Australian Groundwater Technologies AGT

'making water work'

21/07/2015

Jacob Kochergen
Natural Resources Officer
City of Mitcham
PO Box 21
TORRENS PARK SA, 5062

our ref: 1348-14-CAN 21.07.15

Dear Jacob,

Observation Well Monitoring – Urrbrae Wetlands

1. INTRODUCTION

1.1 Background

The Urrbrae Wetland is located within the City of Mitcham on Cross Road, Netherby. The shallow groundwater system is monitored in conjunction with the wetland to identify possible leakage from captured stormwater into shallow aquifers. The monitoring has been undertaken since 1996 at two wells, one to the east of the wetland (East well), and the other to the west (West well). The East well monitors a shallow Quaternary Aquifer (Q1) while the West well monitors a perched water table aquifer positioned above Hindmarsh Clay. Historically the West well has been dry, while the East well has provided reliable recordings for standing water level and salinity. Well details for both wells are summarised in Table 1, with their location presented in Figure 1.

Table 1: Urrbrae Wetland observation well completion details

	East Well	West Well
Unit Number	6628-18410	6628-18409
Easting	282630	282534
Northing	6128138	6128170
Zone	54	54
Total Depth	17 m BGL[1]	7.5 m BGL[1]
Casing	0–17 m, 75 mm PVC 12–16 m Slotted Casing	0–7.5 m, 75 mm PVC 2.5–6.5 m Slotted Casing
Aquifer	Q1	PWT

Note: [1]m BGL = metres below ground level; PWT – perched water table aquifer.

The main wetland pond is clay lined and the water depth is typically greater than 1.5 m. Nearby, the South Australian (SA) Department for Environment, Water and Natural Resources (DEWNR) monitor wells which provide independent data from shallow aquifers. This information was used for comparison with Urrbrae wetland data to determine whether storage of wetland water facilitates leakage to underlying aquifers. The DEWNR monitoring wells are presented in Figure 1, with well details presented in Table 2.

