

CERTIFICATE OF ANALYSIS

Work Order : ES1626714 Client : ORIGIN ENERGY RESOURCES LTD Contact : [REDACTED] Address : PO BOX 443 CHINCHILLA QLD, AUSTRALIA 4413 Telephone : [REDACTED] Project : BEETALOO GROUNDWATER MONITORING Order number : 16231417 C-O-C number : Bet_Fe_COC_DW_23112016 Sampler : ---- Site : BEETALOO Quote number : ---- No. of samples received : 3 No. of samples analysed : 3	Page : 1 of 8 Laboratory : Environmental Division Sydney Contact : [REDACTED] Address : 277-289 Woodpark Road Smithfield NSW Australia 2164 Telephone : [REDACTED] Date Samples Received : 24-Nov-2016 09:30 Date Analysis Commenced : 24-Nov-2016 Issue Date : 07-Dec-2016 10:49
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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
[REDACTED]	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
[REDACTED]	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
[REDACTED]	Organic Coordinator	Sydney Organics, Smithfield, NSW
[REDACTED]	Metals Teamleader	Radionuclides, Fyshwick, ACT



General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED041G: LOR raised for (Sulfate analysis) on various samples due to sample matrix.
- Gross Alpha and Beta Activity analyses are performed by ALS Fyshwick (NATA Accreditation number 992).
- EG020/ED093: Some samples were diluted and rerun due to matrix interference and LOR's have been raised accordingly. (High Total Dissolved Solids)
- EK067G: LOR raised for Total P on sample No 1 & 2 due to sample matrix.
- EP041A, Invalidated duplicate and spike for NIS due to insufficient volume.
- TDS by method EA-015 may bias high due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- EP050: The MBAS reported is calculated as LAS, mol wt ___342___.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- EA250 LSC : LOR for Gross Alpha and Beta raised due to high solid content
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a,h)anthracene (1.0), Benzo(g,h,i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)		Client sample ID		BET_PW001_Fe_15.3	BET_PW001_Fe_15.8	BET_PW001_Fe_16.0	----	----
				%	%	%		
Client sampling date / time				11-Nov-2016 12:00	17-Nov-2016 12:00	20-Nov-2016 12:00	----	----
Compound	CAS Number	LOR	Unit	ES1626714-001	ES1626714-002	ES1626714-003	-----	-----
				Result	Result	Result	---	---
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	6.50	6.40	6.44	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	54400	54800	54900	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	44200	46600	49200	----	----
EA016: Calculated TDS (from Electrical Conductivity)								
Total Dissolved Solids (Calc.)	----	1	mg/L	35400	35600	35700	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	4410	4660	4650	----	----
EA250: Gross Alpha and Beta Activity								
Gross alpha	----	0.05	Bq/L	11.0	10.2	9.30	----	----
Gross beta activity - 40K	----	0.1	Bq/L	5.32	5.08	4.80	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	364	364	390	----	----
Total Alkalinity as CaCO3	----	1	mg/L	364	364	390	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	<10	<10	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	22400	24000	24000	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	1320	1400	1410	----	----
Magnesium	7439-95-4	1	mg/L	271	282	275	----	----
Sodium	7440-23-5	1	mg/L	11700	11900	12000	----	----
Potassium	7440-09-7	1	mg/L	70	70	69	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	<0.010	----	----
Boron	7440-42-8	0.05	mg/L	34.6	33.1	34.8	----	----
Barium	7440-39-3	0.001	mg/L	60.7	65.7	66.5	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.010	<0.010	<0.010	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	<0.0010	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.010	<0.010	----	----



