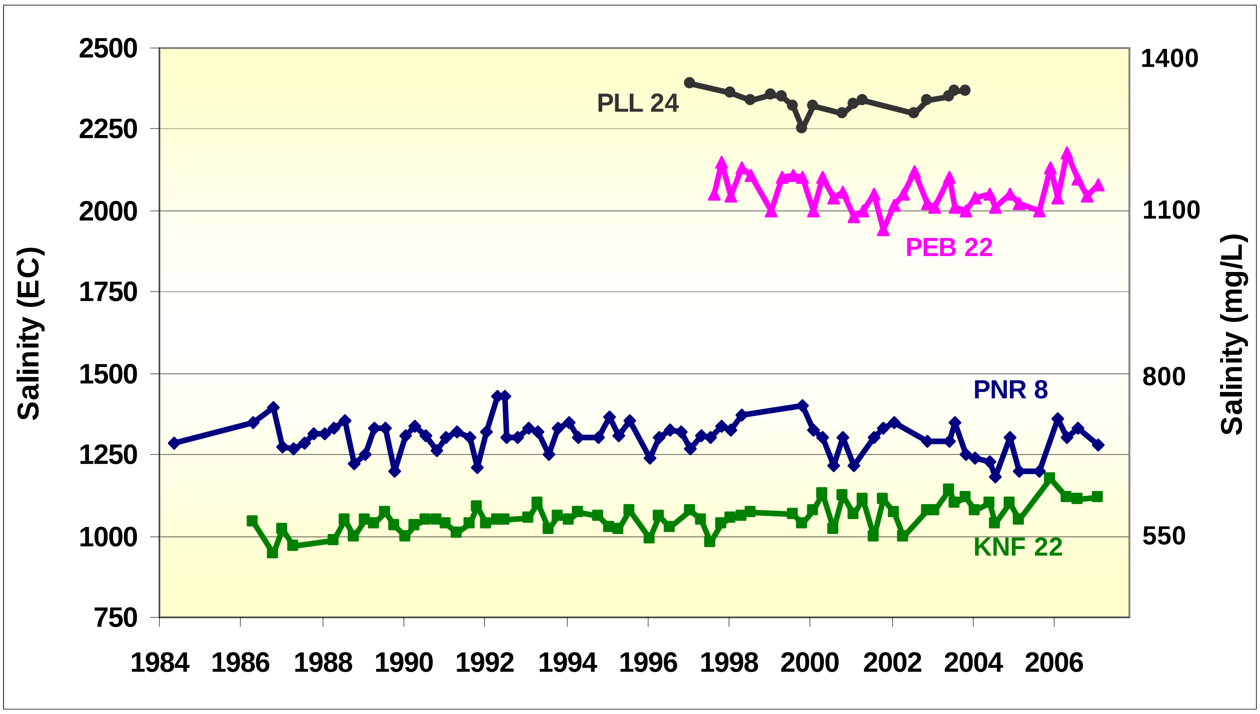

Figure 13. Mallee PWA salinity graphs

EASTERN HILLS –MURRAY PLAINS

In the Mt Lofty Ranges part of the LAP area, groundwater trends usually follow winter rainfall ie wet winters will cause a rise in watertable whereas recent dry winters have resulted in a falling watertable as shown by JEL 28 (Fig. 14). The only long term monitoring carried out in the hills is a small network of 16 wells around Keyneton (KEYNETON). On the plains, monitoring in the Marne – Sedan area has been carried out since 1980, with currently about 34 wells monitored. Recharge from streamflow in the Marne River is the dominant factor in changing groundwater levels in the limestone aquifer, with irrigation having a lesser impact (ANG 10). Reduced stream runoff in recent dry years has reduced the watertable level. Away from the river valley, there are no discernible trends (BAG 2) due to the low rainfall and thick clay layer at the surface which results in low recharge.

Salinity monitoring of the limestone aquifer has shown reasonably stable trends (Fig. 15), with some small increases observed in some wells probably in response to reduced recharge from stream flow. ANG 18 which has previously shown a steady rise due to possible recycling of irrigation drainage, has shown a recent decline, possibly in response to better irrigation efficiency.