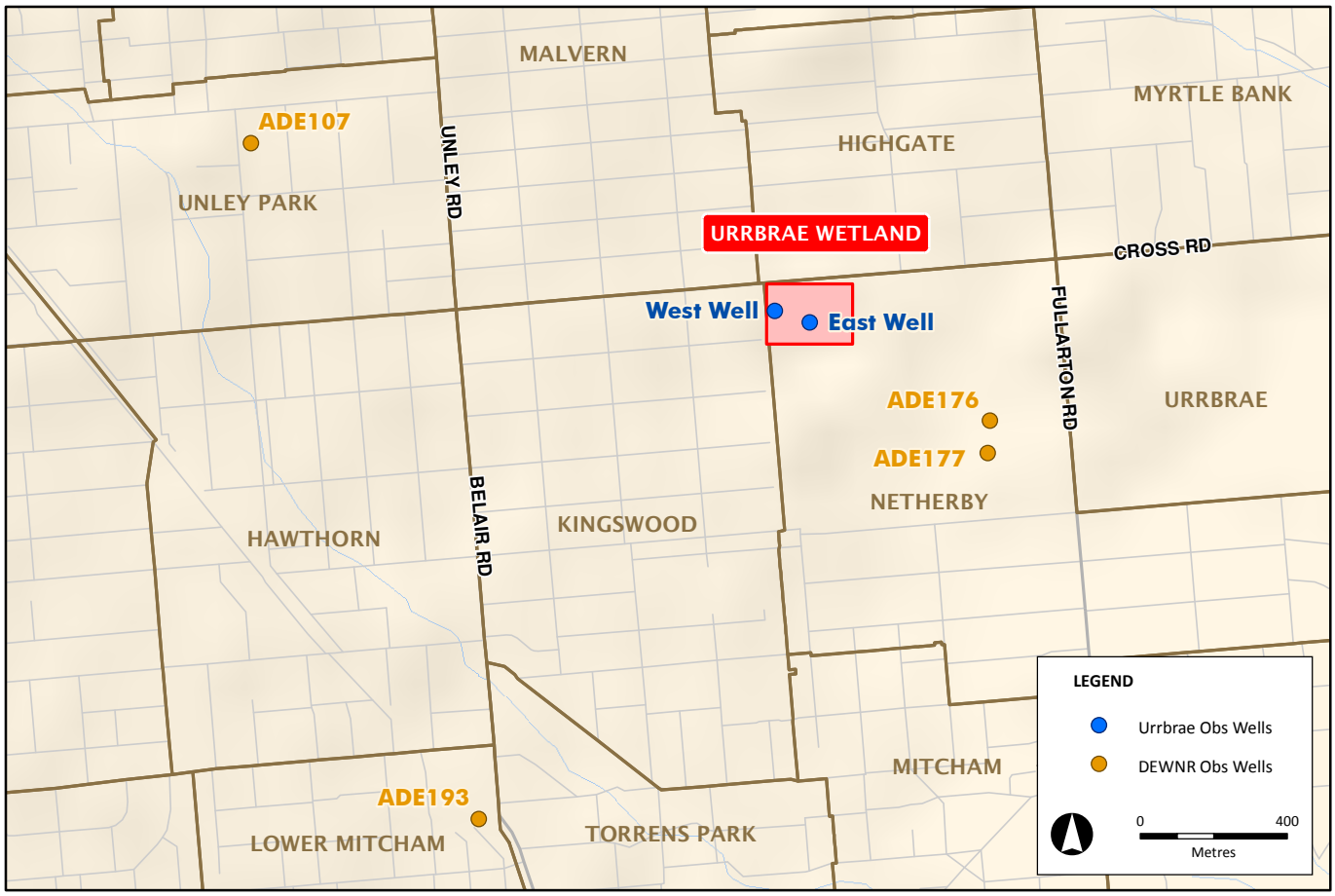

Figure 1 | Urrbrae Wetland location plan

March, 2014 | P:\(CAN)_City_of_Mitcham\Projects\1293-Observation Well MonitoringUrrbrae Wetland 2013\GIS\Maps\CAN_1293_urrbrae wetland location plan.mxd

Table 2: Summary of DEWNR observation wells. Locations presented in Figure 1.

Well name	ADE107	ADE176	ADE177	ADE193
Distance from Site (m)	2,000	200	200	1,800
Total Depth (m BGL)	13	12	57	29
Aquifer Monitored	Q1	Q1	Q2	Q2

1.2 Scope of Work

Australian Groundwater Technologies (AGT) has been engaged by the City of Mitcham to continue monitoring for September 2014 and March 2015 rounds. The monitoring program incorporates standing water level monitoring and sampling from shallow wells, and water sampling from the wetland pond. Details of the monitoring program are summarised in Table 3. For the sampling program the current scope of work is limited to the measurement of field parameters.

Table 3. Monitoring details for Urrbrae Wetland

Site	Location	Parameter	Timing
Urrbrae Wetland	Wetland Pond	Water quality: electrical conductivity, pH and turbidity.	Bi-annually: (September and March to correspond with DEWNR[1] monitoring regionally)
	East Well	Standing water level Water quality: electrical conductivity, pH and turbidity.	
	West Well		

Note: [1]DEWNR = SA Department for Environment Water and Natural Resources.

1.3 Previous Work

AGT has undertaken bi-annual monitoring from shallow wells and the wetland pond since 2010, with the production of the following annual reports:

- AGT (2010), Report 989-10-CAN;
- AGT (2011), Report 1078-11-CAN;
- AGT (2012), Report 1152-11-CAN;
- AGT (2014), Report 1293-13-CAN.

Previous reports concluded that water was not leaking from the clay-lined wetland into the shallow groundwater system, however it was recommended to monitor the East and West wells bi-annually to establish longer term trends (AGT, 2010). This report serves as a further update to monitoring activities, building on previous work completed at the wetland site.

2. RESULTS

In 2014–15 two sampling events were conducted:

- 19th September 2014, and
- 5th March 2015.

During each visit standing water level was recorded using an electric water level probe, with samples collected using bailers and analysed for field parameters (Table 3).

2.1 Groundwater level

The monitoring results for East and West wells are presented in Table 4. Water level results from the East and West well (2014–15 recordings) were added to historical records, with all data presented in Appendix A. These results were compared with DEWNR wells to establish any localised trends. DEWNR monitoring data was updated by downloading from the State data portal *WaterConnect.* All data was plotted against rainfall records from the nearest rainfall station (Bureau of Meterology Station No. 23105). The rainfall station is located at Brown Hill Creek (Scotch College) approximately 2 km south of the Wetland. Hydrographs of on-site and DEWNR wells, including rainfall and *cumulative deviation from monthly mean rainfall* are presented in Figure 2.

Table 4: Groundwater level and quality monitoring results.

Well name	Date	Time	SWL[1] (m BGL[2])	RSWL[3] (m AHD[4])
East Well	19/09/2013	11:30	11.8	60.95
	5/03/2015	16:00	12.3	60.43
West Well	19/09/2013	NA	dry	dry
	5/03/2015	NA	dry	dry

Note: [1]SWL = standing water level, [2]BGL = below ground level, [3]RSWL = reduced standing water level, [4]AHD = Australian height datum.

