KUR-World

Appendix 6

Water Quality

Environmental Impact Statement

Document Control Summary

NRA Environmental Consultants

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Report Summary	
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Abstract	This technical report presents the results of the baseline surface water, groundwater, stream sediment and, aquatic ecology (aquatic macroinvertebrate and fish) surveys to support the KUR-World Integrated Eco-Resort Environmental Impact Statement. The project waters support diverse aquatic species and mitigation measures are recommended to avoid or minimise impacts to the aquatic ecosystems.

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Quality Assurance

Author	**Technical Review**	**Editor**	**Document Version**	**Approved for Issue by QA Manager**	
				Date	**Signature**
Karen Lindee BSust (Sci)	Martine Newman BAppSc(Hons)	-	R01	15/6/17	-
Karen Lindee BSust (Sci) Martine Newman BAppSc(Hons)	Tim Anderson MAgrSc, BAgrSc (Hons)	Kate Steyn BAgrSc	R02	20/10/17	
		Kirsty Anderson BA (Hons)	R03	20/11/17	

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1. Introduction

1.1 Context

The KUR-World Project is an ‘Integrated Eco-Resort’ proposed on an approximately 680 ha[1] site near Myola in north-east Queensland (**Figure 1**) (hereafter referred to as the project area). The proposed development was deemed a ‘Controlled Action’ under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) in June 2016, and a ‘Coordinated Project’ under the Queensland *State Development and Public Works Organisation Act* 1971 in July 2016. The ‘Coordinated Project’ declaration requires that an Environmental Impact Statement (EIS) be prepared. The final Terms of Reference (TOR) for the EIS were issued in October 2016.

The following report addresses specific TOR items relating to water.

1.1.1 Project description

KUR-World Integrated Eco-Resort will include a combination of short-term and permanent residential options, as well as education, recreation, wellbeing/rejuvenation and rural tourism facilities. The Master Plan (Version G, 29 September 2017) features four sequential development stages over 7.5 years, commencing in 2018 (**Figure 2**). These stages are as follows.

Stage 1A (2018):

- Farm Theme Park and Equestrian Centre (Phase 1)
- Residential Precinct: Queenslander Lots (21 lots)
- Organic Produce Garden
- Services and Infrastructure (Phase 1)
- Environmental Area (Phase 1).

Stage 1B (2019-2020):

- Farm Theme Park and Equestrian Centre (Phase 2)
- Residential Precinct: Lifestyle Villas (56 lots)
- Open Space
- KUR-Village (Phase 1)
- Four Star Business and Leisure Hotel and Function Centre (Phase 1, 60 rooms)
- Residential Precinct: Premium Villas (39 lots)
- Rainforest Education Centre and Adventure Park
- Services and Infrastructure (including a sewerage treatment plant, access road from Mount Haren Road to Rainforest Education Centre) (Phase 2)
- Environmental Area (Phase 2).

Stage 2 is planned to start immediately after the completion of Stage 1 and will continue for two years from 2021 to 2022. Stage 2 will include:

- KUR-Village (Phase 2)
- Four Star Business and Leisure Hotel and Function Centre (Phase 2, 210 rooms)

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[1] This is the total property area, including proposed access road area.

- Sporting Precinct
- Golf Club House and Function Centre
- Golf Course
- Residential Precinct: Premium Villas (154 lots and 60 units)
- Services and Infrastructure (Phase 3)
- Environmental Area (Phase 3).

Stage 3 is planned to start immediately after the completion of Stage 2 and will continue for one year from 2023 to 2024. Stage 3 will include:

- Health and Wellbeing Retreat (60 rooms)
- Residential Precinct: Premium Villas (93 lots)
- Five-Star Eco-Resort (200 rooms)
- KUR-World Campus
- Services and Infrastructure (Phase 4)
- Environmental Area (Phase 4).

1.1.2 Site description

The project area is located near Myola in the Mareeba Shire, approximately 2.5 km west of the Kuranda business precinct and 20 km north-west of the Cairns business precinct. The project area is comprised of 12 lots (**Table 1**; **Figure 3**) and gazetted road easements (undeveloped). All lots are zoned as ‘rural’ (MSC 2017).

Table 1: Lots comprising the project area

Lot*	Area (ha)
Lot 22 N157227	37.26
Lot 1 RP703984	16.19
Lot 2 RP703984	48.31
Lot 17 N157227	57.71
Lot 18 N157227	63.01
Lot 19 N157452	39.60
Lot 95 N157452	34.05
Lot 20 N157423	70.62
Lot 131 N157491	64.75
Lot 129 NR456	65.89
Lot 43 N157359	64.51
Lot 290 N157480	64.75

* Tenure data at the time of reporting and sourced from Queensland Department of Natural Resources and Mines (DNRM). An application to combine certain lots and remove road easements has been submitted to DNRM (*pers. comm.* Stephen Whitaker, Planner, Cardno, 11 October 2017).

Current development in the project area comprises a homestead, cattle yards, animal enclosures, unsealed vehicle tracks, a farm dam and a weir on Haren Creek. New fencing has been constructed since 2014 and a number of paddocks established. Cattle have access to creeks for watering.

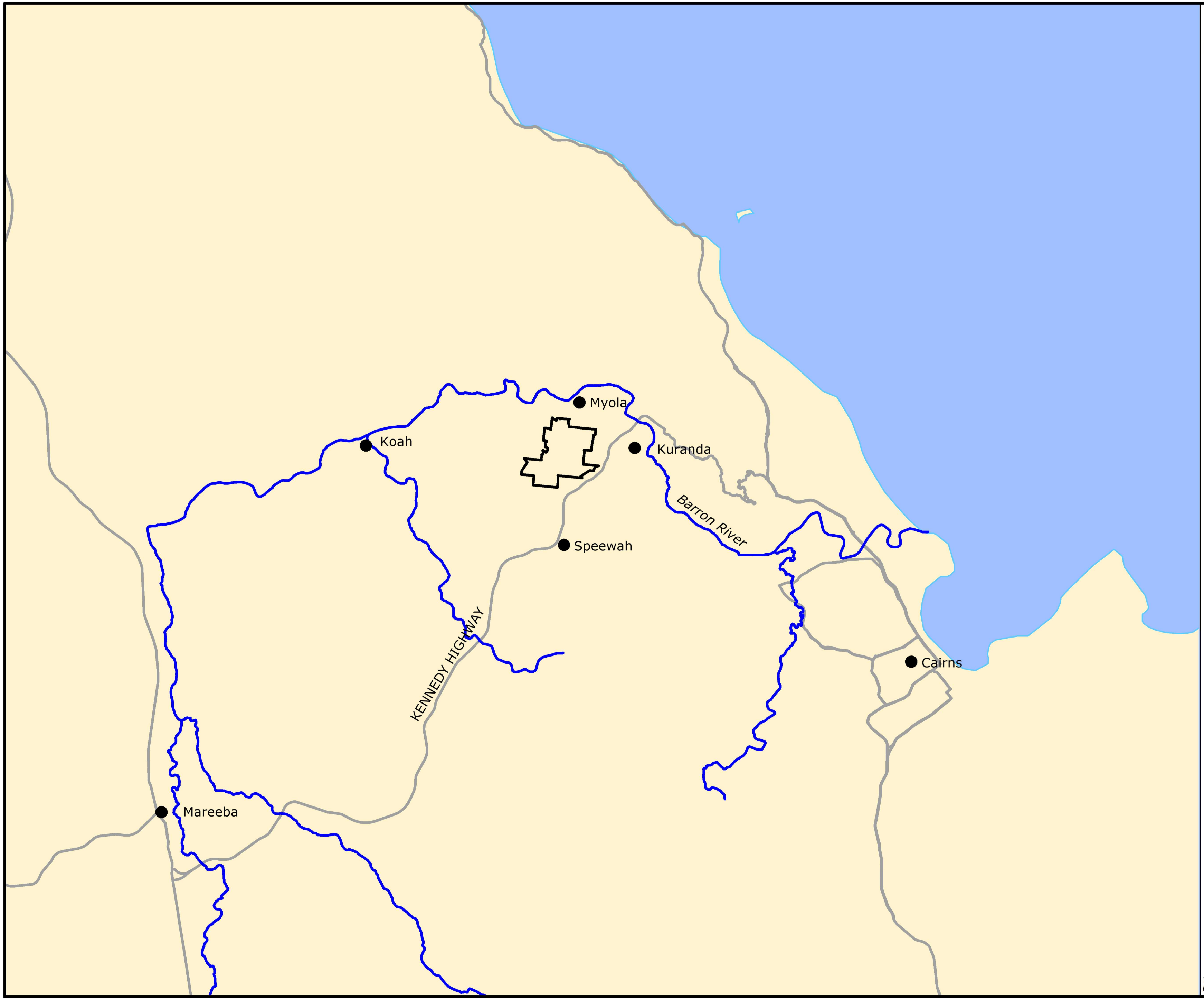

Figure 1: KUR-World project location

Project: KUR-World Water Quality and Aquatic Ecology Technical Report

▭ KUR-World project area
━ Major drainage
━ Major roads

N

0 5 10
Kilometres

NRA Ref: 424103.01
Date: November 2017

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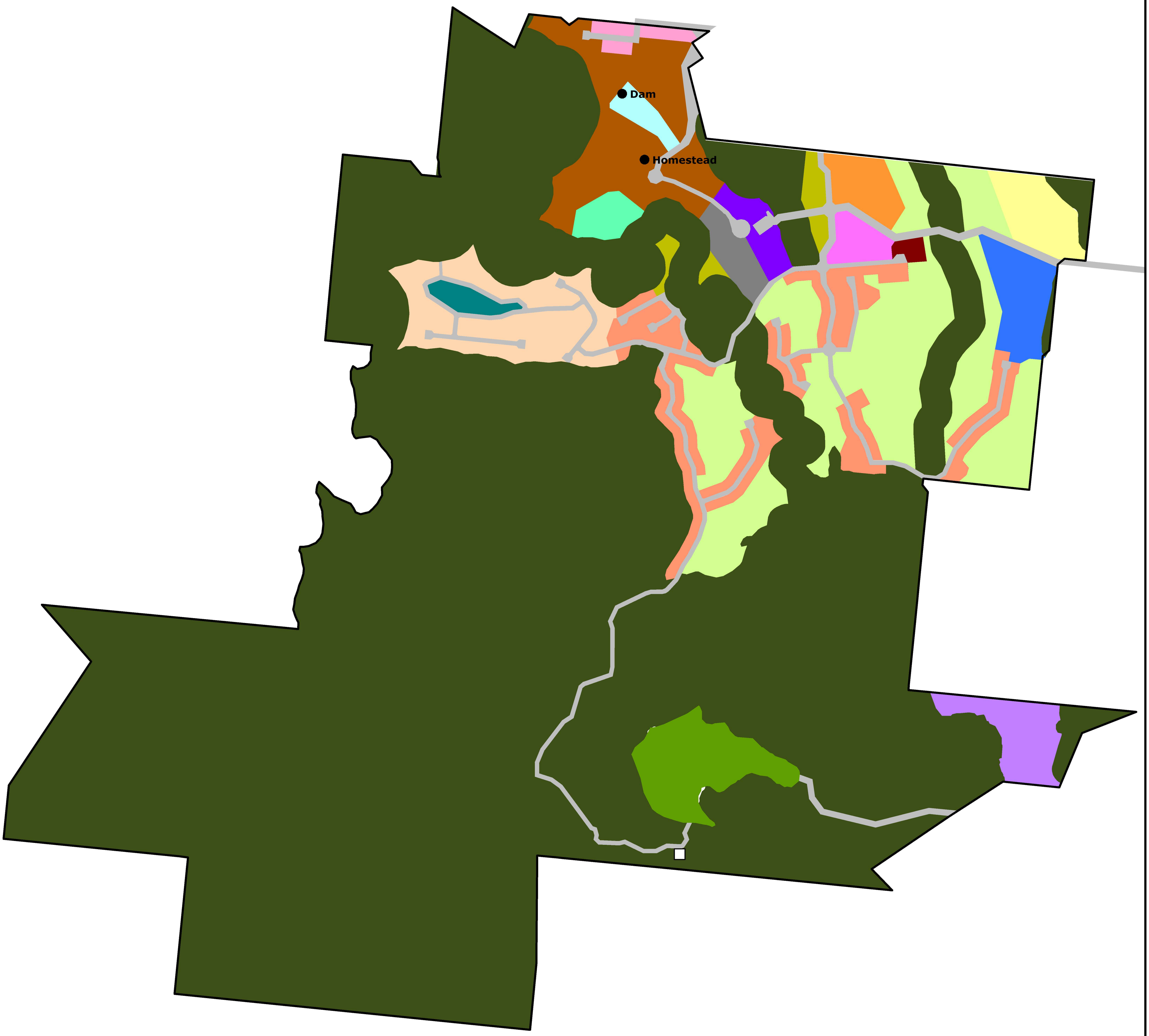

Figure 2: KUR-World master plan

Project: KUR-World Water Quality and Aquatic Ecology Technical Report

☐ KUR-World project area

KUR-World Masterplan Revision G

- 🟧 Lifestyle Villas
- 🟪 Queenslander Lots
- 🟧 Premium Villas
- 🟪 KUR-Village
- 🟦 Five Star Eco Resort
- 🟩 Golf Course
- 🟥 Golf Clubhouse and Function Centre
- ⬛ Business and Leisure Hotel and Function Centre
- 🟨 Health and Wellbeing Retreat
- 🟪 Sporting Precinct
- 🟫 Farm Theme Park and Equestrian Centre
- 🟧 KUR-World Campus
- 🟩 Rainforest Education
- 🟦 Open Space
- 🟩 Produce Garden
- 🟪 Glamping
- 🟨 Service / Infrastructure
- ⬜ Road
- ☐ Helipad
- 🟩 Environmental Area

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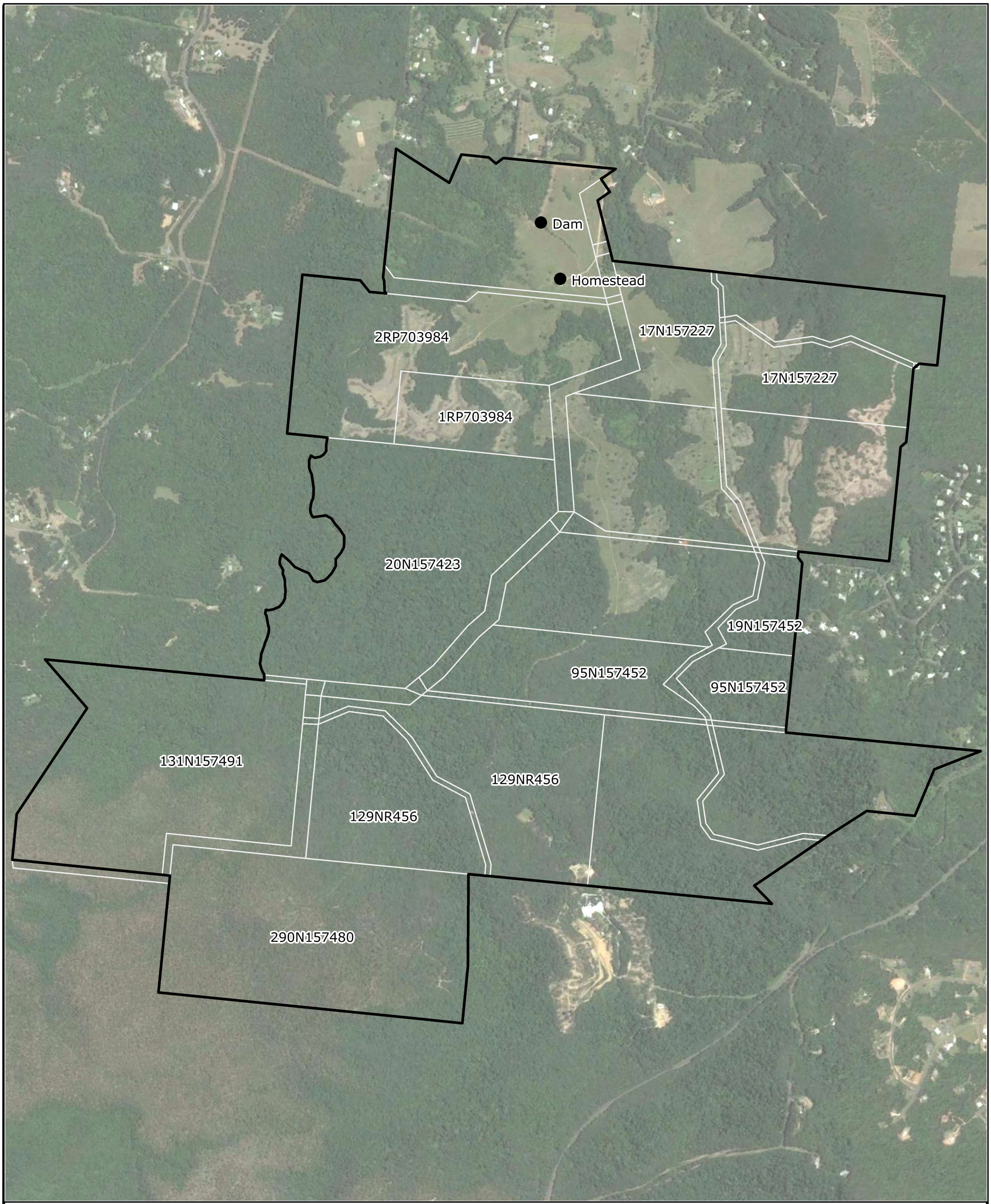

Figure 3: KUR-World project area

Project: KUR-World Water Quality and Aquatic Ecology Technical Report

▭ KUR-World project area

▭ Lot boundary

N

0 0.5 1

Kilometres

Source:
© State of Queensland (Department of Natural Resources and Mines) 2017. Updated data available at http://qldspatial.information.qld.gov.au/catalogue//, Google Earth

NRA Ref: 424103.01
Date: November 2017

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The northern portion of the project area contains low undulating rises dissected by steep gullies. Elevation in this area varies between 340 m and 360 m (Australian Height Datum, AHD). This portion of the property has been used for cattle grazing since the early to mid-20th century and remains in use for this purpose. Historical aerial photography shows that the majority of this northern portion was largely or partially cleared of woody vegetation on a number of occasions from the 1940s to the early 1990s. During the 1990s, regrowth vegetation began to re-establish. In 2014, approximately 46 ha of this regrowth vegetation was cleared to reinstate pasture.

The southern portion of the project area is variable in topography, containing areas of gently to steeply inclined terrain. This portion is dissected by a number of gullies and small streams. Elevation varies between 340 m and 440 m AHD. Remnant vegetation dominates this portion. Historical aerial photographs indicate localised and periodic vegetation clearing events, though regrowth vegetation has since established over most of the cleared land. A network of All-Terrain Vehicle (ATV) tracks occurs near the south-eastern boundary. A paintball business operates within and near the southern boundary.

Four streams and their associated tributaries are present in the project area. The two largest streams are Owen Creek (runs along the western boundary) and Haren Creek (runs through the centre of the project area and joins Owen Creek in the north-west of the project area). The project area contains parts of the headwaters for Warril and Cain Creeks (**Figure 4**). Owen Creek, Warril Creek and Cain Creek enter the Barron River approximately 1 km north of the project area.

1.2 Scope

The scope of works for the water quality and aquatic ecology technical report is based on the requirements of the *Terms of Reference for an Environmental Impact Statement: KUR-World Integrated Eco-Resort, October 2016* (TOR) and the NRA Environmental Consultants (NRA) proposal dated 2 December 2016. This technical report provides information to inform the following items from the TOR. Where items are partially or completely addressed in other technical reports, these are identified following each TOR item description.

- ***10.3.*** *Describe and illustrate the topography of the project site and surrounding area, and highlight any significant features shown on the maps. Include and name dams, rivers, creeks and any other named features and include all mapped waterways as shown in the spatial data layer Queensland waterways for waterway barrier works. Maps should include a scale, a north arrow, a legend and have contours at suitable increments relevant to the scale, location, potential impacts and type of project, shown with respect to Australian Height Datum (AHD) and drafted to GDA94.* Described in NRA 2017a. Mapped waterways for waterway barrier works are included in **Figure 4** of this report.
- ***11.16.*** *The assessment should include, but not be limited to, the following key elements: b) terrestrial and aquatic ecosystems (including groundwater-dependent ecosystems) and their interaction, including with ground and surface water hydrology and the quality of controlled and potentially uncontrolled discharges*. Assessment of terrestrial ecosystems is included in NRA 2017b. Discussion of aquatic ecosystems is included herein.
- ***11.24.*** *Describe the hydrology within the study area and the adjoining waterways in terms of water levels, discharges and freshwater flows. Detail the interaction of groundwater and surface water*. Described in NRA 2017a.

- ***11.25.*** *Detail the chemical and physical characteristics of surface waters and groundwater within the area that may be affected by the project. Include a description of water quality variability associated with climatic and seasonal factors, variability of freshwater flows and extreme events.* Described herein.
- ***11.26.*** *Identify the quantity, quality, timing, duration and location of all potential discharges of water and contaminants by the project, whether as point sources (such as controlled discharges) or diffuse sources (such as irrigation to land of treated sewage effluent).* These details were not available at the time of preparation of this report and will be included in EIS Chapter 9.
- ***11.27.*** *Provide relevant information on existing and proposed sewerage infrastructure (related to ERA 63). Detail how proposed sewage treatment (ERA 63) will comply with the relevant requirements of the EP Act and subordinate legislation.* Information on sewerage infrastructure and compliance with legislative requirements is being prepared by others.
- ***11.28.*** *Describe the proposed management of existing and/or constructed waterbodies on the project site to maintain water quality*. These details were not available at the time of preparation of this report and will be included in EIS Chapter 9.
- ***11.29.*** *Describe erosion and sediment controls to be utilised during construction and operation of the proposed development. Detail the timing of works and design criteria to be adopted for erosion and sediment controls.* Information on erosion and sediment controls is included in NRA 2017c.
- ***11.30.*** *Assess the potential impacts of any discharges on the quality and quantity of receiving waters taking into consideration the assimilative capacity of the receiving environment and the practices and procedures that would be used to avoid or minimise impacts.* General discussion of impacts and mitigation measures are included herein and are to be elaborated on in EIS Chapter 9 as additional information is provided.
- ***11.31.*** *Describe how the achievement of the water quality objectives would be monitored and audited, and how corrective actions would be managed. Describe mitigation strategies and contingency plans for:*
  - *(a) potential accidental discharges of contaminants and sediments during construction and operation*
  - *(b) stormwater run-off from the project facilities and associated infrastructure*
  - *(c) flooding of relevant river systems.*

  Preliminary advice on monitoring, mitigation measures and contingency plans are included herein and are to be elaborated on in EIS Chapter 9 as additional information is provided.

2. Relevant Legislation

Commonwealth and State legislation specify the manner in which development projects can be carried out and the permit requirements for particular activities associated with the development.

2.1 State (Queensland) legislation

State legislation related to issues of water quality and aquatic ecology[2] includes:

- *Water Act* 2000
- *Water Plan (Barron)* 2002
- *Environmental Protection Act* 1994
- *Environmental Protection (Water) Policy* 2009 (EPP (Water))
- *Fisheries Act* 1994.

Relevant policies and guidelines include:

- *State Planning Policy (SPP) July 2017*, *State interest – Water quality*.
- *Environmental Protection (Water) Policy 2009 - Barron River Basin, Environmental Values and Water Quality Objectives - Basin No 110 and Adjacent Coastal Waters* (EHP 2014a).
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000).
- *Monitoring and Sampling Manual – Environmental Protection (Water) Policy 2009* (EHP 2013a).
- *Queensland Water Quality Guidelines 2009* (EHP 2013b).
- *Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines* (Simpson *et al.* 2013).
- *Wet Tropics Water Quality Improvement Plan 2015-2050*, Version 10 (Terrain NRM 2015).
- *Reef Water Quality Protection Plan 2013* (State of Queensland 2013).

2.2 Commonwealth legislation

Commonwealth legislation and policy related to water quality and aquatic ecosystems are:

- *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).
- *Reef 2050 Long-term Sustainability Plan* (Commonwealth of Australia 2015).

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[2] Water quality includes surface water and groundwater, and aquatic ecology includes aquatic macroinvertebrates, fish and sediment.

3. Methods

To inform this report and support the development of the EIS, the following baseline monitoring programs have been undertaken on and around the project area:

- surface water
- stream sediment
- aquatic ecology – aquatic macroinvertebrates
- aquatic ecology – fish
- groundwater.

Monitoring was undertaken between 5 December 2016 and 19 June 2017, with a summary of the sampling schedule provided in **Table 2** and presented on **Graph 2**. Monitoring sites for each program are summarised in **Table 3** and shown on **Figure 4**. Sites were selected according to the following attributes.

- Location with respect to site boundaries, proposed development areas, existing disturbance areas and water flow.
- Physical properties (*eg* to provide adequate aquatic habitats for sampling aquatic macroinvertebrates and fish).
- Accessibility.

The methods for these monitoring programs are detailed in **Appendix A**.

Table 2: Summary of the sampling schedule

Monitoring programs	Dates	Sites sampled	Source	Reporting location
Surface water (full suite)	5-6 December 2016 9-10 January 2017 1-2 February 2017 21-22 February 2017 20-21 April 2017	SW01, SW01B, SW09, SW02, SW02B, SW03, SW04, SW05, SW05Alt, SW06, SW07, SW08, SW10, SW11, SW11Alt, SW12	This report	Reported fully herein
Surface water (TSS & VSS)	5-6 December 2016 13 December 2016 6 January 2017 9-10 January 2017 1-2 February 2017 21-22 February 2017 20-21 April 2017	SW01, SW01B, SW09, SW02, SW02B, SW03, SW04, SW05, SW06, SW07, SW08, SW10, SW11, SW12, SW15, SW16	This report	Reported fully herein
Sediment (undertaken as a component of the aquatic ecology – aquatic macroinvertebrates survey)	20 April 2017	SW01B, SW02, SW02B and SW08	This report	Reported fully herein
Aquatic ecology – aquatic macroinvertebrates	20 April 2017	SW01B, SW02, SW02B and SW08	This report	Reported fully herein
Aquatic ecology – fish	12-13 June 2017	SW01, SW1B, SW02, SW2B, SW03, SW06, SW08, SW09	Tropwater and Tropical River Consulting (Ebner & Vallance 2017)	Summarised herein and fully reported in **Appendix F**.
Groundwater	31 January 2017 13 March 2017 8 May 2017 19 June 2017	WB2, WB5, WB6, WB7 and WB8	Rob Lait & Associates (RLA 2017)	Summarised herein and fully reported in **Appendix I**.

Table 3: Site descriptions

Site	Latitude*	Longitude*	Description
SW01	-16.8239°	145.5935°	Site on Owen Creek. This site receives run-off predominantly from forested areas with little to no clearing. There is some track development and a minor residential component within the catchment for this site. Given the low level of development upstream, this site was selected as a potential benchmark$ site.
SW01B	-16.8186°	145.5973°	Site on Owen Creek, approximately 170 m upstream of the confluence of Owen Creek and Haren Creek. This site receives run-off from areas cleared in 2014.
SW02	-16.8285°	145.6066°	Site on Haren Creek, approximately 3 km upstream of the confluence of Owen Creek and Haren Creek. This site receives run-off from forested areas of the project area as well as neighbouring tourist operations, the Kennedy Highway and residential areas. Cattle access the site for water.
SW02B	-16.8187°	145.5981°	Site on Haren Creek approximately 100 m upstream of the confluence of Owen Creek and Haren Creek. The site receives run-off from areas cleared in 2014, a produce garden developed in 2016 and two low-level crossings. The site is approximately 550 m downstream of the Haren Creek Weir.
SW03	-16.8175°	145.5993°	Site on Owen Creek approximately 100 m downstream of the confluence of Owen Creek and Haren Creek. The site receives flow from sites SW01, SW01B, SW02, SW02B and SW09.
SW04	-16.8144°	145.5993°	Site on an unnamed drainage line discharging into Owen Creek, approximately 330 m downstream of the dam constructed in the project area in 2015/16. This site is on the downstream project area boundary. Flows include remobilised sediments deposited in the channel following construction of the dam.
SW05	-16.8068°	145.5993°	Site at the mouth of Owen Creek, approximately 1.3 km downstream of the project area boundary. This site receives run-off from a rural residential area as well as flow from site SW04 and sites on Owen Creek and Haren Creek. The Owen Creek catchment extends approximately 6.3 km upstream and covers an area of approximately 1,553 ha.
SW05 Alt#	-16.8076°	145.5995°	Alternate site approximately 100 m upstream of site SW05, upstream of the influence of the Barron River high flows observed during sampling events.
SW06	-16.8181°	145.6045°	Site on Cain Creek, 300 m west of the homestead. This site is on the downstream project area boundary and receives run-off from the project area, including cleared and forested areas.
SW07	-16.8073°	145.6027°	Site on Cain Creek immediately upstream of the confluence with the Barron River, approximately 1.8 km downstream of the project area boundary. This site receives run-off from forested and pastoral areas and a rural residential area. The catchment for Cain Creek extends approximately 1.9 km upstream and covers an area of approximately 74 ha.
SW08	-16.8187°	145.6104°	Site on unnamed tributary of Warril Creek. This site is on the downstream project area boundary and receives run-off from forested areas and areas cleared in 2014.
SW09	-16.8386°	145.6030°	Site on Haren Creek, approximately 2.0 km upstream of site SW02 and adjacent to the project area's southern boundary. This site receives run-off from upstream forested areas, tourist operations, the Kennedy Highway and residential areas. This is a background$ site for the project area (*ie* reflecting current upstream conditions).
SW10	-16.8011°	145.6134°	Site on Warril Creek immediately upstream of the confluence with the Barron River, approximately 3.0 km downstream of the project area boundary. This site receives run-off from forested and pastoral areas and a residential area. The catchment for Warril Creek extends approximately 4.0 km upstream and covers an area of approximately 498 ha.
SW10 Alt#	-16.8028°	145.6129°	Alternate site approximately 200 m upstream of site SW10, upstream of the influence of the Barron River high flows observed during sampling events.

Site	**Latitude**[*]	**Longitude**[*]	**Description**
SW11	-16.8062°	145.5991°	Site on the Barron River, approximately 50 m upstream of the mouth of Owen Creek. This site receives water from the Barron River catchment.
SW11 Alt[#]	-16.8030°	145.5900°	Alternate site approximately 1.2 km upstream of site SW11. Three additional tributaries enter the Barron River between sites SW11 Alt and SW11. These tributaries receive run-off from residential areas and pastoral properties.
SW12	-16.8005°	145.6160°	Site on the Barron River, approximately 250 m downstream of the mouth of Warril Creek (site SW10). This site receives water from the Barron River catchment including all flows from the project area to the Barron River.
SW15	-16.8070°	145.6022°	Site on the Barron River approximately 300 m downstream of the mouth of Owen Creek (site SW05) and approximately 75 m upstream of the mouth of Cain Creek (site SW07). This site receives water from the Barron River catchment including flows from Owen Creek.
SW16	-16.8150°	145.6041°	Site on Barnwell Road, approximately 350 m downstream of site SW06. This site is downstream of the access road to the project area.
WB2	-16.8193°	145.6008°	Groundwater bore approximately 120 m south-west of the homestead.
WB5	-16.8174°	145.6007°	Groundwater bore approximately 180 m north-west of the homestead.
WB6	-16.8234°	145.5969°	Groundwater bore approximately 450 m south-west of the homestead.
WB7	-16.8222°	145.5943°	Groundwater bore approximately 890 m west-south-west of the homestead.
WB8	-16.8203°	145.6046°	Groundwater bore approximately 350 m south-east of the homestead.

[#] Alternate sites (SW05 Alt, SW10 Alt and SW11 Alt) were used when the high Barron River water levels caused sampling sites to be inaccessible or site waters were mixed with Barron River water. Alternate sites were chosen to fulfil the same purpose as the original sites.

[$] The term “benchmark” has been used to describe site SW01, which is upstream of the project area but may be influenced by some track development within the property upstream of the site. The term “background” has been used to describe site SW09, which is upstream of the project area and influenced by off-site activities (*eg* tourist operations, residential areas). For the purposes of impact assessment, these sites provide reference conditions for comparison to water quality in sites adjacent to and downstream of the project area.

[*] Co-ordinates are in GDA94 and are the location at which sampling was undertaken. All samples were taken within 100 m of these sampling locations.

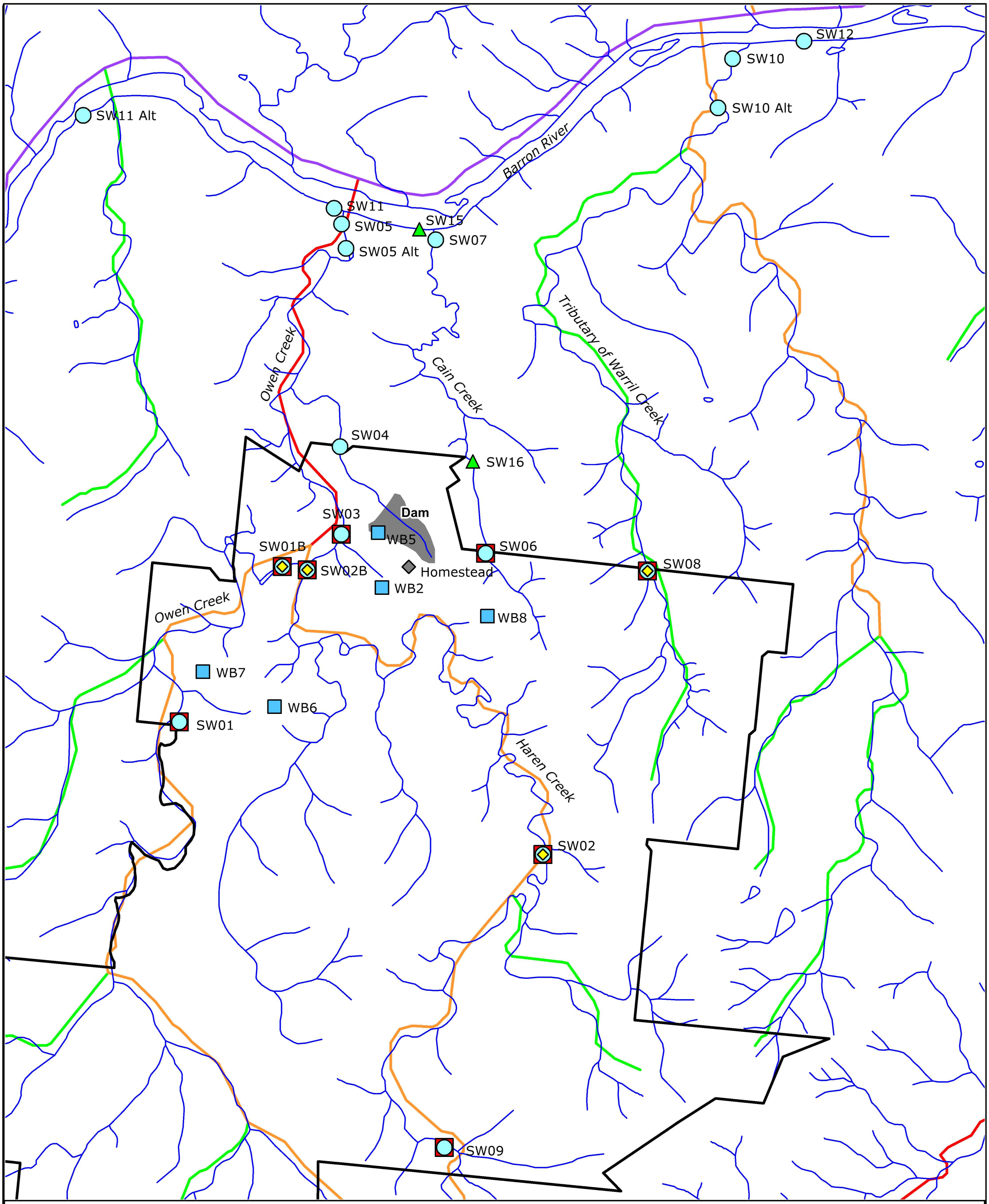

Figure 4: KUR-World sampling and survey sites

Project: KUR-World Water Quality and Aquatic Ecology Technical Report

▭ KUR-World project area

Sampling sites

- ● Surface water (full suite)
- ▲ Surface water (TSS/VSS)
- ◆ Aquatic macroinvertebrates and sediment
- 🟥 Fish
- ■ Groundwater

Government mapped drainage lines (1:25,000)

Waterway (Fisheries Act 1994)
Risk of impact to fish movement

- 🟩 Low
- 🟧 Moderate
- 🟥 High
- 🟪 Major

Source:
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4. Results

4.1 Environmental values

Queensland waterways are managed under the Queensland *Environmental Protection (Water) Policy* 2009 (EPP (Water)), which groups watercourses into river basins for water quality management activities. The *Barron River Basin Environmental Values and Water Quality Objectives* report (EHP 2014a) lists the environmental values applicable to surface and groundwaters within the Barron River Basin. Surface water environmental values (EVs) have been assigned to the Barron River Basin according to subcatchments. Groundwater environmental values are applied at the basin level. Water quality objectives are then identified for receiving waters according to both the EVs and the management intent (*ie* high ecological value (HEV) waters, slightly disturbed (SD) waters, moderately disturbed (MD) waters and highly disturbed (HD) waters), which is also scheduled under the EPP (Water).

Waterways of the project area are part of 'Kauri, Groves, Thirty Three Mile, Blackwater, One Mile, Mona, Jumrum, Haren and Dismal Creeks' subcatchment[3] and are mapped as MD waters. Sections of Haren and Owen Creeks upstream of the project are mapped as HEV waters. These HEV waters coincide with the Formartine Forest Reserve to the south-west of the project area and Barron Gorge Forest Reserve to the south-east. The HEV sections of Haren and Owen Creeks are upstream of the project area and will not be affected by the development.

The close proximity of the project area to the Barron River required monitoring sites to be located on the main Barron River channel. Thus, a second subcatchment, the 'Barron River main channel between weir at Koah and Barron Falls' is also relevant to the surface water monitoring program. All waters within the 'Barron River main channel between weir at Koah and Barron Falls' subcatchment are mapped as MD waters.

The environmental values that apply to water quality in the subcatchments are detailed in **Table 4**.

Table 4: Environmental values for the KUR-World project area receiving waters (EHP 2014a)

Barron River Basin subcatchment	Environmental values											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumption	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values
Kauri, Groves, Thirty Three Mile, Blackwater, One Mile, Mona, Jumrum, Haren and Dismal Creeks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
Barron River main channel between weir at Koah and Barron Falls*	✓	×	×	×	×	✓	✓	✓	✓	×	✓	✓
Groundwater	✓	✓	✓	✓	×	×	×	×	×	✓	✓	✓

* This sub-catchment is outside of the project area but downstream of project activities.

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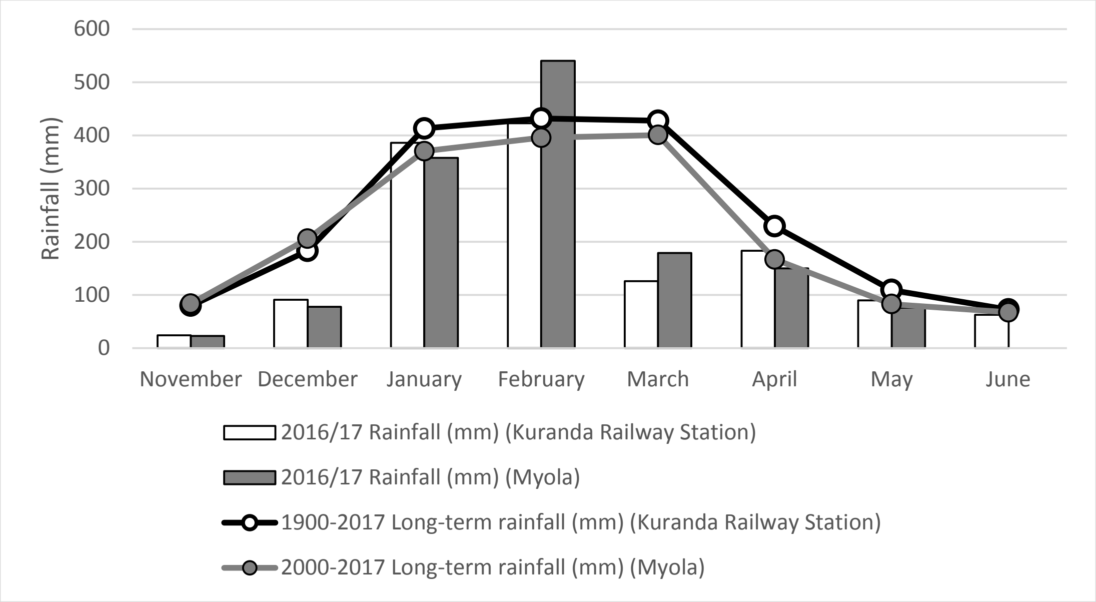
[3] This catchment also includes Cain, Owen and Warril Creeks.

4.2 Rainfall

Rainfall data is collected at stations near the project area. The closest Bureau of Meteorology (BoM) station is the Myola Alert Station (site number 531040), approximately 1.6 km north east of the project area. Barron River water heights were obtained from Myola Alert Station. Long-term and 2016/2017 monthly rainfall data from the Myola Alert Station and Kuranda Railway Station (site number 31036) is shown on **Graph 1**. **Graph 2** presents daily rainfall, Barron River water heights and sampling events for the monitoring period.

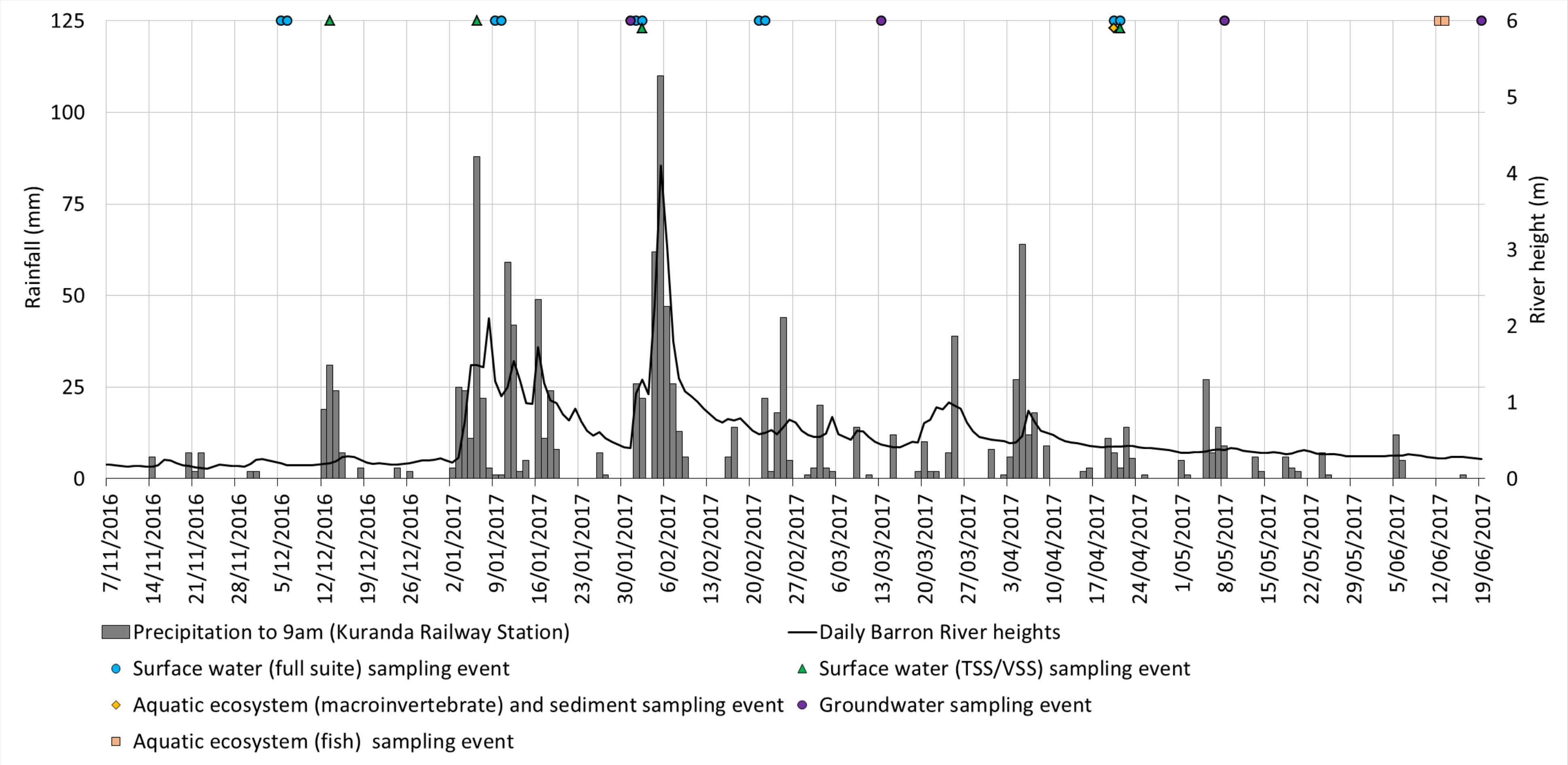
Monthly rainfall averages for 2016/2017 at both Myola and the Kuranda Railway Station during the monitoring period were below long-term averages for November, December and March; were generally comparable to long-term averages for January, February (at Kuranda), April, May and June; and were above the long-term average for February at Myola (**Graph 1**).

Sampling events were planned to coincide with periods of low, average and elevated rainfall (**Graph 2**) to allow assessment of the influence of seasonal and event-based conditions on water quality.



Monthly rainfall data for June 2017 was not available for Myola at the time of preparation of the report.

Graph 1: Myola and Kuranda Railway Station 2016/2017 monthly and long-term average rainfall



Graph 2: **Kuranda Railway Station daily rainfall measurements, Barron River water heights and survey events for the monitoring period**

4.3 Site condition

The condition of surface water sites was recorded on field proformas during each of the five detailed (*ie* full suite) water quality sampling events (**Appendix B**). Site photographs and a brief description of site conditions during each survey is included in **Appendix C**. Surface water TSS/VSS sampling events were undertaken opportunistically following rainfall events and site conditions were not recorded. The conditions of surface water sites sampled during the aquatic ecology (aquatic macroinvertebrate) sampling event were recorded on detailed proformas, including a rapid assessment of biophysical conditions (**Appendix B**).

Site conditions are included, as relevant, in the aquatic ecosystem fish survey report (Ebner & Valance 2017, (**Appendix F**) and groundwater report (RLA 2017, **Appendix I**)).

4.4 Quality assurance/quality control

4.4.1 Surface water

During events where samples were collected for the full water quality suite, NRA collected a field blank sample to determine potential contamination of water samples during sampling, transportation, and laboratory analysis; and a field duplicate sample to determine the reliability of laboratory data.

Analyte concentrations recorded in the field blank sample were less than the laboratory's Limit of Reporting (LOR), with the exception of the following analytes and sampling events.

- 5-6 December 2016: total oxidised nitrogen (TON), ammonia and total inorganic nitrogen.
- 9-10 January 2017: total inorganic nitrogen.
- 1-2 February 2017: nitrate (and associated TON[4]), total inorganic nitrogen and volatile suspended solids (VSS).
- 21-22 February 2017: TON, nitrate and total inorganic nitrogen.
- 20-21 April 2017: total dissolved solids.

For the above, the values were very low (*ie* less than 10 times the LOR) and passed the relative percentage difference (RPD) assessment.

Field duplicates were collected at sites SW10 (5 December 2016), SW09 (9 January, 1 February and 21 February 2017) and SW02 (20 April 2017).

All analytes in the duplicate samples reported valid reproducibility when compared to site samples, with the exception of total suspended solids (TSS) on 9 January 2017. The sample from site SW09 (Laboratory ID CE124925.006) recorded 29 mg/L TSS compared to 22 mg/L recorded in the duplicate sample (Laboratory ID CE124925.011). The nature of TSS means it is a highly variable analyte. The failure of the reproducibility is unlikely to compromise the interpretation of the results.

In situ pH results for sampling on 21 and 22 February 2017 were unreliable due to a faulty probe. Laboratory analysed pH results have been substituted in place of *in situ* results for this event. The samples from 21 and 22 February were analysed outside of the holding time for

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[4] Total oxidised nitrogen (TON) is the sum of nitrite and nitrate. Samples collected on 1-2 February 2017 contained very low concentrations (*ie* below the limit of reporting) of nitrite meaning the TON result is above the LOR due to high nitrate concentrations.

pH (15 minutes) (*pers. comm.* John Dicker, Business Manager, SGS Cairns Environmental Laboratory). While the laboratory cannot confirm the accuracy of the results analysed outside of the holding time, a comparison of pairs of *in situ* and laboratory pH values recorded during monitoring were within 1.1 pH unit. The laboratory pH results reported on 21 and 22 February at each site were comparable to results recorded with the probe in the surveys prior to and following this sampling event. For the purposes of impact assessment, the differences between pH results determined by the laboratory or *in situ* does not affect interpretation of the results presented below.

NRA has confidence in the surface water quality results used in this report.

4.4.2 Stream sediment

NRA generated a duplicate sample set from the sample collected at site SW02 to determine the reliability of the laboratory analysis results. The data showed that all analytes in the duplicate sample set reported valid reproducibility. NRA has confidence in the stream sediment quality results used in this report.

4.4.3 Aquatic macroinvertebrates

Quality assurance (QA) for aquatic macroinvertebrate data includes the comparison of replicate samples, QA verification of specimen identification, and QA checks of field sampling (*ie* identifying and recording taxa present in residual samples).

Residual aquatic macroinvertebrate results (**Table 5**) show that the majority of families present in the residual samples were collected by the live-sort operators. In all cases where a live-sort operator failed to collect taxa during the field survey (shaded in **Table 5**), the taxon occurred in low abundance (*ie* one to five individuals) or had been collected by the same live-sort operator at another site during the survey. The only abundant taxon present in the residual samples that was not collected by either live-sort operator, despite being present in the residual sample, was Oligochaeta. Oligochaeta individuals are small and cryptic and are more likely to be picked in the laboratory using a microscope than in the field during the live-pick. Baetidae, ceratopogonidae, elmidae and an unidentified decapoda were also not collected in the live-sort by both operators, however these taxa occurred in low abundance (*ie* one to five individuals).

The non-metric multi-dimensional scaling (nMDS) ordination (**Graph 5**) and SIMPROF cluster analysis (**Graph 6**) in **Section 4.7** show that the aquatic macroinvertebrate assemblages in replicate samples from the same site were more similar to each other than they were to replicate samples from any other site. This confirms the consistency in aquatic macroinvertebrate live-picking ability between operators.

Table 5: Residual aquatic macroinvertebrate results

Taxa	**Site:**	**SW02B A**	**SW02B A – Residual**	**SW02B B**	**SW02B B – Residual**
	Sample date:	**20/4/17**	**20/4/17**	**20/4/17**	**20/4/17**
	Picker*:	**KL**	**KL**	**MN**	**MN**
Acari		✓	✓^{2}	✓	✓^{1}
Atyidae		✓	✓^{1}	✓	✓^{1}
Baetidae		×	✓^{1}	×	✓^{2}
Caenidae		✓	✓^{3}	✓	✓^{3}
Ceratopogonidae		×	✓^{2}	×	✓^{2}
Chironominae		✓	✓^{3}	✓	✓^{3}

Taxa	Site:	SW02B A	SW02B A – Residual	SW02B B	SW02B B – Residual
	Sample date:	20/4/17	20/4/17	20/4/17	20/4/17
	Picker*:	KL	KL	MN	MN
Copepoda		✓	×	×	×
Corbiculidae		×	✓[2]	✓	✓[2]
Corduliidae		✓	×	✓	×
Corixidae		✓	×	✓	✓[2]
Dytiscidae		×	×	✓	×
Elmidae		×	✓[2]	×	✓[1]
Gerridae		×	×	✓	×
Gomphidae		✓	×	✓	✓[2]
Hirudinea		×	×	✓	×
Isostictidae		✓	×	✓	×
Leptoceridae		✓	✓[2]	✓	✓[2]
Leptophlebiidae		✓	✓[2]	✓	✓[3]
Libellulidae		✓	×	✓	×
Oligochaeta		×	✓[3]	×	✓[2]
Orthocladiinae		✓	✓[2]	×	×
Ostracoda		✓	×	×	✓[1]
Palaemonidae		✓	×	✓	×
Platycnemididae		✓	×	✓	×
Pyralidae		×	×	✓	×
Sialidae		×	×	✓	×
Sisyridae		✓	×	×	✓[1]
Sphaeriidae		✓	×	×	×
Tanypodinae		✓	✓[3]	✓	✓[3]
Thiaridae		✓	×	✓	×
Unidentified Decapoda		×	✓[2]	×	✓[1]
Unidentified Epiprocta		×	×	✓	✓[1]
Unidentified Zygoptera		✓	✓[2]	✓	✓[1]

* Pickers: MN is Martine Newman (NRA) and KL is Karen Lindee (NRA).

× Denotes taxa that were not present

✓ Denotes taxa that were present

[1] One specimen in the residual

[2] Two to five specimens in the residual

[3] Six or more specimens in the residual

Shaded cells indicate where a specimen was present in the residual but was not collected in the live-pick sample.

Based on the results of the QA assessments undertaken on the aquatic macroinvertebrate data, NRA has confidence in the aquatic macroinvertebrate sample collection and identification used for analysis in this report.

4.4.4 Fish

Details of quality assurance/quality control methods applied to fish identification are reported in Ebner and Valance (2017, **Appendix F**).

4.4.5 Groundwater

No duplicate samples were collected for groundwater samples. Although some issues were identified during internal laboratory quality control procedures undertaken by SGS Cairns Environmental Laboratory, the groundwater quality results reported by SGS were considered to have no issues (*pers. comm.* Leanne Orsmond, Quality, Reporting and Microbiology Co-ordinator, SGS Cairns Environmental Laboratory, 11 September 2017).

4.5 Surface water results

Surface water *in situ* and laboratory results are presented in **Table 6** (detailed/full suite water quality sampling events) and **Table 7** (TSS and VSS results from opportunistic and detailed sampling events). Not all sites were sampled during each detailed or opportunistic sampling event; a summary of site sample dates is provided in **Table 2**. The *in situ* field measurements were recorded on proformas provided in **Appendix B**. SGS laboratory analysis reports, sample receipt advice and chain of custody documentation are provided in **Appendix D**.

Water Quality Objectives (WQOs) for the project area were identified based on the nominated EVs (**Table 4**) and are presented in **Appendix A, Table 2** (base flow conditions) and **Table 3** (high flow conditions)). These WQOs are presented for full suite water quality results in **Table 6**. WQOs for total and suspended solids results are presented in **Table 7**.

Results presented in **Table 6** and **Table 7** that are **bold** and **underlined** were above the WQOs. Where exceedances of WQOs were identified, a review of the temporal data (*ie* data for the same site over several sampling events) for these sites was undertaken to identify trends.

Table 8 provides a further comparison of project area waters to an unimpacted Wet Tropics rainforest stream (Jarra Creek[5], a tributary of the Tully River).

Several analytes consistently reported levels below the LOR or WQO in all samples. These analytes include: temperature, total dissolved solids, nitrate, nitrite, dissolved and total arsenic, dissolved and total cadmium, total chromium, total copper, dissolved and total lead, dissolved manganese, dissolved and total nickel, dissolved and total zinc, fluoride, calcium and carbonate and hydroxide alkalinity.

Results were reported above or outside WQOs for the following analytes. Further interpretation of these results is provided after **Table 8**.

- Dissolved oxygen
- Electrical conductivity
- pH
- Turbidity
- Total suspended solids (TSS)
- Total oxidised nitrogen (TON)
- Ammonia
- Total nitrogen (TN)
- Filterable reactive phosphorus (FRP)
- Total phosphorus (TP)
- Dissolved and total aluminium
- Dissolved chromium
- Dissolved and total iron

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[5] Jarra Creek is regarded as one of the highest value waterways in the wet tropics bio-region (Kapitzke *et al*. 1999).

- Dissolved and total manganese
- Total sodium
- Total hardness
- Chloride
- Sulfate
- Total alkalinity.

There are no WQOs available for several analytes monitored during the survey events. Comparison of analyte results between sampling events and sites has been undertaken to identify trends and potential analytes of concern.

Table 6: Surface water quality results for the detailed/full suite sampling events

Analyte	WQO[1]	Owen Creek[#]						Haren Creek											Owen Creek[+]								
		SW01					SW01B	SW09					SW02					SW02B	SW03					SW04*	SW05	SW05 Alt	SW05
		5/12/16	9/1/17	1/2/17	21/2/17	21/4/17	20/4/17	5/12/16	9/1/17	1/2/17	21/2/17	21/4/17	5/12/16	9/1/17	1/2/17	21/2/17	20/4/17	20/4/17	6/12/16	9/1/17	1/2/17	21/2/17	21/4/17	1/2/17	6/12/16	1/2/17	21/2/17
In situ																											
pH[2]	6.5-8.0	**6.35**	**6.46**	6.65	**6.4**	**6.41**	**6.41**	6.56	**6.36**	6.62	6.5	6.61	**6.34**	**6.15**	**6.38**	6.5	**6.32**	6.73	6.69	6.66	**6.43**	6.6	6.75	6.57	6.70	**6.40**	6.5
Dissolved oxygen (% Saturation)	85-120	**13.7**	**26.7**	**60.1**	**12.8**	**11.4**	**34.4**	**28.1**	**40.9**	**35.3**	**21.3**	**14.7**	**3.2**	**16.5**	**28.2**	**16.9**	**30.2**	**69.6**	**2.4**	**62.1**	**79.9**	**68.3**	**71.4**	87.0	**78.2**	**26.6**	**15.3**
Electrical conductivity (µS/cm)	106	**378**	**314**	95.9	**136**	**154**	**197**	**265**	**130**	**123**	**117**	**139**	**171**	**122**	**120**	**141**	**134**	**115**	**141**	**111**	92.6	**117**	**128**	66.8	**122**	99.8	**118**
Temperature (°C)	16-34	24.0	24.9	25.7	25.8	22.4	25.3	24.6	25.7	26.5	26.1	22.6	22.2	24.3	24.7	25.4	24.4	24.9	22.5	24.6	25.7	25.7	22.6	25.8	27.2	25.7	27.1
Turbidity (NTU)	15	5.45	2.48	6.36	5.19	2.03	2.53	4.46	**61.8**	**98.0**	14.0	7.65	**46.9**	**16.6**	**24.7**	10.76	15.0	6.2	8.02	**30.6**	**74.2**	6.23	4.76	**317**	3.21	**60.3**	4.77
Suspended and dissolved solids																											
Total suspended solids (mg/L)	8	4	2[a]	6	4	3	2	<1	**29[a]**	**47**	**9**	4	**18**	7[a]	**16**	5	5	2	7	**12[a]**	**53**	2	2	**81**	<1	**42**	3
Volatile suspended solids (mg/L)	-	-	-	5	2	3	2	-	-	11	3	4	-	-	1	<1	5	2	-	-	11	<1	2	15	-	6	<1
Total dissolved solids (mg/L)	-[c]	230	210	97	110	110	160	160	120	81	100	130	110	110	68	100	97	110	120	120	81	100	100	110	85	50	99
Nutrients																											
Total oxidised nitrogen as N (mg/L)	0.05	0.010	0.036	<0.005	0.032	0.014	0.033	0.024	0.048	0.024	0.049	0.007	<0.005	0.026	<0.005	0.050	0.041	**0.14**	0.009	0.027	**0.066**	**0.097**	**0.066**	0.030	**0.084**	**0.14**	**0.23**
Nitrate, as N (mg/L)	-	-	-	<0.005	0.032	0.014	0.033	-	-	0.024	0.049	<0.005	-	-	<0.005	0.050	0.040	0.14	-	-	0.066	0.097	0.065	0.028	-	0.14	0.23
Nitrite, as N (mg/L)	-	-	-	<0.005	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005
Ammonia, as N (mg/L)	0.01	**0.017**	**0.018**	<0.005	**0.014**	**0.020**	**0.036**	**0.045**	**0.055**	**0.015**	0.008	**0.11**	**0.015**	**0.019**	**0.068**	**0.043**	**0.045**	<0.005	**0.047**	**0.070**	**0.028**	**0.023**	**0.015**	0.009	**0.012**	**0.092**	**0.012**
Total Kjeldahl nitrogen (mg/L)	-	0.50	0.41	0.64	0.50	0.51	0.42	0.42	0.81	0.72	0.62	0.52	0.64	0.55	0.59	0.38	0.27	0.41	0.71	0.85	0.98	0.48	0.40	1.7	0.23	0.87	0.42
Total nitrogen (mg/L)	0.34	**0.51**	**0.45**	**0.64**	**0.54**	**0.52**	**0.45**	**0.44**	**0.85**	**0.74**	**0.66**	**0.52**	**0.64**	**0.57**	**0.59**	**0.43**	0.31	**0.55**	**0.72**	**0.88**	**1.0**	**0.58**	**0.46**	**1.8**	0.31	**1.0**	**0.65**
Total inorganic nitrogen (mg/L)[4]	-	0.03	0.05	<0.01	0.05	0.03	0.07	0.07	0.10	0.04	0.06	0.11	0.01	0.04	0.07	0.09	0.09	0.14	0.06	0.10	0.09	0.12	0.08	0.04	0.10	0.24	0.25
Filterable reactive phosphorus (mg/L)	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.21**	<0.005	0.006	<0.005
Total phosphorus (mg/L)	0.025	**0.03**	**0.03**	**0.03**	**0.03**	0.02	0.02	<0.02	**0.05**	**0.04**	**0.03**	0.01	**0.07**	**0.03**	**0.03**	**0.03**	0.02	0.02	**0.08**	**0.07**	**0.07**	0.02	0.02	**0.42**	<0.02	**0.08**	0.02
Metals and metalloids																											
Dissolved aluminium (mg/L)	0.055[b]	0.007	0.011	**0.33**	**0.29**	0.025	0.024	0.007	**0.44**	**0.13**	**0.12**	**0.082**	<0.005	**0.16**	0.031	0.025	0.014	**0.099**	0.018	**0.32**	**0.21**	**0.13**	**0.076**	**1.5**	0.015	**0.28**	0.046
Total aluminium (mg/L)	0.2	0.008	0.013	**0.43**	**0.76**	0.033	0.032	0.010	**1.3**	**2.3**	**1.3**	0.073	0.015	**0.76**	**0.29**	**0.22**	0.051	0.12	0.056	**0.82**	**1.6**	**0.40**	0.095	**5.4**	0.023	**1.5**	**0.34**
Dissolved arsenic (mg/L)	0.01	0.001	<0.001	0.001	0.002	0.001	0.001	0.002	<0.001	0.002	0.002	0.001	0.002	<0.001	0.002	0.002	0.001	0.001	0.003	0.001	0.001	0.001	0.001	0.004	0.001	0.001	0.001
Total arsenic (mg/L)	0.01	0.002	<0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.003	0.002	0.002	0.004	0.001	0.003	0.002	0.002	0.002	0.004	0.002	0.002	0.002	0.001	0.004	0.001	0.002	0.002
Dissolved cadmium (mg/L) [3]	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total cadmium (mg/L)[3]	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dissolved chromium (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0043**	<0.001	0.0010	<0.001
Total chromium (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001	<0.001	<0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001	0.006	<0.001	0.002	<0.001
Dissolved copper (mg/L) [3]	0.03	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001	0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	0.004	<0.001	0.002	<0.001
Total copper (mg/L)[3]	0.2	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.003	0.001	<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001	<0.001	0.006	<0.001	0.003	<0.001
Dissolved iron (mg/L)	0.20	**0.92**	**0.76**	**0.78**	**0.48**	**1.2**	**1.6**	**1.7**	**0.62**	**0.78**	**0.81**	**1.3**	**0.60**	**1.4**	**1.4**	**0.98**	**1.5**	**2.2**	**2.3**	**1.8**	**1.0**	**0.99**	**2.1**	**1.3**	**1.8**	**1.4**	**0.52**
Total iron (mg/L)	0.2	**2.4**	**1.1**	**1.3**	**1.1**	**2.0**	**2.2**	**2.5**	**2.2**	**4.2**	**2.3**	**2.8**	**7.9**	**2.8**	**4.9**	**3.2**	**3.9**	**2.7**	**6.4**	**4.0**	**3.0**	**2.0**	**2.3**	**3.8**	**2.1**	**3.4**	**1.8**
Dissolved lead (mg/L) [3]	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total lead (mg/L)[3]	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001	<0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	<0.001	<0.001	0.003	<0.001	0.002	<0.001
Dissolved manganese (mg/L)	0.01	**0.11**	**0.037**	0.007	**0.023**	**0.043**	**0.12**	**0.17**	**0.058**	**0.30**	0.006	**0.13**	**0.47**	**0.085**	**0.20**	**0.21**	**0.16**	**0.043**	**0.74**	**0.086**	**0.064**	**0.035**	**0.040**	0.006	**0.067**	**0.079**	**0.036**
Total manganese (mg/L)	0.1	**0.17**	0.076	0.073	0.082	**0.12**	**0.14**	**0.28**	**0.12**	**0.49**	**0.13**	**0.22**	**0.65**	0.089	**0.24**	**0.24**	**0.18**	0.061	**0.79**	**0.15**	**0.12**	0.045	0.050	0.015	0.092	**0.14**	0.054
Dissolved nickel (mg/L) [3]	0.011	<0.001	<0.001	0.001	0.001	0.001	0.001	<0.001	0.001	0.002	0.001	<0.001	0.001	0.002	0.001	0.001	0.001	<0.001	0.001	0.002	0.001	0.001	<0.001	<0.001	<0.001	0.002	0.001
Total nickel (mg/L) [3]	0.02	<0.001	<0.001	0.002	0.001	0.001	0.001	<0.001	0.001	0.003	0.002	<0.001	0.002	0.002	0.002	0.002	0.001	<0.001	0.002	0.002	0.002	0.001	<0.001	0.001	<0.001	0.002	0.002
Dissolved zinc (mg/L) [3]	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	0.007	<0.005
Total zinc (mg/L)[3]	2	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.007	<0.005	<0.005	0.005	<0.005	0.009	<0.005
Major and minor ions																											
Total sodium (mg/L)	11	**32**	**30**	11	**13**	**15**	**20**	**23**	**13**	**12**	11	**13**	**15**	**12**	11	**13**	**13**	**12**	**12**	11	9.5	11	**13**	4.0	11	9.2	**12**
Fluoride	0.11	-	-	-	-	0.06	0.06	-	-	-	-	0.06	-	-	-	-	0.06	0.07	-	-	-	-	0.07	-	-	-	-
Total potassium (mg/L)	-	2.4	2.7	1.7	1.7	2.0	2.0	2.4	2.3	2.4	1.8	1.6	1.2	2.4	1.4	1.2	0.95	1.6	2.3	3.4	2.4	1.7	1.6	10	1.4	3.0	1.6
Total magnesium (mg/L)	-	9.2	8.0	2.1	3.2	4.0	5.0	7.6	3.1	3.5	3.3	4.0	4.8	2.8	3.2	3.9	3.7	3.1	4.5	3.0	2.3	3.2	3.4	1.2	3.1	2.6	3.2
Total calcium (mg/L)	1000	8.2	7.1	2.2	2.6	4.1	4.8	8.0	3.2	4.0	3.4	4.8	6.8	3.4	4.1	4.5	4.4	3.4	5.9	3.7	2.6	3.1	3.5	1.8	3.0	3.3	2.9
Total hardness (mg $CaCO_3$/L)	60-350	**58**	**51**	**14**	**20**	**27**	**33**	**51**	**21**	**25**	**22**	**28**	**37**	**20**	**23**	**27**	**26**	**21**	**33**	**21**	**16**	**21**	**23**	**10**	**20**	**19**	**20**
Chloride, Cl (mg/L)	14	**51**	**72**	**17**	**19**	**24**	**40**	**46**	**21**	**16**	**18**	11	**21**	**19**	9	12	**20**	**18**	**16**	14	**15**	**18**	13	7	**19**	5	**19**
Sulfate as SO_4 (mg/L)	2	0.7	0.8	1.1	0.9	1.2	0.7	0.8	**2.8**	1.8	1.7	1.1	0.6	**7.0**	1.5	1.3	1.1	1.0	0.8	**2.2**	1.5	1.2	0.9	**3.1**	0.8	1.8	1.3
Anion-cation balance (%)	-	7.1	-4.4	0.6	9.9	-2.0	-0.1	-2.9	-4.1	0.6	2.5	11	-4.7	-0.1	6.0	5.1	-3.0	-0.1	-0.9	-1.3	-1.4	0.9	12	7.5	-4.5	15	-0.9
Alkalinity																											
Total alkalinity (mg/L)	33	**42**	29	15	15	31	24	**48**	26	30	20	31	**48**	18	32	33	33	27	**43**	31	20	22	25	16	27	24	21
Bicarbonate alkalinity (mg/L)	-	42	29	15	15	31	24	48	26	30	20	31	48	18	32	33	33	27	43	31	20	22	25	16	27	24	21
Carbonate alkalinity (mg/L)	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Hydroxide alkalinity (mg/L)	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

[1] Water Quality Objectives (WQOs) developed for the project area derived from published guideline values (refer to **Appendix A, Table 2** (base flow conditions)). WQOs are shown as 20th, 50th and 80th percentiles (*ie* 47-72-106), or as a single value of median or 80th percentile (*ie* 15). DO and pH may be shown as a range of 20th and 80th percentiles (*ie* 85-120).

[2] *In situ* pH results for 21 and 22 February 2017 were considered unreliable due to a suspected probe fault. Laboratory analysed pH results have been used in place of *in situ* results for this event.

[3] Hardness-modified trigger values (HMTVs) should be applied to cadmium, lead, nickel and zinc when hardness is above 30 mg/L (as $CaCO_3$). NRA has become aware that, subsequent to the issuing of the ANZECC guidelines, there is recognition in the scientific literature that for some taxa, hardness does not have an ameliorative effect on copper toxicity (Markich *et al.* 2005). In light of this, NRA does not calculate HMTVs for copper. In this case, HMTVs were not required as there were no exceedances of ANZECC guidelines when hardness was above 30 mg/L.

[4] Total Inorganic Nitrogen (also referred to as Dissolved Inorganic Nitrogen (DIN)) has been included as DIN can be used to assist in the interpretation of total nitrogen values. From Queensland Water Quality Guideline 2009 (QWQG) (EHP 2013b): *During periods of low flow and particularly in smaller creeks, build up of organic matter derived from natural sources (eg leaf litter) can result in increased organic N levels (generally in the range of 400 to 800µg/L). This may lead to total N values exceeding the QWQG values. Provided that levels of inorganic N (ie NH3 + oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the guidelines, provided this is due to natural causes.*

[a] The duplicate sample collected on 9 January 2017 did not pass quality assurance procedures. The nature of TSS means it is a highly variable analyte. The failure of the reproducibility is unlikely to compromise the interpretation of the results.

[b] The ANZECC (2000) guideline value for dissolved aluminium only applies to samples where the pH is above 6.5. Due to insufficient data, no guideline value is provided for dissolved aluminium when pH is below 6.5. For reporting purposes, the guideline value for samples with pH above 6.5 has also been applied to samples with pH below 6.5.

[c] As total dissolved solids is analogous to electrical conductivity, a WQO has not been provided for both indicators. Refer to the WQO for electrical conductivity.

Values **bold** and **underlined** exceed WQOs (or are outside the WQO range for pH or dissolved oxygen).

- No value/not applicable.

* SW04 is on a drainage line discharging into Owen Creek.

^ SW08 is on a tributary of Warril Creek.

Upstream of the confluence with Haren Creek.

+ Downstream of the confluence with Haren Creek.

Table 6 *continued*

Analyte	Project-specific WQO[1]	Cain Creek							Warril Creek								Barron River[5]							
		SW06					SW07		SW08^				SW10	SW10 Alt			SW11	SW11 Alt			SW12			
		5/12/16	9/1/17	2/2/17	21/2/17	21/4/17	6/12/16	22/2/17	9/1/17	2/2/17	21/2/17	20/4/17	5/12/16	10/1/17	2/2/17	22/2/17	6/12/16	9/1/17	2/2/17	22/2/17	6/12/16	10/1/17	2/2/17	22/2/17
In situ																								
pH [5]	6.5-8.0	**6.41**	**6.31**	**5.93**	**6.4**	**6.27**	**6.31**	**6.4**	**5.52**	**6.12**	**6.4**	**6.30**	6.72	**6.14**	**6.40**	**6.4**	7.42	6.94	7.01	6.8	7.56	6.71	**6.24**	6.8
Dissolved oxygen (% saturation)	85-120	**63.4**	**69.6**	**60.5**	**77.8**	**77.3**	**76.6**	**68.5**	**23.3**	**56.6**	**57.2**	**64.1**	**53.2**	**33.6**	**61.4**	**68.2**	86.7	89.8	90.2	90.3	91.6	**78.5**	95.7	92.1
Electrical conductivity (µS/cm)	106	68.6	69.6	50.2	65.8	61.3	**108**	88.7	100	72.3	103	91.4	**107**	62.5	61.5	86.1	**143**	**107**	64.7	75.8	**142**	**120**	59.5	**118**
Temperature (°C)	16-34	25.7	25.4	24.8	26.3	23.1	25.4	25.2	23.9	24.5	25.1	24.6	26.5	24.7	25.2	25.1	29.0	27.2	26.2	28.4	28.5	26.4	26.0	29.4
Turbidity (NTU)	15	9.23	8.42	**120**	11.0	**20.1**	2.72	**26.9**	10.6	**34.8**	9.80	**19.5**	6.79	**35.9**	**48.2**	9.29	4.06	**118**	**88.8**	11.3	2.70	**84.1**	**109**	9.30
Suspended and dissolved solids																								
Total suspended solids (mg/L)[a]	8	<1	3[a]	**44**	**15**	8	<1	7	6[a]	**15**	4	6	<1	**15[a]**	**17**	5	<1	**38[a]**	**61**	7	<1	**34[a]**	**57**	5
Volatile suspended solids (mg/L)	-	-	-	12	5	5	-	2	-	7	<1	6	-	-	9	2	-	-	14	<1	-	-	13	<1
Total dissolved solids (mg/L)	-[c]	62	66	54	64	58	78	92	100	68	97	80	85	79	62	77	91	140	70	95	90	140	64	100
Nutrients																								
Total oxidised nitrogen (TON) as N (mg/L)	0.05	**0.14**	**0.20**	**0.25**	**0.25**	**0.24**	**0.79**	**0.16**	**0.063**	**0.11**	**0.15**	**0.16**	**0.080**	**0.15**	**0.29**	**0.23**	0.005	**0.21**	**0.16**	**0.085**	0.010	**0.17**	**0.19**	**0.083**
Nitrate, as N (mg/L)	-	-	-	0.25	0.25	0.24	-	0.16	-	0.11	0.15	0.16	-	-	0.29	0.22	-	-	0.16	0.085	-	-	0.19	0.083
Nitrite, as N (mg/L)	-	-	-	<0.005	<0.005	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-	-	<0.005	0.005	-	-	<0.005	<0.005	-	-	<0.005	<0.005
Ammonia, as N (mg/L)	0.01	**0.023**	**0.047**	**0.031**	**0.023**	**0.046**	0.007	**0.015**	**0.013**	**0.018**	**0.033**	**0.024**	**0.039**	**0.053**	**0.028**	**0.050**	<0.005	**0.014**	**0.014**	**0.011**	**0.011**	**0.025**	**0.020**	**0.011**
Total Kjeldahl Nitrogen (mg/L)	-	0.13	0.20	0.64	0.14	0.17	0.05	0.37	0.77	0.62	0.37	0.28	0.55	0.71	0.60	0.32	0.26	0.71	0.74	0.24	0.31	0.62	0.84	0.22
Total nitrogen (mg/L)	0.34	0.27	**0.40**	**0.89**	**0.39**	**0.42**	**0.84**	**0.53**	**0.83**	**0.73**	**0.53**	**0.44**	**0.63**	**0.86**	**0.89**	**0.54**	0.26	**0.92**	**0.90**	0.33	0.32	**0.80**	**1.0**	0.31
Total inorganic nitrogen (mg/L)[4]	-	0.17	0.24	0.28	0.28	0.29	0.79	0.17	0.08	0.13	0.19	0.18	0.12	0.20	0.32	0.27	<0.01	0.23	0.17	0.10	0.02	0.20	0.21	0.09
Filterable reactive phosphorus (FRP) (mg/L)	0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.025**	<0.005	<0.005	<0.005	**0.018**	<0.005	<0.005
Total phosphorus (mg/L)	0.025	<0.02	<0.02	**0.07**	**0.03**	0.02	<0.02	0.02	**0.03**	<0.02	0.02	<0.01	**0.03**	**0.24**	**0.03**	<0.02	<0.02	**0.13**	**0.05**	<0.02	<0.02	**0.09**	**0.05**	<0.02
Metals and metalloids																								
Dissolved aluminium (mg/L)	0.055[b]	0.018	0.013	**0.43**	0.013	0.018	0.023	0.014	**0.26**	**0.20**	0.032	0.030	0.016	**0.18**	**0.21**	0.018	0.037	**0.74**	**0.57**	**0.22**	0.040	**0.28**	**0.64**	**0.098**
Total aluminium (mg/L)	0.2	0.10	0.20	**4.0**	**0.35**	0.17	0.050	**0.21**	**0.66**	**1.3**	**0.25**	0.20	0.032	**0.87**	**1.3**	0.13	0.070	**3.8**	**3.1**	**0.75**	0.052	**3.5**	**2.7**	**0.74**
Dissolved arsenic (mg/L)	0.01	<0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.002	0.003	0.005	0.002	0.004	0.001	0.001	0.002	0.001	0.001	<0.001	0.001	0.001	0.001	<0.001	0.001
Total arsenic (mg/L)	0.01	0.002	0.003	0.002	0.003	0.002	<0.001	0.003	0.003	0.004	0.008	0.005	0.005	0.002	0.002	0.003	0.001	0.001	0.001	0.002	0.001	0.002	0.001	0.002
Dissolved cadmium (mg/L) [3]	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total cadmium (mg/L)[3]	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dissolved chromium (mg/L)	0.001	<0.001	<0.001	**0.0011**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total chromium (mg/L)	0.05	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001	0.002	0.002	<0.001
Dissolved copper (mg/L) [3]	0.03	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	0.002	0.002	0.002	<0.001	<0.001	0.002	0.001	<0.001
Total copper (mg/L)[3]	0.2	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.003	0.002	<0.001	<0.001	<0.001	0.002	0.002	<0.001	0.001	0.003	0.003	<0.001	<0.001	0.005	0.003	<0.001
Dissolved iron (mg/L)	0.20	**0.40**	**0.51**	**0.88**	**0.43**	**0.52**	0.11	**0.80**	**0.92**	**1.2**	**0.90**	**0.60**	**4.1**	**0.69**	**0.78**	**0.88**	**0.24**	**0.51**	**0.53**	**0.57**	**0.27**	**0.36**	**0.63**	**0.50**
Total iron (mg/L)	0.2	**1.4**	**2.6**	**3.9**	**2.6**	**2.2**	**0.22**	**7.0**	**1.4**	**3.3**	**4.6**	**3.2**	**6.3**	**2.2**	**2.6**	**3.3**	**0.37**	**2.7**	**2.4**	**1.1**	**0.43**	**3.0**	**2.3**	**1.1**
Dissolved lead (mg/L) [3]	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total lead (mg/L)[3]	0.01	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001	0.002	0.002	<0.001
Dissolved manganese (mg/L)	0.01	**0.015**	**0.040**	**0.028**	**0.028**	**0.019**	**0.014**	**0.042**	**0.034**	**0.015**	**0.018**	0.010	**0.14**	**0.041**	**0.024**	**0.054**	0.009	**0.016**	**0.014**	**0.021**	**0.024**	**0.055**	**0.014**	**0.037**
Total manganese (mg/L)	0.1	0.015	0.050	0.036	0.038	0.022	0.014	0.048	0.038	0.019	0.022	0.013	**0.35**	0.070	0.036	0.069	0.054	0.089	0.050	0.044	0.044	**0.23**	0.049	0.052
Dissolved nickel (mg/L) [3]	0.011	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Total nickel (mg/L)[3]	0.02	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	0.003	0.002	<0.001	<0.001	0.003	0.002	<0.001
Dissolved zinc (mg/L) [3]	0.02	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total zinc (mg/L)[3]	2	<0.005	<0.005	0.009	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Major and minor ions																								
Total sodium (mg/L)	11	7.1	7.8	5.6	6.7	7.1	11	8.9	11	8.6	11	11	9.0	6.5	6.6	8.6	11	9.8	7.4	11	11	11	6.5	11
Fluoride	0.11	-	-	-	-	0.07	-	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	-	-
Total potassium (mg/L)	-	1.0	1.2	1.8	1.0	0.99	0.68	1.3	2.3	1.4	1.1	0.84	1.7	2.4	1.8	1.1	2.0	3.9	2.2	1.7	2.0	3.8	2.1	1.7
Total magnesium (mg/L)	-	1.7	1.7	1.0	1.6	1.4	2.7	2.4	1.9	1.5	2.6	2.2	3.1	1.4	1.4	2.3	**5.7**	3.1	1.8	3.9	**5.3**	3.7	1.6	3.9
Total calcium (mg/L)	1000	1.3	1.2	0.70	1.1	0.96	1.7	2.2	1.6	1.3	2.1	1.7	3.6	1.5	1.4	2.1	5.6	4.1	1.8	4.6	5.0	4.9	1.6	4.6
Total hardness (mg $CaCO_3$/L)	60-350	**10**	**10**	**6**	**9**	**8**	**15**	**15**	**12**	**9**	**16**	**13**	**22**	**10**	**9**	**15**	**37**	**23**	**12**	**28**	**34**	**27**	**11**	**28**
Chloride (mg/L)	14	6	10	8	9	5	**20**	14	**18**	14	**18**	**17**	12	10	10	**15**	**15**	14	11	**16**	14	**15**	10	**16**
Sulfate as SO_4 (mg/L)	2	0.5	0.9	1.7	0.7	0.7	0.9	0.9	**5.3**	1.9	1.0	1.0	0.6	1.7	1.5	0.8	0.7	**2.3**	1.4	1.4	0.7	**2.3**	1.3	1.3
Anion-Cation Balance (%)	-	-5.5	-8.8	-6.6	-4.1	14	-8.0	-1.2	-0.5	-3.3	0.6	-0.7	7.2	-1.9	-6.6	-1.9	-4.0	-0.4	6.6	-1.1	-3.3	-0.6	2.9	-0.3
Alkalinity																								
Total alkalinity (mg/L)	33	21	19	11	13	11	15	17	9	13	15	12	26	13	14	16	**47**	28	11	31	**44**	32	12	30
Bicarbonate alkalinity (mg/L)	-	21	19	11	13	11	15	17	9	13	15	12	26	13	14	16	47	28	11	31	44	32	12	30
Carbonate alkalinity (mg/L)	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Hydroxide alkalinity (mg/L)	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

[1] Water Quality Objectives (WQOs) developed for the project area derived from published guideline values (refer to **Appendix A, Table 2** (base flow conditions)). WQOs are shown as 20th, 50th and 80th percentiles (*ie* 47-72-106), or as a single value of median or 80th percentile (*ie* 15). DO and pH may be shown as a range of 20th and 80th percentiles (*ie* 85-120).

[2] *In situ* pH results for 21 and 22 February 2017 were considered unreliable due to a suspected probe fault. Laboratory analysed pH results have been used in place of *in situ* results for this event.

[3] Hardness-modified trigger values (HMTVs) should be applied to cadmium, lead, nickel and zinc when hardness is above 30 mg/L (as $CaCO_3$). NRA has become aware that, subsequent to the issuing of the ANZECC guidelines, there is recognition in the scientific literature that for some taxa, hardness does not have an ameliorative effect on copper toxicity (Markich *et al.* 2005). In light of this, NRA does not calculate HMTVs for copper. In this case, HMTVs were not required as there were no exceedances of ANZECC guidelines when hardness was above 30 mg/L.

[4] Total Inorganic Nitrogen (also referred to as Dissolved Inorganic Nitrogen (DIN)) has been included as DIN can be used to assist in the interpretation of total nitrogen values. From Queensland Water Quality Guideline 2009 (QWQG) (EHP 2013b): *During periods of low flow and particularly in smaller creeks, build up of organic matter derived from natural sources (eg leaf litter) can result in increased organic N levels (generally in the range of 400 to 800µg/L). This may lead to total N values exceeding the QWQG values. Provided that levels of inorganic N (ie NH3 + oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the guidelines, provided this is due to natural causes.*

[4] The WQOs developed for the project area do not apply directly to the waters of the Barron River, due to the differences in the EVs applicable between the project area sub-catchment (Kauri, Groves, Thirty Three Mile, Blackwater, One Mile, Mona, Jumrum, Haren and Dismal Creeks) and the Barron River main channel sub-catchment. However, the WQOs have been used to assess water quality collected from the Barron River during baseline monitoring for comparative purposes.

[a] The duplicate sample collected on 9 January 2017 did not pass quality assurance procedures. The nature of TSS means it is a highly variable analyte. The failure of the reproducibility is unlikely to compromise the interpretation of the results.