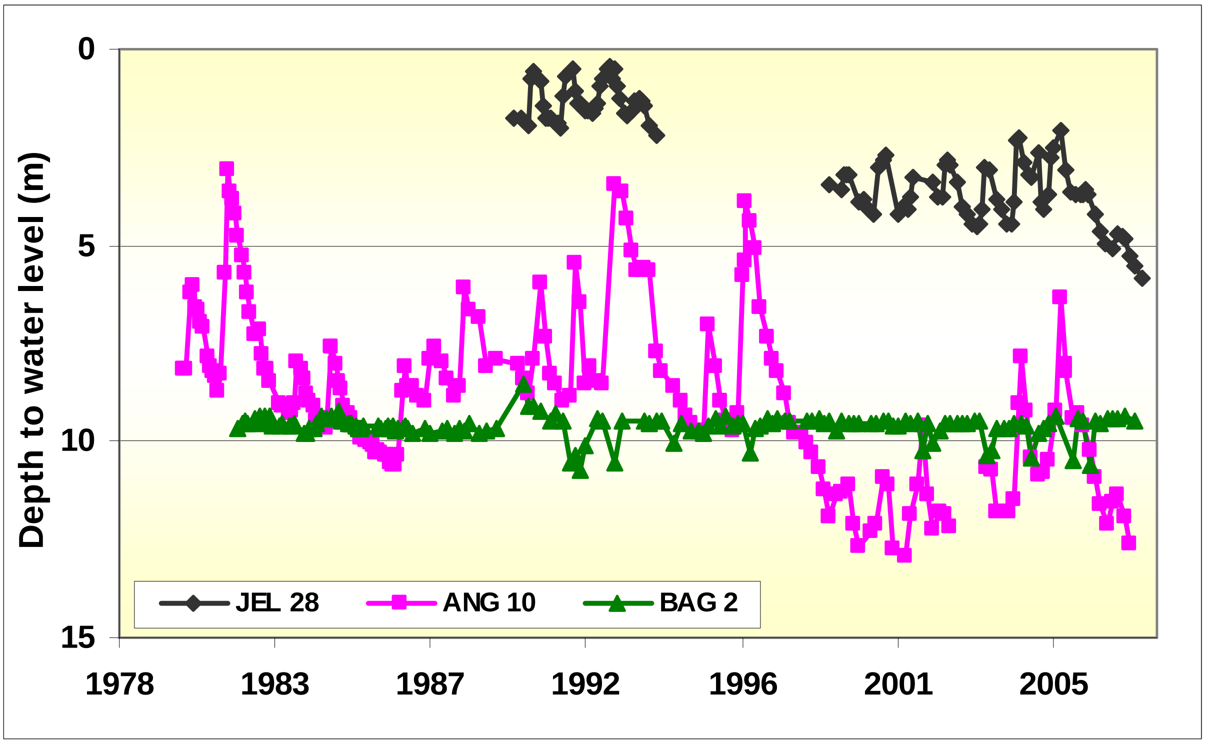

Figure 14. Eastern Hills –Murray Plains hydrographs

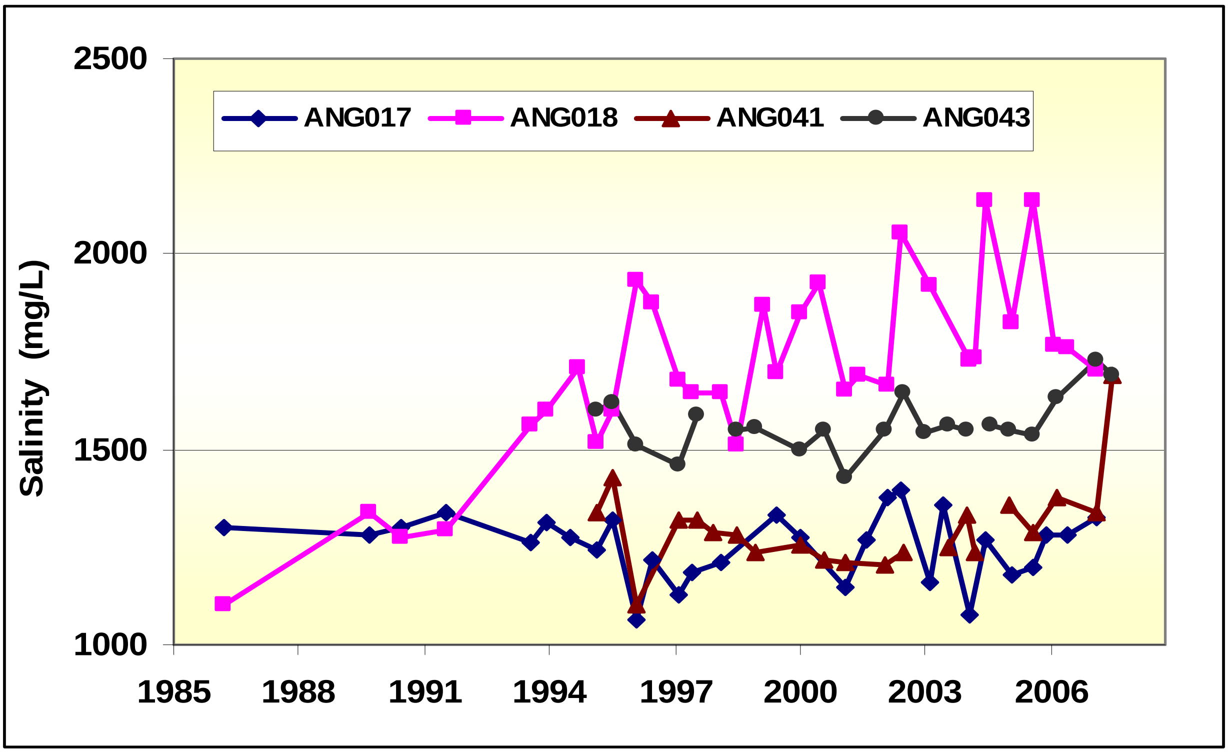

Figure 15. Marne – Saunders PWA salinity graphs

GOOLWA TO WELLINGTON

There are seven monitoring networks in three different groundwater environments in this LAP area.

