Jim Davies & Associates Pty Ltd
ABN 24 067 295 569
Suite 1, 27 York Street, Subiaco WA 6008
PO Box 117, Subiaco WA 6904
Ph: (08) 9388 2436
Fx: (08) 9381 9279
info@jdahydro.com.au
www.jdahydro.com.au

To :	City of Rockingham	Date :	05 July 18
Attention :	Gary Rogers	Our Ref :	J6610a
Email :	Gary.Rogers@rockingham.wa.gov.au	Pages :	16

FUTURE BALDIVIS DISTRICT SPORTING COMPLEX
GROUNDWATER PUMPING ASSESSMENT

1. INTRODUCTION

The City of Rockingham ('the City') proposes to develop a District Sporting Complex at Lots 4, 103, 104 and 105 Eighty Road, Baldivis, herein referred to as the Study Area. The Study Area is 19.41 ha (Figure 1).

The Baldivis District Sporting Complex is necessary to meet the current and future demand for organised sporting spaces in the locality. The project will include four large playing fields, two club rooms, 18 outdoor hard courts, an indoor recreation centre and outdoor youth space.

The City's expectation is that the required resource will ultimately need to deliver approximately 150,000 kL/year, with a desirable flow rate of 17 L/s per bore from at least two bores (35 L/s total).

JDA completed an initial groundwater supply investigation for the Study Area in October 2017 (JDA Ref J6486b). As a part of this, JDA undertook a monitoring test hole snapshot to ascertain the suitability as a non-potable water source for irrigation of the oval and passive landscape areas. All five bores (Figure 1) tested achieved the maximum possible flow rate for the test pump (5 L/s), with a small amount of drawdown. The results also showed groundwater quality is suitable for irrigation.

On 30 March 2017 City of Rockingham made an application to the DWER for a groundwater licence allocation of 150,000 kL/yr. DWER responded in a letter dated 18 May 2018 requesting additional information to assess the potential impact of the proposed groundwater pumping on conservation wetlands Outridge Swamp and Fount Swamp, located north and south of the Study Area (See Appendix A).

JDA found a suitable test pumping bore located in Numbat Reserve, approximately 480 metres east of the Study Area. This report summarises the results of the pump test of the Numbat Reserve production bore to provide an assessment of the extent of the cone of depression and the potential impact on the nearby groundwater dependent ecosystems.

This report is suitable for submission to DWER in support of the 30 March 2017 licence application.

2. CLIMATE / RAINFALL

The Baldivis area is characterised by a Mediterranean climate with warm dry summers and cool wet winters. Rainfall data is available from the nearby Bureau of Meteorology (BoM) Medina Research Station (Site No. 9194).

The long term average annual rainfall is 745 mm (1986 to 2017). This average has decreased between 2005 to present, to an average annual rainfall of 668 mm, reflecting a 11%

reduction compared to the long term average; this is consistent with a general trend in the South West of WA.

3. REGIONAL HYDROGEOLOGY

Regional hydrogeology is presented in Davidson (1995) and Perth Groundwater Atlas (DoE, 2004). Regional mapping shows the Superficial Aquifer is approximately 20 to 25 m depth, underlain by the Rockingham Sands Aquifer. The water table is 5 m below natural surface and groundwater salinity is 500 mg/L. Approximately 1 km west of the Study Area is Lake Walyungup, a groundwater discharge lake. The salinity of the lake is 1500 to 2000 mg/L, higher than the surrounding area, caused by concentration of salts in the groundwater discharge through evaporation. There is a salinity "shadow" of 1000 mg/L west of the lake, which extends to approximately Ennis Ave.

4. GROUNDWATER INVESTIGATIONS

An irrigation bore at Numbat Reserve, Eighty Road, Baldivis was completed by RBM Drilling Company on 14 December 2006, about 480 m east of the planned Baldivis District Sporting Complex (Figure 1). The bore was test pumped in 2006 to determine the safe yield (Appendix B). The results of this test pump were used by JDA to confirm local aquifer parameters and estimate the cone of the depression at the Study Area. Details of the RBM pumping test are described below.