[b] The ANZECC (2000) guideline value for dissolved aluminium only applies to samples where the pH is above 6.5. Due to insufficient data, no guideline value is provided for dissolved aluminium when pH is below 6.5. For reporting purposes, the guideline value for samples with pH above 6.5 has also been applied to samples with pH below 6.5.

[c] As total dissolved solids is analogous to electrical conductivity, a WQO has not been provided for both indicators. Refer to the WQO for electrical conductivity.

Values **bold** and **underlined** exceed WQOs (or are outside the WQO range for pH or dissolved oxygen).

- No value/not applicable.

* SW04 is on a drainage line discharging into Owen Creek.

[^] SW08 is on a tributary of Warril Creek.

[#] Upstream of the confluence with Haren Creek.

[+] Downstream of the confluence with Haren Creek.

Table 7: Suspended solids surface water quality results for full suite and opportunistic sampling events

Analyte and sample date	Project-specific WQO^	Owen Creek$^{\#}$		Haren Creek			Owen Creek^{+}			Cain Creek			Warril Creek		Barron River		
		SW01	SW01B	SW09	SW02	SW02B	SW03	SW04$^{=}$	SW05$^{\%}$	SW06	SW16	SW07	SW08$^{\sim}$	SW10$^{\%}$	SW11$^{\%}$	SW15	SW12
Total suspended solids (TSS) (mg/L)																	
5-6/12/2017	8	4	-	<1	**18**	-	7	-	<1	<1	-	<1	-	<1	<1	-	<1
13/12/2017*	52^{a}	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-
6/1/2017*	52^{a}	-	-	-	6	-	**76**	31	7	-	-	16	15	-	52	-	-
9-10/1/2017	52^{a}	2	-	29	7	-	12	-	-	3	-	-	6	15	38	-	34
1-2/2/2017	52^{a}	6	-	47	16	-	**53**	**81**	42	44	-	-	15	17	**61**	-	**57**
2/2/2017*	52^{a}	-	-	-	-	-	28	33	18	-	-	-	-	-	-	44	-
21-22/2/2017	8	4	-	**9**	5	-	2	-	3	**15**	-	7	4	5	7	-	5
20-21/4/2017	8	3	2	4	5	2	2	-	-	8	-	-	6	-	-	-	-
21/4/2017*	8	-	-	-	-	-	-	-	<1	-	6	5	-	3	**9**	-	6
Volatile suspended solids (VSS) (mg/L)																	
13/12/2016*	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
6/1/2017*	-	-	-	-	6	-	28	15	7	-	-	12	12	-	16	-	-
1-2/2/2017	-	5	-	11	1	-	11	15	6	12	-	-	7	9	14	-	13
2/2/2017*	-	-	-	-	-	-	11	11	10	-	-	-	-	-	-	13	-
21-22/2/2017	-	2	-	3	<1	-	<1	-	<1	5	-	2	<1	2	<1	-	<1
20-21/4/2017	-	3	2	4	5	2	2	-	-	5	-	-	6	-	-	-	-
21/4/2017*	-	-	-	-	-	-	-	-	<1	-	-	4	4	3	4	-	4

Values **bold** and **underlined** exceed WQOs.

* TSS/VSS only events.

^ Water Quality Objectives (WQOs) derived from published guideline values (refer to **Appendix A, Table 2**).

[a] WQO for TSS during high flow periods (refer to **Appendix A, Table 3**).

[#] Upstream of the confluence with Haren Creek.

[+] Downstream of the confluence with Haren Creek.

[=] SW04 is on a drainage line discharging into Owen Creek.

[~] SW08 is on a tributary of Warril Creek.

[%] Data includes alternative sites (*ie* SW05 Alt, SW10 Alt, SW11 Alt) sampled during periods of high flow in the Barron River.

Table 8: Surface water quality results with comparison to an unimpacted rainforest stream (Jarra Creek)

Analyte	Unimpacted Rainforest Stream (Jarra Creek)			Owen Creek[#]						Haren Creek											Owen Creek[+]								
				SW01					SW01B	SW09					SW02					SW02B	SW03					SW04*	SW05	SW05 Alt	SW05
	Median	Max.	Min.	5/12/16	9/1/17	1/2/17	21/2/17	21/4/17	20/4/17	5/12/16	9/1/17	1/2/17	21/2/17	21/4/17	5/12/16	9/1/17	1/2/17	21/2/17	20/4/17	20/4/17	6/12/16	9/1/17	1/2/17	21/2/17	21/4/17	1/2/17	6/12/16	1/2/17	21/2/17
In situ																													
pH [1]	6.42	6.99	6.08	6.35	6.46	6.65	6.4	6.41	6.41	6.56	6.36	6.62	6.5	6.61	6.34	6.15	6.38	6.5	6.32	6.73	6.69	6.66	6.43	6.6	6.75	6.57	6.70	6.40	6.5
Dissolved oxygen (% saturation)	97	115.6	90.4	**13.7**	**26.7**	**60.1**	**12.8**	**11.4**	**34.4**	**28.1**	**40.9**	**35.3**	**21.3**	**14.7**	**3.2**	**16.5**	**28.2**	**16.9**	**30.2**	**69.6**	**2.4**	**62.1**	**79.9**	**68.3**	**71.4**	**87.0**	**78.2**	**26.6**	**15.3**
Electrical conductivity (µS/cm)	45	58	34.7	**378**	**314**	**95.9**	**136.4**	**154.7**	**197.1**	**265**	**130.3**	**123.0**	**116.5**	**139.2**	**171**	**122.3**	**120.1**	**141.1**	**133.9**	**114.9**	**141**	**110.8**	**92.6**	**117.2**	**127.8**	**66.8**	**122.4**	**99.8**	**117.9**
Turbidity (NTU)	0.95	22	0.25	5.45	2.48	6.36	5.19	2.03	2.53	4.46	**61.8**	**98.0**	14.00	7.65	**46.9**	16.64	**24.7**	10.76	15.07	6.2	8.02	**30.6**	**74.2**	6.23	4.76	**317**	3.21	**60.3**	4.77
Suspended and dissolved solids																													
Total suspended solids (mg/L)[a]	1.7	16	1	4	2[a]	6	4	3	2	<1	**29[a]**	**47**	9	4	**18**	7[a]	16	5	5	2	7	**12[a]**	**53**	2	2	**81**	<1	**42**	3
Volatile suspended solids (mg/L)		11.2	5	-	-	5	2	3	2	-	-	11	3	4	-	-	1	<1	5	2	-	-	11	<1	2	**15**	-	6	<1
Nutrients																													
Total oxidised nitrogen as N (mg/L)	0.171	0.237	0.1	0.010	0.036	<0.005	0.032	0.014	0.033	0.024	0.048	0.024	0.049	0.007	<0.005	0.026	<0.005	0.050	0.041	0.14	0.009	0.027	0.066	0.097	0.066	0.030	0.084	0.14	0.23
Nitrate, as N (mg/L)		0.21	0.1	-	-	<0.005	0.032	0.014	0.033	-	-	0.024	0.049	<0.005	-	-	<0.005	0.050	0.040	0.14	-	-	0.066	0.097	0.065	0.028	-	0.14	**0.23**
Nitrite, as N (mg/L)		0.005	0.0008	-	-	<0.005	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	<0.005	-	-	<0.005	<0.005	<0.005	<0.005	-	<0.005	<0.005
Ammonia, as N (mg/L)	0.005	0.038	0.0025	0.017	0.018	<0.005	0.014	0.020	0.036	**0.045**	**0.055**	0.015	0.008	**0.11**	0.015	0.019	**0.068**	**0.043**	**0.045**	<0.005	**0.047**	**0.070**	0.028	0.023	0.015	0.009	0.012	**0.092**	0.012
Total nitrogen (mg/L)	0.18	0.4	0.0634	**0.51**	**0.45**	**0.64**	**0.54**	**0.52**	**0.45**	**0.44**	**0.85**	**0.74**	**0.66**	**0.52**	**0.64**	**0.57**	**0.59**	**0.43**	0.31	**0.55**	**0.72**	**0.88**	**1.0**	**0.58**	**0.46**	**1.8**	0.31	**1.0**	**0.65**
Filterable reactive phosphorus (mg/L)	0.015	0.018	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.21**	<0.005	0.006	<0.005
Total phosphorus (mg/L)	0.021	0.0359	0.005	0.03	0.03	0.03	0.03	0.02	0.02	<0.02	**0.05**	**0.04**	0.03	0.01	**0.07**	0.03	0.03	0.03	0.02	0.02	**0.08**	**0.07**	**0.07**	0.02	0.02	**0.42**	<0.02	**0.08**	0.02
Metals and metalloids																													
Dissolved cadmium (mg/L)	0.000025	0.000025	0.000025	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dissolved chromium (mg/L)	0.0001	0.0008	0.00005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0043**	<0.001	**0.0010**	<0.001
Dissolved copper (mg/L)	0.000275	0.0006	0.0001	<0.001	<0.001	**0.001**	<0.001	<0.001	<0.001	<0.001	**0.002**	**0.001**	**0.001**	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.001	<0.001	<0.001	**0.001**	**0.001**	<0.001	<0.001	**0.004**	<0.001	**0.002**	<0.001
Dissolved nickel (mg/L)	0.00025	0.001	0.00005	<0.001	<0.001	0.001	0.001	0.001	0.001	<0.001	0.001	0.002	0.001	<0.001	0.001	0.002	0.001	0.001	0.001	<0.001	0.001	0.002	0.001	0.001	<0.001	<0.001	<0.001	0.002	0.001
Dissolved zinc (mg/L)	0.00325	0.015	0.0005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005	0.007	<0.005
Major and minor ions																													
Total hardness (mg $CaCO_3$/L)	5.5	7	5	**58**	**51**	**14**	**20**	**27**	**33**	**51**	**21**	**25**	**22**	**28**	**37**	**20**	**23**	**27**	**26**	**21**	**33**	**21**	**16**	**21**	**23**	**10**	**20**	**19**	**20**

[1] *In situ* pH results for 21 and 22 February 2017 were considered unreliable due to a suspected probe fault. Laboratory analysed pH results have been used in place of *in situ* results for this event.

[a] The duplicate sample collected on 9 January 2017 did not pass quality assurance procedures. The nature of TSS means it is a highly variable analyte. The failure of the reproducibility is unlikely to compromise the interpretation of the results.

Values **bold** and **underlined** exceed Jarra Creek maximum values or (or are outside the minimum and maximum value range for pH or dissolved oxygen).

- No value/not applicable.

* SW04 is on a drainage line discharging into Owen Creek.

[^] SW08 is on a tributary of Warril Creek.

[#] Upstream of the confluence with Haren Creek.

[+] Downstream of the confluence with Haren Creek.

Table 8 *continued*

Analyte	Unimpacted Rainforest Stream (Jarra Creek)			Cain Creek							Warril Creek								Barron River							
				SW06					SW07		SW08^				SW10	SW10 Alt			SW11	SW11 Alt			SW12			
	Median	Max.	Min.	5/12/16	9/1/17	2/2/17	21/2/17	21/4/17	6/12/16	22/2/17	9/1/17	2/2/17	21/2/17	20/4/17	5/12/16	10/1/17	2/2/17	22/2/17	6/12/16	9/1/17	2/2/17	22/2/17	6/12/16	10/1/17	2/2/17	22/2/17
In situ																										
pH [1]	6.42	6.99	6.08	6.41	6.31	**5.93**	6.4	6.27	6.31	6.4	**5.52**	6.12	6.4	6.3	6.72	6.14	6.40	6.4	**7.42**	6.94	**7.01**	6.8	**7.56**	6.71	6.24	6.8
Dissolved oxygen (% saturation)	97	115.6	90.4	**63.4**	**69.6**	**60.5**	**77.8**	**77.3**	**76.6**	**68.5**	**23.3**	**56.6**	**57.2**	**64.1**	**53.2**	**33.6**	**61.4**	**68.2**	**86.7**	**89.8**	**90.2**	**90.3**	91.6	**78.5**	95.7	92.1
Electrical conductivity (µS/cm)	45	58	34.7	**68.6**	**69.6**	50.2	**65.8**	**61.3**	**108.7**	**88.7**	**100.9**	**72.3**	**103.4**	**91.4**	**107.6**	**62.5**	**61.5**	**86.1**	**142.8**	**107.4**	**64.7**	**75.8**	**142.2**	**120.2**	**59.5**	**117.5**
Turbidity (NTU)	0.95	22	0.25	9.23	8.42	**120**	11.01	20.1	2.72	**26.9**	10.61	**34.8**	9.80	19.49	6.79	**35.9**	**48.2**	9.29	4.06	**118**	**88.8**	11.29	2.70	**84.1**	**109**	9.30
Suspended and dissolved solids																										
Total suspended solids (mg/L)[a]	1.7	16	1	<1	3[a]	**44**	15	8	<1	7	6[a]	15	4	6	<1	15[a]	**17**	5	<1	**38[a]**	**61**	7	<1	**34[a]**	**57**	5
Volatile suspended solids (mg/L)		11.2	5	-	-	**12**	5	5	-	2	-	7	<1	6	-	-	9	2	-	-	**14**	<1	-	-	**13**	<1
Nutrients																										
Total oxidised nitrogen as N (mg/L)	0.171	0.237	0.1	0.14	0.20	**0.25**	**0.25**	**0.24**	**0.79**	0.16	0.063	0.11	0.15	0.16	0.080	0.15	**0.29**	0.23	0.005	0.21	0.16	0.085	0.010	0.17	0.19	0.083
Nitrate, as N (mg/L)		0.21	0.1	-	-	**0.25**	**0.25**	**0.24**	-	0.16	-	0.11	0.15	0.16	-	-	**0.29**	**0.22**	-	-	0.16	0.085	-	-	0.19	0.083
Nitrite, as N (mg/L)		0.005	0.0008	-	-	<0.005	<0.005	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	-	-	<0.005	0.005	-	-	<0.005	<0.005	-	-	<0.005	<0.005
Ammonia, as N (mg/L)	0.005	0.038	0.0025	0.023	**0.047**	0.031	0.023	**0.046**	0.007	0.015	0.013	0.018	0.033	0.024	**0.039**	**0.053**	0.028	**0.050**	<0.005	0.014	0.014	0.011	0.011	0.025	0.020	0.011
Total nitrogen (mg/L)	0.18	0.4	0.0634	0.27	0.40	**0.89**	0.39	**0.42**	**0.84**	**0.53**	**0.83**	**0.73**	**0.53**	**0.44**	**0.63**	**0.86**	**0.89**	**0.54**	0.26	**0.92**	**0.90**	0.33	0.32	**0.80**	**1.0**	0.31
Filterable reactive phosphorus (mg/L)	0.015	0.018	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	**0.025**	<0.005	<0.005	<0.005	0.018	<0.005	<0.005
Total phosphorus (mg/L)	0.021	0.0359	0.005	<0.02	<0.02	**0.07**	0.03	0.02	<0.02	0.02	0.03	<0.02	0.02	<0.01	0.03	**0.24**	0.03	<0.02	<0.02	**0.13**	**0.05**	<0.02	<0.02	**0.09**	**0.05**	<0.02
Metals and metalloids																										
Dissolved cadmium (mg/L)	0.000025	0.000025	0.000025	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dissolved chromium (mg/L)	0.0001	0.0008	0.00005	<0.001	<0.001	**0.0011**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved copper (mg/L)	0.000275	0.0006	0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.002**	**0.001**	<0.001	<0.001	<0.001	**0.001**	**0.001**	<0.001	**0.002**	**0.002**	**0.002**	<0.001	<0.001	**0.002**	**0.001**	<0.001
Dissolved nickel (mg/L)	0.00025	0.001	0.00005	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Dissolved zinc (mg/L)	0.00325	0.015	0.0005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Major and minor ions																										
Total hardness (mg $CaCO_3$/L)	5.5	7	5	**10**	**10**	6	**9**	**8**	**15**	**15**	**12**	**9**	**16**	**13**	**22**	**10**	**9**	**15**	**37**	**23**	**12**	**28**	**34**	**27**	**11**	**28**

[1] *In situ* pH results for 21 and 22 February 2017 were considered unreliable due to a suspected probe fault. Laboratory analysed pH results have been used in place of *in situ* results for this event.

[a] The duplicate sample collected on 9 January 2017 did not pass quality assurance procedures. The nature of TSS means it is a highly variable analyte. The failure of the reproducibility is unlikely to compromise the interpretation of the results.

Values **bold** and **underlined** exceed Jarra Creek maximum values or (or are outside the minimum and maximum value range for pH or dissolved oxygen).

- No value/not applicable.

* SW04 is on a drainage line discharging into Owen Creek.

^ SW08 is on a tributary of Warril Creek.

[#] Upstream of the confluence with Haren Creek.

[+] Downstream of the confluence with Haren Creek.

Haren Creek (sites SW02, SW02B and background site SW09)

The results collected from Haren Creek sites showed the following.

- Water quality analytes at Haren Creek sites were recorded outside one or more WQOs during the monitoring period (including for physico-chemical properties, nutrients, metals, ions and alkalinity).
- Water quality at Haren Creek sites exceeded maximum values recorded in Jarra Creek (an unimpacted Wet Tropics rainforest stream) for a number of analytes, including dissolved oxygen, EC, turbidity, TSS, ammonia, TN, TP, dissolved copper and hardness.
- Several analyte levels recorded at downstream sites SW02 and SW02B across the monitoring period were comparable to, or lower than, conditions observed across the monitoring period at upstream site SW09 (including electrical conductivity, turbidity, dissolved and total aluminium, ions and alkalinity).
- Site SW02 recorded lower levels of most analytes across the monitoring period compared to upstream site SW09, with the exception of higher levels of ammonia, total phosphorus, dissolved and total iron and dissolved and total manganese on several occasions.
- Site SW02B recorded higher levels of TON (*ie* nitrate, as nitrite was recorded below the LOR) and dissolved iron compared to upstream sites SW02 and SW09.
- Dissolved oxygen was reduced at site SW02, but generally comparable to SW09 and benchmark site SW01 levels on most occasions. Dissolved oxygen was lowest at site SW02 during the first sampling event on 5 December 2016.
- Water quality at Haren Creek sites showed a general decrease in electrical conductivity with the onset of the wet season in January 2017.
- An increase in TSS was observed at SW09 coinciding with high rainfall events (January and February 2017). This correspondence between TSS and rainfall was not clear for SW02 data. Upstream activities may have a greater influence on local water quality.

Owen Creek (site SW01B and benchmark site SW01)

Owen Creek benchmark site SW01 and site SW01B are upstream of the confluence with Haren Creek and upstream of project area activities. Results from SW01 and SW01B show the following.

- Water quality analytes at Owen Creek sites were recorded outside one or more WQOs during the monitoring period (including for physico-chemical properties, nutrients, metals, ions and alkalinity).
- Water quality at Owen Creek sites exceeded maximum values recorded in Jarra Creek (an unimpacted Wet Tropics rainforest stream) for a number of analytes, including dissolved oxygen, EC, TN, dissolved copper and hardness.
- Water quality at sites SW01 and SW01B was generally comparable to water quality at background site SW09.
- SW01 recorded slightly acidic water, reduced dissolved oxygen, elevated EC generally low turbidity and total and volatile suspended solids, elevated nutrients (ammonia, TN and TP) and low concentrations of most metals and metalloids in comparison to WQOs.
- Water quality at SW01 and SW01B did not show a clear seasonal or event-based pattern, with the exception that EC and total dissolved solids were higher prior to the onset of the wet season.

Owen Creek (site SW03)

Site SW03 is downstream of the confluence of Owen and Haren Creeks, and receives run-off from the project area, including the Produce Farm Sediment Traps. Results from SW03 show the following.

- Water quality analytes at site SW03 were recorded outside one or more WQOs during the monitoring period (including for physico-chemical properties, nutrients, metals, ions and alkalinity).
- Water quality at site SW03 exceeded maximum values recorded in Jarra Creek (an unimpacted Wet Tropics rainforest stream) for a number of analytes, including dissolved oxygen, EC, turbidity, TSS, ammonia, TN, TP, dissolved copper and hardness.
- Many analyte levels recorded at site SW03 were lower than or comparable to levels observed at benchmark site SW01 (*eg* pH, dissolved oxygen, EC, most metals and metalloids, ions and alkalinity).
- Concentrations of several nutrients were elevated at SW03 compared to upstream benchmark site SW01, and were higher than concentrations recorded at upstream Haren Creek site SW02 (*eg* TON (*ie* nitrate, as nitrite was recorded below the LOR), ammonia, total nitrogen, total phosphorus).
- Concentrations of metals, including dissolved and total aluminium, iron and manganese, were higher on several occasions at SW03 than upstream and benchmark sites.

Drainage line to Owen Creek (site SW04)

Site SW04 was dry during most sampling events. One sample was collected and analysed for the full analyte suite on 1 February 2017, with TSS and VSS sampling undertaken on 6 January 2017 and 2 February 2017. The results collected from SW04 show the following.

- Water quality analytes at site SW04 were recorded outside one or more WQOs during the monitoring period (including for turbidity and total suspended solids, nutrients, metals and sulfate).
- Water quality at site SW04 exceeded maximum values recorded in Jarra Creek (an unimpacted Wet Tropics rainforest stream) for a number of analytes, including dissolved oxygen, EC, turbidity, TSS, VSS, TN, FRP, TP, dissolved chromium, dissolved copper and hardness.
- The highest concentration of TSS was recorded at site SW04, downstream of the dam constructed during 2015/2016, on 1 February 2017 (81 mg/L), and exceeded the Barron River WQO for high flow conditions (52 mg/L). This sample was collected during a 100 mm rainfall event. Most of the TSS was inorganic matter (*ie* VSS concentrations during this sampling event (15 mg/L) were comparable to those recorded at this site for samples with lower TSS concentrations).
- A number of analytes, including turbidity, nutrients (total Kjeldahl nitrogen, total nitrogen, filterable reactive phosphorus, TP), and metals and metalloids (*eg* dissolved and total aluminium, chromium and copper), were elevated compared to WQOs and higher at SW04 than at other sites on Haren and Owen Creeks (including benchmark and background sites).

Cain Creek (SW06)

Results from Cain Creek site SW06 show the following.

- Water quality analytes at site SW06 were recorded above outside or more WQOs during the monitoring period (including for physico-chemical properties, nutrients, metals and ions).

- Water quality at site SW06 exceeded maximum values recorded in Jarra Creek (an unimpacted Wet Tropics rainforest stream) for a number of analytes, including pH, dissolved oxygen, EC, turbidity, TSS, VSS, TON, nitrate, ammonia, TN, TP, dissolved chromium and hardness.
- Most analyte levels recorded across the monitoring period at SW06 were comparable to or below levels recorded at benchmark site SW01, with the exception of turbidity, TSS, nutrients (TON (*ie* nitrate, as nitrite was recorded below the LOR), ammonia) and several metals (including dissolved aluminium, dissolved and total chromium, iron and total copper and zinc).

Tributary of Warril Creek (SW08)

Results from site SW08 on a tributary of Warril Creek show the following.

- Water quality analytes at site SW08 were recorded outside one or more WQOs during the monitoring period (including for physico-chemical properties, nutrients, metals and ions).
- Water quality at site SW08 exceeded maximum values recorded in Jarra Creek (an unimpacted Wet Tropics rainforest stream) for a number of analytes, including pH, dissolved oxygen, EC, turbidity, TN, dissolved copper and hardness.
- Most analyte levels recorded across the monitoring period at SW08 were comparable to or below levels recorded at benchmark site SW01, with the exception of turbidity, TSS, nutrients (TON (*ie* nitrate, as nitrite was recorded below the LOR), ammonia, total nitrogen) and several metals.
- Turbidity was higher at SW08 than benchmark site SW01.
- Concentrations of total oxidised nitrogen (*ie* nitrate), ammonia and total nitrogen were elevated at SW08 compared to benchmark site SW01.
- Several metals, including total aluminium and chromium, dissolved and total arsenic, copper and iron were higher than benchmark site SW01 concentrations on several occasions during the monitoring period.

Downstream sites on Owen Creek (SW05), Cain Creek (SW07) and Warril Creek (SW10)

- Water quality analytes at downstream sites on Owen Creek (SW05), Cain Creek (SW07) and Warril Creek (SW10) were recorded outside one or more WQOs during the monitoring period (including for physico-chemical properties, nutrients, metals and ions).
- Water quality at downstream sites on Owen Creek (SW05), Cain Creek (SW07) and Warril Creek (SW10) exceeded maximum values recorded in Jarra Creek (an unimpacted Wet Tropics rainforest stream) for a number of analytes, including dissolved oxygen, EC, turbidity, hardness (all sites), TSS, nitrate, ammonia, TN, TP and dissolved copper (SW05, SW10), TON (SW07, SW10), and dissolved chromium (SW05).
- Many analyte levels at downstream site SW05 were comparable to or below levels recorded at benchmark site SW01 or background site SW09 across the monitoring period, including pH, dissolved oxygen, EC, turbidity, TSS and all metals and metalloids with the exception of total and dissolved zinc.
- Total and dissolved zinc concentrations at SW05 on 1 February 2017 were higher than at upstream sites SW03 and SW04 across the monitoring period.
- Several analytes at Cain Creek downstream site SW07 were recorded at levels greater than those recorded at benchmark site SW01, background site SW09 or upstream site SW06, including TON, total inorganic nitrogen and total iron.

- Downstream site SW10 on Warril Creek recorded concentrations of nutrients (including TON (*ie* nitrate, as nitrite was recorded at or below the LOR), ammonia, total nitrogen and total phosphorus) higher than those recorded at upstream site SW08, which is on the downstream boundary of the project area. Other analytes recorded at SW10 across the monitoring period were within levels recorded at benchmark site SW01, background site SW09 or upstream site SW08.

Barron River (site SW11 (upstream), site SW12 (downstream))

- Water quality analytes on the Barron River (sites SW11 and SW12) were recorded outside one or more WQOs during the monitoring period (including for physico-chemical properties, nutrients, metals, ions and alkalinity).
- Water quality on the Barron River (sites SW11 and SW12) exceeded maximum values recorded in Jarra Creek (an unimpacted Wet Tropics rainforest stream) for a number of analytes, including pH, dissolved oxygen, EC, turbidity, TSS, VSS, TN, FRP (SW11), TP, dissolved copper, and hardness.
- Analyte levels recorded at Barron River site SW11 (upstream of confluence with Owen Creek) were generally comparable to or higher than levels recorded at SW12 (downstream of confluence with Warril Creek) during the same sampling event.
- For several analytes where an increase was observed between upstream and downstream samples collected from the Barron River, levels were also elevated at one or more sites monitored within the project area (*eg* turbidity and total nitrogen during the sampling event on 1 and 2 February).

General surface water quality observations

- Surface water quality at sites SW01 and SW09 (upstream of project area activities but influenced by access tracks (SW01) and off-site activities (SW09)) recorded concentrations of nutrients generally comparable to or lower than data collected for reference waters in tropical rainforests of the Tully area (Jarra Creek) with the exception of:
    - total nitrogen, which was higher in most samples collected from project area waters.
    - ammonia and total phosphorus, which was higher in some samples collected from site SW09.
- Sites adjacent to or immediately downstream of the project area generally recorded concentrations of nutrients comparable to or lower than data collected for reference waters in tropical rainforests of the Tully area (Jarra Creek), or lower than concentrations recorded at SW01 or SW09. Exceptions occurred at site SW04 (downstream of the farm dam, sampled on one occasion and recording elevated TN, FRP and TP).
- Some metals were higher in the project area upstream waters than Jarra Creek unimpacted rainforest waters, *ie* chromium, copper and nickel.
- Total and bicarbonate alkalinity and major and minor ions were generally highest prior to the onset of the wet season (during the December 2016 sampling event).
- Sulfate generally recorded the highest concentrations during the sample event following the first significant rainfall events (January 2017).
- TSS concentrations were generally lowest during the first sampling event in December 2016, increased during the wet season with the highest levels coinciding with high rainfall events, and decreased again towards the end of the wet season.
- Total and dissolved aluminium concentrations generally increased following the onset of the wet season and high rainfall events (January 2017 and February 2017), and decreased in subsequent sample events at several sites. The increase in aluminium concentrations is

likely to be associated with the increased suspended solids mobilised by rainfall into creeks, with aluminium a major constituent of most soils.

- Increases in TN and TP concentrations are generally associated with increases in TSS, whereas increases in TON and ammonia (soluble mineral forms) appear to be largely independent of TSS.

4.6 Stream sediment results

Stream sediment sampling was undertaken as a component of the aquatic ecology – aquatic macroinvertebrate survey. Samples were collected at sites SW01B, SW02, SW02B and SW08.

Stream sediment analysis results are presented in **Table 9**, and show that all results were below the published guideline values for aquatic ecosystems with the exception of arsenic (21 mg/kg) at site SW08, which was marginally above the published guideline value (20 mg/kg). Confidence in the exceedance is low given the analytical variability of reported laboratory figures and cannot be confirmed based on a single sample. Analyte concentrations in stream sediments were generally lowest at site SW01B on Owen Creek. The concentration of analytes in stream sediments was variable at sites SW02, SW02B and SW08, with no site consistently recording a higher concentration for all analytes reported.

The laboratory analysis reports, sample receipt advice and chain of custody documentation are provided in **Appendix D**.

Table 9: Stream sediment results

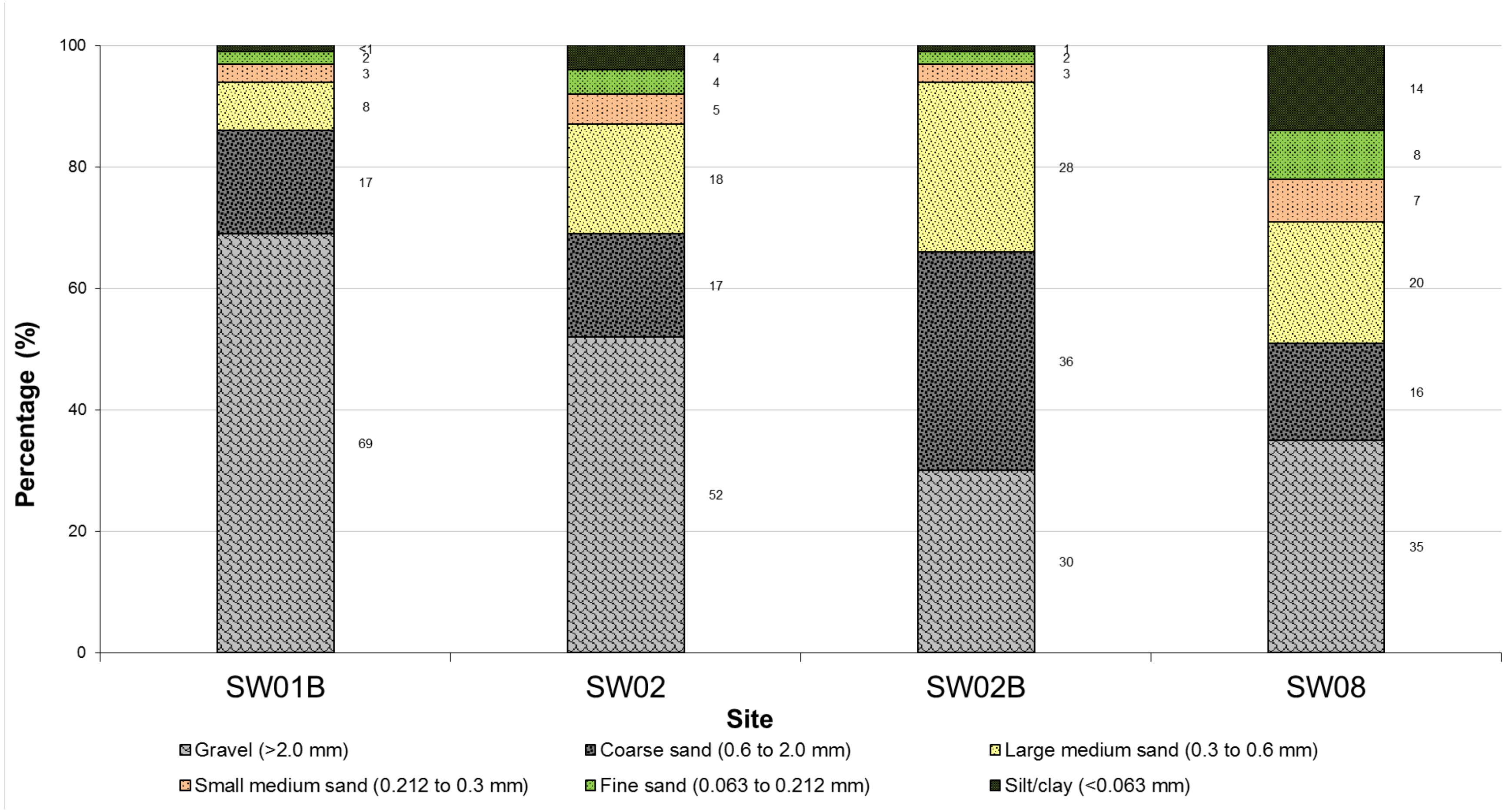
Analyte	Units	Published GV[1]	Owen Creek	Haren Creek		Warril Creek
			SW01B	SW02	SW02B	SW08^
Arsenic	mg/kg	20	0.9	2.6	1.2	**21**
Cadmium	mg/kg	1.5	<0.1	<0.1	<0.1	0.1
Chromium	mg/kg	80	1.8	25	4.8	24
Copper	mg/kg	65	1.0	5.0	1.3	3.5
Manganese	mg/kg	-	26	47	76	27
Nickel	mg/kg	21	1.2	3.5	1.2	1.8
Lead	mg/kg	50	1.8	4.2	2.2	8.7
Zinc	mg/kg	200	6.0	8.7	5.7	11

[1] Published guideline values (GVs) were taken from Table 2 of the Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines (Simpson *et al.* 2013).

^ SW08 is on a tributary of Warril Creek.

Particle size distribution (PSD) results are presented on **Graph 3** and show the following.

- The stream sediment at site SW01B contained a higher proportion of gravel than other sites.
- Site SW01B and SW02B had comparatively low levels of fine sediments (small medium sand, fine sand and silt/clay).
- Stream sediment at site SW08 recorded the highest proportion of fine sediments (small medium sand, fine sand and silt/clay).
- The combined proportion of coarse sand and large medium sand was highest at site SW02B.



Graph 3: Sediment particle size distribution

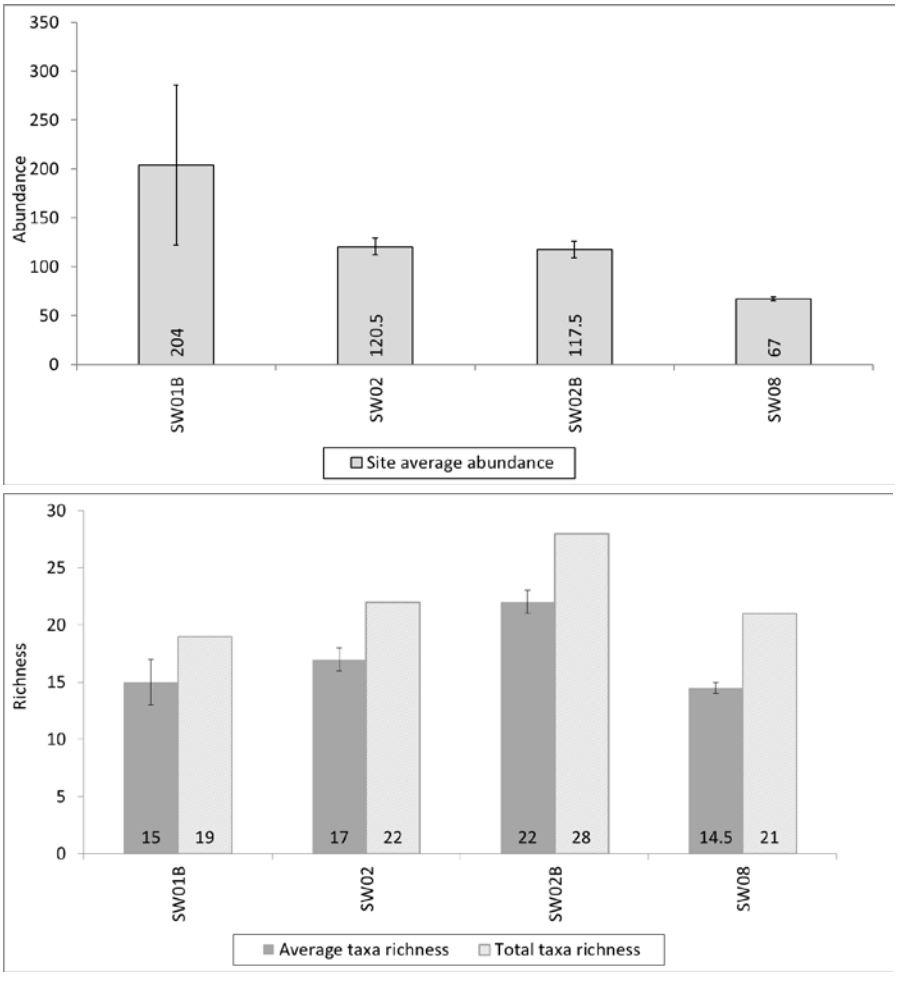
4.7 Aquatic ecology – Aquatic macroinvertebrate results

Sites sampled for aquatic macroinvertebrates were SW01B, SW02, SW02B and SW08.

Statistical analysis of aquatic macroinvertebrate data was used to identify and evaluate trends in the baseline environmental conditions. The analysis undertaken provides a spatial comparison of aquatic macroinvertebrate assemblages recorded across the sample sites.

A total of 1018 aquatic macroinvertebrates from 41 taxa were collected from 4 sites during the aquatic ecology survey. The most abundant taxa were leptophlebiidae (22% of total abundance) followed by acari (13% of total abundance), cladocera (12% of total abundance) and chironominae (11% of total abundance). All other taxa represented ≤5% of total abundance. The complete list of aquatic macroinvertebrates collected during this survey is provided in **Appendix E**.

Taxa abundance and richness data is shown on **Graph 4**. Aquatic macroinvertebrate abundance was highest at site SW01B, although replicate abundance was variable, and lowest at site SW08. Aquatic macroinvertebrate average and total taxa richness was highest at site SW02B and generally similar between other sites.



Graph 4: Aquatic macroinvertebrate abundance and taxa richness results

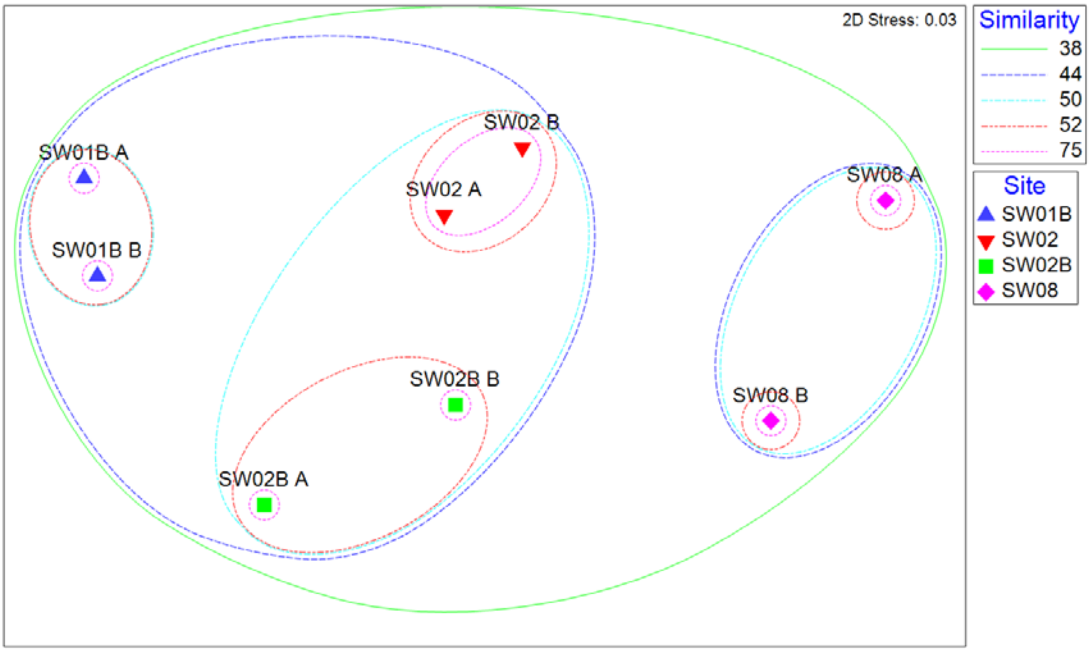
Aquatic macroinvertebrate abundance and richness data should not be used in isolation to assess site conditions. Abundance and taxa richness may fluctuate over time independent of anthropogenic impacts, and an impact may result on a shift from sensitive to tolerant taxa without resulting in a change to overall abundance and richness. Multivariate statistical analysis provides a more detailed comparison of the raw data for further interpretation.

Multivariate analysis was used to identify spatial similarities (*ie* similarities between sites) in aquatic macroinvertebrate assemblages at sites SW01B, SW02, SW02B and SW08.

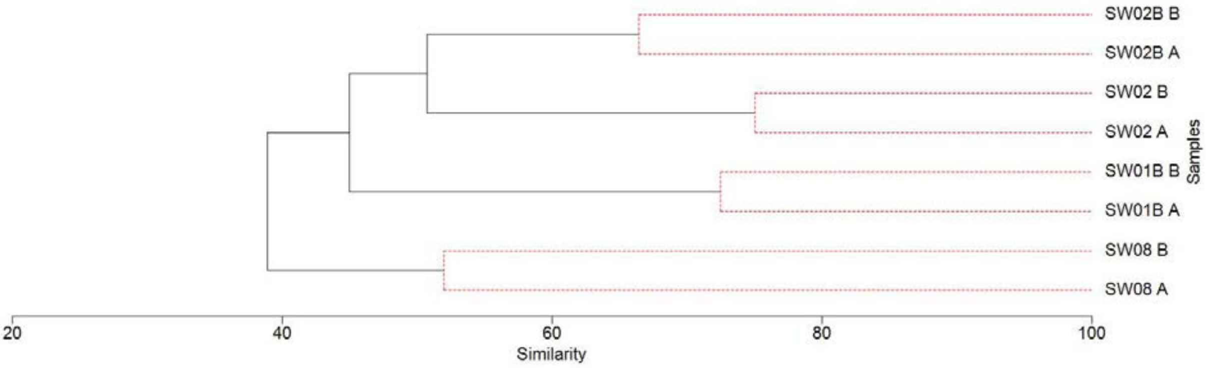
Ordination by non-metric multi-dimensional scaling (nMDS) of transformed data was used to visualise the spatial patterns of aquatic macroinvertebrate assemblages across sites. Interpretation is based on the results of the ordination in combination with cluster analysis (presented as overlay and similarity scores) as recommended by Clarke and Warwick (2001).

The nMDS ordination in **Graph 5** displays the relative similarity of aquatic macroinvertebrate samples collected during the survey. The low stress level achieved by the ordination (*ie* 0.03 stress) indicates an excellent representation of the data with no prospect of misinterpretation (Clarke & Warwick 2001). The nMDS ordination shows that the aquatic macroinvertebrate assemblage at sites SW02 and SW02B were most similar to each other. The aquatic macroinvertebrate assemblage at site SW08 was least similar to other sites.

Similarity levels displayed in **Graph 5** were based on SIMPROF cluster analysis results displayed in **Graph 6**. SIMPROF identified significantly different groups at similarities of approximately 38%, 44% and 50%. Sample replicates within sites did not differ significantly.



Graph 5: **nMDS ordination showing spatial comparison of aquatic macroinvertebrate samples collected from sites SW01B, SW02, SW02B and SW08**



Graph 6: SIMPROF cluster analysis of aquatic macroinvertebrate samples collected from sites SW01B, SW02, SW02B and SW08

4.8 Aquatic ecology – Fish results

Sites sampled for fish were SW01, SW01B, SW02, SW02B, SW03, SW06, SW08 and SW09.

Seven hundred and sixty-five (765) individual fish were collected by backpack electrofishing during the survey, and a further 507 individuals were reliably observed but not caught (see the aquatic ecology fish report **Appendix F** and the aquatic ecology fish survey taxa list in **Appendix G**). From these 1272 fish records, it is apparent that at least ten species of fish occupy the small creeks in the project area. Seven of these species are native to Australia and three are exotic. The three exotic species are commonly referred to as Guppies, Platys and Swordtails, and are small-bodied species. Guppies were the only abundant and widespread exotic fish, representing 23% of the fishes caught and observed and recorded at six of eight sites. Only a single Platy (site SW2B) and two Swordtails (site SW1B) were collected. The seven native fish species did not include any EPBC or state conservation listed species, and specifically, the Lake Eacham Rainbowfish, *Melanotaenia eachamensis*, was not detected at any of the sites. The single occurrence of a glassfish (resembling *Ambassis agrammus*) and a Giant Gudgeon (*Oxyeleotris selheimi*) collected during the survey are considered likely to be the result of translocations (Ebner & Vallance 2017).

4.9 Groundwater results

Sites sampled for groundwater quality were WB2, WB5, WB6, WB7 and WB8.

Groundwater *in situ* and laboratory results are presented in **Table 10**. SGS Laboratory analysis reports, sample receipt advice and chain of custody documentation are provided in **Appendix H**. A report on groundwater hydrogeology, yield and quality is included in **Appendix I**. WQOs for groundwaters of the project area were identified based on the nominated EVs (**Table 4**) and are presented in **Appendix A, Table 6**). These WQOs are also presented in **Table 10** for comparison to the sample values.

Results presented in **Table 10** that are **bold** and **underlined** were above the WQOs. Where exceedances of WQOs were identified, a review of the temporal data for these sites was undertaken to identify trends and is described below.

A number of analytes recorded in groundwater consistently reported levels below the LOR or within WQO in all samples. These include metals (dissolved and total cadmium, dissolved and total chromium, dissolved and total copper, total lead, dissolved and total nickel and total zinc) and ions (total sodium, total magnesium, total calcium, chloride) and alkalinity.

Table 10: Groundwater quality results

Analyte	Project-specific WQO[1]	WB2	WB5				WB6				WB7	WB8			
		31/1/17	31/1/17	13/3/17	8/5/17	19/6/17	31/1/17	13/3/17	8/5/17	19/6/17	31/1/17	31/1/17	13/3/17	8/5/17	19/6/17
In situ															
pH	6.5-7.9	**6.05**	**5.07**	**5.07**	**5.43**	6.81	**5.58**	**5.58**	**5.01**	6.93	**6.14**	**4.3**	**4.3**	**3.86**	**5.77**
Electrical conductivity	90-570	110	<100	<100	<100	150	130	130	110	260	110	<100	<100	<100	**80**
Temperature (°C)	-	-	26.8	25.8	25.2	-	26.6	25.5	24.8	-	27	26.5	26	25	-
Suspended and dissolved solids															
Total suspended solids (mg/L)	--	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	3	<1	4	<1
Total dissolved solids (mg/L)	-[c]	150	71	150	110	140	190	200	170	220	180	85	86	78	84
Nutrients															
Total oxidised nitrogen, NO$_x$ as N (mg/L)	TBC	0.82	0.87	0.11	0.29	0.058	0.70	0.65	0.76	0.33	0.03	1.50	1.5	1.7	1.5
Ammonia nitrogen, NH$_3$ as N (mg/L)	0.01	<0.005	0.005	**0.073**	**0.051**	<0.005	0.006	<0.005	<0.005	<0.005	**0.014**	<0.005	<0.005	<0.005	<0.005
Total Kjeldahl nitrogen (mg/L)	-	<0.05	<0.05	0.08	<0.05	<0.05	0.11	<0.05	<0.05	<0.05	0.11	0.07	<0.05	<0.05	0.06
Total nitrogen (calc) (mg/L)	0.34	**0.82**	**0.87**	0.19	0.29	0.06	**0.81**	**0.65**	**0.76**	0.33	0.14	**1.50**	**1.5**	**1.7**	**1.6**
Total inorganic nitrogen (calc) (mg/L)	-	0.82	0.87	0.18	0.34	0.06	0.71	0.65	0.76	0.33	0.05	1.50	1.5	1.7	1.5
Filterable reactive phosphorus (mg/L)	0.008	**0.011**	**0.024**	**0.027**	**0.019**	**0.030**	**0.036**	**0.032**	**0.032**	**0.014**	**0.059**	**0.014**	**0.010**	**0.021**	**0.011**
Total phosphorus (Kjeldahl Digestion) (mg/L)	0.025	0.02	**0.04**	**0.05**	**0.04**	**0.03**	**0.03**	**0.07**	**0.09**	0.02	**0.06**	**0.03**	**0.03**	**0.03**	**0.03**
Metals and metalloids															
Dissolved aluminium (mg/L)	0.055[a]	<0.005	0.02	<0.005	0.005	0.012	<0.005	<0.005	<0.005	<0.005	<0.005	**0.48**	**0.58**	**0.78**	**0.52**
Total aluminium (mg/L)	0.2	<0.005	0.066	<0.005	0.018	0.010	0.005	<0.005	<0.005	<0.005	0.025	**0.66**	**0.67**	**0.87**	**0.55**
Dissolved arsenic (mg/L)	0.01	0.003	0.002	**0.018**	0.010	**0.014**	0.002	0.002	0.001	0.004	0.004	0.001	0.001	0.001	0.001
Total arsenic (mg/L)	0.01	0.003	0.002	**0.019**	**0.014**	**0.014**	0.002	0.002	0.002	0.005	0.004	0.001	0.002	0.001	0.001
Dissolved cadmium (mg/L)	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total cadmium (mg/L)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dissolved chromium (mg/L)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total chromium (mg/L)	0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved copper (mg/L)	0.01	<0.001	0.003	<0.001	<0.001	0.002	0.005	0.003	0.003	0.004	0.002	0.009	0.007	0.009	0.006
Total copper (mg/L)	0.2	<0.001	0.004	<0.001	<0.001	<0.001	0.005	0.004	0.003	0.003	0.003	0.011	0.008	0.010	0.006
Dissolved iron (mg/L)	0.02	0.02	0.01	**0.56**	**0.23**	**0.50**	0.01	**0.042**	0.007	**0.20**	**0.19**	0.01	0.009	0.011	0.005
Total iron (mg/L)	0.2	0.03	0.06	**0.60**	**0.45**	**0.51**	0.02	0.051	0.013	**0.32**	**0.23**	0.05	0.038	0.039	0.008
Dissolved lead (mg/L)	0.0034	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.001	0.001	0.001	0.002	**0.004**	**0.005**	**0.006**	**0.004**
Total lead (mg/L)	0.01	<0.001	0.002	0.001	<0.001	0.001	0.002	0.001	0.001	<0.001	0.004	0.005	0.005	0.007	0.004
Dissolved manganese (mg/L)	0.03	**0.110**	0.014	**0.16**	**0.089**	**0.16**	0.017	0.023	0.008	**0.076**	**0.18**	**0.057**	**0.063**	**0.075**	**0.042**
Total manganese (mg/L)	0.1	**0.11**	0.01	**0.16**	0.091	**0.16**	0.02	0.021	0.009	**0.12**	**0.18**	0.07	0.065	0.081	0.040
Dissolved nickel (mg/L)	0.011	0.004	0.001	<0.001	<0.001	<0.001	0.003	0.003	0.004	0.003	0.003	0.002	0.002	0.002	0.002
Total nickel (mg/L)	0.02	0.003	0.001	<0.001	<0.001	<0.001	0.003	0.003	0.004	0.002	0.003	0.002	0.002	0.002	0.002
Dissolved zinc (mg/L)	0.01	**0.017** **(0.015)**[b]	**0.040**	0.010	0.010	0.012 (0.013)[b]	**0.054** **(0.012)**[b]	**0.029** **(0.013)**[b]	**0.027** **(0.011)**[b]	**0.026** **(0.017)**[b]	**0.058** **(0.013)**[b]	**0.067**	**0.040**	**0.043**	**0.031**
Total zinc (mg/L)	2	0.019	0.043	0.011	0.009	0.007	0.056	0.041	0.026	0.021	0.065	0.077	0.051	0.048	0.031
Major and minor ions															
Total sodium (mg/L)	97	16	7	13	11	15	27	27	28	32	24	7	6.1	6.4	8.1
Total potassium (mg/L)	-	1.6	1.2	1.6	1.5	1.5	1.3	1.3	1.3	1.2	1.4	1.8	1.6	1.9	1.8
Total magnesium (mg/L)	13	4.2	1.8	4.4	3.1	3.6	7.3	7.8	7.2	7.9	6.6	1.7	1.7	1.8	1.7
Total calcium (mg/L)	25	19	3.0	16	12	15	7	7.5	5.9	15	10	1.0	1.0	1.1	1.1
Total hardness (mg CaCO$_3$/L)	60-115	64	**14**	**59**	**42**	**52**	**47**	**51**	**45**	71	**51**	**10**	**10**	**10**	**10**
Chloride, Cl (mg/L)	61	18	9	10	8	9	59	57	57	53	45	17	17	18	16
Total sulfur as sulfate, SO$_4$ (mg/L)	6	**7.5**	1.0	**6.7**	3.7	5.7	2.2	2.2	2.1	2.5	5.5	<0.5	<0.5	<0.5	<0.5
Anion-Cation Balance (%)	-	-10.0	-11.0	-16	-2.4	0.9	-5.4	-4.8	-2.7	-0.5	-5.0	-11.0	-13	-10	-3.2
Alkalinity															
Total alkalinity as CaCO$_3$ (mg/L)	151	88	23	100	54	67	33	37	27	66	45	<5	<5	<5	<5
Bicarbonate alkalinity as CaCO$_3$ (mg/L)	-	88	23	100	54	67	33	37	27	66	45	<5	<5	<5	<5
Carbonate alkalinity as CaCO$_3$ (mg/L)	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Hydroxide alkalinity as CaCO$_3$ (mg/L)	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

[1] Water Quality Objectives (WQOs) derived from published guideline values (refer to **Appendix A, Table 6**).

TBC – site specific guideline value to be calculated.

[a] The ANZECC (2000) guideline value for dissolved aluminium only applies to samples where the pH is above 6.5. Due to insufficient data, no guideline value is provided for dissolved aluminium when pH is below 6.5. For reporting purposes, the guideline value for samples with pH above 6.5 has also been applied to samples with pH below 6.5.

[b] For values recorded above WQOs, hardness-modified trigger values (HMTVs) have been applied to cadmium, lead, nickel and zinc when hardness is above 30 mg/L (as $CaCO_3$)(ANZECC 2000). NRA has become aware that, subsequent to the issuing of the ANZECC guidelines, there is recognition in the scientific literature that for some taxa, hardness does not have an ameliorative effect on copper toxicity (Markich *et al*. 2005). In light of this, NRA does not calculate HMTVs for copper.

[c] As total dissolved solids is analogous to electrical conductivity, a WQO has not been provided for both indicators. Refer to the WQO for electrical conductivity.

Results were reported above or outside published guideline values for the following analytes. Further interpretation of these results is provided below.

- pH
- Electrical conductivity
- Ammonia
- Total nitrogen (TN)
- Filterable reactive phosphorus (FRP)
- Total phosphorus (TP)
- Dissolved and total aluminium
- Dissolved and total arsenic
- Dissolved and total iron
- Dissolved lead
- Dissolved and total manganese
- Dissolved zinc
- Total hardness
- Sulfate

There are no WQOs available for several analytes monitored during the sampling events. Comparison of analyte results between sampling events and sites has been undertaken to identify trends and potential analytes of concern.

WB2

Groundwater bore WB2 was sampled during the first sample event only (31 January 2017). The results from WB2 show the following.

- Levels of many analytes monitored in WB2 were recorded below the WQOs, with the exception of pH, nutrients (TN, FRP), metals (dissolved and total manganese, dissolved zinc) and sulfate.
- Water quality in WB2 was generally comparable to or better than water quality recorded on one or more occasions in other bores (WB5, WB6, WB7, WB8), with the exception of sulfate, which was highest in WB2.

WB5

Samples were collected from groundwater bore WB5 during each sample event (four samples). The results from WB5 show the following.

- Several analytes in WB5 were recorded above or outside of the WQOs on one or more occasions, including pH, nutrients (ammonia, TN, FRP, TP), metals and metalloids (dissolved and total arsenic, dissolved and total iron, dissolved and total manganese and dissolved zinc) and sulfate.
- WB5 was the only bore during the monitoring period in which elevated concentrations of total and dissolved arsenic were recorded.

WB6

Samples were collected from groundwater bore WB6 during each sample event (four samples). The results from WB6 show the following.

- Several analytes in WB6 were recorded above or outside of the WQOs on one or more occasions, including pH, nutrients (TN, FRP, TP) and metals (dissolved and total iron, dissolved and total manganese and dissolved zinc).

WB7

Groundwater bore WB7 was sampled during the first sample event only (31 January 2017). The results from WB7 show the following.

- Several analytes in WB7 were recorded above or outside of the guideline value range, including pH, nutrients (ammonia, FRP, TP) and metals (dissolved and total iron, dissolved and total manganese and dissolved zinc).

WB8

Samples were collected from groundwater bore WB8 during each sample event (four samples). The results from WB8 show the following.

- Several analytes in WB8 were recorded above or outside of the guideline value range on one or more occasions, including pH, electrical conductivity, nutrients (TN, FRP, TP) metals (dissolved and total aluminium, dissolved lead, dissolved manganese and dissolved zinc) and hardness.
- Water in WB8 across the monitoring period was generally of poorer quality than other bores.
- WB8 was the only bore during the monitoring period in which elevated concentrations of dissolved lead were recorded.

5. Discussion

Baseline surface water and groundwater quality and aquatic ecology surveys were undertaken for the KUR-World project area between December 2016 and June 2017. Surface water and groundwater across the project area recorded elevated levels for a number of analytes above WQOs developed for the environmental values of the Barron River Basin, including at sites upstream of the project area. In addition, project area surface water quality was elevated when compared to the water quality of an unimpacted rainforest stream, Jarra Creek[6], selected to provide a water quality comparison to a high quality Wet Tropics stream. Elevated levels were recorded for physico-chemical properties, major ions, nutrients, metals and metalloids.

The communities of aquatic macroinvertebrates and fish monitored in the project area were indicative of good ecosystem health, with the aquatic macroinvertebrate community generally comparable across the different streams of the project area with populations showing a variety of species and sizes and the presence of locally endemic species.

5.1 Chemical and Physical Characteristics of Surface and Groundwater

Surface Water

In comparison to water quality from the unimpacted Wet Tropics stream (Jarra Creek), water quality for sites monitored for the project area recorded poorer water quality for several physico-chemical (pH, dissolved oxygen, EC, turbidity, total and volatile suspended solids), nutrient (TON, nitrate, ammonia, TN, FRP and TP), metal (chromium, copper) and major ion (hardness) properties. Many of these indicators were also elevated at sites upstream of the project area (benchmark and background sites), and at the Barron River site upstream of where waters from the project area enter the Barron River.

Water quality in creeks of the project area exceeded a number of WQOs, including physico-chemical properties, nutrients (forms of nitrogen and phosphorus), metals and metalloids, major and minor ions and alkalinity indicators. Exceedances of WQOs were recorded at monitoring sites adjacent to and downstream of the project area, as well as at background or benchmark sites upstream of the project area and in the Barron River, upstream of where waters from the project area enter the Barron River.

Water quality in streams adjacent to the project area was generally poorest in the single sample collected from SW04, an un-named drainage line to Owen Creek and downstream of the farm dam. This site recorded the highest levels of TSS and turbidity, total Kjeldahl nitrogen, TN, FRP, TP and metals including dissolved and total aluminium, dissolved and total chromium, dissolved and total copper and total lead.

The elevated indicators recorded in streams adjacent to the project area reflect both historic and current land use within, and upstream of, the project area as follows:

- Historic and continuing disturbance related to upstream operations that include a paintball course encompassing the bed and banks of Haren Creek and an operating quarry and creek crossings and tracks (Owen Creek catchment).

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[6] Jarra Creek is regarded as one of the highest value waterways in the wet tropics bio-region (Kapitzke *et al.* 1999).

- Historic and current on-site activities include cattle grazing and associated disturbance to creek banks and beds and general surface disturbance associated with tracks and infrastructure. Prior to the 2016 wet season, the site access road was realigned and tracks and crossing were upgraded, inclusive of erosion and sediment controls such as sheeting of crossings and approaches and sediment traps.
- New infrastructure constructed in 2015 and 2016 including a terraced produce garden and on-site dam.

The relative contribution from these land uses to downstream water quality depends on flow and thus rainfall events; generally:

- High flow events – remobilisation of sediment downstream of the farm dam (represented by SW04), discharge from sediment basins downstream of the site produce garden, erosion of tracks upstream of the project area and discharge from an operating quarry upstream of the project area (SW01),
- Low flow – upstream tourist operations (SW09) and paintball course (SW02) and site crossings and cattle accessing streams.

In all of the above cases, the major impact on water quality is the release of sediment-laden waters increasing the load of TSS and associated parameters, including turbidity, metals and nutrients.

Groundwater

The main aquifer in the project area comprises fractured rock within the Barron River Metamorphics overlain by up to 10 m of clayey hillwash sediments (surficial sediments) (RLA 2017). The groundwater is characterised by acidic water, elevated nutrients (forms of nitrogen and phosphorus) and metals and metalloids when compared to WQOs.

The aquifer is recharged primarily by vertical infiltration of rainfall, with recharge occurring slowly once surficial sediments are fully saturated (RLA 2017). Due to the depth of the water table below the stream level (minimum 5 m, commonly 10 m), groundwater does not discharge to streams. Therefore no groundwater-surface water exchange is possible in the project area (RLA 2017).

Although there is no groundwater-surface water interaction, the water flowing through the surficial sediments (up to 10 m layer of weathered metasediments and clayey hillwash (RLA 2017)) provides some recharge to streams in the project area.

5.2 Climatic and seasonal factors affecting surface water quality

Surface water quality in streams of the project area reflected the seasonal influence of the Far North Queensland wet season. Several water quality parameters were lowest at a number of monitoring sites prior to the onset of the wet season (December 2016 sampling event) including turbidity, TSS, nutrients (including forms of nitrogen and phosphorus) and metals (including aluminium, chromium, manganese, nickel and zinc).

In contrast, several indicators were highest at some sites prior to the onset of the wet season, including EC, major and minor ions and bicarbonate alkalinity.

These patterns in the surface water data are not unexpected, as rainfall increases the discharge of suspended sediments to the streams, with associated increases in nutrients and metals (for example, site SW04 downstream of the farm dam showed the highest levels of turbidity and suspended solids).

At the end of the wet season, streams were characterised by increasing levels of EC, ions and alkalinity. This may be the result of concentration as water evaporates and streams dry, or due to water flowing through surficial sediments into the creek systems. The influence of water from surficial sediments cannot be confirmed as monitoring of this water has not occurred for the project area. The rains of the wet season appear to dilute the waters, thereby decreasing the concentration of these parameters.

5.3 Aquatic ecosystems

The communities of aquatic macroinvertebrates and fish monitored in the project area were indicative of good ecosystem health, with the aquatic macroinvertebrate community generally comparable across the streams (Haren Creek, Owen Creek, tributary of Warril Creek), with populations showing a variety of species and sizes and the presence of locally endemic species (*eg* the crayfish *Cherax wasseli* and some poorly recorded species including the eel *Anguilla megastoma* (Ebner & Vallance 2017).

Some introduced/exotic fish species were identified during the survey (Guppies, Platys and Swordtails). These small-bodied species have likely been introduced to the mid-Barron-River Catchment from a combination of discards from private aquaria and deliberate stockings of farm dams and ornamental ponds. In addition, the single occurrences of a glassfish (resembling *Ambassis agrammus*) and a Giant Gudgeon (*Oxyeleotris selheimi*) collected during the survey are considered likely to be the result of translocations (Ebner & Vallance 2017).

Stream sediments recorded metal and metalloid concentrations below published guideline values across the project area, with the exception of arsenic at SW08 (Haren Creek).

5.4 Potential discharges of water and contaminants and its impacts

5.4.1 Proposed action and impacts

Reever and Ocean Developments Pty Ltd is proposing to develop the project area into a luxury tourism, health and education experience featuring the following components:

- KUR-Village
- Residential Precinct: Queenslander Lots, Premium Villas, Lifestyle Villas
- Four Star Business and Leisure Hotel and Function Centre
- Health and Wellbeing Retreat
- Five-Star Eco-Resort
- KUR-World Campus
- Farm Theme Park and Equestrian Centre
- Rainforest Education Centre and Adventure Park
- Sporting Precinct
- Golf Club House and Function Centre
- Golf Course
- Organic Produce Garden
- Services and Infrastructure (including wastewater treatment plant, roads)

- Open Space
- Environmental Area.

The project has the potential to result in a range of direct and indirect impacts to surface water, groundwater, stream sediment and aquatic ecosystem values. The potential project-related impacts are described below.

5.4.2 Existing impacts

Surface water

Surface water quality in the streams of the project area contain variable water quality influenced by historic and current land uses. Baseline monitoring identified a number of surface water quality parameters that exceeded local WQO developed for environmental values of the Barron River Basin subcatchment.

Existing impacts are summarised as follows.

- Cattle grazing occurs within the project area. While most paddocks are fenced, cattle have access to waterways and have the potential to increase the volume of suspended sediments and associated contaminants (including nutrients and metals) entering streams through disturbance of creek beds and banks. These disturbances degrade water quality, increase sediment deposition and decrease the quality of the instream aquatic habitat. Disturbance also supresses native plant abundance and diversity in the ground layer, encouraging the proliferation of non-native plants and/or invasive native plants and altering ecological processes (*eg* soil structure and stability, nutrient cycling and water quality).
- Land disturbance for tracks and infrastructure increases the mobilisation of sediments and degrades water quality and aquatic ecosystem habitat.
- Damage to stream banks caused by pigs.

Groundwater

Groundwater quality in the project area is variable. Baseline monitoring identified a number of groundwater quality parameters that exceed WQOs.

Existing impacts are summarised as follows.

- Cattle grazing occurs within the project area. Run-off from grazing areas is likely to have higher concentrations of nutrients, which may enter groundwater through infiltration.

Aquatic ecosystems

The communities of aquatic macroinvertebrates and fish monitored in the project area were generally indicative of good ecosystem health, with the aquatic macroinvertebrate community generally comparable across the different streams and fish populations showing a variety of species and sizes and the presence of locally endemic species (*eg* the crayfish *Cherax wasseli* and some uncommon species including the eel *Anguilla megastoma* (Ebner & Vallance 2017)).

Existing impacts are summarised as follows.

- Cattle grazing occurs within the project area. While most paddocks are fenced, cattle have access to waterways and have the potential to increase the volume of suspended sediments and associated contaminants (including nutrients and metals) entering streams through disturbance of creek beds and banks. These disturbances degrade water quality, increase sediment deposition and decrease the quality of the instream aquatic habitat. Disturbance also supresses native plant abundance and diversity in the ground layer, encourage the proliferation of non-native plants and/or invasive native plants and altering ecological processes (*eg* soil structure and stability, nutrient cycling, water quality and instream habitat smothering).

- Land disturbance for tracks and infrastructure increases the mobilisation of sediments and degrades water quality and aquatic ecosystem habitat.
- Tropical aquarium and ornamental pond species represent a serious threat to stream ecosystems and native fish assemblages specifically in the Wet Tropics (Ebner & Vallance 2017).
- The crayfish, *Cherax wasseli*, is a locally endemic species found in the Kuranda and Speewah region at least north to Black Mountain (B. C. Ebner, Unpubl. data). Damage to the stream banks as caused by pigs and, to some extent, cattle, is of potential threat to the crayfish. Pigs also likely consume the crayfish (Ebner & Vallance 2017).

5.4.3 Potential impacts

The proposed construction of the project will require disturbance to approximately 171 ha and clearing of approximately 87 ha of vegetation. The potential impacts are summarised as follows.

- Land clearing and site disturbance (during construction and operation) increases the risk of erosion and sediment run-off, increasing sediment, nutrient and metal loads in streams, changing aquatic ecosystem habitat and conditions and increasing nutrients and metals infiltration to groundwater.
- The establishment of roads and increased vehicle access to the project area increases the risk of contaminated stormwater entering streams. Associated contaminants may include hydrocarbons and metals.
- The operation of a wastewater treatment plant and associated irrigation and discharge of treated wastewater can impact on surface and groundwater quality through infiltration of water with elevated nutrient concentrations and irrigation run-off or direct discharge to streams of increased sediment and nutrient loads.
- The on-site storage of hazardous chemicals increases the risk of spills leading to contamination of stormwater and project area streams and groundwater.
- Irrigation of the golf course/gardens may lead to increased run-off of fertilisers, nutrients and sediments altering water quality chemistry in the receiving groundwater and surface water systems and changing local aquatic ecosystem conditions.
- Dust may carry contaminants that may enter streams, impacting on water quality and instream habitat.
- Maintenance of animal enclosures/stables resulting in contamination of run-off and wash-down water.
- Operation of the produce garden resulting in increased concentrations of nutrients in run-off water.
- Release of contaminated waters, excessive nutrients or hazardous substances to the natural environment during storm events resulting in reduced surface and groundwater quality and aquatic ecosystem quality.

Site waters are expected to be captured and treated through a stormwater system and wastewater treatment system.

Stormwater

A stormwater drainage strategy developed for the project area (ARUP 2017) provides the following management measures.

- Run-off captured from building roofs will be conveyed to rainwater tanks for re-use, with tank overflows draining to the swales. Rainwater captured in tanks will be used for toilet flushing and irrigation.
- Run-off from all other catchment areas will drain directly to the grassed swales and vegetated buffers.
- Within the more intensely developed commercial/ retail/ educational areas, stormwater will be treated by proprietary stormwater improvement devices, prior to draining to the swales.
- Road run-off will be collected in a conventional kerb and channel/ pipe and pit stormwater drainage network, will be treated by proprietary stormwater improvement devices prior to draining to swales and retention basins.
- Gross Pollutant Traps will act as primary treatment for each catchment to target litter capture.
- Gross Pollutant Traps flow to swales, which flow to bioretention basins with discharge to streams from multiple locations across the project area (*pers. comm.* Priyani Madan, Water Engineer, ARUP, 18 October 2017).

Stormwater volumes will be managed to minimise flows and nutrient loads through this water sensitive urban design. It is understood that stormwater discharges will be managed, where possible, to mimic pre-development discharge conditions.

Wastewater

Based on information on proposed effluent treatment for the project available at the time of preparation of this report, effluent will be treated by a wastewater treatment plant (WWTP) and used to irrigate the golf course and open spaces as required. It is understood that treated effluent may be managed using an in-line balance tank as an intermediate water storage prior to irrigation with the farm dam providing wet weather storage as required (NRA 2017a). The WWTP will incorporate measures to treat water to achieve WQOs, the release of which is intended to maintain or improve water quality in the receiving environment. Discharge may occur from the farm dam during periods of higher rainfall (*ie* when water is not required for irrigation or other purposes).

Discharge to the receiving environment

There will be discharge to the receiving environment from the project area as a result of operations both through construction phases and operation of the project, more likely during high rainfall events or periods. Discharges through the construction phase are expected to be managed through erosion and sediment controls and the application of best practice actions. Discharge during operation of the development will be managed through water sensitive urban design and management of the farm dam in association with the wastewater treatment plant and irrigation. The above potential impacts were assessed with respect to potential spatial and temporal scales of impact; the results are presented in **Table 11**. These mitigation measures are provided based on the project information available to date and can be refined once specific details of the quantity, quality, timing, duration and location of all potential discharges are available.

Table 11: Potential threats (in the absence of mitigation measures) to water quality and aquatic ecosystems)

Potential threat	Probable spatial scale of potential impact [A]	Probable temporal scale of potential impact [B]	Comments
Release of contaminants from roads and vehicles.	Site-specific and local.	Short-term to long-term.	Water sensitive urban design elements (*eg* gross pollutant traps, swales and retention basins) capturing and filtering run-off from vehicle movement and parking areas can reduce risk.
Wastewater treatment plant operation, associated irrigation and discharge.	Site-specific, local and regional.	Short-term to long-term.	Design elements such as prevention of stormwater ingress, reuse and emergency storage can reduce risk.
Golf course irrigation.	Site-specific, local and regional.	Short-term to long-term.	Irrigation protocols based on soil physical and chemical characteristics can reduce risk.
Land clearing and site disturbance.	Site-specific, local and regional.	Short-term to medium-term.	Most disturbance can be mitigated via erosion and sediment controls and rehabilitation, thereby reducing temporal scale of impact to medium-term.
Release of fugitive dust.	Site-specific and local.	Short-term to long-term.	Dust controls during construction can reduce risk.
Release of contaminated waters.	Site-specific, local and regional.	Short-term to long-term.	Water sensitive urban design elements (*eg* gross pollutant traps, swales and retention basins) capture and treatment of run-off can reduce risk.

[A] Spatial scale categories comprise: site-specific (*ie* project area), local area (*eg* within 5 km downstream of project area) and regional (*eg* within 20 km downstream of project area).

[B] Temporal scale categories comprise: short-term (1 to 5 years), medium-term (5 to 30 years) and long-term (>30 years)). Some impacts are readily mitigated or irreversible.

5.4.4 Recommended mitigation measures

“Planning, design, construction and operation of development should be conducted in a way that protects environmental values, and maintains or enhances water quality.” (SPP – Water Quality 2017). The below list presents preliminary recommended mitigation measures based on project details available when preparing this report. These recommendations will be reviewed, revised and augmented as required for the EIS.

Recommendation 1: Minimise vegetation clearing extent via planning and implementation of systems/controls during construction and operation (*eg* permit to clear system and clearly marking clearing extents prior to disturbance).

Recommendation 2: Minimise clearing for new roads and bridges to the absolute minimum required. Sites for bridge crossings should target riparian areas where existing gaps in the canopy are present.

Recommendation 3: Stormwater should be directed to water treatment systems or appropriately designed retention dams considering worst case discharge scenarios to achieve water quality performance objectives for the Wet Tropics nominated in ARUP (2017).

Recommendation 4: Effluent irrigation protocols should be developed based on MEDLI modelling using physical and chemical parameters for site soils and a 90% reuse target (to minimise discharge risk).

Recommendation 5: Prevent run-off or wash-down water from animal enclosures/stables contaminating surface waters by removing faecal matter and contaminated bedding daily to site composting facility.

Recommendation 6: Irrigation practices should be managed to reduce the run-off of irrigated water or the infiltration of potentially contaminated water (*eg* nutrients, pesticides, herbicides) to groundwater.

Recommendation 7: Develop and implement an appropriate rehabilitation plan.

Recommendation 8: Design and operate the wastewater treatment system to meet Barron River Water Quality Objectives or site-specific targets appropriate for the Barron River, *Wet Tropics Water Quality Improvement Plan 2015 - 2020* and *the Reef Water Quality Protection Plan 2013*.

Recommendation 9: Develop and implement a dust management plan.

Recommendation 10: Develop and implement Erosion and Sedimentation Control Plans for each area of construction and for the operational phase, inclusive of certification of the plans by a Certified Professional in Erosion and Sediment Control (CPESC) or equivalent.

Recommendation 11: Develop and implement a management plan for the storage and handling of chemicals and hazardous substances. Develop and implement the management plan to include storage of minimum necessary volumes, emergency response training, procedures and controls in the event of an inadvertent release of chemicals or hazardous substances.

Recommendation 12: Training and site inductions to increase environmental awareness, identification of project-related threats and management requirements/obligations.

Recommendation 13: Pigs should be managed to reduce numbers and limit access to creeks across the project area.

Recommendation 14: Restrict cattle access to creeks to the maximum practicable extent.

Recommendation 15: It is recommended that on-site dams and creeks not be stocked with exotic species or native species that are not endemic to the area (Ebner & Vallance 2017).

Recommendation 16: Management of on-site waterbodies (including the farm dam, retention basins, creeks) should include considerations of biosecurity, exotic fish species, algal blooms and margin management (*eg* for disease vectors).

Recommendation 17: Survey farm dams on the property or in the relevant subcatchments to determine if the Giant Gudgeon *Oxyeleotris selheimi* is established in these habitats and eradicate it (Ebner & Vallance 2017).

Recommendation 18: Maintain an on-property awareness of the environmental benefit of not releasing fish species including native species from elsewhere, into waterways (including dams) on the property. (Ebner & Vallance 2017)

Recommendation 19: Determine if exotic and translocated fish species exist in any farm dams on the project area, and endeavor to remove these species and replace with native species from nearby streams (Ebner & Vallance 2017)

5.5 Future monitoring

The following monitoring program presents preliminary recommended monitoring measures based on project details available at the time of preparation of this report. These recommendations will be reviewed, revised and augmented, as required, for the EIS.

5.5.1 Surface water

Surface water quality data is essential for understanding the impacts of an activity on receiving waters and is the primary indicator used in Receiving Environment Monitoring Programs (EHP 2014b).

Parameters monitored

It is recommended that the parameters monitored during the baseline surface water quality monitoring program (reported on in this report) are used for future monitoring, with the addition of hydrocarbons (as hydrocarbon and metal (*eg* cadmium, zinc) pollutants are associated with vehicle use on bitumen roads). These parameters were selected to provide information on the surface water quality characteristics likely to be influenced by the development. Key risks identified for surface water quality are related to run-off from cleared areas during the construction phase, stormwater from roads, roof tops and hard stand areas and nutrient inputs from sewerage and the application of fertilisers to landscaped areas. Special consideration was given to include parameters known to affect frogs and tadpoles, with populations of the critically endangered Kuranda Tree Frog (*Litoria myola*) present in some of the streams of the project area (NRA 2017b).

It is understood that the proponent’s intention is to manage the development following organic principles. As such, there is no current need to include pesticides in the analyte suite. Should a decision be made in future to use pesticides on the golf course or landscaped gardens, then the parameter list should be updated to include the specific pesticides known to be in use.

A number of analytes were not detected (*ie* were recorded below laboratory limit of reporting) during baseline surface water monitoring. Some parameters could be removed from future monitoring programs if it can be demonstrated that particular parameters are not associated with site activities.

Sites monitored

Project area surface water sites (SW01, SW09, SW02, SW03, SW04, SW06 and SW08) should be included in the routine monitoring program, as well as additional sites where the specific location of discharge infrastructure is known (*eg* downstream of wastewater treatment plant, downstream of stormwater discharge points, on-site water storages/dams).

Monitoring sites may change between construction and operational phases depending on the source of potential discharge and impact. Monitoring sites included in the routine program should be reviewed prior to commencement of each stage of project development (outlined in **Section 1.1.1**) and on completion of the construction phase.

Timing

The EHP draft 2017 *Monitoring and Sampling Manual* (EHP & DSITI 2017) refers to ANZECC (2000) for determining the appropriate frequency of surface water sampling. Although no specific guidance is provided, it is recommended that the frequency is established to meet the program’s objectives. ANZECC (2000) recommend that guideline values are calculated from monthly observations. The Queensland Water Quality Guidelines (QWQG) (EHP 2013a) also adopt this approach. Therefore surface water samples should be collected from reference (benchmark/background) and receiving sites on a monthly basis.

The requirements for ongoing monitoring following completion of the proposed development should be reviewed with consideration to potential ongoing impacts.

Methods

Monitoring should be undertaken in accordance with the methods outlined in the EHP *Monitoring and Sampling Manual* (EHP 2013a) or most recent version.

In situ monitoring should be undertaken for parameters that can change rapidly after sampling, and for which reliable field measurements can be recorded (*eg* pH, EC, turbidity, dissolved oxygen, temperature). Measurements should be made using calibrated water quality meters with resolution sufficient to determine water quality against the WQOs. Samples for laboratory analysis should be collected using suitable containers, follow appropriate sample preservation methods and be received by the laboratory within the holding times for each parameter.

Laboratory analysis

Surface water samples should be analysed by a NATA accredited laboratory. The LOR required to assess the surface water quality at monitoring sites against the WQOs should be achieved for each parameter to allow appropriate impact assessment during data analysis.

Quality assurance samples should be analysed for the same parameters as the monitoring site samples.

Quality assurance

Quality assurance measures that should be employed during surface water sampling include:

- calibration of water quality meters
- decontamination of sampling equipment between sites
- collection of field blank and field duplicate samples
- field-filtration where required using disposable filtering equipment with 0.45 µm filters to prevent cross-contamination and preserve sample integrity
- chain of custody documentation for all samples submitted to the laboratory
- use of a NATA accredited laboratory
- review of laboratory certificates for potentially erroneous results or gross contamination
- data management to ensure information can be easily retrieved in the future.

Data analysis

Surface water quality data should be compared to the WQOs. This analysis will provide an indication of potential impacts on the EVs.

In the early stages of implementing the monitoring program, reliance will primarily be on existing published default guideline values for use as objectives. Once sufficient reference data has been collected, site-specific guideline values (SSGVs) can be derived for the aquatic ecosystem EV[7]. The SSGVs are not static and will continue to change as more reference data is collected. Calculation of SSGVs should be undertaken during reporting using the latest available surface water quality data and compared to test data for parameters that exceed the WQOs based on default guidelines.

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[7] The QWQG (EHP 2013b) and ANZECC & ARMCANZ (2000) provide guidance on how site-specific guideline values (SSGVs) for the protection of slightly-to-moderately disturbed aquatic ecosystems should be derived. The SSGV should be calculated as the 80th percentile (and 20th percentile for pH and dissolved oxygen) of reference site data. A minimum of 8 sample values per reference/control site is required to develop interim SSGVs. The interim SSGV can be updated and replaced once 12 or 18 sample values for each reference/control site has been obtained (12 sample values are required where there are three or more reference sites that can be pooled, and 18 sample values are required where there are one or two reference sites only).

Mitigation strategies and contingency

In addition to the recommended routine monthly program, monitoring should be initiated in the event of accidental discharge of contaminants and sediments during construction, stormwater run-off to adjacent streams and during flooding events.

During this contingency monitoring, it may be necessary to amend the sites or indicators monitored to ensure the potential impacts resulting from the event triggering the monitoring can be assessed.

5.5.2 Groundwater

Groundwater monitoring should be undertaken to identify potential impacts to water level and quality arising from site activities.

Parameters monitored

It is recommended that the parameters monitored during the baseline groundwater quality monitoring program are used for future monitoring, with the addition of hydrocarbons (as hydrocarbon and metal (*eg* cadmium, zinc) pollutants are associated with vehicle use on bitumen roads). These parameters were selected to provide information on the groundwater quality characteristics likely to be influenced by the development. In addition, the water level should be recorded. Key risks identified for groundwater quality are related to infiltration of stormwater from roads, roof tops and hard stand areas and nutrient inputs from sewerage and the application of fertilisers to landscaped areas.

It is understood that the proponent’s intention is to manage the development following organic principles. As such, there is no current need to include pesticides in the analyte suite. Should a decision be made in future to use pesticides on the golf course or landscaped gardens, then the parameter list should be updated to include the specific pesticides known to be in use.

A number of analytes were not detected (*ie* were recorded below laboratory LOR) during baseline groundwater monitoring. Some parameters could be removed from future monitoring programs if it can be demonstrated that particular parameters are not associated with future site activities.

Sites monitored

Project area groundwater sites (WB2, WB5, WB6, WB7, WB8) should be included in the routine monitoring program, as well as any future groundwater bores installed in the project area.

Timing

Groundwater monitoring should be undertaken quarterly.

The requirements for ongoing monitoring following completion of the proposed development should be reviewed with consideration to potential ongoing impacts. For facilities that are environmentally relevant activities (*eg* wastewater treatment plant), licence conditions will apply in which monitoring conditions are expected to be included.

Methods

Monitoring should be undertaken in accordance with the methods outlined in the EHP *Monitoring and Sampling Manual* (EHP 2013a) or most recent version.

In situ monitoring should be undertaken for parameters that can change rapidly after sampling, and for which reliable field measurements can be recorded (*eg* pH, EC, temperature). Measurements should be made using calibrated water quality meters with resolution sufficient to determine water quality against the WQOs. Samples for laboratory analysis should be collected using suitable containers, follow appropriate sample preservation methods and be received by the laboratory within the holding times for each parameter.

Laboratory analysis

Groundwater samples should be analysed by a NATA accredited laboratory. The LOR required to assess the water quality at monitoring sites against the WQOs should be achieved for each parameter to allow appropriate impact assessment during data analysis.

Quality assurance samples should be analysed for the same parameters at the monitoring site samples.

Quality assurance

Quality assurance measures that should be employed during groundwater sampling include:

- calibration of water quality meters
- decontamination of sampling equipment between sites
- collection of field blank and field duplicate samples
- field-filtration where required using disposable filtering equipment with 0.45 µm filters to prevent cross-contamination and preserve sample integrity
- chain of custody documentation for all samples submitted to the laboratory
- use of a NATA accredited laboratory
- review of laboratory certificates for potentially erroneous results or gross contamination.
- data management to ensure information can be easily retrieved in the future.

Data analysis

Groundwater quality data should be compared to the WQOs. This analysis will provide an indication of potential impacts on the EVs.

5.5.3 Aquatic ecology

Aquatic ecology surveys (fish) should be undertaken at a minimum of once annually, and aquatic ecology (aquatic macroinvertebrates) should be undertaken twice annually, along with sediment monitoring and in conjunction with a monthly surface water quality survey to assess potential impacts from the proposed development on aquatic ecosystems of the receiving environment.