Angas-Bremer PWA – Monitoring has been carried out since 1969, with 86 wells currently in the ANGBRM network. Irrigation extraction from the confined limestone aquifer has caused a steady decline in groundwater levels over the years until the very wet 1992-93 season and the transfer of water licences from groundwater to Lake Alexandrina led to a significant reduction in groundwater extractions a large recovery of pressure levels in the confined limestone aquifer (Zulfic and Barnett, 2007), with an average rise of 0.15 m/yr as shown in Figure 16 (BRM 7). A similar trend has been observed in the overlying Quaternary aquifer (BRM 222).

http://www.dwlbc.sa.gov.au/assets/files/ki_dwlbc_report_2007_27.pdf

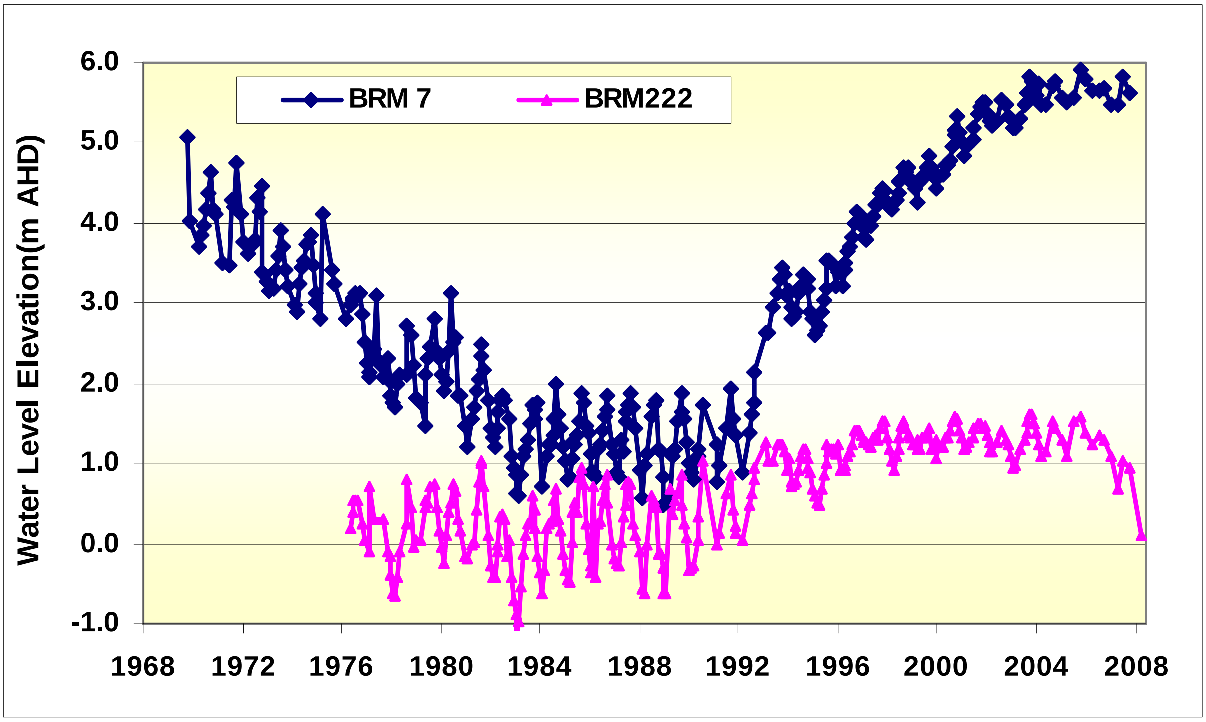

Figure 16. Angas – Bremer PWA hydrographs

Despite the large recovery in limestone pressure levels, salinity levels are continuing to increase at an average rate of ~20 mg/L/yr since 1993 (Fig. 17), driven by lateral inflow of more saline groundwater from upgradient of extraction areas, and downward leakage from the Quaternary aquifer. There is virtually no current recharge of low salinity water to the confined aquifer and consequently, slow salinity rises are expected even at low extraction rates.

