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HYDRO ALUMINIUM SMELTER CAPPED WASTE STOCKPILE, 2018 ANNUAL GROUNDWATER MONITORING REPORT

RAMBOLL

HYDRO ALUMINIUM SMELTER
2018 ANNUAL GROUNDWATER MONITORING REPORT

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CONTENTS

ACRONYMS AND ABBREVIATIONS		**V**
EXECUTIVE SUMMARY		**VI**
1.	**INTRODUCTION**	**1**
1.1	Objective and Scope of Work	1
1.2	Limitations	2
1.3	User Reliance	2
2.	**BACKGROUND**	**3**
2.1	Site Background	3
2.2	Conceptual Site Model	4
2.3	Aquifer Characterisation	6
2.4	Leachate Interception trench	7
2.5	Fate and transport modelling	8
3.	**SAMPLING, ANALYSIS AND QUALITY PLAN**	**10**
3.1	Objective	10
3.2	Scope of Works	10
3.3	Fieldwork Methodology	10
3.4	Data Quality Objectives	11
3.5	Data Quality Indicators	12
4.	**ASSESSMENT CRITERIA**	**14**
4.1	Groundwater Assessment Criteria	14
4.2	Potential Beneficial Uses	14
4.3	Appropriate Criteria for Groundwater	14
5.	**QUALITY ASSURANCE / QUALITY CONTROL**	**16**
6.	**TREND ANALYSIS JULY 2013 TO DECEMBER 2018**	**17**
6.1	Shallow Aquifer – Depth to Groundwater and Flow Direction	17
6.2	Shallow Aquifer – pH Levels	21
6.3	Shallow Aquifer – Key Chemical Concentrations	22
6.3.1	Fluoride	22
6.3.2	Free Cyanide	24
6.4	Deep Aquifer – Depth to Groundwater and Flow Direction	25
6.5	Deep Aquifer – pH Levels	29
6.6	Deep Aquifer – Key Chemical Concentrations	30
6.6.1	Fluoride	30
6.6.2	Free Cyanide	33
7.	**HYDRO DATA**	**36**
8.	**CONCLUSIONS AND RECOMMENDATIONS**	**38**
9.	**REFERENCES**	**40**

APPENDICES

Appendix 1
Attachments

Appendix 2
QA/QC Review

Appendix 3
2013-2018 GME Historical Data

Appendix 4
Field Parameter Forms

Appendix 5
Laboratory Reports

Appendix 6
Calibration Certificates

Appendix 7
Historical Groundwater Flow Direction

Appendix 8
Mann-Kendall Plot

ACRONYMS AND ABBREVIATIONS

AHD	Australian Height Datum
ALS	Australian Laboratory Services
ANZECC	Australian and New Zealand Environment and Conservation Council
BGL	Below Ground Level
CN	Cyanide (total or free)
DP	Deposited Plan
DQO	Data Quality Objective
DQI	Data Quality Indicator
EIL	Ecological Investigation Level
EPA	Environment Protection Authority
ESA	Environmental Site Assessment
Ha	Hectare
km	Kilometres
LOR	Limit of Reporting
m	Metres
Metals	Al: Aluminium
mg/L	Milligrams per Litre
m BGL	Metres below ground level
mg/L	Micrograms per Litre
NATA	National Association of Testing Authorities
NC	Not Calculated
ND	Not Detected
NEHF	National Environmental Health Forum
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
n	Number of Samples
OH&S	Occupational Health & Safety
PQL	Practical Quantitation Limit
pH	a measure of acidity, hydrogen ion activity
QA/QC	Quality Assurance/Quality Control
RPD	Relative Percent Difference
SPL	Spent Pot Lining
UCL	Upper Confidence Limit
µg/L	Micrograms per Litre
-	On tables is "not calculated", "no criteria" or "not applicable”

EXECUTIVE SUMMARY

Twenty-one groundwater monitoring events (GMEs) have been completed between July 2013 and December 2018 to monitor a leachate impacted groundwater plume associated with the Capped Waste Stockpile (CWS) at the former Hydro Aluminium Kurri Kurri Smelter. Monitoring of the groundwater down gradient of the CWS was initiated to assess the impacts to groundwater from leachate and to provide a temporal and spatial evaluation of the plume behaviour.

Each GME included the sampling and analysis of groundwater from a network of 25 shallow and deep wells located on five sections along the length of the leachate plume down-gradient of the CWS. In 2016, two additional shallow wells and two additional deep wells were added to the network. These wells are located adjacent to Swamp Creek, the nearest surface water receptor. Physico-chemical parameters were recorded and groundwater samples analysed for soluble fluoride, total and free cyanide and total aluminium. Dissolved aluminium was analysed in all samples from June 2018.

Evaluation of GME data between 2013 and 2018 has identified the following:

- Groundwater flow is interpreted to be north to north-east in both the shallow and deep aquifer. This is consistent with historical observations.
- The trend for pH in the shallow aquifer was generally 'stable', 'decreasing' or 'no trend'. An 'increasing' trend was identified at only one well, N8, located on Section 5 where pH increased from 6.36 in July 2013 to 6.51 in December 2018.
- The trend for soluble fluoride in the shallow aquifer was mainly 'stable'. An 'increasing' trend was only identified at one well, N8, where the fluoride concentration remains below 1 mg/L and is not impacted by the leachate plume. Fluoride concentrations in N8 remain below the site criteria for the receiving waters.
- Longitudinally along the length of the plume, the most elevated fluoride concentrations on the western edge were in well A7 on Section 3 and on the eastern edge were in well E4 on Section 2.
- The trend for free cyanide in the shallow aquifer was 'stable' or 'decreasing'. No 'increasing' trends were identified. Free cyanide concentrations remained below the site criteria of 0.007 mg/L aside from at wells PUMP, W7M and W3S.
- An 'increasing' trend was identified for pH in two wells in the deep aquifer – W5D and G2. The pH levels in both wells remain indicative of natural levels at the site.
- An 'increasing' trend was identified for soluble fluoride in two wells in the deep aquifer – W2D and G2. Well W2D is the most leachate impacted well, with fluoride concentrations at 1200 mg/L. Fluoride concentrations in well G2 remain below levels identified in leachate impacted groundwater.
- The trend for free cyanide in the deep aquifer was 'stable', except for W2D which had a 'decreasing' trend.
- The most leachate impacted well remains W2D, in the deep aquifer on Section 1. Fluoride concentrations in this well have more than doubled over the twenty-one monitoring rounds from 682 mg/L to a peak of 1700 mg/L in March 2017. Since March 2017, fluoride concentrations have reduced to 1200 mg/L.
- Fluoride concentrations in the deep aquifer down-gradient of Section 1 remain low, indicating a semi-continuous connection between the shallow and deep aquifer;
- Groundwater data from the two pairs of shallow and deep wells adjacent to Swamp Creek, the nearest surface water receptor, show no impact from the leachate plume. This result is anticipated based on the location of high plasticity clays, which limit the migration of the leachate plume in this direction toward Swamp Creek.

Monitoring of groundwater is proposed to continue until remediation of the Capped Waste Stockpile is completed and concentrations are shown to be stable or decreasing.

1. INTRODUCTION

Ramboll Australia Pty Limited (Ramboll) was commissioned by Hydro Aluminium Kurri Kurri Pty Ltd (Hydro) to undertake quarterly groundwater monitoring events on a portion of the Hydro Aluminium Kurri Kurri Smelter, located off Hart Road, Loxford, New South Wales, Australia.

The portion of the Smelter Site subject to the quarterly groundwater monitoring comprises the former smelter waste storage area known as the 'Capped Waste Stockpile' and an associated area of leachate impacted groundwater. The Capped Waste Stockpile (CWS) and associated leachate impacted groundwater were identified as Area of Concern (AEC) 1 in the Phase 2 Environmental Site Assessment completed by Ramboll in 2012. The location of AEC1 is shown in **Figure 1, Appendix 1**.

The results of previous groundwater monitoring events completed between July 2013 and December 2017 have been reported in the following reports:

- 'Hydro Aluminium Kurri Kurri Smelter, Capped Waste Stockpile, 12 Month Groundwater Monitoring Report', by Environ (now Ramboll), dated February 2015
- 'Hydro Aluminium Smelter, Capped Waste Stockpile, 2015 Annual Groundwater Monitoring Report' by Ramboll Environ (now Ramboll), dated April 2016
- 'Hydro Aluminium Smelter, Capped Waste Stockpile, 2016-2017 Annual Groundwater Monitoring Report', by Ramboll, dated February 2018.

This report presents the results of four quarterly groundwater monitoring events, completed in March, June, September and December of 2018, as well as a trend analysis of the results from the twenty-one monitoring events completed between 2013 and 2018.

1.1 Objective and Scope of Work

The objective of each quarterly Groundwater Monitoring Event (GME) was to:

- Assess the current status of the leachate impacts to groundwater occurring from the Capped Waste Stockpile
- Compare the current status of the leachate impacts to historical data to assess changes in groundwater quality.

The objective of this 2018 Summary Report is to:

- Tabulate results for depth to water, physico-chemical parameters and analytical data for data collected in 2018
- Complete trend analysis of monitored parameters in key wells incorporating data collected since July 2013
- Complete trend analysis with rainfall data
- Contouring of contaminant concentrations in the upper and lower aquifer
- Assess the impact of the leachate interception trench on groundwater quality
- Assess the relationship between leachate generation and rainfall infiltration
- Provide conclusions and recommendations.

The scope of work for each quarterly GME included:

- Gauging, purging and sampling of 25 groundwater monitoring wells on five sections through the plume plus two additional shallow wells and two additional deep wells located adjacent to Swamp Creek
- Measurement of groundwater physico-chemical properties during purging, including pH, temperature, electrical conductivity (EC), redox (mV) and dissolved oxygen

- Laboratory analysis of groundwater samples for soluble fluoride, total and free cyanide and aluminium.

1.2 Limitations

Ramboll Australia Pty Ltd (Ramboll) prepared this report in accordance with the scope of work as outlined in our proposal to Hydro Aluminium Kurri Kurri Pty Ltd dated 3 January 2018 and in accordance with our understanding and interpretation of current regulatory standards.

A representative program of sampling and laboratory analyses was undertaken as part of this investigation, based on past and present known uses of the site. While every care has been taken, concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. We cannot therefore preclude the presence of materials that may be hazardous. Site conditions may change over time. This report is based on conditions encountered at the Site at the time of the report and Ramboll disclaims responsibility for any changes that may have occurred after this time.

The conclusions presented in this report represent Ramboll's professional judgment based on information made available during the course of this assignment and are true and correct to the best of Ramboll's knowledge as at the date of the assessment.

Ramboll did not independently verify all of the written or oral information provided to Ramboll during the course of this investigation. While Ramboll has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to Ramboll was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

1.3 User Reliance

This report has been prepared exclusively for Hydro Aluminium Kurri Kurri Pty Ltd and may not be relied upon by any other person or entity without Ramboll's express written permission.

2. BACKGROUND

2.1 Site Background

The Hydro Aluminium Kurri Kurri Smelter is located approximately 30km west of the city of Newcastle and 150km north of Sydney, in New South Wales, Australia. The smelter includes a 60 ha plant area and a 2,000 ha buffer zone.

The Capped Waste Stockpile (CWS) is a repository of waste arising during the operations of the aluminium smelter and includes Spent Pot Lining, anodes, scrubber bags, concrete, brick, bulky waste, fines and other smelter wastes. The CWS is located near the eastern boundary of the smelter footprint and adjacent to the surrounding Hydro owned buffer land.

The CWS was maintained as an uncapped bunded waste repository prior to being capped with clay under development consent in the mid-1990s. At this time, impacts to vegetation in the buffer zone downgradient of the CWS were observed. Leachate from the CWS, caused by rain water and groundwater coming in to contact with the CWS contents, was also known to have impacted on groundwater and investigations commenced to explore the extent of groundwater impact. These investigations identified that leachate impacted groundwater likely originated from the north-east corner of the CWS and extended approximately 250m north-east. The CWS and associated leachate impacted groundwater were identified as Area of Concern (AEC) 1 in the Phase 2 Environmental Site Assessment completed by Environ (now Ramboll) in 2012. The location of AEC1 is shown in **Figure 1, Appendix 1**. Ramboll assessed AEC 1 as part of the following investigations:

- 'Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter', dated 1 November 2012
- 'Environmental Site Assessment, Capped Waste Stockpile, Kurri Kurri Aluminium Smelter', dated 13 December 2012
- 'Plume Delineation Report, Capped Waste Stockpile', dated 6 November 2013

Following these investigations, a Groundwater Monitoring Programme was developed that included monitoring 25 wells on five cross sections along the length of the plume. A summary of the Plume Delineation Report was included in Section 2.2 of the 12 Month Groundwater Monitoring Report (ENVIRON June 2016) and further information regarding the development of the Program is presented in Section 2.4 of that report.