4.1 Bore Construction Details

The Numbat Reserve Irrigation Bore was drilled to 23 m; steel surface casing (323 mm ND) was placed to 9 m to support the upper portion of the hole. Production casing comprising 11 m of 200 mm class 12 white PVC was installed from surface to 11 m. Nine metres of 200 mm inline stainless steel wire wound screens were set below the PVC casing. Casing centralisers were used to centralize the casing. The annulus was packed with 1.5 to 3.2 mm graded gravel pack.
The drilling intersected yellow/orange sand from surface to 9 m which was underlain to 21 m by coarse sand and broken Tamala Limestone. The screens were set in this interval. Dark clays were intersected below the limestone from 21 to 23 m. The static water level was 8.78 m below ground surface.

4.2 Test Pumping

Two tests were performed to assess the performance of the aquifer and determine the long term safe pumping rate: a step rate and a constant rate test on 15 December 2006. The test pumping report does not state the type of pump used for the testing but notes that the pump inlet was set at 13 m. Data from this test were used by RBM to determine the rate for the constant rate test.

4.2.1 Step Rate Test

The step drawdown test (without recovery between steps) at pumping rates of 5.97, 9.91 and 12.5 L/sec with each step of 30 minutes duration (Figure 2). The bore was then left to recover before the constant rate test.

The drawdown stabilized after the first minute of pumping for each step. The results are summarised in Table 1 below:

Table 1: Pumping rate and generated drawdown

Pumping rate (l/sec) {kL/d)	Drawdown (m)
5.97 {516}	0.51
9.91 {856}	0.82
12.5 {1080}	1.07

4.2.2 Constant Rate Test

The 8 hr constant rate test was at 17.5 L/sec (1512 kL/d). The time drawdown plot is presented as Figure 3.
The drawdown at the end of the test was 1.42 m. The drawdown was 1.39 m in the first minute of pumping after which it remained static. The drawdown plot follows a straight horizontal line, with the initial drawdown removal of water from storage in the bore. The slope of the drawdown plot (flat line) indicates a highly transmissive aquifer, but it is not possible to analyse the results to estimate transmissivity due to the lack of slope. The results indicate no drawdown in the aquifer outside (beyond) the pumping bore at a flow rate of 17.5 L/sec.

JDA concludes that a long term pumping rate of 20 L/sec (1728 kL/d) will be sustainable. Monitoring of pumping rates and groundwater levels is appropriate to ensure that the bore is performing as predicted. No impacts are expected on conservation wetlands, Outridge Swamp and Fount Swamp from groundwater pumping.

5. MASTERPLAN

The proposed masterplan of the Baldivis District Sporting Complex is shown in Figure 4 in relation to Numbat Reserve. The suggested locations of the irrigation bores are shown on Figure 4 as PB1 and PB2. The hydrozoning concept for the Study Area is shown in Figure 5. Of the 19.41 ha, less than half is sports turf (8 ha) which has the highest irrigation demand. The garden bed areas have been split into irrigated and non-irrigated areas, with 70% of garden beds non-irrigated following establishment; a water saving of approximately 13,750 kL/yr.

6. CONCLUSIONS

Based on the above investigation JDA concludes:

- Previous work by JDA (2017) in the Study Area indicated that appropriately constructed and developed bores would be expected to yield a supply of between 15 (1,296 kL/d) and 20 L/s (1,726 kL/d) each.

- The City of Rockingham require a groundwater supply of 150,000 kL for watering the proposed Study Area. An irrigation cycle of 200 days per year would require a supply of 35 L/s (3,024 kL/d) that would be spread over at least 2 bores (PB1, PB2) during a 6 hour pumping cycle.

- Local and regional drawdown is expected to be negligible as the bores will not be pumped continuously allowing recovery of groundwater levels.

- No impacts are expected on conservation wetlands, Outridge Swamp and Fount Swamp from groundwater pumping.

- The required supply of 150,000 kL/yr will be able to be drawn from Superficial Aquifer with no local or regional effects on groundwater levels.

- The hydrozoning concept has been prepared for the site to improve water efficiency.

7. References

Davidson, W.A (1995) *Hydrogeology and Groundwater Resources of the Perth Region Western Australia - Bulletin 142*. Geological Survey of Western Australia, Department of Minerals and Energy. Perth 1995.