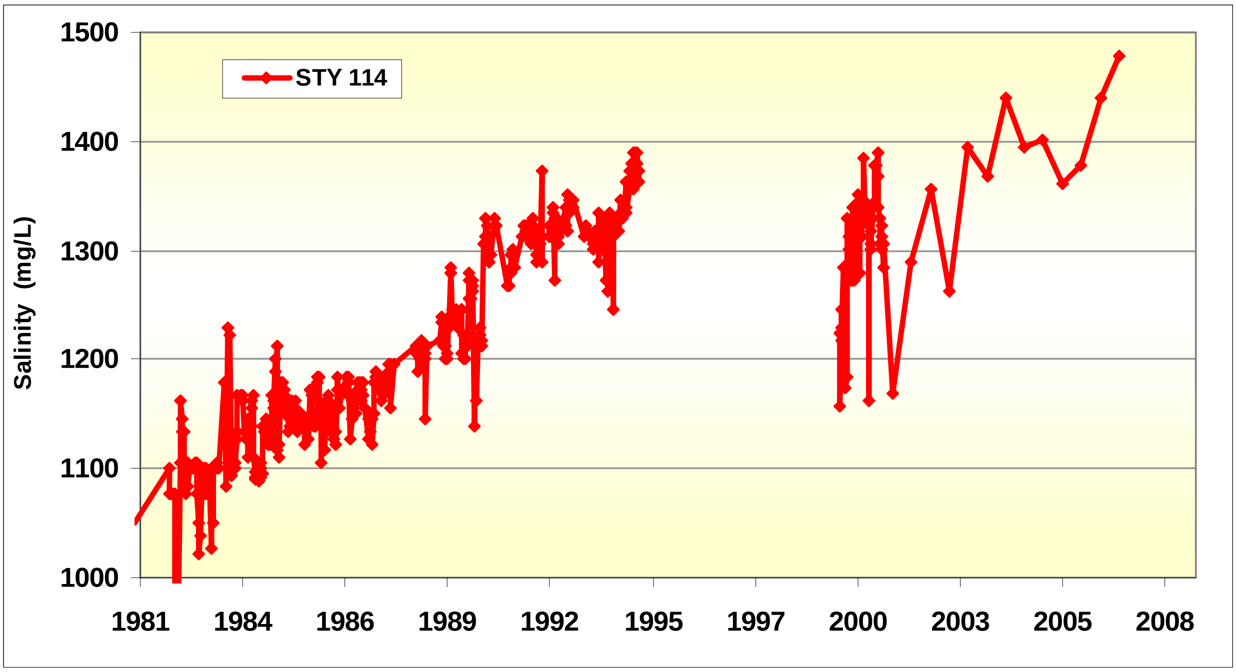

Figure 17. Angas – Bremer PWA salinity graph

Five observation wells have been monitoring water levels in the Permian Sand aquifer in the Mt Compass area of the Tookayerta catchments since 1988 (Fig. 18). An additional twenty wells were added in 1998 which covered the whole of the Tookayerta catchment (MTCOMPAS). In general, the groundwater levels show a subdued respond to rainfall (blue line in Fig. 18), with little influence from irrigation observed at present.