Interim mitigation measures were taken in 2013, 2016 and 2017 to intercept the shallow movement and daylighting of leachate impacted groundwater. Measures involved the installation of passive or active shallow trenches, extending approximately 2.0m below the ground surface perpendicular to the plume migration and providing pipe conveyance of the leachate impacted groundwater to the surface.

Planning approval is currently being sought for the remediation of the site including the CWS. The proposal for remediation is the consolidation of all contaminated materials within one centralised containment cell located to the west of the current CWS site and within residual clay soils. It is anticipated that remediation will be completed within the next two years. Remediation of the CWS will result in the removal of the source of leachate to the groundwater system. Remediation involves some removal of leachate impacted groundwater with the remaining groundwater remediation occurring through natural processes following subsequent rainfall.

2.2 Conceptual Site Model

A conceptual site model was developed following Stage 1 and Stage 2 of the investigations and was included in 12 Month Groundwater Summary Report, 2014.

The Hydro aluminium smelter and surrounding land generally comprises flat, low lying swampy ground that is at an elevation of between 12 mAHD and 15 mAHD. The CWS is located within the smelter portion of the site and is approximately 170 m in length by 130 m in width and is up to 11m high and currently comprises a grassed clay cap. The eastern portion of the site within the buffer zone retains natural bushland vegetation with minor surface filling using refractory bricks along the buffer zone fence line. Two areas of vegetation impact, known as the northern and southern vegetation impact areas are located in the north eastern portion of the site.

The CWS comprises stockpiled spent pot lining wastes and other wastes including cryolite, alumina, floor sweepings, shot blast dust, cement and pot lining mix. The waste is not leachate generating of itself (i.e. no putrescible) however, the uncapped storage of waste and subsequent infiltration of rain water through the waste stockpile led to the generation of leachate over a period of approximately 25 years. Prior to capping, the leachate was collected behind bund walls surrounding the spent pot lining stockpile. During capping, leachate was suspected to have been entrapped within the fill in the north eastern corner of the CWS.

The CWS was capped in 1995 to prevent further infiltration. The suspected burial of leachate during capping and the ongoing contact between waste material and shallow groundwater beneath the CWS is considered to result in the ongoing contribute to leachate generation.

Major contaminants in the leachate are sodium (4,800mg/L to 15,300mg/L), fluoride (1,100mg/L to 3,420mg/L), sulphate (4,000mg/L to 6,740mg/L) and cyanide (70mg/L to 200mg/L) based on data obtained from leachate ponded within the bunded area of the CWS prior to capping (Reference: Dames & Moore (1992) 'Environmental Impact Statement, Upgrades to Waste Storage Facilities at the Alcan Australia Limited Kurri Kurri Smelter'). Leachate impacted groundwater is observed to be brown in colour.

The leachate plume originates from beneath the eastern side of the CWS where seepage into shallow groundwater within a semi-continuous sand aquifer has occurred. The shallow sand aquifer has been delineated as an elongate and sinuous sand lens approximately 50m wide and 250m in length extending to the north east of the CWS. The shallow sand aquifer is surrounded vertically and horizontally by a discontinuous clay aquitard that has been less impacted by leachate in close proximity to the plume and not been impacted by leachate at a distance from the plume. The configuration of the aquifer is a result of the nature of the deposition of sediments within a former estuary during periods of sea level rise and fall. A schematic cross section of the site is included as **Attachment 1** in **Appendix 1**.

The location of the plume within the semi-continuous shallow sand aquifer constrained by the surrounding discontinuous clay aquitard suggests that the movement of the leachate groundwater plume is limited by the geology. The complex interbedded Quaternary sediments comprise estuarine muds (high plasticity clay), fluvial channel sands (fine grained and coarse grained sands), sandy levee deposits (clayey sand/ sandy clay) and high energy flood deposits (coarse grained quartz sand).

Delineation investigations show that the groundwater plume remains confined within one main sand filled channel which directs flow to the north east. This finding is consistent with observations of a

heavily vegetated area evident in the 1961 historical aerial photograph (**Attachment 2** in **Appendix 1**). The heavy vegetation is a reflection of surface and subsurface drainage lines and likely represents the shallow groundwater table present in the sand filled channel. The 1961 aerial photograph depicts the vegetation extending further to the north east and connecting with Swamp Creek. Given the correlation between the plume extent and the vegetation, it is reasonable to conclude that the groundwater flow path will continue along the vegetation alignment toward Swamp Creek and that, should the plume migration reach the surface water receptor, the discharge point will occur approximately 750m to 1000m north-east of the plume, as shown in **Attachment 2** in **Appendix 1**. Fate and transport modelling to predict the migration of the plume along this channel has been undertaken, as summarised in **Section 2.5**.

The shallow nature of the semi-continuous sand aquifer results in the exfiltration of leachate impacted groundwater within topographically low areas of the site and following high rainfall events. The impacts of exfiltration are observed on the eastern edge of the plume where dieback of vegetation has occurred (southern and northern vegetation impact areas). Brown coloured seepage is observed and evaporation of exfiltrated groundwater has left a white salt crust on surface soils in this area. The high electrical conductivity of the exfiltrated groundwater (up to 15,000µs/cm) exceeds the limit (12,200µs/cm) at which conditions are generally too saline for plant growth (ANZECC, 2000).

The semi-continuous shallow sand aquifer that is impacted with leachate is characterised by high pH (>9), electrical conductivity (>5000 µS/cm), fluoride (>200 mg/L) and total cyanide (>6 mg/L) concentrations and is brown in colour. Historical data indicates fluoride concentrations within the leachate plume have been decreasing since the CWS was capped in 1995. Fluoride concentrations near the CWS, the source of the plume, peaked in 1997. Mid-way along the plume, fluoride concentrations peaked around 2000 and at the leading edge, fluoride concentrations peaked between 2004 and 2006, as shown in **Figure 2-1** below.

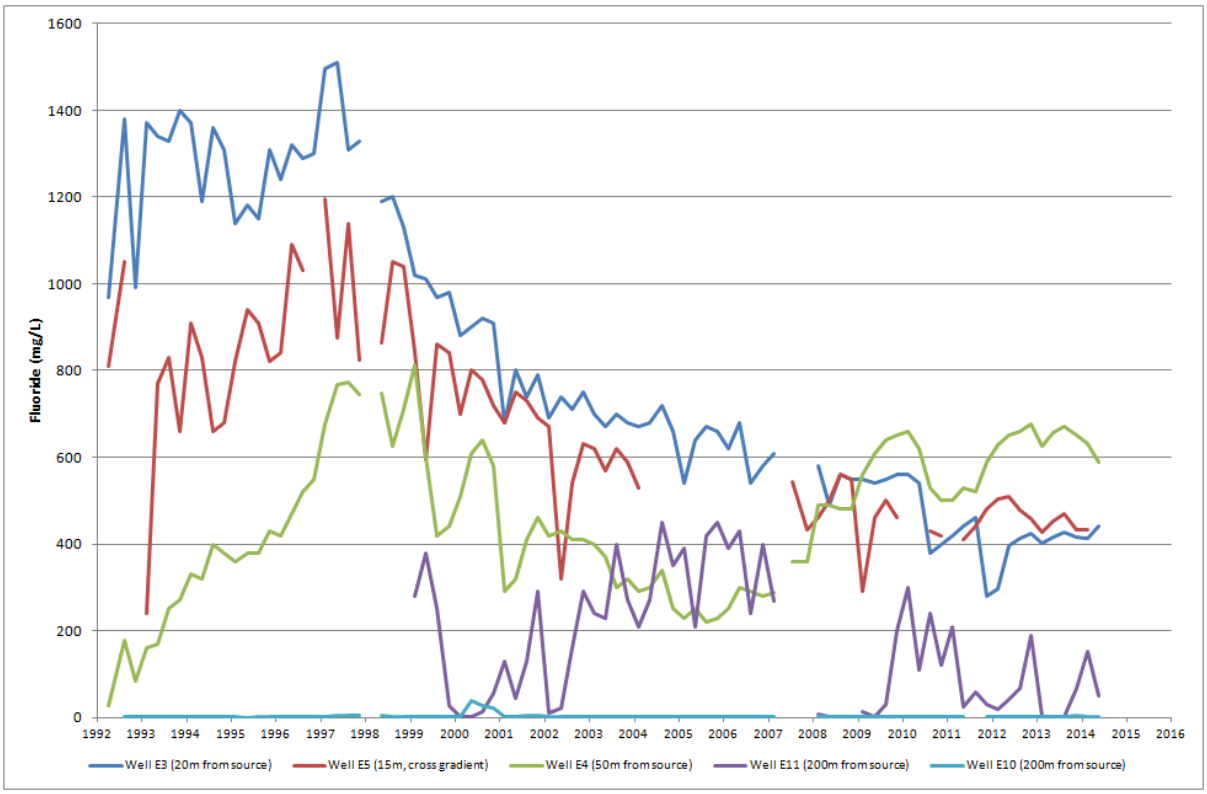


Figure 2-1: Historical Fluoride Concentrations along the Plume

Ex-filtrated leachate impacted groundwater is observed to become overland flow discharging along a surface water flow path to a small dam. During periods of high rainfall, surface water within this dam is able to flow through a culvert structure to a larger dam which discharges to Swamp Creek. The overland flow path is shown in **Attachment 3** in **Appendix 1**.

Fluoride concentrations at the semi-permanent dam, located between the leachate impacted groundwater plume and Swamp Creek, typically vary between 15 mg/L and 25 mg/L. It is considered that the elevated fluoride concentrations in the semi-permanent dam are due to overland flow of exfiltrated groundwater from their source at the southern and northern vegetation impact areas. Sampling found the fluoride concentrations in Swamp Creek vary between 0.49 mg/L up stream of the smelter and 1.2 mg/L down-stream. Adjacent to the semi-permanent dam discharge to Swamp Creek, fluoride concentrations were 1.6mg/L. The Stage 2 Aquatic Assessment - Ecological Risk Assessment completed by ENVIRON in June 2013 indicated there is no discernible impact to the aquatic ecology within the semi-permanent dam as a result of elevated concentrations of fluoride in surface water and sediment.

2.3 Aquifer Characterisation

A sand aquifer within the buffer zone of the Hydro Aluminium Smelter has been impacted by leachate from the CWS. An underlying deep aquifer has also been impacted in close proximity to the contamination source. The characteristics of this sand aquifer and the underlying deep aquifer are critical to the understanding of the site CSM. Aquifer characteristics have been identified as outlined in **Table 2-1**.

Table 2-1: Aquifer Characteristics	
Aquifer Type	Unconsolidated sediment (estuarine)
Aquifer Depth	Shallow: Approximately 0.3 m bgs to 2.5 m bgs
	Deep: Approximately 3.5 m bgs to 7 m bgs
Confined/ unconfined	Shallow: Unconfined
	Deep: Confined by high plasticity clays in some areas
Groundwater flow direction	Shallow: North to north east
	Deep: North east
Recharge mechanism	Shallow: Infiltration
	Deep: Infiltration
Porosity	Shallow: Variable due to variable nature of the sediments. High porosity quartz gravels identified at north east corner of the Capped Waste Stockpile. Mid to low porosity tightly packed sands identified along plume length.
	Deep: Mid to low porosity poorly sorted, tightly packed fine grained sand.

The most important characteristic for the movement of leachate through the shallow aquifer is the nature of the materials, in particular the complex and variable nature of the unconsolidated sediments. The nature of the sediments impacts the porosity, with high porosity quartz gravels, mid to low porosity tightly packed sands and high plasticity clays with very low porosity, all identified within the unconsolidated estuarine sediments. The leachate from the CWS moves through the sediments with mid to high porosity but is retarded by high plasticity clays. Where these barriers to flow coincide with changes in topography, discharge of groundwater to the surface can occur.

2.4 Leachate Interception Trenches

2.4.1 Section 2 – Passive Trench

Prior to the completion of the Stage 1 and Stage 2 investigations in early 2013, a leachate interception trench was installed to collect leachate that was daylighting to the north of Section 2 and flowing into the southern vegetation impact area. This interception trench was a passive system, with the trench installed at a depth of approximately 0.3 mbgs and leachate collecting in the trench flows into a sump tank and is then pumped into a nearby water tank as required. The location of this interception trench is shown in **Attachment 4** in **Appendix 1.**

2.4.2 Section 1- Active Trench

At the completion of the Stage 1 and Stage 2 investigations, a recommendation was made to install a leachate interception trench down gradient of the north eastern toe of the CWS within the coarse grained sand strata identified in well W7M.