Dept. of Environment (2004) *Perth Groundwater Atlas* (2nd Edition).

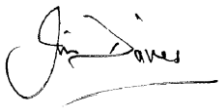
JDA (2017) Groundwater Investigation for Future Baldivis District Sporting Complex. For City of Rockingham, October 2017. (Ref J6486b) 13/10/17

RBM (2006) Numbat Reserve Evermore Estate Baldivis Pump Step Test Report and Bore Construction, December 2006

8. Appendices

A. Letter from Department of Water and Environment Regulation dated 18 May 2018.
B. RBM (2016) Pump Test Report and Bore Construction.

Regards,



JIM DAVIES

JDA CONSULTANT HYDROLOGISTS

Data Source: Nearmap (2017)

Coordinate System: GDA 94, Zone 50

JDA

Job No. J6610

1:4,500

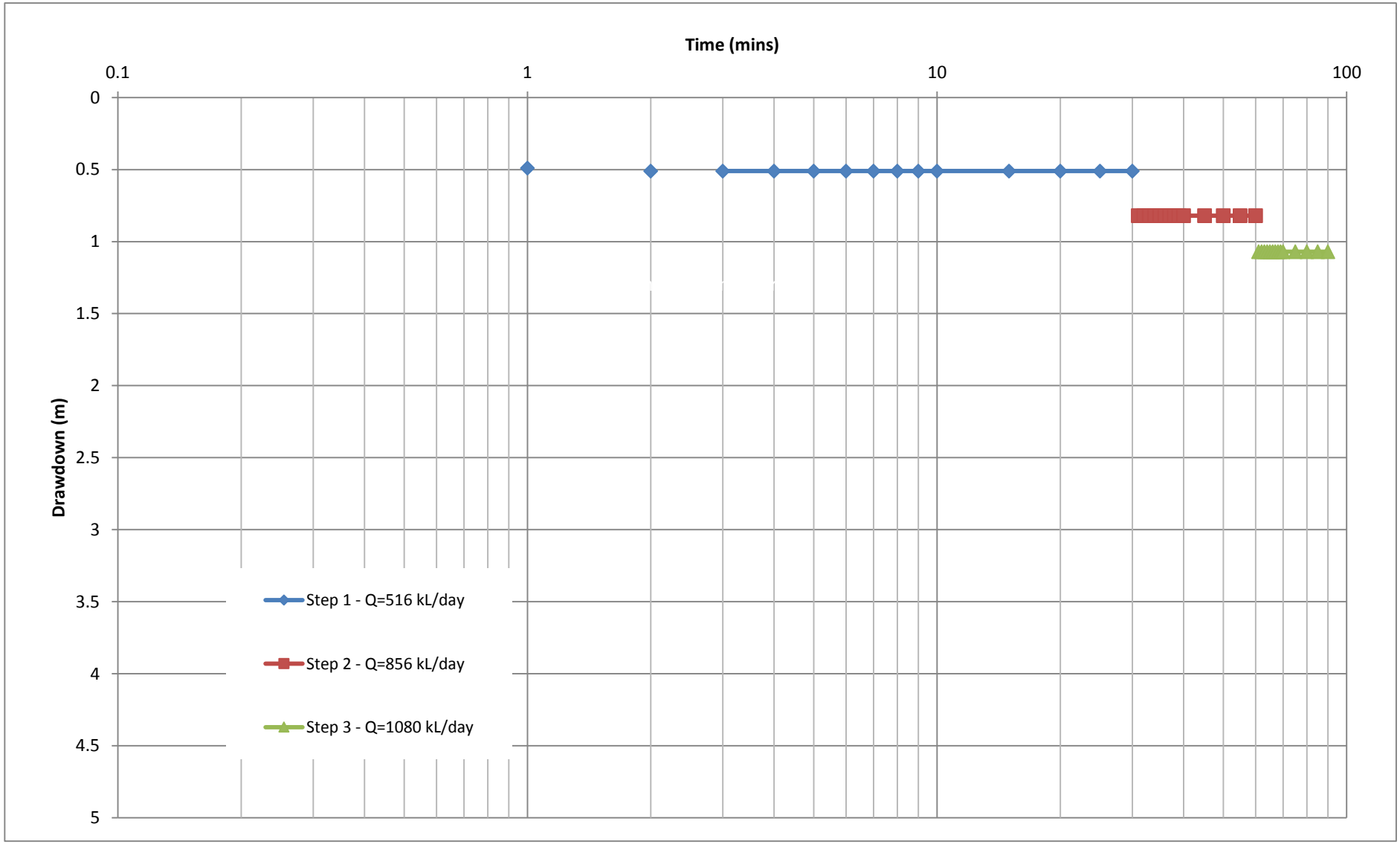
0 45 90 180 270 360 Meters

N

City of Rockingham

Future Baldivis District Sporting Complex

Figure 1: Location Plan



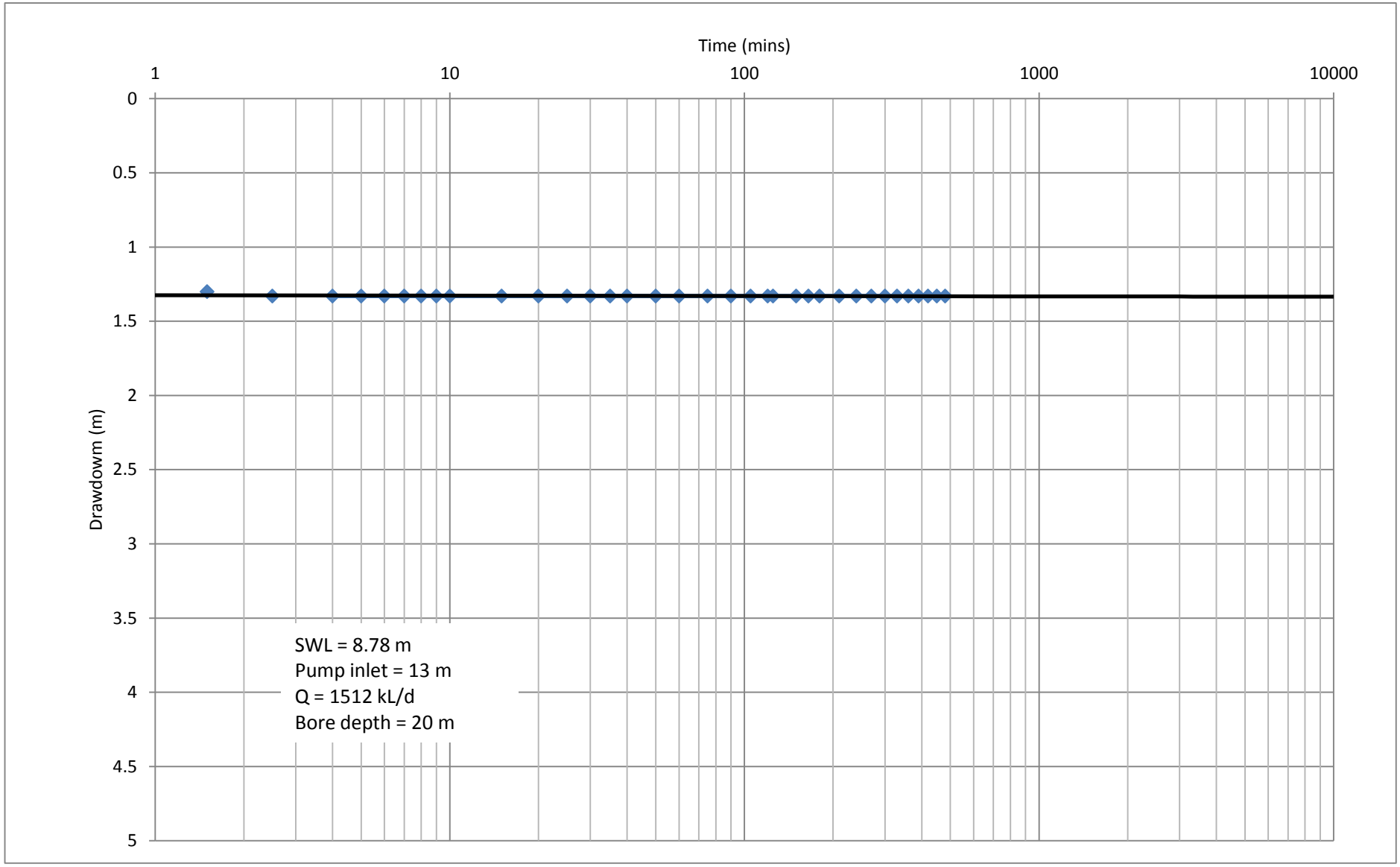
Data Source: RBM (2006)

