TECHNICAL NOTE 2012/08

Department for Environment, Water and Natural Resources

SOUTH EAST TOWN WATER SUPPLY – LUCINDALE TWS 5 – LUCINDALE, SOUTH AUSTRALIA

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Government of South Australia

Department of Environment, Water and Natural Resources

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INTRODUCTION

In early 2011 the former Department for Water (DFW), now the Department for Environment, Water and Natural Resources (DEWNR), was contracted by the South Australian Water Corporation (SA Water) to drill and construct a production well for the township of Lucindale in the South East region of South Australia, a region also known as the Limestone Coast. This well was part of a program of work undertaken during the first half of 2012 which also included the drilling and construction of production wells at Kalangadoo, Millicent, Mount Burr, and Naracoorte. This report discusses the drilling and construction of production well Lucindale TWS 5 which was drilled as a replacement for the existing production well Lucindale TWS 2.

The original well was drilled by the Department for Mines and Energy in 1970 and used steel casing through both the Gambier Limestone and Dilwyn Formation sections in the well. Casing integrity checks indicated corrosion of the steel casing which was considered a risk to the long-term viability of the well.

Diverse Resources Group Pty Ltd was contracted to drill and construct the new well. Drilling commenced on 11 April 2012 and was completed on 16 April 2012.

DEWNR Groundwater Technical Services conducted pumping tests in April 2012.

LUCINDALE TOWN WATER SUPPLY

Lucindale is located approximately 100 kilometres north of the regional centre of Mount Gambier and is reliant on groundwater from the Dilwyn Formation confined aquifer for its town water supply.

The groundwater salinity of the existing water supply well Lucindale TWS 3 completed in the Dilwyn Formation, was approximately 795 mg/L. This well was pumped at approximately 10 to 15 L/s.

Details of the Lucindale production wells (historic and current) are given in Table 1. The location of the new and pre-existing wells is given in Fig. 1 and Fig. 2.

Town supply well TWS 1 is not in use and its current status is unknown. Town water supply well TWS 2 and TWS 4 are in production. TWS 3 had been used as a confined aquifer observation well until it was backfilled after being replaced by TWS 4 in 2008.

Table 1. Lucindale production well details

Well name	Unit number	Drill date	Depth (m)	Obs date	DTW (m)	Obs date	TDS (mg/L)	Obs date	Yield (L/s)
Lucindale TWS 1	6924 - 71	1968	120	1969	Flowing	1970	1070	1982	11
Lucindale TWS 2	6924 - 2244	1970	107	1970	Flowing	2011	775	1984	11
Lucindale TWS 3	6924 – 2245	1970	99	2008	Flowing	2008	795	2006	14
Lucindale TWS 4	6924 - 3983	2008	111	2008	Flowing	2011	785	2012	25
Lucindale TWS 5	6924 - 4115	2012	112	2012	0.5 Above GL	2012	835		

Figure 1. Location of Lucindale TWS 5

Figure 2. Location of the Lucindale Production Wells

WELL DESIGN AND CONSTRUCTION

Diverse Resources Group Pty Ltd was engaged by DWR to drill and construct the production well. The drilling rig employed for the drilling operations was an Atlas Copco T3W. This rig is capable of rotary air and rotary mud drilling methods.

The site of of Lucindale TWS 5 (Fig.2) was chosen by SA Water to target the sands of the Dilwyn Formation confined aquifer. Figure 2 shows the new well located over the top of a tank site based on the GPS coordinates. This concrete tank has been removed since the 2008 photograph and replaced with a new tank further to the east.

Lucindale TWS 5 was drilled as a production well under permit number 206966 (well unit number 6924-4115) and was completed on 16 April 2012.

The final design of Lucindale TWS 5 was based on the completion of Lucindale TWS 4, and the screen and casing were pre-ordered to facilitate the drilling and construction of the well. Strata samples were initially collected every two metres whIch increased to every one metre through the aquifer zone. The final completion depth was based on the strata samples and the downhole geophysics. The well construction diagram (Fig.3) shows the lithology encountered during drilling.

The well was drilled and constructed according to the following steps:

- A hole was drilled to a depth of 6 m using a 450 mm (17.7 inch) blade bit
- Steel surface control casing 355 mm (14 inch) ID was run into the drillhole to a depth of 6 m
- The pilot drillhole was mud drilled to total depth at 120 m using a 230 mm (9.1 inch) blade bit to collect strata samples for use in the well design
- The pilot drillhole was reamed to a depth of 99 m using a 355 mm (14 inch) blade bit
- A Class 12 PVC 253 mm (10 inch) ID casing string was run into the drillhole to a depth of 99 m
- The casing was pressure displacement cemented to surface
- Once the cement had set, the pilot drillhole was re-opened to 112 m using a 245 mm (9.6 inch) blade bit
- A stainless steel (316 grade) telescopic wire-wound screen 200 mm (8.7 inch) ID, 1.5 mm aperture, was set over the interval 99-110 m
- The screen was run with a Figure-K Packer and using a J-latch
- A riser pipe of 200 mm (8.7 inch) ID stainless steel (316 grade) zero-wound screen was set over the interval 97-99 m
- A sump of 200 mm (8.7 inch) ID stainless steel (316 grade) zero-wound screen was set over the interval 110-112 m
- The well was developed by airlifting until the groundwater being produced was clear and free of suspended solids. The groundwater was directed to the drain alongside the site. Further development occurred prior to the pumping tests.

Sterilisation of the well was achieved by adding chlorine to the drilling fluid and maintaining this throughout the drilling process.

The well is artesian with a head calculated at 0.5 m above ground level. An airlift yield of 60 L/s was estimated at the conclusion of drilling.

Groundwater salinity was 810 mg/L (1470 uScm) based on the result of laboratory water chemistry analysis.

The Drillers Well construction Report (Schedule 8) is given in Appendix A and a water well log (including lithological / stratigraphic description) is given in Appendix B. Sieve analysis curves are given in Appendix C.

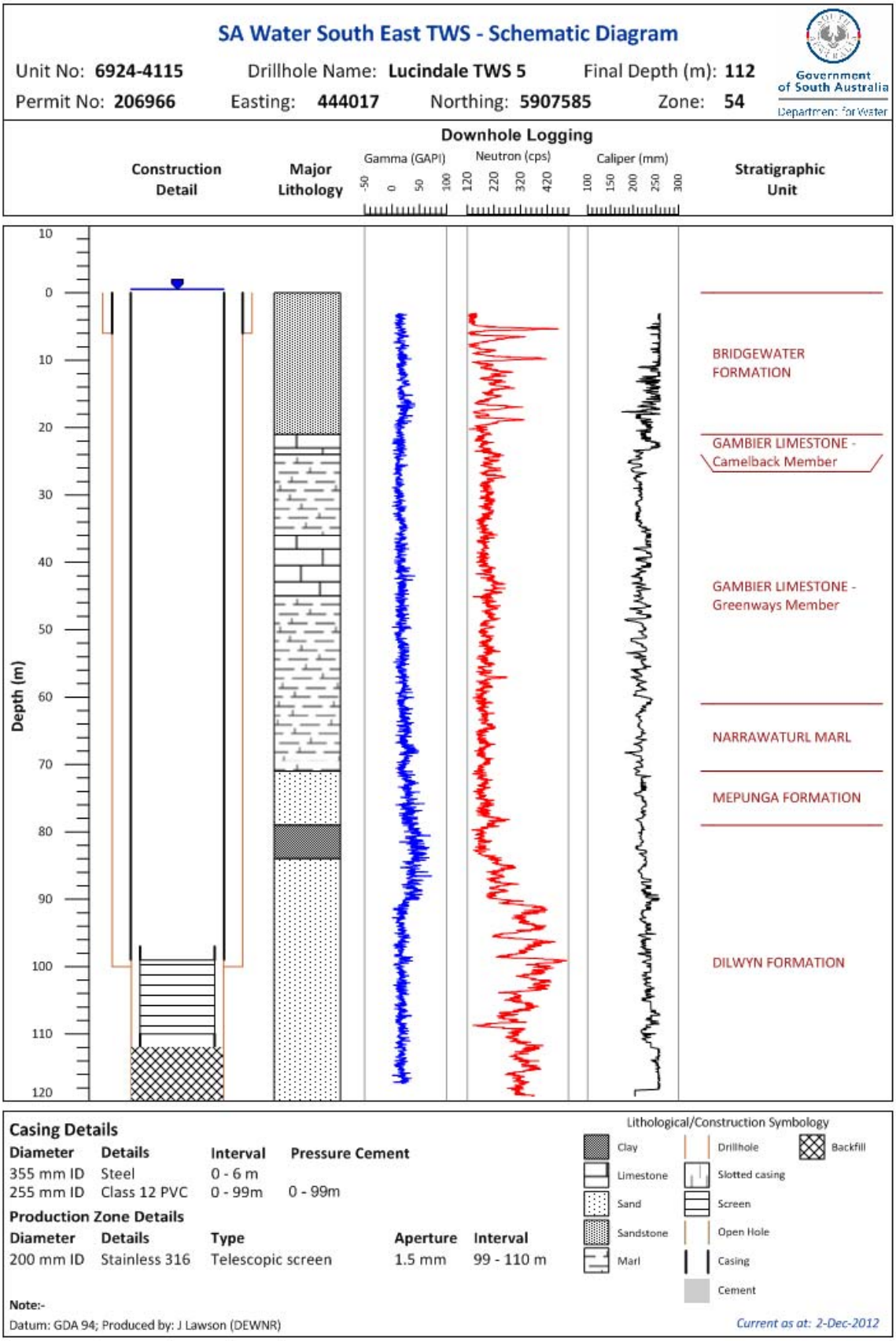


Figure 3. Well construction and lithological sequence Lucindale TWS 5

GEOLOGY - HYDROGEOLOGY

The unconfined sediments at Lucindale appear to be uplifted, probably in response to the location being close to the structural monocline where the Gambier Basin transitions to the Murray Basin

The Gambier Limestone intersected in the Lucindale TWS 5 is interpreted to be the basal grey marl of the Greenway Member. A 10 m section of Narrawaturk Marl and an 8 m section of the Mepunga Formation indicate a relatively great thickness of these transitional units.

The Dilwyn formation has a thin aquitard unit of only 5 m comprising soft, very pliable clay, followed by an uninterrupted section of 36 m of aquifer sand. The sand is generally course and has 50% retention values between approximately 0.7-1.9 mm.

Table 2. Stratigraphic sequence for Lucindale TWS 5

Depth (m)	Lithological Description	Stratigraphic Description
0 - 21	Sandstone	Bridgewater Formation
21 - 61	Limestone, Marl, Marly limestone and Flint	Gambier Limestone – Greenways Member
61 - 71	Marl	Narrawaturk Marl
71 - 79	Sand	Mepunga Formation
79 – 84	Clay	Dilwyn Formation
84 - 120	Sand	Dilwyn Formation

PUMPING TESTS

PUMPING TEST DESIGN

A pumping test (aquifer test) is conducted by pumping a well and observing the aquifer 'response' or drawdown in the well and / or neighbouring observation wells. Pumping tests are carried out on wells to determine one or more of the following:

- The aquifer and aquitard hydraulic parameters used to determine the ability of the aquifer to store and transmit water and which can be used in analytical and numerical groundwater modelling
- The existence and potentially location of sub-surface hydraulic boundaries which may affect, beneficially or adversely, the long-term hydraulic behaviour and pumping performance of the well
- The long-term pumping rate of the well
- The design efficiency of the well
- The performance of the groundwater basin.

In this case, pumping tests were required to determine:

- The maximum sustainable pumping rate for a range of pumping times
- The pump setting
- Whether dewatering of the aquifer was occurring.

The pumping tests that were conducted consisted of a step drawdown test and a constant rate discharge test.

STEP DRAWDOWN TEST

The step drawdown test allows determination of the hydraulic behaviour of the well under pumping stress. The step drawdown test usually consists of three or more steps at increasing pumping rates, but with the rate ramaining constant throughout each step.

The objective of step drawdown testing is to determine the well equation (Equation 1) which reflects the efficiency of the well design and relates drawdown, pumping rate and time. This equation (ideally) allows prediction of the hydraulic performance of production wells for a design pumping rate and generation of yield drawdown curves for any given time.

