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24 February, 2015

Rajan Sinha

Yara Pilbara Nitrates Pty Ltd
5th Floor, 182 St Georges Terrace
PERTH WA 6000

Our Reference: *0220651/01/03*

Attention: **Rajan Sinha**

Dear Rajan,

RE: GROUNDWATER MONITORING EVENT OCTOBER 2014

1. INTRODUCTION

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Yara Pilbara Nitrates Pty Ltd (YPNPL) to conduct a Groundwater Monitoring Event (GME) at the YPNPL Technical Ammonium Nitrates Production Facility (TANPF) on 29 and 30 October 2014.

This report outlines the detection of analytes above trigger levels. The site location and layout are illustrated in *Figures 1* and *2*, provided in *Annex A.*

For the convenience of the reader, an acronyms and abbreviations table is provided below.

Table 1 Acronyms and Abbreviations

Acronym /Abbreviation	Expansion	Further Definition (if applicable)
ALS	ALS Environmental (laboratory)	
ANZECC	Australian and New Zealand Environment Conservation Council	
AS/NZS	Australian Standard/New Zealand Standard	
BIE	Burrup Industrial Estate	
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes	
$CaCO_3$	Calcium Carbonate	
CEO	Chief Executive Officer	

2. PROJECT APPRECIATION

The site (including temporary laydown areas) occupies approximately 35 ha of land in the north-western section of Lot 3017. Lot 3017 totals approximately 49 ha and is located within the Burrup Industrial Estate (BIE). The existing Yara ammonia fertiliser plant is situated adjacent to the western boundary of Lot 3017.

The civil works for the TANPF include the following activities:

- excavation and backfilling works;
- foundations of structures, permanent buildings equipment and modules;
- concrete structures (*in situ* and precast);
- pipe racks foundations;
- roads and pavements;
- underground piping and grounding;
- electrical trenches civil works; and
- civil completion.

3. REGULATORY REQUIREMENTS

Condition 8-4 of Ministerial Statement No. 870 requires YPNPL to sample/monitor all groundwater bores required by Condition 8-3 every six (6) months. The condition sets a trigger value of 10% above the baseline contaminant concentrations which were characterised and established prior to the commencement of works at the site.

In accordance with Condition 8-5 of Ministerial Statement No. 870, YPNPL are required to:

1) report findings to the Chief Executive Officer (CEO) of the Office of the Environmental Protection Authority (OEPA) within seven (7) days of the exceedance being identified;

2) provide evidence which allows for the determination of the cause of the exceedance; and

3) if determined by the CEO to be project attributable, take actions to address the exceedance within seven (7) days of the determination being made.

5) Screening of laboratory results against trigger levels; and

6) The preparation of this factual report to detail the scope of works undertaken and the results of the investigation.

6. METHODOLGY

The methodology applied in this GME followed the relevant ERM Standard Operating Procedures (SOPs) and state and national guidelines as described below. The methodologies followed were consistent with those applied in the previous GMEs undertaken at this site.

6.1 HEALTH AND SAFETY

All works were completed in accordance with ERM health and safety (H&S) procedures. This included the preparation of site works risk/hazard analysis documents and the preparation of an H&S plan to ensure safe work practices at the site. A travel communication plan was also prepared. This was especially important given the level of construction activity on site.

6.2 GAUGING OF GROUNDWATER DEPTHS

Groundwater monitoring wells were gauged during the GME with an interface probe in accordance with ERM's SOP. Groundwater levels are presented in *Table 1* of *Annex B.*

6.3 GROUNDWATER SAMPLING

The five existing groundwater monitoring wells (MW1-MW5) were purged and sampled in accordance with ERM's standard groundwater sampling protocols using low flow methodology.

Field parameters were measured using a calibrated water quality meter and included temperature, pH, oxygen reduction potential, electrical conductivity and dissolved oxygen. The stabilised water quality parameters are detailed in *Table 1* of *Annex B.*

All groundwater samples were collected, stored and transported to the laboratory under strict chain of custody procedures.

Field measured pH has been used in the interpretation of results in this report as, given the location of the TANPF site, it was not possible to deliver the samples to the laboratory within the 6 hour holding time for this parameter for all samples.

- Total dissolved solids (TDS), total alkalinity and silica;
- Dissolved metals (by ultratrace method) including aluminium, arsenic, cadmium, chromium, iron, lead, manganese, mercury, selenium and zinc, and
- Total petroleum hydrocarbons (TPH) C6-C36 and total recoverable hydrocarbons ((TRH) C6-C40.

The water quality parameters analysed are detailed in *Table 2* and *Table 3* of *Annex B.*

7. RESULTS AND DISCUSSION

During the site visit it was noticed that the PVC pipe at well MW4 was bent and the metal casing installed initially to cover and secure the well was laid on the ground next to the well. ERM was able to sample this well and from the review of the results its condition does not appear to have affected the results. ERM recommends the metal well head be reinstalled and the PVC pipe covered with a proper sealing cap, to minimise further damage.

Depth to groundwater recorded during the October GME ranged from 2.57 m (MW3) to 6.29 m (MW1) below top of casing. Compared to data collected at the same time previous year (October 2013), water level has increased in MW1 and MW2, quasi constant in MW5 and decreased in MW3 and MW4. The observed pattern is likely as a result of a combination of increased rainfall over the period and tidal influences.

Groundwater temperature ranged between 30.1 (MW2) and 31.6°C (MW5); which is higher than October 2013 monitoring data and lower than April 2014 data (exception MW3) and these variations can most likely be attributed to seasonal changes in weather conditions.

The pH results are neutral to slightly alkaline with values between 7.14 (MW2) and 7.97 (MW3).

Oxidation Reduction Potential (ORP) readings in the five wells varied between -6.3 mV (MW1) and 46 mV (MW5), describing a decreasing ORP trend compared to April 2014 and October 2013 data. The ORP values are influenced by many natural processes taking place in the subsurface and their variability should not be interpreted in isolation. Given there are no other signs of concern in the physical and chemical composition of the collected data, the currently decreasing ORP values are attributed to natural process and unlikely directly related to anthropogenic influences at the site.

