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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December 2006

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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.

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	12	CF	1.65	
RR 3B	7029-2271	RMK 342	6.5 - 8.5	MS	1.63	45 150
RR 4A	7029-2272	RMK 343	23	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

Table 1. Observation well construction detail

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).





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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	': Ca	dell Ob	s Netv	vork					
				GROUNDWATE	R PRC	OGRAM				Well Name	e: C 3	Obs No	o. CA	D 15	
				WATER WH	ELL	LOG				UNIT No. 6829 - 1532					
		Coor	dinates: E 386072	2 N 6233004 E	El. Surf	face(m)	El. Re	f. Point(m)	Datum: AHD	Hundred: Cadell Sec: 107					
			DEPTH TO	DEPTH TO	INT	ERVAL (m)		SUPPLY		TOT.	AL DISS	OLVED S	OLIDS		
	AQ	UIFER	WATER CUT (m)	(m)	Fro m	То	L/sec	L/sec Test length		mg/L		Analysis No.			
	SUMMARY				7.7	10.7				590		9	62322	ļ	
				(BGL)											
DEPT	H (m)		SEDIMENT		GEOL	.OGICAI	L DESCRIPTION	N	FORMAT	ION/AGE	Core Sam	CASING		J To	
From	То	GRAPHIC LUG	NAME								ple	(mm)	m (m)	(m)	
0	1		TOPSOIL	Brown/red, conta	ins cal	crete.	lorata present		COONAMB	IDGAL		80	-	11.2	
1	5		CLAY	Sandy Clay, brow	IIISII U	range, ca	FM	FM			1.0	10.7			
				2-4m Sandy clay,	brow	n and ye	llow, fine-medi	um sand				51018	7.7	10.7	
					1.		1 1 1								
				4-5m Sandy clay, minor limestone g	grains.	im grain	ed sand with so	ome gravel and							
5	11		SAND	Clayey sand, fine	– mec	lium gra	ined, brownish	yellow, slight							
				6-9m Brownish y	t. rellow	sand,, fi	ne – medium gr	rained	MONOMAI	N SAINDS					
				9-10m Medium	grained	d reddish	brown sand								
11.0	11.0			10-11m Grey fine	e to me	edium gr	ained sand.								
11.0	11.2		CLAY	Sandy clay, pale	grey/18	iwn									
					EI	ND OF H	HOLE 11.2m								
REMA	RKS:	hase of 11		1					DRILL TYPE	DRILL TYPE: Auger COMPLETED:			D: 10/1	/2006	
0.5m s	sump at	base of well			DRILL FLUI	FLUID: Mud LOG: Simone S			e Stew	art					

					PROJECT: Cadell Obs Network										
				GROUNDWATE	R PRO	GRAM	1			Well Name: C 5 Obs No. CAD 18					
				WATER WE		LOG				UNIT No. 6829 - 1531					
		Coordinates:	E 386707 N 623	80850 El	. Surfa	ice(m)	El. Ref.	Point(m)	Datum: AHD	Hundred: Cadell			Sec: 93		
			DEPTH TO WATER CUT	DEPTH TO STANDING WATER	INTE (1	RVAL n)		SUPPLY		TOTA	AL DISS	ISSOLVED SOLIDS			
	AQUIFER (m)		(m)	From	То	L/sec	Test length	Method	mg/L		A	nalysis N	0.		
SUMMARY			2.9 (BGL)	9	12				705	96232		62323			
DEPT	H (m)		SEDIMENT		CEOI	OCICA		ſ	EODMAT		Dept	CASING			
From	То	GRAPHIC LOG	NAME		FORMAT	ION/AGE	Core	Dia From (mm) (m)		To (m)					
0 1.0	1.0 8.5		TOPSOIL CLAY	Grey, contains cal Sandy clay, light fine grained sand,	crete. browni calcre	ish yell ete pres	ow, moderate pla ent.	COONAMB	COONAMBIDGAL FM			-1.0	12.5		
				 2-3m sandy clay, 3-4m as above, gr 4-6m as above, ye sized rock fragme 6-8m as above, gr 8 8 5m sandy clay 	brown ey, con ellow to nts pro- rey, no	and gr ntains g o greyis esent. calcret	ey, as above gravel sized limes sh brown, no calo e.	91					12		
8.5	10.0		SAND	Brown fine – med	lium gi	rained s	sand.		MONOMAN	I SANDS					
10.0	11.0		GRAVEL	Gravel, 1-2mm pa	rticle	size, w	ell sorted rounde	d grains							
11.0	12.5		SAND	Fine to medium g minor clay conten											
REMA 0.5m s	RKS: sump at	base of well							DRILL TYP	DRILL TYPE: Auger COMPLETED: 10/1/2006					
										DRILL FLUID: Mud LOGGED BY: Simone Stewar		Y: vart			
			DATE:	Sheet: 1											

