TECHNICAL NOTE 2006/07

Department of Water, Land and Biodiversity Conservation

OBSERVATION WELL DRILLING PROGRAM IN THE CADELL AND RENMARK AREAS, AND IMPLICATIONS FOR RIVER MURRAY SALINITY MITIGATION

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INTRODUCTION

Groundwater monitoring is an essential part of irrigation management in the Riverland because it indicates where watertable mounds beneath irrigation areas are rising (often with negative impacts on the floodplain environment and river salinity), and also measures the effectiveness of rehabilitation and other salinity amelioration works. In 2005, the DWLBC Salinity Response Team in Berri initiated a project to upgrade the existing observation well networks in the highland irrigation areas of Cadell and Taylorville, and also in the Renmark area on the river floodplain.

Drilling sites were selected after examining the coverage of the existing network, and the existence of alternative observation points, such as the floating flag wells in the Cadell area.

DRILLING PROGRAM

During early January 2006, three wells averaging 12 metres in depth were drilled in the Cadell area (C3, C5 and C6). Unfortunately, the two highland wells (C1 and C2) encountered very hard calcrete and cavities in the limestone which resulted in lost circulation of the drilling mud, and consequently were completed at a later date with a larger drilling rig. A shallow hole (C7) was hand augered in the saline area to the north of the Training Centre in October 2006. The eight holes drilled on the Renmark floodplain were completed in June 2006. Geological logs for all wells are presented in Appendix A.

Table 1. Observation well construction details

Project No.	Unit No.	Obs Well No.	Completion interval (m)	Aquifer	SWL (m bgl)	Salinity (mg/L)
Cadell						
C 1	6829-1533	CAD 24	26 - 29	MGL	25.08	29 470
C 2	6829-1535	CAD 25	26.5 – 29.5	MGL	26.51	22 340
C 3	6829-1532	CAD 15	7.7 – 10.7	MS	7.14	590
C 5	6829-1531	CAD 18	9 - 12	MS	3.18	705
C 6	6829-1530	CAD 22	9 - 12	MS	7.48	583
C 7	6829-1539	CAD 26	1.2 – 2.2	CF	0.45	
Taylorville						
T 1	6829-1534	MAK	25 - 30	MGL		
Renmark						
RR 1	7029-2268	RMK 339	5 - 8	MS	3.42	45 500
RR 2	7029-2269	RMK 340	6 - 8	MS	2.24	23 285
RR 3A	7029-2270	RMK 341	1- -2	CF	1.65	
RR 3B	7029-2271	RMK 342	6.5 – 8.5	MS	1.63	45 150
RR 4A	7029-2272	RMK 343	2 - -3	CF	1.80	
RR 4B	7029-2273	RMK 344	6.5 – 8.5	MS	1.73	46 200
RR 5A	7029-2274	RMK 345	1.5 – 3.	CF	2.44	
RR 5B	7029-2275	RMK 346	8.5 – 10.5	MS	2.31	44 170
RR 6	7029-2276	RMK 347	5.5 – 8	MS	3.38	5493
RR 7	7029-2277	RMK 348	7 – 10	MS	4.41	17 113
RR 8	7029-2278	RMK 349	8.5 – 11.5	MS	4.42	47 670

CADELL

The Cadell Irrigation Area is established in an abandoned meander loop of the River Murray and consequently, is underlain mostly by floodplain sediments. The observation network established as a result of this program is the first in this area. In 1989, CIT requested recommendations from the Department of Mines and Energy for drilling such a network, but no action was taken by CIT after they were received. Figure 1 shows the location of the network and the observed watertable elevation contours in mAHD. It shows a small watertable mound beneath the irrigated area about 3 m above the normal pool level with quite low salinities (below 700 mg/L).

The water level at CAD 26 in the salinised evaporation basin adjacent to the river is 4.6 mAHD (after being density-corrected) compared to the normal river level of 3.1 m. This gradient toward the river has been detected by the instream NanoTEM which shows a high conductivity (in yellow) close to the river. Actual groundwater fluxes are probably low as the 2006 Run of River detected only 1.4 t/day/km downstream from the basin.