Electrical conductivity (EC) was consistent across the monitoring wells compared to previous GME's with the exception of MW4 (68.9 $mScm^{-1}$) where the EC has

Table 2 Exceedences of Trigger Levels (October 2014)

Well	Analyte	Exceedence	Trends (over past 9 GMEs)
MW1	Alkalinity (Hydroxide)	Implied exceedance (in a conservative approach) as unable to screen the result for this analyte as the LOR of 1000 mg/L is higher compared to the maximum acceptable baseline value of 693 mg/L.	Historical results are consistent with current concentrations below the LOR value. Total alkalinity concentrations at this well were below the maximum acceptable baseline value, therefore the potential exceedance of the alkalinity hydroxide parameter is considered unlikely.
	Reactive phosphorus as P	0.018 mg/L compared to the maximum acceptable baseline value of 0.011 mg/L.	Historical results have been below the maximum acceptable baseline value with concentrations between <0.0002 and 0.0008 mg/L.
MW2	Alkalinity (Hydroxide)	Implied exceedance (in a conservative approach) as unable to screen the result for this analyte as the laboratory detection limit (LOR) of 1000 mg/L is higher compared to the maximum acceptable baseline value of 693 mg/L.	Historical results are consistent with current concentrations below the LOR value. Total alkalinity concentrations at this well were below the maximum acceptable baseline value, therefore the potential exceedance of the alkalinity hydroxide parameter is considered unlikely.
MW3	Aluminium	0.024 mg/L compared to the maximum acceptable baseline value of 0.0209 mg/L.	Similar marginal exceedances have been recorded at this well in March and April 2013 with concentration values of 0.072 mg/L and 0.021 mg/L respectively. The exceedance is minimal and likely attributed to natural variations and not considered to be of concern.
	Alkalinity (Hydroxide)	Implied exceedance (in a conservative approach) as unable to screen the result for this analyte as the LOR of 1000 mg/L is higher compared to the maximum acceptable baseline value of 693 mg/L.	Historical results are consistent with current concentrations below the LOR value. Total alkalinity concentrations at this well were below the maximum acceptable baseline value, therefore the potential exceedance of the alkalinity hydroxide parameter is considered unlikely.
	Reactive phosphorus as P	0.021 mg/L compared to the maximum acceptable baseline value of 0.011 mg/L	Historical results have been below the maximum acceptable baseline value with concentrations between <0.0002 and 0.0006 mg/L. The exceedance is minimal and likely attributed to natural variations and not considered to be of concern.

With the exception of the analytes discussed in *Table 2,* all other analytes were below the specified maximum acceptable values and were generally consistent with previously recorded conditions. The results continue to support the fact that the observed variability in the groundwater chemistry with no clear trends suggests the results depict a combination of natural variability in groundwater chemistry and off site contributions as opposed to increasing concentrations of analytes associated with site activities. None of the analytes observed exceeding the trigger levels are regarded as directly attributed to current on site activities.

There could be natural variations in groundwater chemistry between the original and replacement wells because a different part of the aquifer is being sampled.

8. CONCLUSION

The biannual GME undertaken at the site on 29-30 October 2014 included five existing wells (MW1-MW5) and has followed sampling methodologies consistent with those applied during the eight past monitoring events. It is noted that the salinity of the groundwater collected from the five wells range from brackish to hypersaline the closer the wells are to the natural surface water drainage systems represented by the salt pans located to the east of the facility.

As highlighted in previous GME reports, until the wells are surveyed in, it is not possible to assess actual groundwater flow direction. Tidal fluctuations, rainfall events and cyclonic activity causing localised flooding will likely influence groundwater levels and groundwater flow direction..

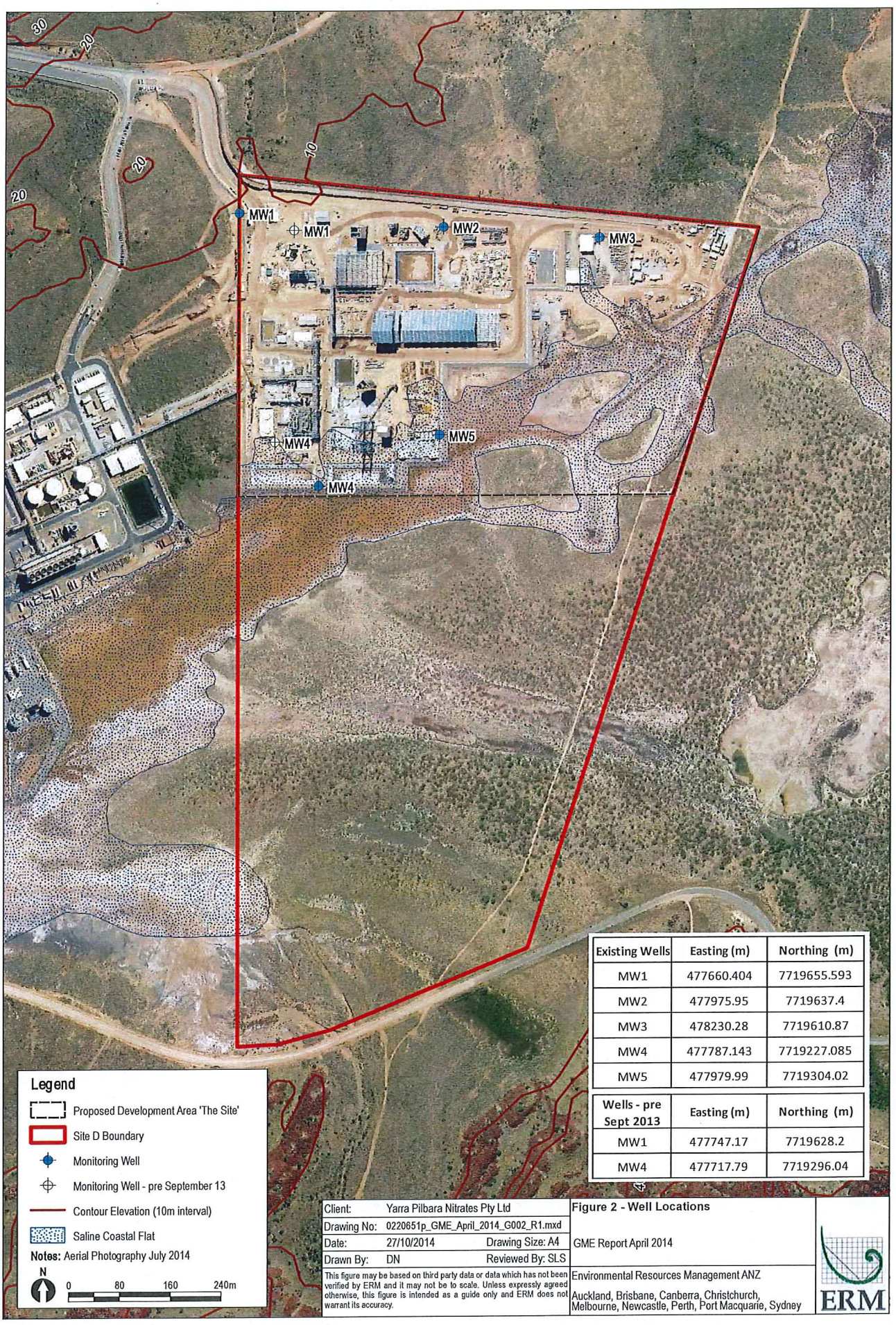
The analytical results of the October 2014 GME display a number of exceedences of the trigger levels established in 2012, generally though, exceedences are marginal to the screening values. It is noted that in the case of alkalinity and selenium the limit of reporting is greater than the trigger values established in 2012 and while flagged as potential exceedances, actual concentrations could well be below these trigger values.