Indicators monitored

It is recommended that the indicators monitored during the baseline aquatic ecology monitoring program are used for future monitoring (*ie* aquatic macroinvertebrates, fish, stream sediment). These parameters were selected to provide information on characteristics of the aquatic ecosystem likely to be influenced by the development.

Sites monitored

Project area surface water sites upstream and downstream of discharge areas (*eg* SW01, SW02, SW02B, SW03, SW06 and SW08) should be included in the monitoring program, as well as additional sites where the specific location of discharge infrastructure is known (*eg* downstream of wastewater treatment plant, downstream of confluence of the farm dam receiving catchment and Owen Creek, downstream of stormwater discharge points, on-site water storages/dams (fish only)).

Monitoring sites may change between construction and operational phases depending on the source of potential discharge and impact. Monitoring sites included in the routine program should be reviewed prior to commencement of each stage of project development (outlined in **Section 1.1.1**) and on completion of the construction phase.

Timing

The AUSRIVAS sampling methods for Queensland (DNRM 2001) recommend biannual sampling, conducted early in the wet season (after the waterway has been flowing for a minimum of four weeks), and at the end of the wet season during the recessional flow period (at least four weeks after the last flushing event).

The timing of the aquatic macroinvertebrate aspect of the field survey is dependent on flows in the watercourse, particularly the occurrence of high flows that ‘flush’ the system. To allow the aquatic macroinvertebrate community to re-establish at the monitoring sites, it is important that at least four weeks of base flow occur after a high flow/flushing event. Publically available stream flow monitoring data should be used when planning the timing of each aquatic ecosystem survey.

A minimum of one aquatic ecosystem (fish) survey and two aquatic ecosystem (aquatic macroinvertebrate) surveys (including sediment monitoring) are recommended per year, timed to occur approximately 6 – 8 weeks following flushing of the creeks.

The requirements for ongoing monitoring following completion of the proposed development should be reviewed with consideration to potential ongoing impacts.

Methods

Fish

Electrofishing should be undertaken by experienced operators to identify native and exotic species present in the streams. Species and total length should be recorded for captured fish, with opportunistically observed fish species also recorded.

Aquatic Macroinvertebrates

Aquatic macroinvertebrate samples should be collected using a 250 μm dip net following the bed habitat. This involves the operator using their feet to disturb the substrate while sweeping the net downstream of the plume to capture dislodged organisms, while moving upstream along a 10 m transect. Net contents are then emptied into white sorting trays and all organisms[8] encountered over a 30 minute period are field-picked into ethanol. Preserved samples are taken for laboratory identification.

A minimum of three replicate samples should be taken at each site during the construction phase to provide an understanding of the natural variability in the aquatic macroinvertebrate community. Differences in micro-habitat between replicates and between sites should be noted on field proformas to inform data interpretation if needed. Where possible, similar micro-habitats between control and receiving sites should be sampled.

Sediment

Sediment sample collection should target depositional zones in the watercourse, because the purpose of the study is to determine if contaminants released from the monitored activity are accumulating in the receiving environment. Composite samples should be collected from 10 subsampling points within depositional zones at each site. A stainless steel trowel should be used for sampling. Sample depth should be standardised, where possible, to ensure only the surface sediment (most recently deposited) is collected (no more than 5 cm deep). Each of the 10 subsamples should be combined in a bucket and mixed well to homogenise the sample. Rocks bigger than 25 mm in diameter should be removed. The entire sample should be placed in a single sample bag and provided to the laboratory for sieving and riffle-splitting.

A duplicate sample should be prepared in the field and analysed by the laboratory for quality assurance purposes. This sample should be split in the field using a method that reduces variability between the samples, particularly with grain size (*eg* ‘coning’ and ‘quartering’).

Laboratory analysis

Sediment samples should be analysed by a NATA accredited laboratory. The LOR required to assess the stream sediment quality at monitoring sites against published guideline values should be achieved for each parameter to allow appropriate impact assessment during data analysis.

Particle size distribution (PSD) should be completed on the same composite sample as that analysed for chemical properties. The PSD should use a defined set of sieve sizes, with the minimum being <63 μm.

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[8] AUSRIVAS field sampling requires up to 10 specimens from each taxon be picked in each sample. This approach is based on a rapid assessment where the data is analysed using presence/absence metrics. This method provides poor resolution for determining local scale impacts, and limits the ability for the data to be used in more meaningful multivariate statistics and other indices. An alternative field-picking approach, where as many individuals of each specimen as possible are collected, is recommended. This approach has been implemented at metalliferous mine sites for EA monitoring since the early 2000s. The method has been accepted by the Department of Environment and Heritage Protection (EHP) for routine and investigation monitoring, and has been reliably used for determining potential impacts to, and recovery of, aquatic macroinvertebrate communities due to poor quality water released from numerous operations in north Queensland (*pers. obs.* Shannon Wetherall, Senior Environmental Scientist, NRA). The benefits of this modified AUSRIVAS approach is that more detailed statistical analysis can be undertaken, while preserving the ability for AUSRIVAS models and other indices to be used if required.

Quality assurnace samples should be analysed for the same parameters as the monitoring site samples.

Quality assurance

Quality assurance measures that should be employed during aquatic ecology (aquatic macroinvertebrate) surveys include:

- Identification and counts of a sub-set of aquatic macroinvertebrate samples by a second experienced scientist to confirm identifications.
- Collection of residual samples to verify the live-picking capability of each operator.

For fish monitoring, where required, fish should be collected under required permits and sent for genetic analysis or to experienced taxonomists for species confirmation.

Quality assurance measures that should be employed during sediment sampling include:

- decontamination of sampling equipment between sites
- collection of field duplicate samples
- chain of custody documentation for all samples submitted to the laboratory
- use of a NATA accredited laboratory
- review of laboratory certificates for potentially erroneous results or gross contamination.
- data management to ensure information can be easily retrieved in the future.

Data analysis

Sediment quality data for the whole sediment (<2 mm fraction) should be compared to published guideline values to provide an indication of the condition of stream sediments in the receiving environment.

A range of statistical analyses will be used to investigate spatial and temporal relationships between aquatic macroinvertebrate and fish assemblages at the monitoring sites. The analysis will include the following.

- Univariate analysis, such as histogram graphs to display taxa abundance and richness results.
- Multivariate analysis, such as cluster analysis and multidimensional scaling (MDS). This analysis is undertaken using statistical software (*eg* PRIMER). To assist in interpretation, cluster analysis results may be overlain onto the MDS plots, and the significance of clusters can be assessed using a SIMPROF test (Clarke & Gorley 2006). Further interrogative analysis may be undertaken, for example SIMPER and BIOENV.
- Other common indices include:
  - PET richness[9]
  - SIGNAL2 index[10]
  - taxa richness[11]
  - % sensitive taxa[12]

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[9] PET richness is the total number of families in the orders Plecoptera, Ephemeroptera and Trichoptera present in a sample. Macroinvertebrates in these orders are considered to be sensitive to human disturbance (EHP 2013a).

[10] SIGNAL2 (stream invertebrate grade number average level) index allocates a sensitivity grade number to macroinvertebrate families based on their sensitivity to various water quality changes.

[11] Taxa richness is the total number of different aquatic macroinvertebrate families in a sample.

[12] % sensitive taxa is based on the proportion of taxa with ‘sensitive’ SIGNAL2 grades of 8-10.

- % tolerant taxa[13].

The analyses should be undertaken by personnel with relevant experience in preparing and interpreting these statistical outputs.

Mitigation strategies and contingency

In addition to the recommended routine monthly program, aquatic ecosystem monitoring should be initiated in the event of accidental discharge of contaminants and sediments during construction.

During this contingency monitoring, it may be necessary to amend the sites or indicators monitored to ensure the potential impacts resulting from the event triggering the monitoring can be assessed.

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[13] % tolerant taxa is based on the proportion of taxa with ‘tolerant’ SIGNAL2 grades of 1-3.

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Appendix A:
Detailed Methods

1. Detailed Methods

Baseline monitoring programs for the KUR-World Project were undertaken between 5 December 2016 and 19 June 2017. A detailed summary of the sampling schedule is provided in **Table 7**. The methods for these monitoring programs are described in the following sections.

1.1 Surface water

1.1.1 Field collection and measurement

Surface water monitoring was conducted between 5 December 2016 and 21 April 2017. Each survey was undertaken by two NRA environmental scientists. Sampling occurred at a number of locations upstream and downstream of the proposed development. Site descriptions are provided in **Table 6** and sites are presented on **Figure 4** of the main report.

On several occasions, alternative sites were used when the high Barron River water levels caused sampling sites to be inaccessible or site water was mixed with Barron River water. Alternative sites (*ie* SW05 Alt, SW10 Alt and SW11 Alt) were chosen to fulfil the same purpose as the original sites.

Surface water sampling involved five detailed and four opportunistic water quality sampling events[1].

Samples were collected at 12 monitoring sites[2] during each of the five detailed water quality sampling events, with the following exceptions.

- Sites SW05 and SW07 could not be sampled on 9 January 2017 due to high Barron River water levels and there was no available alternative site. Site SW07 was also inaccessible on 1 February 2017.
- Sites SW04 and SW08 could not be sampled on 6 December 2016 due to absence of water. No samples could be collected from SW04 on 9 January, 21 February and 21 April 2017 due to absence of water.
- Water quality samples from two additional sites (SW01B and SW02B) were analysed for the full water quality suite as part of aquatic ecology (aquatic macroinvertebrates) sampling on 20 April 2017.

Opportunistic water quality sampling events involved the collection of surface water samples from monitoring sites for analysis of Total Suspended Solids (TSS) and Volatile Suspended Solids (VSS) only (**Figure 4,** main report).

Surface water quality monitoring for the full water quality analyte suite followed the approach described in EHP (2013). Surface water quality was measured *in situ* using

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[1] Detailed water quality sampling events involved sampling and laboratory analysis of a full suite of analytes as well as completion of detailed field proformas. Opportunistic water quality sampling involved sampling for analysis of total suspended solids and volatile suspended solids only.

[2] Routine monitoring sites sampled for analysis of the full water quality suite include sites SW01, SW02, SW03, SW04, SW05 (and associated SW05 Alt), SW06, SW07, SW08, SW09, SW10 (and associated SW10 Alt), SW11 (and associated SW11 Alt) and SW12.

calibrated water quality meters for pH, electrical conductivity, dissolved oxygen, turbidity and temperature. Water quality samples were collected in containers supplied by SGS Cairns Environmental Laboratory (SGS) (NATA accredited laboratory 2562(4354)). Field-filtered samples were collected (using disposable 0.45 µm filters) for dissolved metals and nutrient analysis. Field observations and *in situ* results were recorded on an NRA proforma (**Appendix B**).

1.1.2 Laboratory analysis

The surface water samples were analysed by SGS for TSS, VSS[3], total dissolved solids, nutrients (total oxidised nitrogen (TON), nitrate, nitrite[4], ammonia, total Kjeldahl nitrogen (TKN), total nitrogen, total inorganic nitrogen, filterable reactive phosphorus and total phosphorus), dissolved and total metals and metalloids (aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel and zinc), major and minor ions (total sodium, fluoride[4], total potassium, total magnesium, total calcium, total hardness, chloride, total sulfate) and alkalinity (total alkalinity, bicarbonate alkalinity, carbonate alkalinity and hydroxide alkalinity).

1.1.3 Comparison to guideline values

Water Quality Objectives (WQOs) for the project area were developed based on the environmental values that apply to the project area subcatchments, as detailed in **Table 1** below. Published guideline values used to develop the WQOs are presented in **Table 2** (base flow conditions), **Table 3** (high flow conditions for those analytes differing from WQOs presented in **Table 2**).

Table 1: Environmental values for the KUR-World project area receiving waters (EHP 2014)

Barron River Basin subcatchment	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumption	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values
Kauri, Groves, Thirty Three Mile, Blackwater, One Mile, Mona, Jumrum, Haren and Dismal Creeks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓
Barron River main channel between weir at Koah and Barron Falls*	✓	×	×	×	×	✓	✓	✓	✓	×	✓	✓

* Outside the project area but downstream of project activities.

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[3] Included in the full analyte suite from 1 February 2017.
[4] Included in the full analyte suite from 20 April 2017.

Table 2: Surface water quality objectives for environmental values relevant to the KUR-World project area under base flow conditions

Analyte	Units	Water quality objectives for relevant environmental values												Project-specific WQO
		Aquatic ecosystems[1]	Irrigation[2]	Farm supply/use[2]	Stock water[1]	Aquaculture	Human consumption[2]	Primary recreation[1]	Secondary recreation	Visual appreciation[3]	Drinking water[1]	Industrial use[4]	Cultural and spiritual values[5]	
pH	pH units	6.0-**8.0**	6.0-9.0	6.0-9.0	-	6.8-9.5	-	**6.5**-8.5	-	-	5.5-**8.0**	-	-	6.5-8.0
Dissolved oxygen	% saturation	**85-120**	-	-	-	47[k]	-	80	-	-	65-82[k,l]	-	-	85-120
Electrical conductivity	µS/cm	**106**	950	950	2985[c]	-	-	-	-	-	896[c]	-	-	106
Temperature	°C	-	-	-	-	21-32	-	16-34	-	-	-	-	-	16-34
Turbidity	NTU	15	-	-	-	80	-	-	-	-	**5**[g]	-	-	15[n]
Total suspended solids	mg/L	**8**	-	-	-	-	-	-	-	-	-	-	-	8
Total dissolved solids	mg/L	-	-	-	2000	-	-	-	-	-	**600**[g]	-	-	-[b]
Total oxidised nitrogen	mg/L	**0.05**	-	-	-	-	-	-	-	-	-	-	-	0.05
Ammonia as nitrogen	mg/L	**0.01**	-	-	-	0.822[e]	-	-	-	-	0.411[g,e]	-	-	0.01
Total nitrogen	mg/L	**0.34**	5	5	-	-	-	-	-	-	-	-	-	0.34
Filterable reactive phosphorous	mg/L	**0.008**	-	-	-	-	-	-	-	-	-	-	-	0.008
Total phosphorous	mg/L	**0.025**	0.05	0.05	-	-	-	-	-	-	-	-	-	0.025
Dissolved aluminium	mg/L	**0.055**[a]	-	-	-	-	-	-	-	-	-	-	-	0.055
Total aluminium	mg/L	-	5	5	5	-	-	-	-	-	**0.2**[g]	-	-	0.2
Dissolved arsenic	mg/L	**0.013**[a]	-	-	-	-	-	-	-	-	-	-	-	0.01[m]
Total arsenic	mg/L		0.1	0.1	0.5	0.05	-	0.1[d]	-	-	**0.01**[g]	-	-	0.01
Dissolved cadmium	mg/L	**0.0002**[a]	-	-	-	-	-	-	-	-	-	-	-	0.0002
Total cadmium	mg/L	-	0.01	0.01	0.01	0.003	-	0.020[d]	-	-	**0.002**[g]	-	-	0.002
Dissolved chromium	mg/L	**0.001**[a]	-	-	-	-	-	-	-	-	-	-	-	0.001
Total chromium	mg/L	-	0.1	0.1	1	0.1	-	0.5[d]	-	-	**0.05**[g]	-	-	0.05
Dissolved copper	mg/L	**0.03**	-	-	-	-	-	-	-	-	-	-	-	0.03
Total copper	mg/L	-	**0.2**	**0.2**	0.4	0.006	1	20[d]	-	-	1[g]	-	-	0.2
Dissolved iron	mg/L	**0.20**	-	-	-	-	-	-	-	-	-	-	-	0.20
Total iron	mg/L	-	**0.2**	**0.2**	-	0.5	-	-	-	-	0.3[g]	-	-	0.2
Dissolved lead	mg/L	**0.0034**[a]	-	-	-	-	-	-	-	-	-	-	-	0.0034
Total lead	mg/L	-	2	2	0.1	0.03	-	0.1[d]	-	-	**0.01**[g]	-	-	0.01
Dissolved manganese	mg/L	**0.01**	-	-	-	-	-	-	-	-	-	-		0.01
Total manganese	mg/L	-	0.2	0.2	-	0.01	-	5[d]			**0.1**[g]	-		0.1
Dissolved nickel	mg/L	**0.011**[a]	-	-	-		-	-	-	-	-	-	-	0.011
Total nickel	mg/L	-	0.2	0.2	1	0.01[k], 0.04[l]	-	0.2[d]	-	-	**0.02**[g]	-	-	0.02
Dissolved zinc	mg/L	**0.02**	-	-	-	-	-	-	-	-	-	-	-	0.02
Total zinc	mg/L	-	**2**	**2**	20	0.03-0.06[k] 1-2[l]	5	-	-	-	3[g]	-	-	2
Sodium	mg/L	**11**	115	115	-	-	-	-	-	-	180	-	-	11
Fluoride	mg/L	**0.11**	-	-	-	-	-	15[d]	-	-	1.5[g]	-	-	0.11
Potassium	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	TBC
Magnesium	mg/L	4[h]	-	-	-	10-160	-	-	-	-	-	-	-	-
Calcium	mg/L	5[h]	-	-	**1000**	10-160	-	-	-	-	-	-	-	1000
Chloride	mg/L	**14**	175	175	-	-	-	-	-	-	250[g]	-	-	14
Sulfate	mg/L	**2**	-	-	1000[a]	-	-	5000[d]	-	-	250	-	-	2
Hardness (as $CaCO_3$)	mg/L	**29**[h]	60-350	60-350	-	20-450	-	-	-	-	200[g]	-	-	60-350
Total alkalinity (as $CaCO_3$)	mg/L	**33**	-	-	-	20-400	-	-	-	-	-	-	-	33

Values **bolded** and **underlined** were the most conservative guideline for each parameter and were selected as the Water Quality Objective (WQO).

Shaded columns indicate that the Environmental Value (EV) was not considered relevant to the project area. Aquaculture was listed as an EV for the 'Kauri, Groves, Thirty Three Mile, Blackwater, One Mile, Mona, Jumrum, Haren and Dismal creeks' subcatchment of the Barron River Basin but examination of satellite imagery determined that there were no aquaculture activities downstream of the KUR-World project area.

- No value.

TBC – site specific guideline value to be calculated.

[1] Values are from EHP (2014) unless otherwise indicated. Where 20th, 50th and 80th percentile values were available (*eg* Table 2.4), the 80th percentile was selected as the WQO as this is appropriate for the application of regional specific guideline values to moderately disturbed waters. DO and pH are shown as a range of 20th and 80th percentiles.

[2] Guidelines are from ANZECC and ARMCANZ (2000) unless otherwise indicated. Farm use is assumed to include irrigation/agricultural use rather than drinking water supply.

[3] There are no numerical guidelines for the 'visual use' category of the ANZECC and ARMCANZ (2000) guidelines for recreational water quality and aesthetics. EHP (2014) states that the water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life.

[4] The industrial use EV is not applied to the sub-catchment of the project area (Kauri, Groves, Thirty Three Mile, Blackwater, One Mile, Mona, Jumrum, Haren and Dismal Creeks).

[5] EHP (2014) states that the cultural and spiritual values EV is protected by protecting or restoring indigenous and non-indigenous cultural heritage consistent with any relevant policies and plans. For the purposes of the EIS, it is assumed that the protection of the aquatic ecosystems EV would result in the protection of cultural heritage.

[6] Total Inorganic Nitrogen (also referred to as Dissolved Inorganic Nitrogen (DIN)) has been included as DIN can be used to assist in the interpretation of total nitrogen values. From Queensland Water Quality Guidelines 2009 (QWQG) (EHP 2013b): *During periods of low flow and particularly in smaller creeks, build up of organic matter derived from natural sources (eg leaf litter) can result in increased organic N levels (generally in the range of 400 to 800 µg/L). This may lead to total N values exceeding the QWQG values. Provided that levels of inorganic N (ie NH3 + oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the guidelines, provided this is due to natural causes.*

[a] Guideline value from ANZECC and ARMCANZ (2000).

[b] As total dissolved solids is analogous to electrical conductivity, a WQO has not been provided for both indicators. Refer to the WQO for electrical conductivity.

[c] Calculated from the total dissolved solids guideline by dividing by a factor of 0.67, as per ANZECC and ARMCANZ (2000).

[d] Value is ten times the health based drinking water guideline (NHMRC 2017) as prescribed by NHMRC (2008).

[e] Value for ammonia as nitrogen converted from ammonia (NH_3) by multiplying by a factor of 0.822.

[g] Value is the drinking water guideline from NHMRC (2017).

[h] While the WQOs presented in EHP (2014) represent typical reference concentrations of calcium, magnesium and hardness in the Barron River Basin, it is known that hardness (consisting of calcium and magnesium), ameliorates the toxicity of many metals (Markich et al 2002), therefore, exceedances of the WQOs do not represent a decline in water quality. Accordingly, no WQOs for aquatic ecosystem protection were adopted for calcium, magnesium and hardness. Data for these parameters was used for interpretive purposes.

[i] Value is for soft water (EHP 2014).

[j] Value is for hard water (EHP 2014).

[k] Dissolved oxygen as percent saturation (at 350 m elevation and 25°C) converted from mg/L using online calculator (http://www.fivecreeks.org/monitor/do.shtml).

[l] Upper drinking water guideline for dissolved oxygen of 82% was not considered an appropriate guideline value as both EHP (2013) and NHMRC (2017) set dissolved oxygen concentrations above 85% saturation for the protection of the aquatic ecosystem and drinking water EVs. The upper dissolved oxygen concentration of 82% was therefore not considered when selecting the most conservative value to use as a WQO.

[m] The WQO derived for dissolved arsenic was based on the WQO for aquatic ecosystem EVs, whereas the WQO for total arsenic was based on drinking water. As the WQO for total arsenic is more conservative than the WQO for dissolved arsenic, the total metals WQO has been applied for both total and dissolved arsenic.

[n] The guideline value for aquatic ecosystems has been selected as the project-specific WQO, rather than the guideline value for drinking water. The guideline value for drinking water represents an aesthetic guideline value and is intended for human consumption as supplied from the tap, or indirectly in beverages or food.

Table 3: Surface water quality objectives for environmental values relevant to the KUR-World project area for parameters where water quality objectives for high flow conditions were available

Analyte	Units	Water quality objectives for relevant environmental values												Project-specific WQO
		Aquatic ecosystems[1]	Irrigation[2]	Farm supply/use[2]	Stock water[1]	Aquaculture	Human consumption[2]	Primary recreation[1]	Secondary recreation	Visual appreciation[3]	Drinking water[1]	Industrial use[4]	Cultural and spiritual values[5]	
Total suspended solids	mg/L	**52**	-	-	-	-	-	-	-	-	-	-	-	52
Total oxidised nitrogen	mg/L	**0.101**	-	-	-	-	-	-	-	-	-	-	-	0.101
Ammonia as nitrogen	mg/L	**0.013**	-	-	-	0.822[a]	-	-	-	-	0.411[a,b]	-	-	0.013
Total nitrogen	mg/L	**0.668**	5	5	-	-	-	-	-	-	-	-	-	0.668
Filterable reactive phosphorous	mg/L	**0.004**	-	-	-	-	-	-	-	-	-	-	-	0.004
Total phosphorous	mg/L	0.070	**0.05**	**0.05**	-	-	-	-	-	-	-	-	-	0.05

Values **bolded** and **underlined** were the most conservative guideline for each parameter and were selected as the Water Quality Objective (WQO).

Shaded columns indicate that the Environmental Value (EV) was not considered relevant to the project area. Aquaculture was listed as an EV for the ‘Kauri, Groves, Thirty Three Mile, Blackwater, One Mile, Mona, Jumrum, Haren and Dismal creeks’ subcatchment of the Barron River Basin but examination of satellite imagery determined that there were no aquaculture activities downstream of the KUR-World project area..

- No value.

[1] Values are from Table 2.2 of EHP (2014) for parameters where WQOs for high flow conditions were available.

[2] Guidelines are from ANZECC and ARMCANZ (2000) unless otherwise indicated. Farm use is assumed to include irrigation/agricultural use rather than drinking water supply.

[3] There are no numerical guidelines for the ‘visual use’ category of the ANZECC and ARMCANZ (2000) guidelines for recreational water quality and aesthetics. EHP (2014) states that the water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life.

[4] The industrial use EV is protected by WQOs for other EVs, such as aquatic ecosystems (EHP 2014).

[5] EHP (2014) states that the cultural and spiritual values EV is protected by protecting or restoring indigenous and non-indigenous cultural heritage consistent with any relevant policies and plans. For the purposes of the EIS, it is assumed that the protection of the aquatic ecosystems EV would result in the protection of cultural heritage.

[a] Value for ammonia as nitrogen converted from ammonia (NH_3) by multiplying by a factor of 0.822.

[b] Value is the drinking water guideline from NHMRC (2017).

Surface water quality data was compared to the nominated WQOs. Where results were found to exceed trigger values for cadmium, lead, nickel or zinc sourced from ANZECC (2000) and where hardness concentrations were >30 mg/L $CaCO_3$, Hardness Modified Trigger Values (HMTVs) were calculated as per ANZECC (2000) Table 3.4.3. NRA has become aware that, subsequent to the issuing of the ANZECC guidelines, there is recognition in the scientific literature that for some taxa, hardness does not have an ameliorative effect on copper toxicity (Markich *et al.* 2005). In light of this, NRA does not calculate HMTVs for copper.

1.2 Stream sediment

1.2.1 Field collection and measurement

Stream sediment sampling occurred on 21 April 2017 in conjunction with surface water and aquatic ecology (aquatic macroinvertebrates) monitoring. Composite stream sediment samples were collected from the channel bed of the watercourse at sites SW01B, SW02, SW02B and SW08. Composite samples were collected with a stainless-steel trowel from 10 points within the sampling area of each site to a depth of approximately 5 cm. The sample was split using the ‘coning and quartering’ method. Stones greater than approximately 25 mm were manually removed from each sample. Samples were collected into plastic sediment sample bags. Samples were collected by NRA environmental scientists.

1.2.2 Laboratory analysis

Stream sediment samples were analysed by SGS for chemical and physical properties. Chemical analysis was undertaken on the whole sediment (<2 mm) fraction for arsenic, cadmium, chromium, copper, manganese, nickel, lead and zinc. The whole sediment fraction was analysed to allow comparison against published guideline values (Simpson *et al.* 2013).

Particle size distribution (PSD) analysis describes the proportions of stream sediment that occur across the sediment size classes listed in **Table 4**. These physical results can be used to interpret the chemical analysis data and infer whether substrate smothering has occurred (smothering can reduce microhabitat suitability for aquatic macroinvertebrates).

Table 4: Sediment fraction size ranges for particle size analysis

Size class	Fraction size range (mm)
Gravel	>2.0
Coarse sand	0.6 to 2.0
Large medium sand	0.3 to 0.6
Small medium sand	0.212 to 0.3
Fine sand	0.063 to 0.212
Silt and clay	<0.063

1.2.3 Comparison to guideline values

Chemical properties of the whole sediment fraction (<2 mm) were analysed and compared with published guideline values for the protection of aquatic ecosystems following the approach recommended in the *Sediment Quality Guidelines* (Simpson *et al.* 2013).

1.3 Aquatic ecology – Aquatic macroinvertebrates

Aquatic macroinvertebrates provide an indication of ecosystem health that, in combination with surface water and stream sediment data, can be used to identify and evaluate the impacts of activities on the receiving environment. Water quality can fluctuate at a site and a single surface water sample will not necessarily reflect overall site conditions. Aquatic macroinvertebrate community condition, along with surface water and sediment quality, provide a better representation of the condition of a site than surface water alone.

Aquatic macroinvertebrate sampling occurred on 20 April 2017 in conjunction with surface water and sediment monitoring. Aquatic macroinvertebrate kick samples were collected at sites SW01B, SW02, SW02B and SW08. Kick samples involved the operator using their feet to disturb a 10 m stretch of substrate over a two minute period while sweeping an aquatic macroinvertebrate net (250 µm mesh aperture) behind the plume to collect dislodged material. Two replicate samples (denoted with an A or B) were collected from bed habitat at each site. Material collected from each of the kick sample replicates was emptied into separate white sorting trays. The replicate code (*ie* A or B) is unique to each live-pick operator. Live animals were picked from the tray for 30 minutes using forceps and pipettes. Collected specimens were preserved in methylated spirits for laboratory identification.

Samples were collected by NRA senior environmental scientist Martine Newman (NRA) and live-picking was conducted by Martine Newman and NRA graduate environmental scientist Karen Lindee.

A rapid assessment of biophysical conditions was undertaken at each site, with results recorded on NRA proformas (**Appendix B**). The rapid assessment included water depth, substrate composition, flow, the occurrence of aquatic vegetation or overhanging riparian vegetation and disturbance. This information was used to assist with data interpretation and serves as a permanent record for future reference.

1.3.1 Laboratory identification

Aquatic macroinvertebrates were sorted and identified by NRA environmental scientist Iain Goodrick to the appropriate taxonomic level (family for most taxa) using a stereo microscope and taxonomic keys recommended in Hawking (2000). The abundance of each taxon was recorded.

1.3.2 Statistical analysis

Statistical analysis was undertaken to identify site variation in the aquatic macroinvertebrate assemblages between sites SW01B, SW02, SW02B and SW08.

The PRIMER 7 (Plymouth Routines in Multivariate Ecological Research V7.0.12) computer software package was used to perform multivariate analysis on the aquatic macroinvertebrate assemblages. MDS ordination reduces the complexity of data-sets, which for aquatic macroinvertebrates has as many dimensions as there are taxa, into a two-dimensional plot (ordination) to describe the similarity between samples. The results of the cluster analysis were superimposed on the ordinations and statistical significance of the cluster groups was tested with the ‘similarity profile’ (SIMPROF) routine at a significance level of 0.05. SIMPROF is a permutation test of the null hypothesis that samples within a cluster group do not differ in assemblage structure (Clarke & Gorley 2006). The ordination is intended to support interpretation of the relative similarity between sites based on aquatic macroinvertebrate taxa composition and abundance.

Data analysis was undertaken to identify differences between aquatic macroinvertebrate assemblages in surface waters between sites SW01B, SW02, SW02B and SW08.

Calculations of abundance and taxonomic richness (hereafter referred to as taxa richness) of aquatic macroinvertebrates for each site were derived from the total sample while the following treatments were applied to data prior to multivariate cluster analysis and ordination.

- Dispersion weighting was applied to replicate data to reduce the relative weight of clumped data in the multivariate analysis. Taxa that occur evenly within a habitat provide more meaningful information when they are absent than taxa that occur in isolated clumps, where absence may be due to random effects. Numerically dominant taxa that are clumped together at one site add ‘noise’ rather than ‘signal’ to multivariate data, and down-weighting their influence is advisable prior to further treatments (Clarke *et al*. 2006).
- Square root transformation was applied following dispersion weighting to down-weight the consistently abundant taxa. This mild transformation is suitable where taxa vary in abundance between a single individual and hundreds of individuals within samples (Somerfield *et al*. 1994). Transformation is widely applied in the analysis of abundance data and increases the value of less abundant and moderately abundant taxa, while reducing the dominance of the most abundant taxa in the similarity score.
- The Bray Curtis similarity coefficient was used to calculate similarities between samples, which underpins the cluster analysis and ordination. The coefficient computes the similarity between every pair of samples collected based on the extent to which these samples share taxa at comparable levels of abundance.

1.4 Aquatic ecology – Fish

1.4.1 Field collection and measurement

A freshwater fish survey was conducted on 12 and 13 June 2017 by Brendan Ebner (TropWATER) and Terry Vallance (Tropical River Consulting) (**Appendix F**). The scope of the survey was to:

- identify fish species in each creek flowing through the project area through systematic survey
- identify whether the Lake Eacham Rainbowfish (*Melanotaenia eachamensis*) was present
- identify presence of exotic fish species
- identify management actions required/possible to improve habitat for native fish species.

The fish survey was undertaken at eight sites (*ie* SW01, SW02, SW03, SW06, SW08, SW09, SW1B and SW2B) using a Smith-Root LR-24 backpack electrofisher. The primary operator waded in an upstream direction and, in flowing water, a second operator trailed downstream to collect stunned fish and crustaceans with a dip net and bucket. Electrofisher settings were optimised according to site-specific conditions, mostly relating to water conductivity and temperature. Record was made of total on-time (ranged from 251–469 seconds per site) and distance of stream sampled (50–60 m lengths of stream).

Due to the rapid nature of the surveys, total length (TL) of captured fish was estimated (to the nearest 5 millimetre for fish less than 100 mm TL; 10 mm for fishes 100–300 mm TL; and 50 mm for larger individuals). Fish were identified from experience and with the aid of relevant field guides. Author experience with collecting and maintaining local morphs (*ie* distinct populations) of *Melanotaenia* spp. was also important in visually inspected rainbowfish on-site. A small number of specimens was also retained and sent for genetic analysis for the Lake Eacham Rainbowfish (*Melanotaenia eachamensis*).

Photographs were taken of all species caught and a small subsample of fish was retained for genetic and taxonomic purposes. Photographs were taken of select habitats and crayfish burrows (**Appendix F** of main report).

1.5 Groundwater

1.5.1 Field collection and measurement

Rob Lait & Associates was subcontracted by NRA to design and implement the groundwater quality assessment. Seven bores were installed across the project area from 2 to 10 November 2016. Bores WB2, WB5, WB6, WB7 and WB8 were selected for groundwater quality monitoring (**Figure 4** in the main report). In the first groundwater sampling event, bores WB2, WB5, WB6, WB7 and WB8 were sampled to provide a comprehensive analysis of the project area’s groundwater. Subsequent groundwater sampling was undertaken at selected bores to evaluate the groundwater level and groundwater quality fluctuations at the project area over the sampling period.

Methods for groundwater sample collection are provided in RLA (2017) (**Appendix I** of main report).

1.5.2 Laboratory analysis

The groundwater samples were analysed by SGS for pH, TSS, total dissolved solids, nutrients (total oxidised nitrogen, ammonia, total Kjeldahl nitrogen, total nitrogen, total inorganic nitrogen, filterable reactive phosphorous and total phosphorous), total and dissolved metals and metalloids (*ie* aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel and zinc), major ions (sodium, total potassium, total magnesium, total calcium, total hardness, chloride and total sulfate) and alkalinity (total alkalinity, bicarbonate alkalinity, carbonate alkalinity and hydroxide alkalinity).

1.5.3 Comparison to guideline values

WQOs for groundwater in the project area were developed based on the environmental values that apply to the project area subcatchments, as detailed in **Table 5**. Published guideline values used to develop the groundwater WQOs are presented in **Table 6**.

Table 5: Environmental values for the KUR-World project area groundwaters (EHP 2014)

Barron River Basin subcatchment	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumption	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values
Groundwater	✓	✓	✓	✓	×	×	×	×	×	✓	✓	✓

Groundwater quality data was compared to the nominated WQOs. Where results were found to exceed trigger values for cadmium, lead, nickel or zinc sourced from ANZECC (2000), and where hardness concentrations were >30 mg/L CaCO3, Hardness Modified Trigger Values (HMTVs) were calculated as per ANZECC (2000) Table 3.4.3. NRA has become aware that, subsequent to the issuing of the ANZECC guidelines, there is recognition in the scientific literature that for some taxa, hardness does not have an ameliorative effect on copper toxicity (Markich *et al.* 2005). In light of this, NRA does not calculate HMTVs for copper.

Table 6: Water quality objectives for environmental values relevant to the KUR-World project area groundwaters

Parameter	Units	Water quality objectives for relevant environmental values												Project-specific WQO
		Aquatic ecosystems[1]	Irrigation[2]	Farm supply/use[2]	Stock water[1]	Aquaculture	Human consumption	Primary recreation	Secondary recreation	Visual appreciation	Drinking water[1]	Industrial use[3]	Cultural and spiritual values[4]	
pH	pH units	**6.5-7.9**	6.0-9.0	6.0-9.0	-	-	-	-	-	-	5.5-8.0	-	-	6.5-7.9
Electrical conductivity	µS/cm	**90-570**	950	950	2985[b]	-	-	-	-	-	896[b]	-	-	90-570
Total dissolved solids	mg/L	-	-	-	2000	-	-	-	-	-	**600**[d]	-	-	-[e]
Total oxidised nitrogen	mg/L	**-**	-	-	-	-	-	-	-	-	-	-	-	TBC
Nitrate as nitrogen	mg/L	**1.58**[g]												1.58
Ammonia as nitrogen	mg/L	**0.01**	-	-	-	-	-	-	-	-	0.411[c,d]	-	-	0.01
Total nitrogen	mg/L	**0.34**	5	5	-	-	-	-	-	-	-	-	-	0.34
Filterable reactive phosphorous	mg/L	**0.008**	-	-	-	-	-	-	-	-	-	-	-	0.008
Total phosphorous	mg/L	**0.025**	0.05	0.05	-	-	-	-	-	-	-	-	-	0.025
Dissolved aluminium	mg/L	**0.055**[a]	-	-	-	-	-	-	-	-	-	-	-	0.055
Total aluminium	mg/L	-	5	5	5	-	-	-	-	-	**0.2**[d]	-	-	0.2
Dissolved arsenic	mg/L	**0.013**[a]	-	-	-	-	-	-	-	-	-	-	-	0.01[f]
Total arsenic	mg/L	-	0.1	0.1	0.5	-	-	-	-	-	**0.01**[d]	-	-	0.01
Dissolved cadmium	mg/L	**0.0002**[a]	-	-	-	-	-	-	-	-	-	-	-	0.0002
Total cadmium	mg/L	-	0.01	0.01	0.01	-	-	-	-	-	**0.002**[d]	-	-	0.002
Dissolved chromium	mg/L	**0.001**[a]	-	-	-	-	-	-	-	-	-	-	-	0.001
Total chromium	mg/L	-	0.1	0.1	1	-	-	-	-	-	**0.05**[d]	-	-	0.05
Dissolved copper	mg/L	**0.01**	-	-	-	-	-	-	-	-	-	-	-	0.01
Total copper	mg/L	-	**0.2**	**0.2**	0.4	-	-	-	-	-	1[d]	-	-	0.2
Dissolved iron	mg/L	**0.02**	-	-	-	-	-	-	-	-	-	-	-	0.02
Total iron	mg/L	-	**0.2**	**0.2**	-	-	-	-	-	-	0.3[d]	-	-	0.2
Dissolved lead	mg/L	**0.0034**[a]	-	-	-	-	-	-	-	-	-	-	-	0.0034
Total lead	mg/L	-	2	2	0.1	-	-	-	-	-	**0.01**[d]	-	-	0.01
Dissolved manganese	mg/L	**0.03**	-	-	-	-	-	-	-	-	-	-	-	0.03
Total manganese	mg/L	-	0.2	0.2	-	-	-	-	-	-	**0.1**[d]	-	-	0.1
Dissolved nickel	mg/L	**0.011**[a]	-	-	-	-	-	-	-	-	-	-	-	0.011
Total nickel	mg/L	-	0.2	0.2	1	-	-	-	-	-	**0.02**[d]	-	-	0.02
Dissolved zinc	mg/L	**0.01**	-	-	-	-	-	-	-	-	-	-	-	0.01
Total zinc	mg/L	-	**2**	**2**	20	-	-	-	-	-	3[d]	-	-	2
Sodium	mg/L	**97**	115	115	-	-	-	-	-	-	180	-	-	97
Fluoride	mg/L	**0.50**	-	-	-	-	-	-	-	-	1.5[d]	-	-	0.50
Potassium	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-
Magnesium	mg/L	**13**	-	-	-	-	-	-	-	-	-	-	-	13
Calcium	mg/L	**25**	-	-	1000[a]	-	-	-	-	-	-	-	-	25
Chloride	mg/L	**61**	175	175	-	-	-	-	-	-	250[d]	-	-	61
Sulfate	mg/L	**6**	-	-	1000[a]	-	-	-	-	-	250	-	-	6
Hardness (as $CaCO_3$)	mg/L	**115**	**60**-350	**60**-350	-	-	-	-	-	-	200[d]	-	-	60-115
Total alkalinity (as $CaCO_3$)	mg/L	**151**	-	-	-	-	-	-	-	-	-	-	-	151

Values **bold** and **underlined** were the most conservative guideline for each parameter and were selected as the Water Quality Objective (WQO).

Shaded columns indicate that the Environmental Value (EV) was not considered relevant to groundwaters in the Barron River Basin (EHP 2014).

- No value.

TBC - Site specific guideline value to be calculated.

[1] Values are from EHP (2014) unless otherwise indicated. Values for moderate depth waters (15-40 m) from the Barron River Basin Environmental Values and Water Quality Objectives (EHP 2014) Table 4.2 Water Quality Objectives to protect aquatic ecosystem EVs for Groundwater Chemistry Group (refer to Plan WQ1083) - Wet Tropical Alluvial - 18 Barron Mulgrave Johnstone metamorphics, unless otherwise indicated. The water quality of groundwater associated with the project area does not meet the current moderately disturbed guideline values for pH, nutrients and some metals and major ions (Section 4.9 of the main report), and is therefore not considered to be in pristine condition. For analytes not listed in EHP (2014) Table 4.2, the WQOs from EHP (2014) Table 2.4 (80th percentile which is relevant to moderately disturbed waters) were adopted.

[2] Guidelines are from ANZECC and ARMCANZ (2000) unless otherwise indicated. Farm use is assumed to include irrigation/agricultural use rather than drinking water supply.

[3] The industrial use EV is protected by WQOs for other EVs, such as aquatic ecosystems (EHP 2014).

[4] EHP (2014) states that the cultural and spiritual values EV is protected by protecting or restoring indigenous and non-indigenous cultural heritage consistent with any relevant policies and plans. For the purposes of the EIS, it is assumed that the protection of the aquatic ecosystems EV would result in the protection of cultural heritage.

[a] Guideline value from ANZECC and ARMCANZ (2000).

[b] Calculated from the total dissolved solids guideline by dividing by a factor of 0.67, as per ANZECC and ARMCANZ (2000).

[c] Value for ammonia as nitrogen converted from ammonia (NH_3) by multiplying by a factor of 0.822.

[d] Value is the drinking water guideline from NHMRC (2017).

[e] As total dissolved solids is analogous to electrical conductivity, a WQO has not been provided for both indicators. Refer to the WQO for electrical conductivity.

[f] The WQO derived for dissolved arsenic was based on the WQO for aquatic ecosystem EVs, whereas the WQO for total arsenic was based on drinking water. As the WQO for total arsenic is more conservative than the WQO for dissolved arsenic, the total metals WQO has been applied for both total and dissolved arsenic.

[g] Value for nitrate as nitrogen converted from nitrate (NO_3) by multiplying by a factor of 0.226.

1.6 Quality assurance/quality control

1.6.1 Surface water

The water quality meters were calibrated by NRA prior to undertaking fieldwork.

During events where samples were collected for the full water quality suite, NRA collected a field blank sample using de-ionised water provided by SGS to determine potential contamination of water samples during sampling, transportation and laboratory analysis. To determine the reliability of laboratory analysis, a field duplicate sample was collected from one site during each sampling event for the full analyte suite. The field blank and field duplicate samples were analysed by SGS.

1.6.2 Stream sediment

To confirm analytical reliability of laboratory analyses, NRA collected a duplicate sediment sample from site SW02. The sample was split using the ‘coning and quartering’ method and analysed by SGS.

1.6.3 Aquatic macroinvertebrates

Following aquatic macroinvertebrate identification and abundance counts, specimens in a sub-set of samples were identified and counted by a second NRA environmental scientist to provide a QA/QC check of the results.

Residual samples (*ie* the aquatic macroinvertebrate kick sample material remaining in each tray at the end of live-picking) were collected at site SW02B. The residual samples were checked in the laboratory by an NRA environmental scientist under the stereo microscope and all aquatic macroinvertebrates present were recorded. This process is used to verify the live-picking capability of each operator.

1.6.4 Fish

Details of quality assurance/quality control methods applied to fish identification are reported in Ebner & Valance (2017, **Appendix F**).

1.6.5 Groundwater

Duplicate and blank samples were not collected during groundwater field survey. Laboratory quality control procedures were undertaken by SGS.

Table 7: Sampling schedule

Date	Lab Cert ID	Lab certificate label	Standard site name	Surface Water TSS/VSS only	Surface Water Full analyte suite	Sediment	Aquatic macroinvertebrates	Groundwater	Fish	Samples collected for Quality Assurance and Quality Control
5/12/2016	CE124405.001	SW01	SW01		Y					
5/12/2016	CE124405.002	SW02	SW02		Y					
6/12/2016	CE124405.003	SW03	SW03		Y					
6/12/2016	CE124405.004	SW05	SW05		Y					
5/12/2016	CE124405.005	SW06	SW06		Y					
6/12/2016	CE124405.006	SW07	SW07		Y					
5/12/2016	CE124405.007	SW09	SW09		Y					
5/12/2016	CE124405.008	SW10	SW10		Y[1]					
6/12/2016	CE124405.009	SW11	SW11		Y					
6/12/2016	CE124405.010	SW12	SW12		Y					
5/12/2016	CE124405.011	QA	QA							Y
5/12/2016	CE124405.012	DUP	DUP							Y
13/12/2016	CE124579.001	SW10	SW10	Y						
13/12/2016	CE124579.002	OF Sed Trap	SW13	Y						
13/12/2016	CE124579.003	OF Outflow	SW14	Y						
6/1/2017	CE124888.001	SW02	SW02	Y						
6/1/2017	CE124888.002	SW03	SW03	Y						
6/1/2017	CE124888.003	SW04	SW04	Y						
6/1/2017	CE124888.004	SW05	SW05	Y						
6/1/2017	CE124888.005	SW07	SW07	Y						
6/1/2017	CE124888.006	SW08	SW08	Y						
6/1/2017	CE124888.007	Barron Upstream	SW11 Alt	Y						
9/1/2017	CE124925.001	SW01	SW01		Y					
9/1/2017	CE124925.002	SW02	SW02		Y					
9/1/2017	CE124925.003	SW03	SW03		Y					
9/1/2017	CE124925.004	SW06	SW06		Y					

Date	Lab Cert ID	Lab certificate label	Standard site name	Surface Water TSS/VSS only	Surface Water Full analyte suite	Sediment	Aquatic macroinvertebrates	Groundwater	Fish	Samples collected for Quality Assurance and Quality Control
9/1/2017	CE124925.005	SW08	SW08		Y					
9/1/2017	CE124925.006	SW09	SW09		Y[1]					
10/1/2017	CE124925.007	SW10	SW10 Alt		Y					
9/1/2017	CE124925.008	SW11	SW11 Alt		Y					
10/1/2017	CE124925.009	SW12	SW12		Y					
9/1/2017	CE124925.010	QA	QA							Y
9/1/2017	CE124925.011	DUP	DUP							Y
31/1/2017	CE125368.001	WB2	WB2					Y		
31/1/2017	CE125368.002	WB5	WB5					Y		
31/1/2017	CE125368.003	WB6	WB6					Y		
31/1/2017	CE125368.004	WB7	WB7					Y		
31/1/2017	CE125368.005	WB8	WB8					Y		
1/2/2017	CE125424.001	SW01	SW01		Y					
1/2/2017	CE125424.002	SW02	SW02		Y					
1/2/2017	CE125424.003	SW03	SW03		Y					
1/2/2017	CE125424.004	SW04	SW04		Y					
1/2/2017	CE125424.005	SW05	SW05 Alt		Y					
2/2/2017	CE125424.006	SW06	SW06		Y					
2/2/2017	CE125424.007	SW08	SW08		Y					
1/2/2017	CE125424.008	SW09	SW09		Y[1]					
2/2/2017	CE125424.009	SW10	SW10 Alt		Y					
2/2/2017	CE125424.010	SW11	SW11 Alt		Y					
2/2/2017	CE125424.011	SW12	SW12		Y					
1/2/2017	CE125424.012	QA	QA							Y
1/2/2017	CE125424.013	DUP	DUP							Y
2/2/2017	CE125426.001	SW03	SW03	Y						
2/2/2017	CE125426.002	SW04	SW04	Y						
2/2/2017	CE125426.003	SW05	SW05 Alt	Y						
2/2/2017	CE125426.004	Barron DS Owen	SW15	Y						
21/2/2017	CE125857.001	SW01	SW01		Y					

Date	Lab Cert ID	Lab certificate label	Standard site name	Surface Water TSS/VSS only	Surface Water Full analyte suite	Sediment	Aquatic macroinvertebrates	Groundwater	Fish	Samples collected for Quality Assurance and Quality Control
21/2/2017	CE125857.002	SW02	SW02		Y					
21/2/2017	CE125857.003	SW03	SW03		Y					
21/2/2017	CE125857.004	SW05	SW05		Y					
21/2/2017	CE125857.005	SW06	SW06		Y					
22/2/2017	CE125857.006	SW07	SW07		Y					
21/2/2017	CE125857.007	SW08	SW08		Y					
21/2/2017	CE125857.008	SW09	SW09		Y[1]					
22/2/2017	CE125857.009	SW10	SW10 Alt		Y					
22/2/2017	CE125857.010	SW11	SW11 Alt		Y					
22/2/2017	CE125857.011	SW12	SW12		Y					
21/2/2017	CE125857.012	QA	QA							Y
21/2/2017	CE125857.013	DUP	DUP							Y
13/03/2017	CE126251.001	WB5	WB5					Y		
13/03/2017	CE126251.002	WB6	WB6					Y		
13/03/2017	CE126251.003	WB8	WB8					Y		
21/4/2017	CE126981.001	Owen Ck Mouth	SW05 Alt	Y						
21/4/2017	CE126981.002	Warril Ck Mouth	SW10	Y						
21/4/2017	CE126981.003	Cain Ck Mouth	SW07	Y						
21/4/2017	CE126981.004	Cain Ck Crossing DS	SW16	Y						
21/4/2017	CE126981.005	Barron River DS	SW12	Y						
21/4/2017	CE126981.006	Barron River US	SW11 Alt	Y						
20/4/2017	CE126994.001 and CE126994.006	SW02	SW02			Y[2]				

Date	Lab Cert ID	Lab certificate label	Standard site name	Surface Water TSS/VSS only	Surface Water Full analyte suite	Sediment	Aquatic macroinvertebrates	Groundwater	Fish	Samples collected for Quality Assurance and Quality Control
20/4/2017	CE126994.002 and CE126994.007	SW02B	SW02B			Y				
20/4/2017	CE126994.003 and CE126994.008	SW01B	SW01B			Y				
20/4/2017	CE126994.004 and CE126994.009	SW08	SW08			Y				
20/4/2017	CE126994.005 and CE126994.010	DUP	DUP			Y				
21/4/2017	CE127001.001	SW01	SW01		Y					
20/4/2017	CE127001.002	SW02	SW02		Y[1]					
21/4/2017	CE127001.003	SW03	SW03		Y					
21/4/2017	CE127001.004	SW06	SW06		Y					
20/4/2017	CE127001.005	SW08	SW08		Y					
21/4/2017	CE127001.006	SW09	SW09		Y					
20/4/2017	CE127001.007	QA	QA							Y
20/4/2017	CE127001.008	DUP	DUP							Y
20/4/2017	CE127001.009	SW02B	SW02B		Y					
20/4/2017	CE127001.010	SW01B	SW01B		Y					
20/4/2017	NA	NA	SW01B				Y			
20/4/2017	NA	NA	SW02				Y			
20/4/2017	NA	NA	SW02B				Y[3]			
20/4/2017	NA	NA	SW08				Y			
8/05/2017	CE127244.001	WB5	WB5					Y		
8/05/2017	CE127244.002	WB6	WB6					Y		
8/05/2017	CE127244.003	WB8	WB8					Y		
12/06/2017	NA	NA	NA						Y	
19/06/2017	CE127992.001	WB5	WB5					Y		

Date	Lab Cert ID	Lab certificate label	Standard site name	Surface Water TSS/VSS only	Surface Water Full analyte suite	Sediment	Aquatic macroinvertebrates	Groundwater	Fish	Samples collected for Quality Assurance and Quality Control
19/06/2017	CE127992.002	WB6	WB6					Y		
19/06/2017	CE127992.003	WB8	WB8					Y		

[1] Duplicate surface water sample taken at this site.

[2] Duplicate sediment sample taken at this site.

[3] Aquatic macroinvertebrate residual sample collected for laboratory analysis.

1.7 References

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NHMRC 2008, *Guideline for Managing Risks in Recreational Water*, National Health and Medical Research Council, Canberra.

NHMRC 2017, *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*, version 3.4, National Health and Medical Research Council, Natural Resource Management Ministerial Council, Canberra.

Appendix B:
NRA Field Proformas

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 5/12/16 **Sampler:** KL / JB

Weather: Sunny / Overcast / Light Rain / Heavy Rain

Site	5/12/16 **SW01**	5/12/16 **SW02**	**SW03** WP13
GPS coordinate (GDA94) [NOTE COORDS IF DIFFERENT]	WP8 350092, 8139381 SSK 0350130 8139382 Update after first sampling event	351483, 8138802 WP5 SSK 0351534, 8138880 Update after first sampling event	350761, 8140110 350741 8140095 Update after first sampling event
Sample time	15.00	1030	~~15.00~~ 1140
Water colour/clarity	Brown ~50cm visibility	Brown ~20cm visibility	Clear, slightly tannin stained
Flow conditions (base flow or high flow)	No surface flow	Very low flow	~~No surface flow~~ no flow, pool
Waterbody size (W x L x D) (m)	W = 8 L = continuous D = 1m (in pools)	W = 3m L = >30m D = ~50cm (0.1-0.8m)	W = ~~8~~ 3m L = ~~continuous~~ 40m D = .05
pH	6.35	6.34	6.69
DO (% saturation)	13.7	3.2	2.4
EC (µS/cm)	378	171	141
Turbidity (NTU)	5.45	46.9	8.02
Temp (°C)	24.0	22.2	22.5
Hydrocarbon slick/odour	No hydrocarbons Bacterial colonies film	No	None
Photo Number	**US:** 143 /144 **DS:** 145 **OTHER:** –	**US:** 137 **DS:** 138 **OTHER:** –	**US:** 150 154 **DS:** ~~151~~ 155 **OTHER:**
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	Natural levey ~1m difference in water level around levey More bacterial film downstream of sample site	High ~~co~~ organic matter Natural sediment No reception @ site	Long pool at confluence with [illegible] gullies. Not flowing. Muddy banks, bed. Lots of leaf litter. Bramble + green Suggest access further downstream d/s side of gullies

QA duplicate sample collected at site: SW10

KUR-World Surface Water Monitoring
FIELD SHEET

Date: **Sampler:**

Weather: Sunny / Overcast / Light Rain / Heavy Rain

Site	5/12/16 **SW04**	6/12/16 **SW05**	5/12/16 **SW06**
GPS coordinate (GDA94) [NOTE COORDS IF DIFFERENT]	350749, 8140439 55K 0350747, 8140444 Update after first sampling event	350753, 8141308 350 0750 / 8141288 Update after first sampling event	WP 7 351313, 8140040 55K 0351312, 8140031 Update after first sampling event
Sample time	9:30	1300	13:25
Water colour/clarity	NA	Clear, very slight milkiness	Clear
Flow conditions (base flow or high flow)	NA	Low flow	Low flow
Waterbody size (W x L x D) (m)	W = 0 L = 0 D = 0	W = 4 L = continuous D = 0.3m	W = 0.5 m L = continuous D = 0.05 m
pH	NA	~~6.6~~ 6 70	6.41
DO (% saturation)	NA	78.2	63.4
EC (µS/cm)	NA	122.4	68 6
Turbidity (NTU)	NA	3 21	9.23
Temp (°C)	NA	27 2	25.7
Hydrocarbon slick/odour	NA	NONE	Nil
Photo Number	**US:** 136 **DS:** 106-0135 **OTHER:**	**US:** 157 **DS:** 158 **OTHER:**	**US:** 142 **DS:** 141 **OTHER:**
Comments **(any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)**		Under road bridge, just above level of Barron river. rock bed. Good access from south side of bridge.	Upstream of Billy's caravan

QA duplicate sample collected at site: SW10

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 5/12/16 **Sampler:** KL / JB

Weather: [✓ Sunny] / Overcast / Light Rain / Heavy Rain

Site	**SW07** WP16	6/12/16 **SW08**	5/12/16 **SW09**
GPS coordinate (GDA94) [NOTE COORDS IF DIFFERENT]	351100, 8141260 351110 \ 8141258 Update after first sampling event	WP 12 351942, 8139963 Update after first sampling event	WP6 351234, 8137733 SSK 0351172, 8137775 Update after first sampling event
Sample time	1410	11:00 am	11:20 am
Water colour/clarity	Clear	NA	Dark brown ~40cm visibility
Flow conditions (base flow or high flow)	low flow	NA	Nil obstructed by natural creek crossing bed
Waterbody size (W x L x D) (m)	W = 1 m L = continuous D = 0.3M	W = 0 L = 0 D = 0	W = 10m L = continuous D = 50cm
pH	~~6.40~~ 6.31	NA	6.56
DO (% saturation)	76.6	NA	28.1
EC (µS/cm)	1032	NA	265
Turbidity (NTU)	~~2.54~~ 2.72	NA	4.46
Temp (°C)	25.4	NA	24.6
Hydrocarbon slick/odour	none	NA	Nil
Photo Number	**US:** 162 **DS:** 161 **OTHER:** –	**US:** 152 **DS:** 153 **OTHER:** –	**US:** 139 **DS:** 140 **OTHER:** –
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	Narrow valley Pool formed by old timber		Up stream of creek crossing (natural causeway) Recreational land use in area (Paintball) Chemical storage downstream (possible) (engine oil?)

QA duplicate sample collected at site: SW10

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 5-6/12/16 **Sampler:** KL/JB

Weather: [✓ Sunny] / Overcast / Light Rain / Heavy Rain

Site	5/12/16 **SW10**	US BARRON **SW11** WP15	DS BARRON 920 6 DEC 2016 **SW12**
GPS coordinate (GDA94) [NOTE COORDS IF DIFFERENT]	WP9 352187, 8141801 SSK 0352245, 8141928 Update after first sampling event	350608, 8141440 350 722 | 8141347 Update after first sampling event	Relocated after discussion with NB ~~353242, 8142068~~ 352 568 / 8141999 Update after first sampling event
Sample time	16:20	1320	920
Water colour/clarity	Clear	Slightly turbid	Partly cloudy
Flow conditions (base flow or high flow)	Low flow with pools	Low flow for Barron	Low flow
Waterbody size (W x L x D) (m)	W = 1.5m L = Continuous D = 30cm	W = 70m L = Continuous D = ? 1m	W = 60m L = Continuous D = 0.75m max
pH	6.72	7.42	7.56
DO (% saturation)	53.2	86.7	~~7.56~~ ~~92~~ 91.6
EC (µS/cm)	107.6	142.8	142.2
Turbidity (NTU)	6.79	4.06	2.70
Temp (°C)	26.5	29.0	28.5
Hydrocarbon slick/odour	No	NONE	None.
Photo Number	**US:** 146 **DS:** 147 **OTHER:** –	**US:** 159 **DS:** 160 **OTHER:**	**US:** 149 **DS:** 150 **OTHER:** 151
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	Singapore daisy/sedge/ guinea? grass abundant. tramline + road upstream. Large pool downstream	MUDDY BANK Wide slow flow section of Barron	DS Barron On small sandy beach. Difficult walk down, crossed Warril Ck at SW 10 Wide shallow section of Barron

QA duplicate sample collected at site: SW10 (No time recorded on bottles)
Sample labelled as "DUP"

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 9-10/1/17 **Samplers:** KL + MN

Weather: Sunny / [✓ Overcast] / Light Rain / Heavy Rain

Site	SW01	SW02	SW03
GPS coordinate (UTM – Zone 55K) [NOTE COORDS IF DIFFERENT]	350129, 8139382 WP4 350149, 8139375	351534, 8138879 WP3 351540, 8138889	350740, 8140095 Same site
Date	9/1/17	9/1/17	9/1/17
Sample time	13:20	12:30	10:50
Water colour/clarity	visibility 0.5m ~~[illegible]~~ tannins	Med ~~[illegible]~~ flow	dark brown & 40cm usability
Flow conditions (base flow or high flow)	very low trickle around edge of Dam mostly stagnent DS	Milky brown visibility	Med ~~[illegible]~~ flow
Waterbody size (W x L x D) (m)	W = 9m L = cont D = 1m	W = 3m L = cont. D = ~50cm	W = 3m L = cont. D = 0.5
pH	6.46	6 15	~~6.58~~ 6 66
DO (% saturation)	26.7	~~[illegible]~~ 165	62 1
EC (µS/cm)	314	122.3	110.8
Turbidity (NTU)	2.48	~~[illegible]~~ 1664	30.6
Temp (°C)	24.9	24 3	24 6
Hydrocarbon slick/odour	None	None	None
Photo Number	**US:** 177/8 **DS:** 179 **OTHER:**	**US:** 174 **DS:** 175/6 **OTHER:**	**US:** 170 **DS:** 171 **OTHER:** –
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	No bacterial film (compared to last time) leaf Litter still on wall (indicates flow not considerably higher during rain) Tannin staining	Organic mater remains in creek Fish have hatched. Not much more flow than initial sampling	Rapids down stream from site Pig disturbance in area silty bed w/ gravel

Bottles not rinsed

QA duplicate sample collected at site: SW09 (Dup)

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 9-10/1/17 **Samplers:** KL + MN

Weather: Sunny / [✓ Overcast] / Light Rain / Heavy Rain

Site	**SW04**	**SW05**	**SW06**
GPS coordinate (UTM – Zone 55K) [NOTE COORDS IF DIFFERENT]	350745, 8140441 WP6 350744, 8140439	350750, 8141287	351312, 8140031 WP5 351321, 8140034
Date	9/1/17	9/1/17	9/1/17
Sample time	15:20		14:30
Water colour/clarity	–		Mostly clear tannins
Flow conditions (base flow or high flow)	–		low flow
Waterbody size (W x L x D) (m)	W = L = – D =	W = L = D =	W = 1m L = continuous D = 5-10 cm
pH	–		6.31
DO (% saturation)	–		69.6
EC (µS/cm)	–	Inaccessible	69.6
Turbidity (NTU)	–		8.42
Temp (°C)	– Dry		25.4
Hydrocarbon slick/odour	–		None
Photo Number	**US:** 186 **DS:** 185 **OTHER:** 183 us 184 ds	**US:** 187 **DS:** 188 (189 zoom = Barron) **OTHER:**	**US:** 180 **DS:** 181 **OTHER:** 182 - tree in creek
Comments **(any other activities/factors observed which may affect water quality. eg recent high flow, construction near site, land clearance, runoff)**	silt over black weed US of site (183/4) (lots more than last survey) Site dry	No sample Barron intrusion/backflow Mud indicates highest river height (see photos) Photos taken from bridge	Fence put in recently trees cleared <3 days ago + laying upstream of sample Some Froth on surface where sample taken Fine algae on bed Fine sand bottom downstream of confluence

QA duplicate sample collected at site: SW09 (Dup)

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 9-10/1/17 **Samplers:** MN/KL

Weather: Sunny / [✓ Overcast] / Light Rain / Heavy Rain

Site	**SW0~~7~~8**	**SW0~~8~~ 7**	**SW09**
GPS coordinate (UTM – Zone 55K) [NOTE COORDS IF DIFFERENT]	351109, 8141257 (WP1) 0351926, 8139962	351924, 8139985 (WP10) 351094, 8141252	351171, 8137774 (WP2) 0351169, 8137761
Date	9/1/17	10/1/17	9/1/17
Sample time	10:00	11:50	~~[illegible]~~ 11:45
Water colour/clarity	translucent brown tannin		light brown visibility 20 cm
Flow conditions (base flow or high flow)	very low		low-med flow (trickle along rocks)
Waterbody size (W x L x D) (m)	W = 2m L = Cont D =	W = L = D = Inaccessible	W = 10m L = cont D = 50cm
pH	5.52		6.36
DO (% saturation)	23.3		40.9
EC (µS/cm)	100.9		130.3
Turbidity (NTU)	10.61		61.8
Temp (°C)	23.9		25.7
Hydrocarbon slick/odour	None		None
Photo Number	**US:** 169 **DS:** 168 **OTHER:**	**US:** 208 **DS:** 207 **OTHER:**	**US:** 172 **DS:** 173 **OTHER:**
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	Small pools along bed gravel bottom w/ leaf matter water level dropped from Friday (conv Neil) silty bank	~~[illegible]~~ Barron backflow No sample taken inaccessible upstream	Pooling [illegible] filled w/ sediment Fire smoldering 2km South (in clearing) Craig told Neil (<u>today</u>) the 'Billabong' have done earthworks (cleaning) & released water. Possible cause of high turbidity
	Bottles not rinsed		Bottles <u>rinsed</u>

~~QA~~ duplicate sample collected at site: SW09 (DUP)

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 9-10/1/17 **Samplers:** MN / KL

Weather: Sunny / [✓ Overcast] / Light Rain / Heavy Rain

	New site	New Site	New site
Site	**SW10**	**SW11**	**SW12**
GPS coordinate (UTM – Zone 55K) [NOTE COORDS IF DIFFERENT]	3522~~48, 8141~~928 WP8 352196, 8141736	3507~~21, 8141~~347 WP7 0349756, 8141695	352567, 8141999 WP9 0352523, 8141796
Date	10/1/17	9/1/17	10/1/17
Sample time	9:50	16:15	11:00
Water colour/clarity	light red brown visabillity ~30cm	Red brown visability ~5cm	Red brown visability ~5cm
Flow conditions (base flow or high flow)	Low	high flow	high flow - flood
Waterbody size (W x L x D) (m)	W = 4m L = cont. D = ~1m?	W = 40m L = Cont D = ?	W = L = D =
pH	6.14	6.94	6.71
DO (% saturation)	33.6	89.8	78.5
EC (µS/cm)	62.5	107.4	120.2
Turbidity (NTU)	35.9	118	84.1
Temp (°C)	24.7	27.2	26.4
Hydrocarbon slick/odour	None	None	None
Photo Number	**US:** 194-5 | 196 **DS:** 193 | 197 (New site) **OTHER:**	**US:** 192 (New site) **DS:** 190 **OTHER:**	**US:** 205 (new site) **DS:** 206 **OTHER:** 203-4 (pole position)
Comments **(any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)**	Barron backflow ∴ sample taken up stream check topo to make sure Barron didn't come this high lots of leaf matter on banks + palm leaves in water	likely river was higher than old causeway Sample taken Further upstream @ causeway	Sample pole used on edge Hymenachne abundant.

QA duplicate sample collected at site: SW09 (Dup)

KUR-World Surface Water Monitoring
FIELD SHEET

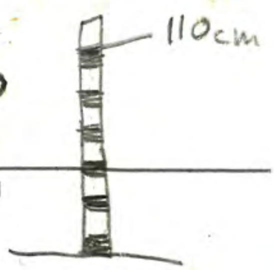
Date: 1-2 Feb 2017 **Samplers:** KL + MN

Weather: Sunny / Overcast / [✓ Light Rain] / Heavy Rain

Site	**SW01**	**SW02**	**SW03**
GPS coordinate (UTM – Zone 55K) [NOTE COORDS IF DIFFERENT]	350129, 8139382 WP 22 6350139, 8139391	351534, 8138879 WP 20 0351539, 8138882	350740, 8140095 WP 19 0350760, 8140104
Date	1/2/17	1/2/17	1/2/17
Sample time	3:30pm	1:15pm	12:15pm
Water colour/clarity	dark brown with tannins - visability ~40cm	dark brown with tannins. visability ~30cm	light choc. brown visability ~15cm
Flow conditions (base flow or high flow)	Med flow 5sec/m | 0·2m/sec	Med flow 5 sec/m | 0·2m/sec	Med Flow 5 sec/m / 0·2m/sec
Waterbody size (W x L x D) (m)	W = 8m L = cont D = 1m WL 0	W = 3m L = cont D = ~40cm	W = ~7m L = cont D = ? WL 0
pH	6·65	6·38	6·43
DO (% saturation)	60·1	28·2	79·9
EC (µS/cm)	95·9	120·1	92·6
Turbidity (NTU)	6·36	24·7	Pre 74·2 Post 334/341
Temp (°C)	25·7	24·7	25·7
Hydrocarbon slick/odour	None	None	None
Photo Number	**US:** 16 **DS:** 17 **OTHER:**	**US:** 8 **DS:** 9 **OTHER:**	**US:** 3 **DS:** 4 **OTHER:** 5, 6, 7 plume
Comments **(any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)**	WL - 0 Water with some white froth at rapids. Frog: Photo 18-23 WL 10cm taller (120) WL Pole DS ~ 20m	DO monitor had issues (neg readings) higher than last sample. Same rapids. Cleaner than downstream evidence of flow ~40cm higher.	Med rain fall - may impact DO? Pre plume in pocket - turbidity Post 12:30 plume - stir up base

QA duplicate sample collected at site: SW09

WL markers = 110cm from top of Black. -110 = 0



KUR-World Surface Water Monitoring
FIELD SHEET

Date: 1-2 Feb 2017 **Samplers:** KL + MN

Weather: Sunny / Overcast / [✓ Light Rain] / Heavy Rain

Site	**SW04**	New site **SW05**	**SW06**
GPS coordinate (UTM – Zone 55K) [NOTE COORDS IF DIFFERENT]	350745, 8140441 WP18 0350750, 8140439	350750, 8141287 WP25 0350768, 814195	351312, 8140031 WP27 0351312, 8140023
Date	1/2/17	1/2/17	2/2/17
Sample time	10:30 am	4:45 pm	11:30
Water colour/clarity	murkey brown light <5cm visability	murkey light brown Visability ~15cm	light murky brown Visability. ~5c
Flow conditions (base flow or high flow)	Low flow <0.1m/sec (11:15am)	low-med flow 4sec/m	Med flow 0.3 m/sec
Waterbody size (W x L x D) (m)	W = 1m L = Cont D = ~10cm - 15cm	W = 6m L = Cont D = ? WLO	W = 1.5m L = Cont D = ~20cm WL 0
pH	6.57	6.40	5.93
DO (% saturation)	87.0	26.6	60.5
EC (μS/cm)	66.8	99.8	50.2
Turbidity (NTU)	317	60.3	120
Temp (°C)	25.8	25.7	24.8
Hydrocarbon slick/odour	None	None	None
Photo Number	**US:** 1 **DS:** 2 **OTHER:**	**US:** 28 **DS:** 29 **OTHER:**	**US:** 34 **DS:** 35 **OTHER:**
Comments **(any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)**	WL - 0 Flow rapidly dropping (pers. coms. NB)	Suspect ~~not~~ influenced by Barron - uncertain WL - ~50 cm below footing under brigde  Barron rose around Midmorning/12pm (NB checked heights. sample influenced	Fine sediment track beside fence trampled/eroding Stock watering has occured here (Pers coms NB)

QA duplicate sample collected at site: SW09

photo 24(US), 25(DS) Owen/Harven Ck Weir WP23 (0350820, 8139687)
(US of weir - Ph 26(US), 27 (DS) WP24 (0350758, 8139718))
Turbidity 113 NTU 4:20pm

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 1-2 Feb 2017 **Samplers:** KL + MN

Weather: Sunny / Overcast / [✓ Light Rain] / Heavy Rain

Site	**SW07**	**SW08**	**SW09**
GPS coordinate (UTM – Zone 55K) [NOTE COORDS IF DIFFERENT]	351109, 8141257	351924, 8139985 WP26 0351940, 8139980	351171, 8137774 WP21 0351171, 8137780
Date	1/2 Feb	2/2/17	1/2/17
Sample time		10:30am	2:15pm
Water colour/clarity		mid brown murky with some tannins. visability ~30cm	light murky brown visability ~ 10cm
Flow conditions (base flow or high flow)	inaccessible	med-high flow 0 4 m/sec	med-high flow (over causeway) 3 m/sec
Waterbody size (W x L x D) (m)	W = L = D =	W = 2m L = cont D = ~46 cm WL 0	W = 10m L = Cont D = 50cm WL 0
pH		6.12	6.62
DO (% saturation)		56.6	35.3
EC (µS/cm)		72.3	123.0
Turbidity (NTU)		34.8	Rep1 80.4 Rep2 98.0 Rep3 129
Temp (°C)		24.5	26.5
Hydrocarbon slick/odour		None	None
Photo Number	**US:** **DS:** **OTHER:**	**US:** 30 **DS:** 31 **OTHER:**	**US:** 10 **DS:** 11, 12 **OTHER:** 13, 14, 15 water patterns unevenly mixed
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	unable to access above possible Barron influence	Sand + gravel bed leaf matter very soft mud on bank.	Appears that thalweg is less turbid Gate code: 2727 - also front gate. WL 20cm taller (130cm)

QA duplicate sample collected at site: DupSW09 | QA 2:25 2/2/17 ~25 m US

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 1-2 Feb 2017 **Samplers:** KL + MN

Weather: Sunny / Overcast / [✓ Light Rain] / Heavy Rain

Site	**SW10**	**SW11** (Alternate)	**SW12**
GPS coordinate (UTM – Zone 55K) [NOTE COORDS IF DIFFERENT]	352248, 8141928 WP30 0352194, 8141740	350721, 8141347 WP,28 0349756, 8141681	352567, 8141999 WP29 0352527, 8141989
Date	2/2/17	2/2/17	2/2/17
Sample time	2:50pm	12:30 pm	1:40 pm
Water colour/clarity	murky light brown visability ~15cm	Murky mid brown visability ~10 cm	murky mid brown visability
Flow conditions (base flow or high flow)	low flow 0.2m/sec	high flow 1.0m/sec	med-high flow 0.8 m/sec
Waterbody size (W x L x D) (m)	W = 6m L = Cont D = 1m	W = 40m L = Cont D = ?	W = 40m L = Cont D = ?
pH	6.40	7.01	6.24
DO (% saturation)	61.4	90.2	95.7
EC (µS/cm)	61.5	64.7	59 5
Turbidity (NTU)	48.2	88.8	109
Temp (°C)	25.2	26.2	26.0
Hydrocarbon slick/odour		None	None
Photo Number	**US:** 42 **DS:** 43,44 **OTHER:**	**US:** 36, 38 **DS:** 37 **OTHER:**	**US:** 39 **DS:** 40, 41 **OTHER:**
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)		Heavy rain while sampling Sampling pole used	Sampling pole used sample taken in hymenachne

QA duplicate sample collected at site: SW09

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 21-22 Feb 2017 **Samplers:** KL + DC + NB

Weather: [✓ Sunny] / Overcast / Light Rain / Heavy Rain

Site	**SW01**	**SW02**		**SW03**
GPS coordinate (UTM – Zone 55K)	350129, 8139382 WP4 350140, 813984	351534, 8138879 WP3 0351537, 8138885		350740, 8140095 WP1 350758, 8140104
Date	21/2/17	21/2/17		21/2/17
Sample time	1:30	12:10		9:40
Water colour/clarity	Med Brown. tannins but mainly cloudy	Med brown mainly tannins		Dark brown - mainly tannins, a little cloudy
Flow conditions	[✓ low] / med / high	[✓ low] / med / high		[✓ low] / med / high
Flow rate (m/s)	too low to measure	at site ~0m/s too low to measure		40 s/m OR m/s
Water level Top of black marker at 110cm unless stated	Top of black marker at 120cm ~ -15cm	~ -10cm		~ -10 cm
Waterbody size (W x L x D) (m)	W = 8 L = cont D = 1m	W = 3m L = Cont D = ~40cm		W = 3m L = cont D = 0.5m
pH	5·23	5·43	5·90	6·61
DO (% saturation)	12·8	16·9	25·5	68·3
EC (µS/cm)	136·4	Site 141·1	Down stream 138·5	117·2
Turbidity (NTU)	5·19	10·76	7·96	6·23
Temp (°C)	25·8	25·4	25·5	25·7
Hydrocarbon slick/odour	None at/near site	Film - but unlikely Hydrocarbons		None
Photo Number	**US:** 17, 18, 20, **DS:** 21 **OTHER:** 19, 22, 23	**US:** 8, 9 **DS:** 11 **OTHER:** 10, 12-16		**US:** 1 **DS:** 2 **OTHER:** 3, 4
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	Some films ~20m US not at sample point Algae abundant ↳ Photo 22, 23 Water appears more turbit lower in water column than where samples taken evidence of high flow ↳ Photo 19 small fish observed	Samples taken from still pool (logs creating incomplete damming effect). DS of dam no film, faster flow, less debris. P cattle seen crossing ~20m DS, Photo 15-16 evidence of very high flow photos 12=14 Dam Photo 10		evidence of very high flow Photos 3+4 debris downstream Possible poisoning on track in (was there previous events)

QA duplicate sample collected at site: SW09 / FB 1130 21/2/17

*compared to marker in stream where top of black marker is 110cm unless otherwise stated.

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 21-22 Feb 2017 **Samplers:** KL + DC + NB

Weather: [✓ Sunny] / Overcast / Light Rain / Heavy Rain

Site	SW04	SW05	SW06
GPS coordinate (UTM – Zone 55K)	350745, 8140441 WP7 350749, 8140436	350750, 8141287 Same site as Event 3	351312, 8140031 WP6 0351314, 8140035
Date	21/2/17	21/2/17	21/2/17
Sample time	350 pm	4:30pm	3:10pm
Water colour/clarity	—	Dark Brown with tanins	Dark brown with tannins
Flow conditions	Nil low / med / high	[✓ low / med] / high	[✓ low] / med / high
Flow rate (m/s)	—	6s/m (DS of rapid)	Too slow to measure at site
Water level Top of black marker at 110cm unless stated	—	NA	~ 5cm
Waterbody size (W x L x D) (m)	W = L = NA D =	W = 5m L = cont D = ~40cm	W = 1m L = cont D = 0·4m
pH	—	4·51	5·16
DO (% saturation)	—	15·3	77·8
EC (µS/cm)	—	117·9	65·8
Turbidity (NTU)	—	4·77	11·01
Temp (°C)	—	27·1	26·3
Hydrocarbon slick/odour	—	Scum US Not hydrocarbon.	Film, but likely bacterial US of dams
Photo Number	**US:** 34 **DS:** 35 **OTHER:**	**US:** 37, 41 **DS:** 38 **OTHER:** 39 (~~DS~~ US looking) 40	**US:** 30, 31 **DS:** 28, 29 **OTHER:** 32, 33
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)		Medium size fish observed Scum ~10m US held back by bamboo lengths + other debris Aquatic plants @ site Gravel bed Evidence of high flow ~5m min Photo 40	evidence of med-high flow - min 50 cm higher than at sample time Many small dams US + DS. Scum accumulating US of them. Photo 32 Scum also in small pools Photo 33

QA duplicate sample collected at site: SW09 | FB 1130 21/2/17

*compared to marker in stream where top of black marker is 110cm unless otherwise stated.

KUR-World Surface Water Monitoring

FIELD SHEET

Date: 21-22 Feb 2017 **Samplers:** KL+DC+NB

Weather: [✓ Sunny] / Overcast / Light Rain / Heavy Rain

Site	~~SW07~~ SW08	~~SW08~~ SW07	**SW09**
GPS coordinate (UTM – Zone 55K)	351109, 8141257 WP5 351931, 8139985	351924, 8139985 WP9 351113, 8141230	351171, 8137774 WP2 351178, 8137769
Date	21/2/17	22/2/17	21/2/17
Sample time	2:15pm	9:50 am	10:50 am
Water colour/clarity	Dark brown with tannins little/no turbidity	med. brown. a little cloudy	med. brown, murky
Flow conditions	[✓ low] / med / high	[✓ low] / med / high	Very [✓ low] / med / high
Flow rate (m/s)	12s/m or m/s		very slow unmeasurable
Water level Top of black marker at 110cm unless stated	~ -5cm		Top of black marker at 130cm ~ -30cm
Waterbody size (W x L x D) (m)	W = 2m L = cont D = ~40cm	W = 1m L = cont D = ~20cm	W = 10m L = cont D = 50cm
pH	5·08	4·86	6·41
DO (% saturation)	57·2	68·5	21·3
EC (µS/cm)	103·4	88·7	116·5
Turbidity (NTU)	9·80	26·9	14·00
Temp (°C)	25·1	25·2	26·1
Hydrocarbon slick/odour	None	None	None in main flow Some film in small pools - Natu
Photo Number	**US:** 23 **DS:** 25, 26 **OTHER:** 24	**US:** – **DS:** 44 **OTHER:**	**US:** 5 **DS:** 6, 7 **OTHER:**
Comments (any other activities/factors observed which may affect water quality. eg recent high flow, construction near site, land clearance, runoff)	evidence of high flow ~110cm min → Photo 24 Debris + obstructions DS (some US also) small fish observed	Sampled under rail bridge lots of grass growing in creek - and sedges lots of algae	Tyre inner tube + chemical(?) container - black oil. on causeway. Ph 6 Small fish present US > leaking slowly possilby no obvious signs of contamination to creek Water appears more turbid lower in water column than samples takes

QA duplicate sample collected at site: SW09 | FB 11:30 21/2/17

*compared to marker in stream where top of black marker is 110cm unless otherwise stated.

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 21-22 Feb 2017 **Samplers:** KL + DC + NB

Weather: [✓ Sunny] / Overcast / Light Rain / Heavy Rain

Site	**SW10** Alt	**SW11** Alt	**SW12** Alt
GPS coordinate (UTM – Zone 55K)	352248, 8141928 WP11 352194, 8141737	350721, 8141347 WP9 349760, 8141684	352567, 8141999 WP10 352517, 8142033
Date	22/2/17	22/2/17	22/2/17
Sample time	11:20am	9.15am	10:30
Water colour/clarity	Dark green-brown	Dark green-brown	Dark green-brown
Flow conditions	[✓ low] / med / high	low / [✓ med] / high	[✓ low / med] / high
Flow rate (m/s)	50s/m	2s/m	10s/m
Water level Top of black marker at 110cm unless stated	NA	NA	NA
Waterbody size (W x L x D) (m)	W = 5m L = cont D = ~1m	W = 40m L = cont D = ?	W = 40m L = cont D = ?
pH	3.82	4.86	4.49
DO (% saturation)	68.2	90.3	92.1
EC (µS/cm)	86.1	75.8	117.5
Turbidity (NTU)	~~11.31~~ 9.29	11.29	9.30
Temp (°C)	25.1	28.4	29.4
Hydrocarbon slick/odour	None	None	None
Photo Number	**US:** 47 **DS:** 48, 49 **OTHER:**	**US:** 43 **DS:** 42 **OTHER:**	**US:** ~~[illegible]~~ 45 **DS:** ~~[illegible]~~ 46 **OTHER:**
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	Some debis in creek (palm fronds, leaves etc, no major obstructions) evidence of high flow ↳ soil on banks disturbed to about 1.2 m above current (normal level) Frog observed Turbidity jar kept condensating in metre < condensation error.		Sampling pole used samples ~ 1m past hymenachne.

QA duplicate sample collected at site: SW09 | FB 1130 21/2/17

*compared to marker in stream where top of black marker is 110cm unless otherwise stated.