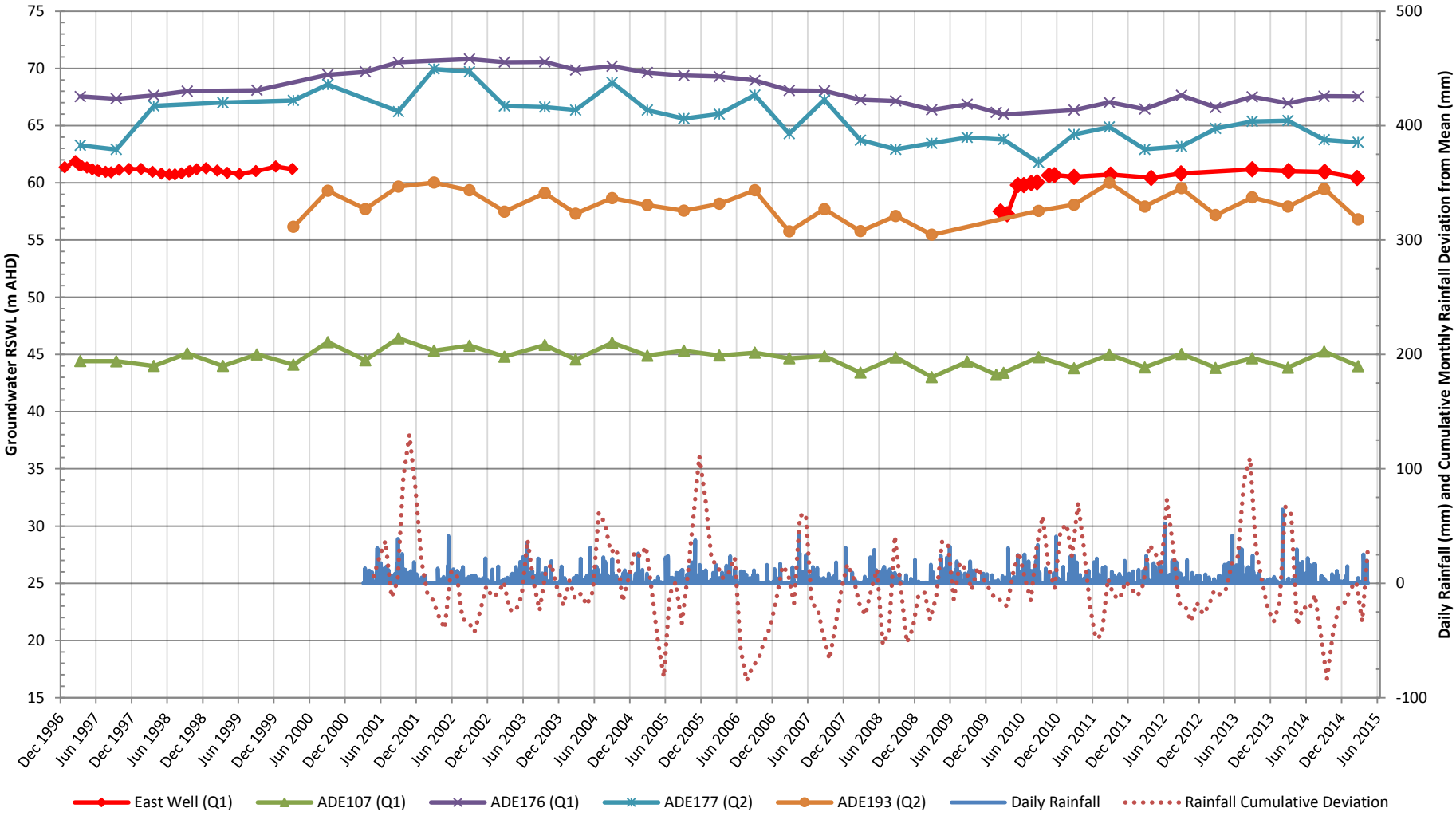

Figure 2: Groundwater levels and rainfall for Urrbrae Wetlands.

2.1.1 East well

Groundwater levels recorded in the East Well in September 2014 (60.95 mAHD) and March 2015 (60.43 mAHD) were consistent with previous readings (RSWL ~61 m AHD) although the March 2015 level was the lowest since April 2012 (Figure 2). Although low, the March 2015 groundwater level is consistent with the observed variation in levels dating back to 1996. This is possibly related to the dry summer in 2014/15 which received below average rainfall. Comparison of the long term groundwater levels in the East Well to the surrounding DEWNR observation well data illustrates the following (Figure 2):

- Groundwater levels have remained consistently between those for DEWNR observation wells ADE176 and ADE107 (both Q1 aquifer wells).
- Groundwater level at East well exhibit variation less than ± 1 m, while corresponding DEWNR wells exhibit variation between (±1–3 m).
- DEWNR observations clearly show seasonal effects, with post-summer readings generally lower than post winter readings. Higher water levels in September correlate with higher rainfall and lower evapotranspiration.
- Groundwater levels in all wells (including DEWNR wells) are consistent with a SE to NW hydraulic gradient. This demonstrates groundwater flow in NW direction towards the coast.
- Groundwater levels in the East Well/ADE193 and in ADE176/ADE177 indicate a slight downward flow gradient between the Q1 and Q2 aquifers (Q1 wells consistently have slightly higher RSWL).
- Groundwater data from the East Well does not indicate any mounding of the shallow water table that could be consistent with leakage from the wetland pond.

2.1.2 West well

The West Well was recorded as dry during both site visits (September 2014 and March 2015) and also during all previous visits throughout 2010 to 2012. This well was also recorded as dry from readings collected from December 1996 to September 1999 (Figure 2).

