5. Results

5.1 Site conditions

During the 2016 monitoring period, all 'deep' monitoring wells were observed to be in working order with the exception of SE8D, which was unable to be accessed in October due to an obstruction within the well (the issue has since been rectified by [redacted]

The shallow monitoring wells SE1S – SE10S, were unable to be sampled during the monitoring period due to insufficient water to provide a representative sample. Although gauging detected the presence of water in some of the shallow wells, the data available is considered unreliable and not representative of a shallow aquifer. As such, this data has not been considered. It is noted that the shallow groundwater wells have typically been observed to be dry in recent sampling events.

5.2 Groundwater elevation and flow direction

Water level gauging data and corrected groundwater elevations (m AHD) for each monitoring event are included in Table 4 below with contours presented on Figure 2. As per Figure 2, groundwater flow is inferred be in a westerly direction, which is consistent with previous investigations and monitoring events.

Groundwater elevation ranged from the following:

- April: 34.857 mAHD (SE4D) to 37.69 mAHD (SE10D)
- October: 35.376 mAHD (SE4D) to 57.084 mAHD (SE5D)

Table 4 Groundwater elevation April and October 2016

Well ID	Monitoring Event	Easting	Northing	TOC elevation (mAHD)	Groundwater depth (m bTOC)	Groundwater elevation (mAHD)
SE1D	April 2016	38348	6300786	74.363	-	-
	Oct 2016	38348	6300786	74.363	34.688	39.675
SE3D	April 2016	387248	6300402	73.097	38.190	34.907
	Oct 2016	387248	6300402	73.097	37.700	35.397
SE4D	April 2016	387171	6300237	71.697	36.840	34.857
	Oct 2016	387171	6300237	71.697	36.321	35.376
SE5D	April 2016	388021	6300376	103.987	-	-
	Oct 2016	388021	6300376	103.987	46.903	57.084
SE6D	April 2016	387099	6300773	63.98	28.830	35.150
	Oct 2016	387099	6300773	63.98	28.449	35.531
SE7D	April 2016	387095	6300625	67.01	31.950	35.060
	Oct 2016	387095	6300625	67.01	31.406	35.604

SE8D	April 2016	387128	6300437	67.05	-	-
	Oct 2016	387128	6300437	67.05	-	-
SE9D	April 2016	386942	6300285	63.89	27.520	36.370
	Oct 2016	386942	6300285	63.89	25.913	37.977
SE10D	April 2016	386942	6300232	64.43	26.740	37.690
	Oct 2016	386942	6300232	64.43	26.592	37.838

5.3 Groundwater parameters

Groundwater at the site was generally observed as turbid but becoming clear during purging with no odour or sheen observed. Water quality parameters observed during the 2016 monitoring events are presented in Table 5 below.

Table 5 Field parameters April and October 2016

Sample ID	Date	pH	EC (µS/cm)	TDS (mg/L)	REDOX (mV)	Dissolved oxygen (mg/L)	Temp
SE1D	14/04/2016	5.76	505	328.25	248	-	19.8
SE3D	19/10/2016	5.27	594	386.1	71.1	5.27	19.2
SE3D	14/04/2016	5.06	547	355.55	303	-	19
	18/10/2016	-	-	-	-	-	-
SE4D	14/04/2016	5.2	221	143.65	184.9	-	19
	19/10/2016	5.18	221	143.65	82.6	3.78	19.1
SE5D	14/04/2016	4.76	1,064	691.6	243	-	19.3
	19/10/2016	5.05	1,750	1137.5	128.6	7.42	18.8
SE6D	14/04/2016	6.39	273	177.45	188.1	-	18.7
	19/10/2016	5.58	210	136.5	64.7	4.63	18.1
SE7D	14/04/2016	5.14	268	174.2	194.3	-	19
	19/10/2016	5.86	275	178.75	78.5	5.4	18.9
SE8D	14/04/2016	4.78	319	207.35	184	-	19.4
	19/10/2016	-	-	-	-	-	-
SE9D	14/04/2016	5.55	385	250.25	487	-	18.8
	19/10/2016	5.36	391	254.15	96.3	4.21	18.5
SE10D	14/04/2016	5.02	377	245.05	325	-	18.9
	19/10/2016	-	-	-	-	-	-

A summary of the main observations from Table 5 is provided below:

- The recorded pH measurements from all of the deeper aquifer wells indicated that the groundwater was slightly acidic and ranged between a pH of 4.76 in April (SE5D) and 6.39 in April (SE6D).

- Field EC ranged from 210 µS/cm in October (SE6D) to 1,750 µS/cm in October (SE5D). This equates to a TDS of 136.5 mg/L and 1,137.5 mg/L for SE6D and SE5D respectively using a conversion factor of 0.65. This range is indicative of a 'fresh' water quality.
- REDOX ranged from 64.7 mV in October (SE6D) to 487 mV in April (SE9D)
- Dissolved oxygen concentrations ranged between 3.78 mg/L in October (SE4D) to 7.42 mg/L in October (SE5D). It is noted that due to the depth to water and sampling methodology, the water may have been disturbed and therefore not represent in situ dissolved oxygen concentration.

5.4 Laboratory results April and October 2016

The detailed analytical results for the April and October 2016 GMEs are presented in Appendix D – Table 1. Laboratory Certificates of Analysis are included in Appendix E.