Job No. J6610

City of Rockingham

Future Baldivis District Sporting Complex

Figure 2: Numbat Reserve Step Test Results



Data Source: RBM (2006)

Job No. J6610

City of Rockingham

Future Baldivis District Sporting Complex

Figure 3: Numbat Reserve Constant Rate Test Results

Data Source: City of Rockingham (2018)

Coordinate System: GDA 94, Zone 50

JDA

Job No. J6610

1:3,200

0 30 60 120 180 240 Meters

N

City of Rockingham

Future Baldivis District Sporting Complex

Figure 4: Proposed Master Plan & Production Bores

Data Source: City of Rockingham (2018)

Job No. J6610

City of Rockingham

Future Baldivis District Sporting Complex

Figure 5: Hydrozoning Concept Diagram

APPENDIX A

Letter from Department of Water and Environment

Regulation dated 18 May 2018

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Your Ref:
Our Ref: RF14922
Enquiries: Alana Patterson
Phone: 9550 4236

City of Rockingham
PO BOX 2142
Rockingham DC WA 6967

Dear Applicant,

Re: Additional information required for a licence under the *Rights in Water and Irrigation Act 1914*

Property(ies):

LOT 103 EIGHTY ROAD BALDIVIS 6171

LOT 104 EIGHTY ROAD BALDIVIS 6171

Lot 105 On Diagram 50627 Volume/Folio 1446/386 Lot 105 Eighty Road, Baldivis

LOT 4 ON DIAGRAM 31062

Thank you for your application dated 30/03/2017 for a licence to take water to draw 150,000 kilolitres per annum from the Stakehill, Outridge, Perth - Superficial Swan for public open space.

The Department of Water and Environmental Regulation has completed an initial assessment of your application which included reviewing additional information provided by JDA Consultants Hydrologists entitled *Groundwater Investigation for Future Baldivis District Sporting Complex*.

The review of JDA's groundwater investigations identified that we require further information as the information provided does not adequately address the potential ecological risks posed to the surrounding groundwater dependant ecosystems. It should be noted that conservation category wetlands Outridge Swamp and Fount Swamp are located to the north and south of the property, therefore it is important to ensure that the proposed abstraction does not cause adverse impacts. Pump testing undertaken by JDA was indicative only and limited by the bore construction and pump infrastructure, therefore to complete assessment of the application we require the following to be provided:

- Undertake pump testing of one appropriately constructed production bore and provide the data to the Department or
- If pump testing has been undertaken, or data is available from a production bore in close proximity then this data can be utilised instead.

- Determine local aquifer parameters and undertake an assessment of the extent of the cone of depression and the potential impact on the groundwater dependant ecosystems, including the terrestrial vegetation.
- Proposed master plan with the location of the production bores, areas of irrigation, hydrozoning considerations and total volume required.

Clarification on any of the hydrogeological requirements can be discussed directly with our Regional Hydrogeologist on 95504208 if required.

Once potential impacts are determined, an addendum to your operating may be required to include a monitoring program.

This letter is notifying you that you have until 13/07/2018 to provide this information to us.

If you believe there are extenuating circumstances to justify why you cannot provide the information, you should write to us with these reasons.

Should the information (or explanation of the extenuating circumstances) not be received within this timeframe, we will return your application to you as it is incomplete and there is insufficient information to allow us to make an informed decision.

If you have any queries please contact Alana Patterson by telephone on 9550 4236.