				PROJECT Cadell Obs Network											
				GROUNDWATE	R PRO	GRAM	1			Well Name: C 6 Obs No. CAD 22					
				WATER WE		LOG				UNIT No. 6829 - 1530					
		Coordinates:	E 385105 N 623	D525El. Surface(m)El. Ref. Point(m)Datum: AF						Hundred: Cadell Sec: 210					
			DEPTH TO WATER CUT	DEPTH TO STANDING WATER	INTE (1	RVAL m)		SUPPLY		TOTAI	AL DISSOLVED SOLIDS				
	AQ	UIFER	(m)	(m)	From	То	L/sec	Test length	Method	mg/L		А	nalysis N	0.	
SUMMARY			(BGL)	BGL) 9 12					583		962324				
DEPTH (m) SEDIMENT					CEC			NT.	EODMA		De pth	(CASING	Ĵ	
From	То	GRAPHIC LOG	NAME		GEC	LOGIC	AL DESCRIPTIC	JIN	FORMA	TION/AGE	Co re	Dia (mm)	FromTon)(m)(m)		
0 1	1 10		TOPSOIL CLAY	Dark brown, con Sandy clay, brow	ntains (wnish (calcrete orange,	e and rock fragme , fine-medium sa	or COONAM	MBIDGAL FM		80	-1.0	12.5		
				2-3m as above v	vith oc	casion	al gravel –sized o				Slots	9	12		
				3-4m greyish br	3-4m greyish brown, fine-medium sand, contains rock fragments										
				and calcrete 4-6m increased	clay co	ontent.									
				6-7m sandy clay	(fine	sand) b	brown, rock fragn	nents							
				7-9m sandy clay	, reddi	ish bro	wn, increased sar	nd and coarse qt	Ζ						
				9-10m sandy cla	ıy, pale	e grey									
10.0	12.0		GRAVEL	Greyish brown, clay	with c	oarse–1	medium sand, mi	nor calcrete and	MONOMA	AN SANDS					
12.0	12.5		SAND	Grey coarse to n	nediun	n graine	ed sand, minor ca	arbonaceous frag	gs.						
12.5	13.0		CLAY	Pale fawn–grey	sandy	clay									
					Б		EUOLE 13 0m								
REMA	RKS:				L		FIOLE 15.0III			DE: Auger	CO	MPLETI	ED:		
0.5m s	sump at	base of well								11/1/2006					
			DRILL FLU	LUID: Mud LOGGED BY: Simone Stewart											

								PROJECT: Renmark Network Upgrade Well Name: RR 1 Obs No. RMK 33!									
		Coordin	otoo, F	474720 N	LCOO	7499 El Surface	(0 1 C E	1 Def Deint (m)	10.17 Deturn C		Hundred: Chaffey IA Allot 10'					
		Coordina	ates: E	474730 N DEPTH T	N 022 10	DEPTH TO	INTE	ERVAL	I. Kel. Point (m)	SUPPLY	DA 94						
	AQUIFER (m) SUMMARY ~5.80			UT	STANDING WATER (m)	(From	(m) To	L/sec	Test length	Method	mg/L	E DISSC	Analysis No.				
					3.35 TOSt	5	8				45 500		1	04757	9		
DEPT	'H (m)		SED	MENT									G	C	CASING		
From	То	GRAPHIC SEDIMENT				Gl	FORMATION/AGE		Sam Dle	Dia (mm)	From (m)	To (m)					
0	1		TOPS	JIL	Bro	wn to dark brown c	rown clayey fine grained sandy					COONAMBIDGAL FM		80	-0.5	8.0	
1	4		CLAY		Yel	low-brown clay wit				slots	5.0	8.0					
4	8		SAND		3-41 Pale 5-81 redo 7-81	 4m Very sandy clay, coarse grained ²ale brown, well sorted, medium grained sand. 5-8m Coarse sand with minor medium component; < 10 %. Pale eddish grey. Mod well sorted 7-8m Grey medium to coarse sand END OF HOLE 8m 						MONOMAN SANDS					
REMA	ARKS:	Well locate	ed in flo	odplain res	erve.	PVC 0 to 8.0 m plu	us 0.5	m stickı	ip; screened from	m 5-8 m. End cap	DRILL TYP	E: Rotary	COM	PLETED): 7/06/2	2006	
at Dast	base. Airlifted/developed.									DATE: 7/06	/2006	SHEE	$\frac{\mathbf{J} \mathbf{E} \mathbf{D} \mathbf{B} \mathbf{Y}}{\mathbf{E} \mathbf{T} \mathbf{I} \mathbf{O}}$	F 1	arey		