The variable trends and exceedances (where noted) highlight a natural variability in groundwater chemistry both at a given point and over time, and are not considered to be the result of activities at the construction site.

In the broader context of the site location, there is an existing adjacent fertiliser manufacturing plant that could potentially contribute to the chemical loading observed in the shallow groundwater in the local area. The current development of the site, with an increased footprint of buildings and hard stand and constructed surface drainage systems may result in less rainfall infiltration into the ground under the site, reducing the potential effects of leaching of metals and chemicals in the existing sub soils into the underlying groundwater.

Annex A

SITE LOCATION & WELL LOCATIONS



Existing Wells	Easting (m)	Northing (m)
MW1	477660.404	7719655.593
MW2	477975.95	7719637.4
MW3	478230.28	7719610.87
MW4	477787.143	7719227.085
MW5	477979.99	7719304.02

Wells - pre Sept 2013	Easting (m)	Northing (m)
MW1	477747.17	7719628.2
MW4	477717.79	7719296.04

Client:	Yarra Pilbara Nitrates Pty Ltd	
Drawing No:	0220651p_GME_April_2014_G002_R1.mxd	
Date:	27/10/2014	Drawing Size: A4
Drawn By:	DN	Reviewed By: SLS

This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.

Figure 2 - Well Locations

GME Report April 2014

Environmental Resources Management ANZ

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Table 1. Groundwater Gauging Results and Field Parameters
YPNPL October 2014
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Well ID	Gauging Date	Event	Depth of Well (mbTOC)	Depth to Water (mbTOC)	DO (mg/L)	EC ($mScm^{-1}$)	pH	Eh (mV)	TEMP (°C)	TDS (mg/L)	Method of sampling	Purge Volume (L)	Comments
MW1**	17-Oct-13	Pre	17.40	6.440	0.30	1.74	5.60	81.40	31.2	1131	Low flow peristaltic pump	3.5	Clear, colourless no odour
	9-Apr-14	Pre	17.56	5.861	0.64	1.88	7.13	40.20	32.6	1222	Low flow peristaltic pump	2.5	Clear, no odour
	29-Oct-14	Pre	17.40	6.297	1.01	2.05	7.44	-6.30	32.1	1333	Low flow peristaltic pump	1.7	Clear, no odour, the drawdown was higher than 10 cm at a flow rate of 150 ml/min
MW2	11-Oct-12	Pre	8.20	4.481	2.22	4.29	7.12	142.50	29.2	2789	Bailer	24.0	Turbid, pale brown, no odour, moderate recharge, good yield
	6-Mar-13	Pre	8.20	4.432	1.65	4.21	7.28	37.90	32.0	2737	Bailer	21.0	Turbid, slightly brown no odour
	17-Apr-14	Pre	8.21	4.600	3.44	4.69	6.90	101.00	32.2	3049	Bailer	33.0	
	17-Oct-13	Pre	8.19	5.800	1.17	3.51	5.34	158.60	29.9	2282	Low flow peristaltic pump	3.0	Clear, colourless no odour
	9-Apr-14	Pre	8.21	3.906	0.49	3.10	6.98	66.90	34.7	2015	Low flow peristaltic pump	3.0	Clear, no odour
	29-Oct-14	Pre	8.20	4.145	0.90	3.31	7.14	4.80	30.1	2148	Low flow peristaltic pump	1.7	Clear, no odour, good recharge, low drawdown
MW3	11-Oct-12	Pre	8.17	2.867	2.88	14.05	7.47	75.30	28.0	9133	Bailer	44.0	Slightly turbid, grey becoming pale brown, moderate recharge
	6-Mar-13	Pre	7.18	2.801	1.49	20.90	7.32	33.20	31.1	13585	Bailer	24.0	Turbid, Pale brown, no odour
	17-Apr-14	Pre	8.19	3.010	1.78	17.95	7.19	27.50	31.9		Bailer	33.0	
	17-Oct-13	Pre	8.17	2.020	1.75	14.70	6.17	145.90	29.3	9555	Low flow peristaltic pump	3.5	Clear, colourless no odour
	9-Apr-14	Pre	8.12	2.446	1.67	16.08	7.50	73.10	29.3	10452	Low flow peristaltic pump	3.5	Clear, no odour
	29-Oct-14	Pre	8.12	2.577	6.16	14.15	7.97	11.90	30.3	9198	Low flow peristaltic pump	2.3	Clear, no odour, good recharge, low drawdown
MW4**	11-Oct-12	Pre	4.64	1.519	2.06	126.60	7.66	123.20	28.7	82290	Bailer	24.0	Highly turbid, silty, orange, no odour, fast recharge
	6-Mar-13	Pre	7.21	3.949	-	-	-	-	-	-	-	-	Unable to be sampled due to curve in PVC Pipe extension
	17-Apr-14	Pre	7.35	4.070	0.13	67.40	7.17	15.72	33.9	43810	Low flow peristaltic pump	2.5	Turbid, red brown
	17-Oct-13	Pre	14.40	3.820	1.99	124.40	4.32	135.00	31.0	80860	Low flow peristaltic pump	4.5	Clear, colourless no odour
	9-Apr-14	Pre	14.53	3.840	1.30	118.10	6.99	62.90	33.0	76765	Low flow peristaltic pump	3.0	Clear, no odour
	29-Oct-14	Pre	13.96	4.265	3.56	68.90	7.15	41.80	31.5	44785	Low flow peristaltic pump	2.0	clear, no odour, good recharge, well head partially damaged
MW5	11-Oct-12	Pre	5.01	1.054	1.73	145.70	6.90	193.20	29.3	94705	Bailer	24.0	Slightly turbid, pale brown, no odour, recharge becoming turbid, red-brown
	6-Mar-13	Pre	5.07	0.905	0.99	141.20	6.84	135.90	34.3	91780	Bailer	24.0	Turbid, cream to pale colour, no odour
	17-Apr-14	Pre	5.97	2.020	2.24	147.30	6.77	210.70	34.4	95745	Bailer	33.0	
	17-Oct-13	Pre	8.95	4.530	0.51	104.00	6.21	125.60	30.3	67600	Low flow peristaltic pump	5.5	Clear, no odour
	9-Apr-14	Pre	9.01	4.415	1.03	70.80	7.08	69.20	32.0	46020	Low flow peristaltic pump	2.5	Clear, no odour
	29-Oct-14	Pre	9.00	4.505	0.78	69.70	7.24	46.00	31.6	45305	Low flow peristaltic pump	2.1	clear, no odour, good recharge