The west well is completed in a perched water table aquifer (shallow sediments) with a screen interval of 2.5- 6.5 m bgl. If leakage from the wetland pond was occuring, it would be expected that mounding in the perched aquifer would occur and water would be observed. As this well has remained dry, the conclusion is that to date no leakage has occurred.

2.2 Water Quality

Water quality results are summarised in Table 5, with time series plots presented for wetland wells and pond presented in the Figures 3-6.

Table 5: Water quality results

Wetland Pond					
Date	**EC (µS/cm)**	**Salinity (mg/L TDS)**	**pH**	**Temperature (°C)**	**Turbidity (NTU)**
19/09/2014	273	175	7.2	18.6	10
05/03/2015	507	324	7.9	24	6.5
East Well					
Date	**EC (µS/cm)**	**Salinity (mg/L TDS)**	**pH**	**Temperature (°C)**	**Turbidity (NTU)**
11/09/2013	3,260	2,086	7.2	19.8	5
17/03/2014	3,210	2,054	7.05	19.7	15

2.2.1 East Well

East Well groundwater salinity and pH over the period 2010–2015 are presented in Figure 3, with the full data series presented in Appendix A. Key observations from Figure 3 include:

- Salinity and pH from September 2014 and March 2015 readings were consistent with historical data and were recorded at 2,054 and 2,086 mg/L TDS. The range of historical data is between 1,600–2,200 mg/L TDS.
- pH in 2014/15 were approximately neutral (pH = 7); the range recorded from 2010-2015 is between pH = 7–8 (neutral to slightly alkaline).
- The relatively low pH noted in March 2014 (as discussed in 2013/14 reporting) is attributed to natural variability.
- Groundwater temperature in September 2014 (19.8°C) and March 2015 (19.7°C) were well within the range of 2010–2015 temperature data (18–21 °C, Appendix A).
- Groundwater turbidity in September 2014 (5 NTU) and March 2015 (15 NTU) were in the middle to lower end of the range of 2010–2015 groundwater turbidity data (Appendix A).

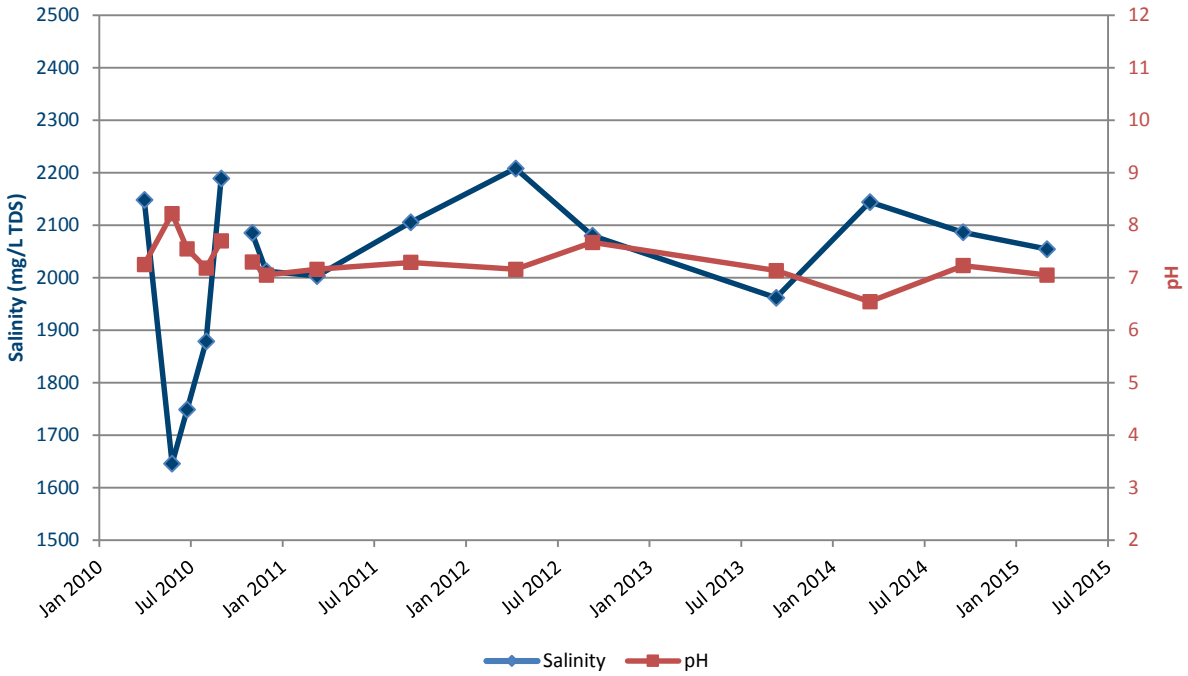

Figure 3: East Well groundwater quality 2010–2015

2.2.2 Wetland (Pond)

Wetland pond water salinity and pH over the period 2010–2015 are presented as Figure 4. Key observations from Figure 4 include:

- Salinity and pH were consistent with historical data dating back to 1997 (Appendix A), however salinity in March 2015 was at the upper end. This relatively higher salinity may be attributable to the below average rainfall in the 2014/15 summer.
- Salinity in September 2014 and March 2015 were recorded at 175 and 324 mg/L TDS. The range of historical data (to 2010) is 50–450 mg/L TDS.
- pH in September 2014 and March 2015 was approximately 7-7.9 (neutral, tending alkaline), but previous readings have been as high as pH = 8.5–9.
- It would be expected that the pH of the wetland pond water would be approximately 7 (neutral) or slightly under unless some hydrochemical process was taking place. The majority of pH readings recorded from 2010–2015 indicate slightly alkaline conditions (pH > 7.5). These readings are consistent with strong rainfall and runnoff events at other wetlands in the Adelaide region, however the mechanism (i.e. cause) is not established.
- Wetland water temperature in September 2014 (18.4°C) and March 2015 (24°C) were well within the range of 2010–2014 data (15–25 °C, Appendix A). These temperature differences reflect seasonal air temperature variation.
- Wetland water turbidity readings in September 2014 (10 NTU) and March 2015 (6.5 NTU) were at the lower end of the 2010–2014 range (0–45 NTU, Appendix A).

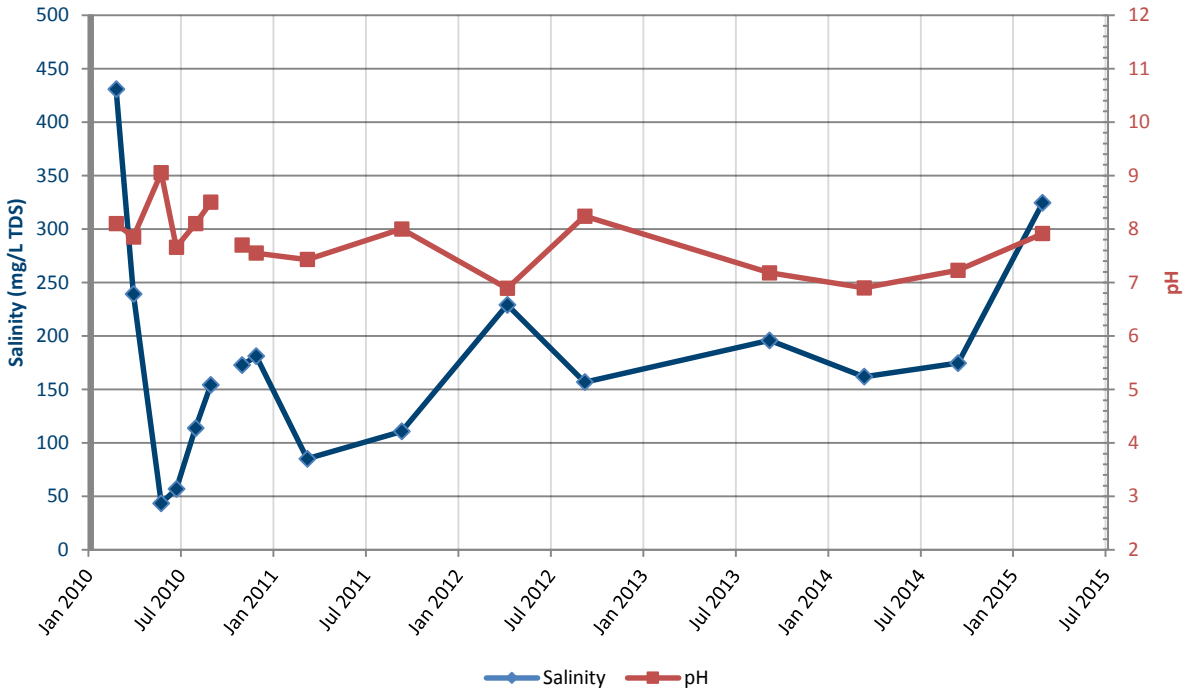

Figure 4: Urrbrae Wetland pond water quality 2010–2015

2.2.3 Wetland and East Well Comparison

A key tool for identifying leakage between the Urrbrae wetland pond and the shallow groundwater table is comparison of water quality (salinity and pH). If leakage were occurring it would be anticipated that the East Well salinity would reduce due to dilution from the wetland pond.

Salinity and pH comparison plots are presented in Figure 5 and Figure 6 respectively. Salinity records span the period 1996–2015, with no data recorded at the Urrbrae site between 2000– 2010 (Figure 5). pH records began in 2010, thus the pH comparison plot covers the period 2010–2015 (Figure 6).

The comparison between wetland pond and East Well salinity does not indicate any leakage between the pond and the shallow groundwater in the period 2010–2015; groundwater salinity remained approximately 10x that of the wetland pond (Figure 5).