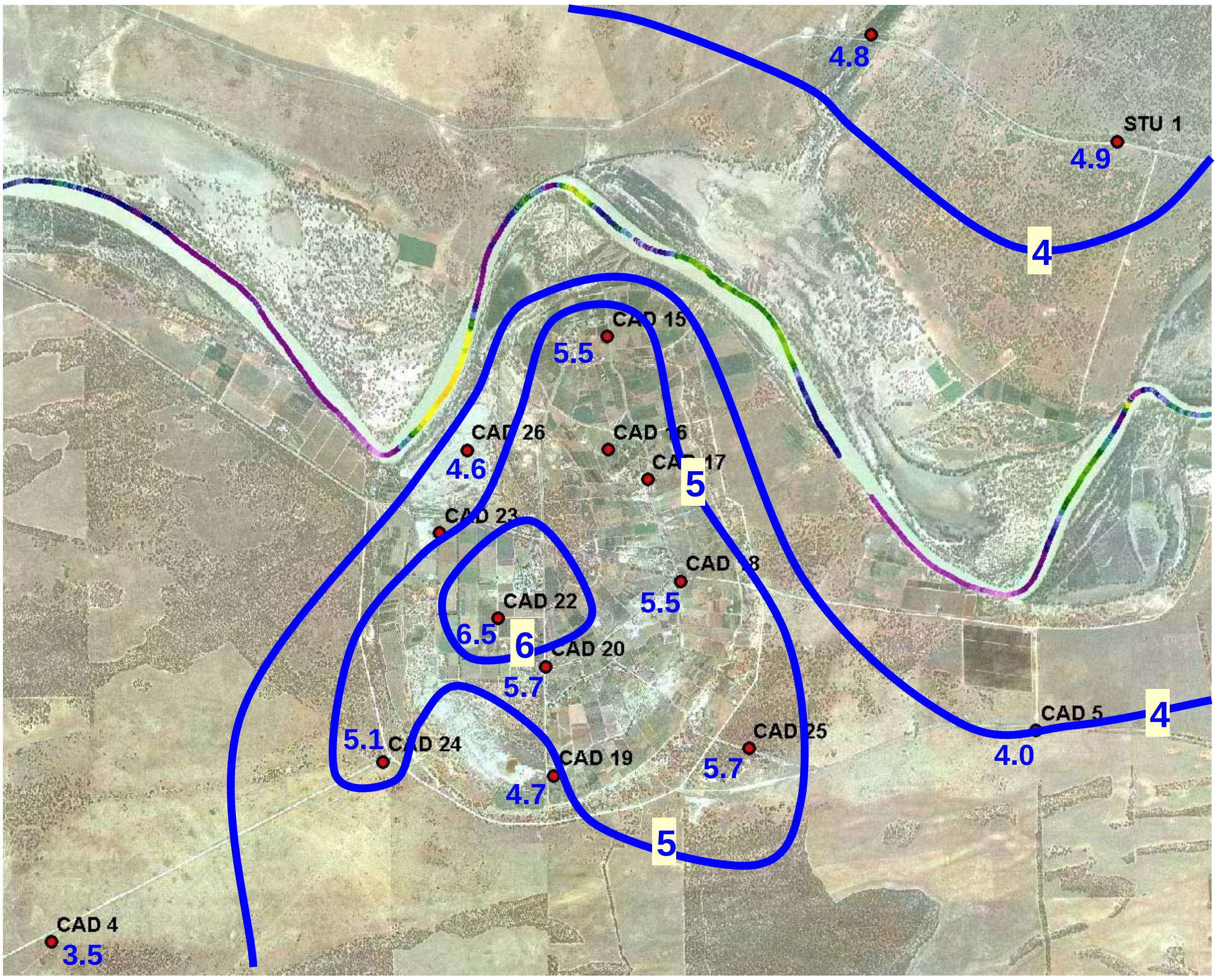


Figure 1. Location of Cadell observation wells and watertable contours

Figure 2 displays recent water level trends for representative observation wells. The regional watertable levels (CAD 4) are static, whereas the remainder show steady declines ranging from 0.5 m/yr in CAD 22 at the top of the mound beneath the Training Centre, to about 0.1 - 0.2 m/yr elsewhere in the irrigation area. It is not known if these declining trends have been consistent at these observed rates since rehabilitation of the water delivery system occurred in 1999.

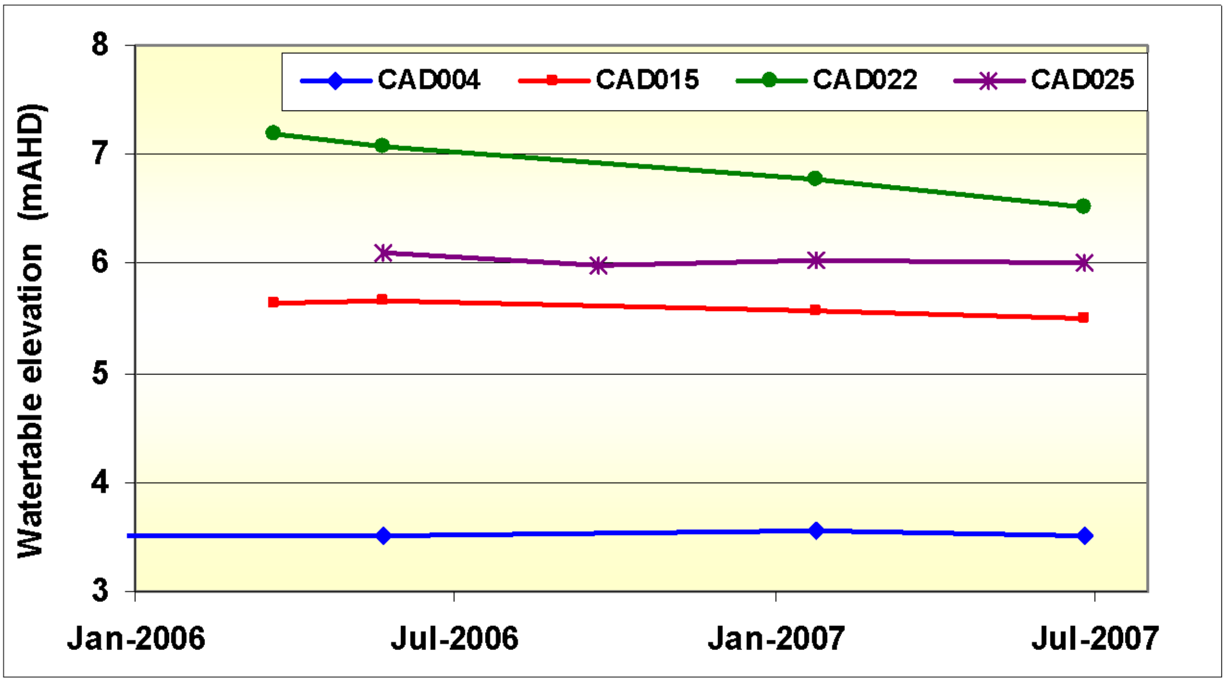


Figure 2. Hydrographs of Cadell observation wells

TAYLORVILLE

Taylorville has had an established observation network since 1985. Only one additional well was drilled in this program to extend the network to the northeast where future irrigation is planned. Figure 3 shows the location of the network and the observed watertable elevation contours in the regional aquifer in mAHD.

