APPENDIX D

East Rockingham industrial park (IP14 Area): Groundwater monitoring review (JDA Consultant Hydrologists, 2012)

LandCorp

East Rockingham Industrial Park (IP14 Area)

Groundwater Monitoring Review

January 2012

JDA Consultant Hydrologists

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1. INTRODUCTION

East Rockingham IP14 is located 4.5km north east of Rockingham. The total site area is 1150ha with 640ha planned for development.

In March 2005, JDA supervised the installation of 21 shallow water table monitoring bores in the study area, see Figure 1.

The purpose of that investigation was to better understand the groundwater hydrology and its influence on wetland flora species found in the southern part of the study area. The bores were monitored for groundwater levels on four occasions between May 2005 and January 2006, and water quality was measured once on 6 May 2005. The results were reported in the East Rockingham Industrial Park (IP14) Groundwater Hydrology Report (JDA, 2006). According to JDA (2006), groundwater levels in winter 2005 did not reach the ground surface.

To confirm the groundwater data remained similar to that recorded in 2005/06, a monitoring snapshot was requested by LandCorp in 2011. The snapshot was completed by JDA on 14 July 2011, with the results summarised in this report. This report should be read in conjunction with groundwater data previously collected (JDA, 2006).

2. CONDITION OF BORES

Table 1 shows the location of all monitoring bores installed in 2005.

- 6 bores were spatially distributed around the northern part of the study area and;
- 15 bores were established through the wetlands in the southern part of the study area.

For selected wetland bores (ERGM 7, 9, 10, 12, 13, 15) one bore was installed to the depth of the regional water table and the second was installed to a total depth of 1m.

Bores ERGM 1 to 15 were drilled to 6m below natural surface using a hollow auger rig and fitted with a 2m screen. These bores are referred to as deep (d). Additional shallow(s) bores were drilled next to ERGM 7, 9, 10, 12, 13 and 15, using a hand auger. The shallow bores are typically 1m depth and used to assess if groundwater perching is occurring.

All bores which had been installed in 2005 were found on 14 July 2011 except for bores ERGM9 (s), ERGM 12 (s) and ERGM 13 (s) which have been destroyed by earthworks.

Water levels and samples could not be obtained from bores ERGM7 (s), ERGM10 (s) and ERGM15 (s) as these bores were dry. Water levels were also measured in Department of Water bore T230 (O).

TABLE 1: MONITORING BORES ID, LOCATION AND DEPTH INFORMATION

Bore	Easting (m)	Northing (m)	Natural Surface (mAHD)	TOC (mAHD)
ERGM1	383826.5	6430505.6	3.92	4.62
ERGM2	385212.6	6431025.3	3.93	4.58
ERGM3	384473.8	6430572.2	4.21	4.95
ERGM4	384287.7	6431077.8	4.19	4.83
ERGM5	383002.2	6429296.7	4.10	4.79
ERGM6	385020.9	6429726.9	4.40	5.05
ERGM7s	384381.1	6428948.6	2.93	3.54
ERGM7d	384377.9	6428951.1	2.90	3.56
ERGM8	383418.8	6429911.8	4.13	4.78
ERGM9s*	383605.2	6429737.5	3.65	4.27
ERGM9d	383604.6	6429734.9	3.67	4.31
ERGM10s	383711.7	6429580.3	3.27	4.17
ERGM10d	383714.0	6429578.4	3.44	3.99
ERGM11	383847.2	6429474.3	4.05	4.71
ERGM12s*	383873.0	6429392.0	3.27	3.79
ERGM12d	383876.1	6429393.0	3.26	3.92
ERGM13s*	383945.8	6429353.7	3.36	3.94
ERGM13d	383945.0	6429360.2	3.62	4.28
ERGM14	384035.1	6429290.1	3.74	4.43
ERGM15s	384149.2	6429168.1	3.10	3.54
ERGM15d	384152.4	6429166.9	2.98	3.67
T230(O)	384864.0	6428724.0	5.92	6.64

Note: 1: values were taken from JDA (2006).
2: *Not found 14/7/2011
3: TOC = Top of Casing

3. RAINFALL DATA 2005/06 AND 2011

Rainfall data (Kwinana BoM Site, Ref No. 009064) shown in Figure 2, indicates that total rainfall from January to December 2005 was 786.8mm. This was 46.5mm more than the average for 1955 to 2010 of 740.3mm.

As sampling occurred in both July 2005 and 2011, it is useful to compare rainfall total in the months leading up July in each year.