As noted in the 2013/14 Urrbrae Wetlands monitoring report, it is considered that if leakage did occur from the wetland pond then it is most likely to have occurred at the time of the wetland's construction (1996). This would occur over the period where the clay liner settled and prior to a biological/detrital film being established.

The East Well groundwater salinity data does not conclusively indicate that the lower groundwater salinity pre-2000 was due to pond leakage, but the higher groundwater salinity post 2010 indicates that current pond leakage to groundwater is not occurring (Figure 5).

Variation in East Well groundwater salinity post-2010 is attributed to natural aquifer recharge processes where-by winter rain leads to a subsequent seasonal freshening of the groundwater. The range of salinity values observed in the East Well post-2010 is consistent expected Q1 aquifer salinity.

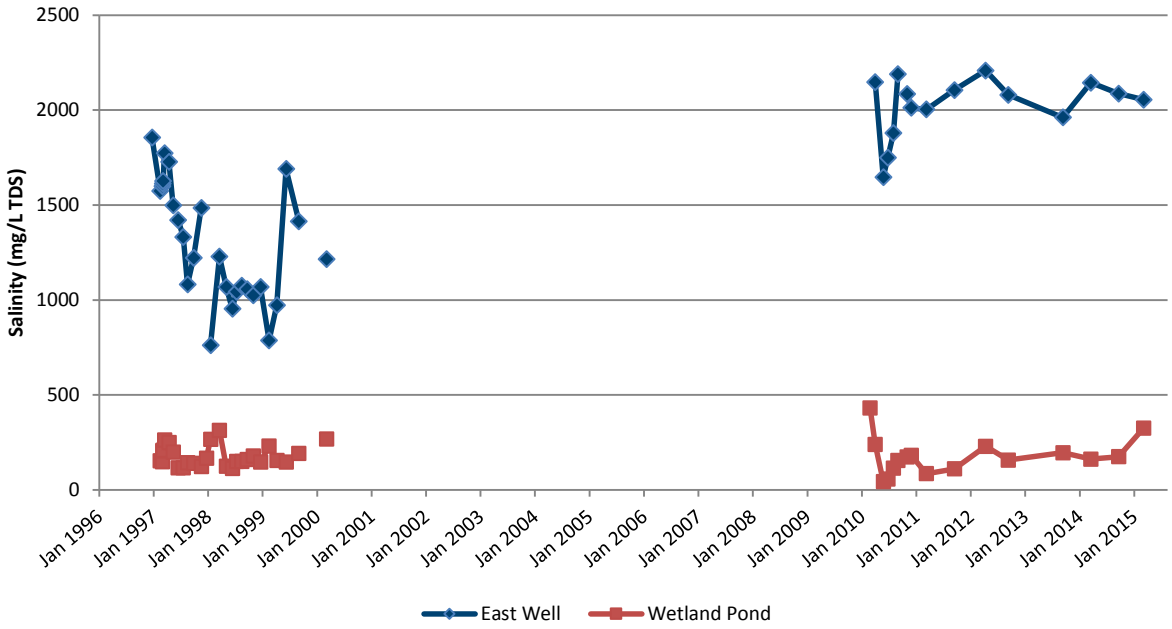

Figure 5: Salinity comparison for East Well and wetland pond

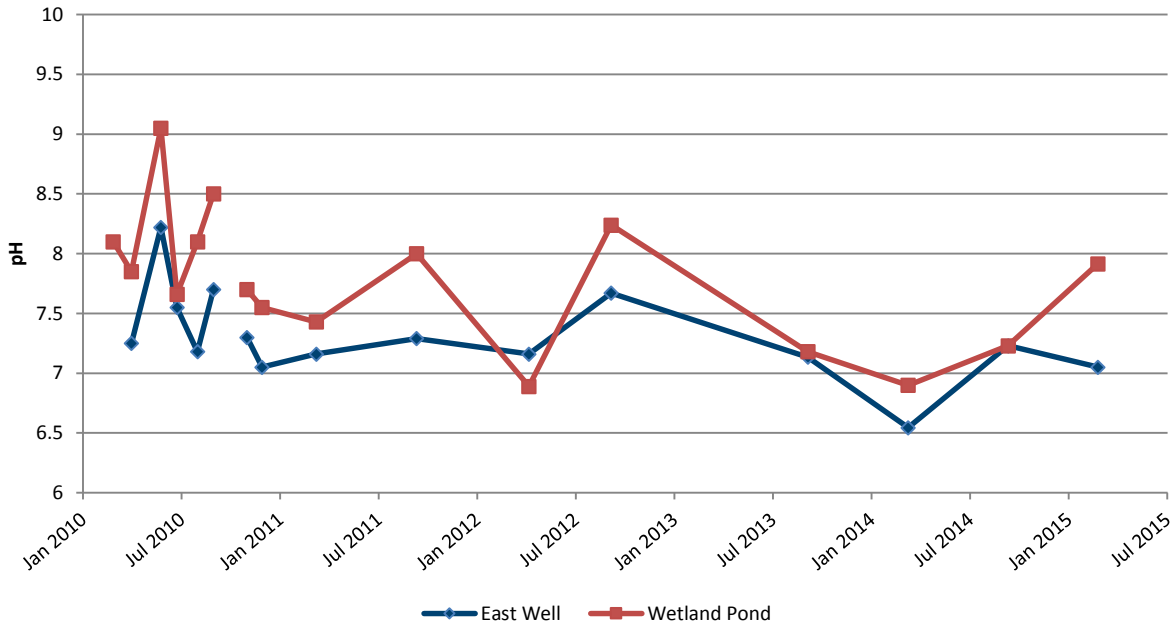

Figure 6: pH comparison for East Well and wetland pond

The pH comparison plot of the East Well and the wetland pond (Figure 6) indicates similar pH throughout the observation period, with the wetland being slightly higher on occasion. Data from both sites remain within the SA EPA guidelines for aquatic ecosystems (pH = 6.5–9).

3. CONCLUSIONS

The following conclusions and recommendations are drawn from the 2014/15 monitoring program at the Urrbrae Wetlands:

- The groundwater levels recorded in the East Well (~11.8 – 12.3 m BGL) are consistent with surrounding Q1 aquifer levels (DEWNR observation wells) and show no indication of leakage from the wetland pond. Groundwater level in March 2015 was the lowest observed since April 2012 but was within the range of previous observations.
- The West Well was dry, consistent with previous readings. To date there is no evidence for pond leakage to the perched water table.
- Water quality samples from the East Well and the wetland pond were consistent with historical monitoring data. No trends have been identified in the East well that indicate wetland leakage.
- Groundwater salinity was observed to be far higher than wetland salinity, consistent with historical monitoring. This confirms findings of no wetland leakage.

4. RECOMMENDATIONS