The leachate interception trench was installed at the toe of the CWS immediately upgradient of the wells on Section 1 in April 2014. The leachate interception trench was designed to intercept and collect shallow, perched leachate impacted groundwater through a slotted pipe under vacuum. The pipe was installed using horizontal trenching equipment (ditch witch trencher) to a depth of 3 m in order to remain above any confining layers. The location of the interception trench is shown in

Attachment 4 in **Appendix 1** and a conceptual cross section of the trench is included in **Attachment 5** in **Appendix 1**.

A vacuum pump was connected to the horizontal pipe to create a vacuum along the pipe length. Groundwater monitoring bores immediately down-gradient of the pipe are regularly monitored for drawdown to assess pipe effectiveness.

The leachate interception trench operated from May 2014 until March 2016 when the discharge rate dropped to 0 L/minute. During this time, the leachate interception trench had an impact on the leachate plume by lowering the groundwater table and removing leachate at the location of the trench. Groundwater levels on Section 1 have not yet recovered.

2.4.3 Section 4 – Passive Trench

A second passive interception trench was installed north of Section 4 in October 2017. This trench was installed along the western edge of the northern vegetation impact area to collect leachate daylighting in this area. The location of this interception trench is shown in **Attachment 4** in **Appendix 1.**

2.4.4 Outcome

The purpose of the leachate interception trenches was as interim remediation measures to reduce daylighting and overland discharge of leachate down gradient of the CWS. The performance of the interception trenches was reviewed in 2016 and it was concluded that the trenches have been effective due to the following:

- Water quality improvements in the down gradient environment
- Regeneration of vegetation along the targeted flow paths
- Declining of groundwater levels to a point where the active trench along the toe of the CWS has remained dry since March 2016

2.5 Fate and transport modelling

ENVIRON (February 2015) conducted a hydrogeological review and analytical groundwater contaminant transport modelling to assess the fate and transport of the leachate plume within the shallow aquifer. The assessment and modelling included a review of site investigation data and the construction of a conceptual hydrogeological model of AEC 1 and its surrounds.

A one-dimensional model (UK EA Remedial Targets Worksheet) was used to simulate the groundwater flow and contaminant transport conditions to predict contaminant (fluoride) concentrations from the source to the nearest down-gradient receptor (Swamp Creek).

The model was calibrated against observed fluoride concentrations from the existing groundwater monitoring well network to the east and north-east of the capped waste stockpile. The groundwater fluoride concentration at the receptor impact point was then evaluated under the simulated model and compared with the guideline criteria.

The following conclusions were drawn from the results of the modelling:

- Based on the existing hydrogeological conditions and the presence of an ongoing source from the CWS, the model estimated a fluoride concentration of 4.3 mg/L at the receptor distance (1000 m), compared to the guideline criteria of 1.5 mg/L
- This value is considered a conservative estimate given the model assumes a continuous source, however, historical, more recent and proposed works are considered to have mitigated the source contribution. Future remedial works are proposed to ultimately remove the source (Spent

Pot Liner (SPL), anodes, scrubber bags, concrete, brick, bulky waste, fines and other smelter wastes stockpiled within the CWS)

- The model demonstrates sensitivity to a number of input parameters including the soil partition coefficient, (Kd). Future studies may include site specific determination of the soil partition coefficient in order to improve model calibration.

3. SAMPLING, ANALYSIS AND QUALITY PLAN

3.1 Objective

The objective of the quarterly groundwater monitoring is to collect water quality data to inform the behaviour of the plume over time. The groundwater monitoring network is shown in **Figure 2, Appendix 1**.

3.2 Scope of Works

The scope of works included the following:

- The collection of groundwater samples and measurement of water levels and physico-chemical in wells on the following five sections:
  - Section 1: Wells E5, E5D, W7S, W7M, PUMP, W2S, W2D;
  - Section 2: Wells E5, E5D, E4, W1S, W1D;
  - Section 3: Wells A7, W3S, W3D, ~~W3SA~~, W4S, ~~W4D~~;
  - Section 4: Wells E11, W5S, W5D, N2;
  - Section 5: Wells G2, N8, N9, W6S, W6D.
- The collection of groundwater samples and measurement of water level in two pairs of shallow and deep wells adjacent to Swamp Creek (F5/G5 and F6/G6), which were added to the program in 2016.
- Field analysis for physico-chemical parameters including pH, temperature, EC, redox and dissolved oxygen; and
- Laboratory analysis of groundwater samples for soluble fluoride, total and free cyanide and total aluminium. Dissolved aluminium was analysed in all samples from June 2018.

Wells W3SA and W4D were damaged in the April 2015 storm. Well W3SA was destroyed by flood water and has not been replaced as this shallow well was dry for the majority of the 2013/2014 sampling events. Well W4D was damaged below the ground with a kink in the standpipe but was able to be sampled until October 2016. This well has not been replaced.

3.3 Fieldwork Methodology

The fieldwork methodology for the collection of groundwater samples is outlined in **Table 3-1**.

Table 3-1: Field Methodology for Quarterly Groundwater Monitoring

Activity	Details
Well Gauging	Monitoring wells were gauged using a water interface probe.
Well Purging	Monitoring wells were purged prior to sampling by pumping water from the wells until the physico-chemical parameters, including pH, temperature, EC, redox and dissolved oxygen, stabilised to within 10 % of the previous reading. Generally, 1 to 2 litres were purged from each well. Readings were recorded on field sheets, which are included in Appendix 4.
Decontamination	The majority of the sampling equipment used during low flow sampling was dedicated and disposable, such as the dedicated and disposable sampling tube. Non-disposable sampling equipment, including the interface probe, was decontaminated by washing in a Decon90 solution and rinsing with water between samples.
Sample Collection and Storage	Groundwater samples were collected into laboratory-supplied bottles with the appropriate preservative for the analysis undertaken. The bottles were stored in an ice-filled esky in the field and in transit to the laboratory.

Chain of Custody	Groundwater samples were dispatched to the laboratory under chain of custody conditions.

3.4 Data Quality Objectives

Data quality objectives (DQO) for the Stage 2 investigations and future groundwater monitoring are outlined in **Table 3-2**.

Table 3-2: Data Quality Objectives

DQO	Outcome
State the Problem	To collect baseline and on-going monitoring data from a network of wells to understand the temporal and spatial behaviour of the aquifer in the area of leachate impacted groundwater.
Identify the Decision	Is the data collected from the monitoring well network of sufficient quality to meet the project objectives? Is the data collected from the monitoring well network of sufficient quality to be comparable between events?
Identify Inputs to the Decision	1) collect physico-chemical properties and samples from the groundwater monitoring well network (see **Figure 2, Appendix 1**) over four groundwater monitoring events, 2) complete analysis of collected groundwater samples for soluble fluoride, total cyanide and total aluminium and 3) analysis of the data.
Define the Study Boundaries	AEC 1 identified in **Figure 1**, **Appendix 1** plus the surface water receptors identified down gradient of AEC 1, including a semi-permanent dam and Swamp Creek. The investigation relates to groundwater. The statistical parameters of interest are the concentrations of the fluoride, cyanide, aluminium, pH and EC identified historically and in the current investigations. The Assessment Criteria outlined in **Section 5** and the historical groundwater concentrations where available for the monitoring wells.
Develop a Decision Rule	The Decision Rules for groundwater are: Groundwater and surface water concentrations were assessed against the acceptance criteria outlined in **Section 5** in combination with a comparison against background criteria where applicable. An evaluation of significance was also undertaken. Recommendations were made for further evaluation for concentrations above criteria or background concentrations.
Specify Limits on Decision Errors	As this investigation involves a series of groundwater monitoring events to monitor the state of a groundwater leachate plume, decision errors relate to the comparability of data between monitoring events. As such, all 29 wells should be sampled during each monitoring event, unless wells are found to be dry. Standard operating procedures, including consistent use of low flow techniques, should be implemented to ensure comparability of data between events. The same primary and secondary laboratories should be used for analysis and laboratory QA/QC should be assessed to ensure comparability between events.
Optimise the Design for Obtaining Data	Low flow sampling techniques will be used to collect groundwater samples to optimise the quality of the samples. Field samples for each round were collected using the same sampling procedures to ensure comparability between sampling events.

3.5 Data Quality Indicators

Project data quality indicators (DQI) have been established to set acceptance limits on field and laboratory data collected as part of the quarterly groundwater monitoring program. The data quality indicators are outlined in **Table 3-3**.

Table 3-3: Data Quality Indicators

DQI	Field	Laboratory
Completeness – a measure of the amount of useable data from a data collection activity	All critical locations sampled. All samples collected, aside from dry wells. Experienced sampler. Documentation correct.	All critical samples analysed. All analysis completed according to standard operating procedures. Appropriate methods Appropriate Practical Quantitation Limits (PQLs).
Comparability – the confidence that data may be considered to be equivalent for each sampling and analytical event	Experienced sampler. Climatic conditions appropriate for the type of analyte. Climatic conditions noted during sampling. Same types of samples collected using same sampling methods.	Same analytical methods used. Same sample PQLs. Same NATA accredited laboratories used. Same units.
Representativeness – the confidence that data are representative of each medium present on site.	Appropriate media sampled.	All samples analysed according to standard operating procedures.
Precision – a quantitative measure of the variability of the data.	Collection of intra-laboratory duplicates at a rate of 1 in 10 primary samples. Collection of inter-laboratory duplicate samples at a rate of 1 in 20 primary samples.	Analysis of field duplicate samples, relative percent difference (RPDs) to be less than 30%. Laboratory duplicates analysed, RPDs to be less than 30%.

Table 3-3: Data Quality Indicators

DQI	Field	Laboratory
Accuracy – a quantitative measure of the closeness of the reported data to the "true" value.	Sampling methodologies appropriate and complied with. Collection of rinsate blank samples from re-usable field equipment.	Analysis of: Field/ trip blanks Rinsate blanks Method blanks Matrix spikes Surrogate spikes Laboratory control samples Reagent blanks. Results for blank samples to be non-detect. Results for spike samples to be between 70% and 130%.

4. ASSESSMENT CRITERIA

4.1 Groundwater Assessment Criteria

The assessment criteria proposed for the assessment of groundwater contamination were sourced from the following references:

- NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination
- ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality
- ANZG (2018) Guidelines for Fresh and Marine Water Quality
- ENVIRON (March 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter.

4.2 Potential Beneficial Uses

NSW DEC (2007) indicates that for assessing groundwater quality, it is first necessary to assess the beneficial uses of groundwater and surface water down gradient of the site.

The closest surface water receptor to the site is a dam and then Swamp Creek located approximately 1.5 km to the north-east of the site within an area of the buffer zone used for farming. This drainage area discharges into Wentworth Swamp, which in turn discharges to the Hunter River approximately 15 km north-east of the site near Maitland.

Surface water acidity/alkalinity within the Swamp Creek is described as generally neutral with pH ranging between 7.0 and 7.8 and conductivity is generally fresh, ranging from 626 µS/cm to 1520 µS/cm. This surface water body is considered to be a fresh water receptor.

Groundwater is expected to follow a subsurface drainage line through a sand filled channel and flow north-east towards Swamp Creek. Water level gauging completed during previous investigations confirmed the groundwater flow direction to the north-east.

According to the Office of Industry and Investment, NSW, there are 17 licensed groundwater abstractions (bores) located within the site, which are known to be associated with monitoring of groundwater impact. There are no other licensed groundwater bores within 2 km of the site.

Potential beneficial uses of groundwater down gradient of the site include:

- Discharge into Swamp Creek, which supports aquatic ecosystems, is used for recreational fishing and flows into Wentworth Swamp, which potentially flows into the Hunter River;
- Extraction of water from Swamp Creek may also be used for stock watering and/ or irrigation.

Drinking water is not been included as a potential beneficial use of water from Swamp Creek for the following reasons:

- Drinking water supply to the local communities is reticulated and originates from Chichester Dam on the Chichester River;
- The Kurri Waste Water Treatment Works is located up gradient of the site. The works has a licensed discharge point into Swamp Creek.

4.3 Appropriate Criteria for Groundwater

Based on the review of potential beneficial uses of groundwater and surface water within the closest receptor, the criteria for protection of aquatic ecosystems, irrigation, stock watering and recreational use will be used.

The investigation levels presented in ANZG (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality are considered applicable for the protection of aquatic ecosystems of receiving waters. ANZG (2018) advocates a site-specific approach to developing guideline trigger values based on such factors as local biological affects data and the current levels of disturbance of the ecosystem. The guidelines present 'low risk trigger values' which are defined as concentrations of key performance parameters below which there is a low risk of adverse biological effects. If these trigger values are exceeded, then further action is required which may include further site-specific investigations to assess potential contamination or management and remedial actions.