The total rainfall recorded in January to June 2005 was 464.2mm compared with 261.4mm in the same period in 2011.

Hence rainfall in the months leading up to July 2011 water level measurement was much lower in 2005.

4. HYDROGEOLOGICAL SETTING

The site is underlain by superficial formations to about 25m depth, consisting of Safety Bay Sand overlying Tamala Limestone. The Safety Bay Sand consists of fine to medium grained calcareous dune sand, the Tamala Limestone of sandy limestone.

Bore ERGM7 was the deepest of the monitoring bores and was drilled to 8m, at which depth it was still in Safety Bay Sand; the bore is screened from 4 to 6m depth.

The superficial formations are underlain by the Rockingham Sand, which has recently been re-assigned to the Leederville Formation by the Department of Water.

The site lies at the northern end of the Stakehill Groundwater Mound, where the regional groundwater flow is northwestwards towards the ocean.

5. GROUNDWATER LEVEL DATA 2005/06 AND 2011

A complete list of recorded water levels for 2005/06 and 2011 is presented in Table 2.

Groundwater levels measured between May 2005 and January 2006 were at a maximum on 27 September 2005.

The groundwater levels measured 7 July 2005 are the closest seasonally to those measured 14 July 2011.

The water levels shown on Figure 4 for July 2011 show a generally flat water table with no obvious flow pattern; levels are generally 0.7 to 0.8m below those recorded in July 2005, reflecting the lower rainfall.

All shallow bores were dry on all monitoring occasions in 2005/06 as well as on 14 July 2011. This indicates that there was no observation of groundwater perching in any bore within the study area, including within wetland areas.

TABLE 2: GROUNDWATER LEVELS FOR DEEP BORES 1 TO 15 AND DOW BORE T230 (O)

	6 May 2005			6 July 2005			27 September 2005			4 January 2006			14 July 2011		
Bore	W.L. (mBTOC)	W.L (mAHD)	W.L below Natural Surface (m)	W.L (mBTOC)	W.L. (mAHD)	W.L below Natural Surface (m)	W.L. (mBTOC)	W.L. (mAHD)	W.L. below Natural Surface (m)	W.L. (mBTOC)	W.L. (mAHD)	W.L. below Natural Surface (m)	W.L. (mBTOC)	W.L. (mAHD)	W.L. below Natural Surface (m)
ERGM1	3.65	0.97	2.96	3.12	1.50	2.43	2.87	1.75	2.18	3.14	1.48	2.45	3.57	1.05	2.88
ERGM2	3.66	0.92	3.01	3.15	1.43	2.50	2.89	1.69	2.24	3.12	1.46	2.47	3.52	1.06	2.87
ERGM3	3.98	0.97	3.24	3.33	1.62	2.59	3.12	1.83	2.38	3.39	1.56	2.65	3.91	1.04	3.17
ERGM4	3.93	0.90	3.29	3.34	1.49	2.70	3.16	1.67	2.52	3.44	1.39	2.80	3.78	1.05	3.14
ERGM5	3.53	1.26	2.84	2.97	1.82	2.28	2.70	2.09	2.01	3.04	1.75	2.35	3.49	1.30	2.80
ERGM6	4.13	0.92	3.49	3.53	1.52	2.89	3.34	1.71	2.70	3.61	1.44	2.97	3.97	1.08	3.33
ERGM7d	2.65	0.91	1.98	1.98	1.58	1.31	1.77	1.79	1.10	2.15	1.41	1.48	2.43	1.13	1.76
ERGM8	3.82	0.96	3.18	3.25	1.53	2.61	3.01	1.77	2.37	3.31	1.47	2.67	3.74	1.04	3.10
ERGM9d	3.33	0.98	2.69	2.76	1.55	2.12	2.55	1.76	1.91	2.80	1.51	2.16	3.28	1.03	2.64
ERGM10d	3.03	0.96	2.48	2.46	1.53	1.91	2.18	1.81	1.63	2.52	1.47	1.97	2.98	1.01	2.43
ERGM11	3.76	0.95	3.10	3.16	1.55	2.50	2.90	1.81	2.24	3.26	1.45	2.60	3.71	1.00	3.05
ERGM12d	2.96	0.96	2.30	2.35	1.57	1.69	2.09	1.83	1.43	2.47	1.45	1.81	2.91	1.01	2.25
ERGM13d	3.36	0.92	2.70	2.74	1.54	2.08	2.47	1.81	1.81	2.86	1.42	2.20	3.29	0.99	2.63
ERGM14	3.49	0.94	2.80	2.87	1.56	2.18	2.60	1.83	1.91	3.00	1.43	2.31	3.40	1.03	2.71
ERGM15d	2.73	0.94	2.04	2.09	1.58	1.40	1.85	1.82	1.16	2.25	1.42	1.56	2.64	1.03	1.95
T230(O)	5.55	1.09	1.83	5.09	1.55	1.37	4.83	1.81	1.11	5.08	1.56	1.36	5.60	1.04	1.88
Min	2.65	0.90	1.83	1.98	1.43	1.31	1.77	1.67	1.10	2.15	1.39	1.36	2.43	0.99	1.76
Max	5.55	1.26	3.49	5.09	1.82	2.89	4.83	2.09	2.70	5.08	1.75	2.97	5.60	1.30	3.33