It is acknowledged that the City of Mitcham is considering plans for stormwater harvesting and ASR operations, and the Urrbrae Wetland may play a role in such a system. The water quality and groundwater level data collected thus far represent a valuable baseline dataset should the wetlands be altered as part of a stormwater harvesting / reuse scheme.

There is currently no evidence of leakage between the wetland pond and the shallow groundwater system and this trend has been established for at least 5 years. At this point in time the Mitcham Council should review the requirement for annual reporting. A provisional recommendation would be to continue monitoring (bi-annually), but undertake reporting activities on a 2 year basis.

Yours sincerely,

Aidan Moyse
Hydrogeologist

APPENDIX A: URRBRAE WETLAND MONITORING DATA

Wetland Pond Monitoring Results 1997–2014

Date	Cond. (µS/cm)	Salinity (mg/L TDS)	pH	Temp (°C)	DO (%)	Redox (mV)	Turbidity (NTU)	Comment
17/02/97	240	154						Data from CSIRO
3/03/97	230	147						Data from CSIRO
5/03/97	320	205						Data from CSIRO
8/03/97	324	207						Data from CSIRO
8/03/97	330	211						Data from CSIRO
18/03/97	410	262						Data from CSIRO
17/04/97	390	250						Data from CSIRO
14/05/97	310	198						Data from CSIRO
17/06/97	181	116						Data from CSIRO
21/07/97	180	115						Data from CSIRO
19/08/97	224	143						Data from CSIRO
29/09/97	218	140						Data from CSIRO
19/11/97	192	123						Data from CSIRO
24/12/97	260	166						Data from CSIRO
20/01/98	416	266						Data from CSIRO
20/03/98	490	314						Data from CSIRO
5/05/98	194	124						Data from CSIRO
15/06/98	175	112						Data from CSIRO
13/07/98	233	149						Data from CSIRO
17/08/98	234	150						Data from CSIRO
22/09/98	250	160						Data from CSIRO
2/11/98	278	178						Data from CSIRO
21/12/98	228	146						Data from CSIRO
16/02/99	360	230						Data from CSIRO
9/04/99	241	154						Data from CSIRO
11/06/99	229	147						Data from CSIRO
3/09/99	301	193						Data from CSIRO
8/03/00	419	268						Data from CSIRO
26/02/10	673	431	8.1	32.8	91%	228		
1/04/10	374	239	7.9	20.2	50%		47	
26/05/10	68	44	9.1	16.9			14	
25/06/10	89	57	7.7	13.1			1	
2/08/10	178	114	8.1	13.5			39	
1/09/10	241	154	8.5	15.5			7	
28/09/10								Access Not Available

Date	Cond. (µS/cm)	Salinity (mg/L TDS)	pH	Temp (°C)	DO (%)	Redox (mV)	Turbidity (NTU)	Comment
2/11/10	270	173	7.7	23.5			17	
30/11/10	283	181	7.6	20.9			26	
11/03/11	133	85	7.4	26.5			27	
14/09/11	173	111	8.0					
10/04/12	358	229	6.9	20.2				
10/09/12	245	157	8.2	22.3	46%		0	
11/09/13	302	193	7.2	17.3	75%		5	
11/09/13	310	198	7.1	18.2				
17/03/14	253	162	6.9	22.0	71%	117	16	
19/9/2014	273	175	7.2	18.6			10	
5/03/15	507	324	7.9	24.0			6.5	