Low risk trigger values are presented in ANZG (2018) for the protection of 80-99% of species in fresh and marine waters, with trigger values depending on the health of the receiving waters.

Groundwater results will be compared against trigger values for the protection of 95% of freshwater species. A 95% protection of fresh water species was selected due to the indication from the Hunter Catchment Management Trust that declining stream water quality and a reduction in diversity of native plants and animals has occurred in the last ten years.

A guideline for fluoride that is protective of the environment has not been developed in Australia.

A summary of the assessment criteria for groundwater are **Table 4-1**.

Table 4-1: Groundwater Assessment Criteria (mg/L)

Contaminant	95% Protection for Aquatic Ecosystems	Irrigation	Stock Watering	Recreational
Aluminium	0.055	5	5	9
Fluoride	No guideline	1	2	1.5
Free Cyanide	0.007	No guideline	No guideline	0.1
pH	6.5 - 8**	No guideline	No guideline	5 - 9
Electrical Conductivity (µS/cm)	No guideline	4500 - 7700*** >12,200****	No guideline	No guideline

** Values for lowland rivers from Table 3.3.2 in ANZECC (2000)

*** Values for tolerant crops from Table 4.2.4 in ANZECC (2000)

**** Value from Table 4.2.4 in ANZECC (2000) for where electrical conductivity is 'generally too saline' for plant growth

5. QUALITY ASSURANCE / QUALITY CONTROL

Four groundwater monitoring events were completed in March 2018, June 2018, September 2018 and December 2018. An evaluation of quality assurance and quality control for the four events is included in **Appendix 2**. Quality assurance and quality control has been assessed against the DQIs outlined in **Section 3.5**, including completeness, comparability, representativeness, precision and accuracy.

Ramboll makes the following conclusions regarding the DQIs:

- Completeness: The data for the 2018 GMEs is considered to be complete. One well, W3SA, was destroyed during the April 2015 storm and has not been replaced. As this well was dry for four of the five prior sampling events, the loss of this well is not considered to affect the completeness of the data. Well W4D was also damaged during the April 2015 storm but was able to be sampled until October 2016. This well has now been damaged beyond repair. This well will not be replaced as a deep well (W3D) remains on Section 2 and is representative of the deep aquifer in this area. Concentrations of fluoride, aluminium and cyanide were similar in both wells. Two additional shallow and deep pairs (F5/F6 and G5/G6) were added to the network in 2016. These wells are located adjacent to Swamp Creek, the nearest surface water receptor. Monitoring of these wells will indicate whether the leachate plume is migrating toward the receptor in this direction.
- Comparability: The groundwater data collected during the four 2018 GMEs is considered to be comparable to previous results because the sampling protocols, analysis methods, quality control methods and monitoring well locations are consistent between sampling events and with prior events.
- Representativeness: The selection of shallow and deep wells on sections along the length of the leachate plume is considered to provide data that is representative of the leachate plume in shallow groundwater and representative of the underlying deep aquifer.
- Precision: In the field, Ramboll achieved precision by using standard operating procedures for the collection of groundwater samples and by collecting duplicate and triplicate samples for analysis. Relative percent difference (RPD) results for duplicate samples were acceptable. Laboratory quality control results indicate precision was achieved at the primary and secondary laboratories.
- Accuracy: In the field, Ramboll achieved accuracy by using standard operating procedures for the collection of groundwater samples. Laboratory quality control results indicate accuracy was achieved at the primary and secondary laboratories.

6. TREND ANALYSIS JULY 2013 TO DECEMBER 2018

Twenty-one groundwater monitoring events have been assessed as part of this trend analysis, with GMEs completed at the following times:

- First GME: July 2013;
- Second GME: November 2013;
- Third GME: February 2014;
- Fourth GME: July 2014;
- Fifth GME: November 2014;
- Sixth GME: February 2015;
- Seventh GME: June 2015;
- Eighth GME: September 2015;
- Ninth GME: December 2015;
- Tenth GME: April 2016;
- Eleventh GME: July 2016:
- Twelfth GME: October 2016;
- Thirteenth GME: December 2016;
- Fourteen GME: March 2017;
- Fifteen GME: June 2017;
- Sixteen GME: September 2017;
- Seventeen GME: December 2017;
- Eighteenth GME: March 2018;
- Nineteenth GME: June 2018;
- Twentieth GME: September 2018; and
- Twenty-First GME: December 2018.

The following parameters have been assessed in the following sections:

- Section 6.1: Shallow aquifer – depth to groundwater and flow direction;
- Section 6.2: Shallow aquifer – pH concentrations;
- Section 6.3: Shallow aquifer – key chemical concentrations;
- Section 6.4: Deep aquifer – depth to groundwater and flow direction;
- Section 6.5: Deep aquifer – pH concentrations;
- Section 6.6: Deep aquifer – key chemical concentrations.

A summary of depth to groundwater, pH and laboratory results for the past twenty-one GMEs, including the four GMEs from 2018 are included in **Appendix 3**. Groundwater field parameter forms are included in **Appendix 4,** laboratory reports are included in **Appendix 5** and calibration certificates for the groundwater quality meter are included in **Appendix 6**.

The identified contaminants of concern associated with the leachate are fluoride, cyanide and aluminium. Fluoride has been selected as the primary contaminant of concern as a result of its persistence observed in groundwater and its concentration range in comparison with the adopted guideline criteria. Aluminium was not selected due to its ubiquity in the environment generally.

6.1 Shallow Aquifer – Depth to Groundwater and Flow Direction

Depth to water results for the shallow wells between July 2013 and December 2018 are included in **Figure**Error! Reference source not found..

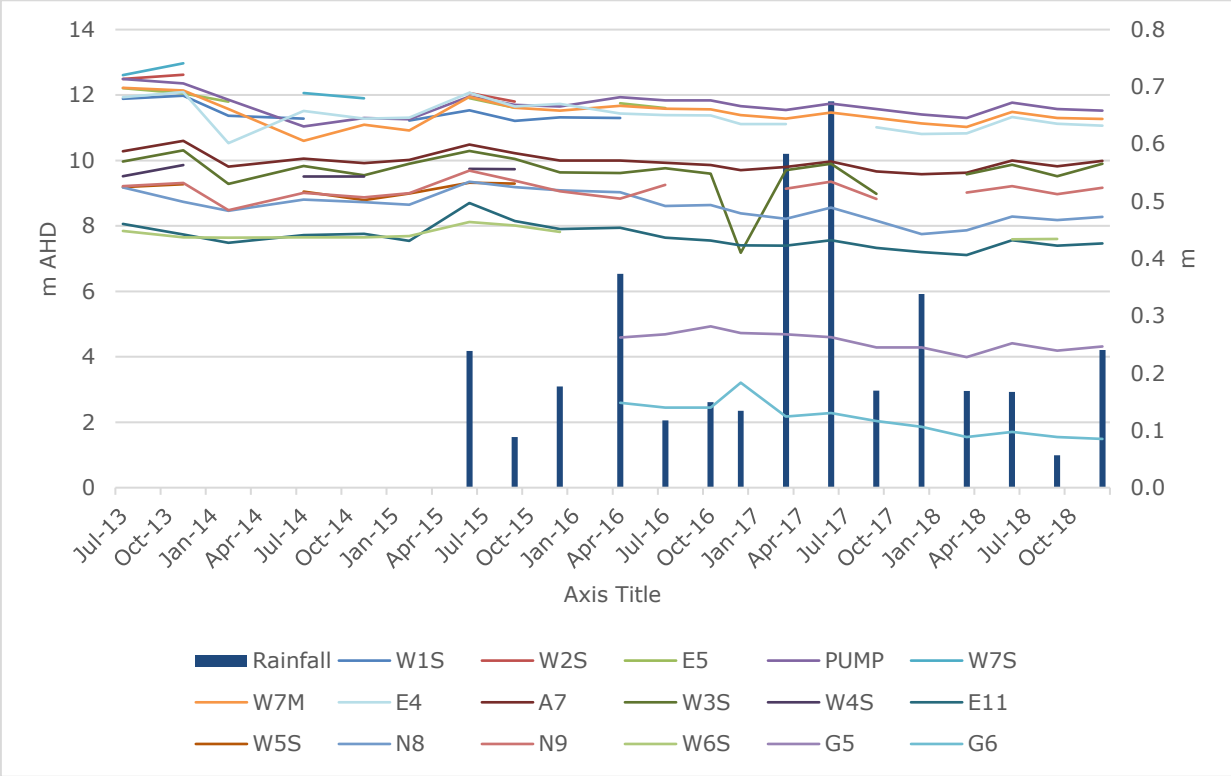


Figure 6-1: Depth to Groundwater in Shallow Wells

Comparison of water levels between March 2018 and December 2018 indicate groundwater levels peaked in June 2018 and then decreased. This is likely due to the highest monthly rainfalls of 107.6 mm and 119.6 mm occurring in February 2018 and March 2018 respectively. Comparison of July 2013 groundwater levels to December 2018 groundwater levels indicate that groundwater levels have decreased between 0.05 m and 0.97 m over five years. Groundwater level decrease at Section 1 is likely related to the installation and commissioning of an interception trench that pumps leachate from the toe of the CWS. The interception trench was installed in May 2014 and operated until March 2016 when the discharge rate dropped to 0 L/minute.

Interpreted groundwater flow directions for 2018 are shown in **Figures 6-2 to 6-5.** Historical groundwater flow directions for 2013 to 2017 are included in **Appendix 7**. Groundwater flow direction in the shallow aquifer is generally to the north and north east. Groundwater flow direction in the shallow aquifer has remained consistent since the first GME in July 2013.



Figure 6-2: Groundwater contours in the shallow aquifer, March 2018

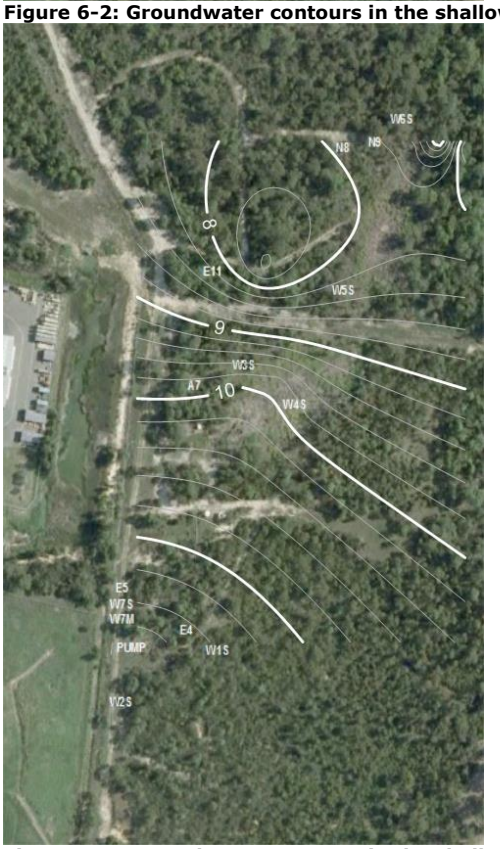


Figure 6-3: Groundwater contours in the shallow aquifer, June 2018

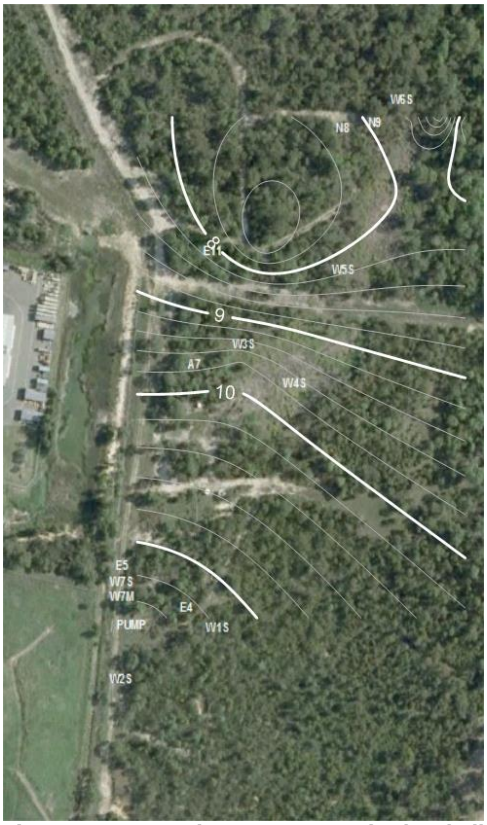


Figure 6-4: Groundwater contours in the shallow aquifer, September 2018



Figure 6-5: Groundwater contours in the shallow aquifer, December 2018

6.2 Shallow Aquifer – pH Levels

The leachate impacted groundwater generally has pH exceeding 9. Shallow aquifer pH levels for the twenty-one GMEs completed between July 2013 and December 2018 are shown in **Figure 6-6.**