KUR-World Surface Water Monitoring

FIELD SHEET

Date: 21/4/17 **Samplers:** KL + NB

Weather: Sunny / Overcast / [✓ Light Rain] / Heavy Rain

Site	**SW01**	**SW02**	**SW03**
GPS coordinate (UTM – Zone 55K)	350129, 8139382 WP6 350148,8139390	351534, 8138879	350740, 8140095 WP7 350761,8140118
Date	21/4/17		21/4/17
Sample time	9:30 am		10:20 am
Water colour/clarity	clear some tanning visability ~ 60cm		clear some tannins visability >40cm
Flow conditions	[✓ low] / med / high	low / med / high	[✓ low] / med / high
Flow rate (m/s)	<0.1 m/s		<0.1 m/s
Water level Top of black marker at 110cm unless stated	Top of black marker at 120cm -180mm		-5cm
Waterbody size (W x L x D) (m)	W = 8 L = Cont D = 1m	W = L = D =	W = 3m L = Cont D = 0.5m
pH	6.41		6.75
DO (% saturation)	11.4		71.4
EC (µS/cm)	154.7		127-8
Turbidity (NTU)	2'03		4'76
Temp (°C)	Ph 24.6/22.4 DO		Ph 24.8 / 22.6 Do
Hydrocarbon slick/odour	None		None
Photo Number	**US:** 026 **DS:** 025 **OTHER:**	**US:** **DS:** **OTHER:**	**US:** 027 **DS:** 028 **OTHER:**
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	Suspect DO probe reading of temp is correct water quite cool to touch. Some bubbles forming pelow riffles	See Aq Ecol 20/4/17	aquatic plans US (ribbon leafed) lots of tadpols

QA/duplicate sample collected at site: ____________________

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 21/4/17 **Samplers:** KL + NB

Weather: Sunny / Overcast / [✓ Light Rain] / Heavy Rain

Site	SW04	SW05	SW06
GPS coordinate (UTM – Zone 55K)	350745, 8140441	350750, 8141287 (alternate 350768, 8141194)	351312, 8140031 WPO8 0351312, 8140036
Date	21/4/17		21/4/17
Sample time	11:00 am		11:35 am
Water colour/clarity			slightly turbid
Flow conditions	low / med / high	low / med / high	[✓ low] / med / high
Flow rate (m/s)			< 0.1 m/s
Water level Top of black marker at 110cm unless stated			~30cm
Waterbody size (W x L x D) (m)	W = L = NA D =	W = L = D =	W = 1m L = cont D = 0.4m
pH			6.27
DO (% saturation)			77.3
EC (µS/cm)			61.3
Turbidity (NTU)			20.1
Temp (°C)			Ph 25.3 / 23.1 DO
Hydrocarbon slick/odour			None
Photo Number	**US:** 029 **DS:** 030 **OTHER:**	**US:** **DS:** **OTHER:**	**US:** 032 **DS:** 031 **OTHER:**
Comments (any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)	Dry	Not sampled this event.	fine sediment / algae settled on sandy substrate Some froth between riffles + obstructions DS of sample

QA/duplicate sample collected at site: ______________________________

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 21/4/17 **Samplers:** KL + NB

Weather: Sunny / Overcast / [✓ Light Rain] / Heavy Rain

Site	**SW07**	**SW08**	**SW09**
GPS coordinate (UTM – Zone 55K)	351109, 8141257	351924, 8139985	351171, 8137774 WPS 351204, 8137791
Date			21/4/17
Sample time			8:30 am
Water colour/clarity			slightly turbid Visability ~ 50cm
Flow conditions	low / med / high	low / med / high	[✓ low] / med / high
Flow rate (m/s)			20c/m in riffles <01 m/s
Water level Top of black marker at 110cm unless stated			Top of black marker at 130cm -20cm
Waterbody size (W x L x D) (m)	W = L = D =	W = L = D =	W = 10 L = Cont D = 50cm
pH			6.61
DO (% saturation)			14.7
EC (µS/cm)			139.2
Turbidity (NTU)			7.65
Temp (°C)			Ph 24.8 / 22.6 DO
Hydrocarbon slick/odour			None
Photo Number	**US:** **DS:** **OTHER:**	**US:** **DS:** **OTHER:**	**US:** 022 **DS:** 023 **OTHER:** 024 - tadpols
Comments **(any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)**	Not sampled this event	See Aq Ecol. 20/4/17	tadpols in pool on crossing water lilies flowering

QA/duplicate sample collected at site: ____________________

KUR-World Surface Water Monitoring
FIELD SHEET

Date: 21/4/17 **Samplers:** KL + NB

Weather: Sunny / Overcast / [✓ Light Rain] / Heavy Rain

Site	**SW10**	**SW11**	**SW12**
GPS coordinate (UTM – Zone 55K)	352248, 8141928 (alternate 352195,8141736)	350721, 8141347 (alternate 352522, 8141996)	352567, 8141999 (alternate 349755, 8141694)
Date			
Sample time			
Water colour/clarity			
Flow conditions	low / med / high	low / med / high	low / med / high
Flow rate (m/s)			
Water level Top of black marker at 110cm unless stated			
Waterbody size (W x L x D) (m)	W = L = D =	W = L = D =	W = L = D =
pH			
DO (% saturation)			
EC (µS/cm)			
Turbidity (NTU)			
Temp (°C)			
Hydrocarbon slick/odour			
Photo Number	**US:** **DS:** **OTHER:**	**US:** **DS:** **OTHER:**	**US:** **DS:** **OTHER:**
Comments **(any other activities/factors observed which may affect water quality. *eg* recent high flow, construction near site, land clearance, runoff)**	Not sampled this event	Not sampled this event	Not Sampled this event

QA/duplicate sample collected at site: ____________________

Site name/number: SW01B	**Collected by:** KL/NB/MN	**Date:** 20/4/17
GPS: WP 3 350532, 8139979 55 K		**Job #:** 424105·01
Photos: US - 018 ; DS - 019		

✓

Rain in past week:	Yes	☑	No	☐		
Weather:	No rain	☑	Showers	☐	Heavy rain	☐
	Sunny	☐	Some cloud	☑	Overcast	☐
	Calm	☐	Breeze	☑	Strong wind	☐
Evidence of fire:	Yes	☐	No	☑		

✓

Evidence of pastoral animals: -

Evidence of non-pastoral animals: -

Evidence of native animals: Small lizards

Land use: Pastoral

Aquatic animal life (*eg* fish, prawn): small fish

✓

Water odour:	None	☑	Effluent	☐	Anoxic	☐	Algae	☐	Other	☐
Water oils:	None	☑	Slick	☐	Sheen	☐	Globs	☐	Flecks	☐
Water foaming:	None	☑	Detergent	☐	Surf. spot	☐	Scum	☐	Other	☐
Turbidity:	Clear	☑ ②	Slight	☐	Turbid	☐	Opaque	☐		
Plume¹:	Little	☐	Some	☐	Lots	☑	NA	☐		

¹ amount of fine sediment generated when kick sampling.

✓

Sediment oils:	None	☑	Light	☐	Moderate	☐	Profuse	☐
Sediment odours:	Normal	☑	Sewage	☐	Petroleum	☐	Chemical	☐
	Anaerobic	☐	Other	☐ :				

✓

Flow level:	No flow (dry/isolated)	☐	Low (<water mark)	☑	Moderate (=)	☐	High (>water mark)	☐	Flood	☐

Mean water depth: 20-40 cm

Mean channel width: 3 m (wet) 4 m (channel)

✓

Debris:	Absent	☐	In trees (above normal flow level)	☑	In channel (unlikely to significantly affect flow)	☑ slight	Sig. in channel (likely to affect flow)	☐

Recent bank erosion:	None	☑	Limited	☐	Moderate	☐	Extensive	☐	Extreme	☐
Local catchment erosion:	None	☐	Some	☑	Moderate	☐	Heavy	☐		
Dams/barriers:	Absent	☐	Present	☑ ①	U'stream	☐	D'stream	☐		

① natural bedrock dams US

② high tannins

NRA

Site Number: SW01B Date: 20/4/17

VEGETATION

Algae:	On substrate:	None ☐	Little ☑	Mod ☐	Lot ☐
	In water column:	None ☑	Little ☐	Mod ☐	Lot ☐

Plant types (aquatic only): None

Width of riparian zone²: Left bank 3 m Right bank 4 m

Introduced vegetation in riparian zone: Dominant (Y [✓ N])

Riparian vegetation: Bare 10 % Grass 30 % Shrubs 10 %
Trees <10 m 10 % Trees >10 m 40 %

Bank overhang vegetation³: None ☐ Slight ☐ Moderate ☑ Extensive ☐

Canopy cover: 50 %

Trailing bank vegetation⁴: None ☐ Slight ☑ Moderate ☐ Extensive ☐

Condition of riparian habitat: Good ☑ Leaf yellowing ☐ Leaf damage ☐ Die back ☐
Other:

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[2] Looking downstream.

[3] Shading of riparian vegetation when the sun is directly overhead.

[4] The amount of bank vegetation hanging over, or in the water.

SUBSTRATE

Bedrock		80 %	**Gravel**	(4 – 16 mm)	10 %
Boulder	(>256 mm)	- %	**Sand**	(1 – 4 mm)	5 %
Cobble	(64 – 256 mm)	- %	**Silt/Clay**	(<1 mm)	5 %
Pebble	(16 – 64 mm)	- %			

Total substrate must equal 100%

Substrate cover:

Filamentous algae	0%- <10% ☑	10-35% ☐	35-65% ☐	65-90% ☐	>90% ☐
Macrophytes	0%- <10% ☑	10-35% ☐	35-65% ☐	65-90% ☐	>90% ☐
Detritus	0%- <10% ☐	10-35% ☐	35-65% ☑	65-90% ☐	>90% ☐
Other: Bare	0%- <10% ☑	10-35% ☐	35-65% ☐	65-90% ☐	>90% ☐

IN SITU WATER ANALYSIS

pH 6.41
Elec. cond. (μS/cm) 197.1
Turbidity (NTU) 2.53
Diss. oxy. (% saturation) 34.4
Temperature (°C) 25.3

Samples collected:

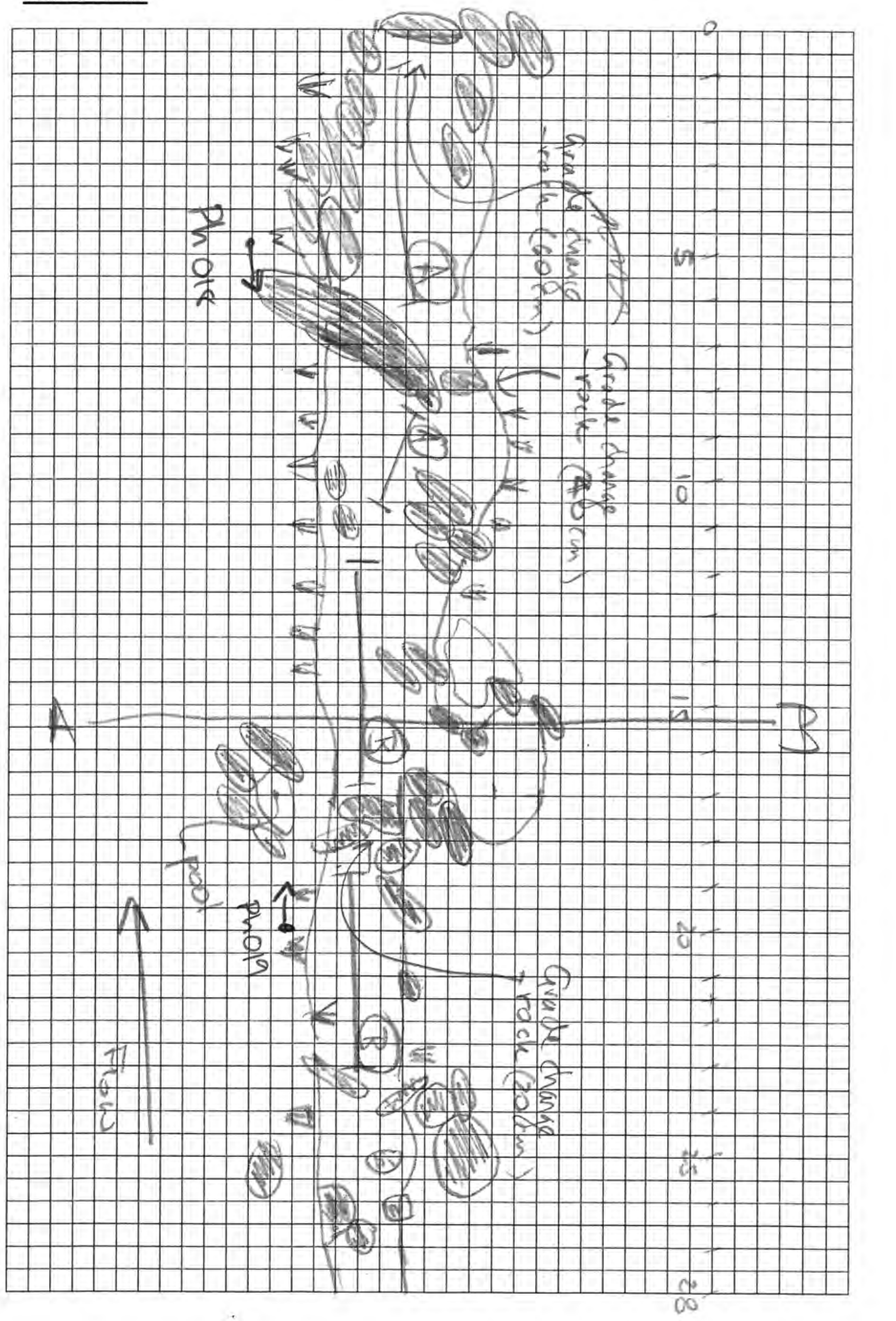
	Lab	QA		Lab	QA
Water	☑	☐	Macroinvertebrates – bed	☑	☐
Sediment	☑	☐	Macroinvertebrates – edge	☐	☐

Comments:
(Include notes on the macroinvertebrate samples *eg* lots of algae in sample A and B, difficult to sort).
lots of rocks ∴ hard to kick up gravel etc for sample
lots of fine detritis (less leaves) making sample murky

NRA

Site Number: SW016 Date: 20/4/17
Owen Ck

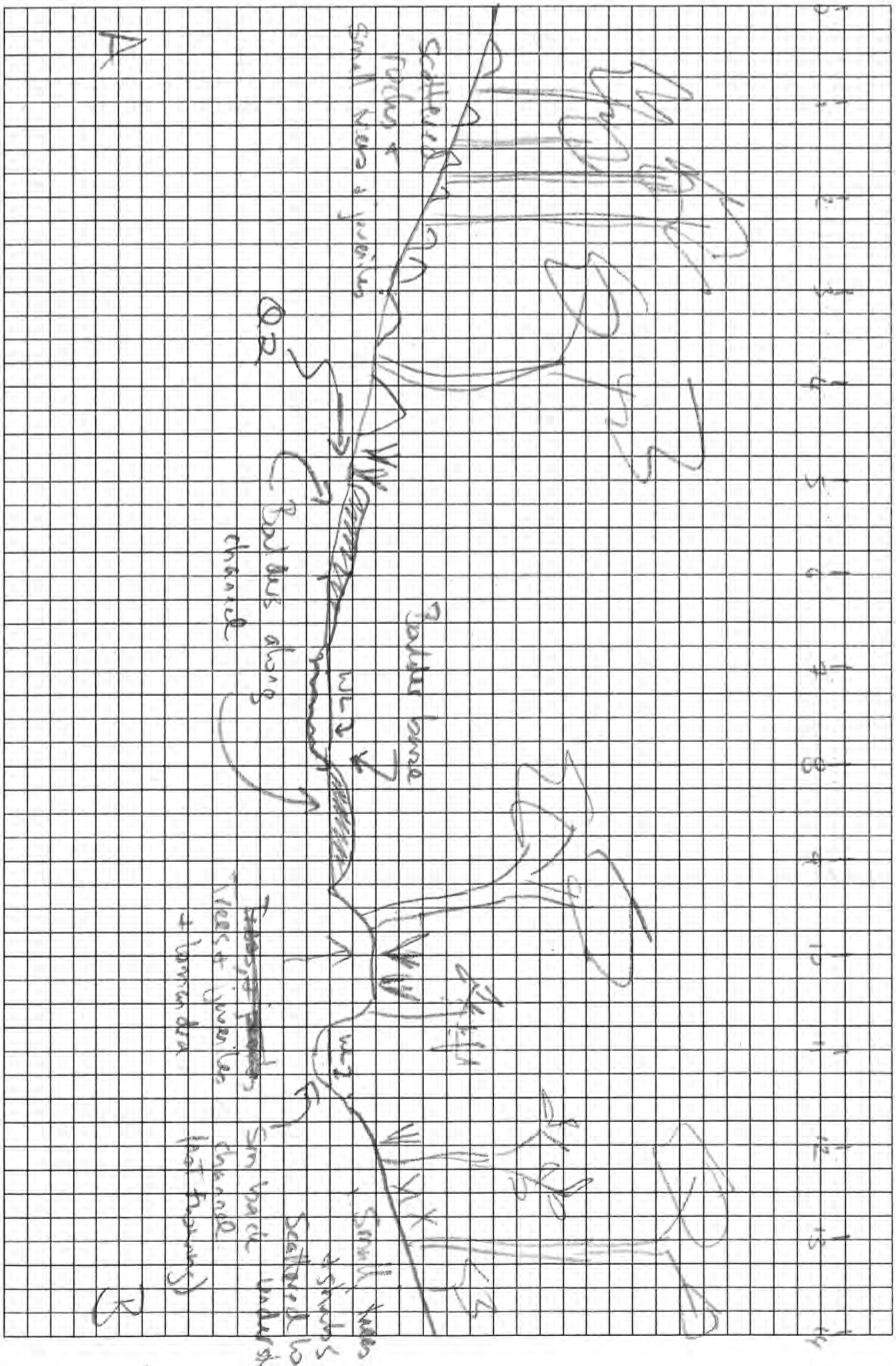
PLAN VIEW



Site Number: SW01b Date: 20/4/17

Owen Ck

CROSS-SECTION VIEW



Site name/number: SW02	**Collected by:** KL/NB/MN	**Date:** 20/4/17
GPS: WP1 55K 351533, 8138897		**Job #:** 42410501
Photos: DS - 001 ; US - 002, 003; SW02 A DS 004; SW02AUS 006		

SW02 B US 007 SW02 B 008

Rain in past week: Yes ☑ No ☐

Weather: No rain ☑ Showers ☐ Heavy rain ☐
Sunny ☐ Some cloud ☑ Overcast ☐
Calm ☑ Breeze ☐ Strong wind ☐

Evidence of fire: Yes ☐ No ☑

Evidence of pastoral animals: Cattle puds US + DS
Evidence of non-pastoral animals: –
Evidence of native animals: heard woodfrog
Land use: Pastoral
Aquatic animal life (*eg* fish, prawn): fingerlings + tadpoles (not toads)

Water odour: None ☑ Effluent ☐ Anoxic ☐ Algae ☐ Other ☐
Water oils: None ☑ Slick ☐ Sheen ☐ Globs ☐ Flecks ☐
Water foaming: None ☐ Detergent ☐ Surf. spot ☐ Scum ☐ Other ☑ ①
Turbidity: Clear ☐ Slight ☑ Turbid ☐ Opaque ☐ tannins also
Plume[1]: Little ☐ Some ☐ Lots ☑ NA ☐

[1] amount of fine sediment generated when kick sampling.

Sediment oils: None ☑ Light ☐ Moderate ☐ Profuse ☐
Sediment odours: Normal ☑ Sewage ☐ Petroleum ☐ Chemical ☐
Anaerobic ☑ slight Other ☐ :

Flow level: No flow (dry/isolated) ☐ Low (<water mark) ☑ Moderate (=) ☐ High (>water mark) ☐ Flood ☐
Mean water depth: 0.3-0.4 m
Mean channel width: 3 m (wet) ③ 5 m (channel)

Debris: Absent ☐ In trees (above normal flow level) ☑ In channel (unlikely to significantly affect flow) ☑ ② Sig. in channel (likely to affect flow) ☐

Recent bank erosion: None ☐ Limited ☑ Moderate ☐ Extensive ☐ Extreme ☐
Local catchment erosion: None ☐ Some ☑ Moderate ☐ Heavy ☐
Dams/barriers: Absent ☑ Present ☐ U'stream ☐ D'stream ☐

① water foaming (5-50mm Patches) DS of riffle + US of barrier
② logs causing pooling at low flow
③ narrower US - 1-3m

Site Number: SWO2 Date: 20/4/17

VEGETATION

Algae:	On substrate:	None ☑	Little ☐	Mod ☐	Lot ☐
	In water column:	None ☑	Little ☐	Mod ☐	Lot ☐

Plant types (aquatic only): N

Width of riparian zone[2]**:** Left bank 3 m Right bank 5-7 m

Introduced vegetation in riparian zone:
Dominant (Y [✓ N])

Riparian vegetation: Bare 10 % Grass 10 % Shrubs 20 %
Trees <10 m 30 % Trees >10 m 30 %

Bank overhang vegetation[3]**:** None ☐ Slight ☒ KL Moderate ☑ Extensive ☐

Canopy cover: 70 %

Trailing bank vegetation[4]**:** None ☐ Slight ☑ Moderate ☐ Extensive ☐

Condition of riparian habitat: Good ☑ Leaf yellowing ☐ Leaf damage ☐ Die back ☐
Other:

---

[2] Looking downstream.
[3] Shading of riparian vegetation when the sun is directly overhead.
[4] The amount of bank vegetation hanging over, or in the water.

SUBSTRATE

Bedrock		%	**Gravel**	(4 – 16 mm)	30 %
Boulder	(>256 mm)	%	**Sand**	(1 – 4 mm)	30 %
Cobble	(64 – 256 mm)	%	**Silt/Clay**	(<1 mm)	30 %
Pebble	(16 – 64 mm)	10 %			

Total substrate must equal 100%

Substrate cover:

Filamentous algae	0%- <10% ☑	10-35% ☐	35-65% ☐	65-90% ☐	>90% ☐
Macrophytes	0%- <10% ☑	10-35% ☐	35-65% ☐	65-90% ☐	>90% ☐
Detritus	0%- <10% ☐	10-35% ☒ KL	35-65% ☑	65-90% ☐	>90% ☐
Other: Bare	0%- <10% ☒ KL	10-35% ☑	35-65% ☐	65-90% ☐	>90% ☐

IN SITU WATER ANALYSIS

pH 6.32
Elec. cond. (µS/cm) 133.9
Turbidity (NTU) 15.07
Diss. oxy. (% saturation) 30.2
Temperature (°C) 24.4

Samples collected:

	Lab	QA		Lab	QA
Water	☑	☑	Macroinvertebrates – bed	☑	☐
Sediment	☑	☑	Macroinvertebrates – edge	☐	☐

Comments:
(Include notes on the macroinvertebrate samples *eg* lots of algae in sample A and B, difficult to sort).
Fine sediment settled on bed
lots of detritus in samples - difficult to sort
lots of macroinvertebrates, fish + tadpols in sample
bug samples taken at + 20cm

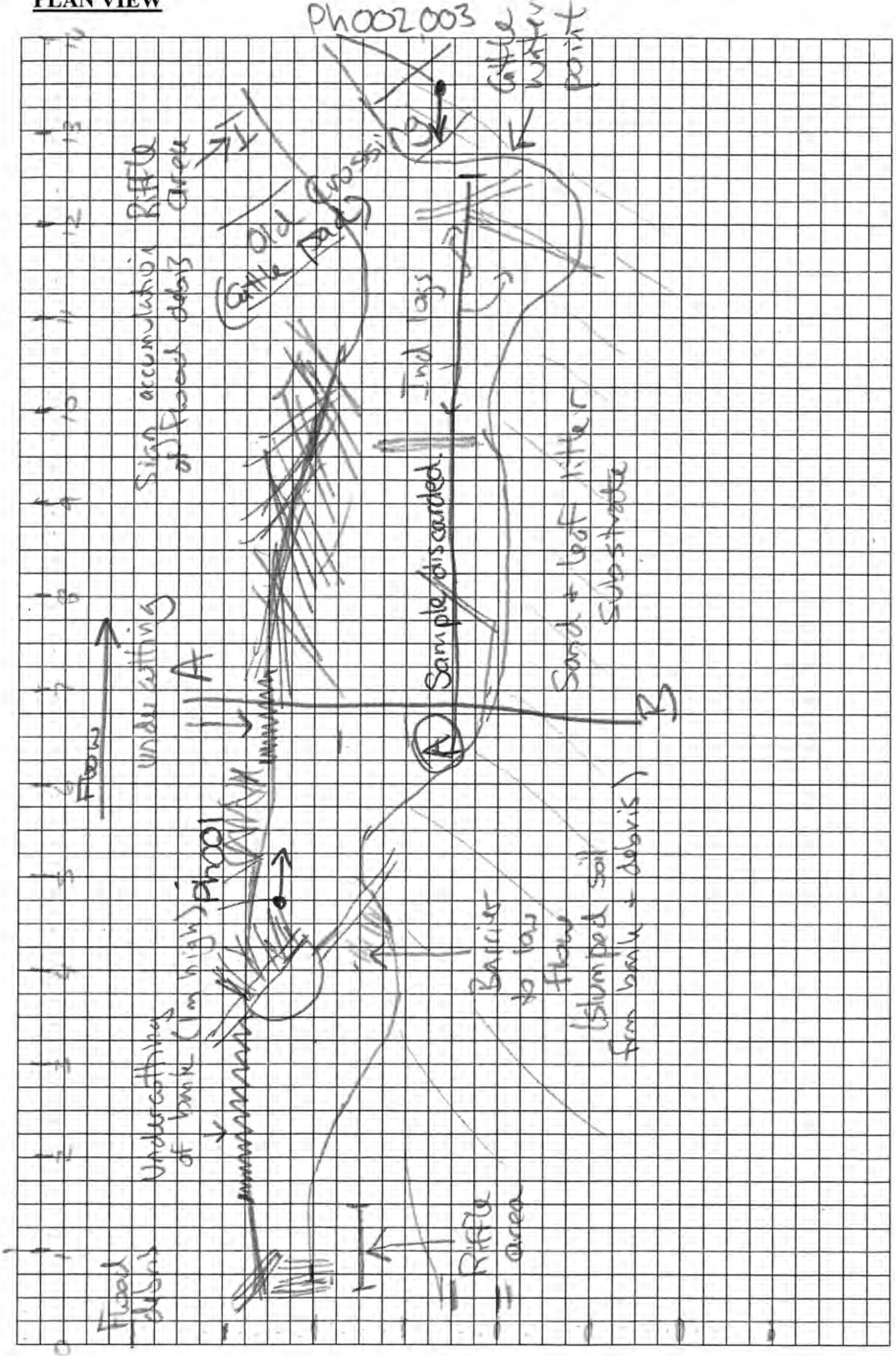
NRA

Aquatic Ecology Proforma

Site Number: SWD2 Date: 20/4/17

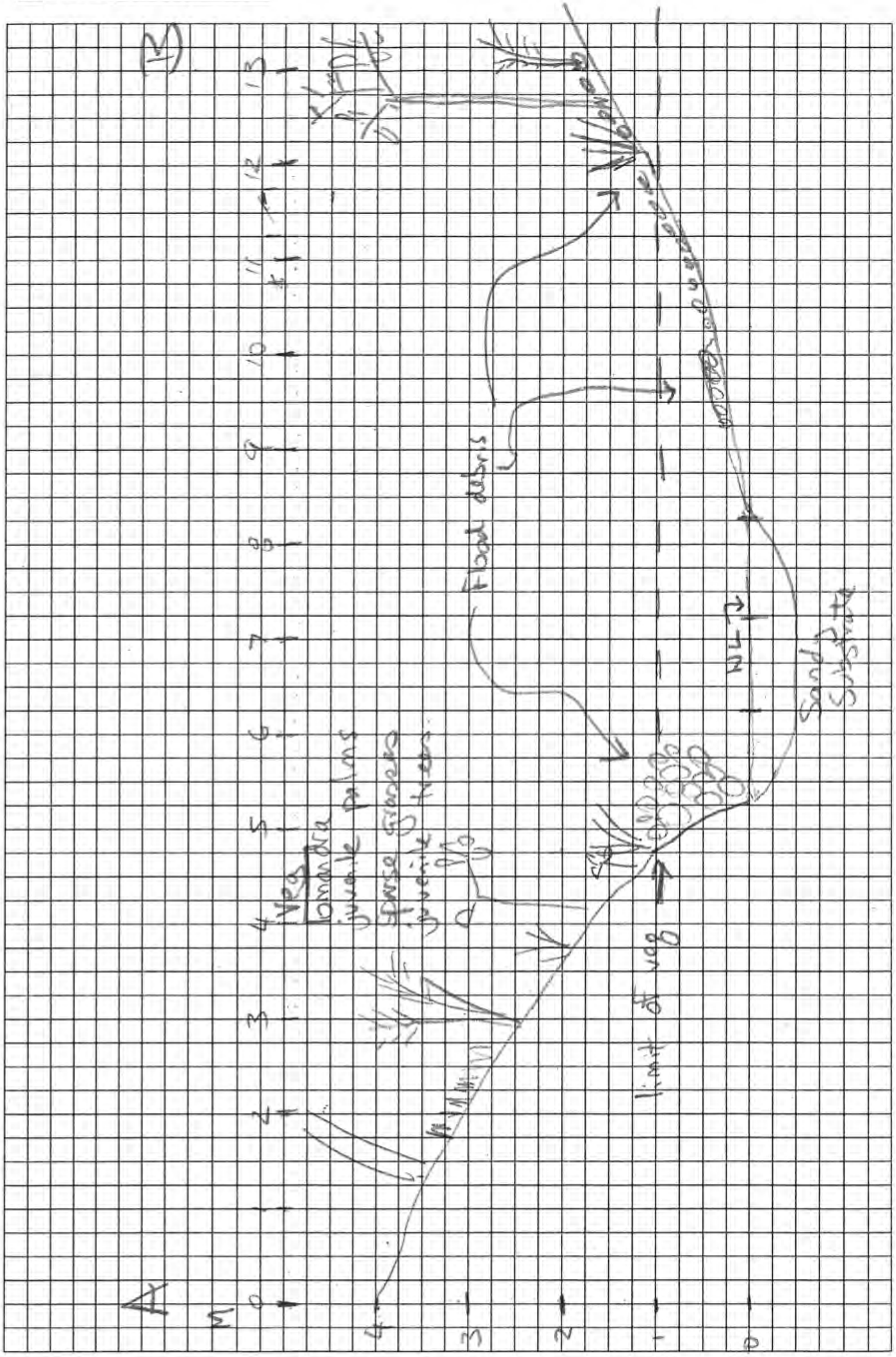
Rep A

PLAN VIEW



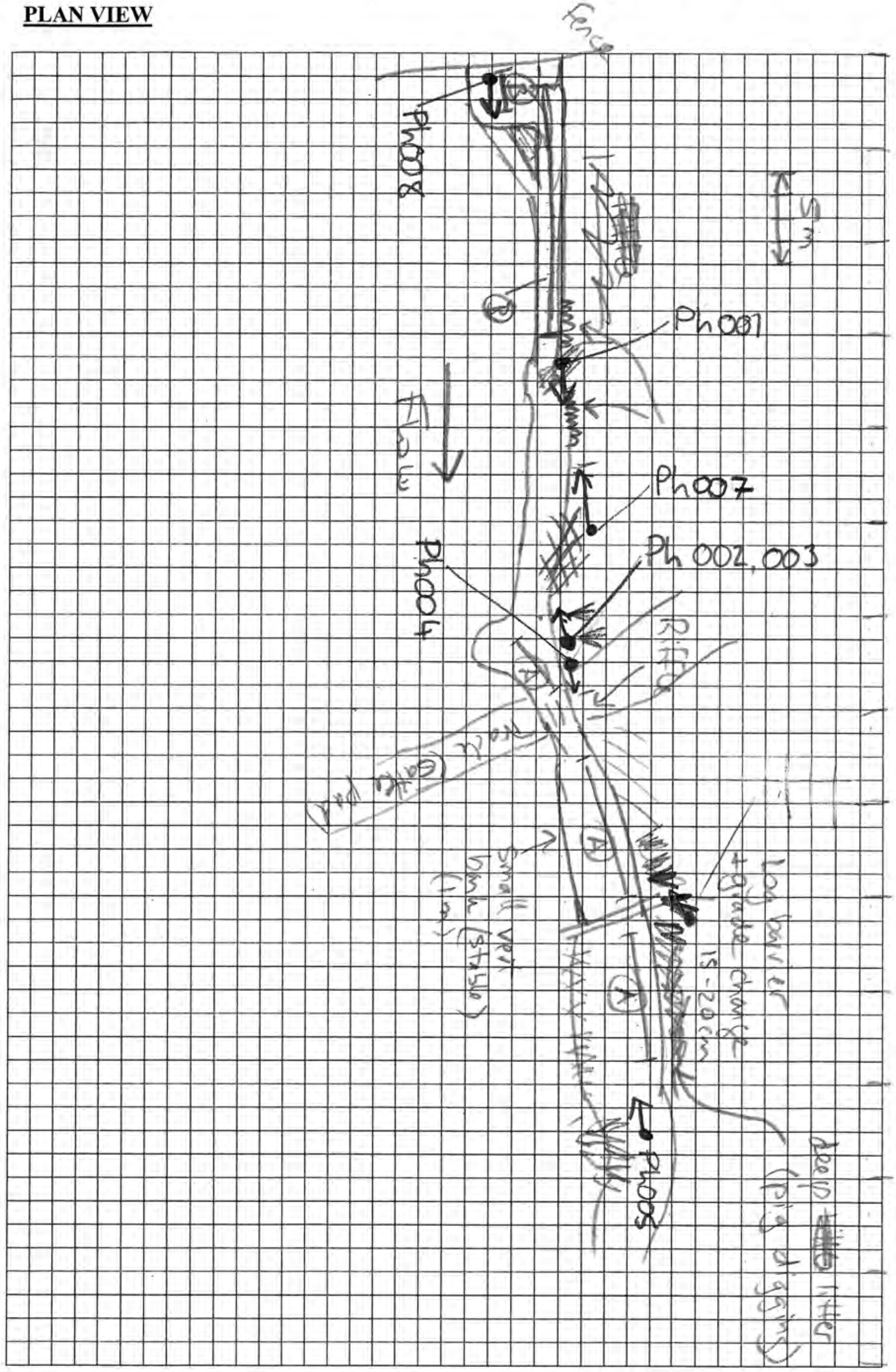
Site Number: SW02 Date: 20/4/17

CROSS-SECTION VIEW



Site Number: SW02 Date: 20/4/17
Rep B extended

PLAN VIEW



Site Number: SW02B Date: 20/4/17

Site name/number: SW02B	**Collected by:** KL / NB / MN	**Date:** 20/4/17
GPS: WP2 55K 350629, 8139968		**Job #:** 424105.01
Photos: DS 012, 013; US 014, 015		

Rain in past week:	Yes ☑	No ☐	
Weather:	No rain ☒	Showers ☑	Heavy rain ☐
	Sunny ☐	Some cloud ☐	Overcast ☑
	Calm ☐	Breeze ☑	Strong wind ☐
Evidence of fire:	Yes ☐	No ☑	

Evidence of pastoral animals: —

Evidence of non-pastoral animals: —

Evidence of native animals: —

Land use: pastoral

Aquatic animal life (*eg* fish, prawn): Sample B had 1 rainbow fish

Water odour:	None ☑	Effluent ☐	Anoxic ☐	Algae ☐	Other ☐
Water oils:	None ☑	Slick ☐	Sheen ☐	Globs ☐	Flecks ☐
Water foaming:	None ☐	Detergent ☐	Surf. spot ☐	Scum ☐	Other ☑ ①
Turbidity:	Clear ☑	Slight ☐	Turbid ☐	Opaque ☐	
Plume[1]:	Little ☐	Some ☑	Lots ☐	NA ☐	

[1] amount of fine sediment generated when kick sampling.

Sediment oils:	None ☑	Light ☐	Moderate ☐	Profuse ☐
Sediment odours:	Normal ☑	Sewage ☐	Petroleum ☐	Chemical ☐
	Anaerobic ☑ slight	Other ☐ :		

Flow level:	No flow (dry/isolated) ☐	Low (<water mark) ☑	Moderate (=) ☐	High (>water mark) ☐	Flood ☐

Mean water depth: 0.2-0.3 m

Mean channel width: 2.5 m (wet) 3.0 m (channel)

Debris:	Absent ☐	In trees (above normal flow level) ☑	In channel (unlikely to significantly affect flow) ☑	Sig. in channel (likely to affect flow) ☐

Recent bank erosion:	None ☐	Limited ☑	Moderate ☐	Extensive ☐	Extreme ☐
Local catchment erosion:	None ☐	Some ☑	Moderate ☐	Heavy ☐	
Dams/barriers:	Absent ☑	Present ☐	U'stream ☐	D'stream ☐	

① water foaming between riffles + obstructions US

NRA

Aquatic Ecology Proforma

Site Number: SW02B Date: 20/4/17

VEGETATION

Algae: On substrate: None ☒ KL Little ☑ Mod ☐ Lot ☐
In water column: None ☑ Little ☐ Mod ☐ Lot ☐

Plant types (aquatic only): unidentified - long linear leaves, no flowers, occasional

Width of riparian zone[2]: Left bank 4 m Right bank 5 m

✓ **Introduced vegetation in riparian zone:** Raspberry
Dominant (Y [✓ N])

Riparian vegetation: Bare 10% Grass 40% Shrubs 5 %
Trees <10 m % Trees >10 m 45 %

Bank overhang vegetation[3]: None ☐ Slight ☐ Moderate ☑ Extensive ☐

Canopy cover: 40%

Trailing bank vegetation[4]: None ☐ Slight ☑ Moderate ☐ Extensive ☐

Condition of riparian habitat: Good ☑ Leaf yellowing ☐ Leaf damage ☐ Die back ☐
Other: Raspberry present US

[2] Looking downstream.

[3] Shading of riparian vegetation when the sun is directly overhead.

[4] The amount of bank vegetation hanging over, or in the water.

SUBSTRATE

Bedrock 10 %
Boulder (>256 mm) 20 %
Cobble (64 – 256 mm) 40 %
Pebble (16 – 64 mm) 10 %
Gravel (4 – 16 mm) 10 %
Sand (1 – 4 mm) <5 %
Silt/Clay (<1 mm) <5 %

✓ Total substrate must equal 100%

Substrate cover:

Filamentous algae 0%- <10% ☑ 10-35% ☐ 35-65% ☐ 65-90% ☐ >90% ☐
Macrophytes 0%- <10% ☑ 10-35% ☐ 35-65% ☐ 65-90% ☐ >90% ☐
Detritus 0%- <10% ☐ 10-35% ☒ KL 35-65% ☑ 65-90% ☐ >90% ☐
Other: Bare 0%- <10% ☑ 10-35% ☐ 35-65% ☐ 65-90% ☐ >90% ☐

IN SITU WATER ANALYSIS

✓ pH 6.73
Elec. cond. (µS/cm) 114.9
Turbidity (NTU) 6.20
Diss. oxy. (% saturation) 69.6
Temperature (°C) 24.9

Samples collected:

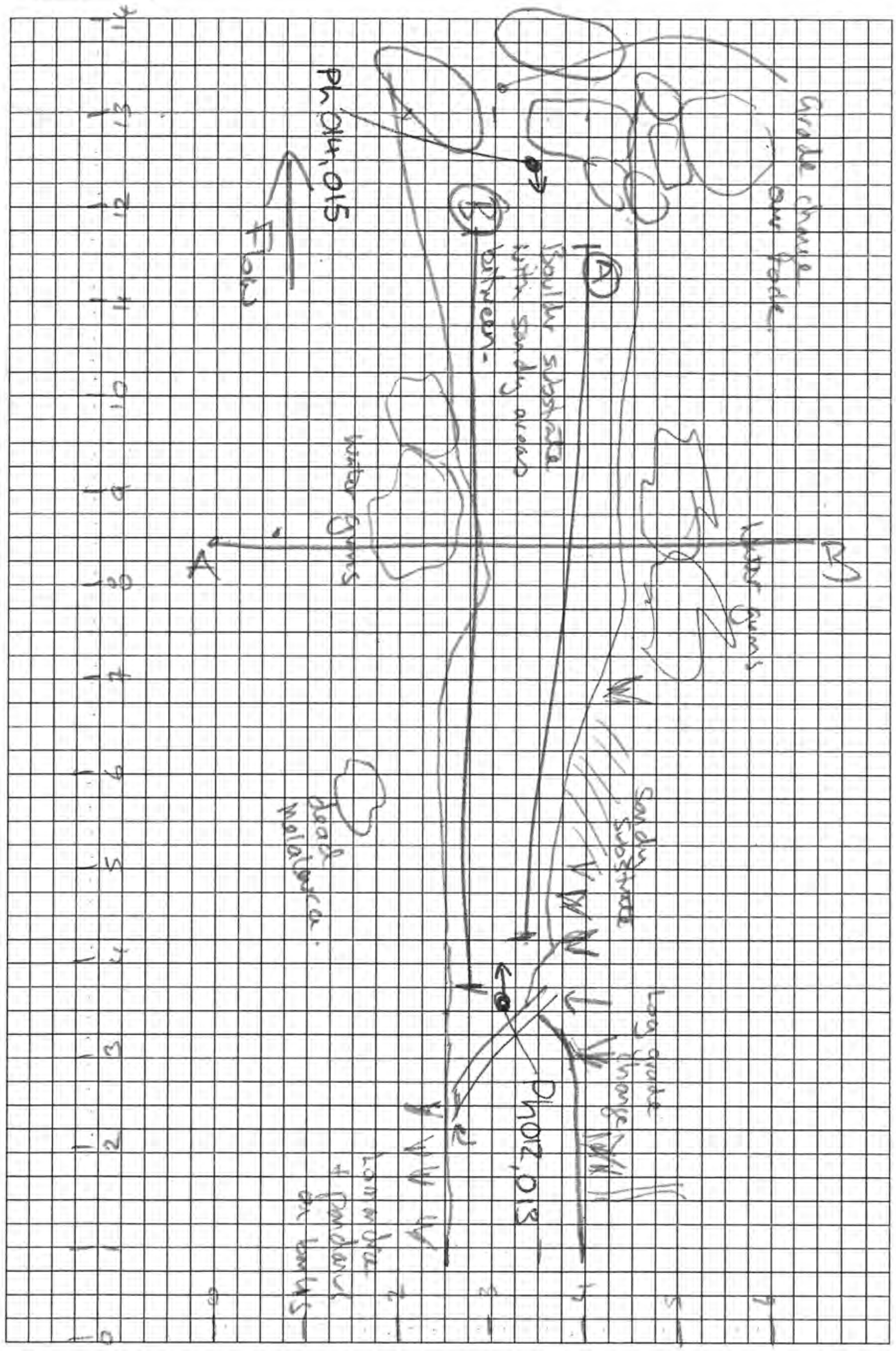
	Lab	QA		Lab	QA
✓ Water	☑	☐	Macroinvertebrates – bed	☑	☑
Sediment	☑	☐	Macroinvertebrates – edge	☒	☐

Comments:
(Include notes on the macroinvertebrate samples *eg* lots of algae in sample A and B, difficult to sort).
lots of detritus in sample
fine sediment accross substrait

NRA

Site Number: SW02b Date: 20/4/17
Harren Ck.

PLAN VIEW



Site Number: SW02B Date: 20/4/17

CROSS-SECTION VIEW

Aquatic Ecology Proforma

Site Number: SW08 Date: 20/4/17

VEGETATION

Algae:	On substrate:	None ☑	Little ☐	Mod ☐	Lot ☐
	In water column:	None ☑	Little ☐	Mod ☐	Lot ☐

Plant types (aquatic only): None

Width of riparian zone²: Left bank 6 m Right bank 1 m ①

Introduced vegetation in riparian zone:

Dominant (Y [✓ N])

Riparian vegetation: Bare 20 %② Grass 20 % Shrubs 20 %

Trees <10 m 20% Trees >10 m 20%

Bank overhang vegetation³: None ☐ Slight ☐ Moderate ☑ Extensive ☐

Canopy cover: 70 %

Trailing bank vegetation⁴: None ☐ Slight ☑ Moderate ☐ Extensive ☐

Condition of riparian habitat: Good ☑ Leaf yellowing ☐ Leaf damage ☐ Die back ☑ wait-a-while only

Other:

---

² Looking downstream.

³ Shading of riparian vegetation when the sun is directly overhead.

⁴ The amount of bank vegetation hanging over, or in the water.

SUBSTRATE

Bedrock		0 %	**Gravel**	(4 – 16 mm)	10 %
Boulder	(>256 mm)	0 %	**Sand**	(1 – 4 mm)	80 %
Cobble	(64 – 256 mm)	0 %	**Silt/Clay**	(<1 mm)	10 %
Pebble	(16 – 64 mm)	0 %			

Total substrate must equal 100%

Substrate cover:

Filamentous algae	0%- <10% ☑	10-35% ☐	35-65% ☐	65-90% ☐	>90% ☐
Macrophytes	0%- <10% ☑	10-35% ☐	35-65% ☐	65-90% ☐	>90% ☐
Detritus	0%- <10% ☐	10-35% ☐	35-65% ☑	65-90% ☐	>90% ☐
Other:	0%- <10% ☑	10-35% ☐	35-65% ☐	65-90% ☐	>90% ☐

IN SITU WATER ANALYSIS

pH 6.30

Elec. cond. (μS/cm) 91.4

Turbidity (NTU) 19.49

Diss. oxy. (% saturation) 64.1

Temperature (°C) 24.6

Samples collected:

	Lab	QA		Lab	QA
Water	☑	☐	Macroinvertebrates – bed	☑	☐
Sediment	☑	☐	Macroinvertebrates – edge	☐	☐

① no distinct boundary

Comments:

(Include notes on the macroinvertebrate samples *eg* lots of algae in sample A and B, difficult to sort).

② detritus covering majority ~5% true bare

Rep B crossed sludgy deep areas

lots of striders on water after sweep

Rep B had more + large detritis

Poor light compromised picks (clouds + afternoon light)

NRA

Site Number: SWO8 Date: 20/4/17

Site name/number: SWO8	**Collected by:** KL/NB/MN	**Date:** 20/4/17
GPS: WP4 55K 351934, 8139972		**Job #:** 424105.1
Photos: DS020; US-021		

Rain in past week:	Yes	☑	No	☐		
Weather:	No rain	☑	Showers	☐	Heavy rain	☐
	Sunny	☐	Some cloud	☑	Overcast	☐
	Calm	☑	Breeze	☐	Strong wind	☐
Evidence of fire:	Yes	☐	No	☑		

Evidence of pastoral animals: –

Evidence of non-pastoral animals:

Evidence of native animals: Turned leaf matter - scrub hen?

Land use: Pastoral

Aquatic animal life (*eg* fish, prawn): Fish (gudgeons?), tadpols

Water odour:	None	☑	Effluent	☐	Anoxic	☐	Algae	☐	Other	☐
Water oils:	None	☑	Slick	☐	Sheen	☐	Globs	☐	Flecks	☐
Water foaming:	None	☑	Detergent	☐	Surf. spot	☐	Scum	☐	Other	☐
Turbidity:	Clear	☐	Slight	☑	Turbid	☐	Opaque	☐		
Plume[1]:	Little	☐	Some	☐	Lots	☑	NA	☐		

[1] amount of fine sediment generated when kick sampling.

Sediment oils:	None	☑	Light	☐	Moderate	☐	Profuse	☐
Sediment odours:	Normal	☒ KL	Sewage	☐	Petroleum,	☐	Chemical	☐
	Anaerobic	☑	Other	☐ :				

Flow level:	No flow (dry/isolated)	☐	Low (<water mark)	☑	Moderate (=)	☐	High (>water mark)	☐	Flood	☐

Mean water depth: 0.2 m (Rep A 10-20 cm; Rep B 20-30 cm)

Mean channel width: 0.5-2 m (wet) 5 m (channel)

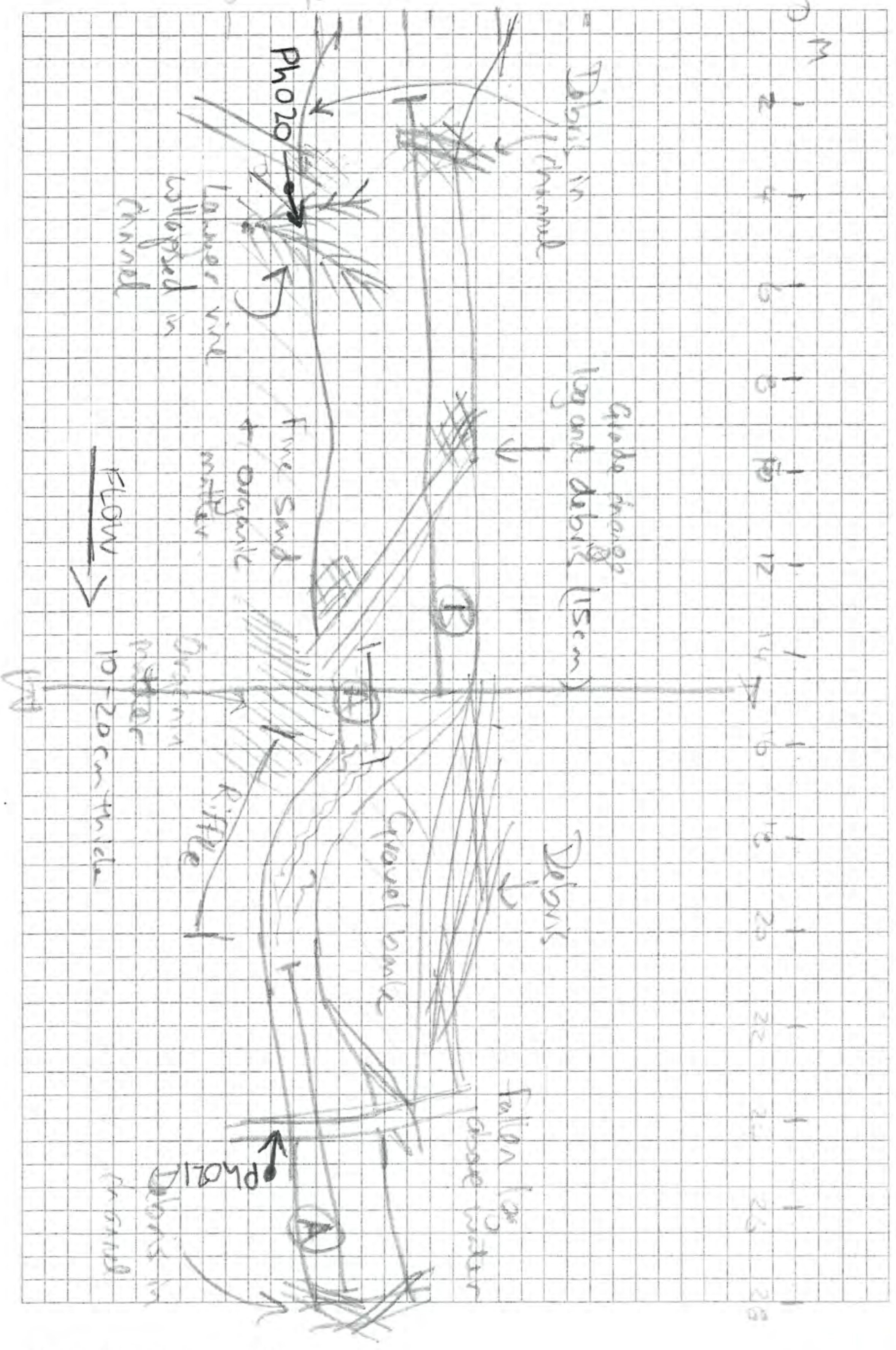
Debris:	Absent	☐	In trees (above normal flow level)	☑	In channel (unlikely to significantly affect flow)	☑	Sig. in channel (likely to affect flow)	☐

Recent bank erosion:	None	☐	Limited	☑	Moderate	☐	Extensive	☐	Extreme	☐
Local catchment erosion:	None	☐	Some	☑	Moderate	☐	Heavy	☐		
Dams/barriers:	Absent	☑	Present	☐	U'stream	☐	D'stream	☐		

NRA

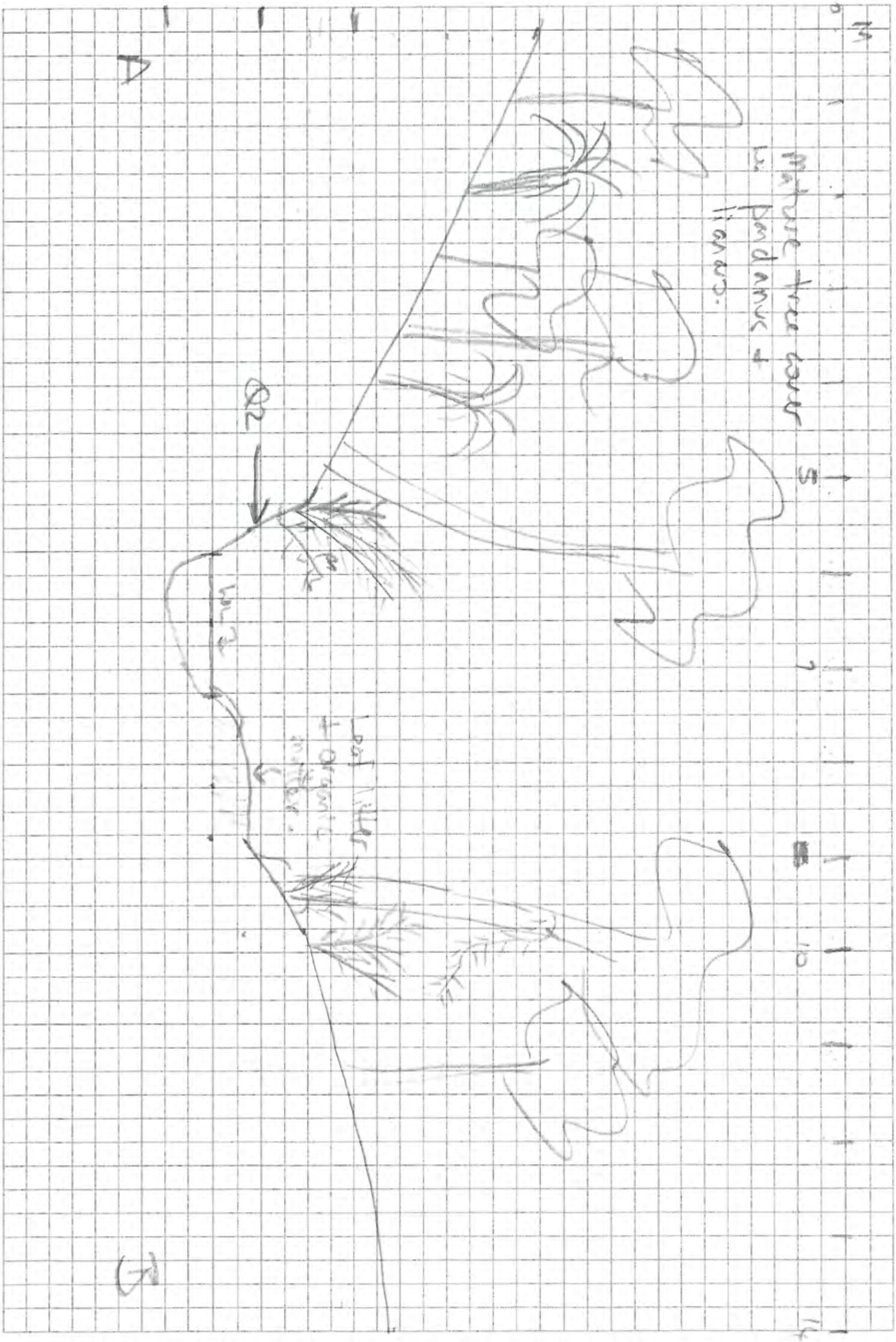
Site Number: SW03 Date: 20/4/17

PLAN VIEW



Site Number: SW08 Date: 20/4/17

CROSS-SECTION VIEW



Appendix C:
Surface Water (Full Suite) Sites - Photographs and Descriptions

Table 1: Surface water (full suite) sites – photographs and descriptions

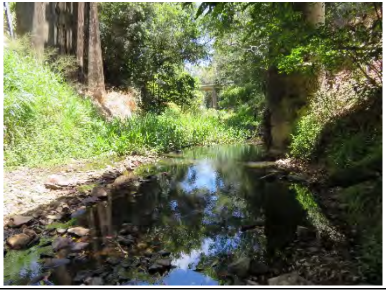
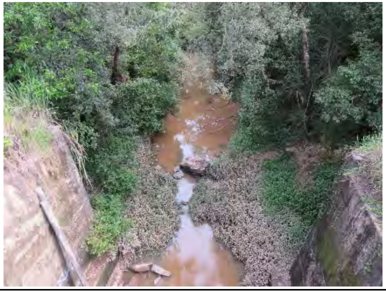
Site description	Photographs and sampling event description	
	Upstream photograph	**Downstream photograph**
SW01 A heavily shaded waterway approximately 8 m wide with a bedrock and bolder substrate covered by leaf litter and other detritus. Samples taken immediately upstream of natural rock dam creating a pool upstream. Shallow water with small riffles present downstream of sampling point.	5/12/2016 Bacterial film observed downstream of sampling point. Water samples collected.	
		
	9/1/2017 Lowest turbidity (2.48 NTU) for SW01 recorded during this sampling event. Water samples collected.	
		
	1/2/2017 Medium flow (approximately 0.2 m/s) observed with light rainfall occurring during sampling. Highest dissolved oxygen (60.1% saturation) for SW01 recorded during this sampling event. Water samples collected.	
		
	21/2/2017 Surface film observed approximately 20 m upstream. Water appeared to be more turbid lower in the water column (*ie* deeper than where water could be sampled). Evidence of recent high flows and debris >1 m above normal flow level. Water samples collected.	
		

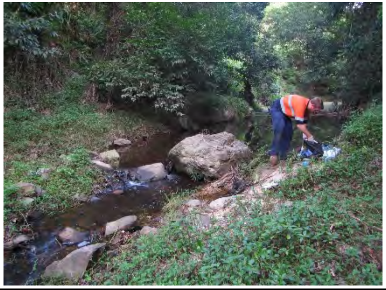
Site description	Photographs and sampling event description	
	Upstream photograph	Downstream photograph
SW01 *continued*	21/4/2017 Observed some bubbles forming on water surface below riffles. Water samples collected.	
		
SW01B A heavily shaded waterway approximately 3 m wide with a bedrock substrate covered by leaf litter and other detritus. Waterway shallow (approximately 20-40 cm depth) during normal flow conditions.	20/4/2017 Some algae present on substrate. Woody debris present both in channel and above normal flow level. Low turbidity (2.53 NTU) recorded during this sampling event. Water, sediment and aquatic macroinvertebrate samples collected.	
		
SW02 A heavily shaded waterway approximately 3 m wide with a gravel and sand substrate covered by leaf litter and other detritus. Waterway shallow (approximately 40-50 cm depth) during normal flow conditions. Evidence of cattle present upstream and downstream of sampling point.	5/12/2016 Lowest dissolved oxygen (3.2% saturation) and highest turbidity (46.9 NTU) for SW02 recorded during this sampling event. Water samples collected.	
		
	9/1/2017 Woody debris created incomplete damming effect downstream. Water samples collected.	
		

<table>
<tr><th rowspan="2">Site description</th><th colspan="2">Photographs and sampling event description</th></tr>
<tr><th>Upstream photograph</th><th>Downstream photograph</th></tr>
<tr><td rowspan="6">SW02 *continued*</td><td colspan="2">1/2/2017
Evidence of recent high flows (approximately 40 cm above normal flow level).
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">21/2/2017
Evidence of recent high flows and debris >1 m above normal flow level. Leaf litter and surface scum observed. Woody debris creating incomplete damming effect upstream. Cattle observed crossing creek downstream of sampling point.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">20/4/2017
Woody debris present both in channel and above normal flow level. Aquatic macroinvertebrate samples taken approximately 50 m downstream of sampling point in deeper water.
Water, sediment and aquatic macroinvertebrate samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="2">SW02B
A heavily shaded waterway approximately 2.5 m wide with a cobble substrate covered by leaf litter and other detritus. Waterway shallow (approximately 20-30 cm depth) during normal flow conditions.</td><td colspan="2">20/4/2017
Woody debris present both in channel and above normal flow level.
Water, sediment and aquatic macroinvertebrate samples collected.</td></tr>
<tr><td></td><td></td></tr>
</table>

Site description	Photographs and sampling event description	
	Upstream photograph	Downstream photograph
SW03 A heavily shaded waterway approximately 3 m wide with a gravel and sand substrate covered by leaf litter and other detritus. Waterway shallow (approximately 50 cm depth) during normal flow conditions. Wild raspberry dominating eastern bank.	6/12/2016 Lowest dissolved oxygen (2.4% saturation) for SW03 recorded during this sampling event. Water samples collected.	
		
	9/1/2017 High turbidity (30.6 NTU) recorded. Water samples collected.	
		
	1/2/2017 Heavy rainfall occurred during sampling. Highest turbidity (74.2 NTU) for SW03 recorded during this sampling event. After samples were collected, a plume of water with very high turbidity (334 NTU) was observed. Water samples collected.	
		
	21/2/17 Evidence of recent high flows and debris >1 m above normal flow level. Woody debris present downstream. Water samples collected.	
		

Site description	**Photographs and sampling event description**	
	Upstream photograph	**Downstream photograph**
SW03 *continued*	21/4/2017 Water samples collected.	
		
SW04 A moderately shaded waterway approximately 1 m wide with a cobble and silt substrate covered by leaf litter.	5/12/2016 Site dry. No samples taken.	
		
	9/1/2017 Site dry. No samples taken.	
		
	1/2/2017 High turbidity (317 NTU) recorded during this event. Flow rapidly decreasing. Sample and photographs taken downstream of sediment traps and black geo-fabric. Water samples collected.	
		

Site description	Photographs and sampling event description	
	Upstream photograph	Downstream photograph
SW04 *continued*	21/2/2017 Site dry. No samples taken.	
		
	21/4/2017 Site dry. No samples taken.	
		
SW05 A heavily shaded waterway approximately 4 m wide with a cobble substrate. Waterway shallow (approximately 30 cm depth) during normal flow conditions. Small riffles present throughout sampling site.	6/12/2016 High dissolved oxygen (78.2% saturation) and low turbidity (3.21 NTU) recorded. Water samples collected.	
		
SW05 Alt A partially shaded waterway approximately 6 m wide with a cobble and gravel substrate. Upstream of road bridge. Waterway shallow (approximately 40 cm depth) during normal flow conditions.	9/1/2017 Evidence of recent high flows. Site influenced by high water levels of the Barron River. No samples taken due to Barron River influence and access limitations upstream.	
		

<table>
<tr><th rowspan="2">Site description</th><th colspan="2">Photographs and sampling event description</th></tr>
<tr><th>Upstream photograph</th><th>Downstream photograph</th></tr>
<tr><td rowspan="4">SW05 Alt continued</td><td colspan="2">1/2/2017
Highest turbidity (99.8 NTU) for SW05 Alt recoded during this sampling event.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">21/2/2017
Lowest turbidity (4.77 NTU) for SW05 Alt recorded during this sampling event.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="4">SW06
A moderately shaded waterway approximately 1 m wide with a sandy substrate partially covered by leaf litter and other detritus. Waterway very shallow (approximately 5-20 cm depth) during normal flow conditions.</td><td colspan="2">5/12/2016
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">9/1/2017
Since last sampling event, some vegetation had been pruned to allow fence replacement. Some pruned branches placed in waterway upstream of sampling point. Some froth on surface of water where sample was taken.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
</table>

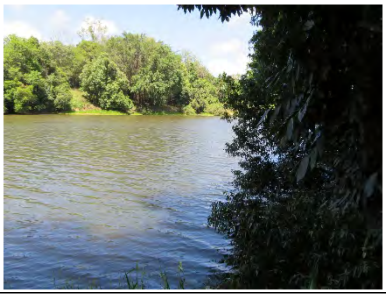
<table>
<tr><th rowspan="2">Site description</th><th colspan="2">Photographs and sampling event description</th></tr>
<tr><th>Upstream photograph</th><th>Downstream photograph</th></tr>
<tr><td rowspan="6">SW06 *continued*</td><td colspan="2">2/2/2017
Highest turbidity (120 NTU) for SW06 recorded during this sampling event. Evidence of cattle access and increased erosion to bank.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">21/2/2017
Evidence of recent high flows - approximately 50 cm above normal flow level. Small pools created upstream by woody debris. Some surface scum in pools.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">21/4/2017
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="2">SW07
A heavily shaded waterway approximately 1 m wide with a cobble and gravel substrate partially covered by leaf litter and other detritus. Waterway shallow (approximately 20-30 cm depth) during normal flow conditions. Small riffles present throughout sampling site.</td><td colspan="2">6/12/2016
Sample taken just upstream of confluence of Barron River, upstream of debris creating incomplete damming effect. Lowest turbidity (2.72 NTU) for SW07 recorded during this sampling event.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
</table>

Site description	**Photographs and sampling event description**	
	Upstream photograph	**Downstream photograph**
SW07 *continued*	10/1/2017 Site influenced by Barron River due to high water levels. No samples taken due to Barron River influence.	
		
	2/2/2017 Site influenced by high water levels in the Barron River. No samples taken due to Barron River influence. No photographs taken due to access limitations.	
	22/2/2017 Water sample taken approximately 50 m upstream of previous sample (6/12/2016). Grass and sedges abundant immediately upstream and downstream of sampling point. No upstream photograph taken. Water sample collected.	
		
SW08 A heavily shaded waterway approximately 2 m wide with a gravel and sand substrate covered by leaf litter and other detritus. Banks consisted of sand and silt. Waterway shallow (approximately 20-40 cm depth) during normal flow conditions.	6/12/2017 Site dry. No samples taken.	
		
	9/1/2017 Lowest dissolved oxygen (23.3% saturation) for SW08 recorded during this sampling event. Evidence of recent high flow. Water samples collected.	
		

Site description	Photographs and sampling event description	
	Upstream photograph	Downstream photograph
SW08 *continued*	2/2/2017 Water samples collected.	
		
	21/2/2017 Water samples collected. Evidence of recent high flows and debris >1 m above normal flow level.	
		
	20/4/2017 Some evidence of disturbance to leaf litter on bank (possibly Scrub Turkey). Water, sediment and aquatic macroinvertebrate samples collected	
		
SW09 A partially shaded waterway approximately 10 m wide with a bedrock substrate. Samples taken from deep pool upstream of a natural dam. Natural dam present. Dam wall used as vehicle crossing. Small riffles present downstream of sampling point.	5/12/2016 Lowest turbidity (4.46 NTU) for SW09 recorded during this sampling event. Water samples collected.	
		

Site description	Photographs and sampling event description	
	Upstream photograph	Downstream photograph
SW09 *continued*	9/1/2017 Possible earthworks had occurred on neighbouring property and water had been released from upstream dam. Water samples collected.	
		
	1/2/2017 Water appeared inconsistently mixed (*ie* some areas of flow seemed more or less turbid than others). Three turbidity measurements were recorded to capture variance (80.4, 98.0 and 129 NTU). Highest turbidity (129 NTU) recorded for SW09 during this sampling event. Water samples collected.	
		
	21/2/2017 Water appeared to be more turbid lower in the water column (*ie* deeper than where water could be sampled). Water samples collected.	
		
	21/4/2017 Water lilies flowering upstream of sampling point. Water samples collected.	
		

Site description	Photographs and sampling event description	
	Upstream photograph	Downstream photograph
SW10 A moderately shaded waterway approximately 1.5 m wide with a cobble substrate. Waterway shallow (approximately 30 cm depth) during normal flow conditions. Small riffles present downstream of sampling point. Singapore Daisy, grasses and sedges abundant along banks.	5/12/2017 Low turbidity (6.79 NTU) recorded. Water samples collected. 	
SW10 Alt A heavily shaded waterway approximately 4-6 m wide with a sand and silt substrate covered by leaf litter and other detritus. Waterway moderately shallow (approximately 1 m depth) during normal flow conditions. Riparian vegetation dominated by palms.	10/1/2017 Water samples collected. 	
	2/2/2017 Water samples collected. 	
	22/2/2017 Evidence of recent high flows and disturbed soil >1 m above normal flow level. Water samples collected. 	

<table>
<tr><th rowspan="2">Site description</th><th colspan="2">Photographs and sampling event description</th></tr>
<tr><th>Upstream photograph</th><th>Downstream photograph</th></tr>
<tr><td rowspan="2">SW011
A predominantly unshaded and deep river. Water samples taken approximately 2 m from southern bank.</td><td colspan="2">6/12/2016
Low turbidity (4.06 NTU) recorded.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="6">SW11 Alt
A predominantly unshaded and deep river. Water samples taken approximately 2 m from southern bank over exposed bedrock.</td><td colspan="2">9/1/2017
Highest turbidity (118 NTU) for SW11 Alt recorded during this sampling event.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">2/2/2017
Heavy rainfall occurred during sampling.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">22/2/2017
Low turbidity (11.29 NTU) recorded during this sampling event.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Site description</th><th colspan="2">Photographs and sampling event description</th></tr>
<tr><th>Upstream photograph</th><th>Downstream photograph</th></tr>
<tr><td rowspan="8">SW12
A predominantly unshaded and deep river. Water samples taken approximately 2 m from southern bank.</td><td colspan="2">6/12/2016
Sample taken approximately 30 m downstream of other samples. Lowest turbidity (2.70 NTU) for SW12 recorded during this sampling event.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">10/1/2017
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">2/2/2017
Highest turbidity (109 NTU) for SW12 recorded during this sampling event.
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">22/2/2017
Water samples collected.</td></tr>
<tr><td></td><td></td></tr>
</table>

Appendix D:
Surface Water and Sediment Laboratory Documentation

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE124405 (Lab use only)

Page 1 of 1

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix: SOIL	Matrix: WATER	Matrix: OTHER		Preservation Method: NONE	Preservation Method: ICE	Preservation Method: ACID	Preservation Method: OTHER		Analysis Required: See attached analyte list for KUR-World WQ Sampling	Comments:
1	SW01	5/12/16 15:00		✓				✓					
2	SW02	5/12/16 10:30		✓				✓					
3	SW03	6/12/16 11:40		✓				✓					
4	SW05	6/12/16 13:00		✓				✓					
5	SW06	5/12/16 13:25		✓				✓					
6	SW07	6/12/16 14:10		✓				✓					
7	SW09	5/12/16 11:20		✓				✓					
8	SW10	5/12/16 16:20		✓				✓					
9	SW11	6/12/16 13:20		✓				✓					
10	SW12	6/12/16 09:20		✓				✓					

SGS Cairns Environmental

CE124405 COC

Received: 07 - Dec - 2016

Company Name: NRA

Address: 320 Sheridan Street, Cairns, 4870

Contact Name: Martine Newman

Email address: martine@natres.com.au

Telephone: 4034 5300 **Facsimile:** 40345301

Client Order Number:

Project Name: KUR-World WQ Monitoring

Project Number: 424103.01

Results Required By:

Bottles Received - Lab use only:

24x 500ml NP
24 x AW
12 x 125ml NP

(Please specify if AW is Field Filtered or Total)

Relinquished by: Karen Lindie **Date:** 6/12/16 **Time:** 4:45pm **Received by:** **Date:** 7/12/16 **Time:**

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO* | **Samples Intact:** [✓ YES]/NO* | **Correct Sample Bottles Used:** [✓ YES]/NO* | **Temperature:** AMBIENT/[✓ CHILLED]*

Comments including subcontracting details:

Please provide client with details ☐

Consent given for subcontracting ☐

SGS Terms and Conditions are available at www.au.sgs.com

SGS Australia Pty Ltd
ABN 44 000 964 278

Environment, Health & Safety Unit 2, 58 Comport Street, PORTSMITH QLD 4870 www.sgs.com
t +61(0)7 4035 5111. f +61(0)7 4035 5122 *e-mail:* shey.goddard@sgs.com

Member of the SGS Group

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: ______________________________ **(Lab use only)**

Page 2 of 2

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER		See attached analyte list for KUR-World WQ Sampling											
11	QA	5/12/16 14:20		✓				✓															
12	Dup	5/12/16		✓				✓															

Company Name: NRA

Address: 320 Sheridan Street, Cairns, 4870

Contact Name: Martine Newman

Email address: martine@natres.com.au

Telephone: 4034 5300 **Facsimile:** 40345301

Client Order Number:

Project Name: KUR-World WQ Monitoring

Project Number: 424103.01

Results Required By:

Bottles Received - Lab use only:

(Please specify if AW is Field Filtered or Total)

Relinquished by: LaurenLinder **Date:** 6/12/16 **Time:** 4 45pm **Received by:** **Date:** **Time:**

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: YES/NO*	**Samples Intact: YES/NO***	**Correct Sample Bottles Used: YES/NO***	**Temperature: AMBIENT/CHILLED***

Comments including subcontracting details:

Please provide client with details ☐

Consent given for subcontracting ☐

SGS Terms and Conditions are available at www.au.sgs.com

SGS Australia Pty Ltd
ABN 44 000 964 278

Environment, Health & Safety Unit 2, 58 Comport Street, PORTSMITH QLD 4870 www.sgs.com
t +61(0)7 4035 5111. f +61(0)7 4035 5122 *e-mail:* shey.goddard@sgs.com

Member of the SGS Group

Uncontrolled proforma when printed, official record on data entry.

Authorised by: Business Manager

Ref: PF-(AU)-[ENV]-(CAI)-OFF16/ver.11/04.12.09

KUR-World Analyte List

- Bottles for 18 samples
- DI water for 2 sets of blanks

Parameter	**LOR (mg/L)**		
Total Suspended Solids ✓	1		LL TSS - requires full 500ml just for this test - request TSS LL on cofc
Total Dissolved Solids ✓	1	10	
Total Nitrogen ✓	0.05		
Total Phosphorus - ultra trace ✓	0.005	0.01	Have to request TP (LL) on cofc
Nitrate and Nitrite as N (Nox) - Ul ✓	0.002	0.005	
Total Kjeldahl Nitrogen ✓	0.05		
Dissolved Inorganic Nitrogen - Ul	0.05		calc - NH3 and TON
Ammonia - Ultra Trace ✓	0.005		
Filterable Reactive Phosphorus - I ✓	0.001	0.005	
Hardness ✓	1		
Alkalinity ✓	1	5	
Major Ions ✓	1		
Aluminium ✓	0.005		
Arsenic ✓	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard	
Cadmium ✓	0.0001		
Chromium ✓	0.001		
Copper ✓	0.001		
Iron ✓	0.05		
Lead ✓	0.001		
Manganese ✓	0.001	normal LOR 0.005 - request special LOR on cofc	
Nickel ✓	0.001		
Zinc ✓	0.005		

Metals
10.

SAMPLE RECEIPT ADVICE

CE124405

CLIENT DETAILS

Contact	Martine Adriaansen
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424103.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	12

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Wed 7/12/2016
Report Due	Fri 16/12/2016
SGS Reference	**CE124405**

SUBMISSION DETAILS

This is to confirm that 12 samples were received on Wednesday 7/12/2016. Results are expected to be ready by Friday 16/12/2016. Please quote SGS reference CE124405 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	
Date documentation received		Type of documentation received	COC
Number of eskies/boxes received		Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Filterable Reactive Phosphorus (FRP)	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	pH in water	TKN Kjeldahl Digestion by Discrete Analyser	Total Phosphorus by Kjeldahl Digestion DA in
001	SW01	4	1	1	1	1	2	1	2	1
002	SW02	4	1	1	1	1	2	1	2	1
003	SW03	4	1	1	1	1	2	1	2	1
004	SW05	4	1	1	1	1	2	1	2	1
005	SW06	4	1	1	1	1	2	1	2	1
006	SW07	4	1	1	1	1	2	1	2	1
007	SW09	4	1	1	1	1	2	1	2	1
008	SW10	4	1	1	1	1	2	1	2	1
009	SW11	4	1	1	1	1	2	1	2	1
010	SW12	4	1	1	1	1	2	1	2	1
011	QA	4	1	1	1	1	2	1	2	1
012	DUP	4	1	1	1	1	2	1	2	1

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	SW01	1	9	3	6	6	1	1	1	1
002	SW02	1	9	3	6	6	1	1	1	1
003	SW03	1	9	3	6	6	1	1	1	1
004	SW05	1	9	3	6	6	1	1	1	1
005	SW06	1	9	3	6	6	1	1	1	1
006	SW07	1	9	3	6	6	1	1	1	1
007	SW09	1	9	3	6	6	1	1	1	1
008	SW10	1	9	3	6	6	1	1	1	1
009	SW11	1	9	3	6	6	1	1	1	1
010	SW12	1	9	3	6	6	1	1	1	1
011	QA	1	9	3	6	6	1	1	1	1
012	DUP	1	9	3	6	6	1	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Martine Newman	Manager	Jon Dicker
Client	Natural Resource Assessments Pty Ltd	Laboratory	SGS Cairns Environmental
Address	PO Box 5678 QLD 4870	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4031 5122	Telephone	+61 07 4035 5111
Facsimile	07 4051 6740	Facsimile	+61 07 4035 5122
Email	martine@natres.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**424103.01_KUR-World WQ Monitoring**	SGS Reference	**CE124405 R0**
Order Number	(Not specified)	Date Received	07 Dec 2016
Samples	12	Date Reported	21 Dec 2016

COMMENTS

Whilst SGS laboratories conform to ISO:17025 standards, results of analysis in this report fall outside of the current scope of NATA accreditation

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE160275.

SIGNATORIES

Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Orsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE124405.001 Water 05 Dec 2016 SW01	CE124405.002 Water 05 Dec 2016 SW02	CE124405.003 Water 06 Dec 2016 SW03	CE124405.004 Water 06 Dec 2016 SW05

pH in water Method: AN101 Tested: 8/12/2016

pH**	pH Units	0.1	**7.0**	**6.9**	**7.0**	**7.0**

Alkalinity Method: AN135 Tested: 8/12/2016

Total Alkalinity as CaCO3	mg/L	5	**42**	**48**	**43**	**27**
Bicarbonate Alkalinity as CaCO3	mg/L	5	**42**	**48**	**43**	**27**
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 12/12/2016

Chloride, Cl	mg/L	1	**51**	**21**	**16**	**19**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 15/12/2016

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.010**	<0.005	**0.009**	**0.084**
Nitrate Nitrogen, NO3 as N	mg/L	0.005	-	-	-	-

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 12/12/2016

Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.017**	**0.015**	**0.047**	**0.012**

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 14/12/2016

Total Kjeldahl Nitrogen	mg/L	0.05	**0.50**	**0.64**	**0.71**	**0.23**
Total Nitrogen (calc)	mg/L	0.05	**0.51**	**0.64**	**0.72**	**0.31**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE124405.001 Water 05 Dec 2016 SW01	CE124405.002 Water 05 Dec 2016 SW02	CE124405.003 Water 06 Dec 2016 SW03	CE124405.004 Water 06 Dec 2016 SW05

Calculated Nitrogen Forms - TN, organic N, inorganic N   Method: AN281/292   Tested: 21/12/2016

Total InorganicNitrogen (calc)	mg/L	0.01	**0.03**	**0.01**	**0.06**	**0.10**

Filterable Reactive Phosphorus (FRP)   Method: AN278   Tested: 13/12/2016

Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Total Phosphorus by Kjeldahl Digestion DA in Water   Method: AN279/AN293(Sydney only)   Tested: 14/12/2016

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.03**	**0.07**	**0.08**	<0.02

Total and Volatile Suspended Solids (TSS / VSS)   Method: AN114   Tested: 8/12/2016

Total Suspended Solids Dried at 103-105°C	mg/L	1	**4**	**18**	**7**	<1

Total Dissolved Solids (TDS) in water   Method: AN113   Tested: 9/12/2016

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**230**	**110**	**120**	**85**

Metals in Water (Dissolved) by ICPOES   Method: AN320/AN321   Tested: 13/12/2016

Aluminium, Al	mg/L	0.005	**0.007**	<0.005	**0.018**	**0.015**
Iron, Fe	mg/L	0.005	**0.92**	**0.60**	**2.3**	**1.8**
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

		Sample Number	CE124405.001	CE124405.002	CE124405.003	CE124405.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	05 Dec 2016	05 Dec 2016	06 Dec 2016	06 Dec 2016
		Sample Name	SW01	SW02	SW03	SW05
Parameter	**Units**	**LOR**				

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 13/12/2016

Total Aluminium	mg/L	0.005	0.008	0.015	0.056	0.023
Total Hardness	mg CaCO3/L	5	58	37	33	20
Total Calcium	mg/L	0.05	8.2	6.8	5.9	3.0
Total Iron	mg/L	0.005	2.4	7.9	6.4	2.1
Total Magnesium	mg/L	0.05	9.2	4.8	4.5	3.1
Total Potassium	mg/L	0.05	2.4	1.2	2.3	1.4
Total Sodium	mg/L	0.5	32	15	12	11
Total Sulphur as SO4	mg/L	0.5	0.7	0.6	0.8	0.8
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 9/12/2016

Arsenic, As	mg/L	0.001	0.001	0.002	0.003	0.001

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 9/12/2016

Total Arsenic	mg/L	0.001	0.002	0.004	0.004	0.001

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 13/12/2016

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	0.11	0.47	0.74	0.067
Nickel, Ni	mg/L	0.001	<0.001	0.001	0.001	<0.001

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 13/12/2016

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	0.001	<0.001	<0.001
Total Manganese, Mn	mg/L	0.001	0.17	0.65	0.79	0.092
Total Nickel, Ni	mg/L	0.001	<0.001	0.002	0.002	<0.001

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 21/12/2016

Anion-Cation Balance	%	-100	7.1	-4.7	-0.9	-4.5

		Sample Number	CE124405.005	CE124405.006	CE124405.007	CE124405.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	05 Dec 2016	06 Dec 2016	05 Dec 2016	05 Dec 2016
		Sample Name	SW06	SW07	SW09	SW10
Parameter	Units	LOR				
pH in water Method: AN101 Tested: 8/12/2016						
pH**	pH Units	0.1	6.8	6.6	7.2	7.0
Alkalinity Method: AN135 Tested: 8/12/2016						
Total Alkalinity as CaCO3	mg/L	5	21	15	48	26
Bicarbonate Alkalinity as CaCO3	mg/L	5	21	15	48	26
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Chloride by Discrete Analyser in Water Method: AN274 Tested: 12/12/2016						
Chloride, Cl	mg/L	1	6	20	46	12
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 15/12/2016						
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.14	0.79	0.024	0.080
Nitrate Nitrogen, NO3 as N	mg/L	0.005	-	-	-	-
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 12/12/2016						
Ammonia Nitrogen, NH3 as N	mg/L	0.005	0.023	0.007	0.045	0.039
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 14/12/2016						
Total Kjeldahl Nitrogen	mg/L	0.05	0.13	0.05	0.42	0.55
Total Nitrogen (calc)	mg/L	0.05	0.27	0.84	0.44	0.63

		Sample Number	CE124405.005	CE124405.006	CE124405.007	CE124405.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	05 Dec 2016	06 Dec 2016	05 Dec 2016	05 Dec 2016
		Sample Name	SW06	SW07	SW09	SW10
Parameter	Units	LOR				

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 21/12/2016

Total InorganicNitrogen (calc)	mg/L	0.01	**0.17**	**0.79**	**0.07**	**0.12**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 13/12/2016

Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 14/12/2016

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	<0.02	<0.02	<0.02	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 8/12/2016

Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	<1	<1

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 9/12/2016

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**62**	**78**	**160**	**85**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 13/12/2016

Aluminium, Al	mg/L	0.005	**0.018**	**0.023**	**0.007**	**0.016**
Iron, Fe	mg/L	0.005	**0.40**	**0.11**	**1.7**	**4.1**
Zinc, Zn	mg/L	0.005	<0.005	**0.008**	<0.005	<0.005

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE124405.005 Water 05 Dec 2016 SW06	CE124405.006 Water 06 Dec 2016 SW07	CE124405.007 Water 05 Dec 2016 SW09	CE124405.008 Water 05 Dec 2016 SW10

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 13/12/2016

Total Aluminium	mg/L	0.005	0.10	0.050	0.010	0.032
Total Hardness	mg CaCO3/L	5	10	15	51	22
Total Calcium	mg/L	0.05	1.3	1.7	8.0	3.6
Total Iron	mg/L	0.005	1.4	0.22	2.5	6.3
Total Magnesium	mg/L	0.05	1.7	2.7	7.6	3.1
Total Potassium	mg/L	0.05	1.0	0.68	2.4	1.7
Total Sodium	mg/L	0.5	7.1	11	23	9.0
Total Sulphur as SO4	mg/L	0.5	0.5	0.9	0.8	0.6
Total Zinc	mg/L	0.005	<0.005	0.007	<0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 9/12/2016

Arsenic, As	mg/L	0.001	<0.001	0.001	0.002	0.004

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 9/12/2016

Total Arsenic	mg/L	0.001	0.002	<0.001	0.002	0.005

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 13/12/2016

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	0.015	0.014	0.17	0.14
Nickel, Ni	mg/L	0.001	<0.001	0.001	<0.001	<0.001

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 13/12/2016

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Manganese, Mn	mg/L	0.001	0.015	0.014	0.28	0.35
Total Nickel, Ni	mg/L	0.001	<0.001	0.001	<0.001	0.001

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 21/12/2016

Anion-Cation Balance	%	-100	-5.5	-8.0	-2.9	7.2

Parameter	Units	LOR	CE124405.009 Water 06 Dec 2016 SW11	CE124405.010 Water 06 Dec 2016 SW12	CE124405.011 Water 05 Dec 2016 QA	CE124405.012 Water 05 Dec 2016 DUP

Sample Number / Sample Matrix / Sample Date / Sample Name

pH in water Method: AN101 Tested: 8/12/2016

pH**	pH Units	0.1	7.5	7.5	5.8	6.9

Alkalinity Method: AN135 Tested: 8/12/2016

Total Alkalinity as CaCO3	mg/L	5	47	44	<5	20
Bicarbonate Alkalinity as CaCO3	mg/L	5	47	44	<5	20
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 12/12/2016

Chloride, Cl	mg/L	1	15	14	<1	13

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 15/12/2016

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.005	0.010	0.012	0.096
Nitrate Nitrogen, NO3 as N	mg/L	0.005	-	-	-	-

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 12/12/2016

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005	0.011	0.005	0.037

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 14/12/2016

Total Kjeldahl Nitrogen	mg/L	0.05	0.26	0.31	<0.05	0.41
Total Nitrogen (calc)	mg/L	0.05	0.26	0.32	<0.05	0.51

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE124405.009 Water 06 Dec 2016 SW11	CE124405.010 Water 06 Dec 2016 SW12	CE124405.011 Water 05 Dec 2016 QA	CE124405.012 Water 05 Dec 2016 DUP

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 21/12/2016

Parameter	Units	LOR	SW11	SW12	QA	DUP
Total InorganicNitrogen (calc)	mg/L	0.01	<0.01	**0.02**	**0.02**	**0.13**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 13/12/2016

Parameter	Units	LOR	SW11	SW12	QA	DUP
Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 14/12/2016

Parameter	Units	LOR	SW11	SW12	QA	DUP
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	<0.02	<0.02	<0.02	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 8/12/2016

Parameter	Units	LOR	SW11	SW12	QA	DUP
Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	<1	**4**

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 9/12/2016

Parameter	Units	LOR	SW11	SW12	QA	DUP
Total Dissolved Solids Dried at 175-185°C	mg/L	10	**91**	**90**	<10	**88**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 13/12/2016

Parameter	Units	LOR	SW11	SW12	QA	DUP
Aluminium, Al	mg/L	0.005	**0.037**	**0.040**	<0.005	**0.017**
Iron, Fe	mg/L	0.005	**0.24**	**0.27**	<0.005	**4.1**
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

		Sample Number	CE124405.009	CE124405.010	CE124405.011	CE124405.012
		Sample Matrix	Water	Water	Water	Water
		Sample Date	06 Dec 2016	06 Dec 2016	05 Dec 2016	05 Dec 2016
		Sample Name	SW11	SW12	QA	DUP
Parameter	Units	LOR				

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 13/12/2016

Total Aluminium	mg/L	0.005	**0.070**	**0.052**	<0.005	**0.038**
Total Hardness	mg CaCO3/L	5	**37**	**34**	<5	**22**
Total Calcium	mg/L	0.05	**5.6**	**5.0**	<0.05	**3.6**
Total Iron	mg/L	0.005	**0.37**	**0.43**	<0.005	**6.5**
Total Magnesium	mg/L	0.05	**5.7**	**5.3**	<0.05	**3.1**
Total Potassium	mg/L	0.05	**2.0**	**2.0**	<0.05	**1.7**
Total Sodium	mg/L	0.5	**11**	**11**	<0.5	**8.9**
Total Sulphur as SO4	mg/L	0.5	**0.7**	**0.7**	<0.5	**0.6**
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 9/12/2016

Arsenic, As	mg/L	0.001	**0.001**	**0.001**	<0.001	**0.004**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 9/12/2016

Total Arsenic	mg/L	0.001	**0.001**	**0.001**	<0.001	**0.006**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 13/12/2016

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	**0.002**	<0.001	<0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.009**	**0.024**	<0.001	**0.14**
Nickel, Ni	mg/L	0.001	<0.001	<0.001	<0.001	<0.001

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 13/12/2016

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	**0.001**	<0.001	<0.001	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Manganese, Mn	mg/L	0.001	**0.054**	**0.044**	<0.001	**0.35**
Total Nickel, Ni	mg/L	0.001	<0.001	<0.001	<0.001	**0.001**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 21/12/2016

Anion-Cation Balance	%	-100	**-4.0**	**-3.3**	-	**13**

QC SUMMARY

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	LB041637	mg/L	5	<5	0 - 6%	107 - 113%
Bicarbonate Alkalinity as CaCO3	LB041637	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB041637	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB041637	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB041750	mg/L	0.005	<0.005	0 - 3%	100 - 107%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB041749	mg/L	1	<1	0 - 1%	107 - 108%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB041811	mg/L	0.005	<0.005	0 - 4%	95 - 97%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB041792	mg/L	0.005	0 - 2%	99%	117%
Total Calcium	LB041792	mg/L	0.05	0 - 1%	106%	119%
Total Iron	LB041792	mg/L	0.005	0 - 1%	105%	111%
Total Magnesium	LB041792	mg/L	0.05	0 - 1%	104%	116%
Total Potassium	LB041792	mg/L	0.05	0 - 1%	105%	127%
Total Sodium	LB041792	mg/L	0.5	0%	95%	117%
Total Sulphur as SO4	LB041792	mg/L	0.5	0 - 5%	103%	NA
Total Zinc	LB041792	mg/L	0.005	0%	109%	125%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB041788	mg/L	0.005	<0.005	0 - 5%	99%	109%
Iron, Fe	LB041788	mg/L	0.005	<0.005	0 - 1%	105%	108%
Zinc, Zn	LB041788	mg/L	0.005	<0.005	0%	109%	117%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB041796	mg/L	0.0001	<0.0001	0%	98%	101%
Chromium, Cr	LB041796	mg/L	0.001	<0.0010	0%	97%	95%
Copper, Cu	LB041796	mg/L	0.001	<0.001	0 - 3%	92%	116%
Lead, Pb	LB041796	mg/L	0.001	<0.001	0%	98%	90%
Manganese, Mn	LB041796	mg/L	0.001	<0.001	0%	NA	NA
Nickel, Ni	LB041796	mg/L	0.001	<0.001	0%	102%	92%

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB041800	mg/L	0.0001	<0.0001	0%	97%	101%
Total Chromium, Cr	LB041800	mg/L	0.001	<0.001	0%	94%	94%
Total Copper, Cu	LB041800	mg/L	0.001	<0.001	0%	93%	103%
Total Lead, Pb	LB041800	mg/L	0.001	<0.001	0%	95%	85%
Total Manganese, Mn	LB041800	mg/L	0.001	<0.001	0 - 7%	NA	NA
Total Nickel, Ni	LB041800	mg/L	0.001	<0.001	0%	101%	91%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB041858	mg/L	0.005	<0.005	0 - 5%	101 - 103%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB041637	pH Units	0.1	5.8 - 6.1	0 - 3%	NA

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB041827	mg/L	0.05	<0.05	0 - 4%	96 - 99%

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	LB041660	mg/L	1	<1	0%	97%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB041715	mg/L	10	<10	0 - 3%	108%	103%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB041827	mg/L	0.02	<0.02	0 - 1%	117%

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

Parameter	QC Reference	Units	LOR	DUP %RPD
Arsenic, As	LB041702	mg/L	0.001	0%

QC SUMMARY

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.