The well equation allows determination of the maximum sustainable pumping rate of the well and consequently the selection of a suitable pumping rate for the constant rate discharge test.

$$\mathbf{s(t) = (a\,Q + c\,Q^2) + b\,\log(t)\,Q} \qquad \textbf{Equation (1)}$$

Where:

s(t)	=	drawdown (m)
Q	=	pumping rate (m^3/min)
t	=	time (min)
a	=	constant related to well loss for laminar flow
c	=	constant related to well loss for turbulent flow
b	=	constant related to aquifer loss for laminar flow

and,

Well loss (m)	=	$a Q + c Q^2$
Aquifer loss (m)	=	b log(t) Q
Well efficiency	=	(aquifer loss as a percentage of S(t)

The specific capacity is defined as:

SC = Q/S	=	(L/s)/m of drawdown

CONSTANT RATE DISCHARGE TEST

The constant rate discharge test allows determination of the hydraulic behaviour of the aquifer system under pumping stress. The constant rate discharge test is conducted at a constant pumping rate for a duration commensurate with the intended use of the well, however this is often compromised by the cost of running long-term tests.

The water level data collected from the constant rate discharge test allows determination of:

- Aquifer and aquitard hydraulic parameters
- Presence of hydraulic boundaries which may have an effect on pumping sustainability under long-term operational pumping
- Dewatering of the aquifer system, which may have an effect on pumping sustainability under long-term operational pumping
- Interference of neighbouring production wells.

The constant rate discharge test should ideally be followed by a period of groundwater level monitoring during the recovery of he well, although this is frequently not undertaken to reduce cost. Recovery is ideally monitored until 95% of the drawdown has been recovered. The residual drawdown data can be used to determine whether interference effects are present from either recharge boundaries, or conversely from impermeable boundaries or dewatering of the aquifer:

- If no interference is present, the extrapolated residual drawdown should intersect the zero residual drawdown line at $t/t_1 = 1$
- If a recharge boundary has been encountered, the line will intersect the zero residual drawdown line at a value of $t/t_1 > 1$
- If dewatering has occurred or an impermeable boundary has been encountered, the line will intersect the zero residual drawdown line at a value of $t/t_1 < 1$.

Observations from monitoring during pumping provide important data for gaining a better understanding of the broader aquifer system. Data are more reliable than those measured in the production well where turbulence may exist due to the pump. The data indicate the extent of the hydraulic influence of the production well and allow accurate determination of aquifer and aquitard hydraulic parameters.

GROUNDWATER QUALITY TEST

Preliminary groundwater sampling for a town water supply production well with domestic application should be tested for the following suite of chemical parameters (pers. Comm. G Dworak and J West, SA Water 5 May 2011):

- basic chemistry: TDS, Na, Ca, Mg, K, CO3, HCO3, Cl, F, SO4, hardness and alkalinity
- pH, colour and turbidity
- nutrients: NH3, NO3, NO2, soluble P and DOC
- metals (total and soluble): Al, Cd, Sb, Ni, Cu, Zn, Pb, Cr, Mn, Fe, As, Ba, Mo, Se, Hg, B, Ag, Be, I, CN, Sn, Zn, Br and U
- radioactivity.

PUMPING TEST RESULTS

CONDUCT OF TEST

The pumping tests conducted on Lucindale TWS 5 consisted of a step drawdown test and a constant rate discharge test and recovery test over the 24 – 26 April 2012. Test details are given in Table 3 the results are given in Appendix D.

DFW Groundwater Technical Services conducted the testing. Further development of the well was initially carried out during which pumping rates and groundwater levels were monitored. From this preliminary data, rates were selected for the step drawdown test.

Groundwater samples were analysed at the Australian Water Quality Centre (AWQC) (Appendix E).

Table 3. Pumping test details Lucindale TWS 5

Test type	Test date	Step	Duration (min)	Pumping Rate (L/s)
Step drawdown	24 April 2012	1	60	15
		2	60	20
		3	60	25
Constant rate discharge	25 – 26 April 2012	1	1440	25
Recovery	26 April 2012	–	1	0

STEP DRAWDOWN TEST

Analysis of the step drawdown results for Lucindale TWS 5 (Fig. 4) leads to the following well equation:

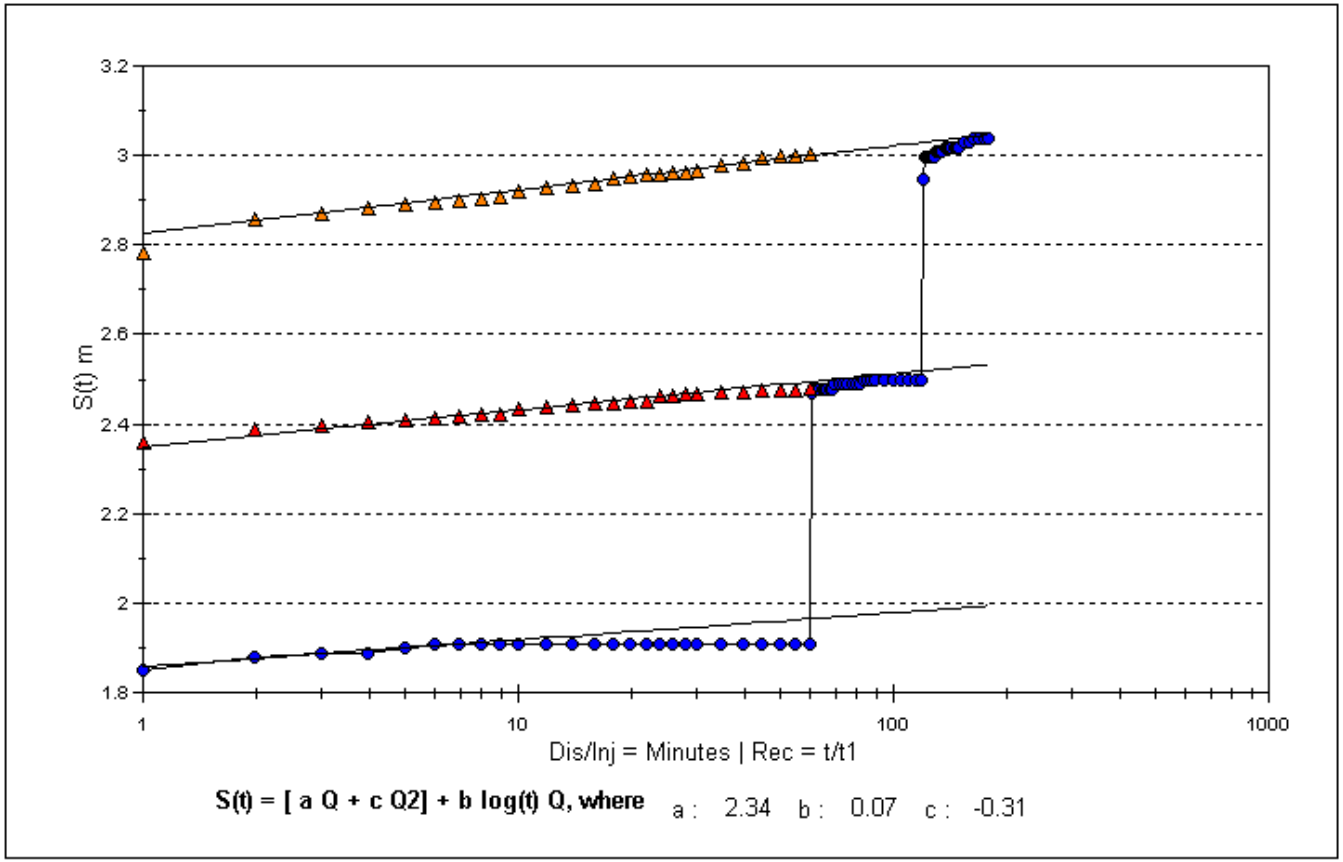
$s(t) = 2.34\,Q - 0.31\,Q^2 + 0.07 \log (t)\,Q$ Equation (2)

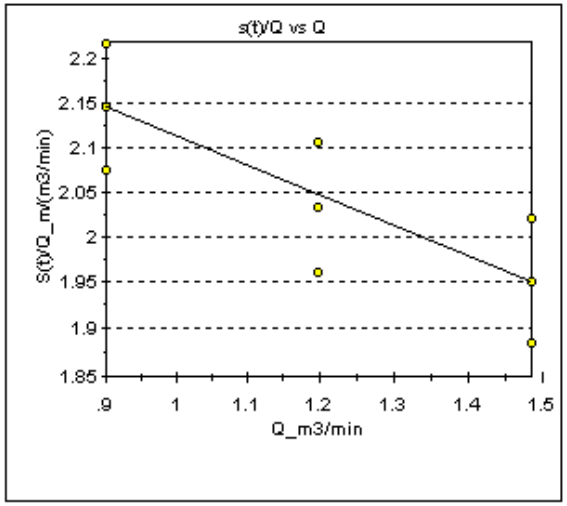
The well equation cannot be sued as a predictive tool due to the negative value of 'c'. This unexpected result is a rare occurrence in analysis of step drawdown tests, and particularly for a well completed in an aquifer which should be a classical example of a 'confined aquifer of infinite extent'. The well equation has however been used to predict drawdown for short duration of 1 000 minutes of continuous pumping at a range of pumping rates. While the theoretical available drawdown is 99 m, drawdowns are very small and this would obviously never be utilised.

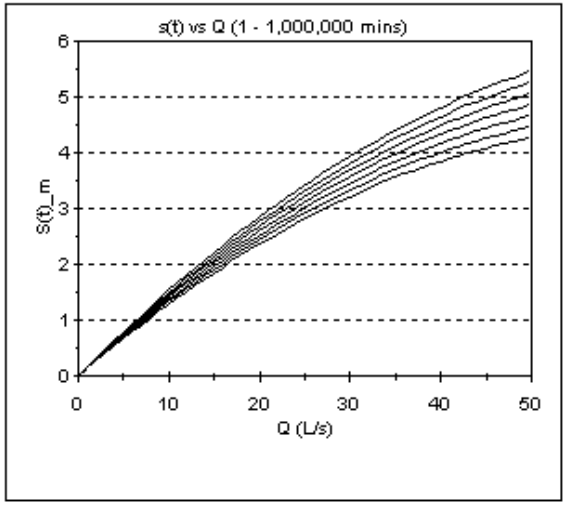
Table 4. Predicted drawdown Lucindale TWS 5

Pumping rate (L/s)	DTW (m)*	Casing length (m)	Theoretical Available DD (m)	Duration (min)	Predicted DD (m)
15	-0.5	99	99	1000	2.04
20	-0.5	99	99	1000	2.61
25	-0.5	99	99	1000	3.12
30	-0.5	99	99	1000	3.58

* Measurement taken at start of step drawdown test







TheStep	Q_L/s	Q_m3/min	Duration_min	St1	St1/Q	St10	St10/Q	St100	St100/Q	dS	dS/Q	T_m2/day
1	15.00	0.90	60	1.86	2.07	1.92	2.13	1.98	2.20	0.06	0.07	3953
2	20.00	1.20	60	2.35	1.96	2.43	2.03	2.51	2.10	0.08	0.07	3904
3	25.00	1.50	60	2.83	1.89	2.93	1.95	3.02	2.02	0.10	0.07	4033
maintest	25.00	1.50										

Figure 4. Step drawdown test analysis of drawdown using Hazel method Lucindale TWS 5

CONSTANT RATE DISCHARGE TEST

Production Well

Drawdown (residual drawdown) were recorded during the constant rate discharge test and recovery (Fig 5).