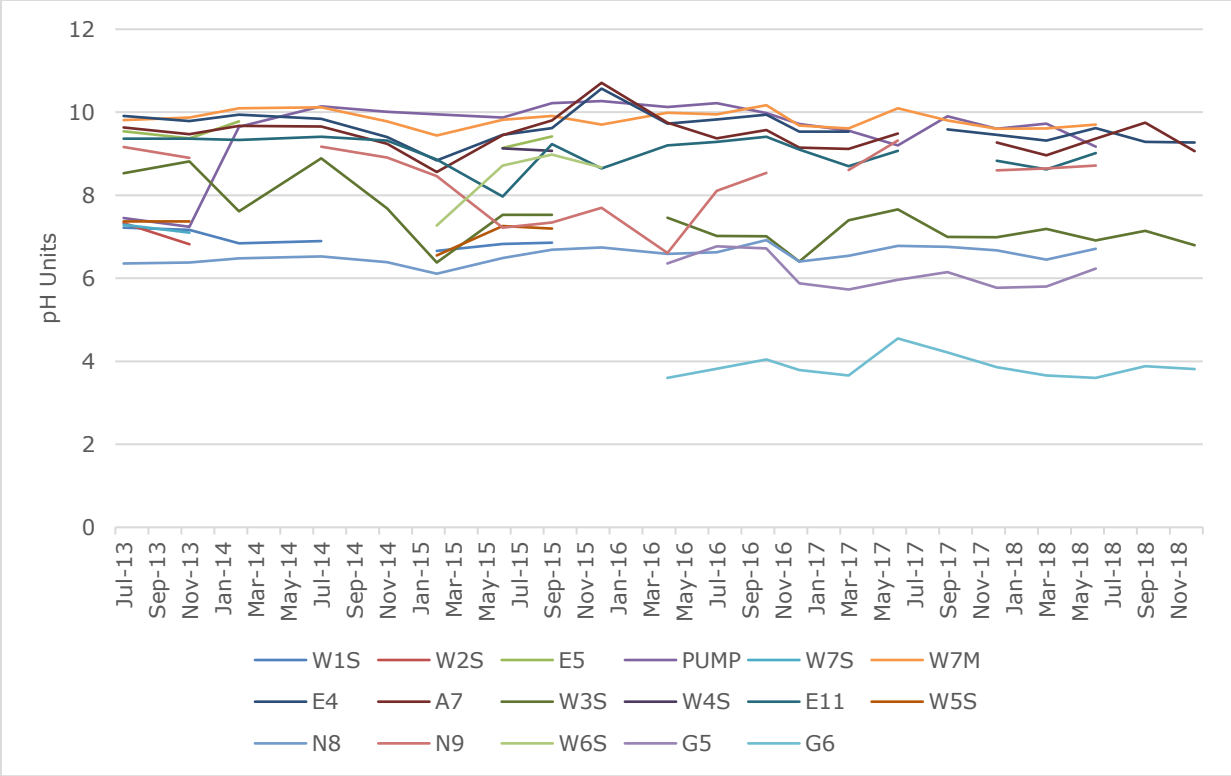


Figure 6-6: pH in Shallow Wells

Trends in pH have been analysed using Mann-Kendall statistical analysis for wells where pH results are available for sufficient sampling rounds. Mann-Kendall analysis for shallow groundwater are included in **Appendix 8**. A summary of the Mann-Kendall statistical analysis is shown in **Table 6-2**.

Table 6-2: Mann-Kendall Trends in pH in Shallow Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
1	PUMP	Stable	Stable
1	W7M	Stable	Probably decreasing
2	E4	Stable	Decreasing
3	W3S	Decreasing	Decreasing
3	A7	Probably decreasing	Probably decreasing
4	E11	Decreasing	Decreasing
5	N8	Increasing	Increasing
5	N9	Stable	No trend

Table 6-2: Mann-Kendall Trends in pH in Shallow Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
NA	G5	Probably decreasing	Decreasing
NA	G6	No trend	Stable

NA Not Applicable

Anomalous pH levels were recorded at wells Pump, W7M, E11, N8, N9 and G5 in the September 2018 event. The recorded pH values were high compared to previous rounds and pH levels in December 2018 returned to usual values. The anomalous pH levels were not included in the Mann-Kendall analysis.

The Mann-Kendall analysis found an increasing trend for pH at N8. The pH in this well has increased from 6.36 in July 2013 to 6.51 in December 2018. The pH levels in this well remain low compared to wells that contain leachate (pH >9). Field notes indicate that the appearance of water in this well has been consistently described as 'light brown', 'slightly brown' or 'brown'.

The pH levels in other wells show 'stable', 'probably decreasing', 'decreasing' trends or 'no trend'.

6.3 Shallow Aquifer – Key Chemical Concentrations

6.3.1 Fluoride

Comparison of fluoride concentrations for the twenty-one GMEs completed between July 2013 and December 2018 are shown in **Figure 6-7**.

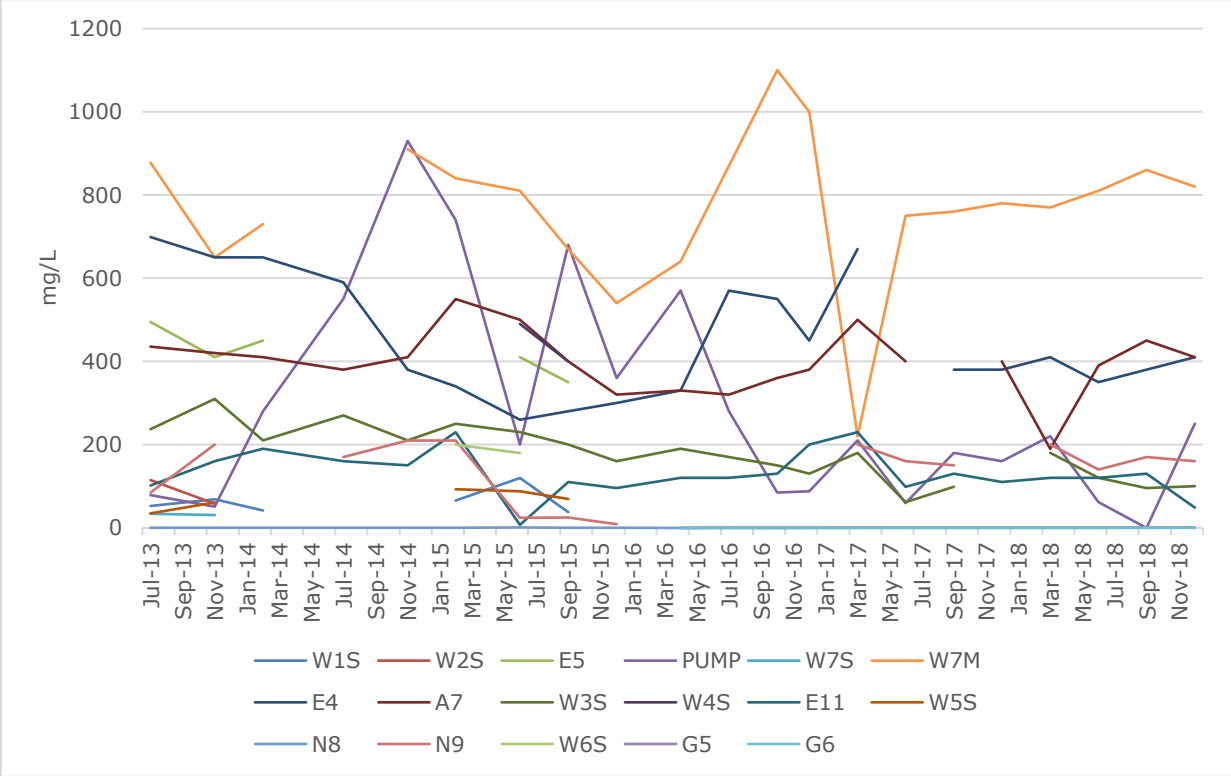


Figure 6-7: Soluble Fluoride Concentrations in Shallow Wells (mg/L)

Fluoride concentrations in all shallow wells, aside from N8, G5 and G6, exceeded the stock watering and recreational guidelines of 2 mg/L and 1.5 mg/L respectively. All shallow wells, with the exception of N8 and G6, exceeded the irrigation guideline of 1 mg/L.

Wells G5 and G6 are located adjacent to the nearest surface water receptor, Swamp Creek. Prior to 2018, fluoride concentrations in these wells remained below 1 mg/L, indicating no impact from the leachate plume adjacent to Swamp Creek. Fluoride concentrations in well G5 exceeded the irrigation guideline of 1 mg/L during the September 2018 GME, with a concentration of 1.3 mg/L. This elevated concentration is considered anomalous as groundwater at G5 during the September 2018 event was described as being 'clear' which is not indicative of leachate impacted groundwater. Fluoride concentrations at G5 returned to values consistent with historical data during the December 2018 event.

The most elevated fluoride concentrations in shallow wells have been consistently identified in wells W7M and PUMP along Section 1 at the toe of the CWS. Fluoride concentrations remained elevated in well W7M during the 2018 GMEs, with a minimum concentration of 770 mg/L. Fluoride concentrations in well PUMP have continued to decline since their peak at 930 mg/L in November 2014, with fluoride concentrations below 250 mg/L during the 2018 GMEs.

Trends in fluoride concentrations in shallow wells have been assessed using Mann-Kendall statistical analysis for wells where fluoride concentrations are available for the sampling rounds, as shown in **Table 6-3**. Mann-Kendall plots for shallow groundwater are included in **Appendix 8**. The only well with an 'increasing' trend in fluoride concentrations is N8, where fluoride concentrations remain below 1 mg/L.

Table 6-3: Mann-Kendall Trends in Fluoride in Shallow Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
1	PUMP	Sable	Stable
1	W7M	Stable	No trend
2	E4	Stable	Stable
3	W3S	Decreasing	Decreasing
3	A7	Stable	Stable
4	E11	Stable	Stable
5	N8	Increasing	Increasing
5	N9	Stable	Stable
NA	G5	Stable	Stable
NA	G6	No trend	Probably increasing

NA Not Applicable

The migration of fluoride longitudinally along the length of the plume can be assessed by looking at fluoride concentrations in the shallow wells on each section from Section 1 to Section 5. Analysis of the most recent data from December 2018 indicates that on the western edge of the plume, the highest fluoride concentration (410 mg/L) is in well A7 on Section 3. To the north of Section 3, the fluoride concentration in well E11 was 49 mg/L. On the eastern edge of the plume, the highest

fluoride concentration (410 mg/L) is in well E4 on Section 2. To the north of Section 2, the fluoride concentration in well W3S is 100 mg/kg and shallow wells further north were dry.

6.3.2 Free Cyanide

Both total and free cyanide were included for analysis in the 2018 GMEs. Free cyanide was introduced for analysis in 2015, as there are no Australian guidelines for total cyanide. Comparison of free cyanide concentrations for the twenty-one GMEs completed between July 2013 and December 2018 are shown in **Figure 6-8**.

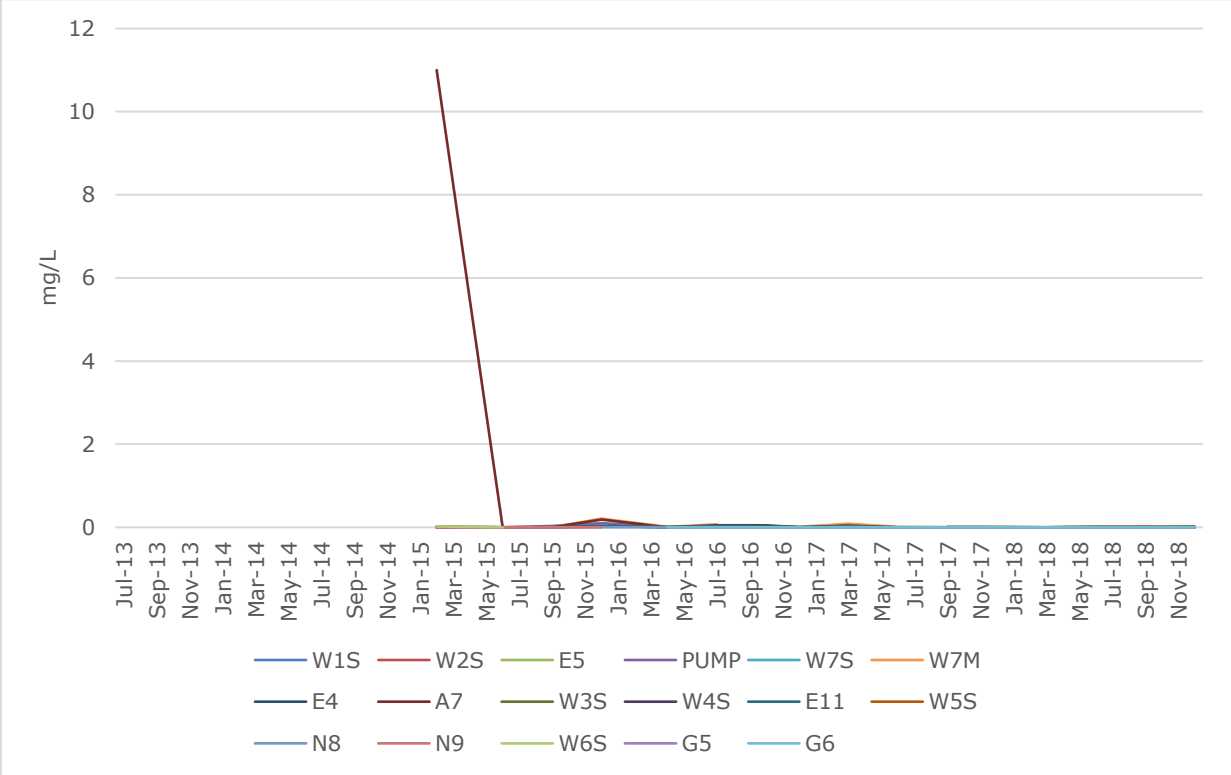


Figure 6-8: Free Cyanide Concentrations in Shallow Wells (mg/L)

Trends in free cyanide concentrations in shallow wells have been assessed using Mann-Kendall statistical analysis for wells where free cyanide concentrations are available for the sampling rounds, as shown in **Table 6-4.** Mann-Kendall analysis for shallow groundwater are included in **Appendix 8**.