Trace Metals (Total) in Water by ICPMS in mg/L Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Arsenic	LB041706	mg/L	0.001	0%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
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 µmhos/cm or µS/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 calculation 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.
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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE124579 *(Lab use only)*

Page 1 **of** 1

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix: SOIL	Matrix: WATER	Matrix: OTHER		Preservation Method: NONE	Preservation Method: ICE	Preservation Method: ACID	Preservation Method: OTHER		Analysis Required: TSS	+VSS (VOLATILE SS)		Comments:
	SW10	13 Dec 2016 1730		✓				✓				✓	✓		
	OF Sed Trap	13 Dec 2016 1730		✓				✓				✓	✓		
	OF Outflow	13 Dec 2016 1730		✓				✓				✓	✓		

SGS Cairns Environmental
CE124579 COC
Received: 14 - Dec - 2016

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 **Facsin** 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 424103.01
Results Required By:

Bottles Received - Lab use only:
3 x 500ml NP
(Please specify if AW is Field Filtered or Total)

Relinquished by: Tim Anderson **Date:** 14 Dec 2016 **Time:**
Received by: **Date:** 14/12/16 **Time:** 4pm

Relinquished by: **Date:** **Time:**
Received by: **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: YES/NO*	**Samples Intact: YES/NO***	**Correct Sample Bottles Used: YES/NO***	**Temperature: AMBIENT/CHILLED***

Comments including subcontracting details:
Please provide client with details ☐
Consent given for subcontracting ☐

SAMPLE RECEIPT ADVICE

CE124579

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424103.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	3

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Wed 14/12/2016
Report Due	Fri 23/12/2016
SGS Reference	**CE124579**

SUBMISSION DETAILS

This is to confirm that 3 samples were received on Wednesday 14/12/2016. Results are expected to be ready by Friday 23/12/2016. Please quote SGS reference CE124579 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	3 waters
Date documentation received	14/12/2016	Type of documentation received	COC
Number of eskies/boxes received		Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CE124579

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Total and Volatile Suspended Solids (TSS /
001	SW10	2
002	OF Sed Trap	2
003	OF Outflow	2

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424103.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	3

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE124579 R1**
Date Received	14 Dec 2016
Date Reported	13 Jan 2017

COMMENTS

Whilst SGS laboratories conform to ISO:17025 standards, results of analysis in this report fall outside of the current scope of NATA accreditation

This report cancels and supersedes the report No.CE124579 R0. dated 23 Dec 2016 issued by SGS Environment, Health and Safety due to amendment of TSS results.

SIGNATORIES

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Parameter	Units	LOR	CE124579.001	CE124579.002	CE124579.003
Sample Matrix			Water	Water	Water
Sample Date			13 Dec 2016	13 Dec 2016	13 Dec 2016
Sample Name			SW10	OF Sed Trap	OF Outflow
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 21/12/2016					
Total Suspended Solids Dried at 103-105°C	mg/L	1	10	600	100
Volatile Suspended Solids Ignited at 550°C	mg/L	1	3	99	23

QC SUMMARY

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.

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	LB042060	mg/L	1	<1	4%	95%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
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

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 calcuated 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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SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE124888 *(Lab use only)*

Page 1 **of** 1

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER		TSS	VSS										
1	SW02	6/1/17 09:30		✓			✓					✓	✓										
2	SW03	6/1/17 09:50		✓			✓					✓	✓										
3	SW04	6/1/17 11:20		✓			✓					✓	✓										
4	SW05	6/1/17 11:50		✓			✓					✓	✓										
5	SW07	6/1/17 11:40		✓			✓					✓	✓										
6	SW08	6/1/17 10:30		✓			✓					✓	✓										
7	Barron upstream	6/1/17 12:00		✓			✓					✓	✓										

SGS Cairns Environmental
CE124888 COC
Received: 09 – Jan – 2017

Company Name: NRA
Address: 320 Sheridan St, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au karen@natres.com.au
Telephone: 4034 5300 **Facsimile:** 4034 5301

Client Order Number:
Project Name: Barnwell General
Project Number: 424000 01
Results Required By:

Bottles Received - Lab use only:
7x500ml NP.
(Please specify if AW is Field Filtered or Total)

Relinquished by: Karen Lindee **Date:** 6/1/17 **Time:** 15:25 **Received by:** **Date:** 6/1/17 **Time:** 3.30pm

Relinquished by: **Date:** **Time:** **Received by:** **Date:** 9/1/17 **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO* **Samples Intact:** [✓ YES]/NO* **Correct Sample Bottles Used:** [✓ YES]/NO* **Temperature:** AMBIENT/[✓ CHILLED]*

Comments including subcontracting details:

Please provide client with details ☐
Consent given for subcontracting ☐

SGS Terms and Conditions are available at www.au.sgs.com

SGS Australia Pty Ltd
ABN 44 000 964 278

Environment, Health & Safety Unit 2, 58 Comport Street, PORTSMITH QLD 4870 www.sgs.com
t +61(0)7 4035 5111. f +61(0)7 4035 5122 *e-mail:* shey.goddard@sgs.com

Member of the SGS Group

Uncontrolled proforma when printed, official record on data entry.

Authorised by: Business Manager

SAMPLE RECEIPT ADVICE

CE124888

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424000.01 Barnwell General**
Order Number	(Not specified)
Samples	7

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Mon 9/1/2017
Report Due	Mon 16/1/2017
SGS Reference	**CE124888**

SUBMISSION DETAILS

This is to confirm that 7 samples were received on Monday 9/1/2017. Results are expected to be ready by Monday 16/1/2017. Please quote SGS reference CE124888 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	7 waters	Type of documentation received	COC
Date documentation received	6/1/2016	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	chilled
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424000.01 Barnwell General

SUMMARY OF ANALYSIS

No.	Sample ID	Total and Volatile Suspended Solids (TSS /
001	SW02	3
002	SW03	3
003	SW04	3
004	SW05	3
005	SW07	3
006	SW08	3
007	Barron Upstream	3

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424000.01 Barnwell General**
Order Number	(Not specified)
Samples	7

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE124888 R1**
Date Received	09 Jan 2017
Date Reported	23 Jan 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(3146)

This report cancels and supersedes the report No.CE124888. dated 17 Jan 2017 issued by SGS Environment, Health and Safety due to TSS re-analysis using GC-50 papers.

SIGNATORIES

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

		Sample Number	CE124888.001	CE124888.002	CE124888.003	CE124888.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	06 Jan 2016	06 Jan 2016	06 Jan 2016	06 Jan 2016
		Sample Name	SW02	SW03	SW04	SW05
Parameter	**Units**	**LOR**				

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 10/1/2017

Total Suspended Solids Dried at 103-105°C	mg/L	5	**6**	**76**	**31**	**7**
Volatile Suspended Solids Ignited at 550°C	mg/L	5	**6**	**28**	**15**	**7**
Non Volatile Suspended Solids Ignited at 550°C	mg/L	5	<5	**48**	**16**	<5

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE124888.005 Water 06 Jan 2016 SW07	CE124888.006 Water 06 Jan 2016 SW08	CE124888.007 Water 06 Jan 2016 Barron Upstream

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 10/1/2017

Parameter	Units	LOR	CE124888.005	CE124888.006	CE124888.007
Total Suspended Solids Dried at 103-105°C	mg/L	5	16	15	52
Volatile Suspended Solids Ignited at 550°C	mg/L	5	12	12	16
Non Volatile Suspended Solids Ignited at 550°C	mg/L	5	<5	<5	35

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery	MS %Recovery
Total Suspended Solids Dried at 103-105°C	LB042423	mg/L	5	<5	95%	101%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
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

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.

LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
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 calcuated 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

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE124925 *(Lab use only)*

Page 1 of 2

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:	Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER		See attached analyte list for KUR-World WQ Sampling	
1	SW01	9/1/17 13:20		✓				✓					
2	SW02	9/1/17 12:30		✓				✓					
3	SW03	9/1/17 10 50		✓				✓					
	~~SW04~~	~~9/1/17 15:20~~		~~✓~~				~~✓~~					
	~~SW05~~	~~9/1/17~~		~~✓~~				~~✓~~					
4	SW06	9/1/17 14 30		✓				✓					
	~~SW07~~	~~10/1/17 11:50~~		~~✓~~				~~✓~~					
5	SW08	9/1/17 10:00		✓				✓					
6	SW09	9/1/17 11 45		✓				✓					
7	SW10	10/1/17 9 50		✓				✓					

SGS Cairns Environmental
CE124925 COC
Received: 10 – Jan – 2017

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 **Facsin** 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 424103.01
Results Required By:

Bottles Received - Lab use only:
22 × 500ml NP
22 × 125ml AW (T+FF)
11 × 125ml NP
(Please specify if AW is Field Filtered or Total)

Relinquished by: **Date:** 10/1/17 **Time:** 1pm **Received by:** Fiona T **Date:** 10/01/17 **Time:** 13:00pm

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES] ~~NO*~~ | **Samples Intact:** [✓ YES] ~~NO*~~ | **Correct Sample Bottles Used:** [✓ YES] ~~NO*~~ | **Temperature:** ~~AMBIENT~~/[✓ CHILLED*]

Comments including subcontracting details:

Please provide client with details ☐
Consent given for subcontracting ☐

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE124925 (Lab use only)

Page 2 **of** 2

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER		See attached analyte list for KUR-World WQ Sampling											
8	SW11	9/1/14 16:15		✓				✓															
9	SW12	10/1/17 11:00		✓				✓															
10	QA	9/1/17		✓				✓															
11	DUP	9/1/17		✓				✓															

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 **Facsin** 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 424103.01
Results Required By:

Bottles Received - Lab use only:

(Please specify if AW is Field Filtered or Total)

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: YES/NO*	Samples Intact: YES/NO*	Correct Sample Bottles Used: YES/NO*	Temperature: AMBIENT/CHILLED*

Comments including subcontracting details:

Please provide client with details ☐
Consent given for subcontracting ☐

KUR-World WQ Monitoring Analyte List

CE124925

Parameter	**LOR (mg/L)**	
Total Suspended Solids	1	LL TSS - requires full 500ml just for this test - request TSS LL on cofc
Total Dissolved Solids	10	
Total Nitrogen	0.05	
Total Phosphorus - ultra trace	0.01	Have to request TP (LL) on cofc
Nitrate and Nitrite as N (Nox) - Ultra Tra	0.005	
Total Kjeldahl Nitrogen	0.05	
Dissolved Inorganic Nitrogen	0.05	calc NH3 and TON
Ammonia - Ultra Trace	0.005	
Filterable Reactive Phosphorus - Ultra T	0.005	
Hardness	1	
Alkalinity	5	
Major Ions	1	
Aluminium (total)	0.005	
Aluminium (field filtered)	0.005	
Arsenic (total)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Arsenic (field filtered)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Cadmium (total)	0.0001	
Cadmium (field filtered)	0.0001	
Chromium (total)	0.001	
Chromium (field filtered)	0.001	
Copper (total)	0.001	
Copper (field filtered)	0.001	
Iron (total)	0.05	
Iron (field filtered)	0.05	
Lead (total)	0.001	
Lead (field filtered)	0.001	
Manganese (total)	0.001	Have to request special LOR on cofc - normally 0.005
Manganese (field filtered)	0.001	Have to request special LOR on cofc - normally 0.005
Nickel (total)	0.001	
Nickel (field filtered)	0.001	
Zinc (total)	0.005	
Zinc (field filtered)	0.005	

SAMPLE RECEIPT ADVICE

CE124925

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424103.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	11

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Tue 10/1/2017
Report Due	Thu 19/1/2017
SGS Reference	**CE124925**

SUBMISSION DETAILS

This is to confirm that 11 samples were received on Tuesday 10/1/2017. Results are expected to be ready by Thursday 19/1/2017. Please quote SGS reference CE124925 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	11 Waters	Type of documentation received	COC
Date documentation received	10/1/2017	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes	Number of eskies/boxes received	2

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Filterable Reactive Phosphorus (FRP)	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	pH in water	TKN Kjeldahl Digestion by Discrete Analyser	Total Phosphorus by Kjeldahl Digestion DA in
001	SW01	4	1	1	1	1	2	1	2	1
002	SW02	4	1	1	1	1	2	1	2	1
003	SW03	4	1	1	1	1	2	1	2	1
004	SW06	4	1	1	1	1	2	1	2	1
005	SW08	4	1	1	1	1	2	1	2	1
006	SW09	4	1	1	1	1	2	1	2	1
007	SW10	4	1	1	1	1	2	1	2	1
008	SW11	4	1	1	1	1	2	1	2	1
009	SW12	4	1	1	1	1	2	1	2	1
010	QA	4	1	1	1	1	2	1	2	1
011	DUP	4	1	1	1	1	2	1	2	1

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	SW01	1	9	3	6	6	1	1	1	1
002	SW02	1	9	3	6	6	1	1	1	1
003	SW03	1	9	3	6	6	1	1	1	1
004	SW06	1	9	3	6	6	1	1	1	1
005	SW08	1	9	3	6	6	1	1	1	1
006	SW09	1	9	3	6	6	1	1	1	1
007	SW10	1	9	3	6	6	1	1	1	1
008	SW11	1	9	3	6	6	1	1	1	1
009	SW12	1	9	3	6	6	1	1	1	1
010	QA	1	9	3	6	6	1	1	1	1
011	DUP	1	9	3	6	6	1	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Martine Newman	Manager	Jon Dicker
Client	Natural Resource Assessments Pty Ltd	Laboratory	SGS Cairns Environmental
Address	PO Box 5678 QLD 4870	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4031 5122	Telephone	+61 07 4035 5111
Facsimile	07 4051 6740	Facsimile	+61 07 4035 5122
Email	martine@natres.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**424103.01_KUR-World WQ Monitoring**	SGS Reference	**CE124925 R0**
Order Number	(Not specified)	Date Received	10 Jan 2017
Samples	11	Date Reported	27 Jan 2017

COMMENTS

Whilst SGS laboratories conform to ISO:17025 standards, results of analysis in this report fall outside of the current scope of NATA accreditation

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE160955.

SIGNATORIES

A. Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

LMOrsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE124925.001 Water 9/1/17 13:20 SW01	CE124925.002 Water 9/1/17 12:30 SW02	CE124925.003 Water 9/1/17 10:50 SW03	CE124925.004 Water 9/1/17 14:30 SW06
pH in water Method: AN101 Tested: 10/1/2017							
pH**	pH Units	0.1		6.7	6.5	6.9	6.6
Alkalinity Method: AN135 Tested: 10/1/2017							
Total Alkalinity as CaCO3	mg/L	5		29	18	31	19
Bicarbonate Alkalinity as CaCO3	mg/L	5		29	18	31	19
Carbonate Alkalinity as CaCO3	mg/L	5		<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5		<5	<5	<5	<5
Chloride by Discrete Analyser in Water Method: AN274 Tested: 13/1/2017							
Chloride, Cl	mg/L	1		72	19	14	10
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 16/1/2017							
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005		0.036	0.026	0.027	0.20
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 17/1/2017							
Ammonia Nitrogen, NH3 as N	mg/L	0.005		0.018	0.019	0.070	0.047
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 10/1/2017							
Total Kjeldahl Nitrogen	mg/L	0.05		0.41	0.55	0.85	0.20
Total Nitrogen (calc)	mg/L	0.05		0.45	0.57	0.88	0.40

		Sample Number	CE124925.001	CE124925.002	CE124925.003	CE124925.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	9/1/17 13:20	9/1/17 12:30	9/1/17 10:50	9/1/17 14:30
		Sample Name	SW01	SW02	SW03	SW06
Parameter	Units	LOR				
Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 21/1/2017						
Total InorganicNitrogen (calc)	mg/L	0.01	0.05	0.04	0.10	0.24
Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 12/1/2017						
Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 10/1/2017						
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.03	0.03	0.07	<0.02
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 12/1/2017						
Total Suspended Solids Dried at 103-105°C	mg/L	1	2	7	12	3
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 12/1/2017						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	210	110	120	66
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 17/1/2017						
Aluminium, Al	mg/L	0.005	0.011	0.16	0.32	0.013
Iron, Fe	mg/L	0.005	0.76	1.4	1.8	0.51
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

		Sample Number	CE124925.001	CE124925.002	CE124925.003	CE124925.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	9/1/17 13:20	9/1/17 12:30	9/1/17 10:50	9/1/17 14:30
		Sample Name	SW01	SW02	SW03	SW06
Parameter	Units	LOR				

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 17/1/2017

Total Aluminium	mg/L	0.005	0.013	0.76	0.82	0.20
Total Hardness	mg CaCO3/L	5	51	20	21	10
Total Calcium	mg/L	0.05	7.1	3.4	3.7	1.2
Total Iron	mg/L	0.005	1.1	2.8	4.0	2.6
Total Magnesium	mg/L	0.05	8.0	2.8	3.0	1.7
Total Potassium	mg/L	0.05	2.7	2.4	3.4	1.2
Total Sodium	mg/L	0.5	30	12	11	7.8
Total Sulphur as SO4	mg/L	0.5	0.8	7.0	2.2	0.9
Total Zinc	mg/L	0.005	<0.005	<0.005	0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 16/1/2017

Arsenic, As	mg/L	0.001	<0.001	<0.001	0.001	0.002

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 16/1/2017

Total Arsenic	mg/L	0.001	<0.001	0.001	0.002	0.003

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 18/1/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	0.002	0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	0.037	0.085	0.086	0.040
Nickel, Ni	mg/L	0.001	<0.001	0.002	0.002	<0.001

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 18/1/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	0.001	0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	0.002	0.002	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	0.001	0.002	<0.001
Total Manganese, Mn	mg/L	0.001	0.076	0.089	0.15	0.050
Total Nickel, Ni	mg/L	0.001	<0.001	0.002	0.002	<0.001

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 21/1/2017

Anion-Cation Balance	%	-100	-4.4	-0.1	-1.3	-8.8

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE124925.005 Water 9/1/17 10:00 SW08	CE124925.006 Water 9/1/17 11:45 SW09	CE124925.007 Water 10/1/17 9:50 SW10	CE124925.008 Water 9/1/17 16:15 SW11
pH in water Method: AN101 Tested: 10/1/2017							
pH**	pH Units	0.1		6.1	6.7	6.5	6.9
Alkalinity Method: AN135 Tested: 10/1/2017							
Total Alkalinity as CaCO3	mg/L	5		9	26	13	28
Bicarbonate Alkalinity as CaCO3	mg/L	5		9	26	13	28
Carbonate Alkalinity as CaCO3	mg/L	5		<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5		<5	<5	<5	<5
Chloride by Discrete Analyser in Water Method: AN274 Tested: 13/1/2017							
Chloride, Cl	mg/L	1		18	21	10	14
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 16/1/2017							
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005		0.063	0.048	0.15	0.21
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 17/1/2017							
Ammonia Nitrogen, NH3 as N	mg/L	0.005		0.013	0.055	0.053	0.014
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 10/1/2017							
Total Kjeldahl Nitrogen	mg/L	0.05		0.77	0.81	0.71	0.71
Total Nitrogen (calc)	mg/L	0.05		0.83	0.85	0.86	0.92

		Sample Number	CE124925.005	CE124925.006	CE124925.007	CE124925.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	9/1/17 10:00	9/1/17 11:45	10/1/17 9:50	9/1/17 16:15
		Sample Name	SW08	SW09	SW10	SW11
Parameter	Units	LOR				

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 21/1/2017

Total InorganicNitrogen (calc)	mg/L	0.01	0.08	0.10	0.20	0.23

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 12/1/2017

Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	0.025

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 10/1/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.03	0.05	0.24	0.13

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 12/1/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	6	29	15	38

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 12/1/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	100	120	79	140

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 17/1/2017

Aluminium, Al	mg/L	0.005	0.26	0.44	0.18	0.74
Iron, Fe	mg/L	0.005	0.92	0.62	0.69	0.51
Zinc, Zn	mg/L	0.005	0.005	<0.005	<0.005	<0.005

		Sample Number	CE124925.005	CE124925.006	CE124925.007	CE124925.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	9/1/17 10:00	9/1/17 11:45	10/1/17 9:50	9/1/17 16:15
		Sample Name	SW08	SW09	SW10	SW11
Parameter	Units	LOR				
Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 17/1/2017						
Total Aluminium	mg/L	0.005	0.66	1.3	0.87	3.8
Total Hardness	mg CaCO3/L	5	12	21	10	23
Total Calcium	mg/L	0.05	1.6	3.2	1.5	4.1
Total Iron	mg/L	0.005	1.4	2.2	2.2	2.7
Total Magnesium	mg/L	0.05	1.9	3.1	1.4	3.1
Total Potassium	mg/L	0.05	2.3	2.3	2.4	3.9
Total Sodium	mg/L	0.5	11	13	6.5	9.8
Total Sulphur as SO4	mg/L	0.5	5.3	2.8	1.7	2.3
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 16/1/2017						
Arsenic, As	mg/L	0.001	0.002	<0.001	0.001	0.001
Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 16/1/2017						
Total Arsenic	mg/L	0.001	0.003	0.001	0.002	0.001
Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 18/1/2017						
Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	0.002	0.002	0.001	0.002
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	0.034	0.058	0.041	0.016
Nickel, Ni	mg/L	0.001	<0.001	0.001	0.001	0.002
Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 18/1/2017						
Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	0.001	<0.001	<0.001	0.001
Total Copper, Cu	mg/L	0.001	0.003	0.002	0.002	0.003
Total Lead, Pb	mg/L	0.001	<0.001	0.002	<0.001	0.001
Total Manganese, Mn	mg/L	0.001	0.038	0.12	0.070	0.089
Total Nickel, Ni	mg/L	0.001	<0.001	0.001	0.001	0.003
Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 21/1/2017						
Anion-Cation Balance	%	-100	-0.5	-4.1	-1.9	-0.4

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE124925.009 Water 10/1/17 11:00 SW12	CE124925.010 Water 09 Jan 2017 QA	CE124925.011 Water 09 Jan 2017 DUP

pH in water Method: AN101 Tested: 10/1/2017

pH**	pH Units	0.1	**7.0**	**5.9**	**6.7**

Alkalinity Method: AN135 Tested: 10/1/2017

Total Alkalinity as CaCO3	mg/L	5	**32**	<5	**26**
Bicarbonate Alkalinity as CaCO3	mg/L	5	**32**	<5	**26**
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 13/1/2017

Chloride, Cl	mg/L	1	**15**	<1	**20**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 16/1/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.17**	<0.005	**0.045**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 17/1/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.025**	<0.005	**0.051**

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 10/1/2017

Total Kjeldahl Nitrogen	mg/L	0.05	**0.62**	<0.05	**0.76**
Total Nitrogen (calc)	mg/L	0.05	**0.80**	<0.05	**0.81**

Parameter	Units	LOR	CE124925.009	CE124925.010	CE124925.011
Sample Matrix			Water	Water	Water
Sample Date			10/1/17 11:00	09 Jan 2017	09 Jan 2017
Sample Name			SW12	QA	DUP

Calculated Nitrogen Forms - TN, organic N, inorganic N   Method: AN281/292   Tested: 21/1/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.20**	**0.01**	**0.10**

Filterable Reactive Phosphorus (FRP)   Method: AN278   Tested: 12/1/2017

Filterable Reactive Phosphorus	mg/L	0.005	**0.018**	<0.005	<0.005

Total Phosphorus by Kjeldahl Digestion DA in Water   Method: AN279/AN293(Sydney only)   Tested: 10/1/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.09**	<0.02	**0.05**

Total and Volatile Suspended Solids (TSS / VSS)   Method: AN114   Tested: 12/1/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	**34**	<1	**22**

Total Dissolved Solids (TDS) in water   Method: AN113   Tested: 12/1/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**140**	<10	**120**

Metals in Water (Dissolved) by ICPOES   Method: AN320/AN321   Tested: 17/1/2017

Aluminium, Al	mg/L	0.005	**0.28**	<0.005	**0.46**
Iron, Fe	mg/L	0.005	**0.36**	<0.005	**0.64**
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005

		Sample Number	CE124925.009	CE124925.010	CE124925.011
		Sample Matrix	Water	Water	Water
		Sample Date	10/1/17 11:00	09 Jan 2017	09 Jan 2017
		Sample Name	SW12	QA	DUP
Parameter	Units	LOR			

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 17/1/2017

Total Aluminium	mg/L	0.005	**3.5**	<0.005	**1.5**
Total Hardness	mg CaCO3/L	5	**27**	<5	**20**
Total Calcium	mg/L	0.05	**4.9**	<0.05	**3.2**
Total Iron	mg/L	0.005	**3.0**	<0.005	**2.2**
Total Magnesium	mg/L	0.05	**3.7**	<0.05	**3.0**
Total Potassium	mg/L	0.05	**3.8**	<0.05	**2.3**
Total Sodium	mg/L	0.5	**11**	<0.5	**13**
Total Sulphur as SO4	mg/L	0.5	**2.3**	<0.5	**2.8**
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 16/1/2017

Arsenic, As	mg/L	0.001	**0.001**	<0.001	<0.001

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 16/1/2017

Total Arsenic	mg/L	0.001	**0.002**	<0.001	**0.001**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 18/1/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	**0.002**	<0.001	**0.002**
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.055**	<0.001	**0.058**
Nickel, Ni	mg/L	0.001	**0.001**	<0.001	**0.001**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 18/1/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	**0.002**	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	**0.005**	<0.001	**0.002**
Total Lead, Pb	mg/L	0.001	**0.002**	<0.001	**0.002**
Total Manganese, Mn	mg/L	0.001	**0.23**	<0.001	**0.13**
Total Nickel, Ni	mg/L	0.001	**0.003**	<0.001	**0.001**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 21/1/2017

Anion-Cation Balance	%	-100	**-0.6**	-	**-3.1**

QC SUMMARY

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	LB042437	mg/L	5	<5	0 - 4%	113 - 115%
Bicarbonate Alkalinity as CaCO3	LB042437	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB042437	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB042437	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB042621	mg/L	0.005	<0.005	0 - 7%	98 - 100%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB042523	mg/L	1	<1	0 - 1%	109 - 111%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB042483	mg/L	0.005	<0.005	0%	97%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB042608	mg/L	0.005	0%	100 - 103%	99%
Total Calcium	LB042608	mg/L	0.05	0%	102 - 105%	101%
Total Iron	LB042608	mg/L	0.005	0 - 1%	106 - 110%	102%
Total Magnesium	LB042608	mg/L	0.05	0%	99 - 101%	99%
Total Potassium	LB042608	mg/L	0.05	0%	106 - 107%	107%
Total Sodium	LB042608	mg/L	0.5	0 - 1%	98 - 101%	93%
Total Sulphur as SO4	LB042608	mg/L	0.5	0 - 5%	99 - 101%	NA
Total Zinc	LB042608	mg/L	0.005	0%	109 - 112%	104%

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB042603	mg/L	0.005	<0.005	0 - 4%	101%	99%
Iron, Fe	LB042603	mg/L	0.005	<0.005	0%	106%	99%
Zinc, Zn	LB042603	mg/L	0.005	<0.005	0%	109%	104%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB042673	mg/L	0.0001	<0.0001	0%	102%	97%
Chromium, Cr	LB042673	mg/L	0.001	<0.0010	0 - 6%	104%	94%
Copper, Cu	LB042673	mg/L	0.001	<0.001	0 - 2%	98%	99%
Lead, Pb	LB042673	mg/L	0.001	<0.001	0%	103%	91%
Manganese, Mn	LB042673	mg/L	0.001	<0.001	0%	NA	NA
Nickel, Ni	LB042673	mg/L	0.001	<0.001	0%	110%	92%

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB042674	mg/L	0.0001	<0.0001	0%	103%	99%
Total Chromium, Cr	LB042674	mg/L	0.001	<0.001	0 - 2%	104%	96%
Total Copper, Cu	LB042674	mg/L	0.001	<0.001	0 - 2%	99%	100%
Total Lead, Pb	LB042674	mg/L	0.001	<0.001	0%	105%	93%
Total Manganese, Mn	LB042674	mg/L	0.001	<0.001	0 - 1%	NA	
Total Nickel, Ni	LB042674	mg/L	0.001	<0.001	0%	110%	97%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB042539	mg/L	0.005	<0.005	0 - 2%	93 - 95%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB042437	pH Units	0.1	5.6 - 5.9	0 - 6%	NA

TKN Kjeldahl Digestion by Discrete Analyser   Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB042429	mg/L	0.05	<0.05	4 - 8%	97%

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	LB042468	mg/L	1	<1	8%	104%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB042494	mg/L	10	<10	1%	100%	98%

Total Phosphorus by Kjeldahl Digestion DA in Water   Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB042429	mg/L	0.02	<0.02	0 - 3%	101%

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

Parameter	QC Reference	Units	LOR	DUP %RPD
Arsenic, As	LB042586	mg/L	0.001	0%

QC SUMMARY

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.

Trace Metals (Total) in Water by ICPMS in mg/L Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Arsenic	LB042588	mg/L	0.001	0%

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
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 µmhos/cm or µS/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 calculation 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.
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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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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CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE125424 (Lab use only) **Page** 1 **of** 2

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix SOIL	Matrix WATER	Matrix OTHER	Matrix	Preservation Method NONE	Preservation Method ICE	Preservation Method ACID	Preservation Method OTHER	Preservation Method	Analysis Required: See attached analyte list for KUR-World WQ Sampling	Comments:
	SW01	1/2/17 330pm		✓				✓					Please use
	SW02	1/2/17 1:15pm		✓				✓					GC·50
	SW03	1/2/17 12:15pm		✓				✓					papers
	SW04	1/2/17 10:30am		✓				✓					
	SW05	1/2/17 4:45pm		✓				✓					
	SW06	2/2/17 11:30am		✓				✓					
	~~SW07~~			✓				✓					
	SW08	2/2/17 10:30am		✓				✓					
	SW09	1/2/17 2:15pm		✓				✓					
	SW10	2/2/17 2:50pm		✓				✓					

SGS Cairns Environmental
CE125424 COC
Received: 03-Feb-2017

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 **Facsimile:** 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 424103.01
Results Required By:

Bottles Received - Lab use only:
(Please specify if AW is Field Filtered or Total)

Relinquished by: Karen Ludie **Date:** 2/2/17 **Time:** 4:15 **Received by:** **Date:** 2/2/17 **Time:** 4 30pm

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO*	**Samples Intact:** [✓ YES]/NO*	**Correct Sample Bottles Used:** [✓ YES]/NO*	**Temperature:** AMBIENT/[✓ CHILLED]* Ice

Comments including subcontracting details: 26×500NP 26×125AW 13×125NP

Please provide client with details ☐
Consent given for subcontracting ☐

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: ____________ *(Lab use only)*

Page 2 of 2

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required: See attached analyte list for KUR-World WQ Sampling	Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER			
	SW11	2/2/17 2:50pm		✓				✓					
	SW12	2/2/17 1:40pm		✓				✓					Please use
	QA	2/2/17 2:25		✓				✓					GC-50
	DUP	1/2/17		✓				✓					papers

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 **Facsimile:** 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 424103.01
Results Required By:

Bottles Received - Lab use only:

(Please specify if AW is Field Filtered or Total)

Relinquished by: **Date:** **Time:** **Received by:** **Date:** 2/2/17 **Time:** 4:20pm

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO* | **Samples Intact:** [✓ YES]/NO* | **Correct Sample Bottles Used:** [✓ YES]/NO* | **Temperature:** AMBIENT/[✓ CHILLED]* Ice

Comments including subcontracting details: 26x500 NP

Please provide client with details ☐
Consent given for subcontracting ☐

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Uncontrolled proforma when printed, official record on data entry.

SGS Australia Pty Ltd
ABN 44 000 964 278

Environment, Health & Safety Unit 2, 58 Comport Street, PORTSMITH QLD 4870 www.sgs.com
t +61(0)7 4035 5111. f +61(0)7 4035 5122 *e-mail:* shey.goddard@sgs.com
Authorised by: Business Manager
Ref: PF-(AU)-[ENV]-(CAI)-OFF16/ver.11/04.12.09

KUR-World WQ Monitoring Analyte List

Parameter	LOR (mg/L)	
Total Suspended Solids	1	LL TSS - requires full 500ml just for this test - request TSS LL on cofc
Volatile Suspended Solids	1	
Total Dissolved Solids	10	
Total Nitrogen	0.05	
Total Phosphorus - ultra trace	0.01	Have to request TP (LL) on cofc
Nitrate and Nitrite as N (Nox) - Ultra Trace	0.005	
Total Kjeldahl Nitrogen	0.05	
Dissolved Inorganic Nitrogen	0.05	calc NH3 and TON
Ammonia - Ultra Trace	0.005	
Filterable Reactive Phosphorus - Ultra Trac	0.005	
Hardness	1	
Alkalinity	5	
Major Ions	1	
Aluminium (total)	0.005	
Aluminium (field filtered)	0.005	
Arsenic (total)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Arsenic (field filtered)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Cadmium (total)	0.0001	
Cadmium (field filtered)	0.0001	
Chromium (total)	0.001	
Chromium (field filtered)	0.001	
Copper (total)	0.001	
Copper (field filtered)	0.001	
Iron (total)	0.05	
Iron (field filtered)	0.05	
Lead (total)	0.001	
Lead (field filtered)	0.001	
Manganese (total)	0.001	Have to request special LOR on cofc - normally 0.005
Manganese (field filtered)	0.001	Have to request special LOR on cofc - normally 0.005
Nickel (total)	0.001	
Nickel (field filtered)	0.001	
Zinc (total)	0.005	
Zinc (field filtered)	0.005	

SAMPLE RECEIPT ADVICE

CE125424

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424103.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	13

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Fri 3/2/2017
Report Due	Tue 14/2/2017
SGS Reference	**CE125424**

SUBMISSION DETAILS

This is to confirm that 13 samples were received on Friday 3/2/2017. Results are expected to be ready by Tuesday 14/2/2017. Please quote SGS reference CE125424 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	ice
Samples received in correct containers	Yes	Sample counts by matrix	13 waters
Date documentation received	2/2/2017	Type of documentation received	COC
Number of eskies/boxes received	2	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CE125424

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Filterable Reactive Phosphorus (FRP)	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	Nitrite in Water	pH in water	TKN Kjeldahl Digestion by Discrete Analyser
001	SW01	4	1	1	1	1	2	1	1	2
002	SW02	4	1	1	1	1	2	1	1	2
003	SW03	4	1	1	1	1	2	1	1	2
004	SW04	4	1	1	1	1	2	1	1	2
005	SW05	4	1	1	1	1	2	1	1	2
006	SW06	4	1	1	1	1	2	1	1	2
007	SW08	4	1	1	1	1	2	1	1	2
008	SW09	4	1	1	1	1	2	1	1	2
009	SW10	4	1	1	1	1	2	1	1	2
010	SW11	4	1	1	1	1	2	1	1	2
011	SW12	4	1	1	1	1	2	1	1	2
012	QA	4	1	1	1	1	2	1	1	2
013	DUP	4	1	1	1	1	2	1	1	2

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CE125424

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Total Phosphorus by Kjeldahl Digestion DA in	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	SW01	1	9	3	6	6	1	1	1	1	1
002	SW02	1	9	3	6	6	1	1	1	1	1
003	SW03	1	9	3	6	6	1	1	1	1	1
004	SW04	1	9	3	6	6	1	1	1	1	1
005	SW05	1	9	3	6	6	1	1	1	1	1
006	SW06	1	9	3	6	6	1	1	1	1	1
007	SW08	1	9	3	6	6	1	1	1	1	1
008	SW09	1	9	3	6	6	1	1	1	1	1
009	SW10	1	9	3	6	6	1	1	1	1	1
010	SW11	1	9	3	6	6	1	1	1	1	1
011	SW12	1	9	3	6	6	1	1	1	1	1
012	QA	1	9	3	6	6	1	1	1	1	1
013	DUP	1	9	3	6	6	1	1	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424103.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	13

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE125424 R0**
Date Received	03 Feb 2017
Date Reported	16 Feb 2017

COMMENTS

Whilst SGS laboratories conform to ISO:17025 standards, results of analysis in this report fall outside of the current scope of NATA accreditation

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE161898.

SIGNATORIES

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

LMOrsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

		Sample Number	CE125424.001	CE125424.002	CE125424.003	CE125424.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	1/2/17 15:30	1/2/17 13:15	1/2/17 12:15	1/2/17 10:30
		Sample Name	SW01	SW02	SW03	SW04
Parameter	Units	LOR				

pH in water Method: AN101 Tested: 3/2/2017

pH**	pH Units	0.1	6.9	6.6	6.7	6.7

Alkalinity Method: AN135 Tested: 3/2/2017

Total Alkalinity as CaCO3	mg/L	5	15	32	20	16
Bicarbonate Alkalinity as CaCO3	mg/L	5	15	32	20	16
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 7/2/2017

Chloride, Cl	mg/L	1	17	9	15	7

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 10/2/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	<0.005	<0.005	0.066	0.030
Nitrate Nitrogen, NO3 as N	mg/L	0.005	<0.005	<0.005	0.066	0.028

Nitrite in Water Method: AN277 Tested: 8/2/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 8/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005	0.068	0.028	0.009

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE125424.001 Water 1/2/17 15:30 SW01	CE125424.002 Water 1/2/17 13:15 SW02	CE125424.003 Water 1/2/17 12:15 SW03	CE125424.004 Water 1/2/17 10:30 SW04

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 6/2/2017

Total Kjeldahl Nitrogen	mg/L	0.05	0.64	0.59	0.98	1.7
Total Nitrogen (calc)	mg/L	0.05	0.64	0.59	1.0	1.8

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 16/2/2017

Total InorganicNitrogen (calc)	mg/L	0.01	<0.01	0.07	0.09	0.04

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 6/2/2017

Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	0.21

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 6/2/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.03	0.03	0.07	0.42

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 9/2/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	6	16	53	81
Volatile Suspended Solids Ignited at 550°C	mg/L	1	5	1	11	15

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 10/2/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	97	68	81	110

		Sample Number	CE125424.001	CE125424.002	CE125424.003	CE125424.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	1/2/17 15:30	1/2/17 13:15	1/2/17 12:15	1/2/17 10:30
		Sample Name	SW01	SW02	SW03	SW04
Parameter	**Units**	**LOR**				
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 9/2/2017						
Aluminium, Al	mg/L	0.005	0.33	0.031	0.21	1.5
Iron, Fe	mg/L	0.005	0.78	1.4	1.0	1.3
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	0.006
Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 9/2/2017						
Total Aluminium	mg/L	0.005	0.43	0.29	1.6	5.4
Total Hardness	mg CaCO3/L	5	14	23	16	10
Total Calcium	mg/L	0.05	2.2	4.1	2.6	1.8
Total Iron	mg/L	0.005	1.3	4.9	3.0	3.8
Total Magnesium	mg/L	0.05	2.1	3.2	2.3	1.2
Total Potassium	mg/L	0.05	1.7	1.4	2.4	10
Total Sodium	mg/L	0.5	11	11	9.5	4.0
Total Sulphur as SO4	mg/L	0.5	1.1	1.5	1.5	3.1
Total Zinc	mg/L	0.005	<0.005	<0.005	0.007	0.005
Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 3/2/2017						
Arsenic, As	mg/L	0.001	0.001	0.002	0.001	0.004
Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 3/2/2017						
Total Arsenic	mg/L	0.001	0.002	0.003	0.002	0.004
Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 9/2/2017						
Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	0.0043
Copper, Cu	mg/L	0.001	0.001	<0.001	0.001	0.004
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	0.007	0.20	0.064	0.006
Nickel, Ni	mg/L	0.001	0.001	0.001	0.001	<0.001
Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 9/2/2017						
Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	0.001	0.002	0.006
Total Copper, Cu	mg/L	0.001	0.001	0.001	0.002	0.006
Total Lead, Pb	mg/L	0.001	<0.001	0.001	0.002	0.003
Total Manganese, Mn	mg/L	0.001	0.073	0.24	0.12	0.015
Total Nickel, Ni	mg/L	0.001	0.002	0.002	0.002	0.001

Parameter	Units	LOR	CE125424.001 Water 1/2/17 15:30 SW01	CE125424.002 Water 1/2/17 13:15 SW02	CE125424.003 Water 1/2/17 12:15 SW03	CE125424.004 Water 1/2/17 10:30 SW04
Calculation of Anion-Cation Balance (SAR Calc)	**Method: AN121**	**Tested: 16/2/2017**				
Anion-Cation Balance	%	-100	0.6	6.0	-1.4	7.5

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE125424.005 Water 1/2/17 16:45 SW05	CE125424.006 Water 2/2/17 11:30 SW06	CE125424.007 Water 2/2/17 10:30 SW08	CE125424.008 Water 1/2/17 14:15 SW09

pH in water Method: AN101 Tested: 3/2/2017

pH**	pH Units	0.1	6.6	6.3	6.4	6.7

Alkalinity Method: AN135 Tested: 3/2/2017

Total Alkalinity as CaCO3	mg/L	5	24	11	13	30
Bicarbonate Alkalinity as CaCO3	mg/L	5	24	11	13	30
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 7/2/2017

Chloride, Cl	mg/L	1	5	8	14	16

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 10/2/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.14	0.25	0.11	0.024
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.14	0.25	0.11	0.024

Nitrite in Water Method: AN277 Tested: 8/2/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 8/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	0.092	0.031	0.018	0.015

		Sample Number	CE125424.005	CE125424.006	CE125424.007	CE125424.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	1/2/17 16:45	2/2/17 11:30	2/2/17 10:30	1/2/17 14:15
		Sample Name	SW05	SW06	SW08	SW09
Parameter	**Units**	**LOR**				
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 6/2/2017						
Total Kjeldahl Nitrogen	mg/L	0.05	0.87	0.64	0.62	0.72
Total Nitrogen (calc)	mg/L	0.05	1.0	0.89	0.73	0.74
Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 16/2/2017						
Total InorganicNitrogen (calc)	mg/L	0.01	0.24	0.28	0.13	0.04
Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 6/2/2017						
Filterable Reactive Phosphorus	mg/L	0.005	0.006	<0.005	<0.005	<0.005
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 6/2/2017						
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.08	0.07	<0.02	0.04
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 9/2/2017						
Total Suspended Solids Dried at 103-105°C	mg/L	1	42	44	15	47
Volatile Suspended Solids Ignited at 550°C	mg/L	1	6	12	7	11
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 10/2/2017						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	50	54	68	81

		Sample Number	CE125424.005	CE125424.006	CE125424.007	CE125424.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	1/2/17 16:45	2/2/17 11:30	2/2/17 10:30	1/2/17 14:15
		Sample Name	SW05	SW06	SW08	SW09
Parameter	Units	LOR				

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 9/2/2017

Aluminium, Al	mg/L	0.005	0.28	0.43	0.20	0.13
Iron, Fe	mg/L	0.005	1.4	0.88	1.2	0.78
Zinc, Zn	mg/L	0.005	0.007	<0.005	<0.005	<0.005

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 9/2/2017

Total Aluminium	mg/L	0.005	1.5	4.0	1.3	2.3
Total Hardness	mg CaCO3/L	5	19	6	9	25
Total Calcium	mg/L	0.05	3.3	0.70	1.3	4.0
Total Iron	mg/L	0.005	3.4	3.9	3.3	4.2
Total Magnesium	mg/L	0.05	2.6	1.0	1.5	3.5
Total Potassium	mg/L	0.05	3.0	1.8	1.4	2.4
Total Sodium	mg/L	0.5	9.2	5.6	8.6	12
Total Sulphur as SO4	mg/L	0.5	1.8	1.7	1.9	1.8
Total Zinc	mg/L	0.005	0.009	0.009	<0.005	0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 3/2/2017

Arsenic, As	mg/L	0.001	0.001	0.001	0.003	0.002

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 3/2/2017

Total Arsenic	mg/L	0.001	0.002	0.002	0.004	0.003

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 9/2/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	0.0010	0.0011	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	0.002	<0.001	0.001	0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	0.079	0.028	0.015	0.30
Nickel, Ni	mg/L	0.001	0.002	<0.001	<0.001	0.002

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 9/2/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	0.002	0.003	0.002	0.002
Total Copper, Cu	mg/L	0.001	0.003	0.002	0.002	0.003
Total Lead, Pb	mg/L	0.001	0.002	0.002	<0.001	0.002
Total Manganese, Mn	mg/L	0.001	0.14	0.036	0.019	0.49
Total Nickel, Ni	mg/L	0.001	0.002	<0.001	<0.001	0.003

		Sample Number	CE125424.005	CE125424.006	CE125424.007	CE125424.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	1/2/17 16:45	2/2/17 11:30	2/2/17 10:30	1/2/17 14:15
		Sample Name	SW05	SW06	SW08	SW09
Parameter	**Units**	**LOR**				

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 16/2/2017

Anion-Cation Balance	%	-100	15	-6.6	-3.3	0.6

		Sample Number	CE125424.009	CE125424.010	CE125424.011	CE125424.012
		Sample Matrix	Water	Water	Water	Water
		Sample Date	2/2/17 14:50	2/2/17 14:50	2/2/17 13:40	2/2/17 14:25
		Sample Name	SW10	SW11	SW12	QA
Parameter	Units	LOR				

pH in water Method: AN101 Tested: 3/2/2017

pH**	pH Units	0.1	6.5	6.7	6.6	5.8

Alkalinity Method: AN135 Tested: 3/2/2017

Total Alkalinity as CaCO3	mg/L	5	14	11	12	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	14	11	12	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 7/2/2017

Chloride, Cl	mg/L	1	10	11	10	<1

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 10/2/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.29	0.16	0.19	0.031
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.29	0.16	0.19	0.030

Nitrite in Water Method: AN277 Tested: 8/2/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 8/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	0.028	0.014	0.020	<0.005

Parameter	Units	LOR	CE125424.009	CE125424.010	CE125424.011	CE125424.012
Sample Matrix			Water	Water	Water	Water
Sample Date			2/2/17 14:50	2/2/17 14:50	2/2/17 13:40	2/2/17 14:25
Sample Name			SW10	SW11	SW12	QA

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 6/2/2017

Parameter	Units	LOR	SW10	SW11	SW12	QA
Total Kjeldahl Nitrogen	mg/L	0.05	0.60	0.74	0.84	<0.05
Total Nitrogen (calc)	mg/L	0.05	0.89	0.90	1.0	<0.05

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 16/2/2017

Parameter	Units	LOR	SW10	SW11	SW12	QA
Total InorganicNitrogen (calc)	mg/L	0.01	0.32	0.17	0.21	0.03

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 6/2/2017

Parameter	Units	LOR	SW10	SW11	SW12	QA
Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 6/2/2017

Parameter	Units	LOR	SW10	SW11	SW12	QA
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.03	0.05	0.05	<0.02

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 9/2/2017

Parameter	Units	LOR	SW10	SW11	SW12	QA
Total Suspended Solids Dried at 103-105°C	mg/L	1	17	61	57	<1
Volatile Suspended Solids Ignited at 550°C	mg/L	1	9	14	13	2

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 10/2/2017

Parameter	Units	LOR	SW10	SW11	SW12	QA
Total Dissolved Solids Dried at 175-185°C	mg/L	10	62	70	64	<10

		Sample Number	CE125424.009	CE125424.010	CE125424.011	CE125424.012
		Sample Matrix	Water	Water	Water	Water
		Sample Date	2/2/17 14:50	2/2/17 14:50	2/2/17 13:40	2/2/17 14:25
		Sample Name	SW10	SW11	SW12	QA
Parameter	**Units**	**LOR**				

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 9/2/2017

Aluminium, Al	mg/L	0.005	**0.21**	**0.57**	**0.64**	<0.005
Iron, Fe	mg/L	0.005	**0.78**	**0.53**	**0.63**	<0.005
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 9/2/2017

Total Aluminium	mg/L	0.005	**1.3**	**3.1**	**2.7**	<0.005
Total Hardness	mg CaCO3/L	5	**9**	**12**	**11**	<5
Total Calcium	mg/L	0.05	**1.4**	**1.8**	**1.6**	<0.05
Total Iron	mg/L	0.005	**2.6**	**2.4**	**2.3**	<0.005
Total Magnesium	mg/L	0.05	**1.4**	**1.8**	**1.6**	<0.05
Total Potassium	mg/L	0.05	**1.8**	**2.2**	**2.1**	<0.05
Total Sodium	mg/L	0.5	**6.6**	**7.4**	**6.5**	<0.5
Total Sulphur as SO4	mg/L	0.5	**1.5**	**1.4**	**1.3**	<0.5
Total Zinc	mg/L	0.005	<0.005	**0.010**	**0.005**	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 3/2/2017

Arsenic, As	mg/L	0.001	**0.001**	<0.001	<0.001	<0.001

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 3/2/2017

Total Arsenic	mg/L	0.001	**0.002**	**0.001**	**0.001**	<0.001

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 9/2/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	**0.001**	**0.002**	**0.001**	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.024**	**0.014**	**0.014**	<0.001
Nickel, Ni	mg/L	0.001	<0.001	<0.001	<0.001	<0.001

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 9/2/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	**0.001**	**0.002**	**0.002**	<0.001
Total Copper, Cu	mg/L	0.001	**0.002**	**0.003**	**0.003**	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	**0.002**	**0.002**	<0.001
Total Manganese, Mn	mg/L	0.001	**0.036**	**0.050**	**0.049**	<0.001
Total Nickel, Ni	mg/L	0.001	<0.001	**0.002**	**0.002**	<0.001

Parameter	Units	LOR	CE125424.009	CE125424.010	CE125424.011	CE125424.012
Sample Matrix			Water	Water	Water	Water
Sample Date			2/2/17 14:50	2/2/17 14:50	2/2/17 13:40	2/2/17 14:25
Sample Name			SW10	SW11	SW12	QA
Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 16/2/2017						
Anion-Cation Balance	%	-100	**-6.6**	**6.6**	**2.9**	-

Parameter	Units	LOR	Sample Number: CE125424.013 Sample Matrix: Water Sample Date: 01 Feb 2017 Sample Name: DUP

pH in water Method: AN101 Tested: 3/2/2017

pH**	pH Units	0.1	**6.7**

Alkalinity Method: AN135 Tested: 3/2/2017

Total Alkalinity as CaCO3	mg/L	5	**30**
Bicarbonate Alkalinity as CaCO3	mg/L	5	**30**
Carbonate Alkalinity as CaCO3	mg/L	5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 7/2/2017

Chloride, Cl	mg/L	1	**18**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 10/2/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.041**
Nitrate Nitrogen, NO3 as N	mg/L	0.005	**0.041**

Nitrite in Water Method: AN277 Tested: 8/2/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 8/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.017**

Parameter	Units	LOR	Sample Number CE125424.013 Sample Matrix Water Sample Date 01 Feb 2017 Sample Name DUP

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 6/2/2017

Total Kjeldahl Nitrogen	mg/L	0.05	**0.76**
Total Nitrogen (calc)	mg/L	0.05	**0.80**

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 16/2/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.06**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 6/2/2017

Filterable Reactive Phosphorus	mg/L	0.005	<0.005

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 6/2/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.04**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 9/2/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	**46**
Volatile Suspended Solids Ignited at 550°C	mg/L	1	**12**

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 10/2/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**80**

Parameter	Units	LOR	Sample Number: CE125424.013 Sample Matrix: Water Sample Date: 01 Feb 2017 Sample Name: DUP

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 9/2/2017

Aluminium, Al	mg/L	0.005	**0.14**
Iron, Fe	mg/L	0.005	**0.77**
Zinc, Zn	mg/L	0.005	<0.005

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 9/2/2017

Total Aluminium	mg/L	0.005	**2.2**
Total Hardness	mg CaCO3/L	5	**24**
Total Calcium	mg/L	0.05	**3.9**
Total Iron	mg/L	0.005	**4.1**
Total Magnesium	mg/L	0.05	**3.5**
Total Potassium	mg/L	0.05	**2.4**
Total Sodium	mg/L	0.5	**12**
Total Sulphur as SO4	mg/L	0.5	**1.8**
Total Zinc	mg/L	0.005	**0.006**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 3/2/2017

Arsenic, As	mg/L	0.001	**0.002**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 3/2/2017

Total Arsenic	mg/L	0.001	**0.002**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 9/2/2017

Cadmium, Cd	mg/L	0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010
Copper, Cu	mg/L	0.001	**0.001**
Lead, Pb	mg/L	0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.30**
Nickel, Ni	mg/L	0.001	**0.002**

Parameter	Units	LOR	Sample Number CE125424.013 Sample Matrix Water Sample Date 01 Feb 2017 Sample Name DUP

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 9/2/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	0.002
Total Copper, Cu	mg/L	0.001	0.003
Total Lead, Pb	mg/L	0.001	0.002
Total Manganese, Mn	mg/L	0.001	0.46
Total Nickel, Ni	mg/L	0.001	0.002

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 16/2/2017

Anion-Cation Balance	%	-100	-2.8

QC SUMMARY

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	LB043199	mg/L	5	<5	11 - 24%	109%
Bicarbonate Alkalinity as CaCO3	LB043199	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB043199	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB043199	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB043287	mg/L	0.005	<0.005	0%	101 - 102%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB043308	mg/L	1	<1	0 - 1%	110 - 112%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB043251	mg/L	0.005	<0.005	0 - 2%	99 - 101%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB043380	mg/L	0.005	1%	98 - 99%	105%
Total Calcium	LB043380	mg/L	0.05	1%	99 - 100%	
Total Iron	LB043380	mg/L	0.005	1%	103%	
Total Magnesium	LB043380	mg/L	0.05	1%	97%	
Total Potassium	LB043380	mg/L	0.05	0%	105 - 106%	
Total Sodium	LB043380	mg/L	0.5	1%	95 - 96%	
Total Sulphur as SO4	LB043380	mg/L	0.5	1%	95 - 97%	
Total Zinc	LB043380	mg/L	0.005	0%	106 - 108%	

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Aluminium, Al	LB043379	mg/L	0.005	<0.005	3 - 7%	99%
Iron, Fe	LB043379	mg/L	0.005	<0.005	0 - 1%	103%
Zinc, Zn	LB043379	mg/L	0.005	<0.005	0%	106%

Metals in Water (Dissolved) by ICPOES-USN   Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Cadmium, Cd	LB043383	mg/L	0.0001	<0.0001	0%	103%
Chromium, Cr	LB043383	mg/L	0.001	<0.0010	1 - 8%	104%
Copper, Cu	LB043383	mg/L	0.001	<0.001	2 - 3%	103%
Lead, Pb	LB043383	mg/L	0.001	<0.001	0%	106%
Manganese, Mn	LB043383	mg/L	0.001	<0.001	0%	NA
Nickel, Ni	LB043383	mg/L	0.001	<0.001	0%	109%

Metals in Water (Total) by ICPOES-USN   Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Cadmium, Cd	LB043384	mg/L	0.0001	<0.0001	0%	102%
Total Chromium, Cr	LB043384	mg/L	0.001	<0.001	2%	103%
Total Copper, Cu	LB043384	mg/L	0.001	<0.001	3%	106%
Total Lead, Pb	LB043384	mg/L	0.001	<0.001	0 - 5%	105%
Total Manganese, Mn	LB043384	mg/L	0.001	<0.001	0 - 1%	NA
Total Nickel, Ni	LB043384	mg/L	0.001	<0.001	0 - 3%	109%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser   Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB043409	mg/L	0.005	<0.005	0 - 8%	99 - 101%

QC SUMMARY

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.

Nitrite in Water Method: ME-(AU)-[ENV]AN277

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrite Nitrogen, NO2 as N	LB043360	mg/L	0.005	<0.005	0 - 2%	94 - 97%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB043199	pH Units	0.1	6.1 - 6.5	0 - 11%	NA

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB043229	mg/L	0.05	<0.05	2 - 3%	98 - 100%

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	LB043368	mg/L	1	<1	11 - 30%	95%
Volatile Suspended Solids Ignited at 550°C	LB043368	mg/L	1	<1	19 - 21%	NA

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB043428	mg/L	10	<10	1 - 4%	96 - 106%	119 - 121%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB043229	mg/L	0.02	<0.02	0 - 1%	99 - 100%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Arsenic, As	LB043206	mg/L	0.001	<0.001	0%	NA

Trace Metals (Total) in Water by ICPMS in mg/L Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Arsenic	LB043208	mg/L	0.001	<0.001	0%	NA

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
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 µmhos/cm or µS/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 calculation 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.
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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN277/WC250.312	Nitrite ions, when reacted with a reagent containing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride produce a highly coloured azo dye that is measured photometrically at 540nm.
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour . The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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 calcuated 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

SGS Cairns Environmental
CE125426 COC
Received: 03 – Feb – 2017

CUSTODY & ANALYSIS REQUEST

Job Number: CE125426
(Lab use only)

Page 1 **of** 1

Laborat		Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER		TDS	VSS										
	SW03	2/2/17		✓			✓					✓	✓										Please use
	SW04	2/2/17		✓			✓					✓	✓										GC-50
	SW05	2/2/17 1640		✓			✓					✓	✓										papers
	Barron ds Owen	2/2/17 1630		✓			✓					✓	✓										

Company Name: NRA
Address: 320 Sheridan St, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au karen@natres.com.au
Telephone: 40345300 **Facsimile:** 40345301

Client Order Number:
Project Name: Barnwell Road - General
Project Number: 424000.
Results Required By:

Bottles Received - Lab use only:
4 x 500 NP
(Please specify if AW is Field Filtered or Total)

Relinquished by: **Date:** 3/2/17 **Time:** 10.50. **Received by:** **Date:** 3/2/17 **Time:** 10 50am

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO*	**Samples Intact:** [✓ YES]/NO*	**Correct Sample Bottles Used:** [✓ YES]/NO*	**Temperature:** [✓ AMBIENT]/CHILLED*

Comments including subcontracting details:
Please provide client with details ☐
Consent given for subcontracting ☐

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SGS Australia Pty Ltd
ABN 44 000 964 278

Environment, Health & Safety Unit 2, 58 Comport Street, PORTSMITH QLD 4870 www.sgs.com
t +61(0)7 4035 5111. f +61(0)7 4035 5122 *e-mail:* shey.goddard@sgs.com
Member of the SGS Group

Uncontrolled proforma when printed, official record on data entry.

Authorised by: Business Manager

Ref: PF-(AU)-[ENV]-(CAI)-OFF16/ver.11/04.12.09

SAMPLE RECEIPT ADVICE

CE125426

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424000 Barnwell General**
Order Number	(Not specified)
Samples	4

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Fri 3/2/2017
Report Due	Tue 14/2/2017
SGS Reference	**CE125426**

SUBMISSION DETAILS

This is to confirm that 4 samples were received on Friday 3/2/2017. Results are expected to be ready by Tuesday 14/2/2017. Please quote SGS reference CE125426 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Na
Samples received in correct containers	Yes	Sample counts by matrix	4 Waters
Date documentation received	3/2/2017	Type of documentation received	COC
Number of eskies/boxes received	Na	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Ambient
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

GC50 filter papers.

SAMPLE RECEIPT ADVICE

CE125426

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424000 Barnwell General

SUMMARY OF ANALYSIS

No.	Sample ID	Total and Volatile Suspended Solids (TSS /
001	SW03	3
002	SW04	3
003	SW05	3
004	Barron ds Owen	3

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424000 Barnwell General**
Order Number	(Not specified)
Samples	4

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE125426 R0**
Date Received	03 Feb 2017
Date Reported	15 Feb 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(3146)

SIGNATORIES

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE125426.001 Water 02 Feb 2017 SW03	CE125426.002 Water 02 Feb 2017 SW04	CE125426.003 Water 2/2/17 16:40 SW05	CE125426.004 Water 2/2/17 16:30 Barron ds Owen

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 9/2/2017

Parameter	Units	LOR	SW03	SW04	SW05	Barron ds Owen
Total Suspended Solids Dried at 103-105°C	mg/L	5	28	33	18	44
Volatile Suspended Solids Ignited at 550°C	mg/L	5	11	11	10	13
Non Volatile Suspended Solids Ignited at 550°C	mg/L	5	17	22	8	31

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Suspended Solids Dried at 103-105°C	LB043367	mg/L	5	<5	5 - 11%	96 - 97%	89 - 96%
Volatile Suspended Solids Ignited at 550°C	LB043367	mg/L	5		3 - 15%		
Non Volatile Suspended Solids Ignited at 550°C	LB043367	mg/L	5		7%		

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
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

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.

LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
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 calcuated 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

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE125857 *(Lab use only)*

Page 1 of 2

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix: SOIL	Matrix: WATER	Matrix: OTHER	Matrix	Preservation Method: NONE	Preservation Method: ICE	Preservation Method: ACID	Preservation Method: OTHER	Preservation Method	Analysis Required: See attached analyte list for KUR-World WQ Sampling	Comments:
1	SW01	21/02/17 1:30pm		✓				✓					Please use GC-50 Papers
2	SW02	21/02/17 12:10pm		✓				✓					
3	SW03	21/02/17 9:40am		✓				✓					
4	SW05	21/02/17 4:30pm		✓				✓					
5	SW06	21/02/17 3:10pm		✓				✓					
6	SW07	22/02/17 9:50am		✓				✓					
7	SW08	21/02/17 2:15pm		✓				✓					
8	SW09	21/02/17 10:50am		✓				✓					
9	SW10	22/02/17 11:20am		✓				✓					
10	SW11	22/02/17 9:15am		✓				✓					

SGS Cairns Environmental
CE125857 COC
Received: 22 – Feb – 2017

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 **Facsimile:** 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 424103.01
Results Required By:

Bottles Received - Lab use only:
26x500NP
13x125NP frozen
13x AW Ⓣ
13x AW Ⓕ
(Please specify if AW is Field Filtered or Total)

Relinquished by: **Date:** 22/2/17 **Time:** 3:45pm **Received by:** **Date:** 22/2/17 **Time:** 3:45pm
Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO*	**Samples Intact:** [✓ YES]/NO*	**Correct Sample Bottles Used:** [✓ YES]/NO*	**Temperature:** AMBIENT/[✓ CHILLED]*

Comments including subcontracting details:
Please provide client with details ☐
Consent given for subcontracting ☐

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: ____________ *(Lab use only)*

Page 2 of 2

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER		See attached analyte list for KUR-World WQ Sampling											
11	SW12	22/02/17 10:30am		✓				✓															Please use GC-50 Papers
12	QA	21/02/17		✓				✓															
13	DUP	21/02/17		✓				✓															

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 **Facsimile:** 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 424103.01
Results Required By:

Bottles Received - Lab use only:

(Please specify if AW is Field Filtered or Total)

Relinquished by: **Date:** 22/2/17 **Time:** 3:45pm **Received by:** **Date:** **Time:**

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: YES/NO*	Samples Intact: YES/NO*	Correct Sample Bottles Used: YES/NO*	Temperature: AMBIENT/CHILLED*

Comments including subcontracting details:

Please provide client with details ☐
Consent given for subcontracting ☐

KUR-World WQ Monitoring Analyte List

Parameter	LOR (mg/L)	
Total Suspended Solids	1	LL TSS - requires full 500ml just for this test - request TSS LL on cofc
Volatile Suspended Solids	1	
Total Dissolved Solids	10	
Total Nitrogen	0.05	
Total Phosphorus - ultra trace	0.01	Have to request TP (LL) on cofc
Total Oxidised Nitrogen	0.005	
Nitrate	0.005	
Nitrite	0.005	
Total Kjeldahl Nitrogen	0.05	
Dissolved Inorganic Nitrogen	0.05	calc NH3 and TON
Ammonia - Ultra Trace	0.005	
Filterable Reactive Phosphorus - Ultra Trac	0.005	
Hardness	1	
Alkalinity	5	
Major Ions	1	
Aluminium (total)	0.005	
Aluminium (field filtered)	0.005	
Arsenic (total)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Arsenic (field filtered)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Cadmium (total)	0.0001	
Cadmium (field filtered)	0.0001	
Chromium (total)	0.001	
Chromium (field filtered)	0.001	
Copper (total)	0.001	
Copper (field filtered)	0.001	
Iron (total)	0.05	
Iron (field filtered)	0.05	
Lead (total)	0.001	
Lead (field filtered)	0.001	
Manganese (total)	0.001	Have to request special LOR on cofc - normally 0.005
Manganese (field filtered)	0.001	Have to request special LOR on cofc - normally 0.005
Nickel (total)	0.001	
Nickel (field filtered)	0.001	
Zinc (total)	0.005	
Zinc (field filtered)	0.005	

SAMPLE RECEIPT ADVICE

CE125857

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424103.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	13

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Wed 22/2/2017
Report Due	Fri 3/3/2017
SGS Reference	**CE125857**

SUBMISSION DETAILS

This is to confirm that 13 samples were received on Wednesday 22/2/2017. Results are expected to be ready by Friday 3/3/2017. Please quote SGS reference CE125857 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	ice
Samples received in correct containers	Yes	Sample counts by matrix	13 waters
Date documentation received	22/2/2017	Type of documentation received	COC
Number of eskies/boxes received	2	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CE125857

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Filterable Reactive Phosphorus (FRP)	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	Nitrite in Water	pH in water	TKN Kjeldahl Digestion by Discrete Analyser
001	SW01	4	1	1	1	1	2	1	1	2
002	SW02	4	1	1	1	1	2	1	1	2
003	SW03	4	1	1	1	1	2	1	1	2
004	SW05	4	1	1	1	1	2	1	1	2
005	SW06	4	1	1	1	1	2	1	1	2
006	SW07	4	1	1	1	1	2	1	1	2
007	SW08	4	1	1	1	1	2	1	1	2
008	SW09	4	1	1	1	1	2	1	1	2
009	SW10	4	1	1	1	1	2	1	1	2
010	SW11	4	1	1	1	1	2	1	1	2
011	SW12	4	1	1	1	1	2	1	1	2
012	QA	4	1	1	1	1	2	1	1	2
013	DUP	4	1	1	1	1	2	1	1	2

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CE125857

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Total Phosphorus by Kjeldahl Digestion DA in	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	SW01	1	9	3	6	6	2	1	1	1	1
002	SW02	1	9	3	6	6	2	1	1	1	1
003	SW03	1	9	3	6	6	2	1	1	1	1
004	SW05	1	9	3	6	6	2	1	1	1	1
005	SW06	1	9	3	6	6	2	1	1	1	1
006	SW07	1	9	3	6	6	2	1	1	1	1
007	SW08	1	9	3	6	6	2	1	1	1	1
008	SW09	1	9	3	6	6	2	1	1	1	1
009	SW10	1	9	3	6	6	2	1	1	1	1
010	SW11	1	9	3	6	6	2	1	1	1	1
011	SW12	1	9	3	6	6	2	1	1	1	1
012	QA	1	9	3	6	6	2	1	1	1	1
013	DUP	1	9	3	6	6	2	1	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Martine Newman	Manager	Jon Dicker
Client	Natural Resource Assessments Pty Ltd	Laboratory	SGS Cairns Environmental
Address	PO Box 5678 QLD 4870	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4031 5122	Telephone	+61 07 4035 5111
Facsimile	07 4051 6740	Facsimile	+61 07 4035 5122
Email	martine@natres.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**424103.01_KUR-World WQ Monitoring**	SGS Reference	**CE125857 R0**
Order Number	(Not specified)	Date Received	22 Feb 2017
Samples	13	Date Reported	06 Mar 2017

COMMENTS

Whilst SGS laboratories conform to ISO:17025 standards, results of analysis in this report fall outside of the current scope of NATA accreditation .

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE162487.

SIGNATORIES

G. Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

LMOrsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

		Sample Number	CE125857.001	CE125857.002	CE125857.003	CE125857.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	21/2/17 13:30	21/2/17 12:10	21/2/17 9:40	21/2/17 16:30
		Sample Name	SW01	SW02	SW03	SW05
Parameter	Units	LOR				
pH in water Method: AN101 Tested: 23/2/2017						
pH**	pH Units	0.1	6.4	6.5	6.6	6.5
Alkalinity Method: AN135 Tested: 23/2/2017						
Total Alkalinity as CaCO3	mg/L	5	15	33	22	21
Bicarbonate Alkalinity as CaCO3	mg/L	5	15	33	22	21
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Chloride by Discrete Analyser in Water Method: AN274 Tested: 24/2/2017						
Chloride, Cl	mg/L	1	19	12	18	19
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 3/3/2017						
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.032	0.050	0.097	0.23
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.032	0.050	0.097	0.23
Nitrite in Water Method: AN277 Tested: 24/2/2017						
Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 27/2/2017						
Ammonia Nitrogen, NH3 as N	mg/L	0.005	0.014	0.043	0.023	0.012

		Sample Number	CE125857.001	CE125857.002	CE125857.003	CE125857.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	21/2/17 13:30	21/2/17 12:10	21/2/17 9:40	21/2/17 16:30
		Sample Name	SW01	SW02	SW03	SW05
Parameter	Units	LOR				
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 27/2/2017						
Total Kjeldahl Nitrogen	mg/L	0.05	0.50	0.38	0.48	0.42
Total Nitrogen (calc)	mg/L	0.05	0.54	0.43	0.58	0.65
Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 6/3/2017						
Total InorganicNitrogen (calc)	mg/L	0.01	0.05	0.09	0.12	0.25
Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 28/2/2017						
Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 27/2/2017						
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.03	0.03	0.02	0.02
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 1/3/2017						
Total Suspended Solids Dried at 103-105°C	mg/L	1	4	5	2	3
Volatile Suspended Solids Ignited at 550°C	mg/L	1	2	<1	<1	<1
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 27/2/2017						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	110	100	100	99

		Sample Number	CE125857.001	CE125857.002	CE125857.003	CE125857.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	21/2/17 13:30	21/2/17 12:10	21/2/17 9:40	21/2/17 16:30
		Sample Name	SW01	SW02	SW03	SW05
Parameter	Units	LOR				

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 1/3/2017

Aluminium, Al	mg/L	0.005	**0.29**	**0.025**	**0.13**	**0.046**
Iron, Fe	mg/L	0.005	**0.48**	**0.98**	**0.99**	**0.52**
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 1/3/2017

Total Aluminium	mg/L	0.005	**0.76**	**0.22**	**0.40**	**0.34**
Total Hardness	mg CaCO3/L	5	**20**	**27**	**21**	**20**
Total Calcium	mg/L	0.05	**2.6**	**4.5**	**3.1**	**2.9**
Total Iron	mg/L	0.005	**1.1**	**3.2**	**2.0**	**1.8**
Total Magnesium	mg/L	0.05	**3.2**	**3.9**	**3.2**	**3.2**
Total Potassium	mg/L	0.05	**1.7**	**1.2**	**1.7**	**1.6**
Total Sodium	mg/L	0.5	**13**	**13**	**11**	**12**
Total Sulphur as SO4	mg/L	0.5	**0.9**	**1.3**	**1.2**	**1.3**
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 23/2/2017

Arsenic, As	mg/L	0.001	**0.002**	**0.002**	**0.001**	**0.001**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 23/2/2017

Total Arsenic	mg/L	0.001	**0.002**	**0.002**	**0.002**	**0.002**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 1/3/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.023**	**0.21**	**0.035**	**0.036**
Nickel, Ni	mg/L	0.001	**0.001**	**0.001**	**0.001**	**0.001**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 1/3/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	**0.001**	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Manganese, Mn	mg/L	0.001	**0.082**	**0.24**	**0.045**	**0.054**
Total Nickel, Ni	mg/L	0.001	**0.001**	**0.002**	**0.001**	**0.002**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE125857.001 Water 21/2/17 13:30 SW01	CE125857.002 Water 21/2/17 12:10 SW02	CE125857.003 Water 21/2/17 9:40 SW03	CE125857.004 Water 21/2/17 16:30 SW05
Calculation of Anion-Cation Balance (SAR Calc)	**Method: AN121**	**Tested: 6/3/2017**					
Anion-Cation Balance	%	-100		9.9	5.1	0.9	-0.9

		Sample Number	CE125857.005	CE125857.006	CE125857.007	CE125857.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	21/2/17 15:10	21/2/17 9:50	21/2/17 14:15	21/2/17 10:50
		Sample Name	SW06	SW07	SW08	SW09
Parameter	Units	LOR				

pH in water Method: AN101 Tested: 23/2/2017

pH**	pH Units	0.1	6.4	6.4	6.4	6.5

Alkalinity Method: AN135 Tested: 23/2/2017

Total Alkalinity as CaCO3	mg/L	5	13	17	15	20
Bicarbonate Alkalinity as CaCO3	mg/L	5	13	17	15	20
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 24/2/2017

Chloride, Cl	mg/L	1	9	14	18	18

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 3/3/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.25	0.16	0.15	0.049
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.25	0.16	0.15	0.049

Nitrite in Water Method: AN277 Tested: 24/2/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 27/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	0.023	0.015	0.033	0.008

Parameter	Units	LOR	Sample Number: CE125857.005 Sample Matrix: Water Sample Date: 21/2/17 15:10 Sample Name: SW06	CE125857.006 Water 21/2/17 9:50 SW07	CE125857.007 Water 21/2/17 14:15 SW08	CE125857.008 Water 21/2/17 10:50 SW09
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 27/2/2017						
Total Kjeldahl Nitrogen	mg/L	0.05	0.14	0.37	0.37	0.62
Total Nitrogen (calc)	mg/L	0.05	0.39	0.53	0.53	0.66
Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 6/3/2017						
Total InorganicNitrogen (calc)	mg/L	0.01	0.28	0.17	0.19	0.06
Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 28/2/2017						
Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 27/2/2017						
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.03	0.02	0.02	0.03
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 1/3/2017						
Total Suspended Solids Dried at 103-105°C	mg/L	1	15	7	4	9
Volatile Suspended Solids Ignited at 550°C	mg/L	1	5	2	<1	3
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 27/2/2017						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	64	92	97	100

		Sample Number	CE125857.005	CE125857.006	CE125857.007	CE125857.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	21/2/17 15:10	21/2/17 9:50	21/2/17 14:15	21/2/17 10:50
		Sample Name	SW06	SW07	SW08	SW09
Parameter	Units	LOR				
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 1/3/2017						
Aluminium, Al	mg/L	0.005	0.013	0.014	0.032	0.12
Iron, Fe	mg/L	0.005	0.43	0.80	0.90	0.81
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 1/3/2017						
Total Aluminium	mg/L	0.005	0.35	0.21	0.25	1.3
Total Hardness	mg CaCO3/L	5	9	15	16	22
Total Calcium	mg/L	0.05	1.1	2.2	2.1	3.4
Total Iron	mg/L	0.005	2.6	7.0	4.6	2.3
Total Magnesium	mg/L	0.05	1.6	2.4	2.6	3.3
Total Potassium	mg/L	0.05	1.0	1.3	1.1	1.8
Total Sodium	mg/L	0.5	6.7	8.9	11	11
Total Sulphur as SO4	mg/L	0.5	0.7	0.9	1.0	1.7
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 23/2/2017						
Arsenic, As	mg/L	0.001	0.002	0.001	0.005	0.002
Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 23/2/2017						
Total Arsenic	mg/L	0.001	0.003	0.003	0.008	0.002
Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 1/3/2017						
Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	0.028	0.042	0.018	0.006
Nickel, Ni	mg/L	0.001	<0.001	<0.001	<0.001	0.001
Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 1/3/2017						
Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	0.001
Total Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	0.001
Total Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Manganese, Mn	mg/L	0.001	0.038	0.048	0.022	0.13
Total Nickel, Ni	mg/L	0.001	<0.001	<0.001	0.001	0.002

Parameter	Units	LOR				
		Sample Number	CE125857.005	CE125857.006	CE125857.007	CE125857.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	21/2/17 15:10	21/2/17 9:50	21/2/17 14:15	21/2/17 10:50
		Sample Name	SW06	SW07	SW08	SW09
Calculation of Anion-Cation Balance (SAR Calc) **Method: AN121** **Tested: 6/3/2017**						
Anion-Cation Balance	%	-100	-4.1	-1.2	0.6	2.5

		Sample Number Sample Matrix Sample Date Sample Name	CE125857.009 Water 22/2/17 11:20 SW10	CE125857.010 Water 22/2/17 9:15 SW11	CE125857.011 Water 22/2/17 10:30 SW12	CE125857.012 Water 21 Feb 2017 QA
Parameter	Units	LOR				
pH in water Method: AN101 Tested: 23/2/2017						
pH**	pH Units	0.1	6.4	6.8	6.8	5.8
Alkalinity Method: AN135 Tested: 23/2/2017						
Total Alkalinity as CaCO3	mg/L	5	16	31	30	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	16	31	30	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Chloride by Discrete Analyser in Water Method: AN274 Tested: 24/2/2017						
Chloride, Cl	mg/L	1	15	16	16	<1
Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 3/3/2017						
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.23	0.085	0.083	0.030
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.22	0.085	0.083	0.030
Nitrite in Water Method: AN277 Tested: 24/2/2017						
Nitrite Nitrogen, NO2 as N	mg/L	0.005	0.005	<0.005	<0.005	<0.005
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 27/2/2017						
Ammonia Nitrogen, NH3 as N	mg/L	0.005	0.050	0.011	0.011	<0.005

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE125857.009 Water 22/2/17 11:20 SW10	CE125857.010 Water 22/2/17 9:15 SW11	CE125857.011 Water 22/2/17 10:30 SW12	CE125857.012 Water 21 Feb 2017 QA
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 27/2/2017							
Total Kjeldahl Nitrogen	mg/L	0.05		**0.32**	**0.24**	**0.22**	<0.05
Total Nitrogen (calc)	mg/L	0.05		**0.54**	**0.33**	**0.31**	<0.05
Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 6/3/2017							
Total InorganicNitrogen (calc)	mg/L	0.01		**0.27**	**0.10**	**0.09**	**0.03**
Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 28/2/2017							
Filterable Reactive Phosphorus	mg/L	0.005		<0.005	<0.005	<0.005	<0.005
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 27/2/2017							
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02		<0.02	<0.02	<0.02	<0.02
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 1/3/2017							
Total Suspended Solids Dried at 103-105°C	mg/L	1		**5**	**7**	**5**	<1
Volatile Suspended Solids Ignited at 550°C	mg/L	1		**2**	<1	<1	<1
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 27/2/2017							
Total Dissolved Solids Dried at 175-185°C	mg/L	10		**77**	**95**	**100**	<10

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE125857.009 Water 22/2/17 11:20 SW10	CE125857.010 Water 22/2/17 9:15 SW11	CE125857.011 Water 22/2/17 10:30 SW12	CE125857.012 Water 21 Feb 2017 QA

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 1/3/2017

Aluminium, Al	mg/L	0.005	0.018	0.22	0.098	<0.005
Iron, Fe	mg/L	0.005	0.88	0.57	0.50	<0.005
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 1/3/2017

Total Aluminium	mg/L	0.005	0.13	0.75	0.74	<0.005
Total Hardness	mg CaCO3/L	5	15	28	28	<5
Total Calcium	mg/L	0.05	2.1	4.6	4.6	<0.05
Total Iron	mg/L	0.005	3.3	1.1	1.1	<0.005
Total Magnesium	mg/L	0.05	2.3	3.9	3.9	<0.05
Total Potassium	mg/L	0.05	1.1	1.7	1.7	<0.05
Total Sodium	mg/L	0.5	8.6	11	11	<0.5
Total Sulphur as SO4	mg/L	0.5	0.8	1.4	1.3	<0.5
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 23/2/2017

Arsenic, As	mg/L	0.001	0.002	0.001	0.001	<0.001

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 23/2/2017

Total Arsenic	mg/L	0.001	0.003	0.002	0.002	<0.001

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 1/3/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	0.054	0.021	0.037	<0.001
Nickel, Ni	mg/L	0.001	<0.001	<0.001	<0.001	<0.001

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 1/3/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Manganese, Mn	mg/L	0.001	0.069	0.044	0.052	<0.001
Total Nickel, Ni	mg/L	0.001	<0.001	<0.001	<0.001	<0.001

Parameter	Units	LOR	CE125857.009 Water 22/2/17 11:20 SW10	CE125857.010 Water 22/2/17 9:15 SW11	CE125857.011 Water 22/2/17 10:30 SW12	CE125857.012 Water 21 Feb 2017 QA
Sample Number / Sample Matrix / Sample Date / Sample Name						
Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 6/3/2017						
Anion-Cation Balance	%	-100	-1.9	-1.1	-0.3	-

Parameter	Units	LOR	Sample Number CE125857.013 Sample Matrix Water Sample Date 21 Feb 2017 Sample Name DUP

pH in water Method: AN101 Tested: 23/2/2017

pH**	pH Units	0.1	**6.5**

Alkalinity Method: AN135 Tested: 23/2/2017

Total Alkalinity as CaCO3	mg/L	5	**21**
Bicarbonate Alkalinity as CaCO3	mg/L	5	**21**
Carbonate Alkalinity as CaCO3	mg/L	5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 24/2/2017

Chloride, Cl	mg/L	1	**18**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 3/3/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.031**
Nitrate Nitrogen, NO3 as N	mg/L	0.005	**0.031**

Nitrite in Water Method: AN277 Tested: 24/2/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 27/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.009**

Parameter	Units	LOR	Sample Number: CE125857.013 Sample Matrix: Water Sample Date: 21 Feb 2017 Sample Name: DUP

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 27/2/2017

Total Kjeldahl Nitrogen	mg/L	0.05	**0.58**
Total Nitrogen (calc)	mg/L	0.05	**0.61**

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 6/3/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.04**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 28/2/2017

Filterable Reactive Phosphorus	mg/L	0.005	<0.005

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 27/2/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 1/3/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	**9**
Volatile Suspended Solids Ignited at 550°C	mg/L	1	**3**

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 27/2/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**94**

		Sample Number	CE125857.013
		Sample Matrix	Water
		Sample Date	21 Feb 2017
		Sample Name	DUP
Parameter	Units	LOR	
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 1/3/2017			
Aluminium, Al	mg/L	0.005	**0.11**
Iron, Fe	mg/L	0.005	**0.78**
Zinc, Zn	mg/L	0.005	<0.005
Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 1/3/2017			
Total Aluminium	mg/L	0.005	**1.4**
Total Hardness	mg CaCO3/L	5	**21**
Total Calcium	mg/L	0.05	**3.2**
Total Iron	mg/L	0.005	**2.2**
Total Magnesium	mg/L	0.05	**3.2**
Total Potassium	mg/L	0.05	**1.6**
Total Sodium	mg/L	0.5	**11**
Total Sulphur as SO4	mg/L	0.5	**1.6**
Total Zinc	mg/L	0.005	<0.005
Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 23/2/2017			
Arsenic, As	mg/L	0.001	**0.002**
Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 23/2/2017			
Total Arsenic	mg/L	0.001	**0.002**
Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 1/3/2017			
Cadmium, Cd	mg/L	0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010
Copper, Cu	mg/L	0.001	**0.001**
Lead, Pb	mg/L	0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.006**
Nickel, Ni	mg/L	0.001	**0.002**

Parameter	Units	LOR	Sample Number: CE125857.013 Sample Matrix: Water Sample Date: 21 Feb 2017 Sample Name: DUP

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 1/3/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	**0.001**
Total Copper, Cu	mg/L	0.001	**0.001**
Total Lead, Pb	mg/L	0.001	<0.001
Total Manganese, Mn	mg/L	0.001	**0.14**
Total Nickel, Ni	mg/L	0.001	**0.002**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 6/3/2017

Anion-Cation Balance	%	-100	**0.2**

QC SUMMARY

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	LB043804	mg/L	5	<5	NVL	94 - 107%
Bicarbonate Alkalinity as CaCO3	LB043804	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB043804	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB043804	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB043895	mg/L	0.005	<0.005	0 - 12%	101 - 104%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB043862	mg/L	1	<1	0 - 1%	107 - 108%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB043946	mg/L	0.005	<0.005	0%	96%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB043967	mg/L	0.005	3 - 5%	100%	101%
Total Calcium	LB043967	mg/L	0.05	0%	104%	103%
Total Iron	LB043967	mg/L	0.005	2 - 4%	105%	99%
Total Magnesium	LB043967	mg/L	0.05	0%	104%	100%
Total Potassium	LB043967	mg/L	0.05	0 - 1%	104%	109%
Total Sodium	LB043967	mg/L	0.5	0 - 1%	97%	97%
Total Sulphur as SO4	LB043967	mg/L	0.5	1%	99%	NA
Total Zinc	LB043967	mg/L	0.005	0%	109%	108%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB043964	mg/L	0.005	<0.005	2%	92%	115%
Iron, Fe	LB043964	mg/L	0.005	<0.005	1%	97%	115%
Zinc, Zn	LB043964	mg/L	0.005	<0.005	0%	105%	117%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB043970	mg/L	0.0001	<0.0001	0%	104%	97%
Chromium, Cr	LB043970	mg/L	0.001	<0.0010	0%	105%	96%
Copper, Cu	LB043970	mg/L	0.001	<0.001	0 - 1%	93%	99%
Lead, Pb	LB043970	mg/L	0.001	<0.001	0%	103%	93%
Manganese, Mn	LB043970	mg/L	0.001	<0.001	0%	NA	NA
Nickel, Ni	LB043970	mg/L	0.001	<0.001	0%	109%	94%

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB043973	mg/L	0.0001	<0.0001	0%	105%	99%
Total Chromium, Cr	LB043973	mg/L	0.001	<0.001	8%	104%	96%
Total Copper, Cu	LB043973	mg/L	0.001	<0.001	0%	98%	101%
Total Lead, Pb	LB043973	mg/L	0.001	<0.001	0%	104%	94%
Total Manganese, Mn	LB043973	mg/L	0.001	<0.001	1%	NA	NA
Total Nickel, Ni	LB043973	mg/L	0.001	<0.001	0%	109%	95%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB044103	mg/L	0.005	<0.005	0%	100 - 103%

QC SUMMARY

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.