Notes:
**MW1 and MW4 Were Replaced in September 2013

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Table 3 Groundwater Anaytical Results - Inorganics and Metals
YPNPL October 2014
0220651

		Inorganics																													
		Alkalinity (Bicarbonate as CaCO3)	Alkalinity (Carbonate as CaCO3)	Alkalinity (Bicarbonate)	Alkalinity(Hydroxide) as CaCO3	Alkalinity (total) as CaCO3	Ammonia	Ammonia as N	Anions Total	Cations Total	Chloride	Fluoride	Hydrogen sulfide	Ionic Balance	Kjeldahl Nitrogen Total	Nitrate (as N)	Nitrate (as NO3-)	Nitrite (as N)	Nitrite (as NO2-)	Nitrogen (Total)	Reactive Phosphorus as P	Silica	Silica (Filtered)	Sodium (Filtered)	Sulphate as SO4	Sulphide	TDS	Hardness as CaCO3 (Filtered)	TSS
		mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	µg/L	meq/L	meq/L	mg/L	mg/L	mg/L	%	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		1	1	5	1000	1	0.005	5	0.01	0.01	1	0.1	0.5	-100	0.05	0.002	0.05	0.002	0.05	50	0.001	100	50	0.5	1	0.1	10	1	5
ANZECC 2000 FW 95%							0.9						0.001				0.7												
ANZECC 2000 MW 95%							0.91																						
Trigger Values (Max Baseline + 10%)					693	561	814	814			95,700	1.65	N/A		2.97	3.63		N/A		5610	0.011			62,700	5720	N/A	143,000	20,900	2090
LocCode	Sampled_Date-Time																														
MW1	30/04/2011	-	-	420	-	350	-	38	-	-	780	-	<0.5	-	-	1.7	-	<0.005	-	2500	<0.002	-	30,000	350	170	-	2000	-	-
	20/09/2011	-	-	390	-	320	-	18	-	-	710	0.4	-	-6	0.28	-	-	-	-	3400	0.008	-	28,000	300	150	<0.5	-	-	180
	27/02/2012	-	-	370	-	300	<0.005	<5	-	-	670	0.5	-	-	0.17	2	8.7	<0.005	<0.05	2100	<0.002	-	29,000	340	140	<0.5	-	-	220
	11/10/2012	-	-	370	-	300	0.064	53	-	-	600	0.4	-	1	0.49	1.1	4.7	<0.005	<0.05	1500	0.003	32,000	-	290	100	<0.5	-	-	520
	6/03/2013	-	-	370	-	300	0.018	15	-	-	570	0.5	<0.5	-	0.14	1.9	<0.05	0.025	0.08	2000	0.003	-	32,000	280	100	<0.5	-	-	2900
	17/04/2013	-	-	350	-	290	<0.005	<5	-	-	560	0.4	-	-	0.15	2.2	9.7	0.022	0.07	2400	0.004	-	33,000	270	120	<0.5	-	-	16
	17/10/2013	367	<1	-	<1000	367	-	32	17.2	17.5	300	0.8	-	0.87	0.15	0.086	-	<0.002	-	240	0.007	-	-	265	-	<0.1	940	284	25
	9/04/2014	358	<1	-	<1000	358	-	114	18.1	17.3	345	0.8	-	2.42	0.49	1.6	-	0.004	-	2090	0.006	37500	-	267	59	<0.1	995	270	<5
	30/10/2014	361	<1	-	<1000	361	-	<5	19.1	17.1	366	0.6	-	5.42	2.46	0.162	-	<0.002	-	2620	0.018	36600	-	226	75	<0.1	981	352	<5
MW2	30/04/2011	-	-	340	-	280	-	200	-	-	930	-	<0.5	-	-	3.3	-	<0.005	-	3900	0.004	-	26,000	570	170	-	2000	-	-
	20/09/2011	-	-	350	-	290	-	<5	-	-	1200	0.6	-	-3	0.2	-	-	-	-	1400	0.004	-	24,000	610	210	<0.5	-	-	190
	27/02/2012	-	-	370	-	300	0.036	30	-	-	1400	0.7	-	-	0.26	0.62	2.7	<0.005	<0.05	880	<0.002	-	24,000	1000	220	<0.5	-	-	84
	11/10/2012	-	-	450	-	370	<0.005	<5	-	-	1300	0.5	-	-5	0.51	0.63	2.8	<0.005	<0.05	1100	<0.002	25,000	-	600	180	<0.5	-	-	440
	6/03/2013	-	-	440	-	360	<0.005	<5	-	-	1000	0.6	<0.5	-	0.1	0.6	2.7	<0.005	<0.05	700	<0.002	-	27,000	580	170	<0.5	-	-	320
	17/10/2013	281	<1	-		281	-	<5	31.7	34.4	811	0.6	-	3.95	0.42	2.28	-	<0.002	-	2700	0.003	-	-	507	-	<0.1	2040	593	10
	17/04/2013	-	-	410	<1000	340	<0.005	<5	-	-	1100	0.6	-	-	0.21	0.51	2.3	<0.005	<0.05	720	0.003	-	28,000	610	200	<0.5	-	-	290
	9/04/2014	250	<1	-	<1000	250	-	<5	28.4	28.8	730	0.8	-	0.7	<0.05	4.94	-	0.007	-	4960	0.007	25200		463	135	<0.1	1550	412	<5