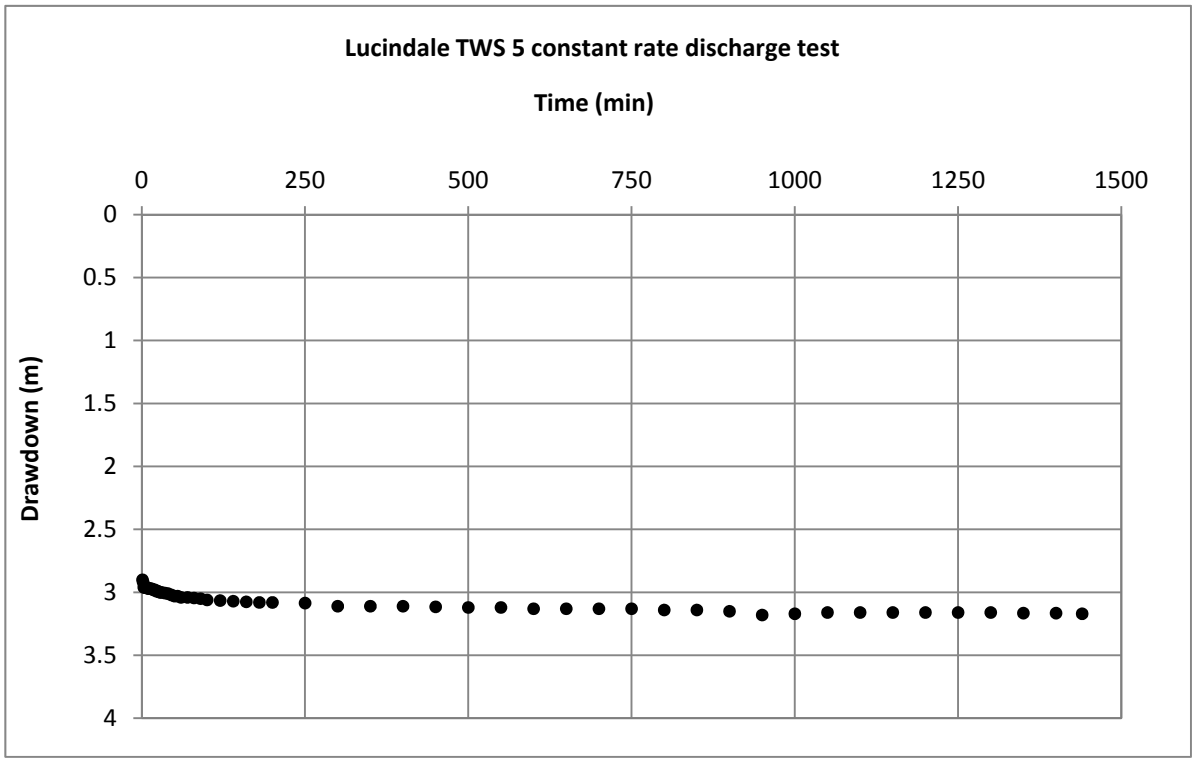


Figure 5. Linear – linear plot of drawdown Lucindale TWS 5 constant rate discharge test

The following general comments can be made:

- A drawdown of 3.2 m developed during the test
- The well equation accurately predicts the observed drawdown at the end of the constant rate discharge test within -0.9% (Fig.6)
- The specific capacity at 100 minutes was 8.17 L/s per metre of drawdown
- Well loss is approximately 90% of drawdown at the end of the test
- The well fully recovered in less than 1 minute when the pump was turned off.

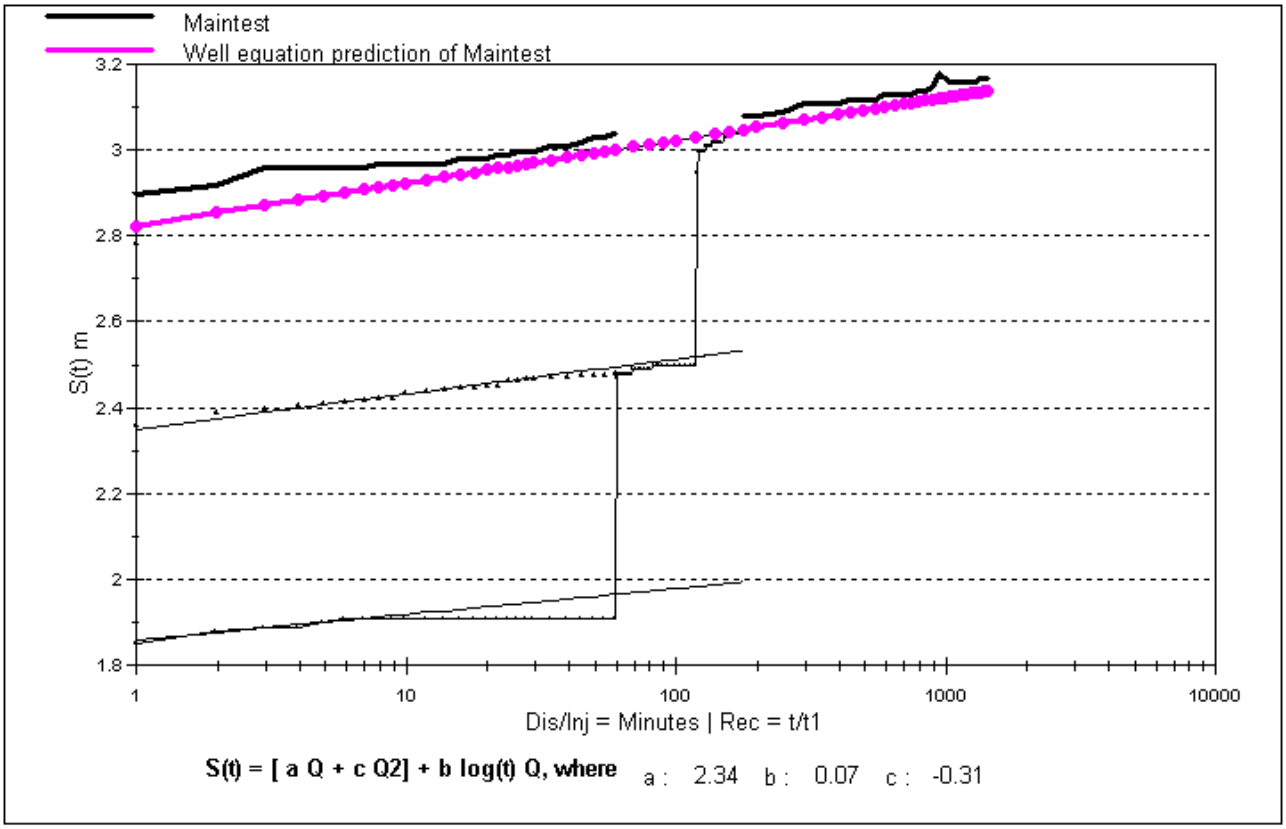


Figure 6. Well equation prediction of constant rate discharge test Lucindale TWS 5

Observation Well

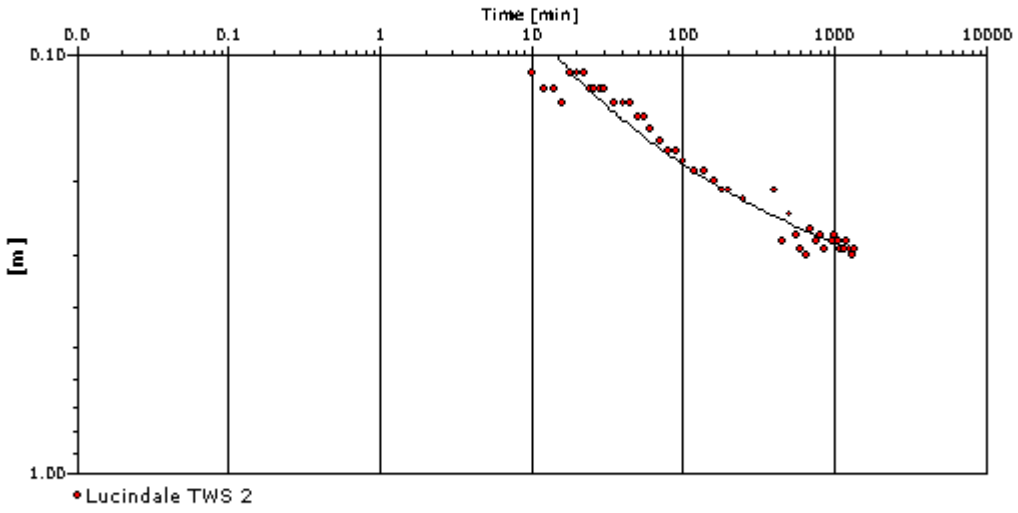
The data from the observation well Lucindale TWS 2 at a radial distance of 22 m from the production were analysed using the Theis method (Fig. 7). The following general comments can be made:

- A drawdown of 0.3 m developed during the test
- The Dilwyn Formation exhibited a drawdown signature at the observation well consistent with a confined aquifer
- The hydraulic parameters of Dilwyn Formation and overlying aquitard are given Table 5. The storage coefficient is given as 1.98 x 10^{-2}. This value is too low for a confined aquifer and this anomaly should be explored further
- During the period of the test no hydraulic boundaries were intersected.

Table 5. Analysis results observation well Lucindale TWS 3

Observation Well	Radial distance to production well (m)	Transmissivity (m^2/day)	Storage coefficient	Hydraulic resistance (day)	Method
Lucindale TWS 2	22	3,930	1.98 x 10-2	-	Theis

Location: Lucindale, South Australia	Pumping Test: Lucindale TWS 5	Pumping Well: Lucindale TWS 5
Test Conducted by:		Test Date: 2/12/2012
Analysis Performed by:	Theis	Analysis Date: 19/12/2012
Aquifer Thickness: 30.00 m	Discharge Rate: 25 [l/s]	



Calculation after Theis

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
Lucindale TWS 2	3.93×10^{1}	1.31×10^{0}	1.58×10^{-2}	22.0	

Figure 7. Theis analysis of drawdown observation well Lucindale TWS 2

GROUNDWATER SALINITY

Groundwater salinity (Fig. 8) was continuously recorded in the field during the constant rate discharge test. Groundwater salinity fluctuated between 600-700 mg/L through the intial 1000 minutes of the test. In the final 500 minutes the salinity fluctuated between 690-730 mg/L. Groundwater salinity was 810 mg/L (1470 uScm) based on the result of laboratory water chemistry analysis.

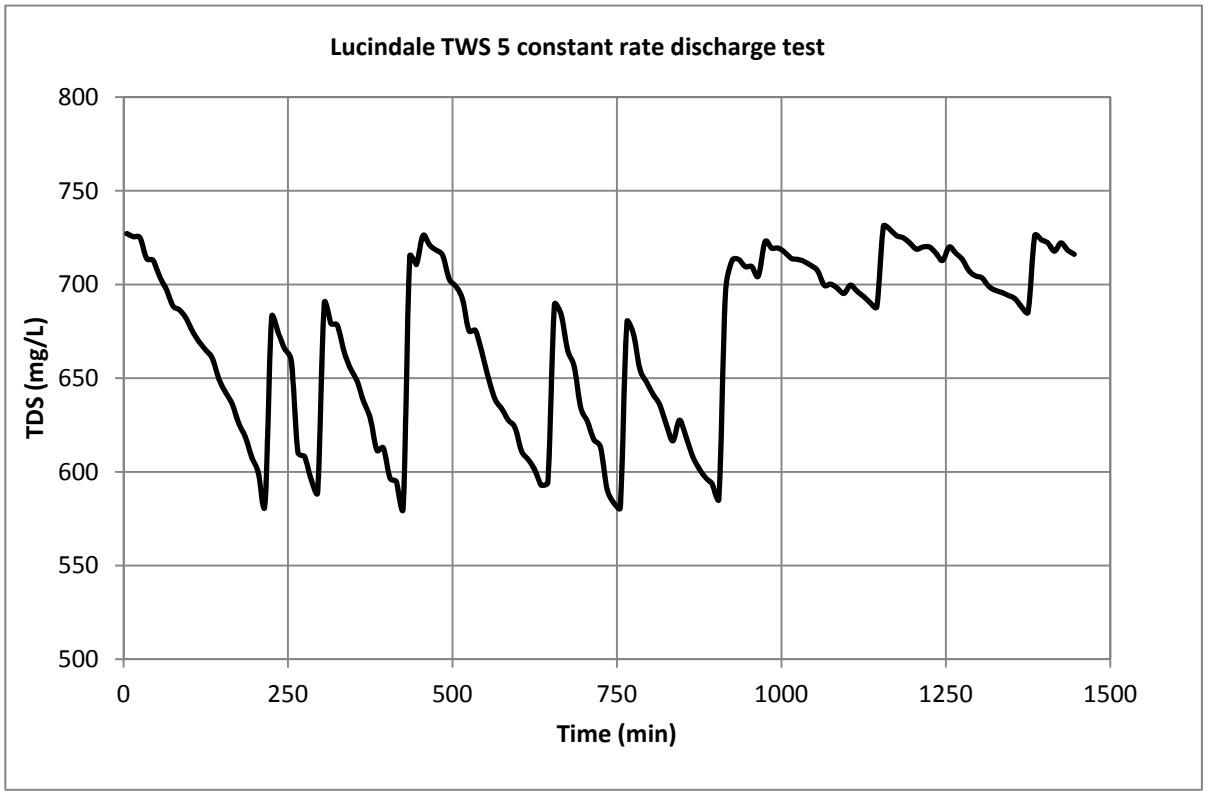


Figure 8. Groundwater salinity Lucindale TWS 5 constant rate discharge test

RECOMMENDATIONS

It is recommended Lucindale TWS 5 be pumped operationally and monitored for a full 12 months to confirm the long-term hydraulic behaviour of the well. The recommended pumping rate and pump depth are given in Table 6.