Yours sincerely,

Matt Viskovich

Program Manager - Regulatory Services (Water)

Peel Region

18 May 2018

APPENDIX B

RBM (2006) Pump Test Report and Bore Construction

ARDMAY Pty Ltd trading as
RBM
ACN 0088 74360 ABN 510088 74360

WATER BORES
AND FOUNDATION DRILLING

SUBMERSIBLE PUMPS

6 LIVERPOOL PLACE, ALEXANDER HEIGHTS WA 6064: TEL/FAX 9343 9891 – MOB. PHONE 0419 929 865

BORE AS CONSTRUCTED REPORT
(INLINE WITH GRAVEL ENVELOPE)

DATE OF REPORT: 15 / 12 / 2006

OWNER: TOTAL EDEN. **COMPLETION DATE:** 14 / 12 / 06

LOCATION: BALDIVIS. **SRART DATE:** 30 / 11 / 06

ADDRESS: EVERMORE ESTATE. **CUMULATIVE TIME:** 11 Days

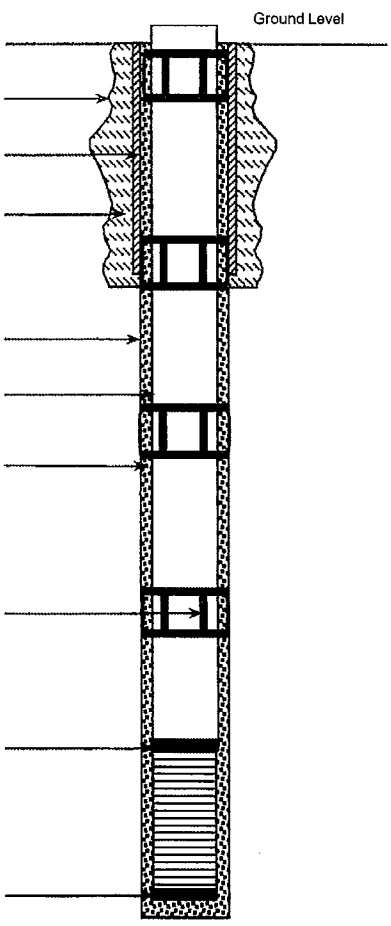
BORE No.: ONE. **REPRT No.:**

DRILLER: NEVILLE WESTPHAL.

MATERIALS USED

1. 13m of 200mm cl12 PVC.
2. 200mm adaptor & baseplate.
3. 9m of 200mm Inline s/screen
4. 2 centralisers.
5. 42 bags of 8/16 gravel pack.
6. 200mm PVC bore cap.

DEPTHS (m)	STRATA LOG DESCRIPTION OF STRATA	COMPONENT DEPTH AS CONSTRUCTED
0 : 9	YELLOWY / ORANGE SAND.	9m of 375mm diameter hole.
9 : 21	COARSE SAND & BROKEN LIMESTONE.	9m of 323mm od steel surface casing.
21 : 23	DARK CLAY.	
:		
:		11m of 311mm diameter hole from 9 to 20metres.
:		11m of 200mm class 12 pvc casing.
:		42.bags of 8/16 graded gravel envelope material
:		
:		2 casing centralisers.
:		
:		
:		11metres to 200mm pvc to screen adaptor.
:		
:		20m to base of 200mm inline s/steel screen.
:		



ARDMAY Pty Ltd trading as

RBM

ACN 0088 74360 ABN 510088 74360

WATER BORES
AND FOUNDATION DRILLING

SUBMERSIBLE PUMPS

6 LIVERPOOL PLACE, ALEXANDER HEIGHTS WA 6064: TELEFAX 9343 9891 – MOBILE PHONE 0419 929 865

PUMP STEP TEST REPORT.

TO: MR BRUCE SCARTERFIELD,
TOTAL EDEN, 1 ALTONA STREET,
BIBRA LAKE.

PROJECT: EVERMORE ESTATE, BALDIVIS.

Date: 15TH DECEMBER, 2006.