	29/10/2014	276	<1	-	<1000	276	-	<5	30.1	27	771	0.6	-	5.54	0.23	2.49	-	<0.002	-	2720	0.01	23200		376	138	<0.1	1650	508	<5
MW3	30/04/2011	-	-	490	-	400	-	54	-	-	5400	-	<0.5	-	-	1.9	-	<0.005	-	2600	0.003	-	34,000	3400	800	-	9800	-	-
	20/09/2011	-	-	530	-	450	-	57	-	-	3700	1.4	-	2	0.18	-	-	-	-	220	0.006	-	32,000	2500	810	<0.5	-	-	280
	27/02/2012	-	-	560	-	460	<0.005	<5	-	-	4000	1.5	-	-	0.29	0.32	1.4	<0.005	<0.05	610	<0.002	-	33,000	3200	940	<0.5	-	-	230
	11/10/2012	-	-	660	-	540	0.015	12	-	-	4200	<0.1	-	3	0.22	0.12	0.51	<0.005	<0.05	330	0.003	33,000	-	2800	710	<0.5	-	-	270
	6/03/2013	-	-	580	-	470	<0.005	<5	-	-	5900	1.4	<0.5	-	0.16	0.26	1.1	<0.005	<0.05	420	0.003	-	36,000	3500	670	<0.5	-	-	180
	17/04/2013	-	-	680	-	560	0.94	770	-	-	28,000	1	-	-	1.5	0.031	0.14	<0.005	<0.05	1500	0.006	-	30,000	8000	1400	<0.5	-	-	470
	17/10/2013	479	<1	-	<1000	479	-	<5	111	121	3140	1.6	-	4.37	<0.05	0.611	-	0.002	-	530	<0.001	-	-	2180	-	<0.1	7280	1180	54
	9/04/2014	466	<1	-	<1000	466	-	<5	164	164	5000	1.7	-	0.14	0.35	0.464	-	0.029	-	840	0.009	35600	-	3050	647	<0.1	9050	1440	6
	29/10/2014	533	<1	-	<1000	533	-	<5	120	112	3480	1.4	-	3.6	0.22	0.175	-	<0.002	-	400	0.021	36700	-	2060	537	<0.1	6520	977	<5
MW4	23/10/2014	-	-	630	-	510	-	740	-	-	3900	-	<0.5	-	-	0.82	-	<0.005	-	2100	0.008	-	19,000	2700	350	-	6700	-	-
	24/10/2014	-	-	420	-	370	-	18	-	-	2500	0.7	-	1	0.31	-	-	-	-	540	0.009	-	16,000	1800	280	<0.5	-	-	670
	25/10/2014	-	-	480	-	390	<0.005	<5	-	-	3200	0.6	-	-	0.59	0.17	0.74	<0.005	<0.05	760	0.007	-	19,000	2700	410	<0.5	-	-	1900
	26/10/2014	-	-	510	-	420	<0.005	<5	-	-	3700	0.4	-	1	0.72	0.44	1.9	<0.005	<0.05	1200	0.007	19,000	-	2400	380	<0.5	-	-	2900
	27/10/2014	-	-	470	-	390	<0.005	<5	-	-	4700	0.4	-	-	0.49	0.24	1	<0.005	<0.05	730	0.01	-	23,000	2600	440	<0.5	-	-	210
	28/10/2014	109	<1	-	<1000	109	-	877	2090	2390	69,800	0.3	-	6.66	0.71	2.89	-	<0.002	-	3600	<0.001	15900	-	45,400	3540	<0.1	136,000	18,500	74
	9/04/2014	148	<1	-	<1000	148	-	14	1460	1620	49,000	0.4	-	5.39	3.8	4.07	-	<0.002	-	7870	<0.001	12500	-	31,800	2290	<0.1	88,300	10,600	43
	30/10/2014	317	<1	-	<1000	317	-	<5	779	724	25,700	0.4	-	3.65	0.99	2.17	-	<0.002	-	3160	0.009	-	-	14,200	-	<0.1	41,000	4410	14
MW5	30/04/2011	-	-	450	-	370	-	56	-	-	87,000	-	<0.5	-	-	1.1	-	<0.005	-	5100	0.007	-	10,000	48,000	5200	-	130,000	-	-
	21/09/2011	-	-	250	-	210	-	47	-	-	87,000	0.3	-	0	2.7	-	-	-	-	2700	0.01	-	9900	48,000	4100	<0.5	-	-	1100
	28/02/2012	-	-	180	-	150	<0.005	<5	-	-	80,000	0.4	-	-	2.2	1.2	5.5	<0.005	<0.05	3400	0.006	-	9800	57,000	4400	<0.5	-	-	1400
	11/10/2012	-	-	200	-	160	0.75	620	-	-	77,000	0.3	-	-4	0.72	1.1	4.7	<0.005	<0.05	1800	0.005	8000	-	39,000	3500	<0.5	-	-	2600
	6/03/2013	-	-	210	-	170	1.2	1000	-	-	64,000	0.4	<0.5	-	2.1	1.3	6	<0.005	<0.05	3400	0.007	-	13,000	36,000	3800	<0.5	-	-	660
	17/04/2013	-	-	210	-	170	<0.005	<5	-	-	58,000	0.4	-	-	1	1.6	6.9	<0.005	<0.05	2600	0.014	-	13,000	33,000	3300	<0.5	-	-	1600
	17/10/2013	207	<1	-	<1000	207	-	<5	1210	1340	40,500	0.6	-	5.06	0.17	3.29	-	<0.002	-	3460	0.005	-	-	25,700	-	<0.1	75,400	9860	63
	9/04/2014	275	<1	-	<1000	275	-	18	774	799	25,700	0.8	-	1.54	2.63	1.54	-	<0.002	-	4170	0.002	14900	-	15,600	2110	<0.1	47,100	5040	78
	30/10/2014	351	<1	-	<1000	351	-	<5	623	584	20,500	0.6	-	3.22	0.32	1.02	-	<0.002	-	1340	0.013	15100	-	11,600	1800	<0.1	33,200	3220	<5