The current program of work included the design, implementation and testing of the production well. The report includes a brief analysis and interpretation of the constant rate discharge test. This analysis and interpretation can be futher explored in a future program of work dealing with regional aquifer and aquitard assesment.

Table 6. Well completion details and pumping test summary Lucindale TWS 5

	Parameter Description	Lucindale TWS 5
Well Design	Target aquifer	Dilwyn Formation
	Assumed depth to water (m)	-0.5 [1]
	Nominal casing inner diameter (mm)	250
	Casing length (m)	99
	Available drawdown (m)	99
SA Water Specification	Required pumping rate (L/s)	11
	Required pumping duration	1 h twice per day
	Modelled pumping rate (L/s)	11
	Modelled pumping duration	2 h (120 min)
	Predicted drawdown (m)	1.5
DFW Recommendation	Pumping rate (L/s)	11
	Pumping duration	3 h (180 min)
	Predicted drawdown (m)	1.5
	Pump intake depth (m)	9 [2]
	Resultant available drawdown safety factor (m)	7.5

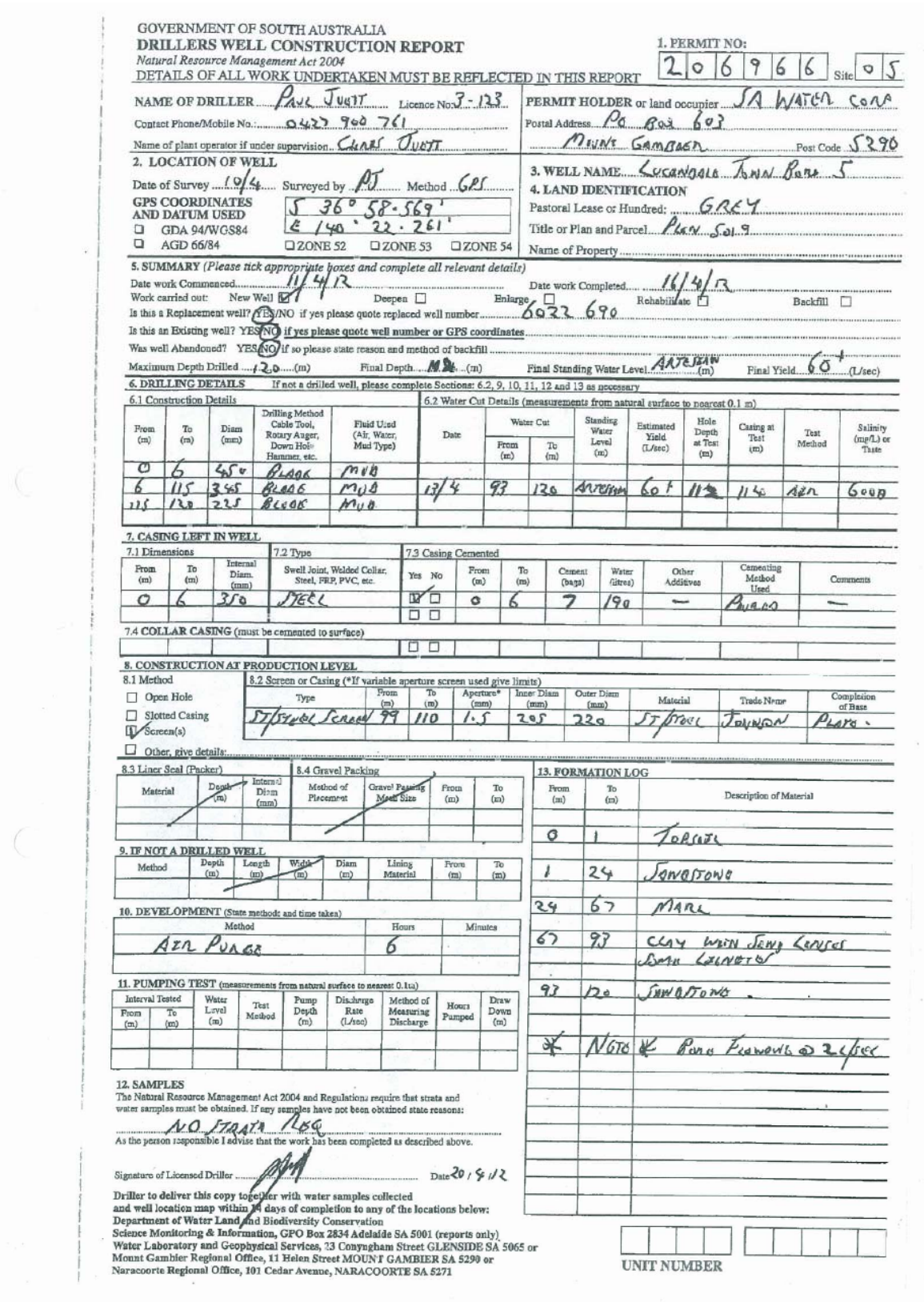
Note:

[1] Measurement taken at start of constant rate discharge test

[2] Pump intake depth based on 3 metre pump column

APPENDIXES

A. WELL CONSTRUCTION REPORT



GOVERNMENT OF SOUTH AUSTRALIA
DRILLERS WELL CONSTRUCTION REPORT
Natural Resource Management Act 2004
DETAILS OF ALL WORK UNDERTAKEN MUST BE REFLECTED IN THIS REPORT

1. PERMIT NO: 206966 Site 05

NAME OF DRILLER: PAUL JUDIT Licence No: 7-123
Contact Phone/Mobile No.: 0423 900 761
Name of plant operator if under supervision: CHRIS JUDIT

PERMIT HOLDER or land occupier: SA WATER CORP
Postal Address: PO BOX 603
MOUNT GAMBIER Post Code: 5290

2. LOCATION OF WELL
Date of Survey: 10/4 Surveyed by: AT Method: GPS
GPS COORDINATES AND DATUM USED: S 36° 58.569' E 140° 22.261'
☐ GDA 94/WGS84 ☐ AGD 66/84 ☐ ZONE 52 ☐ ZONE 53 ☐ ZONE 54

3. WELL NAME: LUCINDALE TOWN BORE 5
4. LAND IDENTIFICATION
Pastoral Lease or Hundred: GREY
Title or Plan and Parcel: PLAN 501
Name of Property:

5. SUMMARY (Please tick appropriate boxes and complete all relevant details)
Date work Commenced: 11/4/12 Date work Completed: 16/4/12
Work carried out: New Well ☑ Deepen ☐ Enlarge ☐ Rehabilitate ☐ Backfill ☐
Is this a Replacement well? YES/NO if yes please quote replaced well number: 6033 690
Is this an Existing well? YES/NO if yes please quote well number or GPS coordinates
Was well Abandoned? YES/NO if so please state reason and method of backfill
Maximum Depth Drilled: 120 (m) Final Depth: N/A (m) Final Standing Water Level: ARTESIAN (m) Final Yield: 60+ (L/sec)

6. DRILLING DETAILS If not a drilled well, please complete Sections: 6.2, 9, 10, 11, 12 and 13 as necessary

6.1 Construction Details

From (m)	To (m)	Diam (mm)	Drilling Method Cable Tool, Rotary Auger, Down Hole Hammer, etc.	Fluid Used (Air, Water, Mud Type)
0	6	450	BLADE	MUD
6	115	365	BLADE	MUD
115	120	225	BLADE	MUD

6.2 Water Cut Details (measurements from natural surface to nearest 0.1 m)

Date	Water Cut From (m)	Water Cut To (m)	Standing Water Level (m)	Estimated Yield (L/sec)	Hole Depth at Test (m)	Casing at Test (m)	Test Method	Salinity (mg/L) or Taste
13/4	93	120	ARTESIAN	60+	118	114	AIR	GOOD

7. CASING LEFT IN WELL

7.1 From (m)	7.1 To (m)	7.1 Internal Diam. (mm)	7.2 Type Swell Joint, Welded Collar, Steel, FRP, PVC, etc.	7.3 Cemented Yes	7.3 Cemented No	From (m)	To (m)	Cement (bags)	Water (litres)	Other Additives	Cementing Method Used	Comments
0	6	350	STEEL	☑	☐	0	6	7	190	—	PUMP	—
				☐	☐							

7.4 COLLAR CASING (must be cemented to surface) ☐ ☐

8. CONSTRUCTION AT PRODUCTION LEVEL
8.1 Method: ☐ Open Hole ☐ Slotted Casing ☑ Screen(s) ☐ Other, give details:

8.2 Screen or Casing (*If variable aperture screen used give limits)

Type	From (m)	To (m)	Aperture* (mm)	Inner Diam (mm)	Outer Diam (mm)	Material	Trade Name	Completion of Base
ST/STEEL SCREEN	99	110	1.5	205	220	ST/STEEL	JOHNSON	PLUG

8.3 Liner Seal (Packer)

Material	Depth (m)	Internal Diam (mm)

8.4 Gravel Packing

Method of Placement	Gravel Passing Mesh Size	From (m)	To (m)

9. IF NOT A DRILLED WELL

Method	Depth (m)	Length (m)	Width (m)	Diam (m)	Lining Material	From (m)	To (m)

10. DEVELOPMENT (State methods and time taken)

Method	Hours	Minutes
AIR PURGE	6	

11. PUMPING TEST (measurements from natural surface to nearest 0.1m)

Interval Tested From (m)	Interval Tested To (m)	Water Level (m)	Test Method	Pump Depth (m)	Discharge Rate (L/sec)	Method of Measuring Discharge	Hours Pumped	Draw Down (m)

12. SAMPLES
The Natural Resource Management Act 2004 and Regulations require that strata and water samples must be obtained. If any samples have not been obtained state reasons:
NO STRATA LOG
As the person responsible I advise that the work has been completed as described above.
Signature of Licensed Driller: Date: 20/4/12

Driller to deliver this copy together with water samples collected and well location map within 14 days of completion to any of the locations below:
Department of Water Land and Biodiversity Conservation
Science Monitoring & Information, GPO Box 2834 Adelaide SA 5001 (reports only)
Water Laboratory and Geophysical Services, 73 Conyngham Street GLENSIDE SA 5065 or
Mount Gambier Regional Office, 11 Helen Street MOUNT GAMBIER SA 5290 or
Naracoorte Regional Office, 101 Cedar Avenue, NARACOORTE SA 5271

13. FORMATION LOG

From (m)	To (m)	Description of Material
0	1	TOPSOIL
1	24	SANDSTONE
24	67	MARL
67	93	CLAY WITH SAND LENSES BOTH CALCITIC
93	120	SANDSTONE
*		NOTE * BORE FLOWING @ 2 L/SEC

UNIT NUMBER

B. WATER WELL LOG

Project**: LUCINDALE TWS 5**

Permit Number: **206966**
Date Completed: **16TH April 2012**
Unit No: **6924 - 4115**
Drillhole Name: **LUNCINDALE TWS 5**
Logged By: **Jeff Lawson**

Backfilled (Y/N): **N**
Total Depth (m): **120**
Drill Method: **Rotary mud**
Drilling Company: **Diverse Resources**
Driller: **Paul Juett**

Coordinates
Easting: **444017**
Northing: **5907585**
Zone: **54**
Datum: **GDA94**

Ground Elevation (mAHD): **28m DEM**
Reference Elevation (mAHD): **TBD**
Reference Point Type: **TOC**

General Comments:

Lithological Description

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
0	3	SANDSTONE	Pale orange, strongly cemented fine grained fragments. Unconsolidated sand. Occasional well preserved fossil remnants.	BRIDGEWATER FORMATION
3	6		Pale orange. Varies from strongly cemented to uncemented, fine grained sand. Strong iron staining.	
6	15		Pale brown. Weakly cemented sand and fossil remnants. Sections are observed as open sandstone, probably highly transmissive. Fine grained almost flint like chips.	
15	21		Weak marl component	
21	24	LIMESTONE	Transitioning to a limestone. Grey fine grained limestone fragments. Strong calcite mist content. Uncemented bryozoa.	GAMBIER LIMESTONE
24	36	MARLY LIMESTONE	White varies from unconsolidated material to strongly cemented fine grained chips. High calcite content related to the marl. Marl weakly bound, easily broken down in water. Overall fine grained.	
36	45	LIMESTONE	White weakly cemented, medium grained limestone. Unconsolidated bryozoa. Weak marl content. Strong glauconitic staining.	
45	48	FLINT	Light to darker grey flint. High % light grey partially silicified fragments. Minor unconsolidated bryozoa and marl.	
48	54	MARLY	Very pale grey, moderately bounded marl. Dominant	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
		LIMESTONE	marl, approx 30% limestone content.	
54	57	MARL	Grey, strongly bounded marl. Minor limestone content.	
57	61		Limestone content increasing.	
61	63	MARL	Grey, moderately bound marl. Strong glauconitic staining.	NARRAWATURK MARL
63	66		Light grey moderately bound marl. 20-30% unconsolidated limestone. Minor flint.	
66	71		Off white, unconsolidated limestone. 20 – 30% grey marl. Glauconitic staining.	
71	79	SAND	Unconsolidated, strongly limonitic sand. Some milky quartz grains.	MEPUNGA FORMATION
79	84	CLAY	Dark brown clay. Very soft, pliable. Minor sand content.	DILWYN FORMATION
84	90	SAND	Very weakly bounded black clay easily broken down. Strongly dominant sand content.	
90	93		50% Sand average – 0.73mm	
93	94		50% Sand average – 0.73mm	
94	95		50% Sand average – 0.72mm	
95	96		50% Sand average – 0.80mm	
96	97		50% Sand average – 0.85mm	
97	98		50% Sand average – 0.82mm	
98	99		50% Sand average – 0.87mm	
99	100		50% Sand average – 0.90mm	
100	101		50% Sand average – 1.30mm	
101	102		50% Sand average – 1.30mm	
102	103		50% Sand average – 1.20mm	
103	104		50% Sand average – 1.30mm	
104	105		50% Sand average – 1.80mm	
105	106		50% Sand average – 1.70mm	
106	107		50% Sand average – 1.90mm	
107	108		50% Sand average – 1.80mm	
108	109		50% Sand average – 1.80mm	
109	110		50% Sand average – 1.40mm	
110	111		50% Sand average – 1.60mm	
111	112		50% Sand average – 1.60mm	
112	113		50% Sand average – 1.40mm	
113	114		50% Sand average – 1.20mm	
114	115		50% Sand average – 1.50mm	
115	116		50% Sand average – 0.95mm	
116	117		50% Sand average – 0.90mm	
117	118		50% Sand average – 0.85mm	

Depth (m)		Major Lith Unit(s)	Lithology	Formation
From	To			
118	119		50% Sand average – 1.20mm	
19	120		50% Sand average – 1.50mm	

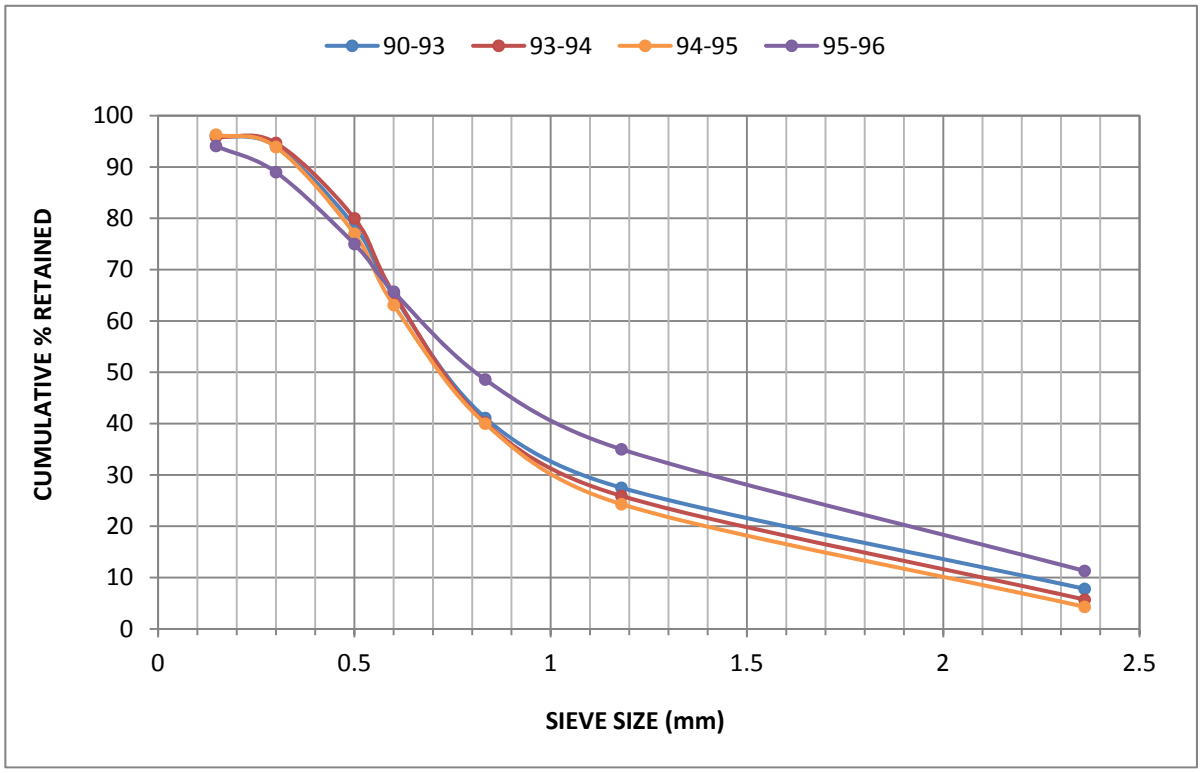
Water Cut Information

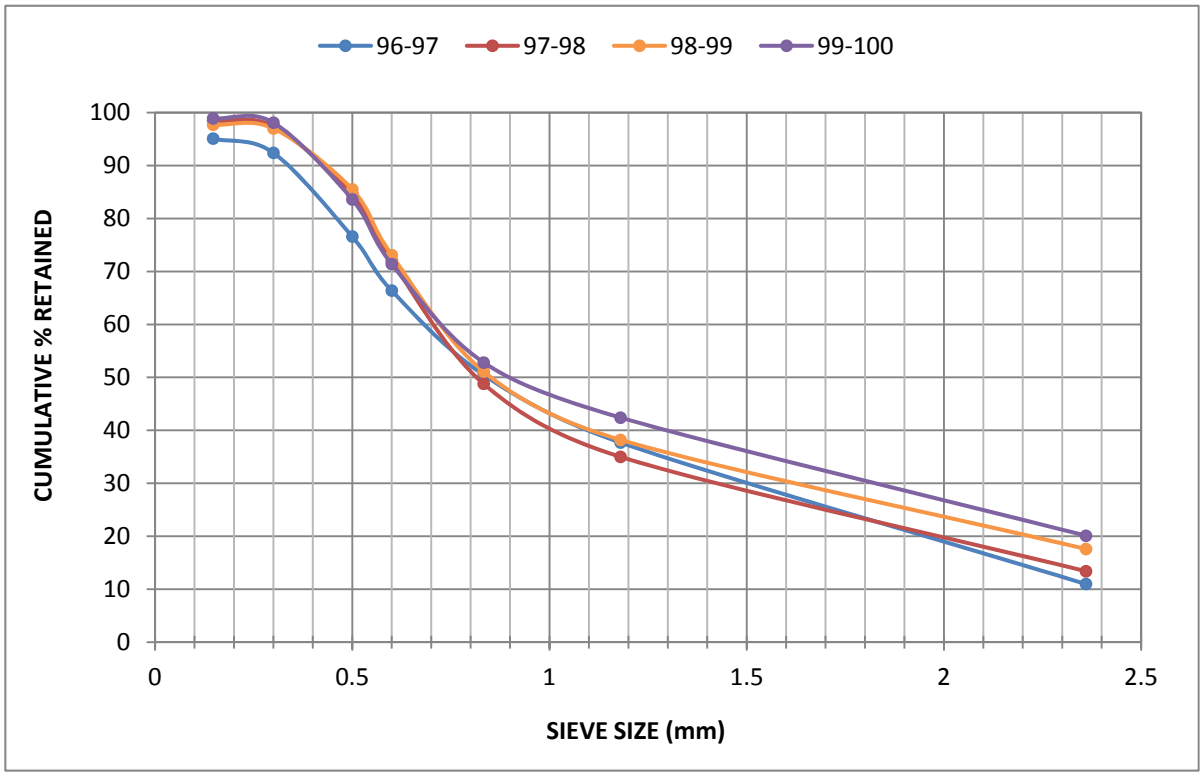
Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		Yield (L/s)	Test Length (min)	Method	Sample No.	Salinity	Salinity Unit (mg/L / EC)
99	110	0.5 above GL	25	1440	Pump	N/A	N/A	810/1470