Exceedances of the adopted criteria are summarised in Tables 6 and 7 below. It is noted that no BTEX, PAH (other than naphthalene), Phenols, PCBs, OCP, OPP or PFAS (monitored in the October event only) were reported above the LOR for either of the biannual sampling events.

Table 6 Exceedances of adopted criteria April 2016

Location		Assessment criteria			
Location Context	Sample ID	DER 2014 Drinking water health	DER 2014 Fresh Waters	DER 2014 Long-term irrigation	DER 2014 Non-potable Groundwater Use (NPUG)
Cross Gradient	SE1D	-	Zn	-	-
Down Gradient (Primary Leachate Pond)	SE3D	-	Cu, Zn, Nitrogen	-	-
Upgradient (Leachate Evaporation Ponds)	SE4D	-	Zn	-	-
Upgradient (site)	SE5D	-	-	-	Chloride
Down Gradient (Crystal Pigment Cell 1)	SE6D	-	Nitrogen	-	-
	SE7D	-	Cu, Zn	-	-
	SE8D	-	Nitrogen	-	-
Down Gradient (Leachate Evaporation Ponds)	SE9D	-	Cu	-	-
	SE10D	-	Zn	-	-

Table 7 Exceedances of adopted criteria October 2016

Location		Assessment criteria			
Location Context	Sample ID	DER 2014 Drinking water health	DER 2014 Fresh Waters	DER 2014 Long-term irrigation	DER 2014 Non-potable Groundwater Use (NPUG)
Cross Gradient	SE1D	-	Cu, Fe, Zn	Fe	-
Down Gradient (Primary Leachate Pond)	SE3D	-	Al, Cu, Fe, Zn, Nitrogen	Fe	-
Upgradient (Leachate Evaporation Ponds)	SE4D	-	Cu, Zn	-	-
Upgradient (site)	SE5D	-	Al, Cu, Fe	Fe, Phosphorus	Chloride
Down Gradient (Crystal Pigment Cell 1)	SE6D	-	Cu, Zn, Nitrogen	Phosphorus	-
	SE7D	-	Cu, Zn	Fe	-
	SE8D	-	-	-	-
Down Gradient (Leachate Evaporation Ponds)	SE9D	-	Al, Zn	-	-
	SE10D	-	Cu, Zn	-	-

5.5 Quality assurance / quality control evaluation

5.5.1 Relative percentage difference

Table 8 outlines the blind duplicate samples that were collected for groundwater monitoring in 2016 during both events.

Table 8 Duplicate samples collected for the 2016 biannual monitoring

Primary sample	Date	Duplicate sample ID
SE8D	12/4/16	Duplicate
SE7D	19/10/16	FD01

The precision of the results for each analyte between the primary sample and the field duplicate/ split is determined by calculating the relative percentage difference (RPD). A quantitative measure of the accuracy of the analytical results reported is made by calculating the RPDs in accordance with the procedure described in AS 4482.1 – 2005 (Standards Australia, 2005). RPD calculations are presented in Appendix D – Table 2.

RPDs exceeding the acceptable range specified are summarised in Table 9 below. An RPD limit of 30% has been adopted for this investigation (whilst 50% is generally considered an acceptable limit).

Table 9 Summary of RPDs exceeding acceptable ranges

Primary sample	Date	QC sample	Laboratory	Analyte	RPD (%)
SE8D	12/4/16	"Duplicate"	Eurofin/MGT	Zinc	50
SE7D	19/10/16	"FD01"	ALS Environmental	Naphthalene	80

The exceeding RPDs outlined in Table 9 are the result of the concentrations of one or both or samples being very low concentrations or marginally above the LOR which exaggerates the resultant RPD calculation. The concentrations of both sample pairs are considered to be of very similar orders of magnitude and the exaggerated RPD calculations in Table 9 are not considered to represent a reproducibility issue within the laboratory analysis.

5.5.2 Blank analytical results

A summary of blank sample results is provided in Appendix D, Table 3.

No blanks were collected during the April monitoring event, while the October event included the collection of the following quality control samples:

- Rinsate Blank: RB01
- Field Blank: FB01 FB02
- Transport Blank: TBW1065 and TBW1066

The analysis of the blank samples indicated that all analytes were below the relevant LORs. The absence of detectable concentrations in the blank samples suggests that the transportation process, the ambient conditions onsite and the use of equipment on multiple locations has not introduced contamination to the samples collected.

5.5.3 Laboratory QA/QC

A review of laboratory holding times, method blanks, duplicates, control outliers and matrix spikes was completed, with the following items identified as being outside the acceptable range:

- April 2016 – Report 497217-W
  - The laboratory quality control /quality assurance assessment was deemed acceptable.
- October 2016 – Report EP1609926
  - Holding time: Major cations – 1 day over holding time.
  - Internal QC frequency: TRH (semi volatile fraction) – QC frequency not met.
  - Matrix spikes: OCP, PAH, phenols, PCBs and pesticides – outside acceptable range.

5.5.4 Data quality review summary

A review of field and laboratory QA/ QC data and procedures confirms an acceptable level of compliance with the general project requirements. As such, there is an acceptable level of confidence in the data upon which the conclusions in this report will be made.