Field Duplicates (WATER)
Filter: SDG in('A 06366')

SDG	A 06366	A 06366	
Field_ID	MW5	DUP01	RPD
Sampled_Date-Time	30/10/2014 15:00	30/10/2014 15:00	

Chem_Group	ChemName	Units	EQL			
	Silicon as SiO2 (Filtered)	mg/l	0.1	15.1	15.0	1
	Sulfate as SO4 - Turbidimetric (Filtered)	mg/l	1	1800.0	1830.0	2
	Unionized Hydrogen Sulfide	mg/l	0.1	<0.1	<0.1	NA
BTEX	Benzene	µg/L	1	<1.0	<1.0	NA
	Ethylbenzene	µg/L	2	<2.0	<2.0	NA
	Toluene	µg/L	2	<2.0	<2.0	NA
	Total BTEX	mg/l	0.001	<0.001	<0.001	NA
	Xylene (m & p)	µg/L	2	<2.0	<2.0	NA
	Xylene (o)	µg/L	2	<2.0	<2.0	NA
	Xylene Total	µg/L	2	<2.0	<2.0	NA
	C6-C10 less BTEX (F1)	mg/l	0.02	<0.02	<0.02	NA
Inorganics	Alkalinity (Bicarbonate as CaCO3)	mg/l	1	351.0	349.0	1
	Alkalinity (Carbonate as CaCO3)	mg/l	1	<1.0	<1.0	NA
	Alkalinity (Hydroxide) as CaCO3	µg/l	1000	<1000.0	<1000.0	NA
	Alkalinity (total) as CaCO3	mg/l	1	351.0	349.0	1
	Ammonia as N	µg/l	5	<5.0	<5.0	NA
	Anions Total	meq/L	0.01	623.0	629.0	1
	Cations Total	meq/L	0.01	584.0	574.0	2
	Chloride	mg/l	1	20500.0	20700.0	1
	Fluoride	mg/l	0.1	0.6	0.6	0
	Kjeldahl Nitrogen Total	mg/l	0.05	0.32	0.36	12
	Nitrate (as N)	mg/l	0.002	1.02	0.985	3
	Nitrite (as N)	mg/l	0.002	<0.002	<0.002	NA
	Nitrogen (Total Oxidised)	mg/l	0.002	1.02	0.985	3
	Nitrogen (Total)	µg/l	50	1340.0	1340.0	0
	Reactive Phosphorus as P	mg/l	0.001	0.013	0.012	8
	Sodium (Filtered)	mg/l	1	11600.0	11400.0	2
	Sulphide	mg/l	0.1	<0.1	<0.1	NA
	TDS	mg/l	10	33200.0	32600.0	2
	Hardness as CaCO3 (Filtered)	mg/l	1	3220.0	3170.0	2
	TSS	mg/l	5	<5.0	<5.0	NA
Lead	Lead (Filtered)	mg/l	0.0002	<0.0002	<0.0002	NA
Metals	Aluminium (Filtered)	mg/l	0.005	<0.005	<0.005	NA
	Aluminium	mg/l	0.01	<0.05	<0.05	NA
	Arsenic (Filtered)	mg/l	0.0005	0.0017	0.0018	6
	Cadmium (Filtered)	mg/l	0.0002	<0.0002	<0.0002	NA
	Calcium (Filtered)	mg/l	1	194.0	192.0	1
	Chromium (hexavalent) (Filtered)	mg/l	0.001	0.006	0.006	0
	Chromium (III+VI) (Filtered)	mg/l	0.0005	0.0065	0.0064	2
	Chromium (Trivalent) (Filtered)	mg/l	0.001	<0.001	<0.001	0
	Copper (Filtered)	mg/l	0.001	<0.001	<0.001	NA
	Iron (Filtered)	mg/l	0.005	0.01	0.011	10
	Iron	mg/l	0.05	<0.25	<0.25	NA
	Magnesium (Filtered)	mg/l	1	665.0	654.0	2
	Manganese (Filtered)	mg/l	0.0005	0.0016	0.0016	0
	Mercury	mg/l	0.0001	<0.0001	<0.0001	NA
	Nickel (Filtered)	mg/l	0.0005	0.0024	0.0021	13
	Phosphorus	mg/l	0.005	0.082	0.088	7
	Potassium (Filtered)	mg/l	1	590.0	582.0	1
	Selenium (Filtered)	mg/l	0.002	0.003	0.002	**40**
	Silicon (Filtered)	µg/l	50	7040.0	6990.0	1
	Zinc (Filtered)	mg/l	0.005	<0.005	<0.005	NA
PAH/Phenols	Naphthalene	µg/L	5	<5.0	<5.0	NA
TPH	C10-C16	mg/l	0.1	<0.1	<0.1	NA
	C16-C34	mg/l	0.1	<0.1	<0.1	NA
	C34-C40	mg/l	0.1	<0.1	<0.1	NA
	F2-NAPHTHALENE	mg/l	0.1	<0.1	<0.1	NA
	C6 - C9	µg/L	20	<20.0	<20.0	NA
	C10 - C14	µg/L	50	<50.0	<50.0	NA
	C15 - C28	µg/L	100	<100.0	<100.0	NA
	C29-C36	µg/L	50	<50.0	<50.0	NA
	+C10 - C36 (Sum of total)	µg/L	50	<50.0	<50.0	NA
	C10 - C40 (Sum of total)	µg/L	100	<100.0	<100.0	NA
	C6-C10	mg/l	0.02	<0.02	<0.02	NA

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 30 (1-10 x EQL); 30 (10-30 x EQL); 30 (> 30 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Annex C

LABORATORY ANALYTICAL REPORTS

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with recommended holding times (USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: WATER

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA015: Total Dissolved Solids							
Clear Plastic Bottle - Natural (EA015H) MW2, MW3	29-OCT-2014	---	05-NOV-2014	-----	03-NOV-2014	05-NOV-2014	✓
Clear Plastic Bottle - Natural (EA015H) MW1, MW4, MW5, DUP01	30-OCT-2014	---	06-NOV-2014	-----	03-NOV-2014	06-NOV-2014	✓
EA025: Suspended Solids							
Clear Plastic Bottle - Natural (EA025H) MW2, MW3	29-OCT-2014	---	05-NOV-2014	-----	03-NOV-2014	05-NOV-2014	✓
Clear Plastic Bottle - Natural (EA025H) MW1, MW4, MW5, DUP01	30-OCT-2014	---	06-NOV-2014	-----	03-NOV-2014	06-NOV-2014	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) MW2, MW3	29-OCT-2014	---	12-NOV-2014	-----	31-OCT-2014	12-NOV-2014	✓
Clear Plastic Bottle - Natural (ED037-P) MW1, MW4, MW5, DUP01, RIN01	30-OCT-2014	---	13-NOV-2014	-----	31-OCT-2014	13-NOV-2014	✓
ED040F: Dissolved Major Anions							
Clear Plastic Bottle - Natural (ED040F) MW2, MW3	29-OCT-2014	---	26-NOV-2014	-----	06-NOV-2014	26-NOV-2014	✓
Clear Plastic Bottle - Natural (ED040F) MW1, MW4, MW5, DUP01	30-OCT-2014	---	27-NOV-2014	-----	06-NOV-2014	27-NOV-2014	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) MW2, MW3	29-OCT-2014	---	26-NOV-2014	-----	05-NOV-2014	26-NOV-2014	✓
Clear Plastic Bottle - Natural (ED041G) MW1, MW4, MW5, DUP01, RIN01	30-OCT-2014	---	27-NOV-2014	-----	05-NOV-2014	27-NOV-2014	✓

Matrix: WATER

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG093A-F) MW4, MW5, DUP01	30-OCT-2014	---	28-APR-2015	----	06-NOV-2014	28-APR-2015	✓
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG093B-F) MW4, MW5, DUP01	30-OCT-2014	---	28-APR-2015	----	06-NOV-2014	28-APR-2015	✓
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG094A-F) MW2, MW3	29-OCT-2014	---	27-APR-2015	----	07-NOV-2014	27-APR-2015	✓
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG094A-F) MW1, RIN01	30-OCT-2014	---	28-APR-2015	----	07-NOV-2014	28-APR-2015	✓
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS							
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG094B-F) MW2, MW3	29-OCT-2014	---	27-APR-2015	----	07-NOV-2014	27-APR-2015	✓
Clear HDPE (U-T ORC) - Filtered; Lab-acidified (EG094B-F) MW1, RIN01	30-OCT-2014	---	28-APR-2015	----	07-NOV-2014	28-APR-2015	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P) MW2, MW3	29-OCT-2014	---	26-NOV-2014	----	31-OCT-2014	26-NOV-2014	✓
Clear Plastic Bottle - Natural (EK040P) MW1, MW4, MW5, DUP01, RIN01	30-OCT-2014	---	27-NOV-2014	----	31-OCT-2014	27-NOV-2014	✓
EK085M: Sulfide as S2-							
Clear Plastic Bottle - Zinc Acetate/NaOH (EK085) MW2, MW3	29-OCT-2014	----	----	----	05-NOV-2014	05-NOV-2014	✓
Clear Plastic Bottle - Zinc Acetate/NaOH (EK085) MW1, MW4, MW5, DUP01	30-OCT-2014	----	----	----	05-NOV-2014	06-NOV-2014	✓
Ultra-Trace Nutrients							
Clear Plastic - Filtered (AS) - for UT Nut. (EK255A-SW) MW2, MW3	29-OCT-2014	---	30-OCT-2014	----	05-NOV-2014	30-OCT-2014	×
Clear Plastic - Filtered (AS) - for UT Nut. (EK255A-SW) MW1, MW4, MW5, DUP01	30-OCT-2014	---	31-OCT-2014	----	05-NOV-2014	31-OCT-2014	×
Ultra-Trace Nutrients							
Clear Plastic - Filtered (AS) - for UT Nut. (EK257A-SW) MW2, MW3	29-OCT-2014	---	30-OCT-2014	----	05-NOV-2014	30-OCT-2014	×
Clear Plastic - Filtered (AS) - for UT Nut. (EK257A-SW) MW1, MW4, MW5, DUP01	30-OCT-2014	---	31-OCT-2014	----	05-NOV-2014	31-OCT-2014	×