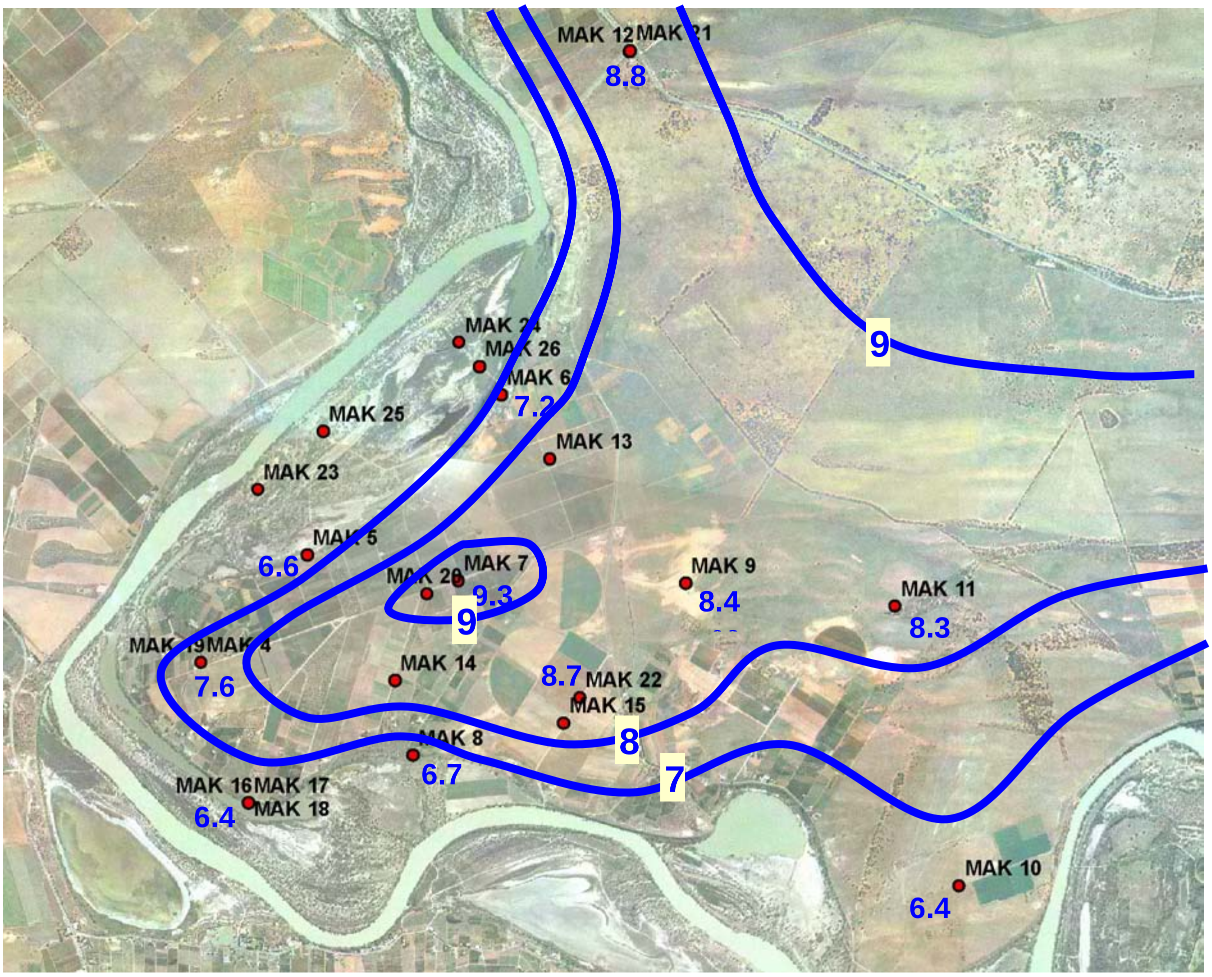


Figure 3. **Location of Taylorville observation wells and watertable contours**

RENMARK

Renmark Irrigation Area has had an established observation network since 1974. The additional wells drilled in this program extended the network closer to Ral Ral Creek to the east, and the River Murray to the south, in order to better understand mechanisms of saline groundwater discharge to the river. Figure 4 shows the location of the network and the observed watertable elevation contours to the north of Renmark. The location of the wells drilled in this program are shown as blue dots. At all sites, the main completion was in the Monoman Sands aquifer, but at three sites, additional casing was inserted to measure the overlying Coonambidgal Formation.

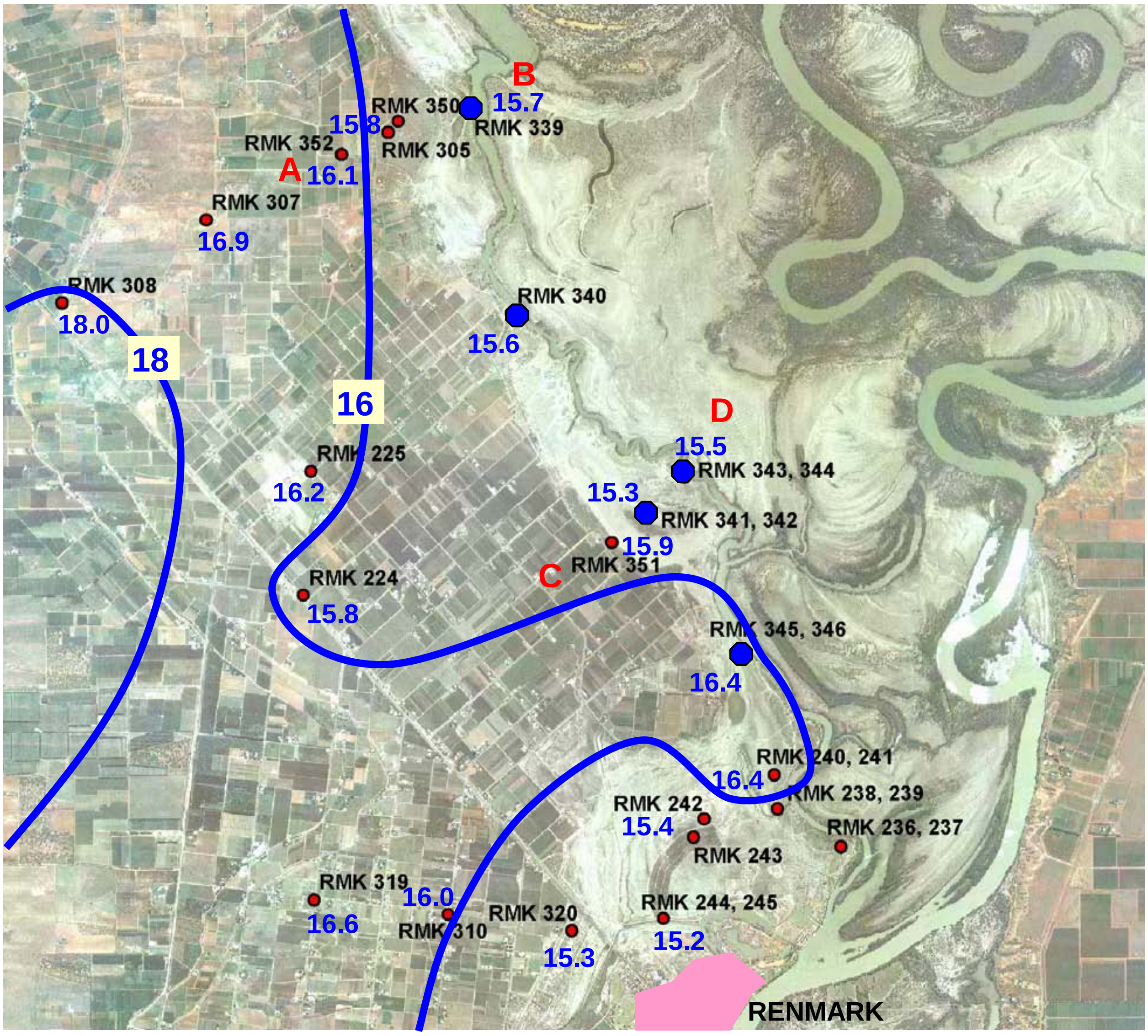


Figure 4. Location of north Renmark observation wells and watertable contours

The drilling program revealed some interesting stratigraphy in the vicinity of Ral Ral Creek. Figure 5 depicts the hydrogeological cross-sections whose locations are shown in red in Figure 4. In these sections, the watertable elevations have been corrected for density to enable accurate comparisons with river and creek levels. Groundwater salinities and flow directions are also shown.