Nitrite in Water Method: ME-(AU)-[ENV]AN277

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrite Nitrogen, NO2 as N	LB043852	mg/L	0.005	<0.005	0%	99%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB043804	pH Units	0.1	5.4 - 5.7	0 - 9%	NA

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB043886	mg/L	0.05	<0.05	1 - 8%	90 - 92%

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	LB043996	mg/L	1	<1	10 - 14%	104%
Volatile Suspended Solids Ignited at 550°C	LB043996	mg/L	1		0%	

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB043916	mg/L	10	<10	0 - 4%	102 - 114%	108 - 109%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB043886	mg/L	0.02	<0.02	0 - 1%	100%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	DUP %RPD
Arsenic, As	LB043833	mg/L	0.001	0%

Trace Metals (Total) in Water by ICPMS in mg/L Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Arsenic	LB043835	mg/L	0.001	0%

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
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 µmhos/cm or µS/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 calculation 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.
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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN277/WC250.312	Nitrite ions, when reacted with a reagent containing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride produce a highly coloured azo dye that is measured photometrically at 540nm.
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour . The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

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SGS Cairns Environmental

CE126994 COC
Received: 24-Apr-2017

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE126994
(Lab use only)

Page 1 of 1

		Sample Date	Matrix				Preservation Method					Analysis Required:							Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER		PSD with sieves: 2mm, 0.6mm, 0.3mm, 0.212mm, 0.063mm		Total metals on <2mm fraction (As, Cd, Cr, Cu, Pb, Mn, Ni, Zn)					
	SW02	20/04/2017	✓				✓					✓		✓					
	SW02B	20/04/2017	✓				✓					✓		✓					
	SW01B	20/04/2017	✓				✓					✓		✓					
	SW08	20/04/2017	✓				✓					✓		✓					
	DUP	20/4/17	✓				✓					✓		✓					

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au, karen@natres.com.au
Telephone: 40345300 **Facsimile:** ###

Client Order Number:
Project Name: KUR-World Aquatic Ecology
Project Number: 424105.01
Results Required By:

Bottles Received - Lab use only:
5 x soils

(Please specify if AW is Field Filtered or Total)

Relinquished by: Karen Lindée **Date:** 21/4/17 **Time:** 2:50pm **Received by:** **Date:** 21/4/17 **Time:** 3:30pm

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO*	**Samples Intact:** [✓ YES]/NO*	**Correct Sample Bottles Used:** [✓ YES]/NO*	**Temperature:** AMBIENT/[✓ CHILLED]*

Comments including subcontracting details:

Please provide client with details ☐
Consent given for subcontracting ☐

SAMPLE RECEIPT ADVICE

CE126994

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424105.01 - KUR-World Aquatic Ecology**
Order Number	(Not specified)
Samples	10

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Mon 24/4/2017
Report Due	Fri 5/5/2017
SGS Reference	**CE126994**

SUBMISSION DETAILS

This is to confirm that 10 samples were received on Monday 24/4/2017. Results are expected to be ready by Friday 5/5/2017. Please quote SGS reference CE126994 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	5 Soils
Date documentation received	21/4/2017 15:30	Type of documentation received	COC
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CE126994

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424105.01 - KUR-World Aquatic Ecology

SUMMARY OF ANALYSIS

No.	Sample ID	Moisture Content	Particle sizing of soils by sieving	Total Recoverable Metals in Soil/Waste
001	SW02	1	10	-
002	SW02B	1	10	-
003	SW01B	1	10	-
004	SW08	1	10	-
005	DUP	1	10	-
006	SW02_<2mm	-	-	8
007	SW02B_<2mm	-	-	8
008	SW01B_<2mm	-	-	8
009	SW08_<2mm	-	-	8
010	DUP_<2mm	-	-	8

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424105.01 - KUR-World Aquatic Ecology**
Order Number	(Not specified)
Samples	10

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE126994 R0**
Date Received	24 Apr 2017
Date Reported	09 May 2017

COMMENTS

Whilst SGS laboratories conform to ISO:17025 standards, results of analysis in this report fall outside of the current scope of NATA accreditation .

SIGNATORIES

Anthony Nilsson Operations Manager	Jon Dicker Manager Northern QLD	Maristela Ganzan Metals Team Leader

		Sample Number	CE126994.001	CE126994.002	CE126994.003	CE126994.004
		Sample Matrix	Soil	Soil	Soil	Soil
		Sample Date	20 Apr 2017	20 Apr 2017	20 Apr 2017	20 Apr 2017
		Sample Name	SW02	SW02B	SW01B	SW08
Parameter	Units	LOR				

Moisture Content Method: AN002 Tested: 24/4/2017

% Moisture	%w/w	0.5	14	16	9.2	18

Particle sizing of soils by sieving Method: AN005 Tested: 9/5/2017

Passing 2.00mm	%w/w	1	48	70	32	65
Retained 2.00mm	%w/w	1	52	30	69	35
Passing 600µm	%w/w	1	31	34	14	49
Retained 600µm	%w/w	1	17	36	17	16
Passing 300µm	%w/w	1	13	6	6	29
Retained 300µm	%w/w	1	18	28	8	20
Passing 212µm	%w/w	1	8	3	3	22
Retained 212µm	%w/w	1	5	3	3	7
Passing 63µm	%w/w	1	4	1	<1	14
Retained 63µm	%w/w	1	4	2	2	8

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 3/5/2017

Arsenic, As	mg/kg	0.5	-	-	-	-
Cadmium, Cd	mg/kg	0.1	-	-	-	-
Chromium, Cr	mg/kg	0.5	-	-	-	-
Copper, Cu	mg/kg	0.5	-	-	-	-
Manganese, Mn	mg/kg	2	-	-	-	-
Nickel, Ni	mg/kg	0.5	-	-	-	-
Lead, Pb	mg/kg	0.5	-	-	-	-
Zinc, Zn	mg/kg	0.5	-	-	-	-

		Sample Number	CE126994.005	CE126994.006	CE126994.007	CE126994.008
		Sample Matrix	Soil	Soil	Soil	Soil
		Sample Date	20 Apr 2017	20 Apr 2017	20 Apr 2017	20 Apr 2017
		Sample Name	DUP	SW02_<2mm	SW02B_<2mm	SW01B_<2mm
Parameter	Units	LOR				

Moisture Content Method: AN002 Tested: 24/4/2017

% Moisture	%w/w	0.5	**16**	-	-	-

Particle sizing of soils by sieving Method: AN005 Tested: 9/5/2017

Passing 2.00mm	%w/w	1	**65**	-	-	-
Retained 2.00mm	%w/w	1	**35**	-	-	-
Passing 600µm	%w/w	1	**39**	-	-	-
Retained 600µm	%w/w	1	**26**	-	-	-
Passing 300µm	%w/w	1	**16**	-	-	-
Retained 300µm	%w/w	1	**23**	-	-	-
Passing 212µm	%w/w	1	**11**	-	-	-
Retained 212µm	%w/w	1	**5**	-	-	-
Passing 63µm	%w/w	1	**6**	-	-	-
Retained 63µm	%w/w	1	**5**	-	-	-

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 3/5/2017

Arsenic, As	mg/kg	0.5	-	**2.6**	**1.2**	**0.9**
Cadmium, Cd	mg/kg	0.1	-	<0.1	<0.1	<0.1
Chromium, Cr	mg/kg	0.5	-	**25**	**4.8**	**1.8**
Copper, Cu	mg/kg	0.5	-	**5.0**	**1.3**	**1.0**
Manganese, Mn	mg/kg	2	-	**47**	**76**	**26**
Nickel, Ni	mg/kg	0.5	-	**3.5**	**1.2**	**1.2**
Lead, Pb	mg/kg	0.5	-	**4.2**	**2.2**	**1.8**
Zinc, Zn	mg/kg	0.5	-	**8.7**	**5.7**	**6.0**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE126994.009 Soil 20 Apr 2017 SW08_<2mm	CE126994.010 Soil 20 Apr 2017 DUP_<2mm

Moisture Content Method: AN002 Tested: 26/4/2017

% Moisture	%w/w	0.5	-	-

Particle sizing of soils by sieving Method: AN005 Tested: 9/5/2017

Passing 2.00mm	%w/w	1	-	-
Retained 2.00mm	%w/w	1	-	-
Passing 600µm	%w/w	1	-	-
Retained 600µm	%w/w	1	-	-
Passing 300µm	%w/w	1	-	-
Retained 300µm	%w/w	1	-	-
Passing 212µm	%w/w	1	-	-
Retained 212µm	%w/w	1	-	-
Passing 63µm	%w/w	1	-	-
Retained 63µm	%w/w	1	-	-

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES Method: AN040/AN320 Tested: 27/4/2017

Arsenic, As	mg/kg	0.5	**21**	**1.9**
Cadmium, Cd	mg/kg	0.1	**0.1**	<0.1
Chromium, Cr	mg/kg	0.5	**24**	**24**
Copper, Cu	mg/kg	0.5	**3.5**	**6.9**
Manganese, Mn	mg/kg	2	**27**	**45**
Nickel, Ni	mg/kg	0.5	**1.8**	**4.8**
Lead, Pb	mg/kg	0.5	**8.7**	**4.2**
Zinc, Zn	mg/kg	0.5	**11**	**9.8**

QC SUMMARY

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.

Total Recoverable Metals in Soil/Waste Solids/Materials by ICPOES Method: ME-(AU)-[ENV]AN040/AN320

Parameter	QC Reference	Units	LOR	LCS %Recovery
Arsenic, As	LB045633	mg/kg	0.5	98%
Cadmium, Cd	LB045633	mg/kg	0.1	107%
Chromium, Cr	LB045633	mg/kg	0.5	102%
Copper, Cu	LB045633	mg/kg	0.5	102%
Manganese, Mn	LB045633	mg/kg	2	104%
Nickel, Ni	LB045633	mg/kg	0.5	99%
Lead, Pb	LB045633	mg/kg	0.5	97%
Zinc, Zn	LB045633	mg/kg	0.5	103%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN005	The particle size distribution of a soil is determined by wet sieving, using a maximum of 900 mL of deionised water to sieve all fractions down to 75 µm. Referenced to AS1289.3.6.1 and AS1141.11.
AN040/AN320	A portion of sample is digested with nitric acid to decompose organic matter and hydrochloric acid to complete the digestion of metals. The digest is then analysed by ICP OES with metals results reported on the dried sample basis. Based on USEPA method 200.8 and 6010C.

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 calcuated 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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SGS Cairns Environmental
CE127001 COC
Received: 21 – Apr – 2017

CUSTODY & ANALYSIS REQUEST

Job Number: CE127001 (Lab use only)

Page 1 of 2

L		mple Date	Matrix: SOIL	Matrix: WATER	Matrix: OTHER	Matrix	Preservation Method: NONE	Preservation Method: ICE	Preservation Method: ACID	Preservation Method: OTHER	Preservation Method	Analysis Required: See attached analyte list for KUR-World WQ Sampling	Comments:
	SW01	21/4/17 9:30 am		✓				✓					
	SW02	20/4/17 9:10 am		✓				✓					
	SW03	21/4/17 10:20am		✓				✓					
	~~SW04~~			~~✓~~				~~✓~~					
	~~SW05~~			~~✓~~				~~✓~~					
	SW06	21/4/17 11:35am		✓				✓					
	~~SW07~~			~~✓~~				~~✓~~					
	SW08	20/4/17 3:45pm		✓				✓					
	SW09	21/4/17 8:30am		✓				✓					
	~~SW10~~			~~✓~~				~~✓~~					

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 Facsimile: 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 42410501
Results Required By:

Bottles Received - Lab use only:
20 x 500 NP
10 x 125 AW (T)
10 x 125 AW (F)
10 x 125 NP (frozen)
(Please specify if AW is Field Filtered or Total)

Relinquished by: Karen Lindeo Date: 21/4/17 Time: 2:50pm Received by: Date: 21/4/17 Time: 3:30pm

Relinquished by: Date: Time: Received by: Date: Time:

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO*	Samples Intact: [✓ YES]/NO*	Correct Sample Bottles Used: [✓ YES]/NO*	Temperature: AMBIENT/[✓ CHILLED]*

Comments including subcontracting details:
Please provide client with details ☐
Consent given for subcontracting ☐

SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: ____________ *(Lab use only)*

Page 2 of 2

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix SOIL	WATER	OTHER		Preservation Method NONE	ICE	ACID	OTHER		Analysis Required: See attached analyte list for KUR-World WQ Sampling	Comments:
	~~SW11~~			✓				✓					
	~~SW12~~			✓				✓					
	QA	20/4/17 8:30am		✓				✓					
	DUP	20/4/17 -		✓				✓					
	SW02B	20/4/17 11:50am		✓				✓					
	SW01B	20/4/17 1:30pm		✓				✓					

Company Name: NRA
Address: 320 Sheridan Street, Cairns, 4870
Contact Name: Martine Newman
Email address: martine@natres.com.au
karen@natres.com.au
Telephone: 4034 5300 **Facsimile:** 40345301

Client Order Number:
Project Name: KUR-World WQ Monitoring
Project Number: 424103.01
Results Required By:

Bottles Received - Lab use only:

(Please specify if AW is Field Filtered or Total)

Relinquished by: ________ **Date:** ________ **Time:** ________ **Received by:** ________ **Date:** ________ **Time:** ________

Relinquished by: ________ **Date:** ________ **Time:** ________ **Received by:** ________ **Date:** ________ **Time:** ________

* Circle whichever is applicable

Sample Cooler Sealed: YES/NO*	**Samples Intact: YES/NO***	**Correct Sample Bottles Used: YES/NO***	**Temperature: AMBIENT/CHILLED***

Comments including subcontracting details:

Please provide client with details ☐
Consent given for subcontracting ☐

KUR-World WQ Monitoring Analyte List

Parameter	**LOR (mg/L)**	
Total Suspended Solids	1	LL TSS - requires full 500ml just for this test - request TSS LL on cofc
Volatile Suspended Solids	1	
Total Dissolved Solids	10	
Total Nitrogen	0.05	
Total Phosphorus - ultra trace	0.01	Have to request TP (LL) on cofc
Total Oxidised Nitrogen	0.005	
Nitrate	0.005	
Nitrite	0.005	
Total Kjeldahl Nitrogen	0.05	
Dissolved Inorganic Nitrogen	0.05	calc NH3 and TON
Ammonia - Ultra Trace	0.005	
Filterable Reactive Phosphorus - Ultra Trac	0.005	
Hardness	1	
Alkalinity	5	
Major Ions	1	
Aluminium (total)	0.005	
Aluminium (field filtered)	0.005	
Arsenic (total)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Arsenic (field filtered)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Cadmium (total)	0.0001	
Cadmium (field filtered)	0.0001	
Chromium (total)	0.001	
Chromium (field filtered)	0.001	
Copper (total)	0.001	
Copper (field filtered)	0.001	
Iron (total)	0.05	
Iron (field filtered)	0.05	
Lead (total)	0.001	
Lead (field filtered)	0.001	
Manganese (total)	0.001	Have to request special LOR on cofc - normally 0.005
Manganese (field filtered)	0.001	Have to request special LOR on cofc - normally 0.005
Nickel (total)	0.001	
Nickel (field filtered)	0.001	
Zinc (total)	0.005	
Zinc (field filtered)	0.005	
Fluoride	0.05	

SAMPLE RECEIPT ADVICE

CE127001

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424105.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	10

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Fri 21/4/2017
Report Due	Fri 5/5/2017
SGS Reference	**CE127001**

SUBMISSION DETAILS

This is to confirm that 10 samples were received on Friday 21/4/2017. Results are expected to be ready by Friday 5/5/2017. Please quote SGS reference CE127001 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	ice
Samples received in correct containers	Yes	Sample counts by matrix	10 Waters
Date documentation received	21/4/2017 15:30	Type of documentation received	COC
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled/Frozen
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424105.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Fluoride by Ion Selective Electrode in Water	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	Nitrite in Water	pH in water	TKN Kjeldahl Digestion by Discrete Analyser
001	SW01	4	1	1	1	1	2	1	1	2
002	SW02	4	1	1	1	1	2	1	1	2
003	SW03	4	1	1	1	1	2	1	1	2
004	SW06	4	1	1	1	1	2	1	1	2
005	SW08	4	1	1	1	1	2	1	1	2
006	SW09	4	1	1	1	1	2	1	1	2
007	QA	4	1	1	1	1	2	1	1	2
008	DUP	4	1	1	1	1	2	1	1	2
009	SW02B	4	1	1	1	1	2	1	1	2
010	SW01B	4	1	1	1	1	2	1	1	2

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CE127001

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424105.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Filterable Reactive Phosphorus (FRP)	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Total Phosphorus by Kjeldahl Digestion DA in	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	SW01	1	9	8	6	6	2	1	1	1	1
002	SW02	1	9	8	6	6	2	1	1	1	1
003	SW03	1	9	8	6	6	2	1	1	1	1
004	SW06	1	9	8	6	6	2	1	1	1	1
005	SW08	1	9	8	6	6	2	1	1	1	1
006	SW09	1	9	8	6	6	2	1	1	1	1
007	QA	1	9	8	6	6	2	1	1	1	1
008	DUP	1	9	8	6	6	2	1	1	1	1
009	SW02B	1	9	8	6	6	2	1	1	1	1
010	SW01B	1	9	8	6	6	2	1	1	1	1

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client	Natural Resource Assessments Pty Ltd	Project	424105.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance
001	SW01	1
002	SW02	1
003	SW03	1
004	SW06	1
005	SW08	1
006	SW09	1
007	QA	1
008	DUP	1
009	SW02B	1
010	SW01B	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424105.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	10

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE127001 R1**
Date Received	21 Apr 2017
Date Reported	10 May 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025-Testing. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE162487.
This report cancels and supersedes the report No.CE127001-R0. dated 10/05/17 issued by SGS Environment, Health and Safety due to amended LOR for TP and F.

SIGNATORIES

Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Orsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name: CE127001.001 Water 21 Apr 2017 SW01	CE127001.002 Water 20 Apr 2017 SW02	CE127001.003 Water 21 Apr 2017 SW03	CE127001.004 Water 21 Apr 2017 SW06

pH in water Method: AN101/MA1490(Melb) Tested: 26/4/2017

pH**	pH Units	0.1	7.5	6.5	6.6	6.4

Alkalinity Method: AN135/MA1127(Melb) Tested: 26/4/2017

Total Alkalinity as CaCO3	mg/L	5	31	33	25	11
Bicarbonate Alkalinity as CaCO3	mg/L	5	31	33	25	11
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 26/4/2017

Chloride, Cl	mg/L	1	24	20	13	5

Fluoride by Ion Selective Electrode in Water Method: AN141 Tested: 26/4/2017

Fluoride by ISE	mg/L	0.05	0.06	0.06	0.07	0.07

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 2/5/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.014	0.041	0.066	0.24
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.014	0.040	0.065	0.24

Nitrite in Water Method: AN277 Tested: 2/5/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

		Sample Number	CE127001.001	CE127001.002	CE127001.003	CE127001.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	21 Apr 2017	20 Apr 2017	21 Apr 2017	21 Apr 2017
		Sample Name	SW01	SW02	SW03	SW06
Parameter	**Units**	**LOR**				
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 5/5/2017						
Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.020**	**0.045**	**0.015**	**0.046**
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 27/4/2017						
Total Kjeldahl Nitrogen	mg/L	0.05	**0.51**	**0.27**	**0.40**	**0.17**
Total Nitrogen (calc)	mg/L	0.05	**0.52**	**0.31**	**0.46**	**0.42**
Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 8/5/2017						
Total InorganicNitrogen (calc)	mg/L	0.01	**0.03**	**0.09**	**0.08**	**0.29**
Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 28/4/2017						
Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 27/4/2017						
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	**0.02**	**0.02**	**0.02**	**0.02**
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 3/5/2017						
Total Suspended Solids Dried at 103-105°C	mg/L	1	**3**	**5**	**2**	**8**
Volatile Suspended Solids Ignited at 550°C	mg/L	1	**3**	**5**	**2**	**5**

Sample Number			CE127001.001	CE127001.002	CE127001.003	CE127001.004
Sample Matrix			Water	Water	Water	Water
Sample Date			21 Apr 2017	20 Apr 2017	21 Apr 2017	21 Apr 2017
Sample Name			SW01	SW02	SW03	SW06
Parameter	Units	LOR				
Total Dissolved Solids (TDS) in water Method: AN113/MA1491(Melb) Tested: 2/5/2017						
Total Dissolved Solids Dried at 175-185°C	mg/L	10	110	97	100	58
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 27/4/2017						
Aluminium, Al	mg/L	0.005	0.025	0.014	0.076	0.018
Calcium, Ca	mg/L	0.2	4.0	4.3	3.5	0.9
Iron, Fe	mg/L	0.005	1.2	1.5	2.1	0.52
Magnesium, Mg	mg/L	0.1	4.0	3.7	3.4	1.4
Sulphur as Sulphate, SO4	mg/L	0.5	1.2	1.0	0.9	0.7
Sulphur, S	mg/L	0.1	0.4	0.3	0.3	0.2
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Total Hardness by Calculation	mg CaCO3/L	1	27	26	23	8
Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 27/4/2017						
Total Aluminium	mg/L	0.005	0.033	0.051	0.095	0.17
Total Hardness	mg CaCO3/L	5	27	26	23	8
Total Calcium	mg/L	0.05	4.1	4.4	3.5	0.96
Total Iron	mg/L	0.005	2.0	3.9	2.3	2.2
Total Magnesium	mg/L	0.05	4.0	3.7	3.4	1.4
Total Potassium	mg/L	0.05	2.0	0.95	1.6	0.99
Total Sodium	mg/L	0.5	15	13	13	7.1
Total Sulphur as SO4	mg/L	0.5	1.2	1.1	0.9	0.7
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 27/4/2017						
Arsenic, As	mg/L	0.001	0.001	0.001	0.001	0.001

		Sample Number	CE127001.001	CE127001.002	CE127001.003	CE127001.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	21 Apr 2017	20 Apr 2017	21 Apr 2017	21 Apr 2017
		Sample Name	SW01	SW02	SW03	SW06
Parameter	**Units**	**LOR**				
Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 27/4/2017						
Total Arsenic	mg/L	0.001	**0.002**	**0.002**	**0.001**	**0.002**
Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 27/4/2017						
Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.043**	**0.16**	**0.040**	**0.019**
Nickel, Ni	mg/L	0.001	**0.001**	**0.001**	<0.001	<0.001
Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 27/4/2017						
Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Manganese, Mn*	mg/L	0.001	**0.12**	**0.18**	**0.050**	**0.022**
Total Nickel, Ni	mg/L	0.001	**0.001**	**0.001**	<0.001	<0.001
Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 8/5/2017						
Anion-Cation Balance	%	-100	**-2.0**	**-3.0**	**12**	**14**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE127001.005 Water 20 Apr 2017 SW08	CE127001.006 Water 21 Apr 2017 SW09	CE127001.007 Water 20 Apr 2017 QA	CE127001.008 Water 20 Apr 2017 DUP

pH in water Method: AN101/MA1490(Melb) Tested: 26/4/2017

pH**	pH Units	0.1	6.4	6.6	5.9	6.5

Alkalinity Method: AN135/MA1127(Melb) Tested: 26/4/2017

Total Alkalinity as CaCO3	mg/L	5	12	31	<5	31
Bicarbonate Alkalinity as CaCO3	mg/L	5	12	31	<5	31
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 26/4/2017

Chloride, Cl	mg/L	1	17	11	<1	19

Fluoride by Ion Selective Electrode in Water Method: AN141 Tested: 26/4/2017

Fluoride by ISE	mg/L	0.05	0.05	0.06	<0.05	0.06

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 2/5/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	0.16	0.007	<0.005	0.034
Nitrate Nitrogen, NO3 as N	mg/L	0.005	0.16	<0.005	<0.005	0.033

Nitrite in Water Method: AN277 Tested: 2/5/2017

Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

		Sample Number	CE127001.005	CE127001.006	CE127001.007	CE127001.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	20 Apr 2017	21 Apr 2017	20 Apr 2017	20 Apr 2017
		Sample Name	SW08	SW09	QA	DUP
Parameter	**Units**	**LOR**				
Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 5/5/2017						
Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.024**	**0.11**	<0.005	**0.053**
TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 27/4/2017						
Total Kjeldahl Nitrogen	mg/L	0.05	**0.28**	**0.52**	<0.05	**0.26**
Total Nitrogen (calc)	mg/L	0.05	**0.44**	**0.52**	<0.05	**0.29**
Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 8/5/2017						
Total InorganicNitrogen (calc)	mg/L	0.01	**0.18**	**0.11**	<0.01	**0.09**
Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 28/4/2017						
Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 27/4/2017						
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	<0.01	**0.01**	<0.01	**0.01**
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 3/5/2017						
Total Suspended Solids Dried at 103-105°C	mg/L	1	**6**	**4**	<1	**7**
Volatile Suspended Solids Ignited at 550°C	mg/L	1	**6**	**4**	<1	**5**

		Sample Number	CE127001.005	CE127001.006	CE127001.007	CE127001.008
		Sample Matrix	Water	Water	Water	Water
		Sample Date	20 Apr 2017	21 Apr 2017	20 Apr 2017	20 Apr 2017
		Sample Name	SW08	SW09	QA	DUP
Parameter	Units	LOR				

Total Dissolved Solids (TDS) in water Method: AN113/MA1491(Melb) Tested: 2/5/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**80**	**130**	**24**	**110**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 27/4/2017

Aluminium, Al	mg/L	0.005	**0.030**	**0.082**	<0.005	**0.013**
Calcium, Ca	mg/L	0.2	**1.6**	**4.6**	<0.2	**4.2**
Iron, Fe	mg/L	0.005	**0.60**	**1.3**	<0.005	**1.4**
Magnesium, Mg	mg/L	0.1	**2.1**	**3.9**	<0.1	**3.6**
Sulphur as Sulphate, SO4	mg/L	0.5	**1.0**	**1.1**	<0.5	**1.1**
Sulphur, S	mg/L	0.1	**0.3**	**0.4**	<0.1	**0.4**
Zinc, Zn	mg/L	0.005	<0.005	<0.005	<0.005	<0.005
Total Hardness by Calculation	mg CaCO3/L	1	**12**	**28**	<1	**26**

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 27/4/2017

Total Aluminium	mg/L	0.005	**0.20**	**0.073**	<0.005	**0.038**
Total Hardness	mg CaCO3/L	5	**13**	**28**	<5	**26**
Total Calcium	mg/L	0.05	**1.7**	**4.8**	<0.05	**4.4**
Total Iron	mg/L	0.005	**3.2**	**2.8**	<0.005	**4.0**
Total Magnesium	mg/L	0.05	**2.2**	**4.0**	<0.05	**3.7**
Total Potassium	mg/L	0.05	**0.84**	**1.6**	<0.05	**0.94**
Total Sodium	mg/L	0.5	**11**	**13**	<0.5	**13**
Total Sulphur as SO4	mg/L	0.5	**1.0**	**1.1**	<0.5	**1.1**
Total Zinc	mg/L	0.005	<0.005	<0.005	<0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 27/4/2017

Arsenic, As	mg/L	0.001	**0.002**	**0.001**	<0.001	**0.001**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE127001.005 Water 20 Apr 2017 SW08	CE127001.006 Water 21 Apr 2017 SW09	CE127001.007 Water 20 Apr 2017 QA	CE127001.008 Water 20 Apr 2017 DUP

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 27/4/2017

Total Arsenic	mg/L	0.001	**0.005**	**0.002**	<0.001	**0.002**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 27/4/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.010**	**0.13**	<0.001	**0.16**
Nickel, Ni	mg/L	0.001	<0.001	<0.001	<0.001	**0.001**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 27/4/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Manganese, Mn*	mg/L	0.001	**0.013**	**0.22**	<0.001	**0.18**
Total Nickel, Ni	mg/L	0.001	<0.001	<0.001	<0.001	**0.001**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 8/5/2017

Anion-Cation Balance	%	-100	**-0.7**	**11**	-	**-1.2**

Parameter	Units	LOR	CE127001.009 Water 20 Apr 2017 SW02B	CE127001.010 Water 20 Apr 2017 SW01B
Sample Number			CE127001.009	CE127001.010
Sample Matrix			Water	Water
Sample Date			20 Apr 2017	20 Apr 2017
Sample Name			SW02B	SW01B

pH in water Method: AN101/MA1490(Melb) Tested: 26/4/2017

Parameter	Units	LOR	SW02B	SW01B
pH**	pH Units	0.1	**6.7**	**6.6**

Alkalinity Method: AN135/MA1127(Melb) Tested: 26/4/2017

Parameter	Units	LOR	SW02B	SW01B
Total Alkalinity as CaCO3	mg/L	5	**27**	**24**
Bicarbonate Alkalinity as CaCO3	mg/L	5	**27**	**24**
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 26/4/2017

Parameter	Units	LOR	SW02B	SW01B
Chloride, Cl	mg/L	1	**18**	**40**

Fluoride by Ion Selective Electrode in Water Method: AN141 Tested: 26/4/2017

Parameter	Units	LOR	SW02B	SW01B
Fluoride by ISE	mg/L	0.05	**0.07**	**0.06**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 2/5/2017

Parameter	Units	LOR	SW02B	SW01B
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.14**	**0.033**
Nitrate Nitrogen, NO3 as N	mg/L	0.005	**0.14**	**0.033**

Nitrite in Water Method: AN277 Tested: 2/5/2017

Parameter	Units	LOR	SW02B	SW01B
Nitrite Nitrogen, NO2 as N	mg/L	0.005	<0.005	<0.005

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE127001.009 Water 20 Apr 2017 SW02B	CE127001.010 Water 20 Apr 2017 SW01B

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 5/5/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005	**0.036**

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 27/4/2017

Total Kjeldahl Nitrogen	mg/L	0.05	**0.41**	**0.42**
Total Nitrogen (calc)	mg/L	0.05	**0.55**	**0.45**

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 8/5/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.14**	**0.07**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 28/4/2017

Filterable Reactive Phosphorus	mg/L	0.005	<0.005	<0.005

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 27/4/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	**0.02**	**0.02**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 3/5/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	**2**	**2**
Volatile Suspended Solids Ignited at 550°C	mg/L	1	**2**	**2**

		Sample Number	CE127001.009	CE127001.010
		Sample Matrix	Water	Water
		Sample Date	20 Apr 2017	20 Apr 2017
		Sample Name	SW02B	SW01B
Parameter	Units	LOR		

Total Dissolved Solids (TDS) in water Method: AN113/MA1491(Melb) Tested: 2/5/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**110**	**160**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 27/4/2017

Aluminium, Al	mg/L	0.005	**0.099**	**0.024**
Calcium, Ca	mg/L	0.2	**3.3**	**4.6**
Iron, Fe	mg/L	0.005	**2.2**	**1.6**
Magnesium, Mg	mg/L	0.1	**3.1**	**4.9**
Sulphur as Sulphate, SO4	mg/L	0.5	**0.9**	**0.7**
Sulphur, S	mg/L	0.1	**0.3**	**0.2**
Zinc, Zn	mg/L	0.005	<0.005	<0.005
Total Hardness by Calculation	mg CaCO3/L	1	**21**	**32**

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 27/4/2017

Total Aluminium	mg/L	0.005	**0.12**	**0.032**
Total Hardness	mg CaCO3/L	5	**21**	**33**
Total Calcium	mg/L	0.05	**3.4**	**4.8**
Total Iron	mg/L	0.005	**2.7**	**2.2**
Total Magnesium	mg/L	0.05	**3.1**	**5.0**
Total Potassium	mg/L	0.05	**1.6**	**2.0**
Total Sodium	mg/L	0.5	**12**	**20**
Total Sulphur as SO4	mg/L	0.5	**1.0**	**0.7**
Total Zinc	mg/L	0.005	<0.005	<0.005

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 27/4/2017

Arsenic, As	mg/L	0.001	**0.001**	**0.001**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE127001.009 Water 20 Apr 2017 SW02B	CE127001.010 Water 20 Apr 2017 SW01B

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 27/4/2017

Total Arsenic	mg/L	0.001	**0.002**	**0.002**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 27/4/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	<0.001
Lead, Pb	mg/L	0.001	<0.001	<0.001
Manganese, Mn	mg/L	0.001	**0.043**	**0.12**
Nickel, Ni	mg/L	0.001	<0.001	**0.001**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 27/4/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	<0.001
Total Lead, Pb	mg/L	0.001	<0.001	<0.001
Total Manganese, Mn*	mg/L	0.001	**0.061**	**0.14**
Total Nickel, Ni	mg/L	0.001	<0.001	**0.001**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 8/5/2017

Anion-Cation Balance	%	-100	**-0.1**	**-0.1**

QC SUMMARY

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/MA1127(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB045539	mg/L	5	<5	0 - 8%	96 - 101%
Bicarbonate Alkalinity as CaCO3	LB045539	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB045539	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB045539	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB045876	mg/L	0.005	<0.005	0 - 5%	94 - 98%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB045568	mg/L	1	<1	0 - 1%	108 - 110%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB045673	mg/L	0.005	<0.005	0 - 7%	96%

Fluoride by Ion Selective Electrode in Water Method: ME-(AU)-[ENV]AN141

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Fluoride by ISE	LB045539	mg/L	0.05	<0.05	0 - 12%	99 - 100%	99 - 102%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB045647	mg/L	0.005	9%	98%	
Total Calcium	LB045647	mg/L	0.05	0%	99%	98%
Total Iron	LB045647	mg/L	0.005	0%	101%	99%
Total Magnesium	LB045647	mg/L	0.05	0%	98%	96%
Total Potassium	LB045647	mg/L	0.05	2%	96%	
Total Sodium	LB045647	mg/L	0.5	2%	97%	
Total Sulphur as SO4	LB045647	mg/L	0.5	0 - 2%	97%	
Total Zinc	LB045647	mg/L	0.005	0%	106%	

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB045644	mg/L	0.005	<0.005	0 - 2%	99%	100%
Calcium, Ca	LB045644	mg/L	0.2	<0.2	0 - 1%	99%	
Iron, Fe	LB045644	mg/L	0.005	<0.005	0 - 2%	102%	
Magnesium, Mg	LB045644	mg/L	0.1	<0.1	1%	99%	
Sulphur as Sulphate, SO4	LB045644	mg/L	0.5	<0.5	4%	NA	
Sulphur, S	LB045644	mg/L	0.1	<0.1	4%	97%	
Zinc, Zn	LB045644	mg/L	0.005	<0.005	0%	107%	105%
Total Hardness by Calculation	LB045644	mg CaCO3/L	1	<1			

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB045650	mg/L	0.0001	<0.0001	0%	103%	
Chromium, Cr	LB045650	mg/L	0.001	<0.0010	0%	101%	
Copper, Cu	LB045650	mg/L	0.001	<0.001	0%	98%	92%
Lead, Pb	LB045650	mg/L	0.001	<0.001	0%	104%	91%
Manganese, Mn	LB045650	mg/L	0.001	<0.001	0%	NA	
Nickel, Ni	LB045650	mg/L	0.001	<0.001	0%	107%	

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Cadmium, Cd	LB045652	mg/L	0.0001	<0.0001	0%	101%
Total Chromium, Cr	LB045652	mg/L	0.001	<0.001	0 - 5%	98%
Total Copper, Cu	LB045652	mg/L	0.001	<0.001	0%	97%
Total Lead, Pb	LB045652	mg/L	0.001	<0.001	0%	102%
Total Manganese, Mn*	LB045652	mg/L	0.001	<0.001	0 - 1%	NA
Total Nickel, Ni	LB045652	mg/L	0.001	<0.001	0%	104%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB045687	mg/L	0.005	<0.005	0 - 3%	102 - 105%

QC SUMMARY

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.

Nitrite in Water   Method: ME-(AU)-[ENV]AN277

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrite Nitrogen, NO2 as N	LB045710	mg/L	0.005	<0.005	0 - 2%	98%

pH in water   Method: ME-(AU)-[ENV]AN101/MA1490(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB045539	pH Units	0.1	5.6 - 5.9	0 - 2%	100 - 101%

TKN Kjeldahl Digestion by Discrete Analyser   Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB045606	mg/L	0.05	<0.05	0 - 6%	91 - 92%

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	LB045754	mg/L	1	<1	0 - 3%	105 - 108%
Volatile Suspended Solids Ignited at 550°C	LB045754	mg/L	1		0 - 14%	

Total Dissolved Solids (TDS) in water   Method: ME-(AU)-[ENV]AN113/MA1491(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB045745	mg/L	10	<10	0 - 8%	104%	99 - 105%

Total Phosphorus by Kjeldahl Digestion DA in Water   Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB045606	mg/L	0.01	<0.01	5 - 15%	97 - 98%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	DUP %RPD
Arsenic, As	LB045602	mg/L	0.001	0%

Trace Metals (Total) in Water by ICPMS in mg/L Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Arsenic	LB045609	mg/L	0.001	0%

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
AN101/MA1490(Melb)	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/MA1489(Melb)	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 µmhos/cm or µS/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/MA1491(Melb)	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 calculation 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.
AN135/MA1127(Melb)	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
AN141	Determination of Fluoride by ISE: A fluoride ion selective electrode and reference electrode combination, in the presence of a pH/complexation buffer, is used to determine the fluoride concentration. The electrode millivolt response is measured logarithmically against fluoride concentration. Reference APHA F- C.
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN277/WC250.312	Nitrite ions, when reacted with a reagent containing sulphanilamide and N-(1-naphthyl)-ethylenediamine dihydrochloride produce a highly coloured azo dye that is measured photometrically at 540nm.
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F

METHOD	METHODOLOGY SUMMARY
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour . The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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 calcuated 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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SGS

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Number: CE126981 *(Lab use only)*

Page ..... **of** .....

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER		TSS	VSS										
	Quen Ck Mouth	21/4/17 12:45		✓			✓					✓	✓										
	Warril Ck Mouth	21/4/17 13:15		✓			✓					✓	✓										
	Cain Ck Mouth	21/4/17 1300		✓			✓					✓	✓										
	Cain Ck Crossing DS	21/4/17 1215		✓			✓					✓	✓										
	Barron River DS	21/4/17 1345		✓			✓					✓	✓										
	Barron River US	21/4/17 1230		✓			✓					✓	✓										

SGS Cairns Environmental
CE126981 COC
Received: 21-Apr-2017

Company Name: NRA
Address: 320 Sheridan St.
Contact Name: Martine Newman
Email address: martine@natres.com.au/karen@natres.com.au
Telephone: 40345300 **Facsimile:**

Client Order Number:
Project Name: KUR World General
Project Number: [redacted]
Results Required By:

Bottles Received - Lab use only:
6x500NP
(Please specify if AW is Field Filtered or Total)

Relinquished by: Karen Lindée **Date:** 21/4/17 **Time:** 2:50pm **Received by:** **Date:** 21/4/17 **Time:** 3pm

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

* Circle whichever is applicable

Sample Cooler Sealed: [✓ YES]/NO* | **Samples Intact:** [✓ YES]/NO* | **Correct Sample Bottles Used:** [✓ YES]/NO* | **Temperature:** AMBIENT/[✓ CHILLED]*

Comments including subcontracting details:

Please provide client with details ☐
Consent given for subcontracting ☐

SAMPLE RECEIPT ADVICE

CE126981

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**KUR-World General**
Order Number	(Not specified)
Samples	6

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Fri 21/4/2017
Report Due	Thu 4/5/2017
SGS Reference	**CE126981**

SUBMISSION DETAILS

This is to confirm that 6 samples were received on Friday 21/4/2017. Results are expected to be ready by Thursday 4/5/2017. Please quote SGS reference CE126981 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	6 waters
Date documentation received	21/4/2017	Type of documentation received	COC
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CE126981

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project KUR-World General

SUMMARY OF ANALYSIS

No.	Sample ID	Total and Volatile Suspended Solids (TSS /
001	Owen Ck Mouth	2
002	Warril Ck Mouth	2
003	Cain Ck Mouth	2
004	Cain Ck Crossing DS	2
005	Barron River DS	2
006	Barron River US	2

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	PO Box 5678 QLD 4870
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**KUR-World General**
Order Number	(Not specified)
Samples	6

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE126981 R0**
Date Received	21 Apr 2017
Date Reported	04 May 2017

COMMENTS

Whilst SGS laboratories conform to ISO:17025 standards, results of analysis in this report fall outside of the current scope of NATA accreditation .

SIGNATORIES

Anthony Nilsson Operations Manager	Jon Dicker Manager Northern QLD

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE126981.001 Water 21 Apr 2017 Owen Ck Mouth	CE126981.002 Water 21 Apr 2017 Warril Ck Mouth	CE126981.003 Water 21 Apr 2017 Cain Ck Mouth	CE126981.004 Water 21 Apr 2017 Cain Ck Crossing DS
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 3/5/2017							
Total Suspended Solids Dried at 103-105°C	mg/L	1		<1	**3**	**5**	**6**
Volatile Suspended Solids Ignited at 550°C	mg/L	1		<1	**3**	**4**	**4**

Parameter	Units	LOR	Sample Number CE126981.005 Sample Matrix Water Sample Date 21 Apr 2017 Sample Name Barron River DS	CE126981.006 Water 21 Apr 2017 Barron River US
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 3/5/2017				
Total Suspended Solids Dried at 103-105°C	mg/L	1	**6**	**9**
Volatile Suspended Solids Ignited at 550°C	mg/L	1	**4**	**4**

QC SUMMARY

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.

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	LB045754	mg/L	1	<1	0 - 3%	105 - 108%
Volatile Suspended Solids Ignited at 550°C	LB045754	mg/L	1		0 - 14%	

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
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

FOOTNOTES

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**	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.

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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.

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Appendix E:
Aquatic Ecology Survey
Macroinvertebrate Taxa List

Aquatic Ecology Survey Macroinvertebrate Taxa List

Order	Family	Common name	Site and replicate$^{\#}$:	SW01B A	SW01B B	SW02 A	SW02 B	SW02B A	SW02B B	SW08 A	SW08 B
			Date:	20/4/17	20/4/17	20/4/17	20/4/17	20/4/17	20/4/17	20/4/17	20/4/17
			Collector*:	MN	MN	MN	MN	MN	MN	MN	MN
			Picker*:	KL	MN	KL	MN	KL	MN	KL	MN
Acari	-	Water Mite		47	39	6	5	27	5	0	2
Bivalvia	Corbiculidae	Little Basket Shell		0	0	0	0	0	1	0	0
Bivalvia	Sphaeriidae	Pea Shell		0	0	0	0	1	0	0	0
Cladocera	-	Water Flea		11	110	1	0	0	0	0	0
Coleoptera	Dytiscidae	Diving Water Beetle		1	3	6	8	0	3	1	0
Coleoptera	Elmidae	Riffle Beetle		0	0	0	0	0	0	0	0
Coleoptera	Hydrophilidae	Water Scavenger Beetle		0	0	0	0	0	0	2	9
Coleoptera	Ptilodactylidae	-		0	0	0	1	0	0	1	0
Coleoptera	Scirtidae	Marsh Beetle		0	0	0	0	0	0	0	1
Copepoda	-	Copepod		2	29	0	1	2	0	0	0
Decapoda	Atyidae	Freshwater Shrimp		0	1	2	0	21	6	0	0
Decapoda	Palaemonidae	Freshwater Prawn		1	0	0	0	1	3	0	0
Decapoda	Parastacidae	Freshwater Crayfish		0	0	1	1	0	0	2	2
Decapoda	Unidentified Decapoda	-		0	0	0	0	0	0	0	0
Diptera	Ceratopogonidae	Pog		1	1	0	0	0	0	0	0
Diptera	Chironominae	Non-biting Midge		20	31	23	14	9	10	0	1
Diptera	Culicidae	Mosquito		0	0	0	1	0	0	0	0
Diptera	Dolichopodidae	Dolly		0	0	0	0	0	0	2	0
Diptera	Orthocladiinae	Non-biting Midge		0	0	0	0	1	0	0	0
Diptera	Tanypodinae	Non-biting Midge		6	13	4	2	1	6	2	5
Ephemeroptera	Baetidae	Mayfly		0	7	2	5	0	0	0	0
Ephemeroptera	Caenidae	Mayfly		0	3	11	7	4	2	0	1
Ephemeroptera	Leptophlebiidae	Mayfly		5	5	22	48	26	40	35	38
Gastropoda	Thiaridae	-		0	0	0	0	1	2	0	0
Hemiptera	Corixidae	Water Boatmen		0	0	9	0	9	7	0	0
Hemiptera	Gerridae	Water Striders		0	0	0	1	0	1	1	2
Hemiptera	Veliidae	Small Water Striders		0	0	0	1	0	0	1	0

Order	Family	Common name	Site and replicate[#]:	SW01B A	SW01B B	SW02 A	SW02 B	SW02B A	SW02B B	SW08 A	SW08 B
			Date:	20/4/17	20/4/17	20/4/17	20/4/17	20/4/17	20/4/17	20/4/17	20/4/17
			Collector*:	MN	MN	MN	MN	MN	MN	MN	MN
			Picker*:	KL	MN	KL	MN	KL	MN	KL	MN
Hirudinea	-	Freshwater Leech		0	0	0	0	0	1	0	0
Lepidoptera	Pyralidae	Aquatic Caterpillar		0	0	0	0	0	1	0	0
Megaloptera	Sialidae	March Fly		0	0	12	13	0	3	0	3
Neuroptera	Sisyridae	-		0	0	0	0	1	0	0	0
Odonata	Chorismagrionidae	-		0	0	0	0	0	0	2	0
Odonata	Corduliidae	Dragonfly		0	1	0	0	1	2	1	0
Odonata	Gomphidae	Dragonfly		0	0	0	1	2	2	0	0
Odonata	Isostictidae	-		1	2	0	0	2	1	4	1
Odonata	Libellulidae	Dragonfly		5	15	4	1	5	2	4	1
Odonata	Platycnemididae	Damselfly		0	0	0	0	2	2	0	0
Odonata	Unidentified Epiprocta	-		0	1	0	0	0	1	0	0
Odonata	Unidentified Zygoptera	-		0	1	1	0	2	2	0	2
Oligochaeta	-	Segmented Worm		1	0	6	16	0	0	1	1
Ostracoda	-	Seed Shrimp		21	24	0	0	5	0	0	0
Trichoptera	Leptoceridae	Stick Caddisfly		0	0	2	3	3	6	6	0

[#] Two replicate samples (denoted with an A or B) were collected from the bed habitat at each site. The replicate code (*ie* A or B) is unique to each live-pick operator.

* Collectors and Pickers: MN is Martine Newman (NRA) and KL is Karen Lindee (NRA).

Appendix F:
Aquatic Ecology Fish Report

Freshwater fish survey of streams at KurWorld, Kuranda

Brendan C. Ebner[A] and Terry Vallance[B]

[A]TropWATER, James Cook University; brendan.ebner@csiro.au

[B]Tropical River Consulting; terry@tropicalriver.com.au

6 July 2017

Tropical River Consulting
196 Winfield Road
Lake Eacham QLD 4884
t 0458 952 001
e terry@tropicalriver.com.au

ABN 180 1591 5487

Introduction

Streams of the Atherton Tablelands contain a number of rainbowfish species including the ubiquitous Eastern Rainbowfish, *Melanotaenia splendida*, the Lake Eacham Rainbowfish, *Melanotaenia eachamensis* and at least one other undescribed species from the Williams Creek catchment immediately south of Malanda (Pusey *et al.* 2004, Unmack *et al.* 2016). The Lake Eacham Rainbowfish is listed as Endangered under the EPBC Act.

The primary aim of this survey was to describe the fish assemblage and determine if the Lake Eacham Rainbowfish is present at any of eight preselected sites on the KurWorld property. This property situated in the greater Kuranda area is drained by a series of small order streams that drain to the mid-Barron River upstream of Kuranda Falls. Additional aims were to identify any alien fish species and provide recommendations regarding possible management actions including habitat remediation for native species.

Methods

A Smith-Root LR-24 backpack electrofisher was used to survey fishes at eight sites. The primary operator waded in an upstream direction and in flowing water a second operator trailed downstream to collect stunned fish and crustaceans with a dip net and bucket. Electrofisher settings were optimised according to site specific conditions, mostly relating to water conductivity and temperature. Record was made of total on-time (ranged from 251–469 seconds per site) and distance of stream sampled (50–60 m lengths of stream).

Due to the rapid nature of the surveys, total length (TL) of captured fish was estimated (to the nearest 5 millimetre for fish less than 100 mm TL; 10 mm for fishes 100–300 mm TL; and 50 mm for larger individuals). Fishes were identified from experience and with the aid of relevant field guides (Herbert and Peeters 1995, Allen *et al.* 2002, Marquet *et al.* 2003, Hogan 2010). Author experience with collecting and maintaining local morphs of *Melanotaenia* spp. were also important in visually inspected rainbowfishes on site. A small number of specimens were also retained and sent for genetic analysis as a failsafe rather than because of any suspicion that they were *Melanotaenia eachamensis*.

As evidence of the species detected photographs were taken and a small subsample of fishes were retained for genetic and taxonomic purposes. Photographs were also taken of select habitats and crayfish burrows.

Backpack electrofishing at Site SW03.

Results

In total 765 individual fish were collected by backpack electrofishing during the survey, and a further 507 individuals were reliably observed but not caught (Table 1). From these 1272 fish records, it is apparent that at least ten species of fishes occupy the small creeks at KurWorld (Table 1, Appendix 1). Seven of these fish species are native to Australia and three are alien species. The three alien species are commonly referred to as Guppies, Platys and Swordtails, and are small-bodied fishes. Guppies were the only abundant and widespread alien fish representing 23% (numerically) of the fishes caught and observed and recorded at six of eight sites. Only a single Platy (at Site SW2B) and two Swordtails (Site SW1B) were collected. The seven native fishes did not include any EPBC or state conservation listed species, and specifically, the Lake Eacham Rainbowfish*, Melanotaenia eachamensis*, was not detected at any of the survey sites.

Table 1: Aquatic fauna collected and observed at all eight sites by backpack electrofishing.

Species	**Caught**	**Caught & Observed**	**Minimum TL (mm)**	**Maximum TL (mm)**	**Native or Alien to Australia**
Marbled Eel, *Anguilla reinhardtii*	4	4	340	650	native
Polynesian Short-finned Eel*,* *Anguilla megastoma*	2	2	500	840	native
Eastern Rainbowfish*, Melanotaenia splendida*	324	563	15	65	native
Northern Purple-spotted gudgeon*,* *Mogurnda mogurnda*	267	397	20	120	native
Mouth Almighty*, Glossamia aprion*	4	4	25	70	native
Glassfish*, Ambassis* sp.	4	5	40	50	native
Giant Gudgeon*, Oxyeleotris selheimi*	1	1	160	160	native
Guppy*, Poecilia reticulata*	156	293	14	38	alien
Platy*, Xiphophorus maculatus*	1	1	32	32	alien
Swordtail*, Xiphophorus helleri*	2	2	35	40	alien
Crayfish*, Cherax wasseli*	15	24	25	65	native
Prawns, *Macrobrachium* spp.	6	11	50	75	native
Shrimps, Atyidae	8	154	15	20	native
Tadpoles (unidentified multiple species)	14	488	15	80	native
Wood Frog*, Hylarana daemeli*	4	3	50	65	native
Waterdragon, *Intellagama lesueurii*	1	1	450	450	native
Macleays Water Python*,* *Pseudoferania polylepis*	1	1	550	550	native
Total	**765**	**1272**			

Figure 1: Fishes from the survey: a) Platy, b) Guppy, c) Swordtail, d), Mouth Almighty, e) Giant Gudgeon, f) Eastern Rainbowfish, g) Purple-spotted gudgeon, h) Glassfish, i) Polynesian Long-finned Eel, j) Marbled eel.

Semi-aquatic vertebrate species that were incidentally collected and observed were Macleays Water Python *Pseudoferania polylepis,* the Wood Frog, *Hylarana daemeli*, and 488 unidentified tadpoles. A single Cane Toad, *Rhinella marina* was observed having been partly eaten at one site.

The local endemic crayfish, *Cherax wasseli* was also present at a number of sites as evidenced by the presence of burrows, and individuals were detected at five of eight sites. Prawns (*Macrobrachium*) and shrimps (Atyidae) were also present in the streams.

Pig damage was visible at the site SW06 and cattle were accessing the bank at site SW02.

Figure 2: Incidental catches during the backpack electrofishing survey including: a) Wood frog, b) Macleays Water Python, c) Crayfish, d) Freshwater Prawn.

Discussion

The three alien fish species detected during this survey are commonly referred to as Guppies, Platys and Swordtails and are small-bodied fishes that have likely been introduced to the mid-Barron-River Catchment from a combination of discards from private aquaria and deliberate stockings into farm dams and ornamental ponds. These three species are becoming increasingly common in streams of the Kuranda-Speewah region (B. C. Ebner, TropWATER, James Cook University, unpubl. data) as a function of human occupancy including peri-urban development. Tropical aquarium and ornamental pond species represent a serious threat to stream ecosystems and native fish assemblages specifically in the Wet Tropics. It is recommended that on site dams and creeks not be stocked with alien species or native species that are not endemic to the mid-Barron catchment.

Of the native fishes, the most notable detections were those of *Anguilla megastoma*, *Ambassis* sp. and *Oxyeleotris selheimi*. Currently, there is only a single published record of the eel *Anguilla megastoma* from Australia based on collection of a large individual from the mid-Daintree-River catchment (Pusey *et al.* 1996). More recently there have been a series of observations of this species in the Wet Tropics especially above waterfalls and on escarpments (B. C. Ebner and J. A. Donaldson, TropWATER, James Cook University, unpubl. data) and a specimen has been deposited in the Northern Territory Museum. *Anguilla megastoma* is essentially an upland species of tropical Pacific Island Streams in the Pacific Ocean (Marquet *et al.* 2003).

The glassfish which was captured at a single site resembles that of *Ambassis agrammus.* We have sent specimens off for genetic analysis since these fish were clearly not *Ambassis macleayi* as is usually found in the mid-Barron catchment. The outcome of the genetic analysis will give us an indication of whether this species is a translocation. Similarly, the single giant gudgeon *Oxyeleotris selheimi* collected in this survey is likely the result of translocation to the area as it is historically known from the Gulf of Carpentaria rivers and catchments from about Cooktown northward on the east coast of Queensland (Allen *et al.* 2002, Pusey *et al.* 2004). This species is a series predator (can attain 55 cm TL) (Allen *et al.* 2002) and should not be encouraged in Wet Tropics streams to which it is foreign. It would be advisable to survey any farm dams on the property or in the relevant sub-catchments to determine if the giant gudgeon is established in these habitats and potentially to eradicate it.

There was no indication of the presence of the EPBC listed Lake Eacham Rainbowfish at the survey sites. All rainbowfishes captured were almost certainly the more common Eastern Rainbowfish, *Melanotaenia splendida*. However, to confirm these visual identifications specimens have been sent off for genetic analysis. There is considerable hybridization among rainbowfishes in some parts of the Atherton Tablelands, rendering it imperative that field results are confirmed by genetic techniques (e.g. Unmack *et al.* 2016). Lake Eacham rainbowfish are generally found higher than 600 m above sea level, and it is therefore unlikely that this species occurs on the KurWorld property.

Also of note in the current survey was the relatively common occurrence of the crayfish, *Cherax wasseli*. It was detected at 5 of 8 survey sites and burrows were visible at most sites. This species is a locally endemic species found in the Kuranda and Speewah region at least north to Black Mountain (B. C. Ebner, Unpubl. data). Damage to the stream banks as caused by pigs and to some extent cattle, is of potential threat to the crayfish. Pigs also likely directly consume the crayfish as food. While pig damage was by no means extensive at the stream sites that were visited at Kurworld, it is important to maintain adequate pig control and cattle exclusion from stream banks.

Recommendations

Continue to minimize cattle access to stream banks, and control pig numbers on the property.

Maintain an on-property awareness of the environmental benefit of not releasing fish species including native species from elsewhere, into waterways including dams on the property.

Determine if alien and translocated fish species exist in any farm dams on the Kurworld property, and endeavor to remove these species and replace with native fishes from nearby streams.

The owners of the property might also be interested in engaging James Cook University Researcher, Dr Brendan Ebner in any follow up study of the rare eel *Anguilla megastoma* and the locally endemic crayfish, *Cherax wasseli*, on the property in regard to understanding their habitat use. The latter species in particular would make a useful long term indicator of stream bank condition and riparian zone quality.

Acknowledgments

All bycatch species were released unharmed. Fishes were surveyed under General Fisheries Permit 187102 and the James Cook University Animal Ethics Permit A2178. We acknowledge the traditional owners of the area at which this survey took place.

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Appendices

Appendix 1: Summary of site based survey data.

SITE	**SW01**		**SW02**		**SW03**		**SW06**		**SW08**		**SW09**		**SW1B**		**SW2B**		**Total**	
C = caught; CO = caught and observed	C	CO	C	CO	C	CO	C	CO	C	CO	C	CO	C	CO	C	CO	C	CO
Species																		
Marbled Eel*, Anguilla reinhardtii*	1	1	1	1	0	0	0	0	0	0	0	0	2	2	0	0	4	4
Polynesian Short-finned Eel*, Anguilla megastoma*	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	2	2
Eastern Rainbowfish*, Melanotaenia splendida*	54	84	32	40	48	52	41	51	16	22	44	84	43	83	46	147	324	563
Northern Purple-spotted gudgeon, *Mogurnda mogurnda*	13	23	38	43	24	27	17	27	23	33	39	15	62	77	51	152	267	397
Mouth Almighty*, Glossamia aprion*	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
Glassfish*, Ambassis* sp.	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5
Giant Gudgeon*, Oxyeleotris selheimi*	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Guppy*, Poecilia reticulata*	0	0	3	6	2	2	4	8	21	31	32	72	94	174	0	0	156	293
Platy*, Xiphophorus maculatus*	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Swordtail*, Xiphophorus helleri*	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	2	2
Crayfish*, Cherax wasseli*	0	0	0	0	0	0	0	2	4	5	3	5	7	9	1	3	15	24
Prawns, *Macrobrachium* spp.	3	6	0	0	0	0	0	0	0	0	3	5	0	0	0	0	6	11
Shrimps, Atyidae	0	0	0	101	1	21	1	1	0	0	1	6	0	0	5	25	8	154
Tadpoles (unidentified multiple species)	0	12	1	1	1	1	1	16	5	25	4	421	1	11	1	1	14	488
Wood Frog*, Hylarana daemeli*	1	0	0	0	0	0	0	0	0	0	2	2	1	1	0	0	4	3
Waterdragon, *Intellagama lesueurii*	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	1
Macleays Water Python*, Pseudoferania polylepis*	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Total fish	77	118	75	91	77	84	62	86	60	86	115	171	201	336	98	300	765	1272

Appendix G:
Aquatic Ecology Fish Survey Taxa List

Aquatic Ecology Fish Survey Taxa List (Source: Ebner & Vallance 2017)

Species	**Total length (mm)**		**Native/ Exotic**	**Site:**	**SW01**		**SW02**		**SW03**		**SW06**		**SW08**		**SW09**		**SW1B**		**SW2B**		**Total**	
	Min.	**Max.**		**Date:**	**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**	
					C	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**
Marbled Eel *Anguilla reinhardtii*	340	650	Native		1	1	1	1	-	-	-	-	-	-	-	-	2	2	-	-	4	4
Polynesian Long-finned Eel* *Anguilla megastoma*	500	840	Native		-	-	-	-	1	1	-	-	-	-	-	-	-	-	1	1	2	2
Eastern Rainbowfish *Melanotaenia splendida*	15	65	Native		54	84	32	40	48	52	41	51	16	22	44	84	43	83	46	147	324	563
Northern Purple-spotted Gudgeon *Mogurnda mogurnda*	20	120	Native		13	23	38	43	24	27	17	27	23	33	39	15	62	77	51	152	267	397
Mouth Almighty *Glossamia aprion*	25	70	Native		4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4
Glassfish *Ambassis* sp.	40	50	Native		4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5
Giant Gudgeon *Oxyeleotris selheimi*	160	160	Native		1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Guppy *Poecilia reticulata*	14	38	Exotic		-	-	3	6	2	2	4	8	21	31	32	72	94	174	-	-	156	293
Platy *Xiphophorus maculatus*	32	32	Exotic		-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Swordtail *Xiphophorus helleri*	35	40	Exotic		-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	2	2
Crayfish *Cherax wasseli*	25	65	Native		-	-	-	-	-	-	-	2	4	5	3	5	7	9	1	3	15	24
Prawns *Macrobrachium* spp.	50	75	Native		3	6	-	-	-	-	-	-	-	-	3	5	-	-	-	-	6	11
Shrimps Atyidae	15	20	Native		-	-	-	101	1	21	1	1	-	-	1	6	-	-	5	25	8	154

Species	**Total length (mm)**		**Native/ Exotic**	**Site:**	**SW01**		**SW02**		**SW03**		**SW06**		**SW08**		**SW09**		**SW1B**		**SW2B**		**Total**	
				Date:	**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**		**12/6/17**	
	Min.	**Max.**			**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**	**C**	**CO**
Tadpoles (multiple unidentified species)	15	80	Native		-	12	1	1	1	1	1	16	5	25	4	421	1	11	1	1	14	488
Wood Frog *Hylarana daemeli*	50	65	Native		1	-	-	-	-	-	-	-	-	-	2	2	1	1	-	-	4	3
Waterdragon *Intellagama lesueurii*	450	450	Native		-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	1	1
Macleays Water Python *Pseudoferania polylepis*	550	550	Native		-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Total fish					77	118	75	91	77	84	62	86	60	86	115	171	201	336	98	300	765	1272

C = Caught, CO = Caught and Observed.

*Incorrectly labelled as Polynesian Short-finned Eel in Ebner and Vallance 2017 (**Appendix F** to the main report).

Appendix H:
Groundwater Laboratory Documentation

CE125368

SGS Cairns Environmental

CE125368 COC
Received: 01-Feb-2017

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Reference Number: ____________ *(AEL Office use only)*

Page ____ **of** ____

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER			Please see attached sheet										
	WB2			✓				✓				✓											
	WB5			✓				✓				✓											
	WB6			✓				✓				✓											
	WB7			✓				✓				✓											
	WB8			✓				✓				✓											

Company Name: Rob Lait and Associates Pty Ltd
Address: PO Box 788
INNISFAIL Qld 4860
Contact Name: Rob Lait
Telephone: 409261460

Client Order Number:
Project Name: Kur World
Project Number:
Results Required By: ASAP
Facsimile: 07 4061 8094

Laboratory Contact:
Laboratory Quotation Number:
Total Number of Samples: 5

Relinquished by: **Date:** 1/2/17 **Time:** 0930 **Received by:** **Date:** **Time:**

Relinquished by: **Date:** **Time:** **Received by:** **Date:** **Time:**

Samples Intact: YES/NO* **Temperature:** AMBIENT/CHILLED* **Sample Cooler Sealed:** YES/NO*

	Parameter	LOR (mg/L)	
✓	Total Suspended Solids	1	LL TSS - requires full 500ml just for this test - request TSS LL on cofc
✓	Total Dissolved Solids	10	
✓	Total Nitrogen	0.05	
✓	Total Phosphorus - ultra trace	0.01	Have to request TP (LL) on cofc
✓	Nitrate and Nitrite as N (Nox) - Ultra Trace	0.005	
✓	Total Kjeldahl Nitrogen	0.05	
✓	Dissolved Inorganic Nitrogen	0.05	calc NH3 and TON
✓	Ammonia - Ultra Trace	0.005	
✓	Filterable Reactive Phosphorus - Ultra Trace	0.005	
✓	Hardness	1	
✓	Alkalinity	5	
✓	Major Ions	1	
✓	Aluminium (total)	0.005	
	Aluminium (field filtered)	0.005	
✓	Arsenic (total)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
✓	Arsenic (field filtered)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
✓	Cadmium (total)	0.0001	
✓	Cadmium (field filtered)	0.0001	
✓	Chromium (total)	0.001	
✓	Chromium (field filtered)	0.001	
✓	Copper (total)	0.001	
✓	Copper (field filtered)	0.001	
✓	Iron (total)	0.05	
✓	Iron (field filtered)	0.05	
✓	Lead (total)	0.001	
✓	Lead (field filtered)	0.001	
✓	Manganese (total)	0.001	Have to request special LOR on cofc - normally 0.005
✓	Manganese (field filtered)	0.001	Have to request special LOR on cofc - normally 0.005
✓	Nickel (total)	0.001	
✓	Nickel (field filtered)	0.001	
✓	Zinc (total)	0.005	
✓	Zinc (field filtered)	0.005	

SAMPLE RECEIPT ADVICE

CE125368

CLIENT DETAILS

Contact	Martine Newman
Client	Natural Resource Assessments Pty Ltd
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4031 5122
Facsimile	07 4051 6740
Email	martine@natres.com.au
Project	**424103.01_KUR-World WQ Monitoring**
Order Number	(Not specified)
Samples	5

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Wed 1/2/2017
Report Due	Fri 10/2/2017
SGS Reference	**CE125368**

SUBMISSION DETAILS

This is to confirm that 5 samples were received on Wednesday 1/2/2017. Results are expected to be ready by Friday 10/2/2017. Please quote SGS reference CE125368 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	5 Waters
Date documentation received	1/2/2017	Type of documentation received	COC
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Filterable Reactive Phosphorus (FRP)	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	pH in water	TKN Kjeldahl Digestion by Discrete Analyser	Total Phosphorus by Kjeldahl Digestion DA in
001	WB2	4	1	1	1	1	1	1	2	1
002	WB5	4	1	1	1	1	1	1	2	1
003	WB6	4	1	1	1	1	1	1	2	1
004	WB7	4	1	1	1	1	1	1	2	1
005	WB8	4	1	1	1	1	1	1	2	1

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CE125368

CLIENT DETAILS

Client Natural Resource Assessments Pty Ltd

Project 424103.01_KUR-World WQ Monitoring

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	WB2	1	9	3	6	6	1	1	1	1
002	WB5	1	9	3	6	6	1	1	1	1
003	WB6	1	9	3	6	6	1	1	1	1
004	WB7	1	9	3	6	6	1	1	1	1
005	WB8	1	9	3	6	6	1	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Rob Lait
Client	Rob Lait & Associates
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4061 3103
Facsimile	07 4061 8094
Email	rob@roblait.com.au
Project	**KUR-World**
Order Number	(Not specified)
Samples	5

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE125368 R0**
Date Received	01 Feb 2017
Date Reported	10 Feb 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE161630.

SIGNATORIES

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

		Sample Number	CE125368.001	CE125368.002	CE125368.003	CE125368.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	31 Jan 2017	31 Jan 2017	31 Jan 2017	31 Jan 2017
		Sample Name	WB2	WB5	WB6	WB7
Parameter	Units	LOR				

pH in water Method: AN101 Tested: 1/2/2017

pH**	pH Units	0.1	**6.9**	**6.3**	**6.4**	**6.6**

Alkalinity Method: AN135 Tested: 1/2/2017

Total Alkalinity as CaCO3	mg/L	5	**88**	**23**	**33**	**45**
Bicarbonate Alkalinity as CaCO3	mg/L	5	**88**	**23**	**33**	**45**
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 1/2/2017

Chloride, Cl	mg/L	1	**18**	**9**	**59**	**45**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 9/2/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.82**	**0.87**	**0.70**	**0.033**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 7/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005	**0.005**	**0.006**	**0.014**

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 2/2/2017

Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	<0.05	**0.11**	**0.11**
Total Nitrogen (calc)	mg/L	0.05	**0.82**	**0.87**	**0.81**	**0.14**

		Sample Number	CE125368.001	CE125368.002	CE125368.003	CE125368.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	31 Jan 2017	31 Jan 2017	31 Jan 2017	31 Jan 2017
		Sample Name	WB2	WB5	WB6	WB7
Parameter	Units	LOR				

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 10/2/2017

Total InorganicNitrogen (calc)	mg/L	0.01	0.82	0.87	0.71	0.05

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 6/2/2017

Filterable Reactive Phosphorus	mg/L	0.005	0.011	0.024	0.036	0.059

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 2/2/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.02	0.04	0.03	0.06

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 6/2/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	<1	2

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 7/2/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	150	71	190	180

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 3/2/2017

Aluminium, Al	mg/L	0.005	<0.005	0.020	<0.005	<0.005
Iron, Fe	mg/L	0.005	0.018	0.007	0.013	0.19
Zinc, Zn	mg/L	0.005	0.017	0.040	0.054	0.058

		Sample Number	CE125368.001	CE125368.002	CE125368.003	CE125368.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	31 Jan 2017	31 Jan 2017	31 Jan 2017	31 Jan 2017
		Sample Name	WB2	WB5	WB6	WB7
Parameter	Units	LOR				

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 3/2/2017

Total Aluminium	mg/L	0.005	<0.005	0.066	0.005	0.025
Total Hardness*	mg CaCO3/L	5	64	14	47	51
Total Calcium	mg/L	0.05	19	2.7	6.9	9.6
Total Iron	mg/L	0.005	0.028	0.057	0.023	0.23
Total Magnesium	mg/L	0.05	4.2	1.8	7.3	6.6
Total Potassium	mg/L	0.05	1.6	1.2	1.3	1.4
Total Sodium	mg/L	0.5	16	7.3	27	24
Total Sulphur as SO4	mg/L	0.5	7.5	1.0	2.2	5.5
Total Zinc	mg/L	0.005	0.019	0.043	0.056	0.065

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 2/2/2017

Arsenic, As	mg/L	0.001	0.003	0.002	0.002	0.004

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 2/2/2017

Total Arsenic	mg/L	0.001	0.003	0.002	0.002	0.004

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 3/2/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	0.003	0.005	0.002
Lead, Pb	mg/L	0.001	<0.001	<0.001	0.001	0.002
Manganese, Mn	mg/L	0.001	0.11	0.014	0.017	0.18
Nickel, Ni	mg/L	0.001	0.004	0.001	0.003	0.003

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 3/2/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	0.004	0.005	0.003
Total Lead, Pb	mg/L	0.001	<0.001	0.002	0.002	0.004
Total Manganese, Mn*	mg/L	0.001	0.11	0.014	0.017	0.18
Total Nickel, Ni	mg/L	0.001	0.003	0.001	0.003	0.003

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 10/2/2017

Anion-Cation Balance	%	-100	-10	-11	-5.4	-5.0

Parameter	Units	LOR	
		Sample Number	CE125368.005
		Sample Matrix	Water
		Sample Date	31 Jan 2017
		Sample Name	WB8

pH in water Method: AN101 Tested: 1/2/2017

pH**	pH Units	0.1	**5.4**

Alkalinity Method: AN135 Tested: 1/2/2017

Total Alkalinity as CaCO3	mg/L	5	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 1/2/2017

Chloride, Cl	mg/L	1	**17**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 9/2/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**1.5**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 7/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 2/2/2017

Total Kjeldahl Nitrogen	mg/L	0.05	**0.07**
Total Nitrogen (calc)	mg/L	0.05	**1.5**

		Sample Number	CE125368.005
		Sample Matrix	Water
		Sample Date	31 Jan 2017
		Sample Name	WB8
Parameter	Units	LOR	

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 10/2/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**1.5**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 6/2/2017

Filterable Reactive Phosphorus	mg/L	0.005	**0.014**

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 2/2/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 6/2/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	**3**

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 7/2/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**85**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 3/2/2017

Aluminium, Al	mg/L	0.005	**0.48**
Iron, Fe	mg/L	0.005	**0.013**
Zinc, Zn	mg/L	0.005	**0.067**

		Sample Number	CE125368.005
		Sample Matrix	Water
		Sample Date	31 Jan 2017
		Sample Name	WB8
Parameter	Units	LOR	

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 3/2/2017

Total Aluminium	mg/L	0.005	**0.66**
Total Hardness*	mg CaCO3/L	5	**10**
Total Calcium	mg/L	0.05	**1.1**
Total Iron	mg/L	0.005	**0.053**
Total Magnesium	mg/L	0.05	**1.7**
Total Potassium	mg/L	0.05	**1.8**
Total Sodium	mg/L	0.5	**6.8**
Total Sulphur as SO4	mg/L	0.5	<0.5
Total Zinc	mg/L	0.005	**0.077**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 2/2/2017

Arsenic, As	mg/L	0.001	**0.001**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 2/2/2017

Total Arsenic	mg/L	0.001	**0.001**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 3/2/2017

Cadmium, Cd	mg/L	0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010
Copper, Cu	mg/L	0.001	**0.009**
Lead, Pb	mg/L	0.001	**0.004**
Manganese, Mn	mg/L	0.001	**0.057**
Nickel, Ni	mg/L	0.001	**0.002**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 3/2/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001
Total Copper, Cu	mg/L	0.001	**0.011**
Total Lead, Pb	mg/L	0.001	**0.005**
Total Manganese, Mn*	mg/L	0.001	**0.070**
Total Nickel, Ni	mg/L	0.001	**0.002**

Parameter	Units	LOR	
		Sample Number	CE125368.005
		Sample Matrix	Water
		Sample Date	31 Jan 2017
		Sample Name	WB8
Calculation of Anion-Cation Balance (SAR Calc) **Method: AN121**	**Tested: 10/2/2017**		
Anion-Cation Balance	%	-100	**-11**

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	LB043126	mg/L	5	<5	1 - 5%	111%
Bicarbonate Alkalinity as CaCO3	LB043126	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB043126	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB043126	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB043249	mg/L	0.005	<0.005	0 - 6%	99 - 102%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB043125	mg/L	1	<1	0%	109%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB043251	mg/L	0.005	<0.005	0 - 2%	99 - 101%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB043193	mg/L	0.005	0 - 2%	100%	112%
Total Calcium	LB043193	mg/L	0.05	1%	102%	
Total Iron	LB043193	mg/L	0.005	1 - 5%	106%	106%
Total Magnesium	LB043193	mg/L	0.05	0%	100%	
Total Potassium	LB043193	mg/L	0.05	0%	104%	
Total Sodium	LB043193	mg/L	0.5	0%	96%	
Total Sulphur as SO4	LB043193	mg/L	0.5	7%	100%	
Total Zinc	LB043193	mg/L	0.005	0 - 1%	108%	113%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB043192	mg/L	0.005	<0.005	0 - 1%	101%	114%
Iron, Fe	LB043192	mg/L	0.005	<0.005	0 - 1%	107%	115%
Zinc, Zn	LB043192	mg/L	0.005	<0.005	0 - 1%	109%	116%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB043194	mg/L	0.0001	<0.0001	0%	95%	109%
Chromium, Cr	LB043194	mg/L	0.001	<0.0010	0%	95%	95%
Copper, Cu	LB043194	mg/L	0.001	<0.001	0 - 8%	93%	107%
Lead, Pb	LB043194	mg/L	0.001	<0.001	5 - 6%	97%	89%
Manganese, Mn	LB043194	mg/L	0.001	<0.001	0%	NA	
Nickel, Ni	LB043194	mg/L	0.001	<0.001	0 - 1%	101%	89%

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB043195	mg/L	0.0001	<0.0001	0%	95%	108%
Total Chromium, Cr	LB043195	mg/L	0.001	<0.001	0%	92%	92%
Total Copper, Cu	LB043195	mg/L	0.001	<0.001	4%	99%	111%
Total Lead, Pb	LB043195	mg/L	0.001	<0.001	3%	98%	92%
Total Manganese, Mn*	LB043195	mg/L	0.001	<0.001	0%	NA	
Total Nickel, Ni	LB043195	mg/L	0.001	<0.001	3%	98%	86%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB043283	mg/L	0.005	<0.005	0 - 4%	100 - 102%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
pH**	LB043126	pH Units	0.1	5.6	100%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB043138	mg/L	0.05	<0.05	3%	97%

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	LB043256	mg/L	1	<1	0%	93%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB043315	mg/L	10	<10	1 - 2%	99%	109%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB043138	mg/L	0.02	<0.02	1%	104%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Arsenic, As	LB043160	mg/L	0.001	<0.001	200%	NA

QC SUMMARY

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.

Trace Metals (Total) in Water by ICPMS in mg/L   Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Arsenic	LB043164	mg/L	0.001	<0.001	0%	NA

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
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 µmhos/cm or µS/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 calculation 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.
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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH, and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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. APHA4500CO2 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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

SGS Cairns Environmental
CE126251 COC
Received: 14-Mar-2017

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Reference Number: CE126251
(AEL Office use only)

Page ___ **of** ___

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER			Please see attached sheet										
	WB5			✓				✓				✓											
	WB6			✓				✓				✓											
	WB8			✓				✓				✓											

3x125AW Ⓣ
3x125AW Ⓕ
3x1L NP
3x500NP

Company Name: Rob Lait and Associates Pty Ltd
Address: PO Box 788
INNISFAIL Qld 4860

Contact Name: Rob Lait
Telephone: 409261460

Client Order Number:
Project Name: Kur World
Project Number:

Results Required By: ASAP
Facsimile: 07 4061 8094

Laboratory Contact:

Laboratory Quotation Number:

Total Number of Samples: 3

Relinquished by: **Date:** 13/3/2017 **Time:** 1615 **Received by:** **Date:** 13/3/17 **Time:** 4:30pm

Relinquished by: ______ **Date:** ______ **Time:** ______ **Received by:** ______ **Date:** ______ **Time:** ______

Samples Intact: [✓ YES]/NO* **Temperature:** AMBIENT/[✓ CHILLED]* **Sample Cooler Sealed:** [✓ YES]/NO*

COMMENTS: C/- Rob Lait and Associates Pty Ltd, INNISFAIL tel: 0409 261 460

* Cross out whichever is not applicable

Parameter	LOR (mg/L)	
Total Suspended Solids	1	LL TSS - requires full 500ml just for this test - request TSS LL on cofc
Total Dissolved Solids	10	
Total Nitrogen	0.05	
Total Phosphorus - ultra trace	0.01	Have to request TP (LL) on cofc
Nitrate and Nitrite as N (Nox) - Ultra Trace	0.005	
Total Kjeldahl Nitrogen	0.05	
Dissolved Inorganic Nitrogen	0.05	calc NH3 and TON
Ammonia - Ultra Trace	0.005	
Filterable Reactive Phosphorus - Ultra Trace	0.005	
Hardness	1	
Alkalinity	5	
Major Ions	1	
Aluminium (total)	0.005	
Aluminium (field filtered)	0.005	
Arsenic (total)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Arsenic (field filtered)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Cadmium (total)	0.0001	
Cadmium (field filtered)	0.0001	
Chromium (total)	0.001	
Chromium (field filtered)	0.001	
Copper (total)	0.001	
Copper (field filtered)	0.001	
Iron (total)	0.05	
Iron (field filtered)	0.05	
Lead (total)	0.001	
Lead (field filtered)	0.001	
Manganese (total)	0.001	Have to request special LOR on cofc - normally 0.005
Manganese (field filtered)	0.001	Have to request special LOR on cofc - normally 0.005
Nickel (total)	0.001	
Nickel (field filtered)	0.001	
Zinc (total)	0.005	
Zinc (field filtered)	0.005	

SAMPLE RECEIPT ADVICE

CE126251

CLIENT DETAILS

Contact	Rob Lait
Client	Rob Lait & Associates
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4061 3103
Facsimile	07 4061 8094
Email	rob@roblait.com.au
Project	**KUR-World**
Order Number	(Not specified)
Samples	3

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Tue 14/3/2017
Report Due	Thu 23/3/2017
SGS Reference	**CE126251**

SUBMISSION DETAILS

This is to confirm that 3 samples were received on Tuesday 14/3/2017. Results are expected to be ready by Thursday 23/3/2017. Please quote SGS reference CE126251 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	3 Waters
Date documentation received	14/3/2017	Type of documentation received	COC
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Rob Lait & Associates

Project KUR-World

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Filterable Reactive Phosphorus (FRP)	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	pH in water	TKN Kjeldahl Digestion by Discrete Analyser	Total Phosphorus by Kjeldahl Digestion DA in
001	WB5	4	1	1	1	1	1	1	2	1
002	WB6	4	1	1	1	1	1	1	2	1
003	WB8	4	1	1	1	1	1	1	2	1

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CE126251

CLIENT DETAILS

Client Rob Lait & Associates

Project KUR-World

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	WB5	1	9	3	6	6	1	1	1	1
002	WB6	1	9	3	6	6	1	1	1	1
003	WB8	1	9	3	6	6	1	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Rob Lait
Client	Rob Lait & Associates
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4061 3103
Facsimile	07 4061 8094
Email	rob@roblait.com.au
Project	**KUR-World**
Order Number	(Not specified)
Samples	3

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE126251 R0**
Date Received	14 Mar 2017
Date Reported	27 Mar 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE163199.
For determination of soluble metals, filtered sample was not received so samples were laboratory filtered on receipt. This may give soluble metals results that do not represent the concentrations present at the time of sampling.