Matrix: WATER

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber VOC Vial - Sulfuric Acid (EP080) MW2, MW3	29-OCT-2014	06-NOV-2014	12-NOV-2014	✓	07-NOV-2014	12-NOV-2014	✓
Amber VOC Vial - Sulfuric Acid (EP080) MW1, MW4, MW5, DUP01, TBW074	30-OCT-2014	06-NOV-2014	13-NOV-2014	✓	07-NOV-2014	13-NOV-2014	✓

Matrix: WATER

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Control Samples (LCS) - Continued							
Nitrite and Nitrate as N - Ultra-Trace in Saline Waters	EK259A-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N - Ultra-Trace in Saline Waters	EK257A-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P - Ultra-Trace in Saline Water	EK271A-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	17	11.8	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Sulfide as S2-	EK085	1	19	5.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	2	19	10.5	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	18	11.1	10.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	1	12	8.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	5.0	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Nitrogen/Persulfate Digestion/Ultra-Trace/Saline	EK262PA-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus/Persulfate Digestion/ Ultra Trace /Saline	EK267PA-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	17	5.9	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	19	5.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Alkalinity by PC Titrator	ED037-P	1	9	11.1	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Ammonia as N - Ultra-Trace in Saline Waters	EK255A-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	1	17	5.9	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Hexavalent Chromium by DA - Low Level	EG050G LL-F	1	8	12.5	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals in Fresh Water -Suite A by ORC-ICPMS	EG094A-F	1	5	20.0	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals in Fresh Water -Suite B by ORC-ICPMS	EG094B-F	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals in Saline Water -Suite A by ORC-ICPMS	EG093A-F	1	18	5.6	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Dissolved Metals in Saline Water -Suite B by ORC-ICPMS	EG093B-F	1	20	5.0	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Fluoride by PC Titrator	EK040P	1	12	8.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Major Anions - Dissolved	ED040F	1	16	6.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	17	5.9	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N - Ultra-Trace in Saline Waters	EK259A-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Nitrite as N - Ultra-Trace in Saline Waters	EK257A-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P - Ultra-Trace in Saline Water	EK271A-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	17	5.9	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Sulfide as S2-	EK085	1	19	5.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Suspended Solids (High Level)	EA025H	1	19	5.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	18	5.6	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Mercury by FIMS	EG035T	1	12	8.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	5.0	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Nitrogen/Persulfate Digestion/Ultra-Trace/Saline	EK262PA-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Total Phosphorus/Persulfate Digestion/ Ultra Trace /Saline	EK267PA-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH - Semivolatile Fraction	EP071	1	17	5.9	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
TRH Volatiles/BTEX	EP080	1	19	5.3	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Ammonia as N - Ultra-Trace in Saline Waters	EK255A-SW	1	6	16.7	5.0	✓	NEPM 2013 Schedule B(3) and ALS QCS3 requirement

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Total Dissolved Solids (High Level)	EA015H	WATER	In-House, APHA 21st ed., 2540C A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In-House, APHA 21st ed., 2540D A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Major Anions - Dissolved	ED040F	WATER	APHA 21st ed., 3120. The 0.45um filtered samples are determined by ICP/AES for Sulfur and/or Silcon content and reported as Sulfate and/or Silica after conversion by gravimetric factor.
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Mercury by FIMS	EG035T	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Nitrite and Nitrate as N - Ultra-Trace in Saline Waters	EK259A-SW	WATER	APHA 21st ed., 4500-NO3- I. Combined oxidised Nitrogen (NO2+NO3) is determined by Cadmium Reduction and direct colourimetry by FIA.
TKN (Total N - NOx-N). (FIA - UT) in Saline Waters	EK261PA-SW	WATER	APHA 21st ed., 4500-P J. & 4500-NO3- I. Calculated by difference from total Nitrogen and NOx. Contributing method parameters are determined by FIA. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen/Persulfate Digestion/Ultra-Trace/Saline	EK262PA-SW	WATER	APHA 21st ed., 4500-P J. Persulfate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus. As sample is digested with persulfate under alkaline conditions yielding orthophosphate and nitrate. Following digestion, analytes are determined by flow injection analysis. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus/Persulfate Digestion/ Ultra Trace /Saline	EK267PA-SW	WATER	APHA 21st ed., 4500-P J. Persulfate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus. As sample is digested with persulfate under alkaline conditions yielding orthophosphate and nitrate. Following digestion, analytes are determined by flow injection analysis. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P - Ultra-Trace in Saline Water	EK271A-SW	WATER	APHA 21st ed., 4500-P E Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by FIA. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	APHA 21st Ed. 1030F. This method is compliant with NEPM (2013) Schedule B(3)
TRH - Semivolatile Fraction	EP071	WATER	USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	USEPA SW846-3005 Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: EP1409015	Page	: 1 of 11
Client	: ENVIRO RESOURCES MANAGEMENT	Laboratory	: Environmental Division Perth
Contact	: MS MONICA PANDELE	Contact	: Scott James
Address	: LEVEL 4 5 MILL STREET ST GEORGE TCE WA, AUSTRALIA 6000	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: monica.pandele@erm.com	E-mail	: perth.enviro.services@alsglobal.com
Telephone	: +61 08 9321 5200	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 9321 5262	Facsimile	: +61-8-9209 7600
Project	: 0220651 YARRA PILBARA NITRATES GHE	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: A 06366	Date Samples Received	: 30-OCT-2014
Sampler	: M.P./L.M.	Issue Date	: 17-NOV-2014
Site	: Bunnup Peninsula		
		No. of samples received	: 8
Quote number	: EP/989/14	No. of samples analysed	: 8