Table 6-4: Mann-Kendall Trends in Free Cyanide in Shallow Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
1	PUMP	Decreasing	Decreasing
1	W7M	Decreasing	Decreasing
2	E4	No trend	No trend
3	W3S	Stable	Stable
3	A7	Probably decreasing	Probably decreasing
4	E11	No trend	No trend

Table 6-4: Mann-Kendall Trends in Free Cyanide in Shallow Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
5	N8	Stable	Stable
5	N9	Stable	No trend
NA	G5	Stable	Stable
NA	G6	Stable	Stable

NA Not Applicable

None of the shallow wells identified an 'increasing' trend in free cyanide concentrations. Trends in free cyanide concentrations did not vary between 2017 and 2018, except for well N9 which changed from a 'stable' trend to 'no trend'.

Free cyanide concentrations exceeded the guideline for protection of 95% of fresh water species of 0.007 mg/L in wells W2S, PUMP, W3S and W7M in 2018. The maximum concentration was 0.017 mg/L in Well W7M in September 2018. Free cyanide concentrations did not exceed the recreational criteria of 0.1 mg/L in any of the wells in 2018.

6.4 Deep Aquifer – Depth to Groundwater and Flow Direction

Comparison of depth to water between the twenty-one GMEs completed between July 2013 GME and December 2018 is included in Error! Reference source not found..

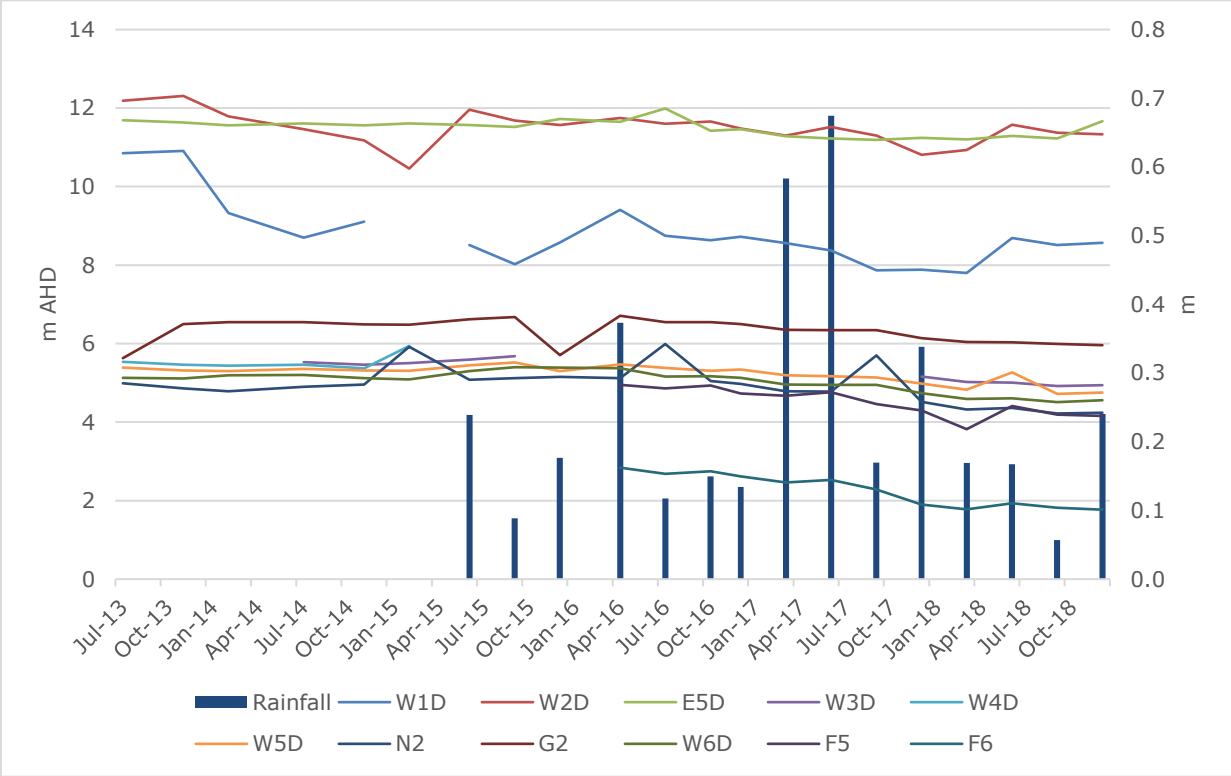


Figure 6-1: Depth to Water in Deep Wells (m AHD)

Comparison of depth to groundwater between the GMEs indicates groundwater levels have decreased with the exception of well G2, which has increased approximately 0.33 m over the twenty-one monitoring events. The majority of wells have decreased approximately 0.6 m. Water levels in well W1D decreased 2.28 m between July 2013 and December 2018 and water levels in well W2D decreased approximately 0.86 m over the same period.

It is noted that wells W1D, W3D and W4D have not been sampled correctly during a number of GMEs. The dip meter has caught up on a join in the uPVC pipework in wells W1D and W3D and sampling has not been completed. Well W4D was damaged below the ground with a kink in the standpipe in the April 2015 storm and the dip meter could not pass the kink but the well could be sampled until October 2016 when the top of the standpipe was irreparably damaged. This well has not been replaced.

Interpreted groundwater flow directions for 2018 is shown in **Figures 6-10** to **6-13.** Historical groundwater flow directions are included in **Appendix 7**. Groundwater flow direction plots show groundwater flow direction in the deep aquifer is consistently to the north-east. The deep aquifer contours show little variation between June 2013 and December 2018. There is a consistent gradient from approximately 11 m bgs near E5D to approximately 6 m bgs near W4D, then the gradient shallows through the northern vegetation impact area.



Figure 6-10: Groundwater contours in the deep aquifer, March 2018



Figure 6-11: Groundwater contours in the deep aquifer, June 2018



Figure 6-12: Groundwater contours in the deep aquifer, September 2018



Figure 6-13: Groundwater contours in the deep aquifer, December 2018

6.5 Deep Aquifer – pH Levels

The deep aquifer has generally not been impacted by leachate with pH levels below 8, aside from well W2D. The pH in W2D is greater than 9, indicating leachate impact. Wells E5D, W5D and W6D recorded pH levels greater than 9 during September 2018 only. The high pH reading at these wells are considered anomalous and should be used as an estimate only. pH concentrations within these wells have historically fallen below 8 and results from chemical analysis during September 2018 showed minimal variation from previous results. Deep aquifer pH levels for the twenty-one GMEs between July 2013 and December 2018 are shown in **Figure 6-14.**

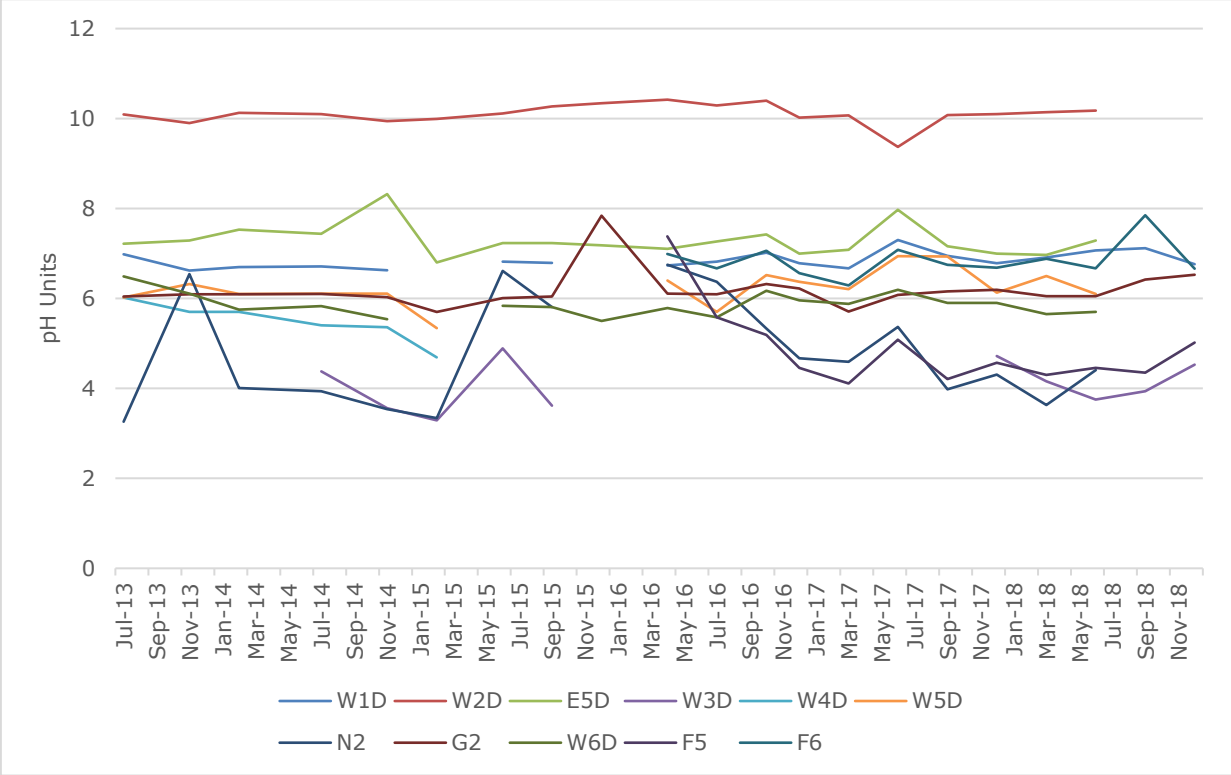


Figure 6-14: pH in Deep Wells

Trends in pH have been analysed using Mann-Kendall statistical analysis for wells where pH results are available for sufficient sampling rounds to generate a trend, as outlined in **Table 6-25**. Mann-Kendall analysis for deep groundwater are included in **Appendix 8**.

Table 6-2: Mann-Kendall Trends in pH in Deep Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
1	W2D	Probably increasing	No trend
1/2	E5D	No trend	Decreasing
2	W1D	Probably decreasing	Stable
3	W3D	Stable	Stable
3	W4D	Decreasing	Decreasing

Table 6-2: Mann-Kendall Trends in pH in Deep Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
4	W5D	Increasing	Increasing
4	N2	No trend	Stable
5	G2	No trend	Increasing
5	W6D	No trend	No trend
NA	F5	Stable	Probably decreasing
NA	F6	Stable	Stable

NA Not Applicable

Anomalous pH levels were recorded at wells W2D, E5D, W5D, N2 and W6D in the September 2018 event. The recorded pH values were high compared to previous rounds and pH levels in December 2018 returned to usual values. The anomalous pH levels were not included in the Mann-Kendall analysis.

Two wells were identified as having an 'increasing' trend between 2013 and 2018 – W5D and G2. At W5D, pH levels have increased from 6.02 in July 2013 to 6.72 in December 2018. At G2, pH levels have increased from 6.04 in July 2013 to 6.53 in December 2018. These pH levels remain indicative of natural conditions at the site and are similar to pH levels in other deep wells.