	Coor AQ SUN	dinates: E UIFER IMARY	475120	N 62256 DEPTH T WATER C (m) ~5.00	54 '0 UT	GRO WA El. Surface (m) 17 DEPTH TO STANDING WATER (m) 3.27 TOSt	UNDW TEH .91 EI INTI From 6	VATER R WE I. Ref. P ERVAL (m) To 8	PROGRAM LL LOG oint (m) 19.02	Datum: (SUPPLY Test length	GDA 94 Method	PROJECT: 2 Well Name: UNIT No. 7 Hundred: Ro TOTA mg/L 23 285	Renma Upgr: RR 2 (029 - : enmar	ark Netv ade Obs No 2269 k IA Al DEVED SOI	work . RMI llot 1 LIDS nalysis N 04757	X 340 5
DEPT	Ϋ́Η (m)	GRAPHIC	SED	DIMENT		GI		FORMA	TION/AGE	Core Sam	Dia	ASING From	То			
From 0 1 5	DEPTH (m) GRAPHIC LOG SEDIMENT NAME GEOLOGICAL DESCRIPTION 0 1 TOPSOIL Brown to dark brown clayey fine grained sandy 1 5 CLAY Yellow-brown clay with minor med-coarse sand. 5 8 SAND Grey well sorted, medium to coarse grained sand. 7-8m Grey coarse sand to gravel. END OF HOLE 8m											BIDGAL FM	ple	(mm) 80 slots	(m) -0.5 6.0	(m) 8.0 8.0
REMA	ARKS:	Drilled wit	th air to	5m. Water	cut no	ot noted					DRILL TYF DRILL FLU DATE: 7/06	E: Rotary ID: Air/Mud /2006	COM LOG SHEE	PLETED GED BY: ET 1 O	: 7/06/2 P Mag F 1	2006 arey

						GROU	JNDW	ATER]	PROGRAM			PROJECT: R	enma Jpgrad	rk Netwo	ork	
						WA	TER	WEI	LL LOG			Well Name: R	R 3A	Obs No	. RMK	\$ 341
	Coor	dinatas: E	176361	N 6773857		El Surfaco (m) 16	05 5	l Dof I	Point (m) 17 025	Dotum: CD	A 0/	UNIT No. 70	29 - 2	270		
	0001	uniates. E	+70301	1 0223037		El. Surface (III) 10	.95 E	1. Kei. I	Ollit (III) 17.923		n 74	Hundred: Rei	ımark	IA Alle	ot 1	
				DEPTH T WATER C	O UT	DEPTH TO STANDING WATER	INTI	ERVAL (m)		SUPPLY		TOTAI	L DISSO	LVED SOL	IDS	
	AQ	UIFER		(m)		(m)	From	То	L/sec	Test length	Method	mg/L		A	nalysis N	0.
	SUN	IMARY		~3.50		2.52 TOSt										
DEPT	°H (m)	GRAPHIC	SED	IMENT		C		EODM		Core	C	ASING	r			
From	То	LOG	N	AME		U.		FORM	ATION/AGE	Sam ple	Dia (mm)	From (m)	To (m)			
0	0.5		CLAY		Silty	green-grey clay.					COONA	MBIDGAL FM		25	-0.5	2.0
0.5	1		SILT		Yell	ow-orange clayey	silt							slots	1.0	2.0
1	2		SAND		Yell	ow-orange fine gra	ained s	ilty sand	1							
	1 2 SAND Yellow-orange fine grained silty sand END OF HOLE 2m															
REMA	ARKS:	Located or	n "salt pa	an" environ	ment	on floodplain. Dua	al com	pletion	with deeper pieze	ometer also	DRILL T	YPE: Rotary	COM	IPLETED	: 8/06/2	2006
install	ed to 8	.5 m. (RR 3	B)								DRILL FI	LUID: Air/Mud	LOG	GED BY:	P Mag	arey
											DATE: 8/	06/2006	SHEI	ET 1 O	F 1	