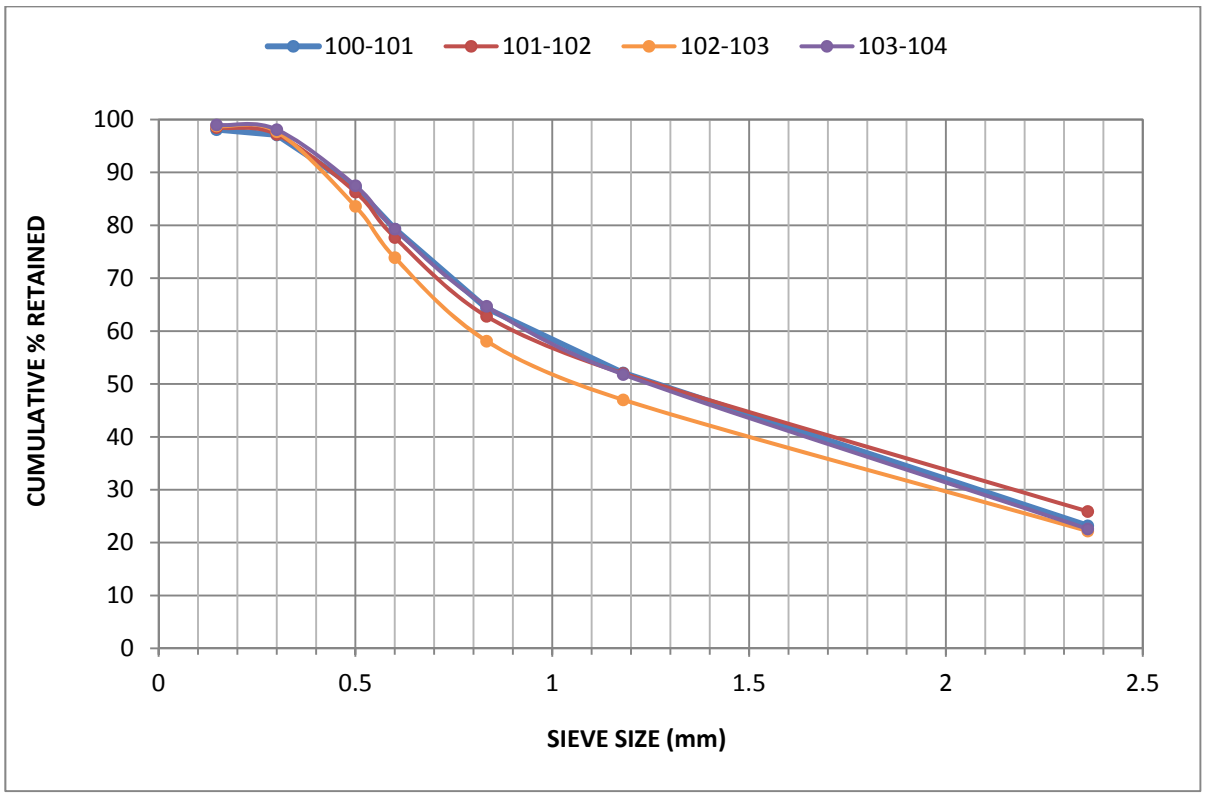
Casing and Production Zone Information

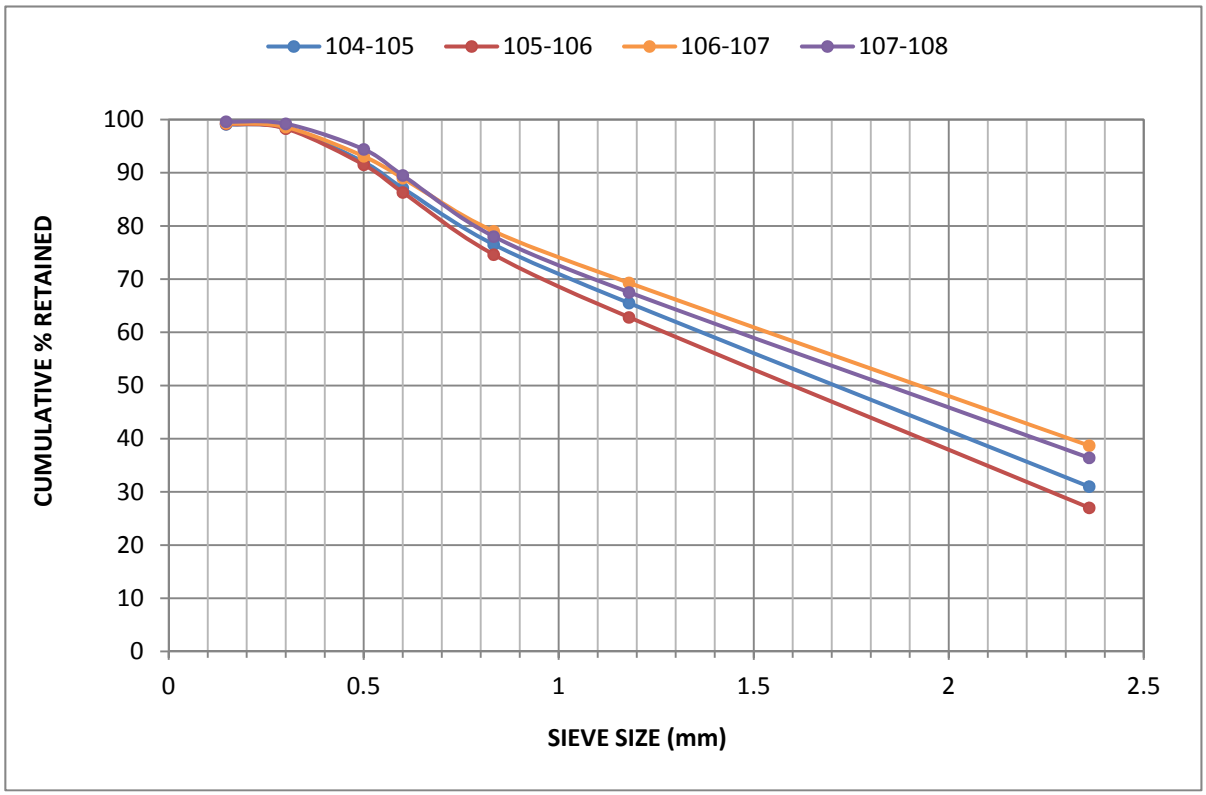
Case or Production Zone	Depth (m)		Inner Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Surface control casing	0	6	355	Schedule 20 steel		y	0	6
Well Casing	0	99	253	Class 12 PVC		Y	0	99
Riser Pipe	97	99	200	Zero aperture stainless steel				
Prod zone	99	110	205	316 Stainless wire-wound screen	1.5			
Sump	110	112		Zero aperture stainless steel				

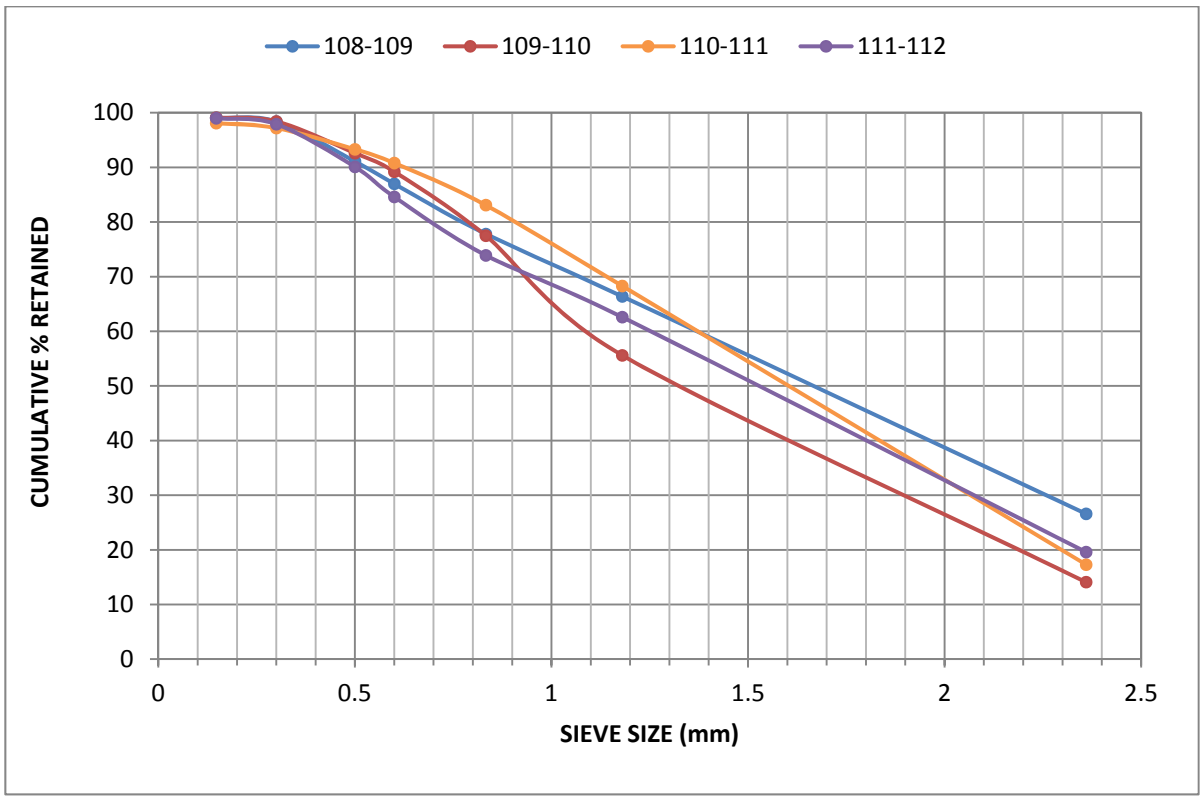
C. DILWYN FORMATION SIEVE ANALYSIS

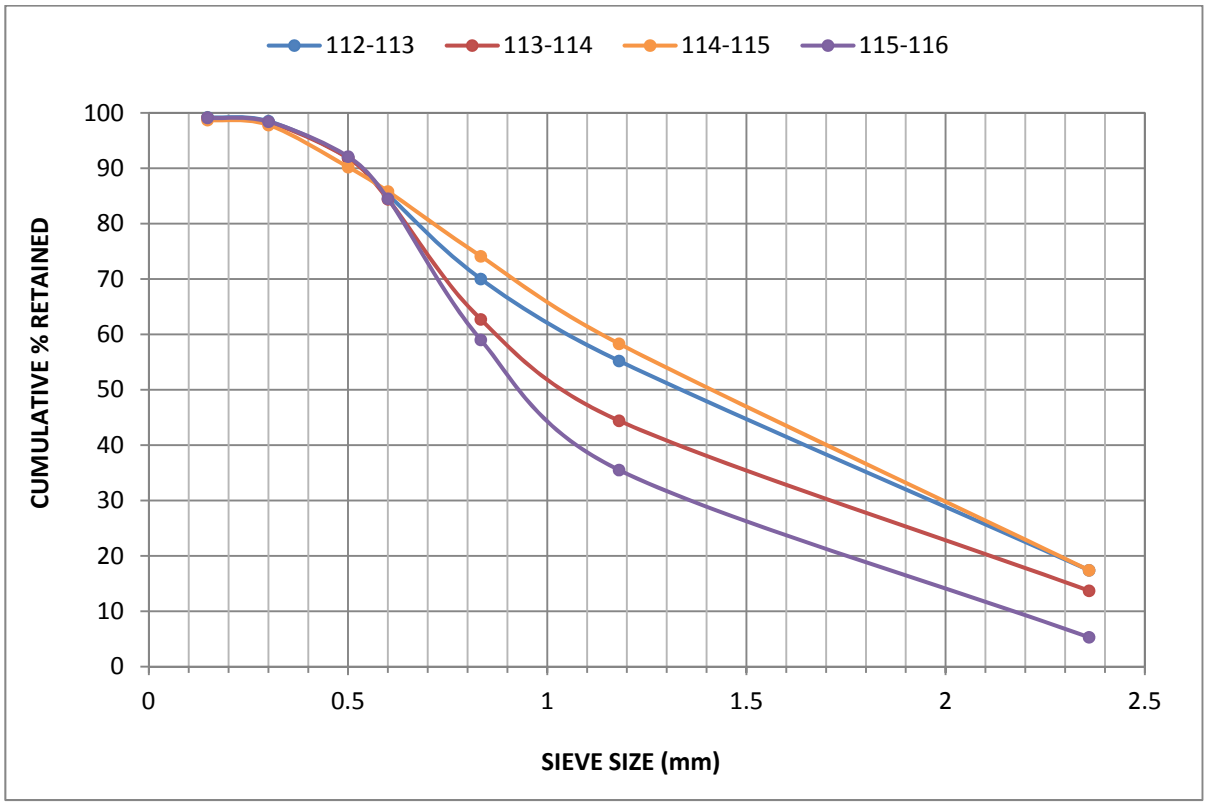


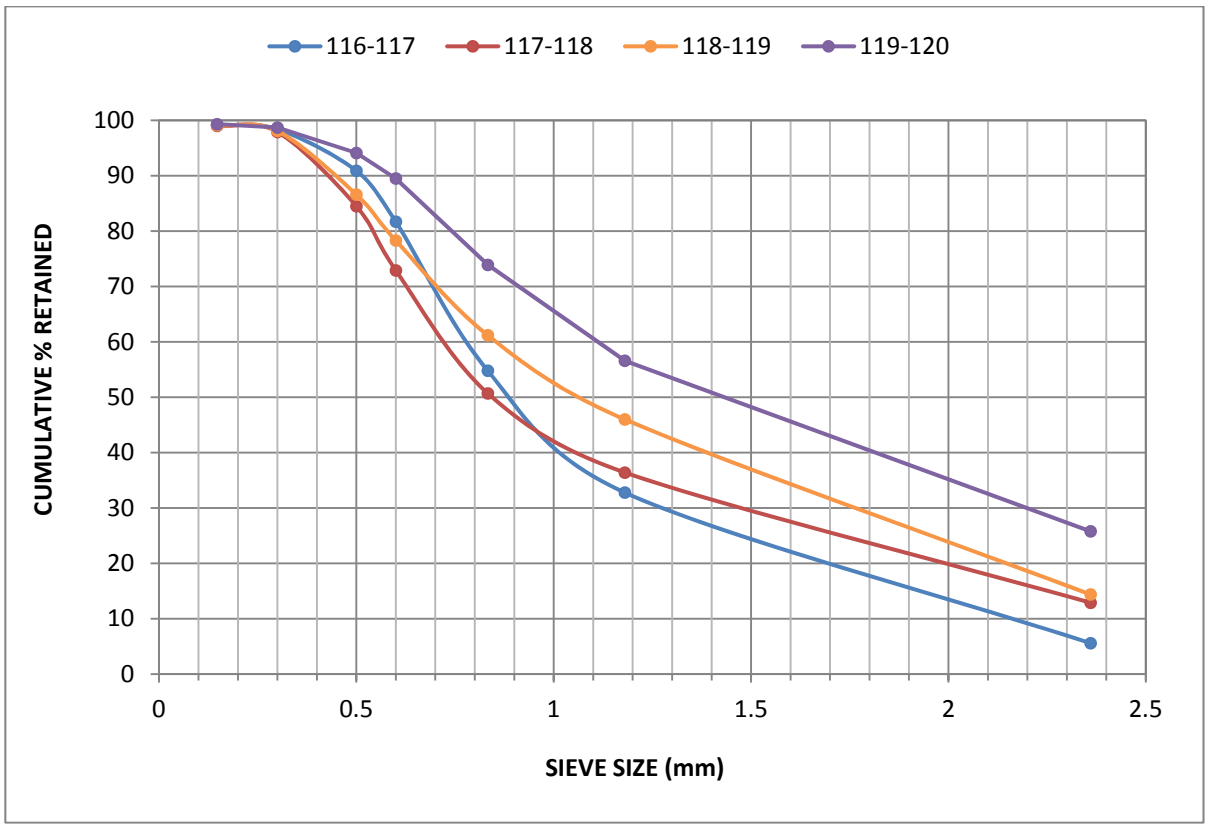



100-101
101-102
102-103
103-104
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)


104-105
105-106
106-107
107-108
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)


108-109
109-110
110-111
111-112
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)


112-113
113-114
114-115
115-116
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)


116-117
117-118
118-119
119-120
CUMULATIVE % RETAINED
100
90
80
70
60
50
40
30
20
10
0
0
0.5
1
1.5
2
2.5
SIEVE SIZE (mm)