The natural pH conditions are slightly acidic to neutral, with pH conditions generally within or below the trigger values for lowland rivers of 6.5 to 8 (ANZECC 2000). Wells W3D, W4D, N2, W6D and F5 have pH levels generally below 6, which is indicative of slightly acidic conditions in the deep aquifer.

6.6 Deep Aquifer – Key Chemical Concentrations

6.6.1 Fluoride

Comparison of fluoride concentrations in the twenty-one GMEs completed between July 2013 and December 2018 is included in **Figure 6-15** with concentrations for W2D only shown in **Figure 6-16**. Fluoride concentrations in the majority of deep wells remain below the irrigation, stock watering and recreational guidelines of 1 mg/L, 2 mg/L and 1.5 mg/L respectively. Deep wells with fluoride concentrations exceeding these guidelines are discussed below in relation to trends in fluoride concentrations.

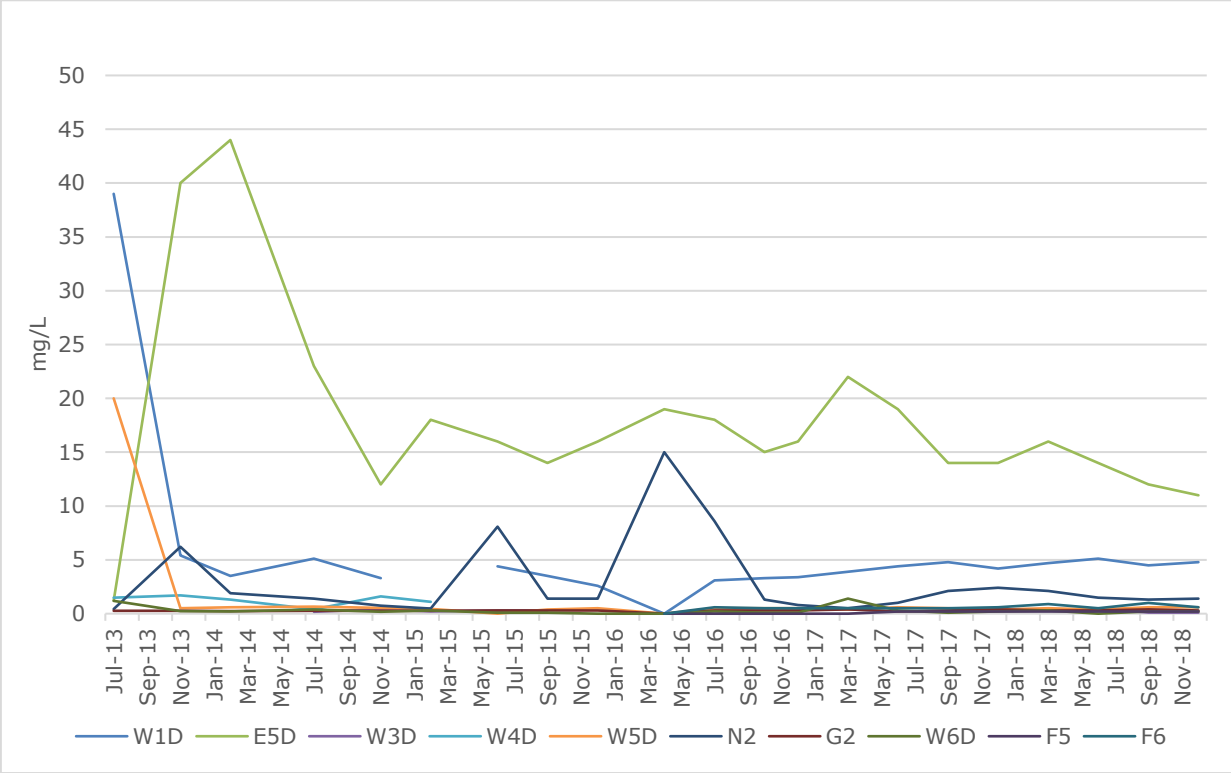


Figure 6-15: Soluble Fluoride in Deep Wells Excluding W2D (mg/L)

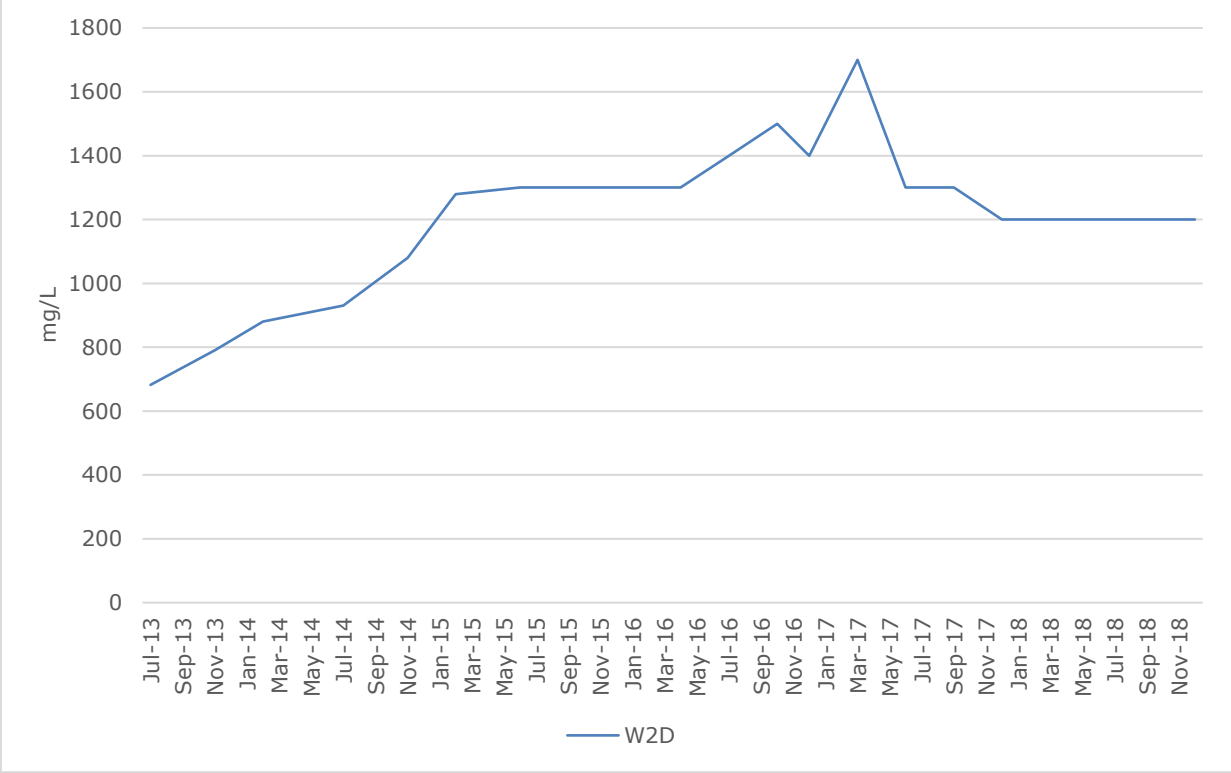


Figure 6-16: Soluble Fluoride in W2D (mg/L)

Trends in fluoride concentrations in deep wells have been assessed using Mann-Kendall statistical analysis for wells where fluoride concentrations are available for sufficient rounds of sampling to generate a trend, as outlined in **Table 6-6**. Mann-Kendall analysis for deep groundwater are included in **Appendix 8**.

Table 6-6: Mann-Kendall Trends in Fluoride in Deep Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
1	W2D	Increasing	Increasing
1/2	E5D	Stable	Decreasing
2	W1D	No trend	No trend
4	W5D	Decreasing	No trend
4	N2	No trend	No trend
5	G2	Increasing	Increasing
5	W6D	No trend	No trend
NA	F5	ID	Stable
NA	F6	Stable	No trend

NA Not Applicable ID Insufficient Data

The most elevated fluoride concentrations in the plume have been identified in deep well W2D. Fluoride concentrations over the twenty-one GMEs have increased from 682 mg/L in July 2013 to a maximum of 1700 mg/L in March 2017. Since March 2017, fluoride concentrations have reduced and fluoride concentrations were 1200 mg/L during the four 2018 GMEs. Although fluoride concentrations have remained stable since December 2017, Mann-Kendall statistical analysis indicates the trend in fluoride concentrations remains 'increasing'.

Elevated fluoride concentrations have also been identified in well E5D on Section 1. The trend in fluoride concentrations at this well was 'stable' to December 2017 and is now 'decreasing' to December 2018. Fluoride concentrations have reduced from a peak of 40 mg/L in November 2013 to 11 mg/L in December 2018. Fluoride concentrations in this well are impacted by leachate, although to a much lesser extent than shallow wells on Section 1.

Elevated fluoride concentrations have also been identified in well W1D on Section 2. Mann-Kendall statistical analysis indicates there is 'no trend' in fluoride concentrations at this well. Fluoride concentrations in this well are generally below 5 mg/L. W1D is located approximately 40 m east of the CWS and intersects groundwater at a depth of 10.5 m bgs to 11.5 m bgs in sand confined by 2.5 m thick high plasticity clay.

Elevated fluoride concentrations have also been identified in well N2 on Section 4. As discussed in the 2016 and 2017 Annual Report, surface water impacted with leachate was able to flow into this well via damaged concrete at the surface. The concrete base was reinstalled in July 2016 and since this time, fluoride concentrations have remained below 3 mg/L. Mann-Kendall statistical analysis currently shows 'no trend' in fluoride concentrations in this well.

Two wells were identified as having an 'increasing' trend between July 2013 and December 2018 - W2D and G2. Well W2D is discussed above. Fluoride concentrations in well G2 have increased from 0.28 mg/L in July 2013 to 0.3 mg/L in December 2018 and these concentrations remain below levels identified in leachate impacted groundwater.

6.6.2 Free Cyanide

Comparison of free cyanide concentrations in the twenty-one GMEs completed between July 2013 and December 2018 is included in **Figure 6-17** with concentrations for W2D only shown in Error! Reference source not found.**8**.

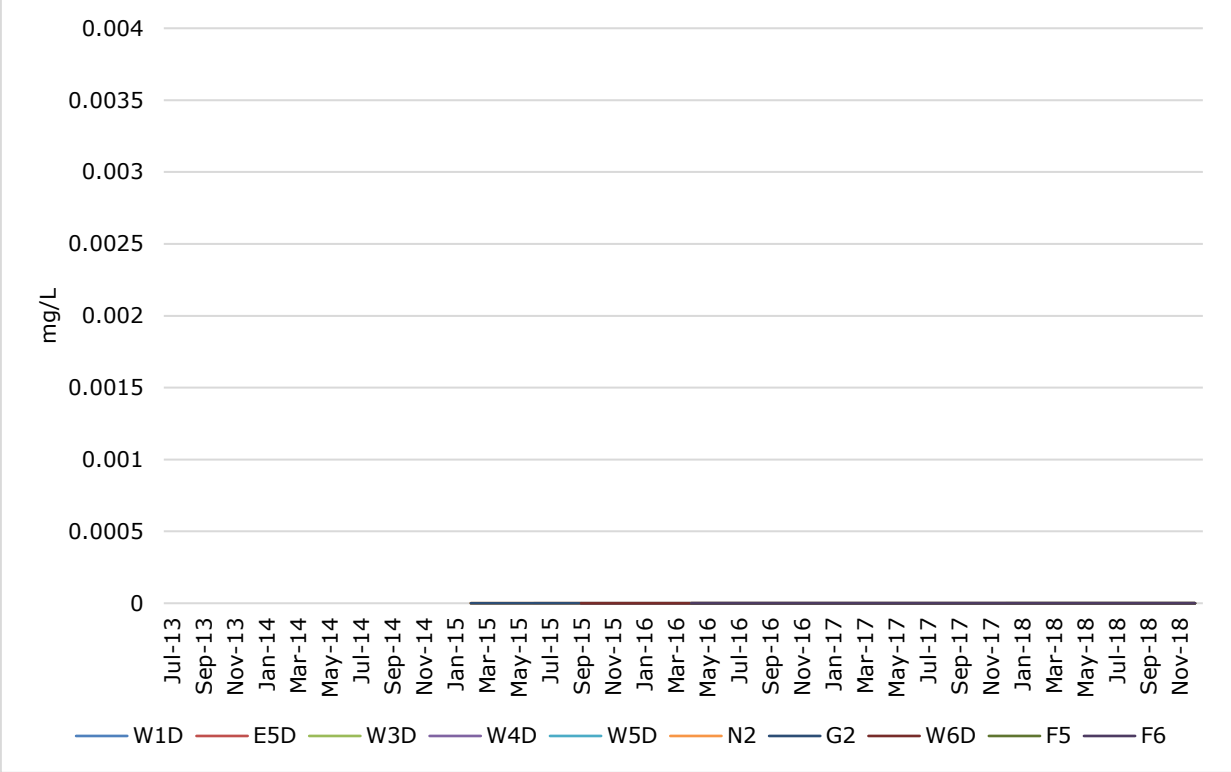


Figure 6-17: Free Cyanide in Deep Wells Excluding W2D (mg/L)