		Coordina	ates: E4	476361 N depth t	6223 o	GROU WA 856 El. Surface DEPTH TO	UNDW TER (m) 1	ATER I WEL	PROGRAM J L LOG I. Ref. Point (m)	17.93 Datum: GI	DA 94	PROJECT: R UNIT No. 702 Hundred: Ren	enman Jpgrad R 3B 29 - 22 nmark	ck Netwo le Obs No 71 IA Allo	ork . RMK ot 1 ^{IDS}	342
	AQ	UIFER		WATER C (m)	UT	(m)	From	То	L/sec	Test length	Method	mg/L		А	nalysis N	0.
	SUM	IMARY		~3.50		2.51 TOC	6.5	8.5				45 150		1	04757	3
DEPI	°H (m)	GRAPHIC	SED	IMENT		G		FORM	ATION/AGE	Core	C	ASING				
From	То	LOG	N	AME				TORM	ATION/AGE	Sam ple	Dia (mm)	From (m)	To (m)			
0	0.5		CLAY		Silt	y green-grey clay.		COONAN	ABIDGAL FM		80	-0.5	8.5			
0.5	1		SILT		Yel	low-orange clayey	silt							slots	6.5	8.5
1	8.5		SAND		Yel	low-orange fine gra	ined s	ilty sand	l		MONOM	AN SANDS				
					3-51	m Red-yellow fine	to med	lium san	d							
					5-71	m Medium sand wi	th min	or coars	e component. O	range-yellow						
					7-8.	.5m Well sorted me	dium g	grey san	d							
						E	ND OF	FHOLE	8.5 m							
REMA	ARKS:	Located or	n "salt pa	an" environ	ment	on floodplain. Dua	l com	pletion v	vith shallow pie	zometer installed	DRILL TY	PE: Rotary	СОМ	PLETED	: 8/06/2	2006
to 2.0	m. (RR	3A)	1			ł		L	I		DRILL FL	UID: Air/Mud	LOG	GED BY:	P Mag	arey
											DATE: 8/0	06/2006	SHEE	ET 1 O	F 1	

	AQ	Coordin UIFER IMARY	ates: E	476701 N 6 DEPTH T WATER CU (m) ~3.50	52241 0 UT	GROU WA 52 El. Surface DEPTH TO STANDING WATER (m) 2.74 TOSt	INDW TER e (m) 1 INTE (From 2.0	ATER F WEL 7.34 El ERVAL m) To 3.0	PROGRAM L LOG . Ref. Point (m) L/sec) 18.39 Datum: G SUPPLY Test length	DA 94 Method	PROJECT: R U Well Name: R UNIT No. 70 Hundred: Ren TOTAL mg/L	enmar Jpgrad R 4A 29 - 22 mark	k Netwo le Obs No 272 IA Allo	<pre>>rk .RMK >t 1 IDS nalysis No</pre>	343
DEPT From O	TH (m) To 3	GRAPHIC LOG	SED N CLAY	DIMENT	Stic		FORM	ATION/AGE //BIDGAL FM	Core Sam ple	C Dia (mm) 25 slots	ASING From (m) -0.5 2.0	To (m) 3.0 3.0				
REMA to 8.5	ARKS: m. (RR	Well locate (4B)	ed appro	ox 15 m froi	m Ra	l Ral Creek. Dual c	omple	tion with	n deeper piezon	neter also installed	DRILL TY DRILL FL DATE: 8/0	PE: Rotary UID: Air/Mud 06/2006	COM LOGO SHEE	PLETED GED BY: ET 1 O	: 8/06/2 P Maga F 1	2006 arey