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET_PW001_Fe_15.3	BET_PW001_Fe_15.8	BET_PW001_Fe_16.0	----	----
					%	%	%		
Client sampling date / time				11-Nov-2016 12:00	17-Nov-2016 12:00	20-Nov-2016 12:00	----	----	
Compound	CAS Number	LOR	Unit	ES1626714-001	ES1626714-002	ES1626714-003	-----	-----	
				Result	Result	Result	---	---	
EG020F: Dissolved Metals by ICP-MS - Continued									
Chromium	7440-47-3	0.001	mg/L	<0.010	0.015	0.013	----	----	
Copper	7440-50-8	0.001	mg/L	<0.010	<0.010	<0.010	----	----	
Manganese	7439-96-5	0.001	mg/L	2.26	2.42	2.53	----	----	
Nickel	7440-02-0	0.001	mg/L	0.018	<0.010	0.028	----	----	
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	<0.010	----	----	
Selenium	7782-49-2	0.01	mg/L	<0.10	<0.10	<0.10	----	----	
Vanadium	7440-62-2	0.01	mg/L	<0.10	<0.10	<0.10	----	----	
Zinc	7440-66-6	0.005	mg/L	<0.050	<0.050	<0.050	----	----	
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	1.1	1.1	1.1	----	----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.04	<0.01	----	----	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	55.1	50.1	54.8	----	----	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L	55.1	50.1	54.8	----	----	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	0.30	----	----	
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L	639	684	685	----	----	
Total Cations	----	0.01	meq/L	599	612	617	----	----	
Ionic Balance	----	0.01	%	3.25	5.54	5.23	----	----	
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	1	µg/L	4760	5220	6480	----	----	
Ethene	74-85-1	1	µg/L	<1	<1	<1	----	----	
Ethane	74-84-0	1	µg/L	510	479	518	----	----	
Propene	115-07-1	1	µg/L	<1	<1	<1	----	----	
Propane	74-98-6	1	µg/L	15	18	20	----	----	
Butene	25167-67-3	1	µg/L	<1	<1	<1	----	----	
Butane	106-97-8	1	µg/L	<1	<1	<1	----	----	
EP041A: Nonionic Surfactants									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET_PW001_Fe_15.3 %	BET_PW001_Fe_15.8 %	BET_PW001_Fe_16.0 %	----	----
Client sampling date / time				11-Nov-2016 12:00	17-Nov-2016 12:00	20-Nov-2016 12:00	----	----	
Compound	CAS Number	LOR	Unit	ES1626714-001 Result	ES1626714-002 Result	ES1626714-003 Result	-----	-----	
EP041A: Nonionic Surfactants - Continued									
Nonionic Surfactants as CTAS	----	5	mg/L	<5	<5	<5	----	----	
EP050: Anionic Surfactants as MBAS									
Anionic Surfactants as MBAS	----	0.1	mg/L	0.2	0.1	0.2	----	----	
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1	µg/L	2.8	2.1	3.5	----	----	
2-Chlorophenol	95-57-8	1	µg/L	<1.0	<1.0	<1.0	----	----	
2-Methylphenol	95-48-7	1	µg/L	<1.0	<1.0	<1.0	----	----	
3- & 4-Methylphenol	1319-77-3	2	µg/L	5.2	5.6	10.3	----	----	
2-Nitrophenol	88-75-5	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,4-Dimethylphenol	105-67-9	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,4-Dichlorophenol	120-83-2	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,6-Dichlorophenol	87-65-0	1	µg/L	<1.0	<1.0	<1.0	----	----	
4-Chloro-3-methylphenol	59-50-7	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,4,6-Trichlorophenol	88-06-2	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,4,5-Trichlorophenol	95-95-4	1	µg/L	<1.0	<1.0	<1.0	----	----	
Pentachlorophenol	87-86-5	2	µg/L	<2.0	<2.0	<2.0	----	----	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1	µg/L	<1.0	<1.0	<1.0	----	----	
Acenaphthylene	208-96-8	1	µg/L	<1.0	<1.0	<1.0	----	----	
Acenaphthene	83-32-9	1	µg/L	<1.0	<1.0	<1.0	----	----	
Fluorene	86-73-7	1	µg/L	<1.0	<1.0	<1.0	----	----	
Phenanthrene	85-01-8	1	µg/L	<1.0	<1.0	<1.0	----	----	
Anthracene	120-12-7	1	µg/L	<1.0	<1.0	<1.0	----	----	
Fluoranthene	206-44-0	1	µg/L	<1.0	<1.0	<1.0	----	----	
Pyrene	129-00-0	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(a)anthracene	56-55-3	1	µg/L	<1.0	<1.0	<1.0	----	----	
Chrysene	218-01-9	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----	
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	<1.0	<1.0	----	----	
Dibenz(a.h)anthracene	53-70-3	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	<1.0	<1.0	----	----	
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET_PW001_Fe_15.3 %	BET_PW001_Fe_15.8 %	BET_PW001_Fe_16.0 %	----	----
Client sampling date / time					11-Nov-2016 12:00	17-Nov-2016 12:00	20-Nov-2016 12:00	----	----
Compound	CAS Number	LOR	Unit	ES1626714-001	ES1626714-002	ES1626714-003	-----	-----	
				Result	Result	Result	---	---	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----	
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L	50	100	110	----	----	
C10 - C14 Fraction	----	50	µg/L	<50	60	80	----	----	
C15 - C28 Fraction	----	100	µg/L	1080	410	200	----	----	
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----	
^ C10 - C36 Fraction (sum)	----	50	µg/L	1080	470	280	----	----	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L	40	90	90	----	----	
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	40	80	80	----	----	
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	----	----	
>C16 - C34 Fraction	----	100	µg/L	1020	410	220	----	----	
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----	
^ >C10 - C40 Fraction (sum)	----	100	µg/L	1020	410	220	----	----	
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	----	----	
EP080: BTEXN									
Benzene	71-43-2	1	µg/L	3	3	3	----	----	
Toluene	108-88-3	2	µg/L	2	2	2	----	----	
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----	
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----	
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----	
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	----	----	
^ Sum of BTEX	----	1	µg/L	5	5	5	----	----	
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----	
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%	24.0	24.4	24.5	----	----	
2-Chlorophenol-D4	93951-73-6	1	%	58.9	38.8	65.0	----	----	
2,4,6-Tribromophenol	118-79-6	1	%	83.8	76.3	94.9	----	----	
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%	85.5	68.2	91.8	----	----	
Anthracene-d10	1719-06-8	1	%	86.6	77.0	89.9	----	----	
4-Terphenyl-d14	1718-51-0	1	%	72.6	68.1	78.4	----	----	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET_PW001_Fe_15.3 %	BET_PW001_Fe_15.8 %	BET_PW001_Fe_16.0 %	----	----
Client sampling date / time					11-Nov-2016 12:00	17-Nov-2016 12:00	20-Nov-2016 12:00	----	----
Compound	CAS Number	LOR	Unit	ES1626714-001	ES1626714-002	ES1626714-003	-----	-----	
				Result	Result	Result	---	---	
EP080S: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	2	%	118	102	109	----	----	
Toluene-D8	2037-26-5	2	%	114	111	114	----	----	
4-Bromofluorobenzene	460-00-4	2	%	108	110	113	----	----	



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2,4,6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128