D. PUMPING TEST DATA

D.1 LUCINDALE TWS 5 STEP DRAWDOWN TEST

LUCINDALE TWS 5

Start date	Start time	Step	Duration (min)	Q (L/s)	Well Name	Well Type	r (m)	Aquifer	Ref Elev. (mAHD)
24/04/2012	09:30	1	60	15	Lucindale TWS 5 6924-4115	Prod.	0	Dilwyn Formation	28m (DEM)
"		2	60	20	"	"	"	"	"
"		3	60	25	"	"	"	"	"

LUCINDALE TWS 5 MANUAL DATA

Step No.	Q (L/s)	Time (min)	DTW (m)	DD (m)
		0	flowing	-0.51
1	15	1	1.34	1.85
1	15	2	1.37	1.88
1	15	3	1.38	1.89
1	15	4	1.38	1.89
1	15	5	1.39	1.9
1	15	6	1.40	1.91
1	15	7	1.40	1.91
1	15	8	1.40	1.91
1	15	9	1.40	1.91
1	15	10	1.40	1.91
1	15	12	1.40	1.91
1	15	14	1.40	1.91
1	15	16	1.40	1.91
1	15	18	1.40	1.91
1	15	20	1.40	1.91
1	15	22	1.40	1.91
1	15	24	1.40	1.91
1	15	26	1.40	1.91
1	15	28	1.40	1.91
1	15	30	1.40	1.91
1	15	35	1.40	1.91
1	15	40	1.40	1.91
1	15	45	1.40	1.91
1	15	50	1.40	1.91
1	15	55	1.40	1.91
1	15	60	1.40	1.91
2	20	61	1.96	2.47
2	20	62	1.97	2.48
2	20	63	1.97	2.48
2	20	64	1.97	2.48

Step No.	Q (L/s)	Time (min)	DTW (m)	DD (m)
2	20	65	1.97	2.48
2	20	66	1.97	2.48
2	20	67	1.97	2.48
2	20	68	1.97	2.48
2	20	69	1.97	2.48
2	20	70	1.98	2.49
2	20	72	1.98	2.49
2	20	74	1.98	2.49
2	20	76	1.98	2.49
2	20	78	1.98	2.49
2	20	80	1.98	2.49
2	20	82	1.98	2.49
2	20	84	1.99	2.50
2	20	86	1.99	2.50
2	20	88	1.99	2.50
2	20	90	1.99	2.50
2	20	95	1.99	2.50
2	20	100	1.99	2.50
2	20	105	1.99	2.50
2	20	110	1.99	2.50
2	20	115	1.99	2.50
2	20	120	1.99	2.50
3	25	121	2.44	2.95
3	25	122	2.49	3.00
3	25	123	2.49	3.00
3	25	124	2.49	3.00
3	25	125	2.49	3.00
3	25	126	2.49	3.00
3	25	127	2.49	3.00
3	25	128	2.49	3.00
3	25	129	2.49	3.00
3	25	130	2.50	3.01
3	25	132	2.50	3.01
3	25	134	2.50	3.01
3	25	136	2.50	3.01
3	25	138	2.51	3.02
3	25	140	2.51	3.02
3	25	142	2.51	3.02
3	25	144	2.51	3.02
3	25	146	2.51	3.02
3	25	148	2.51	3.02
3	25	150	2.51	3.02

Step No.	Q (L/s)	Time (min)	DTW (m)	DD (m)
3	25	155	2.52	3.03
3	25	160	2.52	3.03
3	25	165	2.53	3.04
3	25	170	2.53	3.04
3	25	175	2.53	3.04
3	25	180	2.53	3.04

D2 LUCINDALE TWS 5 CONSTANT RATE DISCHARGE TEST

LUCINDALE TWS 5

Start date	Start time	Step	Duration (min)	Q (L/s)	Well Name	Well Type	r (m)	Aquifer	Ref Elev. (mAHD)
25/04/2012	08:45	1	Pumping 1440 Recovery 450	25	Lucindale TWS 5 6924-4115	Prod.	0	Dilwyn Formation	28 m (DEM)
					Lucindale TWS 2	Obs	22	Dilwyn Formation	28 m (DEM)

LUCINDALE TWS 5 MANUAL DATA

Q (L/s)	Time (min)	DTW (m)	DD (m)
	0	-0.51	
25	1	2.39	2.90
25	2	2.41	2.92
25	3	2.45	2.96
25	4	2.45	2.96
25	5	2.45	2.96
25	6	2.45	2.96
25	7	2.45	2.96
25	8	2.46	2.97
25	9	2.46	2.97
25	10	2.46	2.97
25	12	2.46	2.97
25	14	2.46	2.97
25	16	2.47	2.98
25	18	2.47	2.98
25	20	2.47	2.98
25	22	2.48	2.99
25	24	2.48	2.99
25	26	2.49	2.98
25	28	2.49	3.00
25	30	2.49	3.00
25	35	2.50	3.01
25	40	2.50	3.01
25	45	2.51	3.02
25	50	2.52	3.03
25	55	2.52	3.03
25	60	2.53	3.04
25	70	2.53	3.04
25	80	2.54	3.04
25	90	2.54	3.05
25	100	2.55	3.06
25	120	2.56	3.07

Q (L/s)	Time (min)	DTW (m)	DD (m)
25	140	2.56	3.07
25	160	2.57	3.08
25	180	2.57	3.08
25	200	2.57	3.08
25	250	2.58	3.09
25	300	2.60	3.11
25	350	2.60	3.11
25	400	2.60	3.11
25	450	2.61	3.12
25	500	2.61	3.12
25	550	2.61	3.12
25	600	2.62	3.13
25	650	2.62	3.13
25	700	2.62	3.13
25	750	2.62	3.13
25	800	2.63	3.14
25	850	2.63	3.14
25	900	2.64	3.15
25	950	2.67	3.18
25	1000	2.66	3.17
25	1050	2.65	3.16
25	1100	2.65	3.16
25	1150	2.65	3.16
25	1200	2.65	3.16
25	1250	2.65	3.16
25	1300	2.65	3.16
25	1350	2.66	3.17
25	1400	2.66	3.17
25	1440	2.66	3.17

LUCINDALE TWS 2 MANUAL DATA

Q (L/s)	Time (min)	DTW (m)	DD (m)
	0	-0.56	
	1	0.00	
	2	0.00	
	3	0.00	
	4	0.00	
	5	0.00	
	6	0.00	
	7	0.00	
	8	0.00	

Q (L/s)	Time (min)	DTW (m)	DD (m)
	9	0.00	
	10	-0.45	0.11
	12	-0.44	0.12
	14	-0.44	0.12
	16	-0.43	0.13
	18	-0.45	0.11
	20	-0.45	0.11
	22	-0.45	0.11
	24	-0.44	0.12
	26	-0.44	0.12
	28	-0.44	0.12
	30	-0.44	0.12
	35	-0.43	0.13
	40	-0.43	0.13
	45	-0.43	0.13
	50	-0.42	0.14
	55	-0.42	0.14
	60	-0.41	0.15
	70	-0.40	0.16
	80	-0.39	0.17
	90	-0.39	0.17
	100	-0.38	0.18
	120	-0.37	0.19
	140	-0.37	0.19
	160	-0.36	0.20
	180	-0.35	0.21
	200	-0.35	0.21
	250	-0.34	0.22
	400	-0.35	0.21
	450	-0.28	0.28
	500	-0.32	0.24
	550	-0.29	0.27
	600	-0.27	0.29
	650	-0.26	0.30
	700	-0.30	0.26
	750	-0.28	0.28
	800	-0.29	0.27
	850	-0.27	0.29
	900	0.00	
	950	-0.28	0.28
	1000	-0.29	0.27
	1050	-0.28	0.28

Q (L/s)	Time (min)	DTW (m)	DD (m)
	1100	-0.27	0.29
	1150	-0.27	0.29
	1200	-0.28	0.28
	1250	-0.27	0.29
	1300	-0.26	0.30
	1350	-0.27	0.29

E. WATER CHEMISTRY

PO Box 1751
Adelaide SA 5001

250 Victoria Square
Adelaide SA 5000

Tel: 1300 653 366
Fax: 1300 883 171

Internet: www.awqc.com.au
Email: awqc@sawater.com.au

Australian Water Quality Centre

SAW Infrastructure
ATTN: Tim Driver
250 Victoria Square
Adelaide
SA 5100 AUSTRALIA

23/05/2012

Dear Tim

Please find attached the Final Analytical Report for

Customer Service Request: 105296-2012-CSR-11
Account: 105296
Project: AWQC-59829 SAW Infrastructure - Lucindale Bore Commissioning 11/12

This report has also been sent to: Maree Shephard

Please note AWQC Sample Receipt hours are Monday to Friday 8.30am - 4.30pm.

Yours sincerely,

Pat Poldervaart
Account Manager
Pat.Poldervaart@sawater.com.au
+61 8 7424 2095

NATA
WORLD RECOGNISED ACCREDITATION

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Adelaide SA 5001

250 Victoria Square
Adelaide SA 5000

Tel: 1300 653 366
Fax: 1300 883 171

Internet: www.awqc.com.au
Email: awqc@sawater.com.au

Australian Water Quality Centre

FINAL REPORT: 103417

Report Information

Project Name	AWQC-59829
Customer	SAW Infrastructure
CSR_ID	105296-2012-CSR-11

Analytical Results

Customer Sample Description	Lucindale Bore 5
Sampling Point	22332-Lucindale Bore No 5
Sampled Date	19/04/2012 9:45:00AM
Sample Received Date	24/04/2012 8:07:54PM
Sample ID	*2012-002-2810
Status	Endorsed
Collection Type	Customer Collected

Bacteriology	LOR	Result
Coliforms T0080-07 WMZ-500		
Coliforms		0 /100mL
Coliforms - Presumptive		0 /100mL
E.coli T0081-07 WMZ-500		
E.coli		0 /100mL
E.coli - Presumptive		0 /100mL

Customers - eg Regional Samplers	LOR	Result
Temperature EXT		
# Temperature		21.7 °C

Inorganic Chemistry - Metals	LOR	Result
Aluminium - Acid Soluble TIC-003 W09-023		
Aluminium - Acid Soluble	0.001	0.004 mg/L
Aluminium - Soluble TIC-003 W09-023		
Aluminium - Soluble	0.001	0.001 mg/L
Aluminium - Total TIC-003 W09-023		
Aluminium - Total	0.001	0.005 mg/L
Antimony - Soluble TIC-003 W09-023		
Antimony - Soluble	0.0005	<0.0005 mg/L
Antimony - Total TIC-003 W09-023		
Antimony - Total	0.0005	<0.0005 mg/L
Arsenic - Soluble TIC-003 W09-023		
Arsenic - Soluble	0.0003	<0.0003 mg/L
Arsenic - Total TIC-003 W09-023		
Arsenic - Total	0.0003	<0.0003 mg/L
Barium - Soluble TIC-003 W09-023		
Barium - Soluble	0.0005	0.0313 mg/L
Barium - Total TIC-003 W09-023		
Barium - Total	0.0005	0.0307 mg/L
Beryllium - Soluble TIC-003 W09-023		

NATA
WORLD RECOGNISED ACCREDITATION

Corporate Accreditation No.1115
Chemical and Biological Testing
This document is issued in accordance with NATA's accreditation requirements.