												PROJECT: R	enmai Ipgrad	rk Netw le	ork	
						GROU WA	INDW TFR	ATER I WFI	PROGRAM			Well Name: R	R 4B	Obs No	. RMK	344
							1 121					UNIT No. 70	29 - 22	273		
		Coordin	ates: E	476701 N	6224	152 El. Surface	e(m) 1	7.34 E	l. Ref. Point (m)) 18.39 Datum: (GDA 94	Hundred: Ren	mark	IA Alle	ot 1	
				DEPTH T WATER C	O UT	DEPTH TO STANDING WATER	INTE (ERVAL m)		SUPPLY		TOTAL	DISSO	LVED SOL	IDS	
	AQ	UIFER		(m)	01	(m)	From	То	L/sec	Test length	Method	mg/L		А	nalysis N	0.
	SUN	IM A DV		~3.50		2.79 TOC	6.5	8.5				46 200		1	047572	2
	501	ΙΝΙΑΚΙ														
DEPI	°H (m)		SED							9	C	ASING				
From	То	LOG	N SED	AME		Gl		FORM	ATION/AGE	Sam	Dia	From	To			
0	8		CLAY		Stic	ky and stiff green-g		COONAN	MBIDGAL FM	pie	80	-0.5	8.5			
							•	2						slots	6.5	8.5
					3 11	m Vallow brown al	01/ 00 0	bovo								
					5-41		ay as c	luove								
					4-51	m Yellow-brown si	lty clay	У								
					5-81	m Stiff grey-green d	clay									
							2									
8	9	5555555	SAND)	Lig	ht grey medium to a	coarse	sand, po	orly sorted. Lig	gnite present.	MONOM	AN SANDS				
_		********						· .		- •						
						E	ND OF	HOLE	9m							
RFM	ARKS	Well locat	ed appro	\sim 15 m from	m Ra	Ral Creek Drilled	with	air to 5 1	n and then mu	d to ~9 m Dual	DRILL TY	PE: Rotary	СОМ	 PLETED): 8/06/2	2006
compl	etion w	vith shallow	piezom	eter also in	stalle	d to 3 m. (RR 4A)		un 10 J I	in, una men mu		DRILL FL	UID: Air/Mud	LOG	GED BY	P Mag	arey
											DATE: 8/0)6/2006	SHEE	ET 1 O	F 1	

	Co AQ SUN	oordinates: UIFER	E 4772	29 N 6222: DEPTH T WATER CU (m) ~3.0	552 El. Surfa O DEPTH STANDING (m) 3.12 T	GROU WA ce (m) TO WATER	JNDW TER 18.77 INTF (From 1.5	ATER I WEL El. Rei ERVAL (m) To 3.0	PROGRAM LLOG f. Point (m) 19.	656 SUPI Test	Datum: GE PLY length	DA 94 Method	PROJECT: R UVII Name: R UNIT No. 70 Hundred: Ren TOTAL	enman Jpgrad R 5A 29 - 22 umark	ik Netwo le Obs No 274 IA Allo LVED SOL	ork . RMK ot 803 IDS nalysis No	5 345
AQUIFER (m) (m) From To L/sec SUMMARY ~3.0 3.12 TOC 1.5 3.0 DEPTH (m) GRAPHIC LOG SEDIMENT NAME GEOLOGICAL DESCRIPTION 0 3 CLAY Stiff reddish brown clay.												FORM	ATION/AGE MBIDGAL FM	Core Sam ple	Dia (mm) 25 slots	ASING From (m) -0.5 1.5	To (m) 3.0 3.0
REMA	ARKS:	Dual comp	oletion v	vith deeper	piezometer insta	lled to	10.5 m.	(RR 51	3)			DRILL TY DRILL FL DATE: 8/0	PE: Rotary UID: Air/Mud 06/2006	COM LOG SHEP	PLETED GED BY: ET 1 O	: 8/06/2 P Mag F 1	arey