East Well Monitoring Results 1996–2014

Date	SWL (mBGL)	RSWL (mAHD)	Cond (µS/cm)	Salinity (mg/L TDS)	pH	Temp (°C)	DO (%)	Redox (mV)	Turbidity (NTU)	Comment
24/12/96	11.4	61.4	2,900	1,856						Data from CSIRO
17/02/97	10.9	61.9	2,460	1,574						Data from CSIRO
3/03/97	11.1	61.6	2,500	1,600						Data from CSIRO
5/03/97	11.2	61.6	2,520	1,613						Data from CSIRO
8/03/97	11.2	61.6	2,540	1,626						Data from CSIRO
18/03/97	11.2	61.5	2,770	1,773						Data from CSIRO
17/04/97	11.4	61.3	2,700	1,728						Data from CSIRO
14/05/97	11.6	61.2	2,340	1,498						Data from CSIRO
11/06/97	11.7	61.1								Data from CSIRO
17/06/97	11.7	61.0	2,220	1,421						Data from CSIRO
21/07/97	11.8	61.0	2,080	1,331						Data from CSIRO
19/08/97	11.8	60.9	1,690	1,082						Data from CSIRO
29/09/97	11.6	61.1	1,910	1,222						Data from CSIRO
19/11/97	11.6	61.2	2,320	1,485						Data from CSIRO
20/01/98	11.6	61.2	1,190	762						Data from CSIRO
20/03/98	11.8	61.0	1,920	1,229						Data from CSIRO
5/05/98	12.0	60.8	1,670	1,069						Data from CSIRO

Date	SWL (mBGL)	RSWL (mAHD)	Cond (µS/cm)	Salinity (mg/L TDS)	pH	Temp (°C)	DO (%)	Redox (mV)	Turbidity (NTU)	Comment
15/06/98	12.0	60.7	1,490	954						Data from CSIRO
13/07/98	12.0	60.7	1,630	1,043						Data from CSIRO
17/08/98	11.9	60.8	1,680	1,075						Data from CSIRO
22/09/98	11.8	61.0	1,650	1,056						Data from CSIRO
29/09/98	11.7	61.0								Data from CSIRO
2/11/98	11.6	61.2	1,600	1,024						Data from CSIRO
21/12/98	11.5	61.3	1,670	1,069						Data from CSIRO
16/02/99	11.7	61.1	1,230	787						Data from CSIRO
9/04/99	11.9	60.9	1,520	973						Data from CSIRO
11/06/99	12.0	60.8	2,640	1,690						Data from CSIRO
3/09/99	11.7	61.0	2,210	1,414						Data from CSIRO
14/12/99	11.3	61.4								Data from CSIRO
8/03/00	11.6	61.2	1,899	1,215						Data from CSIRO
26/02/10	15.3	57.5								
1/04/10	15.5	57.3	3,356	2148	7.3	19.9	25%		0	
26/05/10	13.0	59.8	2,572	1,646	8.2	20.3			3	
25/06/10	13.0	59.8	2,733	1,749	7.6	18.3			0	
2/08/10	12.8	60.0	2,935	1,878	7.2	18.7			15	
1/09/10	12.7	60.1	3,420	2,189	7.7	19.3			22	
28/09/10										Access not available
2/11/10	12.1	60.7	3,258	2,085	7.3	19.9			0	
30/11/10	12.1	60.7	3,144	2,012	7.1	20.8			14	
11/03/11	12.2	60.5	3,130	2,003	7.2	20.7			7	
14/09/11	12.0	60.7	3,290	2,106	7.3					
10/04/12	12.3	60.4	3,450	2,208	7.2	19.9				
10/09/12	11.9	60.8	3,250	2,080	7.7	23.5	54%		0	
11/09/13	11.6	61.2	2,800	1,792	7.2	18.7	36%		15	
11/09/13	11.6	61.2	3,330	2,131	7.1	19.9				
17/03/14	11.7	61.0	3,350	2,144	6.5	19.8	47%	142.5	30	
19/09/14	11.8	60.95	3,260	2,086	7.23	19.8			5	
5/03/15	12.32	60.43	3,210	2,054	7.05	19.6			15.5	

West Well Monitoring Data 2010–2014

Date	Comment
26/02/10	Dry
01/04/10	Small Amount of Water in Bottom of Well
26/05/10	Dry
25/06/10	Dry
02/08/10	Dry
01/09/10	Dry
28/09/10	Access Not Available
02/11/10	Dry
30/11/10	Dry
11/03/11	Dry
14/09/11	Small Amount of Water in Bottom of Well
10/04/12	Dry
10/09/12	Dry
11/09/13	Dry
17/03/14	Dry
19/09/2014	Dry
5/03/2015	Dry