SIGNATORIES

Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Maristela Ganzan
Metals Team Leader

			Sample Number Sample Matrix Sample Date Sample Name	CE126251.001 Water 13/3/17 12:30 WB5	CE126251.002 Water 13/3/17 10:30 WB6	CE126251.003 Water 13/3/17 11:50 WB8
Parameter	Units	LOR				

pH in water Method: AN101 Tested: 14/3/2017

pH**	pH Units	0.1	**7.1**	**6.4**	**5.3**

Alkalinity Method: AN135 Tested: 14/3/2017

Total Alkalinity as CaCO3	mg/L	5	**100**	**37**	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	**100**	**37**	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 16/3/2017

Chloride, Cl	mg/L	1	**10**	**57**	**17**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 21/3/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.11**	**0.65**	**1.5**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 20/3/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.073**	<0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 15/3/2017

Total Kjeldahl Nitrogen	mg/L	0.05	**0.08**	<0.05	<0.05
Total Nitrogen (calc)	mg/L	0.05	**0.19**	**0.65**	**1.5**

		Sample Number	CE126251.001	CE126251.002	CE126251.003
		Sample Matrix	Water	Water	Water
		Sample Date	13/3/17 12:30	13/3/17 10:30	13/3/17 11:50
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 27/3/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.18**	**0.65**	**1.5**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 17/3/2017

Filterable Reactive Phosphorus	mg/L	0.005	**0.027**	**0.032**	**0.010**

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 15/3/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.05**	**0.07**	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 15/3/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	<1

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 15/3/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**150**	**200**	**86**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 20/3/2017

Aluminium, Al	mg/L	0.005	<0.005	<0.005	**0.58**
Iron, Fe	mg/L	0.005	**0.56**	**0.042**	**0.009**
Zinc, Zn	mg/L	0.005	**0.010**	**0.029**	**0.040**

Parameter	Units	LOR	Sample Number	CE126251.001	CE126251.002	CE126251.003
			Sample Matrix	Water	Water	Water
			Sample Date	13/3/17 12:30	13/3/17 10:30	13/3/17 11:50
			Sample Name	WB5	WB6	WB8

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 20/3/2017

Parameter	Units	LOR	CE126251.001	CE126251.002	CE126251.003
Total Aluminium	mg/L	0.005	<0.005	<0.005	**0.67**
Total Hardness*	mg CaCO3/L	5	**59**	**51**	**10**
Total Calcium	mg/L	0.05	**16**	**7.5**	**1.0**
Total Iron	mg/L	0.005	**0.60**	**0.051**	**0.038**
Total Magnesium	mg/L	0.05	**4.4**	**7.8**	**1.7**
Total Potassium	mg/L	0.05	**1.6**	**1.3**	**1.6**
Total Sodium	mg/L	0.5	**13**	**27**	**6.1**
Total Sulphur as SO4	mg/L	0.5	**6.7**	**2.2**	<0.5
Total Zinc	mg/L	0.005	**0.011**	**0.041**	**0.051**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 17/3/2017

Parameter	Units	LOR	CE126251.001	CE126251.002	CE126251.003
Arsenic, As	mg/L	0.001	**0.018**	**0.002**	**0.001**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 17/3/2017

Parameter	Units	LOR	CE126251.001	CE126251.002	CE126251.003
Total Arsenic	mg/L	0.001	**0.019**	**0.002**	**0.002**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 20/3/2017

Parameter	Units	LOR	CE126251.001	CE126251.002	CE126251.003
Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	**0.003**	**0.007**
Lead, Pb	mg/L	0.001	<0.001	**0.001**	**0.005**
Manganese, Mn	mg/L	0.001	**0.16**	**0.023**	**0.063**
Nickel, Ni	mg/L	0.001	<0.001	**0.003**	**0.002**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 20/3/2017

Parameter	Units	LOR	CE126251.001	CE126251.002	CE126251.003
Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	**0.004**	**0.008**
Total Lead, Pb	mg/L	0.001	**0.001**	**0.001**	**0.005**
Total Manganese, Mn*	mg/L	0.001	**0.16**	**0.021**	**0.065**
Total Nickel, Ni	mg/L	0.001	<0.001	**0.003**	**0.002**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 27/3/2017

Parameter	Units	LOR	CE126251.001	CE126251.002	CE126251.003
Anion-Cation Balance	%	-100	**-16**	**-4.8**	**-13**

QC SUMMARY

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	LB044394	mg/L	5	<5	0 - 1%	118%
Bicarbonate Alkalinity as CaCO3	LB044394	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB044394	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB044394	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB044540	mg/L	0.005	<0.005	0 - 2%	100 - 115%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB044440	mg/L	1	<1	0 - 1%	108%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB044488	mg/L	0.005	<0.005	7%	96%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB044508	mg/L	0.005	1 - 10%	98 - 100%	
Total Calcium	LB044508	mg/L	0.05	0%	109 - 111%	
Total Iron	LB044508	mg/L	0.005	3 - 13%	110 - 112%	
Total Magnesium	LB044508	mg/L	0.05	0%	107 - 111%	
Total Potassium	LB044508	mg/L	0.05	0%	103 - 105%	
Total Sodium	LB044508	mg/L	0.5	1%	99 - 101%	
Total Sulphur as SO4	LB044508	mg/L	0.5	1 - 11%	103 - 107%	
Total Zinc	LB044508	mg/L	0.005	1 - 4%	114%	110%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB044507	mg/L	0.005	<0.005	0%	95%	
Iron, Fe	LB044507	mg/L	0.005	<0.005	0%	107%	
Zinc, Zn	LB044507	mg/L	0.005	<0.005	0%	112%	108%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB044509	mg/L	0.0001	<0.0001	0%	102%	100%
Chromium, Cr	LB044509	mg/L	0.001	<0.0010	0%	102%	
Copper, Cu	LB044509	mg/L	0.001	<0.001	0%	93%	122%
Lead, Pb	LB044509	mg/L	0.001	<0.001	0%	103%	97%
Manganese, Mn	LB044509	mg/L	0.001	<0.001		NA	
Nickel, Ni	LB044509	mg/L	0.001	<0.001	0%	106%	

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB044510	mg/L	0.0001	<0.0001	0%	100 - 102%	103%
Total Chromium, Cr	LB044510	mg/L	0.001	<0.001	0%	99%	
Total Copper, Cu	LB044510	mg/L	0.001	<0.001	0%	91 - 93%	105%
Total Lead, Pb	LB044510	mg/L	0.001	<0.001	0%	102 - 103%	96 - 106%
Total Manganese, Mn*	LB044510	mg/L	0.001	<0.001		NA	
Total Nickel, Ni	LB044510	mg/L	0.001	<0.001	0%	104 - 105%	94%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB044560	mg/L	0.005	<0.005	0 - 1%	104 - 105%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB044394	pH Units	0.1	5.7	0 - 5%	100%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB044408	mg/L	0.05	<0.05	1 - 2%	98 - 99%

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	LB044402	mg/L	1	<1	0 - 13%	102%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB044407	mg/L	10	<10	1 - 2%	103%	100%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB044408	mg/L	0.02	<0.02	0 - 4%	103 - 112%

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

Parameter	QC Reference	Units	LOR	DUP %RPD
Arsenic, As	LB044473	mg/L	0.001	0%

QC SUMMARY

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.

Trace Metals (Total) in Water by ICPMS in mg/L   Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Arsenic	LB044477	mg/L	0.001	0%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
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 µmhos/cm or µS/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 calculation 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.
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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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SGS Cairns Environmental
CE127244 COC
Received: 08 – May – 2017

HAIN OF CUSTODY & ANALYSIS REQUEST

Job Reference Number: CE127244 *(AEL Office use only)*

Page ____ **of** ____

Laboratory ID	Client SAMPLE ID	Sample Date	Matrix				Preservation Method					Analysis Required:											Comments:
			SOIL	WATER	OTHER		NONE	ICE	ACID	OTHER			Please see attached sheet										
	WB5			✓				✓				✓											
	WB6			✓				✓				✓											
	WB8			✓				✓				✓											

Company Name: Rob Lait and Associates Pty Ltd
Address: PO Box 788
INNISFAIL Qld 4860
Contact Name: Rob Lait
Telephone: 409261460

Client Order Number:
Project Name: Kur World
Project Number:
Results Required By: ASAP
Facsimile: 07 4061 8094

Laboratory Contact:
Laboratory Quotation Number:
Total Number of Samples: 3

Relinquished by: Date: 8/5/17 Time: 13:45 **Received by:** Date: Time:

Relinquished by: Date: Time: **Received by:** Date: 8/5/17 Time: 13:50

Samples Intact: [✓ YES]/NO* **Temperature:** AMBIENT/[✓ CHILLED]* **Sample Cooler Sealed:** [✓ YES]/NO*

COMMENTS: C/- Rob Lait and Associates Pty Ltd, INNISFAIL tel: 0409 261 460

* Cross out whichever is not applicable

Parameter	LOR (mg/L)	
Total Suspended Solids	1	LL TSS - requires full 500ml just for this test - request TSS LL on cofc
Total Dissolved Solids	10	
Total Nitrogen	0.05	
Total Phosphorus - ultra trace	0.01	Have to request TP (LL) on cofc
Nitrate and Nitrite as N (Nox) - Ultra Trace	0.005	
Total Kjeldahl Nitrogen	0.05	
Dissolved Inorganic Nitrogen	0.05	calc NH3 and TON
Ammonia - Ultra Trace	0.005	
Filterable Reactive Phosphorus - Ultra Trace	0.005	
Hardness	1	
Alkalinity	5	
Major Ions	1	
Aluminium (total)	0.005	
Aluminium (field filtered)	0.005	
Arsenic (total)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Arsenic (field filtered)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard
Cadmium (total)	0.0001	
Cadmium (field filtered)	0.0001	
Chromium (total)	0.001	
Chromium (field filtered)	0.001	
Copper (total)	0.001	
Copper (field filtered)	0.001	
Iron (total)	0.05	
Iron (field filtered)	0.05	
Lead (total)	0.001	
Lead (field filtered)	0.001	
Manganese (total)	0.001	Have to request special LOR on cofc - normally 0.005
Manganese (field filtered)	0.001	Have to request special LOR on cofc - normally 0.005
Nickel (total)	0.001	
Nickel (field filtered)	0.001	
Zinc (total)	0.005	
Zinc (field filtered)	0.005	

SAMPLE RECEIPT ADVICE

CE127244

CLIENT DETAILS

Contact	Rob Lait
Client	Rob Lait & Associates
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4061 3103
Facsimile	07 4061 8094
Email	rob@roblait.com.au
Project	**KUR-World**
Order Number	(Not specified)
Samples	3

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Mon 8/5/2017
Report Due	Wed 17/5/2017
SGS Reference	**CE127244**

SUBMISSION DETAILS

This is to confirm that 3 samples were received on Monday 8/5/2017. Results are expected to be ready by Wednesday 17/5/2017. Please quote SGS reference CE127244 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	3 Waters
Date documentation received	8/5/2017	Type of documentation received	COC
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client Rob Lait & Associates

Project KUR-World

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Filterable Reactive Phosphorus (FRP)	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	pH in water	TKN Kjeldahl Digestion by Discrete Analyser	Total Phosphorus by Kjeldahl Digestion DA in
001	WB5	4	1	1	1	1	2	1	2	1
002	WB6	4	1	1	1	1	2	1	2	1
003	WB8	4	1	1	1	1	2	1	2	1

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CE127244

CLIENT DETAILS

Client Rob Lait & Associates

Project KUR-World

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	WB5	1	9	3	6	6	1	1	1	1
002	WB6	1	9	3	6	6	1	1	1	1
003	WB8	1	9	3	6	6	1	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Rob Lait
Client	Rob Lait & Associates
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4061 3103
Facsimile	07 4061 8094
Email	rob@roblait.com.au
Project	**KUR-World**
Order Number	(Not specified)
Samples	3

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE127244 R0**
Date Received	08 May 2017
Date Reported	18 May 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025-Testing. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE165295.
For determination of soluble metals, filtered sample was not received so samples were laboratory filtered on receipt. This may give soluble metals results that do not represent the concentrations present at the time of sampling.

SIGNATORIES

A. Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

LOrsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE127244.001 Water 08 May 2017 WB5	CE127244.002 Water 08 May 2017 WB6	CE127244.003 Water 08 May 2017 WB8

pH in water Method: AN101/MA1490(Melb) Tested: 9/5/2017

Parameter	Units	LOR	WB5	WB6	WB8
pH**	pH Units	0.1	**6.6**	**6.3**	**5.1**

Alkalinity Method: AN135/MA1127(Melb) Tested: 9/5/2017

Parameter	Units	LOR	WB5	WB6	WB8
Total Alkalinity as CaCO3	mg/L	5	**54**	**27**	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	**54**	**27**	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 10/5/2017

Parameter	Units	LOR	WB5	WB6	WB8
Chloride, Cl	mg/L	1	**8**	**57**	**18**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 12/5/2017

Parameter	Units	LOR	WB5	WB6	WB8
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.29**	**0.76**	**1.7**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 12/5/2017

Parameter	Units	LOR	WB5	WB6	WB8
Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.051**	<0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 10/5/2017

Parameter	Units	LOR	WB5	WB6	WB8
Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	<0.05	<0.05
Total Nitrogen (calc)	mg/L	0.05	**0.29**	**0.76**	**1.7**

		Sample Number	CE127244.001	CE127244.002	CE127244.003
		Sample Matrix	Water	Water	Water
		Sample Date	08 May 2017	08 May 2017	08 May 2017
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 18/5/2017

Total InorganicNitrogen (calc)	mg/L	0.01	0.34	0.76	1.7

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 12/5/2017

Filterable Reactive Phosphorus	mg/L	0.005	0.019	0.032	0.021

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 10/5/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	0.04	0.09	0.03

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 18/5/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	4

Total Dissolved Solids (TDS) in water Method: AN113/MA1491(Melb) Tested: 10/5/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	110	170	78

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 15/5/2017

Aluminium, Al	mg/L	0.005	0.005	<0.005	0.78
Iron, Fe	mg/L	0.005	0.23	0.007	0.011
Zinc, Zn	mg/L	0.005	0.010	0.027	0.043

		Sample Number	CE127244.001	CE127244.002	CE127244.003
		Sample Matrix	Water	Water	Water
		Sample Date	08 May 2017	08 May 2017	08 May 2017
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 15/5/2017

Total Aluminium	mg/L	0.005	0.018	<0.005	0.87
Total Hardness	mg CaCO3/L	5	42	45	10
Total Calcium	mg/L	0.05	12	5.9	1.1
Total Iron	mg/L	0.005	0.45	0.013	0.039
Total Magnesium	mg/L	0.05	3.1	7.2	1.8
Total Potassium	mg/L	0.05	1.5	1.3	1.9
Total Sodium	mg/L	0.5	11	28	6.4
Total Sulphur as SO4	mg/L	0.5	3.7	2.1	<0.5
Total Zinc	mg/L	0.005	0.009	0.026	0.048

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 10/5/2017

Arsenic, As	mg/L	0.001	0.010	0.001	0.001

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 10/5/2017

Total Arsenic	mg/L	0.001	0.014	0.002	0.001

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 15/5/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	0.003	0.009
Lead, Pb	mg/L	0.001	<0.001	0.001	0.006
Manganese, Mn	mg/L	0.001	0.089	0.008	0.075
Nickel, Ni	mg/L	0.001	<0.001	0.004	0.002

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 15/5/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	0.003	0.010
Total Lead, Pb	mg/L	0.001	<0.001	0.001	0.007
Total Manganese, Mn*	mg/L	0.001	0.091	0.009	0.081
Total Nickel, Ni	mg/L	0.001	<0.001	0.004	0.002

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 18/5/2017

Anion-Cation Balance	%	-100	-2.4	-2.7	-10

QC SUMMARY

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/MA1127(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB045952	mg/L	5	<5	0 - 4%	99 - 101%
Bicarbonate Alkalinity as CaCO3	LB045952	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB045952	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB045952	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB046101	mg/L	0.005	<0.005	96%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB046002	mg/L	1	<1	0 - 1%	98 - 102%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB046120	mg/L	0.005	<0.005	1 - 2%	102%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB046135	mg/L	0.005	0%	101%	106%
Total Calcium	LB046135	mg/L	0.05	1%	105%	110%
Total Iron	LB046135	mg/L	0.005	0%	105%	110%
Total Magnesium	LB046135	mg/L	0.05	1%	103%	107%
Total Potassium	LB046135	mg/L	0.05	0%	105%	113%
Total Sodium	LB046135	mg/L	0.5	1%	99%	103%
Total Sulphur as SO4	LB046135	mg/L	0.5	1%	99%	NA
Total Zinc	LB046135	mg/L	0.005	1%	111%	114%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB046132	mg/L	0.005	<0.005	1%	101%	
Iron, Fe	LB046132	mg/L	0.005	<0.005	0%	106%	
Zinc, Zn	LB046132	mg/L	0.005	<0.005	0 - 1%	112%	113%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB046136	mg/L	0.0001	<0.0001	0%	101%	105%
Chromium, Cr	LB046136	mg/L	0.001	<0.0010	0%	99%	
Copper, Cu	LB046136	mg/L	0.001	<0.001	1%	91%	
Lead, Pb	LB046136	mg/L	0.001	<0.001	0 - 3%	101%	87%
Manganese, Mn	LB046136	mg/L	0.001	<0.001	0%	NA	
Nickel, Ni	LB046136	mg/L	0.001	<0.001	1%	104%	

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB046139	mg/L	0.0001	<0.0001	0%	101%	103%
Total Chromium, Cr	LB046139	mg/L	0.001	<0.001	0%	100%	97%
Total Copper, Cu	LB046139	mg/L	0.001	<0.001	6%	92%	104%
Total Lead, Pb	LB046139	mg/L	0.001	<0.001	0%	103%	93%
Total Manganese, Mn*	LB046139	mg/L	0.001	<0.001	8%	NA	NA
Total Nickel, Ni	LB046139	mg/L	0.001	<0.001	2%	105%	93%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB046100	mg/L	0.005	<0.005	9 - 13%	103 - 108%

QC SUMMARY

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.

pH in water **Method: ME-(AU)-[ENV]AN101/MA1490(Melb)**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB045952	pH Units	0.1	5.5 - 5.8	0 - 1%	100%

TKN Kjeldahl Digestion by Discrete Analyser **Method: ME-(AU)-[ENV]AN281**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB045992	mg/L	0.05	<0.05	1 - 7%	93 - 96%

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	LB046266	mg/L	1	<1	0 - 12%	96 - 100%

Total Dissolved Solids (TDS) in water **Method: ME-(AU)-[ENV]AN113/MA1491(Melb)**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB046007	mg/L	10	<10	0%	99 - 100%	100 - 103%

Total Phosphorus by Kjeldahl Digestion DA in Water **Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB045992	mg/L	0.01	<0.01	0 - 1%	102 - 105%

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
AN101/MA1490(Melb)	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/MA1489(Melb)	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 µmhos/cm or µS/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/MA1491(Melb)	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 calculation 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.
AN135/MA1127(Melb)	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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH, and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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. APHA4500CO2 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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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SGS Cairns Environmental

CE127992 COC

Received: 20 – Jun – 2017

CHAIN OF CUSTODY & ANALYSIS REQUEST

Job Reference Number: CE127992 *(AEL Office use only)*

Page ___ **of** ___

Laboratory ID	**Client SAMPLE ID**	**Sample Date**	**Matrix**				**Preservation Method**					**Analysis Required:**											**Comments:**
			SOIL	**WATER**	**OTHER**		**NONE**	**ICE**	**ACID**	**OTHER**		**Please see attached sheet**											
																							EXACTLY
	WB5	19/6/17		✓				✓				✓											AS LAST
	WB6	19/6/17		✓				✓				✓											JOB
	WB8	19/6/17		✓				✓				✓											

Company Name: Rob Lait and Associates Pty Ltd

Address: PO Box 788
INNISFAIL Qld 4860

Contact Name: Rob Lait

Telephone: 409261460

Client Order Number:

Project Name: Kur World

Project Number:

Results Required By: ASAP

Facsimile: 07 4061 8094

Laboratory Contact:

Laboratory Quotation Number: 6 x 500NP 3x125AW(T) 3x125AW(F)

Total Number of Samples: 3

Relinquished by: amcDonald **Date:** 20/6/17 **Time:** 0700 **Received by:** Petersons Transport **Date:** 20/6/17 **Time:**

Relinquished by: **Date:** **Time:** **Received by:** **Date:** 20/6/17 **Time:** 4:20pm

Samples Intact: YES/NO* **Temperature:** AMBIENT/CHILLED* **Sample Cooler Sealed:** YES/NO*

COMMENTS: C/- Rob Lait and Associates Pty Ltd, INNISFAIL tel: 0409 261 460

* Cross out whichever is not applicable

Parameter	LOR (mg/L)	
Total Suspended Solids	1	LL TSS - requires full 500ml just for this test - request TSS LL on cofc ✓
Total Dissolved Solids	10	✓
Total Nitrogen	0.05	✓
Total Phosphorus - ultra trace	0.01	Have to request TP (LL) on cofc ✓
Nitrate and Nitrite as N (Nox) - Ultra Trace	0.005	✓
Total Kjeldahl Nitrogen	0.05	✓
Dissolved Inorganic Nitrogen	0.05	calc NH3 and TON ✓
Ammonia - Ultra Trace	0.005	✓
Filterable Reactive Phosphorus - Ultra Trace	0.005	✓
Hardness	1	✓
Alkalinity	5	✓
Major Ions	1	✓
Aluminium (total)	0.005	✓
Aluminium (field filtered)	0.005	✓
Arsenic (total)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard ✓
Arsenic (field filtered)	0.001	Have to request special LOR on cofc - normally 0.003mg/L as standard ✓
Cadmium (total)	0.0001	✓
Cadmium (field filtered)	0.0001	✓
Chromium (total)	0.001	✓
Chromium (field filtered)	0.001	✓
Copper (total)	0.001	✓
Copper (field filtered)	0.001	✓
Iron (total)	0.05	✓
Iron (field filtered)	0.05	✓
Lead (total)	0.001	✓
Lead (field filtered)	0.001	✓
Manganese (total)	0.001	Have to request special LOR on cofc - normally 0.005 ✓
Manganese (field filtered)	0.001	Have to request special LOR on cofc - normally 0.005 ✓
Nickel (total)	0.001	✓
Nickel (field filtered)	0.001	✓
Zinc (total)	0.005	✓
Zinc (field filtered)	0.005	✓

SAMPLE RECEIPT ADVICE

CE127992

CLIENT DETAILS

Contact	Rob Lait
Client	Rob Lait & Associates
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4061 3103
Facsimile	07 4061 8094
Email	rob@roblait.com.au
Project	**KUR-World**
Order Number	(Not specified)
Samples	3

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
Samples Received	Tue 20/6/2017
Report Due	Thu 29/6/2017
SGS Reference	**CE127992**

SUBMISSION DETAILS

This is to confirm that 3 samples were received on Tuesday 20/6/2017. Results are expected to be ready by Thursday 29/6/2017. Please quote SGS reference CE127992 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	3 Waters
Date documentation received	20/6/17 4:20pm,	Type of documentation received	COC
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

SAMPLE RECEIPT ADVICE

CE127992

CLIENT DETAILS

Client Rob Lait & Associates

Project KUR-World

SUMMARY OF ANALYSIS

No.	Sample ID	Alkalinity	Ammonia Nitrogen by Discrete Analyser	Calculated Nitrogen Forms - TN, organic N, inorganic	Chloride by Discrete Analyser in Water	Filterable Reactive Phosphorus (FRP)	Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto	pH in water	TKN Kjeldahl Digestion by Discrete Analyser	Total Phosphorus by Kjeldahl Digestion DA in
001	WB5	4	1	1	1	1	1	1	2	1
002	WB6	4	1	1	1	1	1	1	2	1
003	WB8	4	1	1	1	1	1	1	2	1

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

CE127992

CLIENT DETAILS

Client Rob Lait & Associates

Project KUR-World

SUMMARY OF ANALYSIS

No.	Sample ID	Calculation of Anion-Cation Balance	Metals in Water (Total) by ICPOES	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	Metals in Water (Total) by ICPOES-USN	Total and Volatile Suspended Solids (TSS /	Total Dissolved Solids (TDS) in water	Trace Metals (Dissolved) in Water by ICPMS in	Trace Metals (Total) in Water by ICPMS in mg/L
001	WB5	1	9	3	6	6	1	1	1	1
002	WB6	1	9	3	6	6	1	1	1	1
003	WB8	1	9	3	6	6	1	1	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Rob Lait
Client	Rob Lait & Associates
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4061 3103
Facsimile	07 4061 8094
Email	rob@roblait.com.au
Project	**KUR-World**
Order Number	(Not specified)
Samples	3

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE127992 R0**
Date Received	20 Jun 2017
Date Reported	03 Jul 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025-Testing. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE167259.
For determination of soluble metals, filtered sample was not received so samples were laboratory filtered on receipt. This may give soluble metals results that do not represent the concentrations present at the time of sampling.

SIGNATORIES

Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Orsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

		Sample Number	CE127992.001	CE127992.002	CE127992.003
		Sample Matrix	Water	Water	Water
		Sample Date	19 Jun 2017	19 Jun 2017	19 Jun 2017
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

pH in water Method: AN101/MA1490(Melb) Tested: 21/6/2017

pH**	pH Units	0.1	**6.4**	**6.4**	**5.6**

Alkalinity Method: AN135/MA1127(Melb) Tested: 21/6/2017

Total Alkalinity as CaCO3	mg/L	5	**67**	**66**	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	**67**	**66**	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 22/6/2017

Chloride, Cl	mg/L	1	**9**	**53**	**16**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 21/6/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.058**	**0.33**	**1.5**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 26/6/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005	<0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 21/6/2017

Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	<0.05	**0.06**
Total Nitrogen (calc)	mg/L	0.05	**0.06**	**0.33**	**1.6**

		Sample Number	CE127992.001	CE127992.002	CE127992.003
		Sample Matrix	Water	Water	Water
		Sample Date	19 Jun 2017	19 Jun 2017	19 Jun 2017
		Sample Name	WB5	WB6	WB8
Parameter	**Units**	**LOR**			
Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 30/6/2017					
Total InorganicNitrogen (calc)	mg/L	0.01	0.06	0.33	1.5
Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 21/6/2017					
Filterable Reactive Phosphorus	mg/L	0.005	0.030	0.014	0.011
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 21/6/2017					
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	0.03	0.02	0.03
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 26/6/2017					
Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	<1
Total Dissolved Solids (TDS) in water Method: AN113/MA1491(Melb) Tested: 26/6/2017					
Total Dissolved Solids Dried at 175-185°C	mg/L	10	140	220	84
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 27/6/2017					
Aluminium, Al	mg/L	0.005	0.012	<0.005	0.52
Iron, Fe	mg/L	0.005	0.50	0.20	0.005
Zinc, Zn	mg/L	0.005	0.012	0.026	0.031

		Sample Number	CE127992.001	CE127992.002	CE127992.003
		Sample Matrix	Water	Water	Water
		Sample Date	19 Jun 2017	19 Jun 2017	19 Jun 2017
		Sample Name	WB5	WB6	WB8
Parameter	**Units**	**LOR**			

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 27/6/2017

Total Aluminium	mg/L	0.005	**0.010**	<0.005	**0.55**
Total Hardness	mg CaCO3/L	5	**52**	**71**	**10**
Total Calcium	mg/L	0.05	**15**	**15**	**1.1**
Total Iron	mg/L	0.005	**0.51**	**0.32**	**0.008**
Total Magnesium	mg/L	0.05	**3.6**	**7.9**	**1.7**
Total Potassium	mg/L	0.05	**1.5**	**1.2**	**1.8**
Total Sodium	mg/L	0.5	**15**	**32**	**8.1**
Total Sulphur as Sulfate, SO4	mg/L	0.5	**5.7**	**2.5**	<0.5
Total Zinc	mg/L	0.005	**0.007**	**0.021**	**0.031**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 21/6/2017

Arsenic, As	mg/L	0.001	**0.014**	**0.004**	**0.001**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 21/6/2017

Total Arsenic	mg/L	0.001	**0.014**	**0.005**	**0.001**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 27/6/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	**0.002**	**0.004**	**0.006**
Lead, Pb	mg/L	0.001	**0.001**	**0.001**	**0.004**
Manganese, Mn	mg/L	0.001	**0.16**	**0.076**	**0.042**
Nickel, Ni	mg/L	0.001	<0.001	**0.003**	**0.002**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 27/6/2017

Total Cadmium, Cd	mg/L	0.0001	**0.0002**	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	**0.003**	**0.006**
Total Lead, Pb	mg/L	0.001	**0.001**	<0.001	**0.004**
Total Manganese, Mn*	mg/L	0.001	**0.16**	**0.12**	**0.040**
Total Nickel, Ni	mg/L	0.001	<0.001	**0.002**	**0.002**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 3/7/2017

Anion-Cation Balance	%	-100	**0.9**	**-0.5**	**-3.2**

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/MA1127(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB047192	mg/L	5	<5	1%	104%
Bicarbonate Alkalinity as CaCO3	LB047192	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB047192	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB047192	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB047279	mg/L	0.005	<0.005	0 - 5%	93 - 102%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB047214	mg/L	1	<1	0 - 5%	99 - 103%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB047169	mg/L	0.005	<0.005	0 - 4%	95 - 96%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
Total Aluminium	LB047332	mg/L	0.005	4%	98%
Total Calcium	LB047332	mg/L	0.05	3%	105%
Total Iron	LB047332	mg/L	0.005	3%	99%
Total Magnesium	LB047332	mg/L	0.05	2%	100%
Total Potassium	LB047332	mg/L	0.05	3%	102%
Total Sodium	LB047332	mg/L	0.5	4%	119%
Total Sulphur as Sulfate, SO4	LB047332	mg/L	0.5	2%	100%
Total Zinc	LB047332	mg/L	0.005	2%	107%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Aluminium, Al	LB047331	mg/L	0.005	0.010	0 - 1%	97%
Iron, Fe	LB047331	mg/L	0.005	<0.005	0%	102%
Zinc, Zn	LB047331	mg/L	0.005	<0.005	1%	110%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB047316	mg/L	0.0001	<0.0001	0%	104%	108%
Chromium, Cr	LB047316	mg/L	0.001	<0.0010	0%	102%	
Copper, Cu	LB047316	mg/L	0.001	<0.001	1 - 2%	100%	106%
Lead, Pb	LB047316	mg/L	0.001	<0.001	0 - 2%	101%	99%
Manganese, Mn	LB047316	mg/L	0.001	<0.001	1%	NA	
Nickel, Ni	LB047316	mg/L	0.001	<0.001	0%	105%	

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB047312	mg/L	0.0001	<0.0001	0%	104%	111%
Total Chromium, Cr	LB047312	mg/L	0.001	<0.001	0 - 2%	103%	104%
Total Copper, Cu	LB047312	mg/L	0.001	<0.001	1 - 5%	88%	108%
Total Lead, Pb	LB047312	mg/L	0.001	<0.001	0 - 3%	102%	103%
Total Manganese, Mn*	LB047312	mg/L	0.001	<0.001	1%	NA	
Total Nickel, Ni	LB047312	mg/L	0.001	<0.001	0%	105%	97%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB047166	mg/L	0.005	<0.005	0 - 6%	96 - 105%

QC SUMMARY

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.

pH in water Method: ME-(AU)-[ENV]AN101/MA1490(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB047192	pH Units	0.1	5.8	0 - 1%	100%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB047165	mg/L	0.05	<0.05	0%	97%

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	LB047274	mg/L	1	<1	0 - 11%	114%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113/MA1491(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB047272	mg/L	10	<10	1 - 2%	103%	109%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB047165	mg/L	0.01	<0.01	0 - 4%	114%

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

Parameter	QC Reference	Units	LOR	DUP %RPD
Arsenic, As	LB047180	mg/L	0.001	0%

QC SUMMARY

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.

Trace Metals (Total) in Water by ICPMS in mg/L   Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Arsenic	LB047181	mg/L	0.001	0%

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
AN101/MA1490(Melb)	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/MA1489(Melb)	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 µmhos/cm or µS/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/MA1491(Melb)	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 calculation 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.
AN135/MA1127(Melb)	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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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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Appendix I:
KUR-World Groundwater Report

Rob Lait & Associates PTY LTD
ABN 15 127 209 965

PO Box 788
(27 Scheu Street)
INNISFAIL
Queensland 4860
AUSTRALIA
Phone 617 4061 3103
Fax 617 4061 8094

RL/rl: (261)
Project No. Kur World Groundwater
October 2017

KUR WORLD

GROUNDWATER REPORT

REEVER AND OCEAN PTY LTD

Table of Contents

1.0 INTRODUCTION

Groundwater investigations and testing have taken place at the proposed Kur World Development from late 2016 until the present. This report summarises the hydrogeological regime and the investigation results.

2.0 SCOPE OF WORK

The scope of the work undertaken included:

1. Collection and assessment of private bore data in the Kur World vicinity;
2. Groundwater investigation drilling and the installation of a number of production bores intended for water supply for the development;
3. A temporal groundwater level and groundwater quality sampling program in the first half of 2017;
4. A pumping test program on selected production bores and analysis of the data from that program; and
5. Synthesis of all groundwater information for reporting purposes.

3.0 PHYSICAL SETTING

3.1 Physiography

The plateau to the west of Cairns occurs at an elevation of 400 to 450 m with ridges rising to about 650 m. The Barron River and two major tributaries (Clohesy River and Flaggy Creek) drain this plateau. A zone of rugged topography comprising the Macalister, Lamb and Whitfield Ranges, and a steep irregular scarp, separate the plateau from the coastal plain.

3.2 Climate

The Kuranda district has a tropical climate with distinct wet and dry seasons. The tropical latitude, proximity to the sea and elevation of the ranges, primarily influence the climate. The area has a warm climate with consistently high relative humidity, and approximately 80% of the annual rainfall occurring between December and April. Rainfall during the summer months results from orographical lifting, tropical cyclones and occasional southward incursions of monsoonal troughs (Figure 1). The highest monthly rainfall levels recorded were during the months of January, February, and March, with lower rainfall levels during the cooler months (June through October).

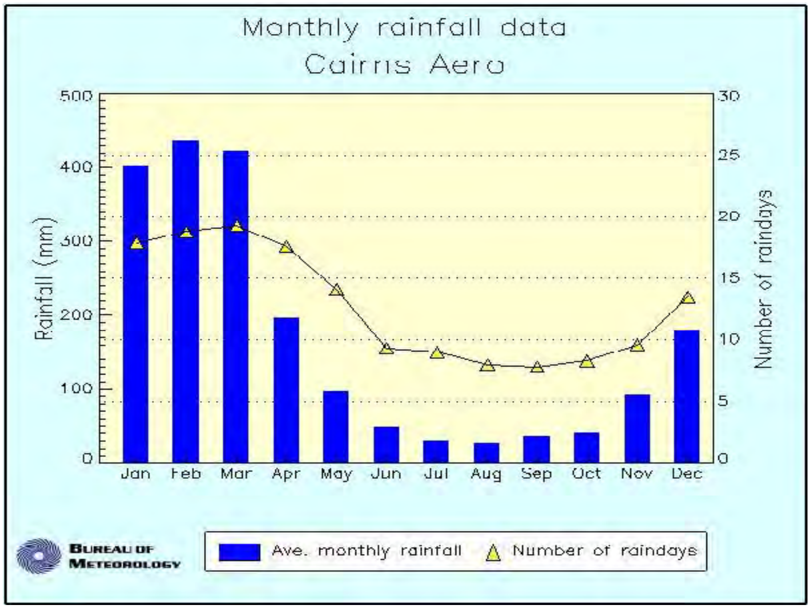

Figure 1: Average monthly rainfall for the Cairns region (Bureau of Meteorology).

Average maximum temperatures for the area range between 31 and 27 °C, with the highest maximum temperatures ranging between 32 and 40 °C. Average minimum temperatures for the Cairns area range between 25 and 18 °C, with lowest minimum temperatures ranging between 6 and 18 °C (Figure 2).

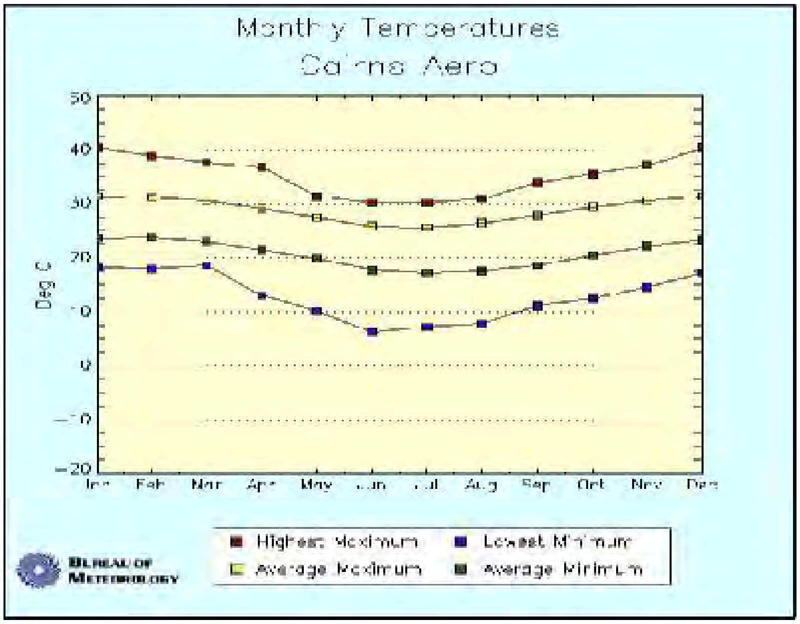

Figure 2: Monthly Average, Minimum and Maximum Temperatures for the Cairns Region (Bureau of Meteorology)

4.0 GEOLOGICAL SETTING

The Kur World development is located mainly over a geological formation known as the Barron River Metamorphics which is a lithological correlative of the Hodgkinson Formation. The Barron River Metamorphics Formation is composed of low-grade metasediments including micaceous schist, phyllite and metamorphosed siltstone and mudstone. These lithologies are most often referred to simply as 'shale' by drilling contractors. These rocks tend to be steeply dipping, strongly folded, and often overturned with prominent cleavage[1]. They are deeply weathered in places, with a varying thickness of the soil profile. This soil profile typically consists of gravelly loam from the surface to about 1.5m and poorly drained grey clay soil from 1.5 to 5m.

4.1 Surficial Sediments

Overlying the Barron River Metamorphics is a 5 to 10m thick layer of very weathered metasediments and clayey hillwash sediments that have either developed in situ, but, more likely are the product of mass wasting from more elevated areas. These are known as surficial sediments for the purposes of this report. They extend from the surface to a depth of between 5 and 10m.

4.2 Barron River Metamorphics

The Barron River Metamorphics are located immediately below the surficial sediments. In the Kuranda area they consist of phyllite, metamorphosed siltstone and mudstone and, occasionally muddy sandstone. These rocks have been intensely folded and faulted and are very steeply dipping (almost vertical). The folding and faulting process has separated the original beds from each other in places and has left void spaces.

4.3 Mareeba Granite

The Barron River Metamorphics has been intruded by the Mareeba Granite which has contact metamorphosed the original sedimentary sequence. Intrusion of the granite was accompanied by emplacement of quartz veins, generally transverse to the bedding trend of the Barron River Metamorphics. As the magma cooled the quartz veins contracted and shattered. The Mareeba Granite crops out to the south of Kur World.

Figure 3 is a diagrammatic cross-section (A – B) from west to east that shows the interpretation of the geology of the Kur World development. It has been derived from data from groundwater investigation bores which are shown in the cross-section, together with the depths of water strikes and the static water level in September 2017.

---

[1] Willmott, W.F., Trezise, D.L., O'Flynn, M.L., Holmes, P.R., and Hofmann, G.W., (1988). Cairns Region: 1: 100 000 Geological Map Commentary. Queensland Department of Mines. Pages 9-22.

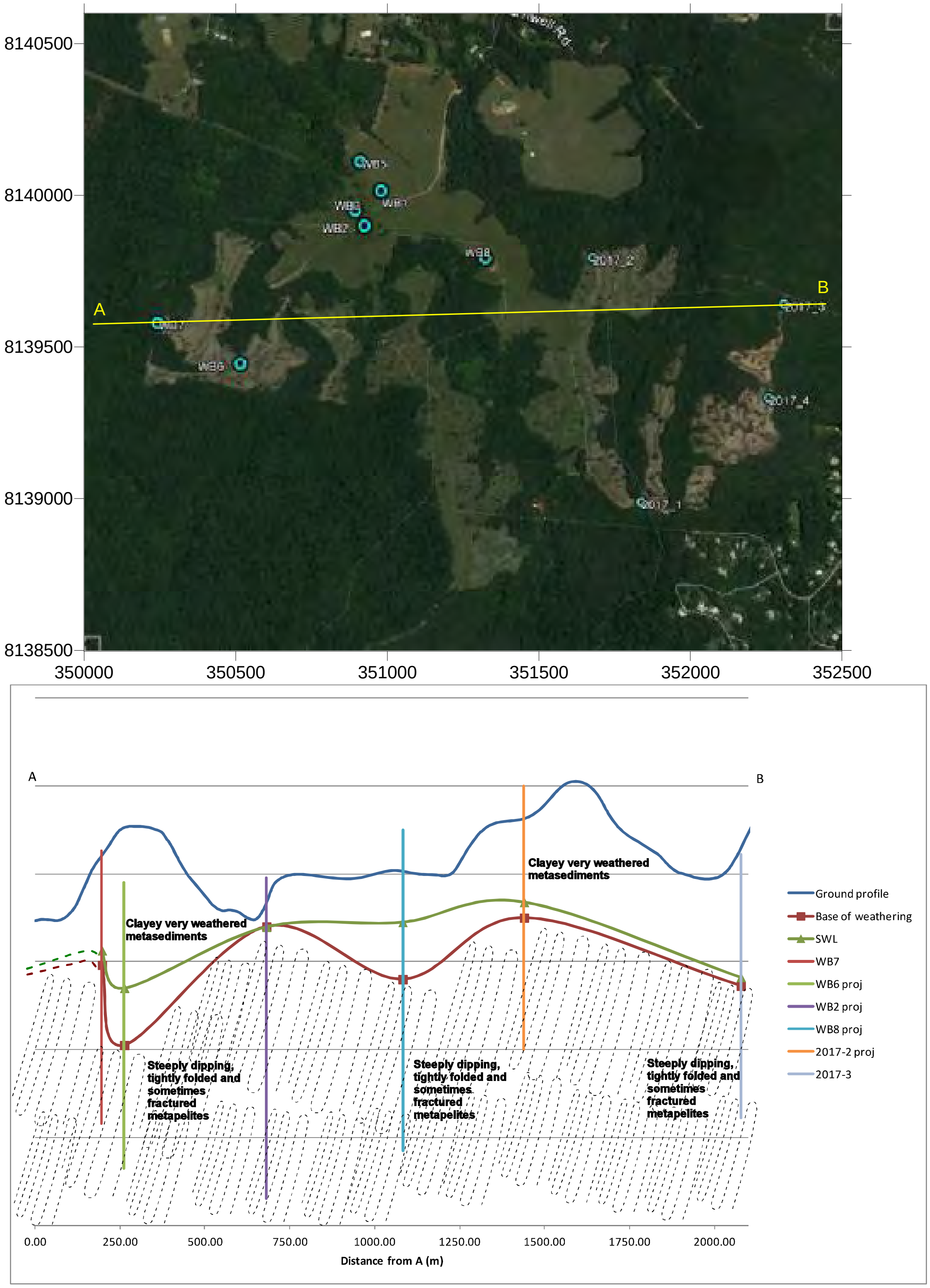

Figure 3: Diagrammatic West-East Geological Cross-section

5.0 PRIVATELY OWNED BORES

5.1 Department of Natural Resources and Mines Groundwater Database

A search of the Department of natural Resources and Mines (DNRM) groundwater database showed the following airlift yield results from bores in the vicinity of the Kur World development. Figure 4 shows the locations of those bores and Table 1 shows the airlift yield results from that search.

Figure 4: Locations of 2016 Kur World Bores and Neighbouring Bores

TABLE 1: AIRLIFT YIELD OF BORES IN KUR WORLD VICINITY	
Registered number	**Airlift Yield L/s**
72326	1
72327	2
72356	1.1
72801	0.8
72802	0.4
72803	0.7
72804	0.7
72805	0.8
72806	0.55
72951	1.2
72996	1.25
109558	1.2
126038	1.25

It is apparent that the groundwater supply from most bores in the area is of the order of 0.75 to 1.0L/s.

5.2 2017 Neighbouring Bore Census

Private water bore information was sought from 37 neighbouring properties in the vicinity of the Kur World development. This census was undertaken to ascertain if any of the close by bores could be used as observation bores during the pumping test program. Table 2 shows the census results. Owners' names have been omitted for privacy considerations.

TABLE 2: PRIVATE BORE CENSUS RESULTS							
Bore Registered Numbers	**Address**	**Bore Equip-ped**	**Use**	**Details (if any)**	**Quality**	**Dry Season Issues**	**Yield**
72328 45354	76 High Chapparal Rd, Myloa	y	Domestic		Good supply.		
72801	23 Monaro Close, Kuranda	y	Garden and backup.	App 50 m.	Good quality		App 1800 gal/hr
72804	77 Monaro Close, Kuranda						
72805	78 Barnwell Rd, Kuranda	y	Domestic		Good quality		
72937	5 Fairyland Rd, Kuranda	y	Top up water for rainwater tanks - seldom				

TABLE 2: PRIVATE BORE CENSUS RESULTS							
Bore Registered Numbers	**Address**	**Bore Equip-ped**	**Use**	**Details (if any)**	**Quality**	**Dry Season Issues**	**Yield**
			used				
72941	17 Jarawee Rd, Kuranda	y	Domestic		Good quailty.		
109501	264 Boyles Rd, Kuranda	y	Domestic		Good supply		
126126	54 Monaro Close	y	Domestic		Good quailty.		
139432	17 Leola's Way, Kuranda	y	Domestic		Good quality. Sand in bore.		
148916	36 Monaro Close, Kuranda	y	Garden		Slight smell. Don't use for drinking.		Not great yield.
157505	13 Fairyland Rd, Kuranda	y	No longer active.		Good quality		
171115	53 Monaro Close, Kuranda	?					
No RN	278 Boyles Rd, Kuranda	y	Domestic		Good supply		
72356	73 High Chapparal Rd, Myloa	?					
72326	64 High Chapparal Rd, Myloa	y	Domestic		Good supply.		
No RN	197 Boyles Rd, Kuranda	y	Domestic	Approx 55m.	Good quaity, had potability test done - pH a bit low.		1L/s
No RN	3 Harley Rd, Kuranda	y	Domestic	Approx 30m. Water at 11m.	Good quailty.		
No RN	279 Myola Rd, Myola via Kuranda	y	Irrigation	x	Ok for irrigation.	Sometimes low yield.	Sometimes slows down but if turn off recharges within 10-15 mins.

TABLE 2: PRIVATE BORE CENSUS RESULTS							
Bore Registered Numbers	**Address**	**Bore Equip-ped**	**Use**	**Details (if any)**	**Quality**	**Dry Season Issues**	**Yield**
No RN	27 High Chapparal Rd, Kuranda	y	Domestic	Approx. 50m deep but water at 3-4 m.	Good supply but if leave running all day water has "mineral' smell.	Sometimes poor flow.	
No RN	43 High Chapparal Rd, Kuranda	y	Top up water 1-2 per year.		Good supply.		
No RN	31 High Chapparal Rd, Myola	y	Garden	Sierra drillers	Good quality, some sulphur. Shale.	Sometimes .	Poor yield. 0.5 hr only.
No RN	8 McKenzie St, Kuranda	No bore		No bore. pump in creek, part of water supply. Animal watering and irrigation.		Early 2000's creek close to dry.	
No RN	331 Myola Rd, Kuranda	No bore					
No RN	58 Monaro Close, Myola	No bore		No bore. 4 tanks.		Owen Ck dried to puddles (early 2000s).	
No RN	28 Monaro Close, Myola	No bore					
No RN	73 Kingfisher Dr, Myola	y	Domestic		Good quality.		Yield slows sometimes.
No RN	51 Kingfisher Dr, Kuranda	y	Domestic		Good quality - metallic taste.		
No RN	63 Kingfisher Dr, Kuranda	y	Domestic				
No RN	7 High Chapparal Rd, Kuranda	y	Domestic				

TABLE 2: PRIVATE BORE CENSUS RESULTS							
Bore Registered Numbers	**Address**	**Bore Equip-ped**	**Use**	**Details (if any)**	**Quality**	**Dry Season Issues**	**Yield**
No RN	19 High Chapparal Rd, Kuranda	y	Domestic	Approx 53m.	Used to be brackish in dry. Now brackish all time.		
No RN	41 Monaro Close, Kuranda	y	Domestic		Good quailty.		
No RN	29 Monaro Close, Kuranda	y	Domestic	Approx 52m. 9L/min (sec?)	Pulls in sediment.	Sometimes runs dry.	
No RN	86 Boyles Rd, Kuranda						
No RN	22 Lotus Lane, Kuranda	y	Domestic	Perhaps 34m. Westerberg drilled.	Did have hydrophonics business, regular testing. Water mineralised and saline.		
No RN	21 Lotus Lane. Kuranda	y	Domestic	Approx 26m. Delai drilling.	Good quality.		Good supply.
No RN	165 Boyles Rd, Kuranda	y	Domestic		Good quality.		

TABLE 2: PRIVATE BORE CENSUS RESULTS							
Bore Registered Numbers	**Address**	**Bore Equip-ped**	**Use**	**Details (if any)**	**Quality**	**Dry Season Issues**	**Yield**
139306 45746 139007	302 Boyles Rd, Kuranda	y	Part domestic - shower and gardening only.	One of three RN on property but is tenants in common. Installed about 1990. Approx. 55m at 35m went through aquifer. Brown shale.	Saline water.		Can't pump dry.

It is assessed from the information in Table 2 that:

1. The majority of the neighbouring bores are used for domestic purposes;
2. Groundwater quality from the bores is generally reported to be good but some bores are reported to deliver mineralised or saline groundwater;
3. Groundwater supplies from the bores are probably low, with sustained yields not possible in some bores; and
4. Bore yields may diminish as groundwater levels fall with the advance of the dry season.

6.0 GROUNDWATER DRILLING AT KUR WORLD

6.1 Electroseismic Survey and 2016 Test Drilling

It is understood that an electroseismic survey was carried out by HydroGeology Australia in October 2016. Sites for seven production bores were selected from the results of that survey (WB1, WB2, WB3, WB5, WB6, WB7 and WB8). These seven bores (shown on Figure 3) were subsequently installed in November and December 2016. Table 3 shows brief statistics regarding those bores.

TABLE 3: STATISTICS FOR 2016 KUR WORLD BORES

Bore_ID	Depth drilled (m)	Depth Cased (m)	Casing ID (mm)	Perforated zone top (m)	Perforated zone bottom (m)	Filter pack (m)	Cement grout (m)	AIRLIFT YIELD* (L/s)	Static water level when drilled (m)
WB1	72	71	125	23	71	5-71	0 - 5	0.3	19.5
WB2	73	73	125	13	73	5-73	0-5	3	11.1
WB3	85	85	125	19	85	5-85	0-5	3.5	12.4
WB5	61	61	125	25	61	5-61	0-5	0.6	16.6
WB6	65	65	125	35	65	5-65	0-5	4.5	24
WB7	62	62	175	32	62	5-62	0-24	9	22.7
WB8	73	73	125	31	73	5-73	0-5	0.5	21

*Airlift yield

6.2 2017 Test Drilling Program

As the sustainable yields of the four pump tested bores were less than considered desirable, a test drilling campaign consisting of four groundwater investigation bores was undertaken in September 2017. Prior to this drilling campaign a decision was taken not to case the bores if the airlift yield was less than 2.5L/s.

Table 4 shows brief details of these four groundwater investigation bores.

TABLE 4: BRIEF STATISTICS OF 2017 GROUNDWATER INVESTIGATION BORES									
Bore_ID	**Depth drilled (m)**	**Depth Cased (m)**	**Casing ID (mm)**	**Perforated zone top (m)**	**Perforated zone bottom (m)**	**Filter pack (m)**	**Cement grout (m)**	**ALY (L/s)**	**Static water level when drilled (m)**
2017_1	61	n/a						0.5	33.7
2017_2	61	n/a						0.45	26.45
2017_3	61	n/a						1.2	28.05
2017_4	61	n/a						1.3	19.2

None of the 2017 groundwater investigation bores was cased.

7.0 HYDROGEOLOGY

7.1 Aquifer Occurrence and Aquitards

The data from the DNRM groundwater database and information from surrounding catchments were assessed. From that assessment the hydraulic units beneath kur World may be described as detailed below.

Surficial Sediments – an aquitard

The surficial sediments are generally clayey and rarely sandy but they act as a confining layer for the main aquifer located immediately below them. In general, the surficial sediments are only saturated during, and immediately following the wet season. They are not regarded as an aquifer *per se*.

Barron River Metamorphics – The Prime Aquifer

Based on information from the Department of Natural Resources and Mines (DNRM) groundwater database, the main aquifer in the Kur World vicinity comprises fractured rock within the Barron River Metamorphics. Fracturing within these rocks permits the infiltration and transportation of water along fracture and cleavage planes. Groundwater resides in the void spaces and fractures along these bedding planes within the unweathered Barron River Metamorphics. The void spaces and fractures are sub-vertical and trend in a northwest-southeast direction. Overall, the supply of groundwater from individual bores is dependent on the degree of fracturing and the local connectivity of fracture sets.

Drilling records indicate that most registered bores in the wider Kuranda area obtain supplies of between 2 and 4 L/s from depths of around 30 to 40m. Exceptional bores obtain supplies of 10 L/s. These bores usually intercept zones where a bedding plane is intersected by a large fractured quartz vein.

The Barron River Metamorphics has been intruded by the Mareeba Granite which has contact metamorphosed the original sedimentary sequence. Intrusion of the granite was accompanied by emplacement of quartz veins, generally transverse to the bedding trend of the Barron River Metamorphics. As the magma cooled the quartz veins contracted and shattered. These quartz veins provide lateral continuity between groundwater residing in the saturated bedding planes of the Barron River Metamorphics.

Mareeba Granite – Hydrogeological Basement

The Mareeba Granite crops out to the south of Kur World. It is hydrogeologically unproductive in the Kuranda area owing to its massive nature.

For the purposes of this report it is regarded as hydrogeological basement.

7.2 Strata Sequence

The driller's description for bore WB6 is regarded as typical for the strata sequence that underlies Kur World. This description is shown in Table 5.

It can be seen from Table 5 that groundwater strikes occur in fractured sequences throughout the sequence.

TABLE 5: TYPICAL STRATA SEQUENCE AT KUR WORLD

Depth from	Depth to	Driller's strata description	Water Strike	Hydrostratgraphic Unit
0	1	TOPSOIL		Surficial sediments
1	22	CLAY		
22	35	SHALE - decomposed		
35	37	SHALE - weathered	Yes	
37	40	SHALE - fractured	Yes	Barron River Metamorphics
40	41	SHALE		
41	44	SHALE - fractured	Yes	
44	45	SHALE		
45	47	SHALE - fractured		
47	60	SHALE and QUARTZ - fractured	Yes	
60	65	SHALE		

Figure 4 shows a chart of the depth at which fractures that contain groundwater occurred in all the groundwater investigation bores at Kur World.

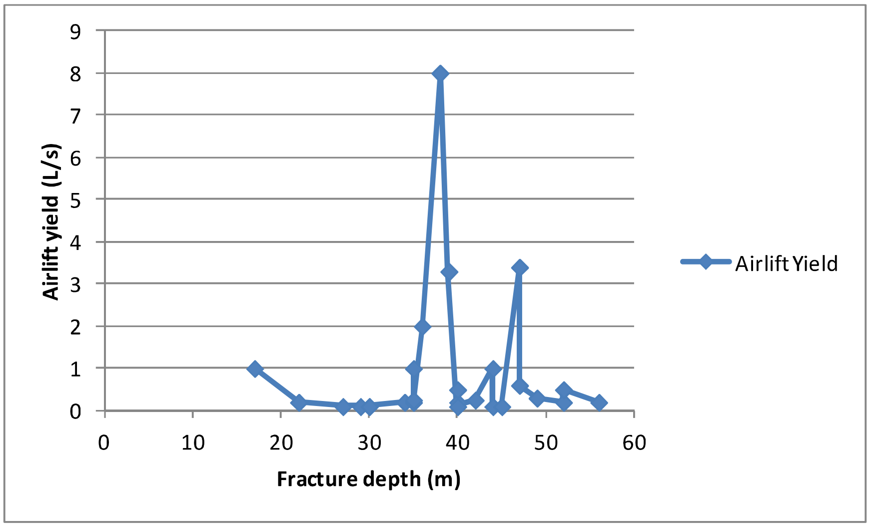

Figure 4: Chart of Fracture Depth versus Airlift Yield in Kur World groundwater investigation bores

The extent of void spaces and fracturing decreases proportionally with increasing depth until there is virtually no secondary porosity at depths below about 60m. It can be seen from Figure 4 that the most productive saturated fractures at Kur World (and, in fact, in the Kuranda area in general) occur at about 40m depth.

7.3 Groundwater Recharge

Aquifers within the Barron River Metamorphics are recharged primarily by direct vertical infiltration of rainfall. It is estimated that only 5 to 10% of rainfall received in the area percolates as far as the water table. The rest of the rainfall evaporates, runs off or is stored in the soil as soil water.

Soil Water Fluctuation

In the Kuranda area, as in most areas in Queensland's wet tropics, a distinction needs to be made between soil water and groundwater. Soil water is considered to be that component of rainfall that infiltrates into the soil profile and either resides in the soil temporarily, or, equally as likely, flows laterally into streams. Groundwater on the other hand is that component of rainfall that passes through the soil into the underlying saturated zone. Figure 5 is a diagram of the soil water system that may serve to explain this concept.

It should be noted that Figure 5 is only diagrammatic and it shows that the water table is intersected by a stream. This is not the case at Kur World as the water table is at least 5m below stream incision depth. This will be discussed in more detail later Section 7.4.

At Kur World the soil water may sustain flow in the streams that traverse the site for two or three months following the wet season. Reports of creeks drying out as the dry season advances reinforce this concept.

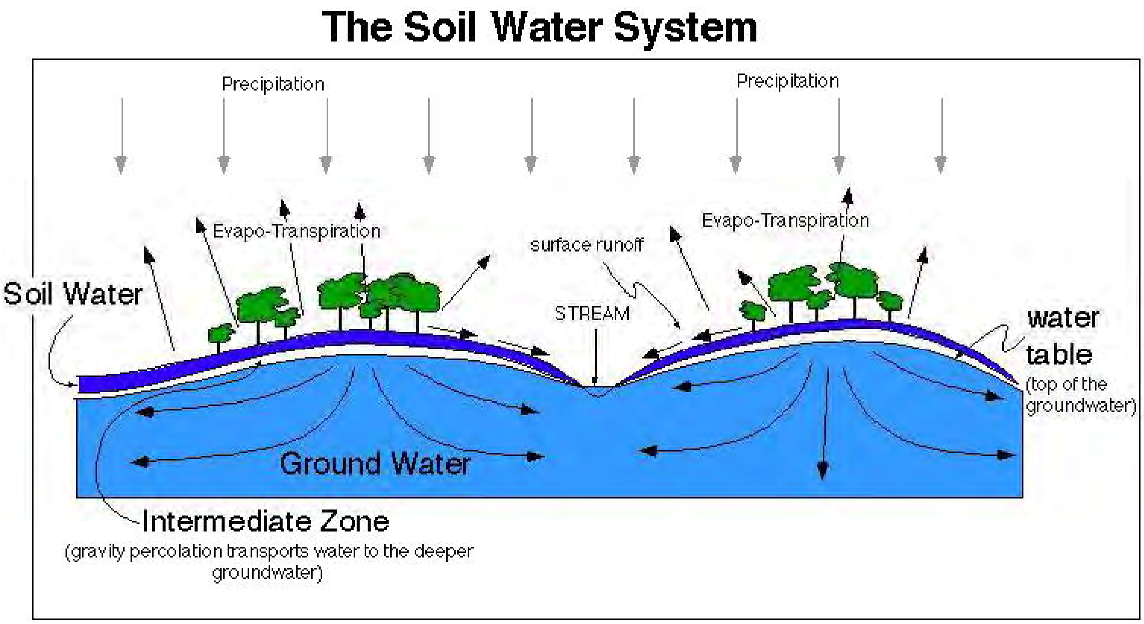

Figure 5: Soil Water System Conceptual Diagram
(after Bice, 2016)[2]

Water Table Fluctuation

The depth to groundwater in four of the Kur World bores has been measured at regular intervals throughout 2017. Figure 6 shows a chart of those groundwater levels.

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[2] Bice, D, 2016. Exploring the Dynamics of Earth Systems - *a guide to constructing and experimenting with computer models of Earth systems using STELLA. Dept. of Geosciences, Penn State University*

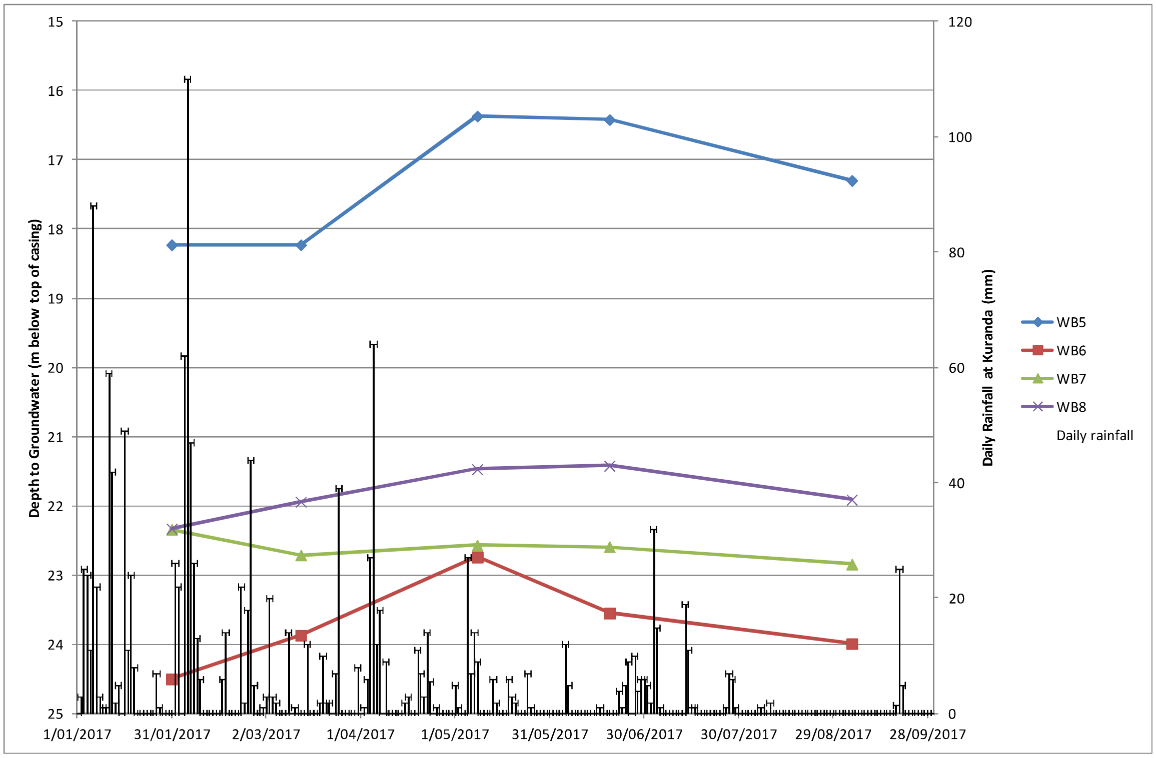

Figure 6: Groundwater levels at Kur World 2017

The water table at Kur World has the potential to vary seasonally by up to 2.5m. There is a lag time of some two to three months between significant rainfall and the corresponding peak in the water table.

Vertical movement of water to the water table is generally slow. Recharge only occurs once the surficial sediments are fully saturated. This means that virtually no recharge occurs in the first few spring storm events where most of the rainfall received runs off. Little or no recharge occurs during the long, relatively dry period from May to November.

Very little ‘flushing” of the aquifer by recharging water occurs in the prime aquifer sequence as rainfall recharge is generally a slow process (estimated to be in the order of two to three years in these deeper zones), which probably accounts for the observations of saline or mineralised water in some neighbouring bores..

7.4 Groundwater Flow Directions and Groundwater – Surface Water Interactions

Groundwater flow directions were assessed by calculating the elevation of the water table for September 2017 from all the measureable bores at Kur World. Figure 7 shows the groundwater flow directions from the potentiometric surface[3] contours on the top of the water table.

The Kur World surface water quality sites and their estimated elevations, together with the potentiometric surface contours, are also shown on Figure 7.

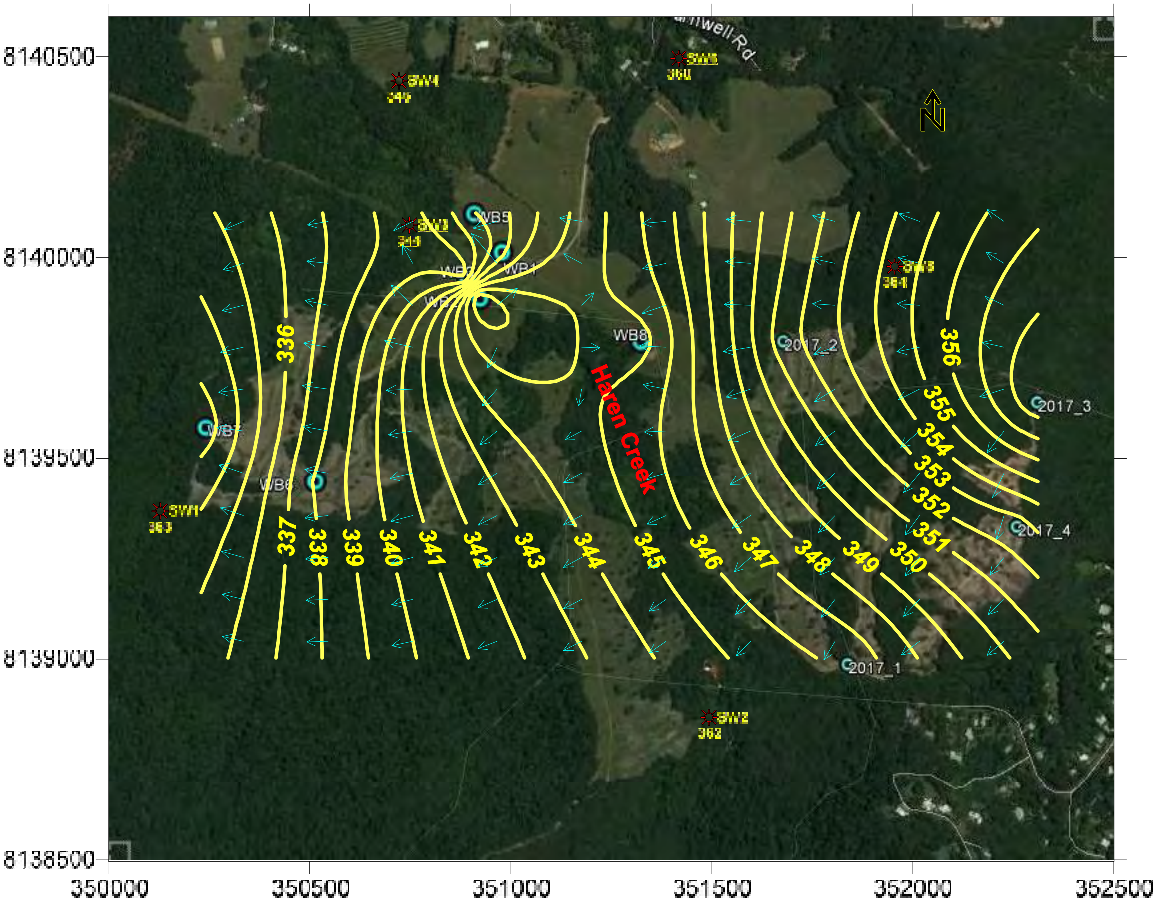

Figure 7: Potentiometric Surface Contours and Groundwater Flow Directions at Kur World September 2017

Groundwater flow is primarily from east to west at Kur World at a gradient of 1.25%.

By extrapolating some of the contours, and comparing sites included in the contour domain, it is assessed that the water table is at least 5m below the stream levels, even at the lowest topographic point near SW3.

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[3] The imaginary surface on the top of the water table.

Almost everywhere else the water table is about 10m below stream levels.

Given these observations, and even taking into account a potential rise of 2.5m in the water table after the wet season, it is not possible for groundwater to discharge into the streams. This is because the vertical distance for such discharge to occur is simply too great, given the rather shallow gradient that exists and the fact that the upper intervals in all the boreholes show significant clay sequences.

Therefore, it is assessed that no groundwater – surface water exchange is possible at Kur World.

7.5 Groundwater Dependent Ecosystems

A narrow terrestrial groundwater dependent ecosystem adjacent to Haren Creek is shown on published GDE mapping. It is designated as having a low potential for groundwater interaction.

It can be seen from Figure 7 that the elevation of surface water site SW2 is approximately 362m AHD and that the elevation of the water table along Haren Creek is about 345m AHD. It is unlikely that the vegetation along Haren Creek would have root depths of 17m to access the water table.

8.0 GROUNDWATER YIELD ASSESSMENT

The following pumping test strategy was intended at Kur World.

- **WB7:** One 100-hour pumping test, consisting of three initial discharge steps of one to two hours duration at approximately 5L/s, 6.5L/s, and 8L/s, followed by an extended final step at 9L/s (the airlift yield reported by the drilling contractor) for the remainder of the test. At the conclusion of pumping up to a 24-hour recovery test was undertaken.

- **WB6:** One 24-hour pumping test, consisting of three initial discharge steps of one to two hours duration at approximately 2.5L/s and 3L/s, followed by an extended final step at 4.5L/s (the airlift yield reported by the drilling contractor) for the remainder of the test. At the conclusion of pumping up to an 8-hour recovery test was undertaken.

- **WB5:** One 6-hour pumping test at a constant discharge rate of 0.6L/s (the airlift yield reported by the drilling contractor) for the remainder of the test. At the conclusion of pumping up to an 8-hour recovery test was undertaken.

- **WB3:** WB2 and WB3 were already equipped with pumps. Reever and Ocean arranged for the top plates and pumps that are in bores WB3 and WB2 to be lifted by approximately 30cm. Water levels were to be measured via tremie pipes. One 24-hour constant pumping test was intended in WB3 followed by an 8-hour recovery test. Step discharge tests were not possible using the existing pump.

- The airlift yields from WB1and WB8 were too low to warrant formal pumping tests.

The sections that follow describe in detail the pumping test program on a bore-by-bore basis.

8.1 WB7

Pumping of WB7 commenced on 8th June 2017. The static water level prior to the pumping test was 22.54m below the top of the casing (m btoc). The pump suction inlet was placed at 58m depth so that the maximum available drawdown could be available for the test. The available drawdown was therefore 35.46m.

A step drawdown test was carried out as follows:

- Pump start to 120 minutes : 5L/s;
- 120 minutes to 240 minutes: 6.5L/s;
- 240 minutes to 694 minutes: 8L/s;
- 694 minutes to 1200 minutes: Discharge reduced to 5L/s owing to concern that the pump would break suction

At completion of the step discharge test, a water level recovery test of 3,340 minutes duration was undertaken in the bore at which time there still remained 1.35m of residual drawdown in the bore.

Data Analysis

The drawdown and recovery data were analysed using Microsoft Excel.

Figure 8 shows the pumping and residual drawdown (recovery) water levels in the bore, plotted on a semi-logarithmic basis. This method permits the data analyst to assess the sustainability of the bore.

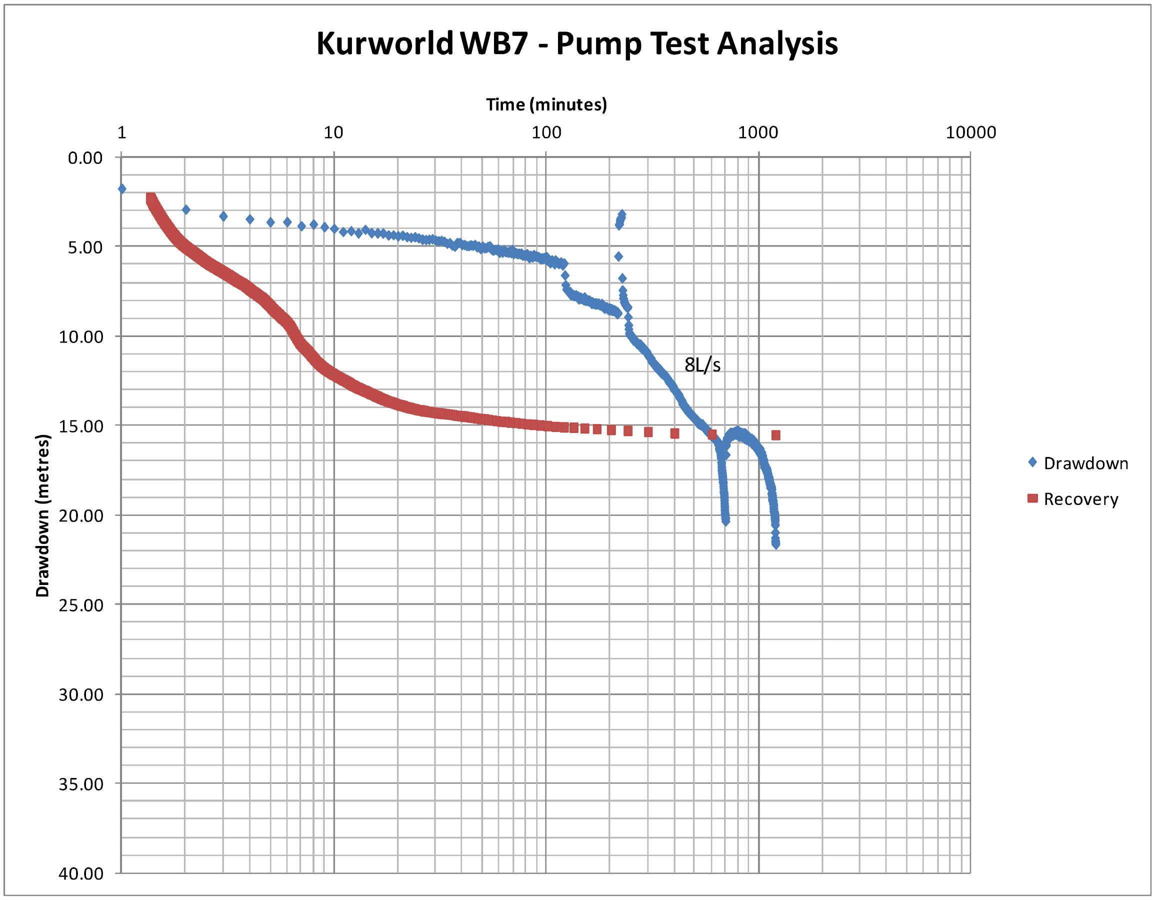

Figure 8: Semi-logarithmic Plot of Drawdown versus Pumping Time

It can be seen from Figure 8 that:

- Initial drawdown during step 1 proceeded linearly to about 6m;
- Drawdown during step 2 proceeded linearly but with an increased slope;
- Drawdown during step 3 proceeded at quite a steep slope until 625 minutes pumping duration at which point the drawdown fell at an alarming rate until 694 minutes pumping duration;
- At 694 minutes pumping duration the testing officer reduced the pumping rate to 5L/s to prevent the pump breaking suction, with consequent damage. Despite the discharge rate reduction the drawdown continued to plummet at an unsustainable rate. The testing officer discontinued the test at 1200 minutes pumping duration as it is obvious that the aquifer cannot supply water to the bore at this rate.
- After an initial recovery jump of about 8m, the recovery rate in this bore was virtually nil for the next 20 minutes. This indicates local dewatering of the aquifer by the bore.

- As reported above the residual drawdown in the bore was still 1.35m after 3,340 minutes (55.67 hours) of recovery. This observation, in itself, signals that the aquifer at WB7 does not receive adequate natural replenishment for WB7 to be used as a community water supply bore.

Impact on Surrounding Bores

It is significant that no drawdown was induced in WB6 which is only some 300m distant from WB7 during the pumping test. This is evidence that the fractured rock aquifer in the ‘quartz ridge’ vicinity is compartmentalized and it also suggests that very little hydraulic connectivity is present.

Drawdown could not be measured in WB3 or WB2 during pumping of WB7.

Long Term Pumping Rate

Given the rapid drawdown in WB7, its failure to recover after a relatively short pumping period, and the apparent lack of hydraulic connectivity in the aquifer, the long term pumping rate of this bore should be restricted to 3 to 3.5L/s. Even at this reduced rate the bore should be pumped at a 12 hours on, 12 hours off cycle to prevent over-exploitation of the aquifer.

8.2 WB6

Pumping of WB6 commenced on 30th June 2017. The static water level prior to the pumping test was 23.58 m btoc. The pump suction inlet was placed at 58m depth so that the maximum available drawdown could be available for the test. The available drawdown was therefore 34.42m.

A step drawdown test was carried out as follows:

Pump start to 60 minutes :	2.5L/s;
60 minutes to 120 minutes:	3L/s;
120 minutes to 480 minutes:	3.5L/s;
480 minutes to 1440 minutes:	4L/s

At completion of the step discharge test, a water level recovery test of 2,996 minutes duration (i.e. about 50 hours) was undertaken in the bore, at which time there still remained 0.54m of residual drawdown in the bore.

Data Analysis

Figure 9 shows the pumping and residual drawdown (recovery) water levels in the bore, plotted on a semi-logarithmic basis.

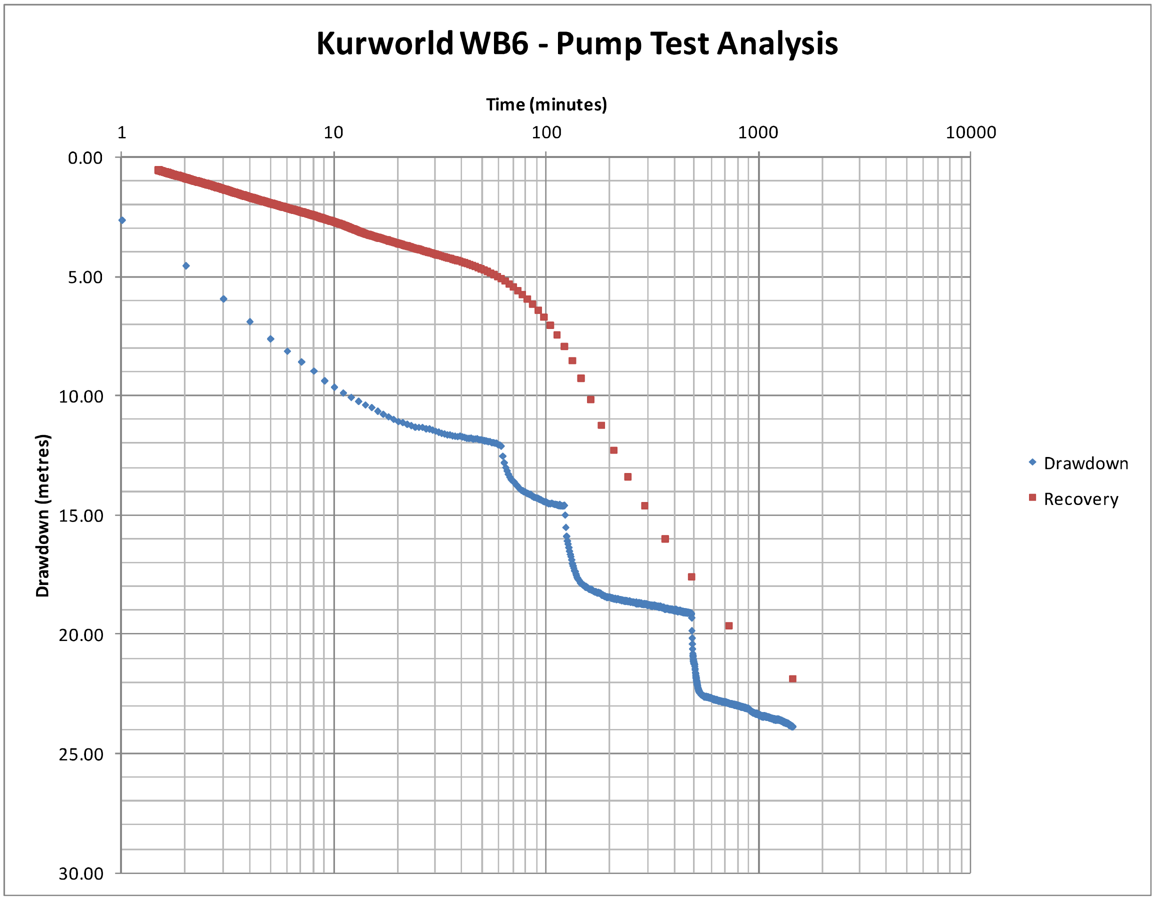

Figure 9: Semi-logarithmic Plot of Drawdown versus Pumping Time

Figure 9 shows drawdown and recovery behaviour that is normally associated with a bore in the fractured rock aquifer of the Barron River Metamorphics. At the conclusion of the pumping phase there remained about 10m of available drawdown.

Impact on Surrounding Bores

Bore registered number (RN) 171557 is located on the Kur World development and is 440mm to the north east of WB6. Pumping of WB6 resulted in drawdown of some 0.18m in RN 171557 as shown in Figure 10.

RN 171557 continued to draw down for 28 hours after pumping of WB6 ceased indicating delayed yield in the aquifer sequence. RN 171557 only commenced recovery after this time.

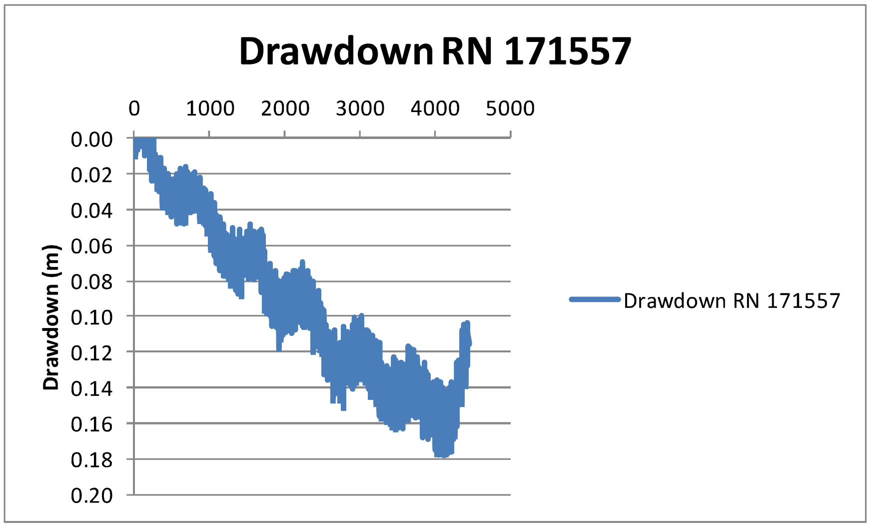

Figure 10: Drawdown and Recovery in RN 171557 during pumping of WB6

Long Term Pumping Rate

The recovery rate of the groundwater level in WB6 is slow, which, as for WB7, indicates that the aquifer at WB6 does not receive rapid natural replenishment after pumping, although the drawdown in RN 171557 does show that there is increased aquifer hydraulic connectivity between RN 171557 and WB6.

The combination of these observations indicates that the use of WB6 as a long-term community water supply bore is also limited.

The long term pumping rate of WB6 is assessed to be 4L/s.

8.3 WB5

Pumping of WB5 commenced on 7th July 2017. The static water level prior to the pumping test was 16.79 m btoc. The pump suction inlet was placed at 40m depth so that the maximum available drawdown could be available for the test. The available drawdown was therefore 23.21m.

A constant discharge test was carried out at 0.6L/s for a pumping period of 360 minutes, followed by a recovery test of 903 minutes duration.

Data Analysis

Figure 11 shows the pumping and residual drawdown (recovery) water levels in the bore, plotted on a semi-logarithmic basis. This method permits the data analyst to assess the sustainability of the bore.

