

CLIENT DETAILS

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Project **Process Water Borefield**
 Order Number **BOBLD281016**
 Samples **5**

LABORATORY DETAILS

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SGS Reference **PE111594 R0**
 Date Received **28 Oct 2016**
 Date Reported **04 Nov 2016**

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

SIGNATORIES

Donald Smith
Chemist

Louise Hope
Laboratory Technician

Mary Ann Ola-A
Inorganics Team Leader

Michael McKay
Inorganics and ARD Supervisor

Ohmar David
Metals Chemist

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Sample Number			PE111594.001	PE111594.002	PE111594.003	PE111594.004
Sample Matrix			Water	Water	Water	Water
Sample Date			14 Oct 2016	20 Oct 2016	18 Oct 2016	16 Oct 2016
Sample Name			Bore P31	Bore LDRC1601	Bore LDRC1602	Bore P50

pH in water Method: AN101 Tested: 28/10/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
pH**	pH Units	-	7.8	8.0	8.0	7.9

Conductivity and TDS by Calculation - Water Method: AN106 Tested: 28/10/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Conductivity @ 25 C	µS/cm	2	2200	4400	4200	1600

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 31/10/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Total Dissolved Solids Dried at 175-185°C	mg/L	10	1300	2500	2400	960

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 2/11/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Total Suspended Solids Dried at 103-105°C	mg/L	5	<5	<5	<5	<5

Alkalinity Method: AN135 Tested: 28/10/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Total Alkalinity as CaCO3	mg/L	5	150	230	210	160
Carbonate Alkalinity as CO3	mg/L	1	<1	<1	<1	<1
Bicarbonate Alkalinity as HCO3	mg/L	5	190	290	250	200

Chloride by Discrete Analyser in Water Method: AN274 Tested: 1/11/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Chloride, Cl	mg/L	1	470	1100	1100	310

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Sample Number			PE111594.001	PE111594.002	PE111594.003	PE111594.004
Sample Matrix			Water	Water	Water	Water
Sample Date			14 Oct 2016	20 Oct 2016	18 Oct 2016	16 Oct 2016
Sample Name			Bore P31	Bore LDRC1601	Bore LDRC1602	Bore P50

Sulphate in water Method: AN275 Tested: 1/11/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Sulphate, SO4	mg/L	1	170	280	230	120

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 1/11/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Calcium, Ca	mg/L	0.2	88	94	72	64
Magnesium, Mg	mg/L	0.1	35	45	37	29
Potassium, K	mg/L	0.1	20	38	33	19
Sodium, Na	mg/L	0.5	330	780	790	230

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 31/10/2016

Parameter	Units	LOR	PE111594.001	PE111594.002	PE111594.003	PE111594.004
Thorium, Th	µg/L	1	<1	<1	<1	<1
Uranium, U	µg/L	1	3	12	7	3

Sample Number PE111594.005
 Sample Matrix Water
 Sample Date 20 Sep 2016
 Sample Name Bore P54

Parameter	Units	LOR
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pH in water Method: AN101 Tested: 28/10/2016

pH**	pH Units	-	8.0
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 28/10/2016

Conductivity @ 25 C	µS/cm	2	3100
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Total Dissolved Solids (TDS) in water Method: AN113 Tested: 31/10/2016

Total Dissolved Solids Dried at 175-185°C	mg/L	10	1700
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Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 2/11/2016

Total Suspended Solids Dried at 103-105°C	mg/L	5	<5
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Alkalinity Method: AN135 Tested: 28/10/2016

Total Alkalinity as CaCO3	mg/L	5	150
Carbonate Alkalinity as CO3	mg/L	1	<1
Bicarbonate Alkalinity as HCO3	mg/L	5	180

Chloride by Discrete Analyser in Water Method: AN274 Tested: 1/11/2016

Chloride, Cl	mg/L	1	730
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Sample Number PE111594.005
 Sample Matrix Water
 Sample Date 20 Sep 2016
 Sample Name Bore P54

Parameter Units LOR

Sulphate in water Method: AN275 Tested: 1/11/2016

Sulphate, SO4	mg/L	1	160
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Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 1/11/2016

Calcium, Ca	mg/L	0.2	97
Magnesium, Mg	mg/L	0.1	44
Potassium, K	mg/L	0.1	24
Sodium, Na	mg/L	0.5	490

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 31/10/2016

Thorium, Th	µg/L	1	<1
Uranium, U	µg/L	1	6

MB blank results are compared to the Limit of Reporting
 LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
 DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB124254	mg/L	5	<5	0 - 2%	100 - 101%
Carbonate Alkalinity as CO3	LB124254	mg/L	1	<1		
Bicarbonate Alkalinity as HCO3	LB124254	mg/L	5	<5		

Chloride by Discrete Analyser in Water Method: ME-(AU)-[ENV]AN274

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Chloride, Cl	LB124271	mg/L	1	<1	1 - 2%	101 - 102%	98 - 99%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB124252	µS/cm	2	<2	0%	99%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320/AN321

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Calcium, Ca	LB124283	mg/L	0.2	<0.2	1%	104%	102%
Magnesium, Mg	LB124283	mg/L	0.1	<0.1	0%	103%	103%
Potassium, K	LB124283	mg/L	0.1	<0.1	1%	102%	102%
Sodium, Na	LB124283	mg/L	0.5	<0.5	0%	113%	105%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB124252	pH Units	-	5.4	3%	101%

MB blank results are compared to the Limit of Reporting
 LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
 DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Sulphate in water Method: ME-(AU)-[ENV]AN275

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Sulphate, SO4	LB124271	mg/L	1	<1	0 - 2%	107 - 108%	102 - 104%

Total and Volatile Suspended Solids (TSS / VSS) Method: ME-(AU)-[ENV]AN114

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Suspended Solids Dried at 103-105°C	LB124356	mg/L	5	<5	0 - 76%	98 - 102%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery	MSD %RPD
Total Dissolved Solids Dried at 175-185°C	LB124244	mg/L	10	<10	1 - 2%	93%	97%	2%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery	MS %Recovery
Thorium, Th	LB124225	µg/L	1	<1	95%	97%
Uranium, U	LB124225	µg/L	1	<1	103%	106%

METHOD

METHODOLOGY SUMMARY

AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as $\mu\text{mhos/cm}$ or $\mu\text{S/cm}$ @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN114	Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114
AN121	This method is used to calculate the balance of major Anions and Cations in water samples and converts major ion concentration to milliequivalents and then summed. Anions sum and Cation sum is calculated as a difference and expressed as a percentage.
AN121	The sum of cations and anions in mg/L may also be reported. This sums Na, K, Ca, Mg, NH ₃ , Fe, Cl, Total Alkalinity, SO ₄ and NO ₃ .
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN274	Chloride by Aquakem DA: Chloride reacts with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference APHA 4500Cl-
AN275	sulfate by Aquakem DA: sulfate is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulfate concentration in the sample. Reference APHA 4500-SO ₄ -. Internal reference AN275.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320/AN321	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320/AN321	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
Calculation	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO ₂ D.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- a. 1 Bq is equivalent to 27 pCi
- b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : <http://www.sgs.com.au/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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