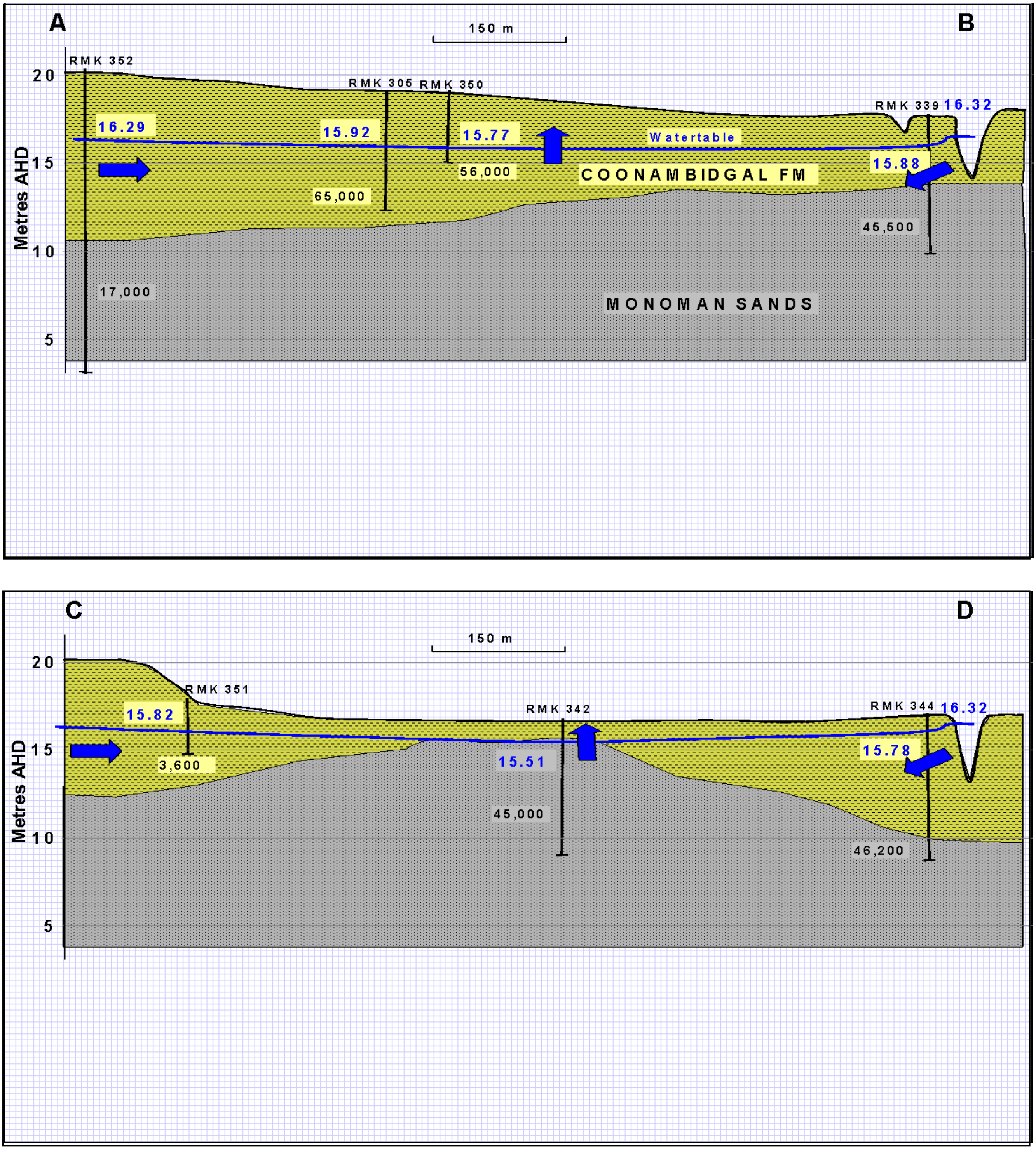


Figure 5. Hydrogeological cross-sections across the floodplain near Ral Ral Creek

These sections show that evaporative discharge from the floodplain has concentrated the groundwater salinities to very high levels, and has lowered the watertable to a level below Ral Ral Creek such that a small discharge from the creek to the floodplain is occurring. In other words, evaporative discharge from the floodplain is intercepting and preventing any flow from the watertable mound beneath the irrigation area from entering Ral Ral Creek, and ultimately the River Murray. Because the Coonambidgal Formation clays are quite thick and completely underlie Ral Ral Creek, the rate of flow into, or out of the creek would be quite small in any case.

Figure 6 displays the location of the network and the observed watertable elevation contours to the south of Renmark, with the location of the wells drilled in this program shown as blue dots. All sites were completed in the Monoman Sands aquifer. Instream NanoTEM and 2006 Run of River results are also shown.

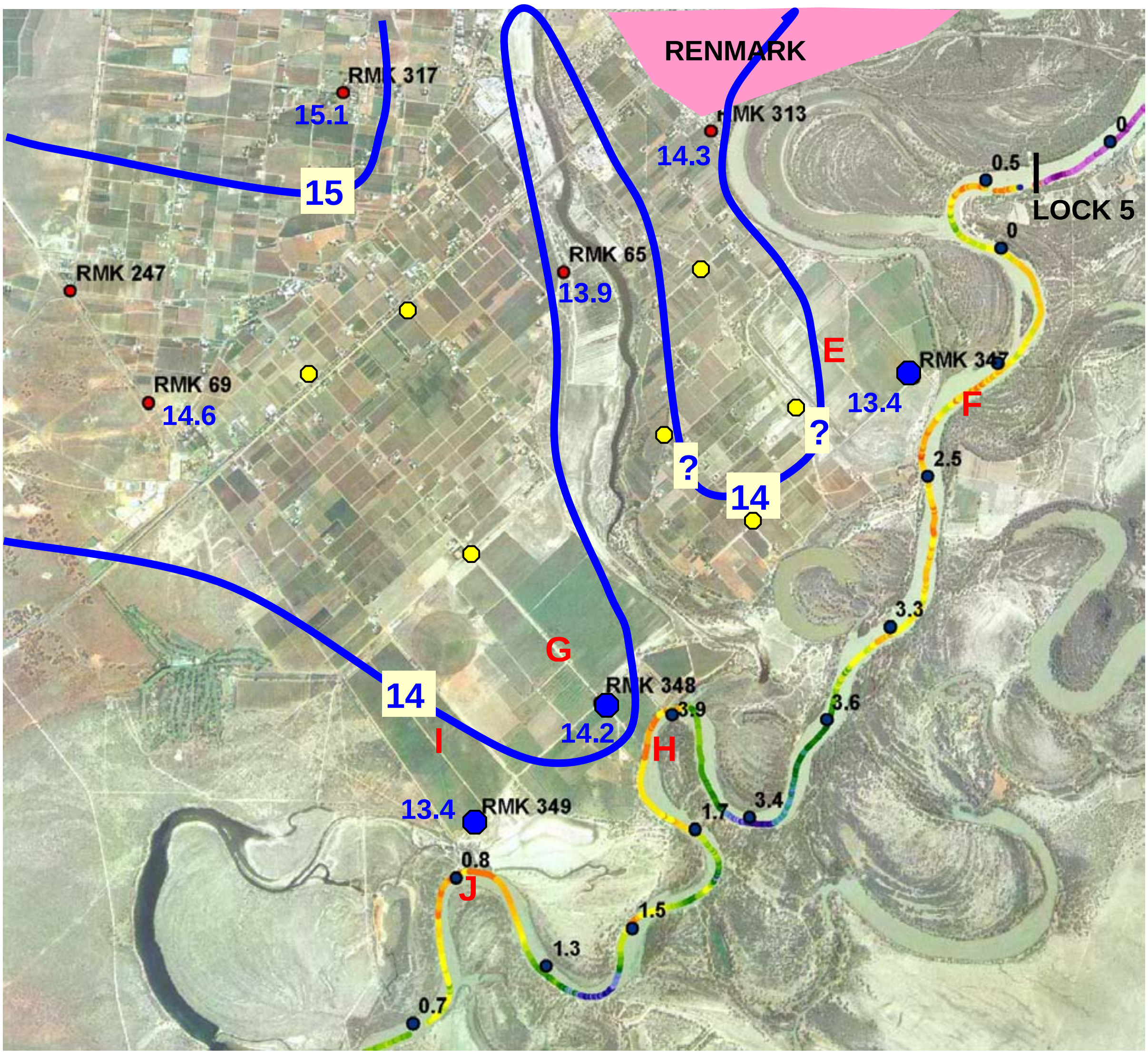


Figure 6. Location of south Renmark observation wells and watertable contours

The instream NanoTEM displays high conductivities (in yellow and orange) in meander loops close to irrigation north of the river. Cross sections G - H and I - J in Figure 7 show that the river is incised into the high permeability Monoman Sands which contain high salinity groundwater, and that a significant watertable gradient exists toward the river after density corrections have been made. Further upstream at section E – F, a gradient also exists toward the river but groundwater salinities appear to be lower. The high NanoTEM conductivities in this reach may also be due to inflows from the floodplain on the eastern side of the river driven by the fall in pool level below Lock 5.