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MW1	MW2	MW3	MW4	MW5
				Client sampling date / time	30-OCT-2014 15:00	29-OCT-2014 15:00	29-OCT-2014 15:00	30-OCT-2014 15:00	30-OCT-2014 15:00
Compound	CAS Number	LOR	Unit		EP1409015-001	EP1409015-002	EP1409015-003	EP1409015-004	EP1409015-005
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		981	1650	6520	41000	33200
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		<5	<5	<5	14	<5
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		352	508	977	4410	3220
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		361	276	533	317	351
Total Alkalinity as CaCO3	----	1	mg/L		361	276	533	317	351
ED040F: Dissolved Major Anions									
Silicon as SiO2	14464-46-1	0.1	mg/L		36.6	23.2	36.7	12.5	15.1
Silicon	7440-21-3	0.05	mg/L		17.1	10.8	17.1	5.82	7.04
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		75	138	537	2290	1800
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		366	771	3480	25700	20500
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		88	98	68	248	194
Magnesium	7439-95-4	1	mg/L		32	64	196	921	665
Sodium	7440-23-5	1	mg/L		226	376	2060	14200	11600
Potassium	7440-09-7	1	mg/L		11	18	100	724	590
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		0.03	0.01	0.03	0.66	<0.05
Iron	7439-89-6	0.05	mg/L		0.33	<0.05	<0.05	1.02	<0.25
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG049G LL-F: Dissolved Trivalent Chromium - Low Level									
Trivalent Chromium	16065-83-1	0.001	mg/L		<0.001	<0.001	<0.001	----	<0.001
Trivalent Chromium	16065-83-1	0.001	mg/L		----	----	----	<0.001	----
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level									
Hexavalent Chromium	18540-29-9	0.001	mg/L		<0.001	<0.001	<0.001	0.002	0.006
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Compound	CAS Number	LOR	Unit	Client sample ID	MW1	MW2	MW3	MW4	MW5
				Client sampling date / time	30-OCT-2014 15:00	29-OCT-2014 15:00	29-OCT-2014 15:00	30-OCT-2014 15:00	30-OCT-2014 15:00
					EP1409015-001	EP1409015-002	EP1409015-003	EP1409015-004	EP1409015-005
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	---	20	µg/L		<20	<20	<20	<20	<20
C10 - C14 Fraction	---	50	µg/L		<50	<50	<50	<50	<50
C15 - C28 Fraction	---	100	µg/L		<100	<100	<100	<100	<100
C29 - C36 Fraction	---	50	µg/L		<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	---	50	µg/L		<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	<20	<20	<20	<20
>C10 - C16 Fraction	>C10_C16	100	µg/L		<100	<100	<100	<100	<100
>C16 - C34 Fraction	---	100	µg/L		<100	<100	<100	<100	<100
>C34 - C40 Fraction	---	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	---	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	---	100	µg/L		<100	<100	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	<2	<2	<2
^ Sum of BTEX	---	1	µg/L		<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
Ultra-Trace Nutrients									
Ammonia as N	7664-41-7	0.005	mg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Nitrite as N	---	0.002	mg/L		<0.002	<0.002	<0.002	<0.002	<0.002
Nitrate as N	14797-55-8	0.002	mg/L		0.162	2.49	0.175	2.17	1.02
Nitrite + Nitrate as N	---	0.002	mg/L		0.162	2.49	0.175	2.17	1.02
Total Kjeldahl Nitrogen as N	---	0.05	mg/L		2.46	0.23	0.22	0.99	0.32
Total Nitrogen as N	---	0.05	mg/L		2.62	2.72	0.40	3.16	1.34
Reactive Phosphorus as P	14265-44-2	0.001	mg/L		0.018	0.010	0.021	0.009	0.013
Total Phosphorus as P	---	0.005	mg/L		0.034	0.039	0.038	0.078	0.082
EP080S: TPH(V)/BTEX Surrogates									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	DUP01	RIN01	TBW074	----	----
				Client sampling date / time	30-OCT-2014 15:00	30-OCT-2014 15:00	30-OCT-2014 15:00	----	----
Compound	CAS Number	LOR	Unit		EP1409015-006	EP1409015-007	EP1409015-008	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		32600	----	----	----	----
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		<5	----	----	----	----
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		3170	<1	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		349	<1	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		349	<1	----	----	----
ED040F: Dissolved Major Anions									
Silicon as SiO2	14464-46-1	0.1	mg/L		15.0	----	----	----	----
Silicon	7440-21-3	0.05	mg/L		6.99	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		1830	<1	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		20700	<1	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		192	<1	----	----	----
Magnesium	7439-95-4	1	mg/L		654	<1	----	----	----
Sodium	7440-23-5	1	mg/L		11400	<1	----	----	----
Potassium	7440-09-7	1	mg/L		582	<1	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L		<0.25	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG049G LL-F: Dissolved Trivalent Chromium - Low Level									
Trivalent Chromium	16065-83-1	0.001	mg/L		<0.001	----	----	----	----
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level									
Hexavalent Chromium	18540-29-9	0.001	mg/L		0.006	----	----	----	----
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	DUP01	RIN01	TBW074	----	----
				Client sampling date / time	30-OCT-2014 15:00	30-OCT-2014 15:00	30-OCT-2014 15:00	----	----
Compound	CAS Number	LOR	Unit		EP1409015-006	EP1409015-007	EP1409015-008	----	----
EP080/071: Total Petroleum Hydrocarbons - Continued									
C6 - C9 Fraction	----	20	µg/L		<20	----	<20	----	----
C10 - C14 Fraction	----	50	µg/L		<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	<20	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	----	<20	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	<1	----	----
Toluene	108-88-3	2	µg/L		<2	----	<2	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	<2	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	<2	----	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	----	<2	----	----
^ Sum of BTEX	----	1	µg/L		<1	----	<1	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	<5	----	----
Ultra-Trace Nutrients									
Ammonia as N	7664-41-7	0.005	mg/L		<0.005	----	----	----	----
Nitrite as N	----	0.002	mg/L		<0.002	----	----	----	----
Nitrate as N	14797-55-8	0.002	mg/L		0.985	----	----	----	----
Nitrite + Nitrate as N	----	0.002	mg/L		0.985	----	----	----	----
Total Kjeldahl Nitrogen as N	----	0.05	mg/L		0.36	----	----	----	----
Total Nitrogen as N	----	0.05	mg/L		1.34	----	----	----	----
Reactive Phosphorus as P	14265-44-2	0.001	mg/L		0.012	----	----	----	----
Total Phosphorus as P	----	0.005	mg/L		0.088	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									

Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	60.5	141.2
Toluene-D8	2037-26-5	73.4	126
4-Bromofluorobenzene	460-00-4	59.6	125.3