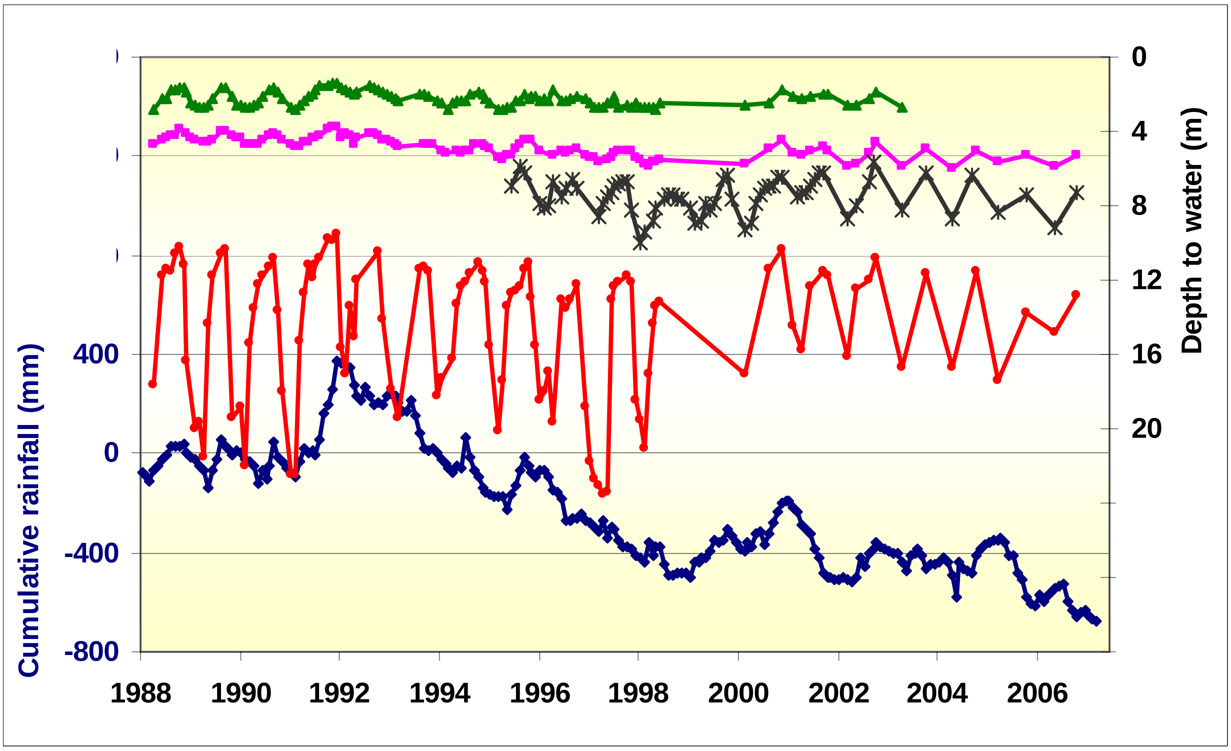

Figure 18. Tookayerta catchment hydrographs

In the Finniss Catchment, 18 wells monitor the Permian Sand aquifer near Ashbourne, where irrigation extraction results in a seasonal drawdown of 2 – 4 m as shown by KND 3 in Figure 19. Here, the Permian Sand aquifer is mostly confined with little variation in the pressure level trend apart from the recent very dry years (KND 5).