Although the 2006 Run of River results do not indicate significant inflows, simple calculations using Darcy's Law show a potential does exist (Table 2).

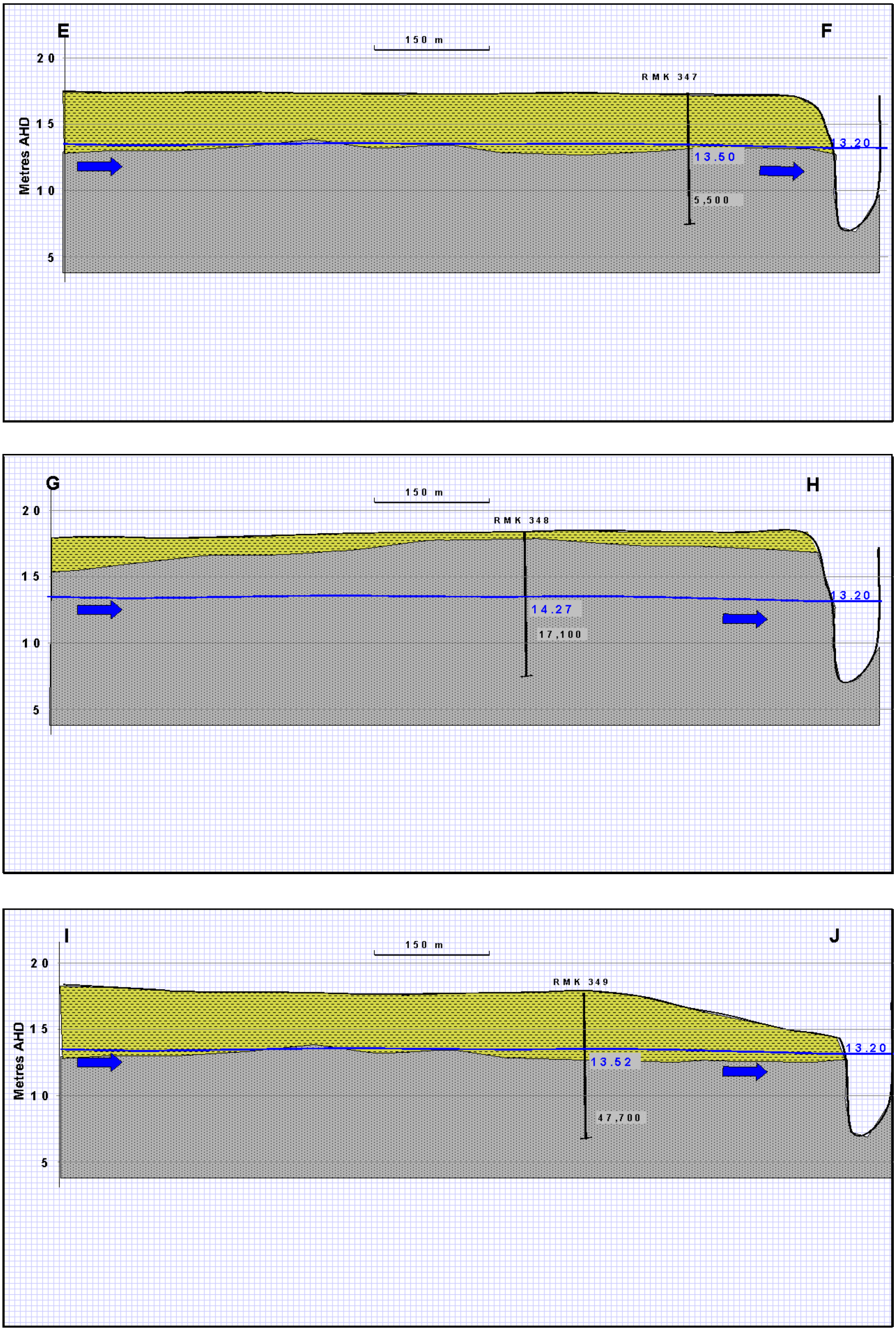


Figure 7. Hydrogeological cross-sections across the floodplain south of Renmark

Table 2. Calculated salt inflows

Section	Salt Inflow (tonnes/day)
E – F	0. 75
G - H	11
I - J	6

Figure 8 presents representative hydrographs from the Renmark Irrigation Area. Of interest is the widespread fall in the watertable elevation since 2000 of about 1.5 m. This could be due to improved irrigation practices, changes in irrigated crop area and type, below average rainfall, or the fact that some drainage caissons are connected to the watertable and pumping from them is lowering the watertable in their vicinity. Although this is a positive trend from a salinity impact perspective, several older observation wells are now dry as the watertable has fallen below the bottom of the wells. These wells are shown in yellow in Figure 6.