												PROJECT: R	enmai Jpgrad	rk Netw le	ork	
						GROU WA	INDW TFR	MER I	PROGRAM			Well Name: R	R 5B	Obs No	. RMK	346
						•••						UNIT No. 70	29 - 22	275		
	Coor	dinates: E	477228	N 6222552		El. Surface (m) 18	.77 El.	. Ref. Po	oint (m) 19.656	5 Datum: GDA 9	94	Hundred: Ren	mark	IA All	ot 803	
				DEPTH T WATER C	0 UT	DEPTH TO STANDING WATER	INTE	ERVAL (m)		SUPPLY		TOTAL	DISSO	LVED SOL	LIDS	
	AQ	UIFER		(m)	-	(m)	From	То	L/sec	Test length	Method	mg/L		А	nalysis N	0.
	SIL	ллару		~3.50		3.22 TOC	8.5	10.5				44 170		1	04757	7
	501															
DEPT	`H (m)		SED					_		ASING	r					
From	То	LOG	N N	AME		FORM	ATION/AGE	Core Sam	Dia	From	To					
0	8		CLAY	•	Stif		COONAN	MBIDGAL FM	pie	80	-0.5	10.5				
							2							slots	8.5	10.5
					4-81	m Brown grey stiff	clay									
8	10.5	ssesses	SAND)	Bro	wnish grey coarse s	sand, p	oorly so	rted. Lignite pr	esent.	MONOM	AN SANDS				
									10.5							
						E	ND OF	HULE	10.5 m							
REMA	ARKS:	Dual comp	oletion w	vith shallow	piez	cometer installed to	3 m. (RR 5A)			DRILL TY	PE: Rotary	COM	IPLETED	D: 8/06/2	2006
											DRILL FL	UID: Air/Mud	LOG	GED BY	: P Mag	arey
											DATE: 8/0	06/2006	SHE	ET 1 O	F 1	

		Coordin	ates: E	477607 N	6215	GROU WA 497 El. Surface	UNDW ATEF e (m)	VATER R WE I 16.85	PROGRAM L L LOG El. Ref. Point (n	n) 17.755 Datum	n: GDA 94	PROJECT: 7 Well Name: UNIT No. 7 Hundred: Ro	Renma Upgra RR 6 (029 - 1 enmar	ark Netv ade Obs No 2276 k IA Al	work o. RMI llot 11:	X 347 5
				DEPTH T WATER C	O UT	DEPTH TO STANDING WATER	INTE (ERVAL (m)		SUPPLY		TOTA	L DISSC	DLVED SO	LIDS	
	AQ	UIFER		(m)	-	(m)	From	То	L/sec	Test length	Method	mg/L		А	nalysis N	0.
	SUM	IMARY		~5.50		4.20 TOC			5493		1	04757	4			
DEPT	'H (m)	GRAPHIC	SED	DIMENT		G		FORMA	TION/AGE	Core	C	ASING				
From	То	LOG	N	AME				TORMA	nonvinol	Sam ple	Dia (mm)	From (m)	To (m)			
0	4		CLAY		Stic	ky brown-grey clay		COONAM	BIDGAL FM		80	-0.5	8.0			
4	8		SAND		Yel 5-81 redo	low-orange-grey, w m Coarse sand with dish grey. Mod well EN	vell sor minor l sorted	rted, find r medium 1 F HOLE	e to medium gra n component; < 8m	ined sand.	MONOMA	N SANDS	COM	SIOIS	5.5	8.0
REMA mediu	ARKS: m to co	Well locate	ed near i Drilled	intersection to 5.5 m w	of 2 ith ai	1st and Nelwart St, r until water was st	Renma uck.	ark Sou	h. Screened fro	m 5.5 – 8.0 m in	DRILL FU	E: Rotary	COM	PLETED): 6/06/2 · P Mag	2006 arev
											DATE: 6/06	/2006	SHEE	ET 1 0	F 1	