Notes
1. **The last figure of the result value is a significant figure.**
2. **Samples are analysed as received.**
3. **# determination of the component is not covered by NATA Accreditation.**
4. **^ indicates result is out of specification according to the reference Guideline. Refer to Report footer.**
5. *** indicates incident have been recorded against the sample. Refer to Report footer.**
6. **& indicates the results have changed since the last issued report.**
7. **The Limit of Reporting (LOR) is the lowest concentration of analyte which is reported at the AWQC and is based on the LOQ rounded up to a more readily used value. The Limit of Quantitation (LOQ) is the lowest concentration of analyte for which quantitative results may be obtained within a specified degree of confidence.**

ABN 69336525019

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Australian Water Quality Centre

FINAL REPORT: 103417

Analytical Results

Customer Sample Description	Lucindale Bore 5
Sampling Point	22332-Lucindale Bore No 5
Sampled Date	19/04/2012 9:45:00AM
Sample Received Date	24/04/2012 8:07:54PM
Sample ID	*2012-002-2810
Status	Endorsed
Collection Type	Customer Collected

Beryllium - Soluble TIC-003 W09-023		
Beryllium - Soluble	0.0003	<0.0003 mg/L
Beryllium - Total TIC-003 W09-023		
Beryllium - Total	0.0003	<0.0003 mg/L
Boron - Soluble TIC-003 W09-023		
Boron - Soluble	0.020	0.212 mg/L
Cadmium - Soluble TIC-003 W09-023		
Cadmium - Soluble	0.0001	<0.0001 mg/L
Cadmium - Total TIC-003 W09-023		
Cadmium - Total	0.0001	<0.0001 mg/L
Calcium Hardness as CaCO3 W09-023		
Calcium Hardness as CaCO3	2.0	204 mg/L
Calcium TIC-003 W09-023		
Calcium	0.04	81.6 mg/L
Carbonate Hardness as CaCO3 T0203-01 W09-023		
Carbonate hardness as CaCO3	2	322 mg/L
Chlorides - Total as NaCl W09-023		
Chlorides - Total as NaCl	7	461 mg/L
Chromium - Soluble TIC-003 W09-023		
Chromium - Soluble	0.0001	<0.0001 mg/L
Chromium - Total TIC-003 W09-023		
Chromium - Total	0.0001	<0.0001 mg/L
Copper - Soluble TIC-003 W09-023		
Copper - Soluble	0.0001	<0.0001 mg/L
Copper - Total TIC-003 W09-023		
Copper - Total	0.0001	0.0011 mg/L
Dissolved Solids by Calculation W09-023		
Dissolved solids by calculation	0	786 mg/L
Ion Balance W09-023		
Ion balance		1.42 %
Iron - Soluble TIC-003 W09-023		
Iron - Soluble	0.0005	0.1115 mg/L
Iron - Total TIC-003 W09-023		
Iron - Total	0.0005	0.7204 mg/L
Langelier Index W09-023		
Langelier Index		0.15
Lead - Soluble TIC-003 W09-023		
Lead - Soluble	0.0001	<0.0001 mg/L

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FINAL REPORT: 103417

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Lead - Total TIC-003 W09-023		
Lead - Total	0.0001	<0.0001 mg/L
Magnesium Hardness as CaCO3 W09-023		
Magnesium Hardness as CaCO3	2	136 mg/L
Magnesium TIC-003 W09-023		
Magnesium	0.04	33.0 mg/L
Manganese - Soluble TIC-003 W09-023		
Manganese - Soluble	0.0001	0.0227 mg/L
Manganese - Total TIC-003 W09-023		
Manganese - Total	0.0001	0.0223 mg/L
Mercury - Soluble TIC-003 W09-023		
Mercury - Soluble	0.00003	0.00004 mg/L
Mercury - Total TIC-003 W09-023		
Mercury - Total	0.00003	0.00007 mg/L
Molybdenum - Soluble TIC-003 W09-023		
Molybdenum - Soluble	0.0001	0.0006 mg/L
Molybdenum - Total TIC-003 W09-023		
Molybdenum - Total	0.0001	0.0006 mg/L
Nickel - Soluble TIC-003 W09-023		
Nickel - Soluble	0.0001	0.0001 mg/L
Nickel - Total TIC-003 W09-023		
Nickel - Total	0.0001	0.0002 mg/L
Noncarbonate Hardness as CaCO3 T0204-01 W09-023		
Noncarbonate hardness as CaCO3	2	18 mg/L
Potassium TIC-003 W09-023		
Potassium	0.040	7.51 mg/L
Selenium - Soluble TIC-003 W09-023		
Selenium - Soluble	0.0001	<0.0001 mg/L
Selenium - Total TIC-003 W09-023		
Selenium - Total	0.0001	<0.0001 mg/L
Silver - Soluble TIC-003 W09-023		
Silver - Soluble	0.00003	<0.00003 mg/L
Silver - Total TIC-003 W09-023		
Silver - Total	0.00003	<0.00003 mg/L
Sodium Adsorption Ratio W09-023		
Sodium Adsorption Ratio - Calculation		4.32
Sodium TIC-003 W09-023		
Sodium	0.04	183 mg/L

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Sodium/Total Cations Ratio W09-023		
Sodium/Total cations ratio	1	53.3 %
Sulphur TIC-004 W09-023		
Sulphate	1.5	8.7 mg/L
Tin - Soluble TIC-003 W09-023		
Tin - Soluble	0.0005	<0.0005 mg/L
Tin - Total TIC-003 W09-023		
Tin - Total	0.0005	<0.0005 mg/L
Total Hardness as CaCO3 W09-023		
Total Hardness as CaCO3	2.0	340 mg/L
Uranium - Soluble TIC-003 W09-023		
Uranium - Soluble	0.0001	<0.0001 mg/L
Uranium - Total TIC-003 W09-023		
Uranium - Total	0.0001	<0.0001 mg/L
Zinc - soluble TIC-003 W09-023		
Zinc - Soluble	0.0003	0.0039 mg/L
Zinc - Total TIC-003 W09-023		
Zinc - Total	0.0003	0.0039 mg/L

Inorganic Chemistry - Nutrients	LOR	Result
Ammonia as N T0100-01 W09-023		
Ammonia as N	0.005	0.243 mg/L
Bromide T0114-01 W09-023		
Bromide	0.025	0.53 mg/L
Chloride T0104-02 W09-023		
Chloride	4.0	280 mg/L
Fluoride W09-023		
Fluoride	0.10	0.30 mg/L
Iodide T0117-01 W09-023		
Iodide	0.01	0.03 mg/L
Nitrate + Nitrite as N T0161-01 W09-023		
Nitrate + Nitrite as N	0.003	0.004 mg/L
Nitrate + Nitrite as NO3 T0161-01 W09-023		
Nitrate + Nitrite as NO3	0.02	<0.02 mg/L
Nitrate as N W09-023		
Nitrate as Nitrogen	0.005	<0.005 mg/L
Nitrite as N T0107-01 W09-023		

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Nitrite as N T0107-01 W09-023		
Nitrite as Nitrogen	0.003	<0.003 mg/L
Phosphorus - Filterable Reactive as P T0108-01 W09-023		
Phosphorus - Filterable Reactive as P	0.003	0.006 mg/L
Phosphorus - Total T0109-01 W09-023		
Phosphorus - Total	0.005	0.034 mg/L
Silica - Reactive T0111-01 W09-023		
Silica - Reactive	1	11 mg/L
TKN as N T0112-01 W09-023		
TKN as Nitrogen	0.05	0.32 mg/L

Organic Chemistry	LOR	Result
Dissolved Organic Carbon W09-023		
Dissolved Organic Carbon	0.3	2.4 mg/L
GCMS Scan - Dichloromethane T1072-01 W09-023		
# GCMS Scan		The GC scan showed the sample contained a number of semi-volatile organic compounds. Some compounds may not have even been extracted using dichloromethane and/or detected by GC/MS. The peaks detected were unable to be identified as NIST Mass Spectral Search Program 2002 showed very poor matches.
OrganoChlorine Pesticides T0700-01 W09-023		
Aldrin	0.01	<0.01 µg/L
Chlordane-a	0.01	<0.01 µg/L
Chlordane-g	0.01	<0.01 µg/L
Chlorothalonil	0.05	<0.05 µg/L
Chlorpyrifos	0.05	<0.05 µg/L
Chlorthal-Dimethyl	0.05	<0.05 µg/L
DDD	0.05	<0.05 µg/L
DDE	0.05	<0.05 µg/L
DDT	0.05	<0.05 µg/L
Dieldrin	0.01	<0.01 µg/L
Endosulfan 1	0.05	<0.05 µg/L
Endosulfan 2	0.05	<0.05 µg/L
Endosulfan Sulphate	0.05	<0.05 µg/L

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OrganoChlorine Pesticides T0700-01 W09-023

Endrin	0.05	<0.05 µg/L
Heptachlor	0.05	<0.05 µg/L
Heptachlor Epoxide	0.05	<0.05 µg/L
Hexachlorobenzene	0.05	<0.05 µg/L
Lindane	0.05	<0.05 µg/L
Methoxychlor	0.05	<0.05 µg/L
Total Aldrin and Dieldrin	0.02	<0.02 µg/L
Trifluralin	0.05	<0.05 µg/L
Vinclozolin	0.05	<0.05 µg/L

Organophosphorous and Triazine Pesticides T0800-01 W09-023

Atrazine	0.5	<0.5 µg/L
Azinphos-methyl	0.5	<0.5 µg/L
Diazinon	0.5	<0.5 µg/L
Fenitrothion	0.5	<0.5 µg/L
Hexazinone	0.5	<0.5 µg/L
Malathion	0.5	<0.5 µg/L
Parathion	0.5	<0.5 µg/L
Parathion methyl	0.3	<0.3 µg/L
Prometryne	0.5	<0.5 µg/L
Simazine	0.5	<0.5 µg/L

Inorganic Chemistry - Physical	LOR	Result

Alkalinity Carbonate Bicarbonate and Hydroxide T0101-01 W09-023

Alkalinity as Calcium Carbonate		322 mg/L
Bicarbonate		393 mg/L
Carbonate		0 mg/L
Hydroxide		0 mg/L

Carbon Dioxide - Free W09-023

Carbon Dioxide - Free	0	31 mg/L

Conductivity & Total Dissolved Solids T0016-01 W09-023

Conductivity	1	1470 µScm
Total Dissolved Solids (by EC)	1.0	810 mg/L

pH T0010-01 W09-023

pH		7.3 pH units

Inorganic Chemistry - Waste Water	LOR	Result

Chlorine Demand - 24 hrs T0136-03 W09-023

Chlorine Demand 24hrs		3.49 mg/L

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Chlorine Demand - 30 mins T0136-03 W09-023		
Chlorine Demand 30 mins		2.94 mg/L
Chlorine Demand - 8 hrs T0136-03 W09-023		
Chlorine Demand 8 hrs		2.56 mg/L
Cyanide - Total T0167-03 W09-023		
Cyanide as CN - Total	0.05	<0.05 mg/L

Western Radiation Services	LOR	Result
Gross Alpha Activity W09-023		
!External Lab Report No.		WRS-J6874
Gross Alpha Activity	0.005	0.055 Bq/L
Gross Beta Activity (K-40 corrected) W09-023		
!External Lab Report No.		WRS-J6874
Gross Beta Activity (K-40 corrected)	0.010	0.513 Bq/L

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NATA Signatories

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Vickie Dalgleish - Microbiology Senior Technical Officer

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Stephanie Semczuk - Inorganic Chemistry Team Leader

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Incidents

Sample ID	S.Point	Description	Sampled Date	Analysis (where Applicable)	Incident Description
2012-002-2810	22332	Lucindale Bore 5	19/04/2012	Barium - Soluble	Dependent results are within acceptable analytical uncertainty
2012-002-2810	22332	Lucindale Bore 5	19/04/2012	Manganese - Soluble	Dependent results are within acceptable analytical uncertainty

Analytical Method

Analytical Method Code	Description
T0010-01	Determination of pH
T0016-01	Determination of Conductivity
T0080-07	Coliforms - MPN Defined Substrate Technique
T0081-07	E Coli - MPN Define Substrate Technique Refer T0080-07
T0100-01	Ammonia/Ammonium - Automated Flow Colorimetry
T0101-01	Alkalinity - Automated Acidimetric Titration
T0104-02	Chloride - Automated Flow Colorimetry
T0107-01	Nitrite - Automated Flow Colorimetry
T0108-01	Filterable Reactive Phosphorus - Automated Flow Colorimetry
T0109-01	Total Phosphorus - Automated Flow Colorimetry
T0111-01	Reactive Silica - Automated Flow Coloimetry
T0112-01	TKN - Automated Flow Colorimetry
T0114-01	Bromide
T0117-01	Iodide
T0136-03	Chlorine Demand
T0161-01	Nitrate + Nitrate (NOx) - Automated Flow Colorimetry
T0167-03	Cyanide - Total
T0203-01	Carbonate Hardness as CaCo3
T0204-01	Noncarbonate Hardness as CaCo3
T0700-01	Chlorinated Pesticides
T0800-01	Nitrogen and Phosphorous Containing Pesticides
T1072-01	Fullscan by GCMS
TIC-003	Elemental Analysis - ICP Mass Spectrometry
TIC-004	Determination of Metals - ICP Spectrometry by ICP2
W-052	Preparation of Samples for Metal Analysis

Sampling Method

Sampling Method Code	Description
EXT	EXTERNAL
EXT	Sampled externally
W09-023	Sampling Method for Chemical Analyses
WMZ-500	Sampling Method for Microbiological Analyses

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Laboratory	NATA accreditation ID
Bacteriology	1115
Customers - eg Regional Samplers	-
Inorganic Chemistry - Metals	1115
Inorganic Chemistry - Nutrients	1115
Organic Chemistry	1115
Inorganic Chemistry - Physical	1115
Inorganic Chemistry - Waste Water	1115
Western Radiation Services	14174

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