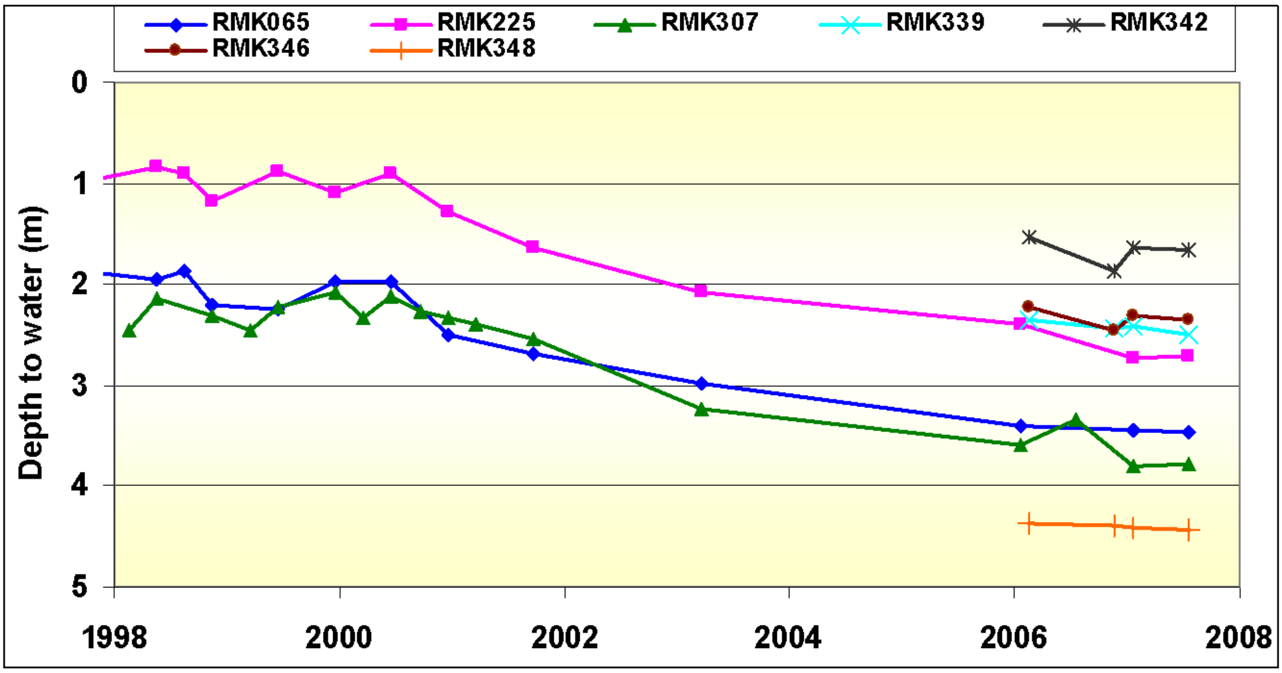


Figure 8. Hydrographs of Renmark Irrigation Area observation wells

It is possible that if these falling trends continue, the reduced watertable gradients toward the river may reduce whatever salt inflows are currently occurring.

Given that future SIS infrastructure may be constructed close to the locations of the cross sections south of Renmark, further investigations into the magnitude of current inflows and improvements to the monitoring network are strongly recommended to determine the feasibility of a small SIS that could reduce saltloads at relatively low cost.

SUMMARY

In 2005, the DWLBC Salinity Response Team in Berri initiated a project to upgrade the existing observation well networks in the highland irrigation areas of Cadell and Taylorville, and also in the Renmark area on the river floodplain. Fifteen wells were drilled between January and June 2006.

Drilling at Cadell revealed a small watertable mound beneath the irrigated area about 3 m above the normal river pool level with quite low salinities (below 700 mg/L). This mound is decreasing in height because rehabilitation of the delivery system in 1999 has reduced drainage to the watertable.

Drilling on the floodplain to the north of Renmark found that evaporative discharge from the floodplain has concentrated the groundwater salinities to very high levels, and has lowered the watertable to a level below Ral Ral Creek. Evaporative discharge from the floodplain is therefore intercepting and preventing any flow from the watertable mound beneath the irrigation area from entering Ral Ral Creek, and ultimately the River Murray.

To the south of Renmark, drilling revealed the river to be incised into the Monoman Sands which would ensure a high connectivity with groundwater and a high potential for salt accessions if watertable gradients were sufficiently steep to result in significant groundwater inflows. If this proves to be the case, the feasibility of constructing a small SIS that could reduce saltloads at relatively low cost should be investigated.

APPENDIX A

GEOLOGICAL LOGS

	PROJECT: Cadell Obs Network
GROUNDWATER PROGRAM	**Well Name: C 3 Obs No. CAD 15**
WATER WELL LOG	**UNIT No. 6829 - 1532**
Coordinates: E 386072 N 6233004 El. Surface(m) El. Ref. Point(m) Datum: AHD	**Hundred: Cadell Sec: 107**

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
		(BGL)	7.7	10.7				590	962322

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING Dia (mm)	CASING From (m)	CASING To (m)
0	1		TOPSOIL	Brown/red, contains calcrete.	COONAMBIDGAL FM		80	-	11.2
1	5		CLAY	Sandy clay, brownish orange, calcrete present. 2-4m Sandy clay, brown and yellow, fine-medium sand 4-5m Sandy clay, medium grained sand with some gravel and minor limestone grains.			Slots	1.0 7.7	10.7
5	11		SAND	Clayey sand, fine – medium grained, brownish yellow, slight limestone content. 6-9m Brownish yellow sand,, fine – medium grained 9-10m Medium grained reddish brown sand 10-11m Grey fine to medium grained sand.	MONOMAN SANDS				
11.0	11.2		CLAY	Sandy clay, pale grey/fawn END OF HOLE 11.2m					

REMARKS: 0.5m sump at base of well	DRILL TYPE: Auger	COMPLETED: 10/1/2006
	DRILL FLUID: Mud	LOG: Simone Stewart

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 386707 N 6230850 El. Surface(m) El. Ref. Point(m) Datum: AHD

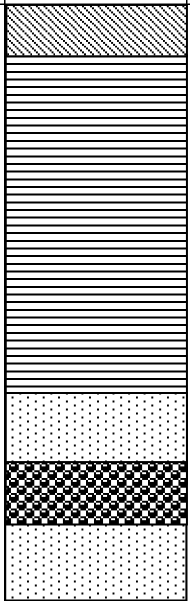
PROJECT: Cadell Obs Network

Well Name: C 5 Obs No. CAD 18

UNIT No. 6829 - 1531

Hundred: Cadell Sec: 93

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
		2.9 (BGL)	9	12				705	962323

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Depth Core	CASING		
From	To						Dia (mm)	From (m)	To (m)
0 1.0	1.0 8.5		TOPSOIL CLAY	Grey, contains calcrete. Sandy clay, light brownish yellow, moderate plasticity, mainly fine grained sand, calcrete present. 2-3m sandy clay, brown and grey, as above 3-4m as above, grey, contains gravel sized limestone particles. 4-6m as above, yellow to greyish brown, no calcrete, some gravel sized rock fragments present. 6-8m as above, grey, no calcrete. 8-8.5m sandy clay, brown.	COONAMBIDGAL FM		80 Slots	-1.0 9	12.5 12
8.5	10.0		SAND	Brown fine – medium grained sand.	MONOMAN SANDS				
10.0	11.0		GRAVEL	Gravel, 1-2mm particle size, well sorted rounded grains					
11.0	12.5		SAND	Fine to medium grained brown sand, contains some gravel and minor clay content. END OF HOLE 12.5m					

REMARKS: 0.5m sump at base of well	DRILL TYPE: Auger	COMPLETED: 10/1/2006
	DRILL FLUID: Mud	LOGGED BY: Simone Stewart
	DATE:	SHEET: 1

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 385105 N 6230525 | El. Surface(m) | El. Ref. Point(m) | Datum: AHD