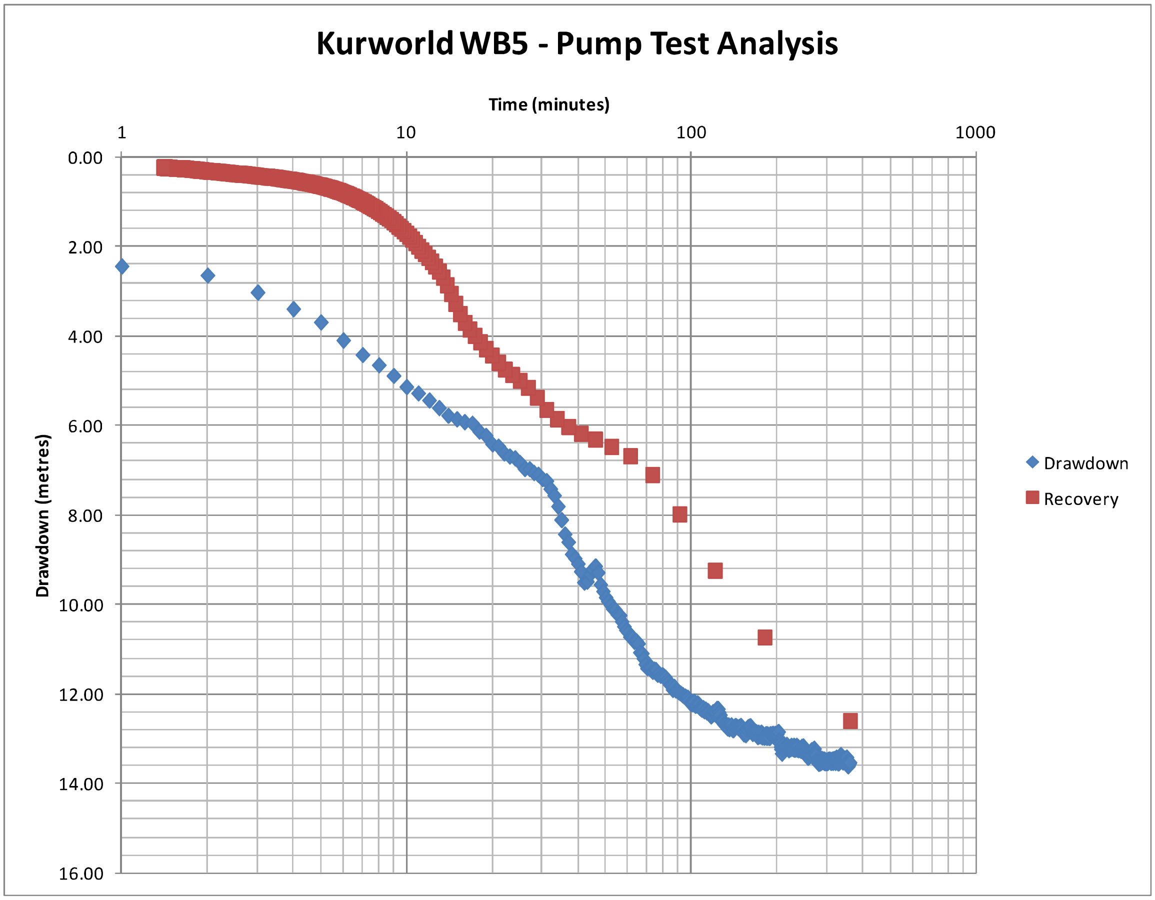

Figure 11: Semi-logarithmic Plot of Drawdown versus Pumping Time

Figure 11 shows the drawdown and recovery behaviour that is normally associated with a bore in the fractured rock aquifer of the Barron River Metamorphics. At the conclusion of the pumping phase there remained about 10m of available drawdown.

The recovery of the groundwater level in WB5 is considered adequate.

Impact on Surrounding Bores

Pumping of WB5 resulted in drawdown in WB1 but not in WB2. Figure 12 shows the drawdown (and recovery) in WB1 during the pumping test on WB5.

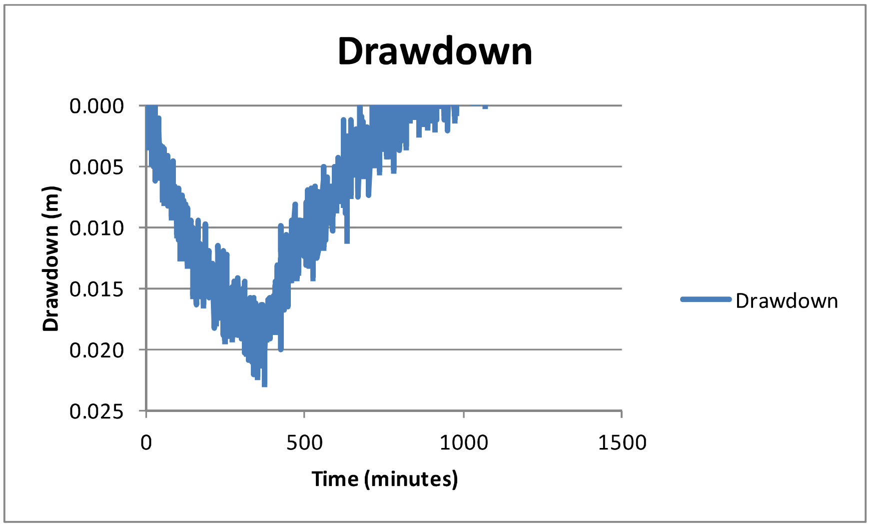

Figure 12: Drawdown and Recovery in WB1 during pumping of WB5

The drawdown and recovery in WB1 shows that there is aquifer hydraulic connectivity between WB5 and WB1.

Long Term Pumping Rate

The long term pumping rate of WB5 is assessed at 1L/s.

Should this rate be sufficient for water supply purposes at Kur World it is recommended that the bore be re-tested for a period of at least 24 hours to assess its sustainable long term pumping rate.

8.4 WB3

When the water level tremie pipe was installed in WB3 on 29th June 2017 the groundwater level in the bore was 13.12 m btoc. The bore was used all weekend until noon on 3rd July 2017 at which time it was shut down by the testing officer. At 8 am the following morning (4th July 2017), after 18 hours of recovery the static water level was measured at 38.2 m btoc. This means that about 25m of the original saturated thickness of the aquifer at this site had still not replenished 20 hours after pumping had ceased. Hence, the aquifer at this site is not capable of rapid natural replenishment.

Regardless of the fact that 25m of saturated thickness had been 'lost' the testing officer proceeded with a pumping test (Figure 13).

The pumping test was commenced at 3L/s but the discharge rapidly declined to 1.7L/s after only 40 minutes pumping time. At 40 minutes pumping time a drawdown of 36.63m had been induced, leaving only 1.6m of available drawdown in the bore. The testing officer concluded the test as he was concerned that the pump would break suction and that damage to the pump could result.

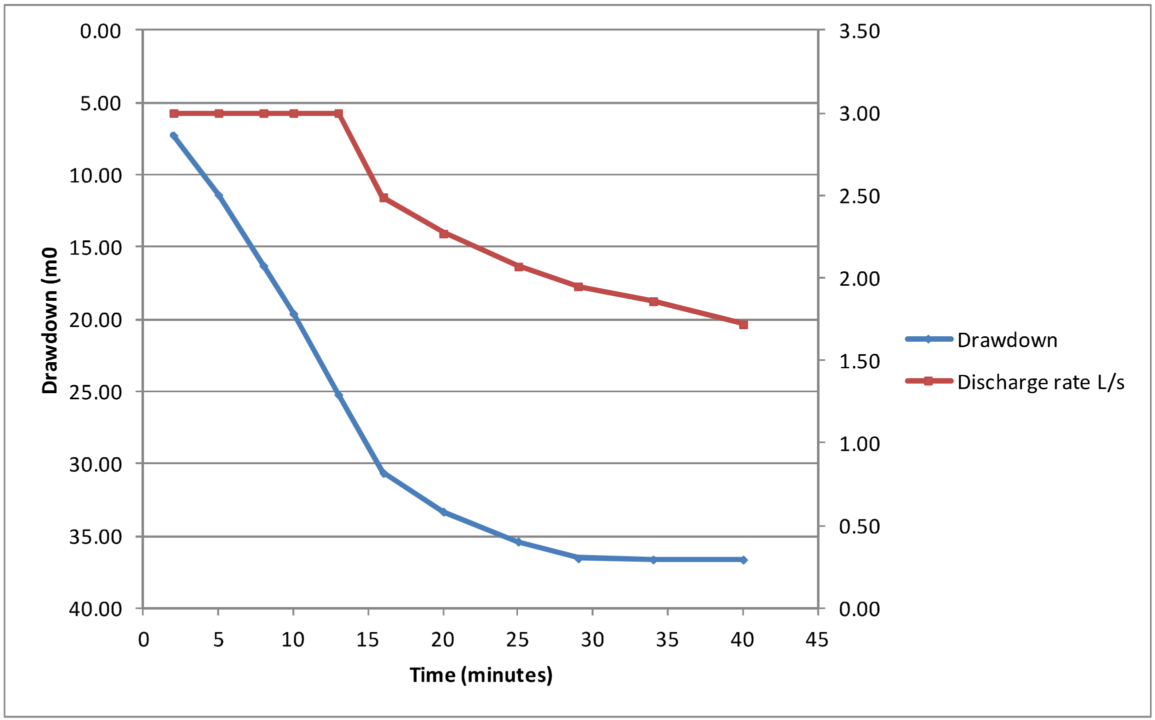

Figure 13: Plot of Drawdown and Discharge in WB3

The groundwater level in WB3 recovered to within 1.05m of the pre-test static water level after one hour.

The combination of rapid (and unsustainable) drawdown and pre-test slow recovery in the aquifer at WB3 indicates a highly compartmentalized aquifer at this location.

Impact on Surrounding Bores

The test duration was insufficient to induce drawdown in WB2 or WB5.

Long Term Pumping Rate

The long term pumping rate of WB3 is assessed at 1.7L/s.

8.5 WB2

Bore WB2 is located only about 120m from WB3. It is understood that the bores are hooked up in tandem to a common pipeline that feeds groundwater to a farm dam near WB5. It is understood that WB2 and WB3 are not pumped simultaneously. This is a sound strategy as the bores are so close that local 'groundwater mining[4]' would probably occur if both bores were to be pumped simultaneously.

WB2 was not pump tested owing to its close proximity to WB3.

Anecdotal evidence and observations by the Kur World caretaker suggests that a similar supply to that from WB3 could be expected from WB2.

8.6 WB8

WB8 was considered to have too little airlift yield to warrant pump testing. Given the nature of the aquifer, a conservative yield of 0.5L/s should be available from this bore.

8.7 Aquifer Hydraulic Parameters

The data from the pumping tests on WB6 and WB7 were analysed using the proprietary software package AquiferTest 2016. The graphical analyses of the data from are presented in Appendix 1.

Using that package the average transmissivity (T) of the Barron River Metamorphics aquifer at Kur World was assessed at 237 m^3/day/m and the average storativity (S) at 0.3336. These values are within the expected range for T and S for a fractured rock aquifer in this vicinity.

Ostensibly an aquifer with these hydraulic parameters should deliver sustainable groundwater supplies, if reasonable hydraulic connectivity exists. It is the case at Kur World, however, that the Barron River Metamorphics aquifer is highly compartmentalized as evidenced by the large variations in airlift yields in the investigation bores and the pumping test results. This compartmentalization does not permit groundwater flow locally in all directions into any of the bores, resulting in large drawdown in bores if pumped at moderate or high discharge rates. The same compartmentalization explains the long recovery times that were observed during the pumping test program.

8.8 Summary of Long Term Pumping Rates

Given the rapid drawdown in WB7, its failure to recover after a relatively short pumping period, and the apparent lack of hydraulic connectivity in the aquifer, the long term pumping rate of this bore should be restricted to 3 to 3.5L/s. Even at this reduced rate the bore should be pumped at a 12 hours on, 12 hours off cycle to prevent over-exploitation of the aquifer.

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[4] The term groundwater mining is used when groundwater abstraction exceeds reasonable natural aquifer replenishment after pumping.

The recovery rate of the groundwater level in WB6 is slow, which, as for WB7, indicates that the aquifer at WB6 does not receive rapid natural replenishment after pumping, although the drawdown in RN 171557 does show that there is increased aquifer hydraulic connectivity between RN 171557 and WB6.

The combination of these observations indicates that WB6 for use as a sustainable community water supply bore is also limited.

In summary the individual pumping rates for the bores that were discharge tested at Kur World are as follows:

- WB7 3.5L/s;
- WB6 4.0L/s;
- WB5 1.0L/s; and
- WB3 1.7L/s.

The almost ubiquitously slow recovery in each of the bores limits the combined use of the bores as the sole water source for the Kur World development. If groundwater were to be considered as a component of the water source for Kur World, a rigid pumping and recovery schedule (14 hours pumping followed by 10 hours recovery for all tested bores) would need to be adopted.

Table 6 shows what is considered to be the long term sustainable yield from groundwater at the Kur World development. The calculations in Table 6 are based on the premises that have been adopted for the prudent assessment of the yield of the aquifer underlying Kur-World:

- Slow recovery rates in individual bores following pumping limit continuous pumping of the bores. A period of recovery should be adopted each day;
- The water level in the aquifer could fall by as much as 2.5m below the level at the time the pumping tests were undertaken. This reduces the available drawdown in the aquifer;
- Reports of diminishing supplies in neighbouring bores in the same aquifer signal that a cautious pumping strategy should be adopted at Kur World to preclude ‘groundwater mining’ of the aquifer.

TABLE 6: LONG TERM SUSTAINABLE YIELD OF GROUNDWATER AT KUR WORLD

Bore	Individual pumping rate	Recommended maximum pumping time per day		Volume/day based on a 14-hour pumping day	
	L/s	hours	seconds	L	L/s (over a 24-hour day)
WB7	3.5	14	50400	176400	2.04
WB6	4	14	50400	201600	2.33
WB5	1	14	50400	50400	0.58
WB2* or WB3	1.7	14	50400	85680	0.99
WB8*	0.5	14	50400	25200	0.29
Total					6.24

Note: * these bores not pump tested

Although a total sustainable groundwater yield of 6.25L/s in a 24-hour day is not sufficient for the water supply for the Kur World development, it is considered that, if the pumping strategy outlined above were to be adopted, groundwater could provide a component of that water supply.

9.0 GROUNDWATER QUALITY

9.1 Field Sampling Program and Techniques

In order to obtain an understanding of temporal fluctuations in groundwater level and groundwater quality a selected subset of the November 2016 bores was measured four times before July 2017 at an approximately two-monthly frequency.

In the first sampling round (January 2017) bores WB2, WB5, WB6, WB7 and WB8 were sampled. In subsequent sampling rounds only WB5, WB6 and WB8 were sampled.

The field sampling program followed this protocol in every case:

1. The static water level was measured and recorded in each bore;
2. The volume of groundwater contained within the casing above the pump suction depth was calculated. This was then multiplied by a factor of three for purging purposes;
3. A trailer mounted Grundfos electric submersible pump was lowered to below the weathered zone (i.e. the pump suction was always within the Barron River Metamorphics aquifer);
4. A diesel generator provided electrical power to the sampling pump. The pump discharge was assessed on site and each bore was pumped until a minimum of three casing volumes of groundwater was extracted;
5. Groundwater electrical conductivity, pH and temperature were measured at regular intervals until the sampler was satisfied that these parameters had stabilised. The electrical conductivity, pH and temperature were recorded at this time;
6. Both filtered and non-filtered groundwater samples were collected in laboratory supplied sample containers;
7. The samples were immediately preserved in ice and delivered to a NATA accredited water laboratory on the same day as sampling occurred, under appropriate chain of custody documentation;
8. A solution of *Decon 90* was pumped through the sampling pump and discharge line prior to sampling the next bore.

Table 7 shows the field measurements for all the groundwater sampling rounds.

TABLE 7: FIELD MEASUREMENTS OF GROUNDWATER						
Bore	**Date sampled**	**Static water level m btoc**	**Temper -ature °C**	**Final electrical conductivity µS/cm**	**Final pH**	**Comment**
RN 171557	4/09/2017	2.86				No sample
WB1	4/09/2017	19.85				No sample
WB2		Equipped with submersible pump		110	6.05	
WB5	31/01/2017	18.23	26.8	0	5.07	electrical conductivity too low to measure with available instrument
WB5	13/03/2017	18.23	25.8	0	5.07	electrical conductivity too low to measure with available instrument
WB5	8/05/2017	16.37	25.2	0	5.43	electrical conductivity too low to measure with available instrument
WB5	19/06/2017	16.42		150	6.81	
WB5	4/09/2017	17.3				
WB6	31/01/2017	24.5	26.6	130	5.58	
WB6	13/03/2017	23.87	25.5	130	5.58	
WB6	8/05/2017	22.74	24.8	110	5.01	
WB6	19/06/2017	23.55		260	6.93	
WB6	4/09/2017	23.99				
WB7	31/01/2017	22.34	27	110	6.14	
WB7	13/03/2017	22.71				
WB7	8/05/2017	22.57				
WB7	19/06/2017	22.59				
WB7	4/09/2017	22.84				
WB8	31/01/2017	22.33	26.5	0	4.3	electrical conductivity too low to measure with available instrument
WB8	13/03/2017	21.94	26	0	4.3	
WB8	8/05/2017	21.47	25.1	0	3.86	electrical conductivity too low to measure with available instrument
WB8	19/06/2017	21.42		80	5.77	
WB8	4/09/2017	21.91				electrical conductivity too low to measure with available instrument

9.2 Analytical Results

The results of the groundwater chemical analyses are presented in Tables 8, 9, 10 and 11. The analyte results are compared with the Australian Drinking Water Guideline (ADWG) values. Where any analyte result exceeds the ADWG guideline value it is shown bold.

The original certificates of analysis are presented in Appendix 2.

TABLE 8: GROUNDWATER ANALYSES KUR WORLD JANUARY 2017

				WB2	**WB5**	**WB6**	**WB7**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**31/1/17**	**31/1/17**	**31/1/17**	**31/1/17**	**31/1/17**
pH**	pH Units	0.1	6.5-8.5	6.9	**6.3**	**6.4**	6.6	**5.4**
Total Alkalinity as CaCO3	mg/L	5		88	23	33	45	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5		88	23	33	45	<5
Carbonate Alkalinity as CaCO3	mg/L	5		<5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5		<5	<5	<5	<5	<5
Chloride, Cl	mg/L	1	250	18	9	59	45	17
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005		0.82	0.87	0.70	0.033	1.5
Ammonia Nitrogen, NH3 as N	mg/L	0.005		<0.005	0.005	0.006	0.014	<0.005
Total Kjeldahl Nitrogen	mg/L	0.05		<0.05	<0.05	0.11	0.11	0.07
Total Nitrogen (calc)	mg/L	0.05	50.00	0.82	0.87	0.81	0.14	1.5
Total Inorganic Nitrogen (calc)	mg/L	0.01		0.82	0.87	0.71	0.05	1.5
Filterable Reactive Phosphorus	mg/L	0.005		0.011	0.024	0.036	0.059	0.014
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02		0.02	0.04	0.03	0.06	0.03
Total Suspended Solids Dried at 103-105°C	mg/L	1		<1	<1	<1	2	3

TABLE 8: GROUNDWATER ANALYSES KUR WORLD JANUARY 2017

				WB2	**WB5**	**WB6**	**WB7**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**31/1/17**	**31/1/17**	**31/1/17**	**31/1/17**	**31/1/17**
Total Dissolved Solids Dried at 175-185°C	mg/L	10	500	150	71	190	180	85
Aluminium, Al	mg/L	0.005	0.200	<0.005	0.020	<0.005	<0.005	**0.48**
Iron, Fe	mg/L	0.005		0.018	0.007	0.013	0.19	0.013
Zinc, Zn	mg/L	0.005		0.017	0.040	0.054	0.058	0.067
Total Calcium	mg/L	0.05		19	2.7	6.9	9.6	1.1
Total Potassium	mg/L	0.05		1.6	1.2	1.3	1.4	1.8
Total Sodium	mg/L	0.5	180.0	16	7.3	27	24	6.8
Total Magnesium	mg/L	0.05		4.2	1.8	7.3	6.6	1.7
Total Hardness	mg CaCO3/L	5	200	64	14	47	51	10
Total Sulphur as SO4	mg/L	0.5	250.0	7.5	1.0	2.2	5.5	<0.5
Total Aluminium	mg/L	0.005		<0.005	0.066	0.005	0.025	0.66
Total Iron	mg/L	0.005	0.300	0.028	0.057	0.023	0.23	0.053
Total Zinc	mg/L	0.005		0.019	0.043	0.056	0.065	0.077
Arsenic, As	mg/L	0.001		0.003	0.002	0.002	0.004	0.001
Total Arsenic	mg/L	0.001	0.007	0.003	0.002	0.002	0.004	0.001
Cadmium, Cd	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
Copper, Cu	mg/L	0.001		<0.001	0.003	0.005	0.002	0.009
Lead, Pb	mg/L	0.001		<0.001	<0.001	0.001	0.002	0.004
Manganese, Mn	mg/L	0.001		0.11	0.014	0.017	0.18	0.057
Nickel, Ni	mg/L	0.001		0.004	0.001	0.003	0.003	0.002
Total Cadmium, Cd	mg/L	0.0001	0.0020	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	2.000	<0.001	0.004	0.005	0.003	0.011
Total Lead, Pb	mg/L	0.001	0.010	<0.001	0.002	0.002	0.004	0.005
Total Manganese, Mn	mg/L	0.001	0.100	**0.11**	0.014	0.017	**0.18**	0.070

TABLE 8: GROUNDWATER ANALYSES KUR WORLD JANUARY 2017

				WB2	**WB5**	**WB6**	**WB7**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**31/1/17**	**31/1/17**	**31/1/17**	**31/1/17**	**31/1/17**
Total Nickel, Ni	mg/L	0.001		0.003	0.001	0.003	0.003	0.002
Anion-Cation Balance	%	-100		-10	-11	-5.4	-5.0	-11

TABLE 9: GROUNDWATER ANALYSES KUR WORLD MARCH 2017

				WB5	**WB6**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**13/03/17**	**13/03/17**	**13/03/17**
pH**	pH Units	0.1	6.5-8.5	7.1	**6.4**	**5.3**
Total Alkalinity as CaCO3	mg/L	5		100	37	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5		100	37	<5
Carbonate Alkalinity as CaCO3	mg/L	5		<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5		<5	<5	<5
Chloride, Cl	mg/L	1	250	10	57	17
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005		0.11	0.65	1.5
Ammonia Nitrogen, NH3 as N	mg/L	0.005		0.073	<0.005	<0.005
Total Kjeldahl Nitrogen	mg/L	0.05		0.08	<0.05	<0.05
Total Nitrogen (calc)	mg/L	0.05	50.00	0.19	0.65	1.5
Total InorganicNitrogen (calc)	mg/L	0.01		0.18	0.65	1.5
Filterable Reactive Phosphorus	mg/L	0.005		0.027	0.032	0.010
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02		0.05	0.07	0.03
Total Suspended Solids Dried at 103-105°C	mg/L	1		<1	<1	<1
Total Dissolved Solids Dried at 175-185°C	mg/L	10	500	150	200	86
Aluminium, Al	mg/L	0.005	0.200	<0.005	<0.005	0.58
Iron, Fe	mg/L	0.005		0.56	0.042	0.009
Zinc, Zn	mg/L	0.005		0.010	0.029	0.040

TABLE 9: GROUNDWATER ANALYSES KUR WORLD MARCH 2017

				WB5	**WB6**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**13/03/17**	**13/03/17**	**13/03/17**
Total Calcium	mg/L	0.05		16	7.5	1.0
Total Potassium	mg/L	0.05		1.6	1.3	1.6
Total Sodium	mg/L	0.5	180.0	13	27	6.1
Total Magnesium	mg/L	0.05		4.4	7.8	1.7
Total Hardness	mg CaCO3/L	5	200	59	51	10
Total Sulphur as SO4	mg/L	0.5	250.0	6.7	2.2	<0.5
Total Aluminium	mg/L	0.005		<0.005	<0.005	0.67
Total Iron	mg/L	0.005	0.300	0.60	0.051	0.038
Total Zinc	mg/L	0.005		0.011	0.041	0.051
Arsenic, As	mg/L	0.001		0.018	0.002	0.001
Total Arsenic	mg/L	0.001	0.007	**0.019**	0.002	0.002
Cadmium, Cd	mg/L	0.0001		<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001		<0.001	<0.001	<0.001
Copper, Cu	mg/L	0.001		<0.001	0.003	0.007
Lead, Pb	mg/L	0.001		<0.001	0.001	0.005
Manganese, Mn	mg/L	0.001		0.16	0.023	0.063
Nickel, Ni	mg/L	0.001		<0.001	0.003	0.002
Total Cadmium, Cd	mg/L	0.0001	0..002	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001		<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	2.000	<0.001	0.004	0.008
Total Lead, Pb	mg/L	0.001	0.010	0.001	0.001	0.005
Total Manganese, Mn	mg/L	0.001	0.100	**0.16**	0.021	0.065
Total Nickel, Ni	mg/L	0.001		<0.001	0.003	0.002
Anion-Cation Balance	%	-100		-16	-4.8	-13

TABLE 10: GROUNDWATER ANALYSES KUR WORLD MAY 2017						
				WB5	**WB6**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**8/5/17**	**8/5/17**	**8/5/17**
pH**	pH Units	0.1	6.5-8.5	6.6	**6.3**	**5.1**
Total Alkalinity as CaCO3	mg/L	5		54	27	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5		54	27	<5
Carbonate Alkalinity as CaCO3	mg/L	5		<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5		<5	<5	<5
Chloride, Cl	mg/L	1	250	8	57	18
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005		0.29	0.76	1.7
Ammonia Nitrogen, NH3 as N	mg/L	0.005		0.051	<0.005	<0.005
Total Kjeldahl Nitrogen	mg/L	0.05		<0.05	<0.05	<0.05
Total Nitrogen (calc)	mg/L	0.05	50.00	0.29	0.76	1.7
Total InorganicNitrogen (calc)	mg/L	0.01		0.34	0.76	1.7
Filterable Reactive Phosphorus	mg/L	0.005		0.019	0.032	0.021
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02		0.04	0.09	0.03
Total Suspended Solids Dried at 103-105°C	mg/L	1		<1	<1	4
Total Dissolved Solids Dried at 175-185°C	mg/L	10	500	110	170	78
Aluminium, Al	mg/L	0.005	0.200	0.005	<0.005	**0.78**
Iron, Fe	mg/L	0.005		0.23	0.007	0.011
Zinc, Zn	mg/L	0.005		0.010	0.027	0.043
Total Calcium	mg/L	0.05		12	5.9	1.1
Total Potassium	mg/L	0.05		1.5	1.3	1.9
Total Sodium	mg/L	0.5	180.0	11	28	6.4
Total Magnesium	mg/L	0.05		3.1	7.2	1.8
Total Hardness	mg CaCO3/L	5	200	42	45	10
Total Sulphur as SO4	mg/L	0.5	250.0	3.7	2.1	<0.5

TABLE 10: GROUNDWATER ANALYSES KUR WORLD MAY 2017						
				WB5	**WB6**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**8/5/17**	**8/5/17**	**8/5/17**
Total Aluminium	mg/L	0.005		0.018	<0.005	0.87
Total Iron	mg/L	0.005	0.300	**0.45**	0.013	0.039
Total Zinc	mg/L	0.005		0.009	0.026	0.048
Arsenic, As	mg/L	0.001		0.010	0.001	0.001
Total Arsenic	mg/L	0.001	0.007	**0.014**	0.002	0.001
Cadmium, Cd	mg/L	0.0001		<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001		<0.001	<0.001	<0.001
Copper, Cu	mg/L	0.001		<0.001	0.003	0.009
Lead, Pb	mg/L	0.001		<0.001	0.001	0.006
Manganese, Mn	mg/L	0.001		0.089	0.008	0.075
Nickel, Ni	mg/L	0.001		<0.001	0.004	0.002
Total Cadmium, Cd	mg/L	0.0001	0.0020	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001		<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	2.000	<0.001	0.003	0.010
Total Lead, Pb	mg/L	0.001	0.010	<0.001	0.001	0.007
Total Manganese, Mn	mg/L	0.001	0.100	0.091	0.009	0.081
Total Nickel, Ni	mg/L	0.001		<0.001	0.004	0.002
Anion-Cation Balance	%	-100		-2.4	-2.7	-10

TABLE 11: GROUNDWATER ANALYSES KUR WORLD JUNE 2017						
				WB5	**WB6**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**19/6/17**	**19/6/17**	**19/6/17**
pH**	pH Units	0.1	6.5-8.5	**6.4**	**6.4**	**5.6**
Total Alkalinity as CaCO3	mg/L	5		67	66	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5		67	66	<5
Carbonate Alkalinity as CaCO3	mg/L	5		<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5		<5	<5	<5
Chloride, Cl	mg/L	1	250	9	53	16
Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005		0.058	0.33	1.5
Ammonia Nitrogen, NH3 as N	mg/L	0.005		<0.005	<0.005	<0.005
Total Kjeldahl Nitrogen	mg/L	0.05		<0.05	<0.05	0.06
Total Nitrogen (calc)	mg/L	0.05	50.00	0.06	0.33	1.6
Total InorganicNitrogen (calc)	mg/L	0.01		0.06	0.33	1.5
Filterable Reactive Phosphorus	mg/L	0.005		0.030	0.014	0.011
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02		0.03	0.02	0.03
Total Suspended Solids Dried at 103-105°C	mg/L	1		<1	<1	<1
Total Dissolved Solids Dried at 175-185°C	mg/L	10	500	140	220	84
Aluminium, Al	mg/L	0.005	0.200	0.012	<0.005	**0.52**
Iron, Fe	mg/L	0.005		0.50	0.20	0.005
Zinc, Zn	mg/L	0.005		0.012	0.026	0.031
Total Calcium	mg/L	0.05		15	15	1.1
Total Potassium	mg/L	0.05		1.5	1.2	1.8
Total Sodium	mg/L	0.5	180.0	15	32	8.1
Total Magnesium	mg/L	0.05		3.6	7.9	1.7
Total Hardness	mg CaCO3/L	5	200	52	71	10
Total Sulphur as SO4	mg/L	0.5	250.0	5.7	2.5	<0.5

TABLE 11: GROUNDWATER ANALYSES KUR WORLD JUNE 2017						
				WB5	**WB6**	**WB8**
Analyte Name	**Units**	**Reporting Limit**	**ADWG**	**19/6/17**	**19/6/17**	**19/6/17**
Total Aluminium	mg/L	0.005		0.010	<0.005	0.55
Total Iron	mg/L	0.005	0.300	**0.51**	**0.32**	0.008
Total Zinc	mg/L	0.005		0.007	0.021	0.031
Arsenic, As	mg/L	0.001		0.014	0.004	0.001
Total Arsenic	mg/L	0.001	0.007	**0.014**	0.005	0.001
Cadmium, Cd	mg/L	0.0001		<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001		<0.001	<0.001	<0.001
Copper, Cu	mg/L	0.001		0.002	0.004	0.006
Lead, Pb	mg/L	0.001		0.001	0.001	0.004
Manganese, Mn	mg/L	0.001		0.16	0.076	0.042
Nickel, Ni	mg/L	0.001		<0.001	0.003	0.002
Total Cadmium, Cd	mg/L	0.0001	0.0020	0.0002	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001		<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	2.000	<0.001	0.003	0.006
Total Lead, Pb	mg/L	0.001	0.010	0.001	<0.001	0.004
Total Manganese, Mn	mg/L	0.001	0.100	**0.16**	**0.12**	0.040
Total Nickel, Ni	mg/L	0.001		<0.001	0.002	0.002
Anion-Cation Balance	%	-100		0.9	-0.5	-3.2

As shown in Tables 8 to 11:

The pH of the groundwater is regularly lower than the ADWG guideline value;

Iron and manganese sporadically exceed the ADWG guideline values but not always in the same bore for successive samples; and

Occasional exceedances of the ADWG guideline values for Aluminium and Arsenic occur but not always in the same bore for successive samples.

In general the groundwater at Kur World is considered to be of good chemical quality. The salinity of the groundwater is low, as are sulphate and nitrate, and there are few problems with metal exceedances.

10.0 CONCLUSIONS

Based on the analysis of the groundwater data available at and around Kur World, the following conclusions are presented:

1. The Kur World development is located mainly over a geological formation known as the Barron River Metamorphics which is a lithological correlative of the Hodgkinson Formation. The Barron River Metamorphics Formation is composed of low-grade metasediments. Overlying the Barron River Metamorphics is a 5 to 10m thick layer of very weathered metasediments and clayey hillwash sediments that have either developed in situ, but, more likely are the product of mass wasting from more elevated areas.

2. The main aquifer in the Kur World vicinity comprises fractured rock within the Barron River Metamorphics. The main aquifer is overlain by up to 10m of clayey hillwash sediments that form a reasonably effective aquitard. Therefore the main aquifer is confined.

3. A search of the Department of natural Resources and Mines (DNRM) groundwater database showed that airlift yield results from bores in the vicinity of the Kur World development is of the order of 0.75 to 1.0L/s.

4. A census of neighbouring bores revealed that the majority of the neighbouring bores are used for domestic purposes. Groundwater quality from the bores is generally reported to be good but some bores are reported to deliver mineralised or saline groundwater. Sustained yields are not possible in some bores and bore yields may diminish as groundwater levels fall with the advance of the dry season.

5. Aquifers within the Barron River Metamorphics are recharged primarily by direct vertical infiltration of rainfall. The water table at Kur World has the potential to vary seasonally by up to 2.5m. There is a lag time of some two to three months between significant rainfall and the corresponding peak in the water table. Vertical movement of water to the water table is generally slow. Recharge only occurs once the surficial sediments are fully saturated. This means that virtually no recharge occurs in the first few spring storm events where most of the rainfall received runs off. Little or no recharge occurs during the long, relatively dry period from May to November. Very little ‘flushing” of the aquifer by recharging water occurs in the prime aquifer sequence as rainfall recharge is generally a slow process (estimated to be in the order of two to three years in these deeper zones), which probably accounts for the observations of saline or mineralised water in some neighbouring bores.

6. Groundwater flow is primarily from east to west at Kur World at a gradient of 1.25%.

7. The water table is at least 5m below the stream levels, even at the lowest topographic point near SW3. Almost everywhere else the water table is about 10m below stream levels. Given these observations, and even taking into account a potential rise of 2.5m in the water table after the wet season, it is not possible for groundwater to discharge into the streams. This is because the vertical distance for such discharge to occur is simply too great, given the rather shallow gradient that exists and the fact that the upper intervals in all the boreholes show significant clay sequences. Therefore, no groundwater – surface water exchange is possible at Kur World.

8. The almost ubiquitously slow recovery in each of the bores following pumping tests limits the combined use of the bores as the sole water source for the Kur World development. If

groundwater were to be considered as a component of the water source for Kur World, a rigid pumping and recovery schedule (14 hours pumping followed by 10 hours recovery for all tested bores) would need to be adopted.

9. A total sustainable groundwater yield of 6.25L/s in any 24-hour day has been assessed for Kur World. This is not sufficient for the water supply for the Kur World development, but it is considered that, if the pumping strategy outlined above were to be adopted, groundwater could provide a component of that water supply.

10. In general the groundwater at Kur World is considered to be of good chemical quality. The salinity of the groundwater is low, as are sulphate and nitrate, and there are few problems with metal exceedances. The pH of the groundwater is regularly lower than the ADWG guideline value. Iron and manganese sporadically exceed the ADWG guideline values but not always in the same bore for successive samples and Occasional exceedances of the ADWG guideline values for aluminium and arsenic occur but not always in the same bore for successive samples.

Rob Lait and Associates Pty Ltd

ROB LAIT
Principal Hydrogeologist

Attachments:

Appendix 1 Graphical Analyses of Pumping test data

Appendix 2 Certificates of Chemical Analyses

LIMITATIONS OF REPORT

Rob Lait and Associates Pty Ltd (RLA) has prepared this report for the use of Reever and Ocean Pty Ltd Pty Ltd in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report.

This study was undertaken between 1st January and 18th October 2017 using data obtained from drilling and hydraulic conductivity testing, and is based on the conditions encountered and the information available at the time of preparation of the report. RLA disclaims responsibility for any changes that may occur after this time.

The methodology adopted and sources of information used by RLA are outlined in this report. RLA has made no independent verification of this information beyond the agreed scope of works and RLA assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to RLA was false.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. It may not contain sufficient information for the purposes of other parties or other users. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing and other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. Where borehole logs are provided they indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the frequency and method of sampling, and the uniformity of the site, as constrained by the project budget limitations. The behaviour of groundwater is complex.

Our conclusions are based upon the analytical data presented in this report and our experience.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, RLA must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge, information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time. Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

Appendix 1 Graphical Analyses of Pumping test data

Rob Lait and Associates Pty Ltd
PO Box 788
Innisfail,
Queensland 4860

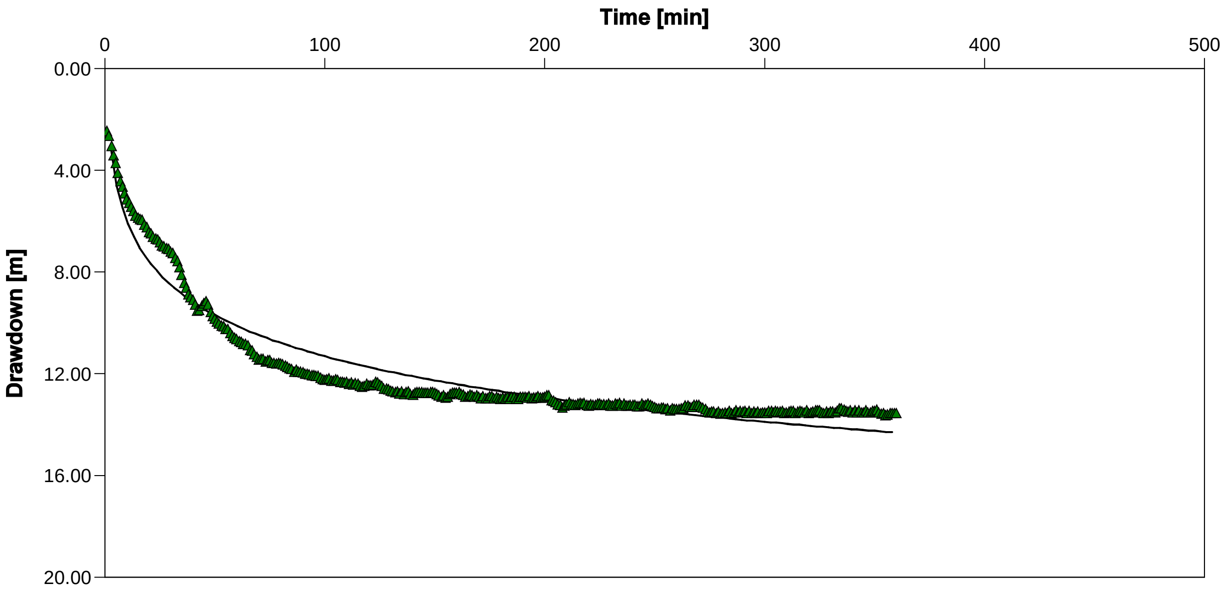
Pumping Test Analysis Report

Project: Kur World

Number: 261

Client: Reever and Ocean Pty Ltd

Location: Myola	Pumping Test: WB5	Pumping Well: WB5
Test Conducted by: A McDonald		Test Date: 7/07/2017
Analysis Performed by: R Lait	Theis	Analysis Date: 1/08/2017
Aquifer Thickness: 31.00 m	Discharge Rate: 0.6 [l/s]	



Calculation using Theis

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
WB5	1.75×10^{0}	5.66×10^{-2}	4.13×10^{-1}	0.07	

Rob Lait and Associates Pty Ltd
PO Box 788
Innisfail,
Queensland 4860

Pumping Test Analysis Report

Project: Kur World

Number: 261

Client: Reever and Ocean Pty Ltd

Location: Myola

Pumping Test: WB6

Pumping Well: WB6

Test Conducted by: A McDonald

Test Date: 30/06/2017

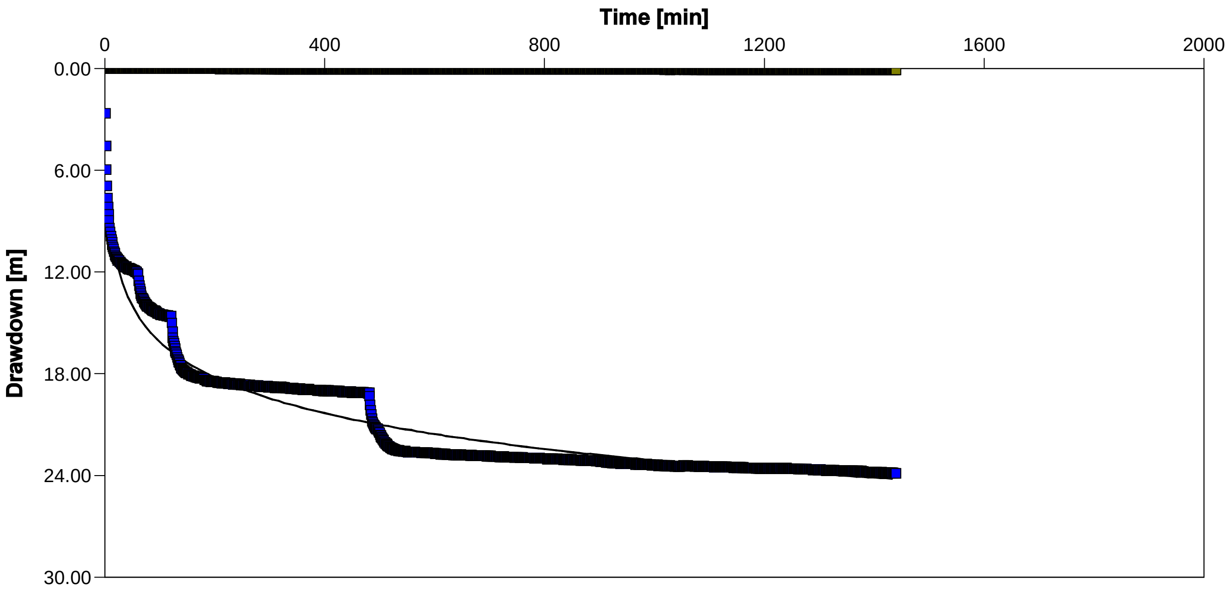
Analysis Performed by: R Lait

Theis

Analysis Date: 10/07/2017

Aquifer Thickness: 28.00 m

Discharge: variable, average rate 3.7708 [l/s]



Calculation using Theis

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
WB6	8.53×10^{0}	3.05×10^{-1}	9.90×10^{-1}	0.08	
WB7	2.77×10^{3}	9.88×10^{1}	1.47×10^{-2}	305.94	
171557	4.39×10^{2}	1.57×10^{1}	2.11×10^{-3}	437.2	
Average	1.07×10^{3}	3.83×10^{1}	3.36×10^{-1}		

Rob Lait and Associates Pty Ltd
PO Box 788
Innisfail,
Queensland 4860

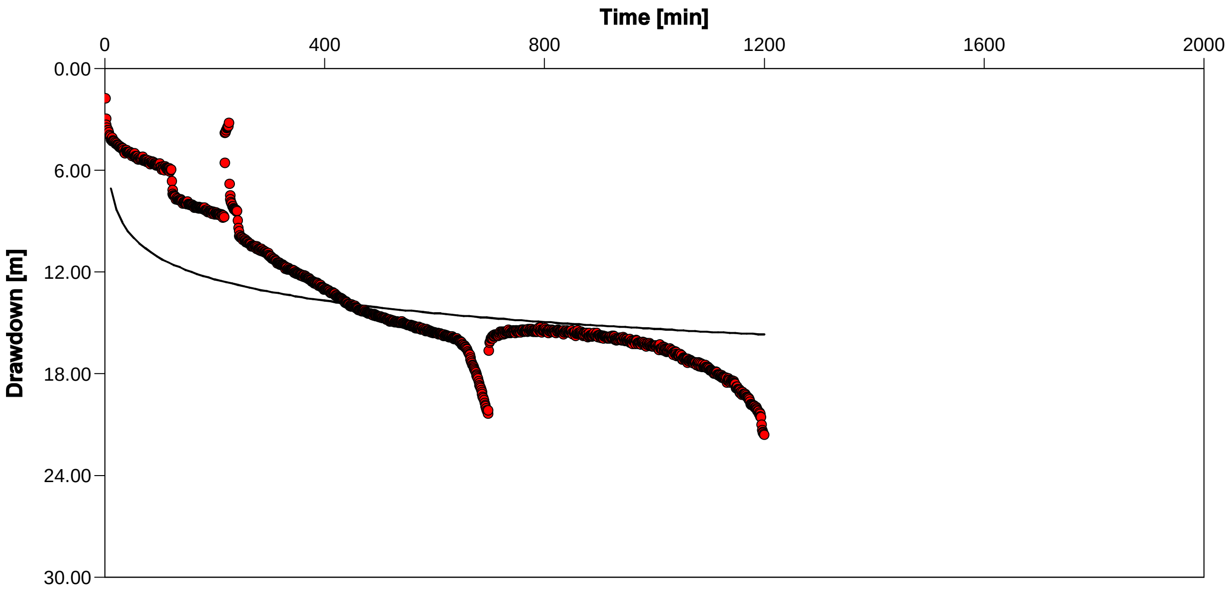
Pumping Test Analysis Report

Project: Kur World

Number: 261

Client: Reever and Ocean Pty Ltd

Location: Myola	Pumping Test: WB7	Pumping Well: WB7
Test Conducted by: A McDonald		Test Date: 9/06/2017
Analysis Performed by: R Lait	Theis	Analysis Date: 10/07/2017
Aquifer Thickness: 31.00 m	Discharge: variable, average rate 6.285 [l/s]	



Calculation using Theis

Observation Well	Transmissivity [m²/d]	Hydraulic Conductivity [m/d]	Storage coefficient	Radial Distance to PW [m]	
WB7	2.37×10^{1}	7.66×10^{-1}	9.90×10^{-1}	0.09	

Appendix 1 Certificates of Chemical Analyses

ANALYTICAL REPORT

Accreditation No. 252

CLIENT DETAILS

Contact	Rob Lait
Client	Rob Lait & Associates
Address	27 Scheu St INNISFAIL QLD 4860
Telephone	07 4061 3103
Facsimile	07 4061 8094
Email	rob@roblait.com.au
Project	**KUR-World**
Order Number	(Not specified)
Samples	5

LABORATORY DETAILS

Manager	Jon Dicker
Laboratory	SGS Cairns Environmental
Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	+61 07 4035 5111
Facsimile	+61 07 4035 5122
Email	AU.Environmental.Cairns@sgs.com
SGS Reference	**CE125368 R0**
Date Received	01 Feb 2017
Date Reported	10 Feb 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE161630.

SIGNATORIES

Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Orsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

		Sample Number	CE125368.001	CE125368.002	CE125368.003	CE125368.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	31 Jan 2017	31 Jan 2017	31 Jan 2017	31 Jan 2017
		Sample Name	WB2	WB5	WB6	WB7
Parameter	Units	LOR				

pH in water Method: AN101 Tested: 1/2/2017

pH**	pH Units	0.1	**6.9**	**6.3**	**6.4**	**6.6**

Alkalinity Method: AN135 Tested: 1/2/2017

Total Alkalinity as CaCO3	mg/L	5	**88**	**23**	**33**	**45**
Bicarbonate Alkalinity as CaCO3	mg/L	5	**88**	**23**	**33**	**45**
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 1/2/2017

Chloride, Cl	mg/L	1	**18**	**9**	**59**	**45**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 9/2/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.82**	**0.87**	**0.70**	**0.033**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 7/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005	**0.005**	**0.006**	**0.014**

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 2/2/2017

Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	<0.05	**0.11**	**0.11**
Total Nitrogen (calc)	mg/L	0.05	**0.82**	**0.87**	**0.81**	**0.14**

		Sample Number	CE125368.001	CE125368.002	CE125368.003	CE125368.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	31 Jan 2017	31 Jan 2017	31 Jan 2017	31 Jan 2017
		Sample Name	WB2	WB5	WB6	WB7
Parameter	**Units**	**LOR**				

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 10/2/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.82**	**0.87**	**0.71**	**0.05**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 6/2/2017

Filterable Reactive Phosphorus	mg/L	0.005	**0.011**	**0.024**	**0.036**	**0.059**

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 2/2/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.02**	**0.04**	**0.03**	**0.06**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 6/2/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	<1	**2**

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 7/2/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**150**	**71**	**190**	**180**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 3/2/2017

Aluminium, Al	mg/L	0.005	<0.005	**0.020**	<0.005	<0.005
Iron, Fe	mg/L	0.005	**0.018**	**0.007**	**0.013**	**0.19**
Zinc, Zn	mg/L	0.005	**0.017**	**0.040**	**0.054**	**0.058**

		Sample Number	CE125368.001	CE125368.002	CE125368.003	CE125368.004
		Sample Matrix	Water	Water	Water	Water
		Sample Date	31 Jan 2017	31 Jan 2017	31 Jan 2017	31 Jan 2017
		Sample Name	WB2	WB5	WB6	WB7
Parameter	Units	LOR				

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 3/2/2017

Total Aluminium	mg/L	0.005	<0.005	**0.066**	**0.005**	**0.025**
Total Hardness*	mg CaCO3/L	5	**64**	**14**	**47**	**51**
Total Calcium	mg/L	0.05	**19**	**2.7**	**6.9**	**9.6**
Total Iron	mg/L	0.005	**0.028**	**0.057**	**0.023**	**0.23**
Total Magnesium	mg/L	0.05	**4.2**	**1.8**	**7.3**	**6.6**
Total Potassium	mg/L	0.05	**1.6**	**1.2**	**1.3**	**1.4**
Total Sodium	mg/L	0.5	**16**	**7.3**	**27**	**24**
Total Sulphur as SO4	mg/L	0.5	**7.5**	**1.0**	**2.2**	**5.5**
Total Zinc	mg/L	0.005	**0.019**	**0.043**	**0.056**	**0.065**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 2/2/2017

Arsenic, As	mg/L	0.001	**0.003**	**0.002**	**0.002**	**0.004**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 2/2/2017

Total Arsenic	mg/L	0.001	**0.003**	**0.002**	**0.002**	**0.004**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 3/2/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	**0.003**	**0.005**	**0.002**
Lead, Pb	mg/L	0.001	<0.001	<0.001	**0.001**	**0.002**
Manganese, Mn	mg/L	0.001	**0.11**	**0.014**	**0.017**	**0.18**
Nickel, Ni	mg/L	0.001	**0.004**	**0.001**	**0.003**	**0.003**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 3/2/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	**0.004**	**0.005**	**0.003**
Total Lead, Pb	mg/L	0.001	<0.001	**0.002**	**0.002**	**0.004**
Total Manganese, Mn*	mg/L	0.001	**0.11**	**0.014**	**0.017**	**0.18**
Total Nickel, Ni	mg/L	0.001	**0.003**	**0.001**	**0.003**	**0.003**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 10/2/2017

Anion-Cation Balance	%	-100	**-10**	**-11**	**-5.4**	**-5.0**

Parameter	Units	LOR	Sample Number: CE125368.005 Sample Matrix: Water Sample Date: 31 Jan 2017 Sample Name: WB8

pH in water Method: AN101 Tested: 1/2/2017

pH**	pH Units	0.1	**5.4**

Alkalinity Method: AN135 Tested: 1/2/2017

Total Alkalinity as CaCO3	mg/L	5	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 1/2/2017

Chloride, Cl	mg/L	1	**17**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 9/2/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**1.5**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 7/2/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 2/2/2017

Total Kjeldahl Nitrogen	mg/L	0.05	**0.07**
Total Nitrogen (calc)	mg/L	0.05	**1.5**

		Sample Number	CE125368.005
		Sample Matrix	Water
		Sample Date	31 Jan 2017
		Sample Name	WB8
Parameter	Units	LOR	

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 10/2/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**1.5**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 6/2/2017

Filterable Reactive Phosphorus	mg/L	0.005	**0.014**

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 2/2/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 6/2/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	**3**

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 7/2/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**85**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 3/2/2017

Aluminium, Al	mg/L	0.005	**0.48**
Iron, Fe	mg/L	0.005	**0.013**
Zinc, Zn	mg/L	0.005	**0.067**

Parameter	Units	LOR	Sample Number CE125368.005 Sample Matrix Water Sample Date 31 Jan 2017 Sample Name WB8

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 3/2/2017

Total Aluminium	mg/L	0.005	**0.66**
Total Hardness*	mg CaCO3/L	5	**10**
Total Calcium	mg/L	0.05	**1.1**
Total Iron	mg/L	0.005	**0.053**
Total Magnesium	mg/L	0.05	**1.7**
Total Potassium	mg/L	0.05	**1.8**
Total Sodium	mg/L	0.5	**6.8**
Total Sulphur as SO4	mg/L	0.5	<0.5
Total Zinc	mg/L	0.005	**0.077**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 2/2/2017

Arsenic, As	mg/L	0.001	**0.001**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 2/2/2017

Total Arsenic	mg/L	0.001	**0.001**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 3/2/2017

Cadmium, Cd	mg/L	0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010
Copper, Cu	mg/L	0.001	**0.009**
Lead, Pb	mg/L	0.001	**0.004**
Manganese, Mn	mg/L	0.001	**0.057**
Nickel, Ni	mg/L	0.001	**0.002**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 3/2/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001
Total Copper, Cu	mg/L	0.001	**0.011**
Total Lead, Pb	mg/L	0.001	**0.005**
Total Manganese, Mn*	mg/L	0.001	**0.070**
Total Nickel, Ni	mg/L	0.001	**0.002**

Parameter	Units	LOR	Sample Number CE125368.005 Sample Matrix Water Sample Date 31 Jan 2017 Sample Name WB8
Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 10/2/2017			
Anion-Cation Balance	%	-100	**-11**

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	LB043126	mg/L	5	<5	1 - 5%	111%
Bicarbonate Alkalinity as CaCO3	LB043126	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB043126	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB043126	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB043249	mg/L	0.005	<0.005	0 - 6%	99 - 102%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB043125	mg/L	1	<1	0%	109%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB043251	mg/L	0.005	<0.005	0 - 2%	99 - 101%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB043193	mg/L	0.005	0 - 2%	100%	112%
Total Calcium	LB043193	mg/L	0.05	1%	102%	
Total Iron	LB043193	mg/L	0.005	1 - 5%	106%	106%
Total Magnesium	LB043193	mg/L	0.05	0%	100%	
Total Potassium	LB043193	mg/L	0.05	0%	104%	
Total Sodium	LB043193	mg/L	0.5	0%	96%	
Total Sulphur as SO4	LB043193	mg/L	0.5	7%	100%	
Total Zinc	LB043193	mg/L	0.005	0 - 1%	108%	113%

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB043192	mg/L	0.005	<0.005	0 - 1%	101%	114%
Iron, Fe	LB043192	mg/L	0.005	<0.005	0 - 1%	107%	115%
Zinc, Zn	LB043192	mg/L	0.005	<0.005	0 - 1%	109%	116%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB043194	mg/L	0.0001	<0.0001	0%	95%	109%
Chromium, Cr	LB043194	mg/L	0.001	<0.0010	0%	95%	95%
Copper, Cu	LB043194	mg/L	0.001	<0.001	0 - 8%	93%	107%
Lead, Pb	LB043194	mg/L	0.001	<0.001	5 - 6%	97%	89%
Manganese, Mn	LB043194	mg/L	0.001	<0.001	0%	NA	
Nickel, Ni	LB043194	mg/L	0.001	<0.001	0 - 1%	101%	89%

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB043195	mg/L	0.0001	<0.0001	0%	95%	108%
Total Chromium, Cr	LB043195	mg/L	0.001	<0.001	0%	92%	92%
Total Copper, Cu	LB043195	mg/L	0.001	<0.001	4%	99%	111%
Total Lead, Pb	LB043195	mg/L	0.001	<0.001	3%	98%	92%
Total Manganese, Mn*	LB043195	mg/L	0.001	<0.001	0%	NA	
Total Nickel, Ni	LB043195	mg/L	0.001	<0.001	3%	98%	86%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB043283	mg/L	0.005	<0.005	0 - 4%	100 - 102%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
pH**	LB043126	pH Units	0.1	5.6	100%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB043138	mg/L	0.05	<0.05	3%	97%

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	LB043256	mg/L	1	<1	0%	93%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB043315	mg/L	10	<10	1 - 2%	99%	109%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB043138	mg/L	0.02	<0.02	1%	104%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Arsenic, As	LB043160	mg/L	0.001	<0.001	200%	NA

QC SUMMARY

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.

Trace Metals (Total) in Water by ICPMS in mg/L Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Arsenic	LB043164	mg/L	0.001	<0.001	0%	NA

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
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 µmhos/cm or µS/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 calculation 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.
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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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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ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS | LABORATORY DETAILS

Contact	Rob Lait	Manager	Jon Dicker
Client	Rob Lait & Associates	Laboratory	SGS Cairns Environmental
Address	27 Scheu St INNISFAIL QLD 4860	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4061 3103	Telephone	+61 07 4035 5111
Facsimile	07 4061 8094	Facsimile	+61 07 4035 5122
Email	rob@roblait.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**KUR-World**	SGS Reference	**CE126251 R0**
Order Number	(Not specified)	Date Received	14 Mar 2017
Samples	3	Date Reported	27 Mar 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE163199.
For determination of soluble metals, filtered sample was not received so samples were laboratory filtered on receipt. This may give soluble metals results that do not represent the concentrations present at the time of sampling.

SIGNATORIES

G. Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Maristela Ganzan
Metals Team Leader

		Sample Number	CE126251.001	CE126251.002	CE126251.003
		Sample Matrix	Water	Water	Water
		Sample Date	13/3/17 12:30	13/3/17 10:30	13/3/17 11:50
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

pH in water Method: AN101 Tested: 14/3/2017

pH**	pH Units	0.1	**7.1**	**6.4**	**5.3**

Alkalinity Method: AN135 Tested: 14/3/2017

Total Alkalinity as CaCO3	mg/L	5	**100**	**37**	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	**100**	**37**	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 16/3/2017

Chloride, Cl	mg/L	1	**10**	**57**	**17**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 21/3/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.11**	**0.65**	**1.5**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 20/3/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.073**	<0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 15/3/2017

Total Kjeldahl Nitrogen	mg/L	0.05	**0.08**	<0.05	<0.05
Total Nitrogen (calc)	mg/L	0.05	**0.19**	**0.65**	**1.5**

		Sample Number	CE126251.001	CE126251.002	CE126251.003
		Sample Matrix	Water	Water	Water
		Sample Date	13/3/17 12:30	13/3/17 10:30	13/3/17 11:50
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 27/3/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.18**	**0.65**	**1.5**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 17/3/2017

Filterable Reactive Phosphorus	mg/L	0.005	**0.027**	**0.032**	**0.010**

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 15/3/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	**0.05**	**0.07**	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 15/3/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	<1

Total Dissolved Solids (TDS) in water Method: AN113 Tested: 15/3/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**150**	**200**	**86**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 20/3/2017

Aluminium, Al	mg/L	0.005	<0.005	<0.005	**0.58**
Iron, Fe	mg/L	0.005	**0.56**	**0.042**	**0.009**
Zinc, Zn	mg/L	0.005	**0.010**	**0.029**	**0.040**

		Sample Number	CE126251.001	CE126251.002	CE126251.003
		Sample Matrix	Water	Water	Water
		Sample Date	13/3/17 12:30	13/3/17 10:30	13/3/17 11:50
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 20/3/2017

Total Aluminium	mg/L	0.005	<0.005	<0.005	**0.67**
Total Hardness*	mg CaCO3/L	5	**59**	**51**	**10**
Total Calcium	mg/L	0.05	**16**	**7.5**	**1.0**
Total Iron	mg/L	0.005	**0.60**	**0.051**	**0.038**
Total Magnesium	mg/L	0.05	**4.4**	**7.8**	**1.7**
Total Potassium	mg/L	0.05	**1.6**	**1.3**	**1.6**
Total Sodium	mg/L	0.5	**13**	**27**	**6.1**
Total Sulphur as SO4	mg/L	0.5	**6.7**	**2.2**	<0.5
Total Zinc	mg/L	0.005	**0.011**	**0.041**	**0.051**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 17/3/2017

Arsenic, As	mg/L	0.001	**0.018**	**0.002**	**0.001**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 17/3/2017

Total Arsenic	mg/L	0.001	**0.019**	**0.002**	**0.002**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 20/3/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	**0.003**	**0.007**
Lead, Pb	mg/L	0.001	<0.001	**0.001**	**0.005**
Manganese, Mn	mg/L	0.001	**0.16**	**0.023**	**0.063**
Nickel, Ni	mg/L	0.001	<0.001	**0.003**	**0.002**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 20/3/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	**0.004**	**0.008**
Total Lead, Pb	mg/L	0.001	**0.001**	**0.001**	**0.005**
Total Manganese, Mn*	mg/L	0.001	**0.16**	**0.021**	**0.065**
Total Nickel, Ni	mg/L	0.001	<0.001	**0.003**	**0.002**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 27/3/2017

Anion-Cation Balance	%	-100	**-16**	**-4.8**	**-13**

QC SUMMARY

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	LB044394	mg/L	5	<5	0 - 1%	118%
Bicarbonate Alkalinity as CaCO3	LB044394	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB044394	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB044394	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB044540	mg/L	0.005	<0.005	0 - 2%	100 - 115%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB044440	mg/L	1	<1	0 - 1%	108%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB044488	mg/L	0.005	<0.005	7%	96%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB044508	mg/L	0.005	1 - 10%	98 - 100%	
Total Calcium	LB044508	mg/L	0.05	0%	109 - 111%	
Total Iron	LB044508	mg/L	0.005	3 - 13%	110 - 112%	
Total Magnesium	LB044508	mg/L	0.05	0%	107 - 111%	
Total Potassium	LB044508	mg/L	0.05	0%	103 - 105%	
Total Sodium	LB044508	mg/L	0.5	1%	99 - 101%	
Total Sulphur as SO4	LB044508	mg/L	0.5	1 - 11%	103 - 107%	
Total Zinc	LB044508	mg/L	0.005	1 - 4%	114%	110%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB044507	mg/L	0.005	<0.005	0%	95%	
Iron, Fe	LB044507	mg/L	0.005	<0.005	0%	107%	
Zinc, Zn	LB044507	mg/L	0.005	<0.005	0%	112%	108%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB044509	mg/L	0.0001	<0.0001	0%	102%	100%
Chromium, Cr	LB044509	mg/L	0.001	<0.0010	0%	102%	
Copper, Cu	LB044509	mg/L	0.001	<0.001	0%	93%	122%
Lead, Pb	LB044509	mg/L	0.001	<0.001	0%	103%	97%
Manganese, Mn	LB044509	mg/L	0.001	<0.001		NA	
Nickel, Ni	LB044509	mg/L	0.001	<0.001	0%	106%	

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB044510	mg/L	0.0001	<0.0001	0%	100 - 102%	103%
Total Chromium, Cr	LB044510	mg/L	0.001	<0.001	0%	99%	
Total Copper, Cu	LB044510	mg/L	0.001	<0.001	0%	91 - 93%	105%
Total Lead, Pb	LB044510	mg/L	0.001	<0.001	0%	102 - 103%	96 - 106%
Total Manganese, Mn*	LB044510	mg/L	0.001	<0.001		NA	
Total Nickel, Ni	LB044510	mg/L	0.001	<0.001	0%	104 - 105%	94%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB044560	mg/L	0.005	<0.005	0 - 1%	104 - 105%

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB044394	pH Units	0.1	5.7	0 - 5%	100%

TKN Kjeldahl Digestion by Discrete Analyser   Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB044408	mg/L	0.05	<0.05	1 - 2%	98 - 99%

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	LB044402	mg/L	1	<1	0 - 13%	102%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB044407	mg/L	10	<10	1 - 2%	103%	100%

Total Phosphorus by Kjeldahl Digestion DA in Water   Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB044408	mg/L	0.02	<0.02	0 - 4%	103 - 112%

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

Parameter	QC Reference	Units	LOR	DUP %RPD
Arsenic, As	LB044473	mg/L	0.001	0%

QC SUMMARY

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.

Trace Metals (Total) in Water by ICPMS in mg/L   Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Arsenic	LB044477	mg/L	0.001	0%

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
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 µmhos/cm or µS/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 calculation 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.
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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 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 calcuated 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

This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/en/terms-and-conditions. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

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SGS

ANALYTICAL REPORT

ilac-MRA

NATA
Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Rob Lait	Manager	Jon Dicker
Client	Rob Lait & Associates	Laboratory	SGS Cairns Environmental
Address	27 Scheu St INNISFAIL QLD 4860	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4061 3103	Telephone	+61 07 4035 5111
Facsimile	07 4061 8094	Facsimile	+61 07 4035 5122
Email	rob@roblait.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**KUR-World**	SGS Reference	**CE127244 R0**
Order Number	(Not specified)	Date Received	08 May 2017
Samples	3	Date Reported	18 May 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025-Testing. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE165295.
For determination of soluble metals, filtered sample was not received so samples were laboratory filtered on receipt. This may give soluble metals results that do not represent the concentrations present at the time of sampling.

SIGNATORIES

Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Orsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

		Sample Number	CE127244.001	CE127244.002	CE127244.003
		Sample Matrix	Water	Water	Water
		Sample Date	08 May 2017	08 May 2017	08 May 2017
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

pH in water Method: AN101/MA1490(Melb) Tested: 9/5/2017

pH**	pH Units	0.1	**6.6**	**6.3**	**5.1**

Alkalinity Method: AN135/MA1127(Melb) Tested: 9/5/2017

Total Alkalinity as CaCO3	mg/L	5	**54**	**27**	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	**54**	**27**	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 10/5/2017

Chloride, Cl	mg/L	1	**8**	**57**	**18**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 12/5/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.29**	**0.76**	**1.7**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 12/5/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	**0.051**	<0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 10/5/2017

Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	<0.05	<0.05
Total Nitrogen (calc)	mg/L	0.05	**0.29**	**0.76**	**1.7**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE127244.001 Water 08 May 2017 WB5	CE127244.002 Water 08 May 2017 WB6	CE127244.003 Water 08 May 2017 WB8

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 18/5/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.34**	**0.76**	**1.7**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 12/5/2017

Filterable Reactive Phosphorus	mg/L	0.005	**0.019**	**0.032**	**0.021**

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 10/5/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	**0.04**	**0.09**	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 18/5/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	**4**

Total Dissolved Solids (TDS) in water Method: AN113/MA1491(Melb) Tested: 10/5/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**110**	**170**	**78**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 15/5/2017

Aluminium, Al	mg/L	0.005	**0.005**	<0.005	**0.78**
Iron, Fe	mg/L	0.005	**0.23**	**0.007**	**0.011**
Zinc, Zn	mg/L	0.005	**0.010**	**0.027**	**0.043**

		Sample Number	CE127244.001	CE127244.002	CE127244.003
		Sample Matrix	Water	Water	Water
		Sample Date	08 May 2017	08 May 2017	08 May 2017
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 15/5/2017

Total Aluminium	mg/L	0.005	**0.018**	<0.005	**0.87**
Total Hardness	mg CaCO3/L	5	**42**	**45**	**10**
Total Calcium	mg/L	0.05	**12**	**5.9**	**1.1**
Total Iron	mg/L	0.005	**0.45**	**0.013**	**0.039**
Total Magnesium	mg/L	0.05	**3.1**	**7.2**	**1.8**
Total Potassium	mg/L	0.05	**1.5**	**1.3**	**1.9**
Total Sodium	mg/L	0.5	**11**	**28**	**6.4**
Total Sulphur as SO4	mg/L	0.5	**3.7**	**2.1**	<0.5
Total Zinc	mg/L	0.005	**0.009**	**0.026**	**0.048**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 10/5/2017

Arsenic, As	mg/L	0.001	**0.010**	**0.001**	**0.001**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 10/5/2017

Total Arsenic	mg/L	0.001	**0.014**	**0.002**	**0.001**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 15/5/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	<0.001	**0.003**	**0.009**
Lead, Pb	mg/L	0.001	<0.001	**0.001**	**0.006**
Manganese, Mn	mg/L	0.001	**0.089**	**0.008**	**0.075**
Nickel, Ni	mg/L	0.001	<0.001	**0.004**	**0.002**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 15/5/2017

Total Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	**0.003**	**0.010**
Total Lead, Pb	mg/L	0.001	<0.001	**0.001**	**0.007**
Total Manganese, Mn*	mg/L	0.001	**0.091**	**0.009**	**0.081**
Total Nickel, Ni	mg/L	0.001	<0.001	**0.004**	**0.002**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 18/5/2017

Anion-Cation Balance	%	-100	**-2.4**	**-2.7**	**-10**

QC SUMMARY

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/MA1127(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB045952	mg/L	5	<5	0 - 4%	99 - 101%
Bicarbonate Alkalinity as CaCO3	LB045952	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB045952	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB045952	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB046101	mg/L	0.005	<0.005	96%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB046002	mg/L	1	<1	0 - 1%	98 - 102%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB046120	mg/L	0.005	<0.005	1 - 2%	102%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery	MS %Recovery
Total Aluminium	LB046135	mg/L	0.005	0%	101%	106%
Total Calcium	LB046135	mg/L	0.05	1%	105%	110%
Total Iron	LB046135	mg/L	0.005	0%	105%	110%
Total Magnesium	LB046135	mg/L	0.05	1%	103%	107%
Total Potassium	LB046135	mg/L	0.05	0%	105%	113%
Total Sodium	LB046135	mg/L	0.5	1%	99%	103%
Total Sulphur as SO4	LB046135	mg/L	0.5	1%	99%	NA
Total Zinc	LB046135	mg/L	0.005	1%	111%	114%

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB046132	mg/L	0.005	<0.005	1%	101%	
Iron, Fe	LB046132	mg/L	0.005	<0.005	0%	106%	
Zinc, Zn	LB046132	mg/L	0.005	<0.005	0 - 1%	112%	113%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB046136	mg/L	0.0001	<0.0001	0%	101%	105%
Chromium, Cr	LB046136	mg/L	0.001	<0.0010	0%	99%	
Copper, Cu	LB046136	mg/L	0.001	<0.001	1%	91%	
Lead, Pb	LB046136	mg/L	0.001	<0.001	0 - 3%	101%	87%
Manganese, Mn	LB046136	mg/L	0.001	<0.001	0%	NA	
Nickel, Ni	LB046136	mg/L	0.001	<0.001	1%	104%	

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB046139	mg/L	0.0001	<0.0001	0%	101%	103%
Total Chromium, Cr	LB046139	mg/L	0.001	<0.001	0%	100%	97%
Total Copper, Cu	LB046139	mg/L	0.001	<0.001	6%	92%	104%
Total Lead, Pb	LB046139	mg/L	0.001	<0.001	0%	103%	93%
Total Manganese, Mn*	LB046139	mg/L	0.001	<0.001	8%	NA	NA
Total Nickel, Ni	LB046139	mg/L	0.001	<0.001	2%	105%	93%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB046100	mg/L	0.005	<0.005	9 - 13%	103 - 108%

QC SUMMARY

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.

pH in water Method: ME-(AU)-[ENV]AN101/MA1490(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB045952	pH Units	0.1	5.5 - 5.8	0 - 1%	100%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB045992	mg/L	0.05	<0.05	1 - 7%	93 - 96%

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	LB046266	mg/L	1	<1	0 - 12%	96 - 100%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113/MA1491(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB046007	mg/L	10	<10	0%	99 - 100%	100 - 103%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB045992	mg/L	0.01	<0.01	0 - 1%	102 - 105%

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
AN101/MA1490(Melb)	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/MA1489(Melb)	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 µmhos/cm or µS/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/MA1491(Melb)	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 calculation 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.
AN135/MA1127(Melb)	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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
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AN322	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 . APHA4500CO2 D.

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.

LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
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 calcuated 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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ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Rob Lait	Manager	Jon Dicker
Client	Rob Lait & Associates	Laboratory	SGS Cairns Environmental
Address	27 Scheu St INNISFAIL QLD 4860	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4061 3103	Telephone	+61 07 4035 5111
Facsimile	07 4061 8094	Facsimile	+61 07 4035 5122
Email	rob@roblait.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**KUR-World**	SGS Reference	**CE127992 R0**
Order Number	(Not specified)	Date Received	20 Jun 2017
Samples	3	Date Reported	03 Jul 2017

LABORATORY DETAILS

COMMENTS

Accredited for compliance with ISO/IEC 17025-Testing. NATA accredited laboratory 2562(3146)

Arsenic subcontracted to SGS Sydney, Unit 16 33 Maddox St Alexandria NSW 2015, NATA Accreditation Number: 2562, Site Number: 4354, SE167259.
For determination of soluble metals, filtered sample was not received so samples were laboratory filtered on receipt. This may give soluble metals results that do not represent the concentrations present at the time of sampling.

SIGNATORIES

Bergamo

Alyson Bergamo
Senior Laboratory Technician

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Orsmond

Leanne Orsmond
Quality & Microbiology Coordinator

Maristela Ganzan
Metals Team Leader

Parameter	Units	LOR	CE127992.001	CE127992.002	CE127992.003
Sample Number			CE127992.001	CE127992.002	CE127992.003
Sample Matrix			Water	Water	Water
Sample Date			19 Jun 2017	19 Jun 2017	19 Jun 2017
Sample Name			WB5	WB6	WB8

pH in water Method: AN101/MA1490(Melb) Tested: 21/6/2017

pH**	pH Units	0.1	**6.4**	**6.4**	**5.6**

Alkalinity Method: AN135/MA1127(Melb) Tested: 21/6/2017

Total Alkalinity as CaCO3	mg/L	5	**67**	**66**	<5
Bicarbonate Alkalinity as CaCO3	mg/L	5	**67**	**66**	<5
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5	<5

Chloride by Discrete Analyser in Water Method: AN274 Tested: 22/6/2017

Chloride, Cl	mg/L	1	**9**	**53**	**16**

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: AN248 Tested: 21/6/2017

Nitrate/Nitrite Nitrogen, NOx as N	mg/L	0.005	**0.058**	**0.33**	**1.5**

Ammonia Nitrogen by Discrete Analyser Method: AN280 Tested: 26/6/2017

Ammonia Nitrogen, NH3 as N	mg/L	0.005	<0.005	<0.005	<0.005

TKN Kjeldahl Digestion by Discrete Analyser Method: AN281 Tested: 21/6/2017

Total Kjeldahl Nitrogen	mg/L	0.05	<0.05	<0.05	**0.06**
Total Nitrogen (calc)	mg/L	0.05	**0.06**	**0.33**	**1.6**

		Sample Number	CE127992.001	CE127992.002	CE127992.003
		Sample Matrix	Water	Water	Water
		Sample Date	19 Jun 2017	19 Jun 2017	19 Jun 2017
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

Calculated Nitrogen Forms - TN, organic N, inorganic N Method: AN281/292 Tested: 30/6/2017

Total InorganicNitrogen (calc)	mg/L	0.01	**0.06**	**0.33**	**1.5**

Filterable Reactive Phosphorus (FRP) Method: AN278 Tested: 21/6/2017

Filterable Reactive Phosphorus	mg/L	0.005	**0.030**	**0.014**	**0.011**

Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 21/6/2017

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.01	**0.03**	**0.02**	**0.03**

Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 26/6/2017

Total Suspended Solids Dried at 103-105°C	mg/L	1	<1	<1	<1

Total Dissolved Solids (TDS) in water Method: AN113/MA1491(Melb) Tested: 26/6/2017

Total Dissolved Solids Dried at 175-185°C	mg/L	10	**140**	**220**	**84**

Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 27/6/2017

Aluminium, Al	mg/L	0.005	**0.012**	<0.005	**0.52**
Iron, Fe	mg/L	0.005	**0.50**	**0.20**	**0.005**
Zinc, Zn	mg/L	0.005	**0.012**	**0.026**	**0.031**

		Sample Number	CE127992.001	CE127992.002	CE127992.003
		Sample Matrix	Water	Water	Water
		Sample Date	19 Jun 2017	19 Jun 2017	19 Jun 2017
		Sample Name	WB5	WB6	WB8
Parameter	Units	LOR			

Metals in Water (Total) by ICPOES Method: AN022/AN320 Tested: 27/6/2017

Total Aluminium	mg/L	0.005	**0.010**	<0.005	**0.55**
Total Hardness	mg CaCO3/L	5	**52**	**71**	**10**
Total Calcium	mg/L	0.05	**15**	**15**	**1.1**
Total Iron	mg/L	0.005	**0.51**	**0.32**	**0.008**
Total Magnesium	mg/L	0.05	**3.6**	**7.9**	**1.7**
Total Potassium	mg/L	0.05	**1.5**	**1.2**	**1.8**
Total Sodium	mg/L	0.5	**15**	**32**	**8.1**
Total Sulphur as Sulfate, SO4	mg/L	0.5	**5.7**	**2.5**	<0.5
Total Zinc	mg/L	0.005	**0.007**	**0.021**	**0.031**

Trace Metals (Dissolved) in Water by ICPMS in mg/L Method: AN318 Tested: 21/6/2017

Arsenic, As	mg/L	0.001	**0.014**	**0.004**	**0.001**

Trace Metals (Total) in Water by ICPMS in mg/L Method: AN318 Tested: 21/6/2017

Total Arsenic	mg/L	0.001	**0.014**	**0.005**	**0.001**

Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 27/6/2017

Cadmium, Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium, Cr	mg/L	0.001	<0.0010	<0.0010	<0.0010
Copper, Cu	mg/L	0.001	**0.002**	**0.004**	**0.006**
Lead, Pb	mg/L	0.001	**0.001**	**0.001**	**0.004**
Manganese, Mn	mg/L	0.001	**0.16**	**0.076**	**0.042**
Nickel, Ni	mg/L	0.001	<0.001	**0.003**	**0.002**

Metals in Water (Total) by ICPOES-USN Method: AN320/AN322 Tested: 27/6/2017

Total Cadmium, Cd	mg/L	0.0001	**0.0002**	<0.0001	<0.0001
Total Chromium, Cr	mg/L	0.001	<0.001	<0.001	<0.001
Total Copper, Cu	mg/L	0.001	<0.001	**0.003**	**0.006**
Total Lead, Pb	mg/L	0.001	**0.001**	<0.001	**0.004**
Total Manganese, Mn*	mg/L	0.001	**0.16**	**0.12**	**0.040**
Total Nickel, Ni	mg/L	0.001	<0.001	**0.002**	**0.002**

Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 3/7/2017

Anion-Cation Balance	%	-100	**0.9**	**-0.5**	**-3.2**

QC SUMMARY

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/MA1127(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB047192	mg/L	5	<5	1%	104%
Bicarbonate Alkalinity as CaCO3	LB047192	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB047192	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB047192	mg/L	5	<5		

Ammonia Nitrogen by Discrete Analyser Method: ME-(AU)-[ENV]AN280

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH3 as N	LB047279	mg/L	0.005	<0.005	0 - 5%	93 - 102%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride, Cl	LB047214	mg/L	1	<1	0 - 5%	99 - 103%

Filterable Reactive Phosphorus (FRP) Method: ME-(AU)-[ENV]AN278

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Filterable Reactive Phosphorus	LB047169	mg/L	0.005	<0.005	0 - 4%	95 - 96%

Metals in Water (Total) by ICPOES Method: ME-(AU)-[ENV]AN022/AN320

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
Total Aluminium	LB047332	mg/L	0.005	4%	98%
Total Calcium	LB047332	mg/L	0.05	3%	105%
Total Iron	LB047332	mg/L	0.005	3%	99%
Total Magnesium	LB047332	mg/L	0.05	2%	100%
Total Potassium	LB047332	mg/L	0.05	3%	102%
Total Sodium	LB047332	mg/L	0.5	4%	119%
Total Sulphur as Sulfate, SO4	LB047332	mg/L	0.5	2%	100%
Total Zinc	LB047332	mg/L	0.005	2%	107%

QC SUMMARY

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Aluminium, Al	LB047331	mg/L	0.005	0.010	0 - 1%	97%
Iron, Fe	LB047331	mg/L	0.005	<0.005	0%	102%
Zinc, Zn	LB047331	mg/L	0.005	<0.005	1%	110%

Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Cadmium, Cd	LB047316	mg/L	0.0001	<0.0001	0%	104%	108%
Chromium, Cr	LB047316	mg/L	0.001	<0.0010	0%	102%	
Copper, Cu	LB047316	mg/L	0.001	<0.001	1 - 2%	100%	106%
Lead, Pb	LB047316	mg/L	0.001	<0.001	0 - 2%	101%	99%
Manganese, Mn	LB047316	mg/L	0.001	<0.001	1%	NA	
Nickel, Ni	LB047316	mg/L	0.001	<0.001	0%	105%	

Metals in Water (Total) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Cadmium, Cd	LB047312	mg/L	0.0001	<0.0001	0%	104%	111%
Total Chromium, Cr	LB047312	mg/L	0.001	<0.001	0 - 2%	103%	104%
Total Copper, Cu	LB047312	mg/L	0.001	<0.001	1 - 5%	88%	108%
Total Lead, Pb	LB047312	mg/L	0.001	<0.001	0 - 3%	102%	103%
Total Manganese, Mn*	LB047312	mg/L	0.001	<0.001	1%	NA	
Total Nickel, Ni	LB047312	mg/L	0.001	<0.001	0%	105%	97%

Nitrate Nitrogen and Nitrite Nitrogen (NOx) by Auto Analyser Method: ME-(AU)-[ENV]AN248

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Nitrate/Nitrite Nitrogen, NOx as N	LB047166	mg/L	0.005	<0.005	0 - 6%	96 - 105%

QC SUMMARY

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.

pH in water Method: ME-(AU)-[ENV]AN101/MA1490(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB047192	pH Units	0.1	5.8	0 - 1%	100%

TKN Kjeldahl Digestion by Discrete Analyser Method: ME-(AU)-[ENV]AN281

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Kjeldahl Nitrogen	LB047165	mg/L	0.05	<0.05	0%	97%

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	LB047274	mg/L	1	<1	0 - 11%	114%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113/MA1491(Melb)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB047272	mg/L	10	<10	1 - 2%	103%	109%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB047165	mg/L	0.01	<0.01	0 - 4%	114%

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

Parameter	QC Reference	Units	LOR	DUP %RPD
Arsenic, As	LB047180	mg/L	0.001	0%

QC SUMMARY

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.

Trace Metals (Total) in Water by ICPMS in mg/L Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	DUP %RPD
Total Arsenic	LB047181	mg/L	0.001	0%

METHOD	METHODOLOGY SUMMARY
AN022/AN320	Total (acid soluble) Metals by ICP-OES: Samples are digested in nitric or nitric and hydrochloric acids prior to analysis 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.
AN101/MA1490(Melb)	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/MA1489(Melb)	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 µmhos/cm or µS/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/MA1491(Melb)	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 calculation 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.
AN135/MA1127(Melb)	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
AN248	Nitrate / Nitrite by Auto Analyser: In an acidic medium, nitrate is reduced quantitatively to nitrite by cadmium metal. This nitrite plus any original nitrite is determined as an intense red-pink azo dye at 540 nm following diazotisation with sulphanilamide and subsequent coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. Reference APHA 4500-NO3- F.
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-
AN278	Filterable Reactive Phosphorus by DA (determined on filtered sample): Orthophosphate reacts with ammonium molybdate (Mo VI) and potassium antimonyl tartrate (Sb III) in acid medium to form an antimony-phosphomolybdate complex. This complex is subsequently reduced with ascorbic acid to form a blue colour and the absorbance is read at 880 nm. The sensitivity of the automated method is 10-20 times that of the macro method. Reference APHA 4500-P F
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K2SO4 and CuSO4. All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN280	A filtered water sample containing ammonia (NH3) or ammonium cations (NH4+) is reacted with alkaline phenol and hypochlorite in a buffered solution to form the blue indophenol colour. The absorbance is measured at 630nm and compared with calibration standards to obtain the concentration of ammonia in the sample.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN281	An unfiltered water or soil sample is first digested in a block digestor with sulfuric acid, K2SO4 and CuSO4. The ammonia produced following digestion is then measured colourimetrically using the Aquakem 250 Discrete Analyser. A portion of the digested sample is buffered to an alkaline pH , and interfering cations are complexed. The ammonia then reacts with salicylate and hypochlorite to give a blue colour whose absorbance is measured at 660nm and compared with calibration standards. This is proportional to the concentration of Total Kjeldahl Nitrogen in the original sample.
AN281/292	Calculation of total nitrogen and organic nitrogen.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	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.
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.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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/AN322	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
AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser 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.
AN322	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 . APHA4500CO2 D.

FOOTNOTES

IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.

LOR	Limit of Reporting
↑↓	Raised or Lowered Limit of Reporting
QFH	QC result is above the upper tolerance
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 calcuated 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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Environmental Approval & Compliance Solutions

Cairns Office:
Level 1, 320 Sheridan Street, PO Box 5678 Cairns QLD 4870
P: 61 7 4034 5300 **F:** 61 7 4034 5301

Townsville Office:
Suite 2A, Level 1, 41 Denham Street, PO Box 539 Townsville QLD 4810
P: 61 7 4796 9444 **F:** 61 7 4796 9410

www.natres.com.au • nra@natres.com.au

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