STATIC WATER LEVEL: 8.780 metres **PUMP INLET:** 13.000 metres

STEP 1	5.97	Lts./sec	STEP 2	9.91	Lts./sec	STEP 3	12.5	Lts./sec	STEP 4		Lts./sec
Time		Actual Pumping level.	Time		Actual Pumping Level.	Time		Actual Pumping Level.	Time		Actual Pumping Level.
1 Min.	9.270	m	1 Min.	9.600	m	1 Min.	9.850	m	1 Min.		m
2 Min.	9.280	m	2 Min.	9.600	m	2 Min.	9.850	m	2 Min.		m
3 Min.	9.290	m	3 Min.	9.600	m	3 Min.	9.850	m	3 Min.		m
4 Min.	9.290	m	4 Min.	9.600	m	4 Min.	9.850	m	4 Min.		m
5 Min.	9.290	m	5 Min.	9.600	m	5 Min.	9.850	m	5 Min.		m
6 Min.	9.290	m	6 Min.	9.600	m	6 Min.	9.850	m	6 Min.		m
7 Min.	9.290	m	7 Min.	9.600	m	7 Min.	9.850	m	7 Min.		m
8 Min.	9.290	m	8 Min.	9.600	m	8 Min.	9.850	m	8 Min.		m
9 Min.	9.290	m	9 Min.	9.600	m	9 Min.	9.850	m	9 Min.		m
10 Min.	9.290	m	10 Min.	9.600	m	10 Min.	9.850	m	10 Min.		m
15 Min.	9.290	m	15 Min.	9.600	m	15 Min.	9.850	m	15 Min		m
20 Min.	9.290	m	20 Min.	9.600	m	20 Min.	9.850	m	20 Min		m
25 Min.	9.290	m	25 Min.	9.600	m	25 Min.	9.850	m	25 Min		m
30 Min.	9.290	m	30 Min.	9.600	m	30 Min.	9.850	m	30 Min		m

ARDMAY Pty Ltd trading as
RBM
ACN 0088 74360 ABN 510088 74360

WATER BORES
AND FOUNDATION DRILLING

SUBMERSIBLE PUMPS

6 LIVERPOOL PLACE, ALEXANDER HEIGHTS WA 6064: TELEFAX 9343 9891 – MOBILE PHONE 0419 929 865

CONTINOUS RATE PUMPING TEST

TO: MR BRUCE SCARTERFIELD,
TOTAL EDEN, 1 ALTONA STREET,
BIBRA LAKE.

PROJECT: EVERMORE ESTATE, BALDIVIS.

Date: 15TH DECEMBER, 2006.

STATIC WATER LEVEL: 8.780 **metres** **PUMP INLET:** 13.000 **metres**

PUMPING RATE: 17.50 **LTS/ SEC.** **PUMPING RATE:** **0.000** Lts/sec

Time	Actual Pumping Level	Time	Actual Pumping Level	Time	Actual Pumping Level	Time	Actual Pumping Level
1 Min.	10.17 m	4¼ Hr.	10.20 m	RECOVERY READINGS			
2 Min.	10.20 m	4½ Hr.	10.20 m	1 Min.	1/2 m		
3 Min.	10.20 m	4¾ Hr.	10.20 m	2 Min.	m		
4 Min.	10.20 m	5 Hr.	10.20 m	3 Min.	m		
5 Min.	10.20 m	5¼ Hr.	10.20 m	4 Min.	m		
6 Min.	10.20 m	5½ Hr.	10.20 m	5 Min.	m		
7 Min.	10.20 m	5¾ Hr.	10.20 m	6 Min.	m		
8 Min.	10.20 m	6 Hr.	10.20 m	7 Min.	m		
9 Min.	10.20 m	6½ Hr.	10.20 m	8 Min.	m		
10 Min.	10.20 m	7 Hr.	10.20 m	9 Min.	m		
15 Min.	10.20 m	7½ Hr.	10.20 m	10 Min.	m		
20 Min.	10.20 m	8 Hr	10.20 m	15 Min.	m		
25 Min.	10.20 m			m Min.	m		
30 Min.	10.20 m			25 Min.	m		
35 Min.	10.20 m			30 Min.	m		
40 Min.	10.20 m						
50 Min.	10.20 m						
1 Hr.	10.20 m						
1¼ Hr.	10.20 m						
1½ Hr.	10.20 m						
1¾ Hr.	10.20 m						
2 Hr.	10.20 m						
2¼ Hr.	10.20 m						
2½ Hr.	10.20 m						
2¾ Hr.	10.20 m						
3 Hr.	10.20 m						
3¼ Hr.	10.20 m						
3½ Hr.	10.20 m						
3¾ Hr.	10.20 m						
4 Hr.	10.20 m						