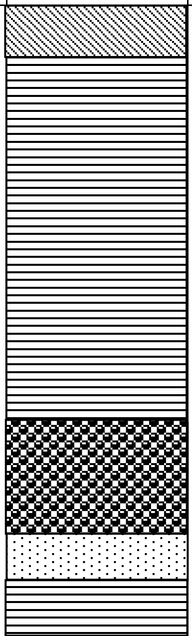
PROJECT Cadell Obs Network

Well Name: C 6 Obs No. CAD 22

UNIT No. 6829 - 1530

Hundred: Cadell Sec: 210

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
		(BGL)	9	12				583	962324

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Depth Core	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	1		TOPSOIL	Dark brown, contains calcrete and rock fragments.					
1	10		CLAY	Sandy clay, brownish orange, fine-medium sand, contains minor calcrete 2-3m as above with occasional gravel –sized quartz grains. 3-4m greyish brown, fine-medium sand, contains rock fragments and calcrete 4-6m increased clay content. 6-7m sandy clay (fine sand) brown, rock fragments 7-9m sandy clay, reddish brown, increased sand and coarse qtz 9-10m sandy clay, pale grey	COONAMBIDGAL FM		80 Slots	-1.0 9	12.5 12
10.0	12.0		GRAVEL	Greyish brown, with coarse–medium sand, minor calcrete and clay	MONOMAN SANDS				
12.0	12.5		SAND	Grey coarse to medium grained sand, minor carbonaceous frags.					
12.5	13.0		CLAY	Pale fawn–grey sandy clay					
				END OF HOLE 13.0m					

REMARKS:
0.5m sump at base of well

DRILL TYPE: Auger	COMPLETED: 11/1/2006
DRILL FLUID: Mud	LOGGED BY: Simone Stewart

GROUNDWATER PROGRAM **WATER WELL LOG**	**PROJECT: Renmark Network Upgrade**
	Well Name: RR 1 Obs No. RMK 339
	UNIT No. 7029 - 2268
Coordinates: E 474730 N 6227488 El. Surface (m) 18.16 El. Ref. Point (m) 19.17 Datum: GDA 94	**Hundred: Chaffey IA Allot 102**

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	~5.80	3.35 TOSt	5	8				45 500	1047579

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	1		TOPSOIL	Brown to dark brown clayey fine grained sandy	COONAMBIDGAL FM		80	-0.5	8.0
1	4		CLAY	Yellow-brown clay with minor med-coarse sand. 3-4m Very sandy clay, coarse grained			slots	5.0	8.0
4	8		SAND	Pale brown, well sorted, medium grained sand. 5-8m Coarse sand with minor medium component; < 10 %. Pale reddish grey. Mod well sorted 7-8m Grey medium to coarse sand END OF HOLE 8m	MONOMAN SANDS				

REMARKS: Well located in floodplain reserve. PVC 0 to 8.0 m plus 0.5 m stickup; screened from 5-8 m. End cap at base. Airlifted/developed.	DRILL TYPE: Rotary	COMPLETED: 7/06/2006
	DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
	DATE: 7/06/2006	SHEET 1 OF 1

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 475120 N 6225654 El. Surface (m) 17.91 El. Ref. Point (m) 19.02 Datum: GDA 94

PROJECT: Renmark Network Upgrade

Well Name: RR 2 Obs No. RMK 340

UNIT No. 7029 - 2269

Hundred: Renmark IA Allot 1

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	~5.00	3.27 TOSt	6	8				23 285	1047575

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	1		TOPSOIL	Brown to dark brown clayey fine grained sandy	COONAMBIDGAL FM		80	-0.5	8.0
1	5		CLAY	Yellow-brown clay with minor med-coarse sand.			slots	6.0	8.0
5	8		SAND	Grey well sorted, medium to coarse grained sand.	MONOMAN SANDS				
				7-8m Grey coarse sand to gravel.					
				END OF HOLE 8m					

REMARKS: Drilled with air to 5m. Water cut not noted..	DRILL TYPE: Rotary	COMPLETED: 7/06/2006
	DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
	DATE: 7/06/2006	SHEET 1 OF 1

PROJECT: Renmark Network Upgrade

Well Name: RR 3A Obs No. RMK 341

UNIT No. 7029 - 2270

Hundred: Renmark IA Allot 1

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 476361 N 6223857 El. Surface (m) 16.95 El. Ref. Point (m) 17.925 Datum: GDA 94

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	~3.50	2.52 TOSt	1.0	2.0					

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	0.5		CLAY	Silty green-grey clay.	COONAMBIDGAL FM		25	-0.5	2.0
0.5	1		SILT	Yellow-orange clayey silt			slots	1.0	2.0
1	2		SAND	Yellow-orange fine grained silty sand					
				END OF HOLE 2m					

REMARKS: Located on "salt pan" environment on floodplain. Dual completion with deeper piezometer also installed to 8.5 m. (RR 3B)

DRILL TYPE: Rotary	COMPLETED: 8/06/2006
DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
DATE: 8/06/2006	SHEET 1 OF 1

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 476361 N 6223856 El. Surface (m) 16.95 El. Ref. Point (m) 17.93 Datum: GDA 94

PROJECT: Renmark Network Upgrade

Well Name: RR 3B Obs No. RMK 342

UNIT No. 7029 - 2271

Hundred: Renmark IA Allot 1

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	~3.50	2.51 TOC	6.5	8.5				45 150	1047573

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING Dia (mm)	CASING From (m)	CASING To (m)
0	0.5		CLAY	Silty green-grey clay.	COONAMBIDGAL FM		80	-0.5	8.5
0.5	1		SILT	Yellow-orange clayey silt			slots	6.5	8.5
1	8.5		SAND	Yellow-orange fine grained silty sand	MONOMAN SANDS				
				3-5m Red-yellow fine to medium sand					
				5-7m Medium sand with minor coarse component. Orange-yellow					
				7-8.5m Well sorted medium grey sand					
				END OF HOLE 8.5 m					

REMARKS: Located on “salt pan” environment on floodplain. Dual completion with shallow piezometer installed to 2.0 m. (RR 3A)	DRILL TYPE: Rotary	COMPLETED: 8/06/2006
	DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
	DATE: 8/06/2006	SHEET 1 OF 1

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 476701 N 6224152 El. Surface (m) 17.34 El. Ref. Point (m) 18.39 Datum: GDA 94

PROJECT: Renmark Network Upgrade

Well Name: RR 4A Obs No.RMK 343

UNIT No. 7029 - 2272

Hundred: Renmark IA Allot 1

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	~3.50	2.74 TOSt	2.0	3.0					

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	3		CLAY	Sticky and stiff green-grey clay.	COONAMBIDGAL FM		25	-0.5	3.0
							slots	2.0	3.0
				END OF HOLE 3m					

REMARKS: Well located approx 15 m from Ral Ral Creek. Dual completion with deeper piezometer also installed to 8.5 m. (RR 4B)

DRILL TYPE: Rotary	COMPLETED: 8/06/2006
DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
DATE: 8/06/2006	SHEET 1 OF 1

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 476701 N 6224152   El. Surface (m) 17.34 El. Ref. Point (m) 18.39   Datum: GDA 94

PROJECT: Renmark Network Upgrade

Well Name: RR 4B Obs No. RMK 344

UNIT No. 7029 - 2273

Hundred: Renmark IA Allot 1

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	~3.50	2.79 TOC	6.5	8.5				46 200	1047572