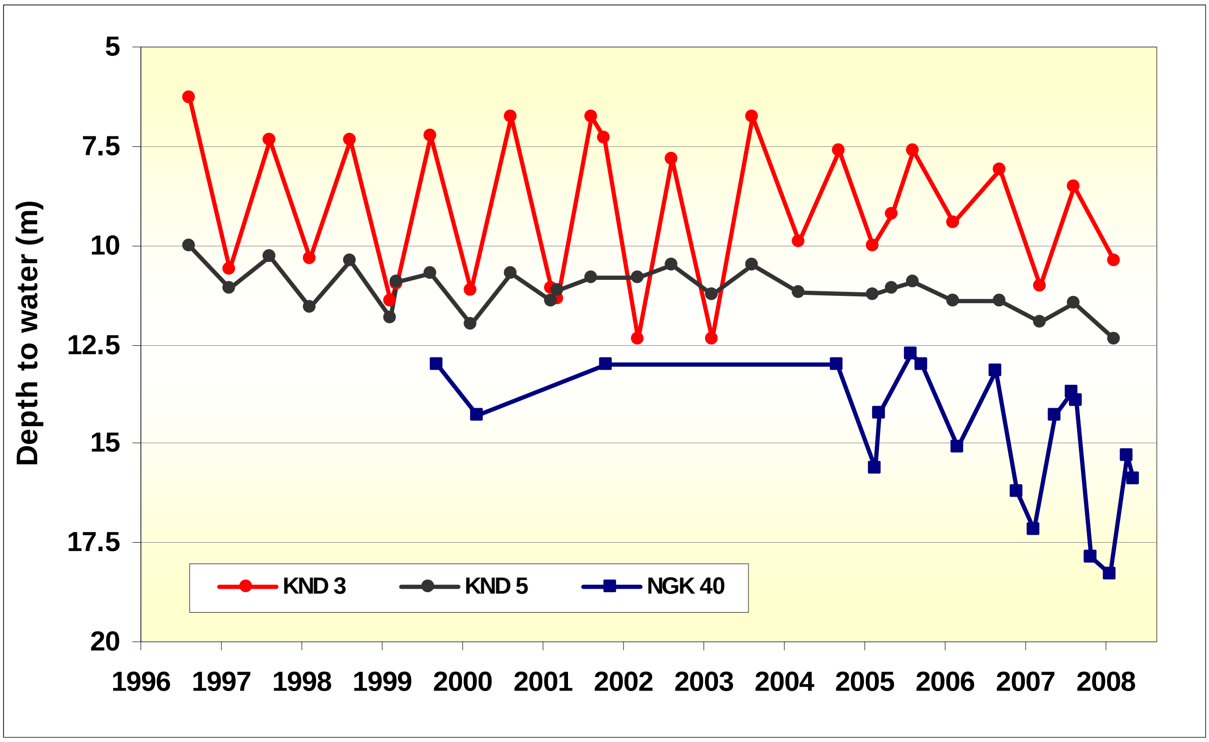

Figure 19. Finniss catchment hydrographs

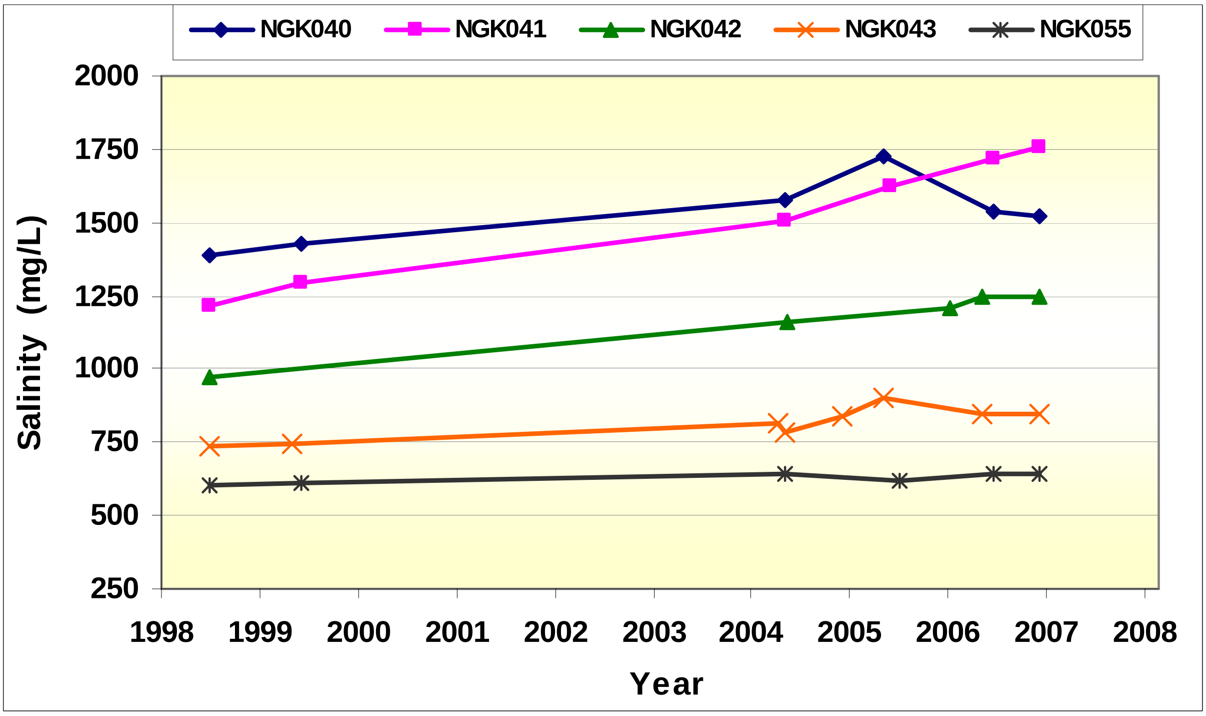

Figure 20. Currency Creek salinity graphs

At the southern end of the Finniss Catchment, extraction from the confined Murray Group limestone in the Currency Creek area has lead to declines in pressure levels (NGK 40 in Figure 19), particularly in recent years when surface water supplies have become too saline for irrigation. Barnett (2007) has identified similar sustainability issues as experienced at Langhorne Creek with increasing salinities (Fig. 20) indicating depletion of limited fresh groundwater reserves that are not being currently recharged.

http://www.dwlbc.sa.gov.au/assets/files/dwlbc_technote_2007_10.pdf

About 40 wells in the CURR_CRK network are monitored for water level and salinity in the fractured rock and Permian Sand aquifers in the lower Finniss Catchment, as well as the confined limestone aquifer in the Currency Creek area.

Elsewhere within the Mt Lofty Ranges, two networks monitor the fractured rock aquifer in the Mt Barker (five wells in the MTBARKER network) and Macclesfield areas (17 wells in the MCFIELD network). In general, as in other areas in the Ranges, groundwater trends follow rainfall as can be seen in Figure 21. However in the Mt Barker area, the impacts of vegetable irrigation can be seen in the large seasonal drawdowns in the late 1990s (MCF 7, 11). Urban encroachment has reduced the area of irrigation and the drawdowns since 2000.