						GROL WA	JNDW TER	ATER WE	E PROGRAM LL LOG			PROJECT: R U Well Name: R UNIT No. 702	enma Jpgrad R 7 (29 - 22	rk Netw le Obs No. 277	ork RMK	348
			Coordinate	es: E N	-	El. Surface (m) El.	Ref. Poir	nt (m)	Datum: GDA 94			Hundred: Ker	imark	IA AQ	Allot	<i>9</i> 5
		LIEFE		DEPTH T WATER C	O UT	STANDING WATER	(1	m)		SUPPLY		TOTAL	L DISSO	LVED SOL	LIDS	
	AQ	UIFER		(m)		(m)	From	To	L/sec	Test length	Method	mg/L		A	nalysis N).
	SUN	IMARY		~6.50		5.38 TOC			17 113			1047570)			
DEPT	H (m)	GRAPHIC	SED	DIMENT				FODM		Core	C	ASING				
From	То	LOG	N	AME		G		FORM	ATION/AGE	Sam ple	Dia (mm)	From (m)	To (m)			
0	1		TOPS	OIL	Silt	y, fine sand with m		COONA	MBIDGAL FM	•	80	-0.5	10			
1	10		SAND)	1-2	m Fine sand (~0.2 r	nm), s	ub ang	ular. Light brown	1.	MONOM	IAN SANDS		slots	7	10
					2-4 ora 4-1 Mo	rown with minor minor clay peds. nded.										
REMA	ARKS:	Well locate	ed near	intersection	of 2	7 th and Purnong St.	Piezoi	meter (drilled with air to	5 m, and from 5-	DRILL TY	PE: Rotary	COM	IPLETED	0: 6/06/2	.006
10 111 \	v1111 111	ia by Under		mers. wate	i cut	is approximate only	y (estil	nateu	by driffer).		DRILL FL	LUID: Air/Mud	LOG	GED BY	: P Mag	arey
											DATE: 6/0	06/2006	SHEI	ET 1 0	F 1	

						GRO WA	UNDV ATEI	VATER R WEJ	PROGRAM L L LOG			PROJECT: 1 Well Name: 1	Renm Upgr: RR 8	ark Netv ade Obs No 2278	work 5. RMI	K 349
		Coordin	ates: E	474452 N	6212	2296 El. Surface	e (m)	17.83 E	l. Ref. Point (m) 18.71 Datum: C	GDA 94	Hundred: Re	enmar	·k IA A	llot 93	
				DEPTH T	0	DEPTH TO	INTI	ERVAL		SUPPLY		тота	L DISSO	DLVED SO	LIDS	
	AQ	UIFER		WATER C (m)	UT	(m)	From	То	L/sec	Test length	Method	mg/L		A	nalysis N	0.
	SUN	IMARY		~6.50		5.24 TOC	8.5	11.5				47 670		1	.04757	8
DEPT	Ή (m)	GRAPHIC	SED	DIMENT			II			Core	C	ASING	ł			
From	То	LOG	N	AME		Gl		FORMA	TION/AGE	Sam ple	Dia (mm)	From (m)	To (m)			
0	1		TOPS	OIL	Med	dium sand; well sor	resent	COONAM	BIDGAL FM		80	-0.5	12			
1	5		CLAI		4-5r	m Brown clay tendi	ng to :	fine sand	ly silt. Mottled	yellow-orange.				SIOLS	8.3	11.5
5	12		SAND)	Fine med	e sand; ~0.1 mm dia lium grained.	ameter	. Yellow	/-orange-grey, v	well sorted, fine to	MONOMA	N SANDS				
					9-12 orar	2m Coarse to very on 2m Coarse to very on 2m Coarse to very on 2m	coarse low. S	sand wi ub roun	th minor gravel; led.	s < 10 %. Mottled						
						E	ND OF	FHOLE	12m							
REMA Screen	ARKS:	Well locat	ed on Jo	hn Treazise	e prop	perty off 28th St. W	ell con	nstructed	l to 12 m plus st	andpipe/stickup.	DRILL TYP	E: Rotary	COM	PLETED	0: 6/06/2	2006
Scieel			, with H			sump) at the bottom	ı. vv al		1 ween 0-7 m.		DATE: 6/06	1D: AII/IVIUU	SHE	$\frac{\mathbf{U} \mathbf{E} \mathbf{U} \mathbf{B} \mathbf{Y}}{\mathbf{T} \mathbf{T} \mathbf{T} \mathbf{T} \mathbf{O}$	F 1	arey
1											DATE. 0/00	2000	SHE	51 1 0	1 1	