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING Dia (mm)	CASING From (m)	CASING To (m)
0	8		CLAY	Sticky and stiff green-grey clay. 3-4m Yellow-brown clay as above 4-5m Yellow-brown silty clay 5-8m Stiff grey-green clay	COONAMBIDGAL FM		80 slots	-0.5 6.5	8.5 8.5
8	9		SAND	Light grey medium to coarse sand, poorly sorted. Lignite present. END OF HOLE 9m	MONOMAN SANDS				

REMARKS: Well located approx 15 m from Ral Ral Creek. Drilled with air to 5 m, and then mud to ~9 m. Dual completion with shallow piezometer also installed to 3 m. (RR 4A)

DRILL TYPE: Rotary	COMPLETED: 8/06/2006
DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
DATE: 8/06/2006	SHEET 1 OF 1

GROUNDWATER PROGRAM **WATER WELL LOG** Coordinates: E 477229 N 6222552 El. Surface (m) 18.77 El. Ref. Point (m) 19.656 Datum: GDA 94	**PROJECT: Renmark Network Upgrade** **Well Name: RR 5A Obs No. RMK 345** **UNIT No. 7029 - 2274** **Hundred: Renmark IA Allot 803**

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	~3.0	3.12 TOC	1.5	3.0					

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	3		CLAY	Stiff reddish brown clay.	COONAMBIDGAL FM		25	-0.5	3.0
							slots	1.5	3.0
				END OF HOLE 3m					

REMARKS: Dual completion with deeper piezometer installed to 10.5 m. (RR 5B)	DRILL TYPE: Rotary	COMPLETED: 8/06/2006
	DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
	DATE: 8/06/2006	SHEET 1 OF 1

GROUNDWATER PROGRAM **WATER WELL LOG** Coordinates: E 477228 N 6222552 El. Surface (m) 18.77 El. Ref. Point (m) 19.656 Datum: GDA 94	**PROJECT: Renmark Network Upgrade** **Well Name: RR 5B Obs No. RMK 346** **UNIT No. 7029 - 2275** **Hundred: Renmark IA Allot 803**

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	~3.50	3.22 TOC	8.5	10.5				44 170	1047577

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	8		CLAY	Stiff reddish-brown clay. 4-8m Brown grey stiff clay	COONAMBIDGAL FM		80 slots	-0.5 8.5	10.5 10.5
8	10.5		SAND	Brownish grey coarse sand, poorly sorted. Lignite present. END OF HOLE 10.5 m	MONOMAN SANDS				

REMARKS: Dual completion with shallow piezometer installed to 3 m. (RR 5A)	DRILL TYPE: Rotary	COMPLETED: 8/06/2006
	DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
	DATE: 8/06/2006	SHEET 1 OF 1

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 477607 N 6215497 El. Surface (m) 16.85 El. Ref. Point (m) 17.755 Datum: GDA 94

PROJECT: Renmark Network Upgrade

Well Name: RR 6 Obs No. RMK 347

UNIT No. 7029 - 2276

Hundred: Renmark IA Allot 115

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m) From	INTERVAL (m) To	SUPPLY L/sec	SUPPLY Test length	SUPPLY Method	TOTAL DISSOLVED SOLIDS mg/L	TOTAL DISSOLVED SOLIDS Analysis No.
	~5.50	4.20 TOC	5.5	8				5493	1047574

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING Dia (mm)	CASING From (m)	CASING To (m)
0	4		CLAY	Sticky brown-grey clay with minor fine sand.	COONAMBIDGAL FM		80 slots	-0.5 5.5	8.0 8.0
4	8		SAND	Yellow-orange-grey, well sorted, fine to medium grained sand. 5-8m Coarse sand with minor medium component; < 10 %. Pale reddish grey. Mod well sorted END OF HOLE 8m	MONOMAN SANDS				

REMARKS: Well located near intersection of 21st and Nelwart St, Renmark South. Screened from 5.5 – 8.0 m in medium to coarse sands. Drilled to 5.5 m with air until water was struck.	DRILL TYPE: Rotary	COMPLETED: 6/06/2006
	DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
	DATE: 6/06/2006	SHEET 1 OF 1

GROUNDWATER PROGRAM

WATER WELL LOG

PROJECT: Renmark Network Upgrade

Well Name: RR 7 Obs No. RMK 348

UNIT No. 7029 - 2277

Hundred: Renmark IA Adj Allot 95

Coordinates: E N | El. Surface (m) | El. Ref. Point (m) | Datum: GDA 94

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	~6.50	5.38 TOC	7	10				17 113	1047576

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	1		TOPSOIL	Silty, fine sand with minor clays. Dark reddish grey.	COONAMBIDGAL FM		80	-0.5	10
1	10		SAND	1-2m Fine sand (~0.2 mm), sub angular. Light brown. 2-4m Medium to coarse sand, poorly sorted. Light brown with minor orange.. 4-10m Coarse to very coarse sand with minor gravel; minor clay peds. Mottled orange/yellow/red/grey. Sub-rounded to rounded. END OF HOLE 10m	MONOMAN SANDS		slots	7	10

REMARKS: Well located near intersection of 27th and Purnong St. Piezometer drilled with air to 5 m, and from 5-10 m with mud by Underdale drillers. Water cut is approximate only (estimated by driller).	DRILL TYPE: Rotary	COMPLETED: 6/06/2006
	DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
	DATE: 6/06/2006	SHEET 1 OF 1

PROJECT: Renmark Network Upgrade
Well Name: RR 8   Obs No. RMK 349
UNIT No.   7029 - 2278
Hundred: Renmark IA Allot 93

GROUNDWATER PROGRAM

WATER WELL LOG

Coordinates: E 474452 N 6212296   El. Surface (m) 17.83 El. Ref. Point (m) 18.71   Datum: GDA 94

AQUIFER SUMMARY	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL (m)		SUPPLY			TOTAL DISSOLVED SOLIDS	
			From	To	L/sec	Test length	Method	mg/L	Analysis No.
	~6.50	5.24 TOC	8.5	11.5				47 670	1047578

DEPTH (m)		GRAPHIC LOG	SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION/AGE	Core Sample	CASING		
From	To						Dia (mm)	From (m)	To (m)
0	1		TOPSOIL	Medium sand; well sorted. Brown, organic content present	COONAMBIDGAL FM		80	-0.5	12
1	5		CLAY	Stiff brown-grey clay. 4-5m Brown clay tending to fine sandy silt. Mottled yellow-orange.			slots	8.5	11.5
5	12		SAND	Fine sand; ~0.1 mm diameter. Yellow-orange-grey, well sorted, fine to medium grained. 9-12m Coarse to very coarse sand with minor gravel; < 10 %. Mottled orange/grey/brown/yellow. Sub rounded.	MONOMAN SANDS				
				END OF HOLE 12m					

REMARKS		
REMARKS: Well located on John Treazise property off 28th St. Well constructed to 12 m plus standpipe/stickup. Screened from 8.5 – 11.5 with half metre blank (sump) at the bottom. Water cut between 6-7 m.	DRILL TYPE: Rotary	COMPLETED: 6/06/2006
	DRILL FLUID: Air/Mud	LOGGED BY: P Magarey
	DATE: 6/06/2006	SHEET 1 OF 1