Notes: 1. Data shown between 2005 and 2006 was taken from JDA (2006)
2. All shallow bores were dry on all occasions

6. GROUNDWATER QUALITY DATA FOR 2005 AND 2011

Water quality was sampled by JDA on 6 May 2005 and 14 July 2011. In 2005 8 bores, namely ERGM1, ERGM2, ERGM4, ERGM5, ERGM6, ERGM7, ERGM10 and ERGM15 were sampled to provide good spatial coverage. On 14 July 2011 bores ERGM1 to ERGM8 were sampled to provide an understanding of the groundwater quality entering and leaving the study area. Nutrients and metals in May 2005 and July 2011 were analysed by a NATA approved laboratory and are supplied in Appendix A.

Key results from 2005/06 and 2011 analysis are as follows:

- Except for Bore ERGM7, TDS concentrations did not exceed 1000mg/L in either 2005 or 2011. Appendix A shows TDS concentrations in bore ERGM7 (d) were 4900mg/L in 2005 and similar at 4800mg/L in 2011; this bore was originally drilled 2m deeper than any of the other bores, and indicates that the salinity increases with depth.

- Bore pH in July 2005 was relatively uniform in all bores ranging between 7.3 and 7.8 pH. In 2011 pH ranged between 7.1 and 8.1. This difference is not significant.

- The groundwater is generally of calcium-magnesium-bicarbonate type, typical of a calcareous sand aquifer.

- Concentration of major ions was generally somewhat higher in July 2011 than in July 2005, reflecting reduced recharge as a result of reduced rainfall.

- None of the heavy metals or trace elements exceeded the NHMRC/ARMCANZ Drinking Water Guidelines except for Arsenic, which generally exceeded the health guidelines of 0.007 mg/L. This is almost certainly due to the natural presence of pyrite in the Safety Bay Sand, a common occurrence on the Swan Coastal Plain.

- Nitrogen concentrations were below 4.6mg/L in both 2005 and 2011, with the exception of ERGM6 on the extreme eastern boundary of the site which showed higher concentrations in both 2005 and 2011.

- Total Phosphorus concentrations recorded in 2005 ranged between 0.04mg/L and 0.14mg/L compared with 0.06 to 0.38mg/L in 2011. Phosphate as P followed a similar range change as indicated in Appendix A. These differences are not significant.

7. CONCLUSIONS

- Since the 2005/06 study, 3 bores have been destroyed, namely ERGM9(s), ERGM12(s) and ERGM13(s)**.**
- Rainfall January to June 2011 was less than the same period 2005 so that water levels are correspondingly lower.
- Except for bore ERGM7, TDS concentrations did not exceed 1000mg/L in either 2005 or 2011. Bore ERGM7 was 2m deeper than any other bore and indicates that salinity increases with depth.
- Concentration of major ions was generally somewhat higher in July 2011 than in July 2005, reflecting reduced rainfall recharge.
- Nitrogen and Phosphorus concentrations were comparable in both 2005 and 2011.
- ERGM6 showed the highest Nitrogen concentrations in both 2005 and 2011. This bore is located on the extreme eastern boundary of the site.
- None of the heavy metals or trace elements exceeded the NHMRC/ARMCANZ Drinking Water Guidelines except for Arsenic. This is almost certainly due to the natural presence of pyrite in the Safety Bay Sand, a common occurrence on the Swan Coastal Plain.

8. REFERENCES

JDA (2006) East Rockingham Industrial Park (IP14 Area) Groundwater Hydrology, Prepared for LandCorp, November 2006 (Ref No: J3477)

Suite 1, 27 York St, Subiaco WA 6008
PO Box 117, Subiaco WA 6904
Ph: +61 8 9388 2436
Fx: +61 8 9381 9279

www.jdahydro.com.au

info@jdahydro.com.au