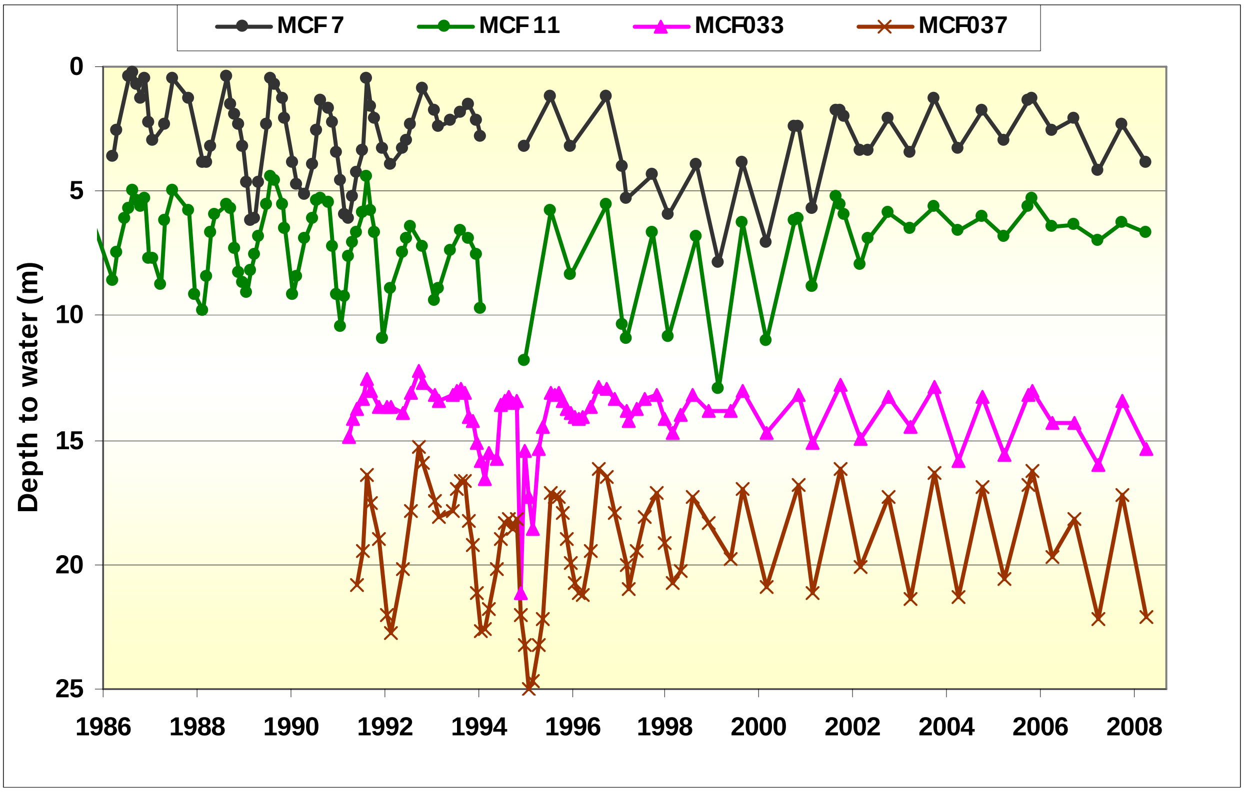

Figure 21. Mt Barker and Macclesfield hydrographs

COORONG DISTRICT

Monitoring in the SA MDB NRMB portion of the Coorong District LAP area commenced in 1987 with a network of 27 wells (COASTPLN) to measure rising watertables and predict the impacts of dryland salinity. Figure 22 shows the initial rising trends until 2000, and the subsequent falling levels in response to below average rainfall in recent years. BKR 8 on the Narrung Peninsula in particular, displays a dramatic decline of over a metre and is probably influenced by falling water levels in Lake Albert.

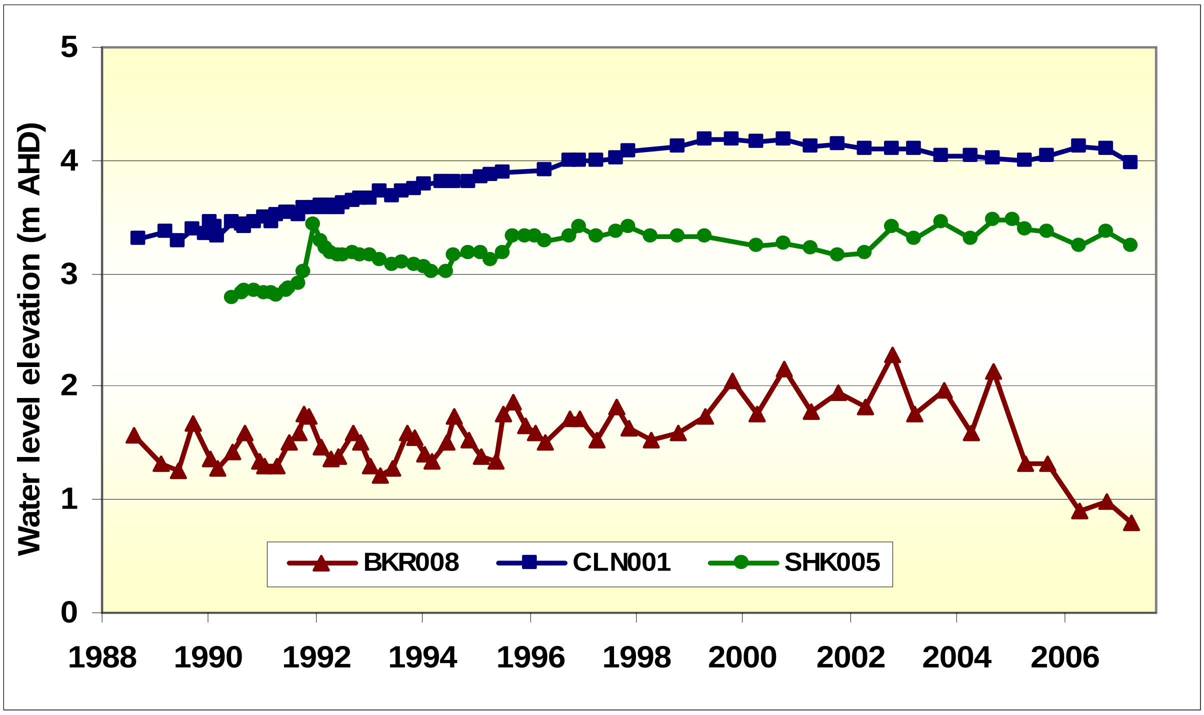

Figure 22. Coastal Plain hydrographs

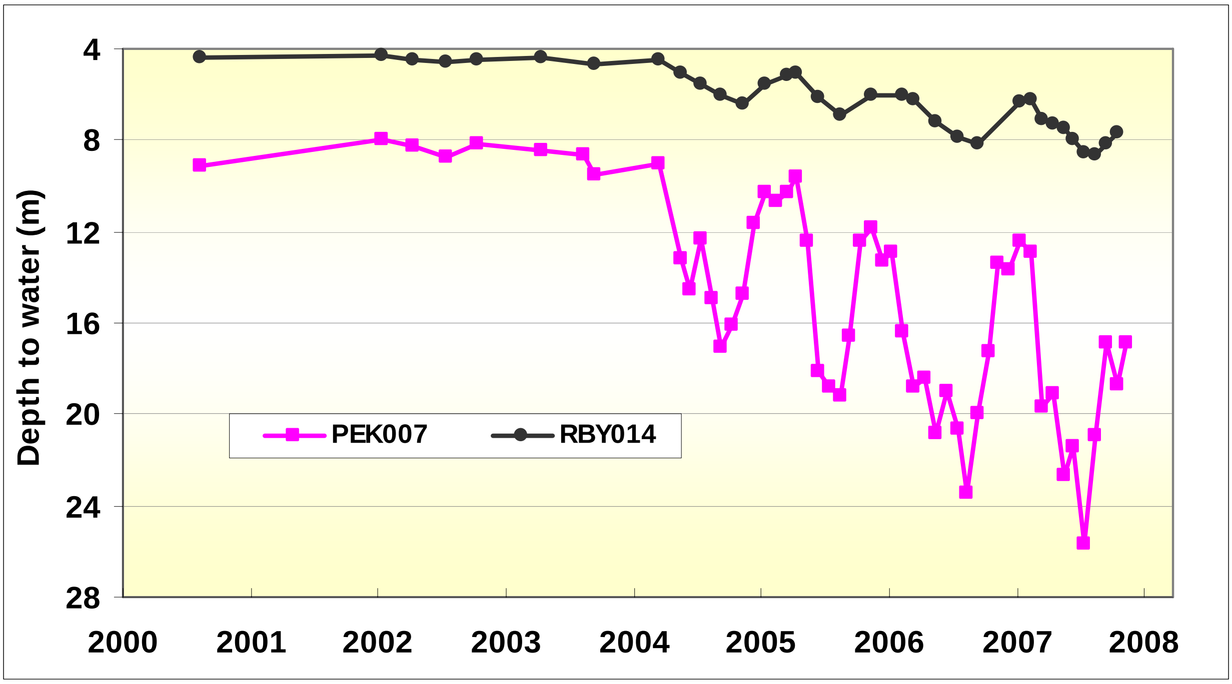

Figure 23. Peake-Roby-Sherlock PWA hydrographs

The recent commencement of irrigation in the Peake-Roby-Sherlock PWA utilising the confined Renmark Group aquifer has resulted in a sudden increase in pressure level drawdowns as shown in Figure 23. The capacity of the resource (Barnett and Yan, 2008) is based on minimising salinity increases due to flow reversal caused by the drawdowns. Groundwater salinity monitoring commenced in 2006, but it is too early to detect any long term trends.

SUMMARY

Impacts from irrigation are the biggest influence on groundwater levels and salinity within the SA MDB NRMB area. In the Riverland, drainage beneath highland irrigation areas has formed watertable mounds which have displaced saline groundwater to the River Murray and floodplain. In recent years, the levels of the mounds have stabilised and are beginning to decline as a result of interception scheme pumping, rehabilitation of the delivery systems and improved irrigation practices. This declining trend is expected to continue as a result of reduced irrigation applications due to the drought.

Drawdowns in pressure levels due to irrigation extractions have occurred from the confined Murray Group Limestone aquifer in the Mallee PWA, and the confined Renmark Group aquifer in the Peake-Roby-Sherlock PWA. Monitoring and modelling suggest that these drawdowns will not have significant adverse impacts on the resource.

Rising groundwater salinity levels in the confined Murray Group Limestone aquifer are a cause for concern in the Angas-Bremer PWA and the Currency Creek area in the Eastern Mt Lofty PWRA. In these areas, the low salinity groundwater is not currently being recharged and hence extractions are depleting the resource.

Rises in groundwater levels due to native vegetation clearance have slowed due to recent dry years, with falls in levels gradually becoming apparent in most areas.

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