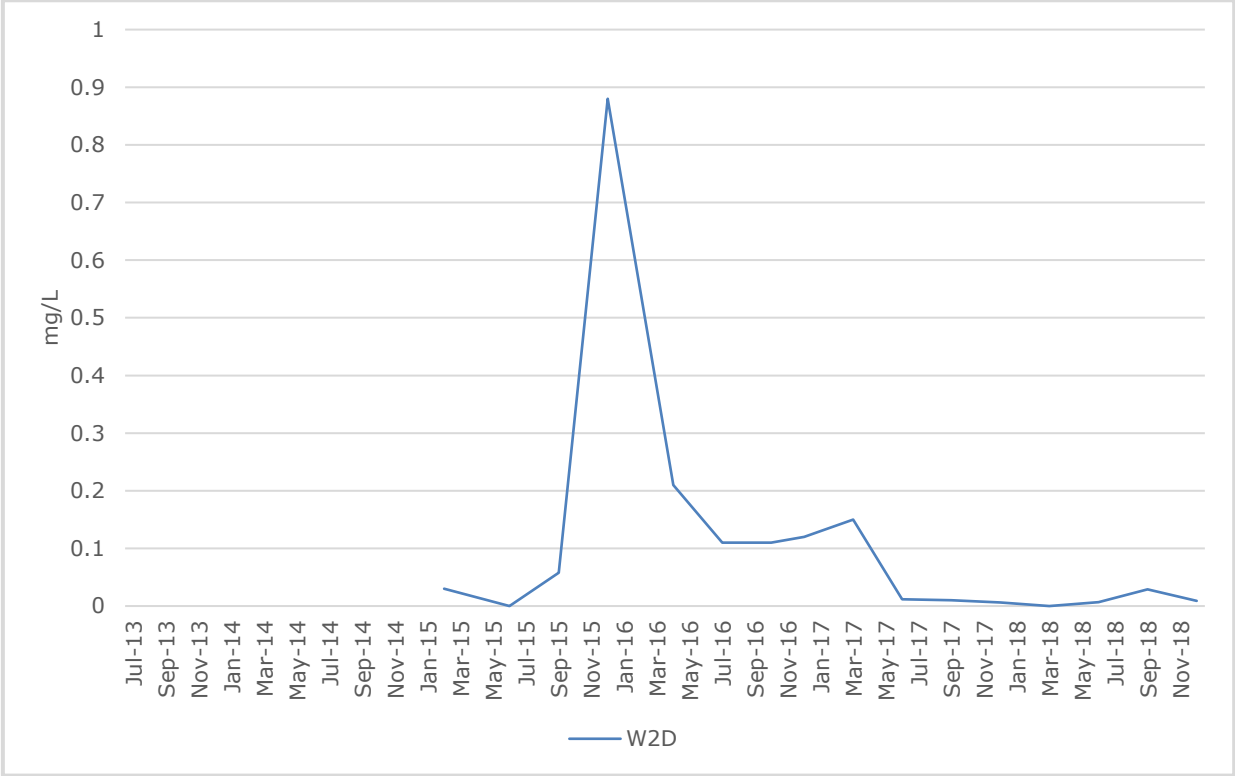


Figure 6-18: Free Cyanide in W2D (mg/L)

Trends in free cyanide concentrations in deep wells have been assessed using Mann-Kendall statistical analysis for wells where free cyanide concentrations are available for sufficient rounds of sampling to generate a trend, as outlined in **Table 6-7**. Mann-Kendall plots for deep groundwater are included in **Appendix 8**.

Table 6-7: Mann-Kendall Trends in Free Cyanide in Deep Wells

Section	Well	Previous Trend 2013 to 2017	Current Trend 2013 to 2018
1	W2D	Probably decreasing	Decreasing
1/2	E5D	Stable	Stable
2	W1D	Stable	Stable
4	W5D	Stable	Stable
4	N2	Stable	Stable
5	G2	Stable	Stable
5	W6D	Stable	Stable
NA	F5	Stable	Stable
NA	F6	Stable	Stable

NA Not Applicable ID Insufficient Data

Free Cyanide from deep groundwater well samples analysed between February 2015 and December 2018 were below the limit of reporting and show a ‘stable’ trend, aside from W2D. The trend in free cyanide concentrations in W2D changed from ‘probably decreasing’ in 2017 to ‘decreasing’ in 2018. Free cyanide concentrations in this well generally exceed the guideline for protection of 95% fresh water species of 0.007 mg/L with a maximum value recorded of 0.029 mg/L measured during the 2018 GME.

7. HYDRO DATA

Hydro collect groundwater samples for analysis from the monitoring well network in between the Ramboll quarterly groundwater monitoring events. Twenty (20) sampling events have been completed by Hydro between May 2014 and December 2018. Hydro personnel gauged the depth to water and collected groundwater samples for pH, conductivity, fluoride and total cyanide.

Fluoride concentrations for wells sampled by Hydro are included in **Table 7-1** with a graphic representation provided in **Figure 7-1**. Wells W2S and W7M have been dry for all sampling rounds. Wells W1S, W7S, W4S, W5S and W6S have been dry for the majority of sampling rounds. Fluoride concentrations have been most elevated in W2D. Elevated fluoride concentrations in wells W1S, W2D, W3S, W4S, W5S and W6S show impact from the leachate plume. Fluoride concentrations in wells W1D and E5D are also elevated but to a lower extent. Fluoride concentrations in W6D are not elevated and indicate no impact by the leachate plume. The results from the Hydro sampling are similar to the results of the quarterly sampling completed by Ramboll.

Table 7-1: Fluoride Concentrations in Wells Sampled by Hydro (mg/L)

Date	W1S	W1D	W2S	W2D	W7S	W7M	E5D	W3S	W4S	W5S	W6S	W6D
May 2014	70	8.9	-	840	39	-	39	410	610	180	-	-
June 2014	75	5.7	-	660	-	-	36	310	400	87	-	1.1
Sep 2014	79	3	-	1200	-	-	15	270	460	110	-	0.7
Dec 2014	58	2	-	1200	-	-	10	230	-	89	-	0.7
Mar 2014	-	2	-	1200	-	-	10	230	-	-	-	<0.5
June 2014	-	3.4	-	1300	-	-	14	240	500	95	150	0.7
Sep 2015	-	2	-	1300	-	-	7	220	-	77	-	<0.5
Dec 2015	-	<5	-	1100	-	-	9	180	-	8.3	-	<0.5
Mar 2016	-	8.3	-	1200	-	-	14	230	-	-	-	0.9
June 2016	-	3.7	-	1600	-	-	<0.5	160	-	-	-	<0.5
Sep 2016	-	4.1	-	1100	-	-	12	130	-	-	-	<0.5
Dec 2016	-	7.5	-	1400	-	-	15	-	-	-	-	<0.5
Mar 2017	-	5.3	-	1200	-	-	14	220	-	-	-	<0.5
June 2017	-	4.5	-	1300	-	-	18	140	-	-	-	<0.5
Sep 2017	-	4.2	-	1200	-	-	20	90	-	-	-	<0.5
Dec 2017	-	6.7	-	1600	-	-	200	1100	-	-	-	1.7
Mar 2018	-	15.0	-	1700	-	-	25	1700	-	-	-	-
June 2018	-	6.4	-	2200	-	-	30	120	-	-	-	-
Sep 2018	-	4.5	-	860	-	-	12	96	-	-	-	-
Dec 2018	-	4.3	-	1100	-	-	10	87	-	-	-	-

-Well not sampled

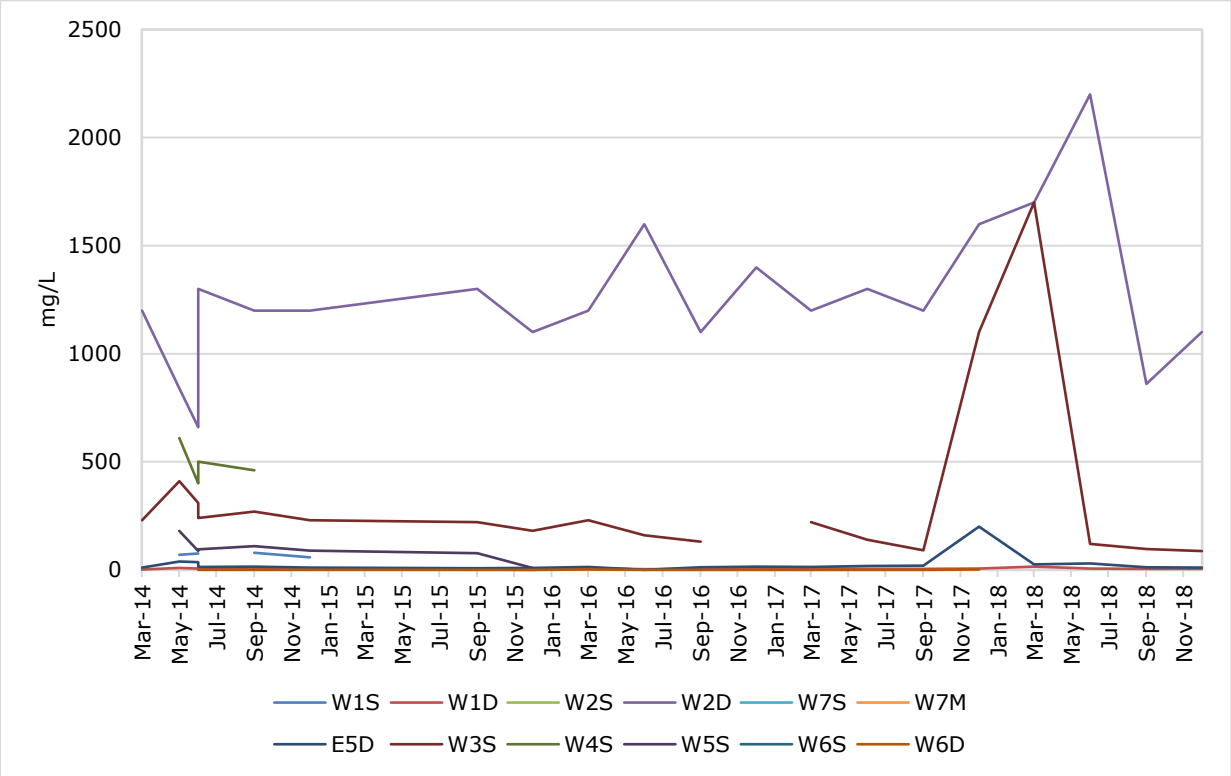


Figure 7-2: Fluoride Concentrations in Wells Sampled by Hydro (mg/L)

8. CONCLUSIONS AND RECOMMENDATIONS

Twenty-one groundwater monitoring events (GMEs) have been completed within a leachate impacted groundwater plume associated with the Capped Waste Stockpile (AEC 1) at the former Hydro Aluminium Kurri Kurri Smelter. The four most recent events were completed in March 2018, June 2018, September 2018 and December 2018.

Monitoring of the groundwater down gradient of the Capped Waste Stockpile was initiated to assess the impacts to groundwater from leachate and to provide a temporal and spatial evaluation of the plume.

Each GME included the sampling and analysis of groundwater from a network of 25 shallow and deep wells located on five sections along the length of the leachate plume down-gradient of the Capped Waste Stockpile. In 2016, two additional shallow wells and two additional deep wells were added to the network. These wells are located adjacent to Swamp Creek, the nearest surface water receptor. Physico-chemical parameters were recorded and groundwater samples were analysed for soluble fluoride, total and free cyanide as well as total and dissolved aluminium.

Evaluation of 2018 GME data has identified the following:

- Groundwater flow is interpreted to be north to north-east in both the shallow and deep aquifer. This is consistent with historical observations.
- The trend for pH in the shallow aquifer was generally 'stable', 'decreasing' or 'no trend'. An 'increasing' trend was identified at only one well, N8, located on Section 5 where pH increased from 6.36 in July 2013 to 6.51 in December 2018.
- The trend for soluble fluoride in the shallow aquifer was mainly 'stable'. An 'increasing' trend was only identified at one well, N8, where the fluoride concentration remains below 1 mg/L and is not impacted by the leachate plume. Fluoride concentrations in N8 remain below the site criteria for the receiving waters.
- Longitudinally along the length of the plume, the most elevated fluoride concentrations on the western edge were in well A7 on Section 3 and on the eastern edge were in well E4 on Section 2.
- The trend for free cyanide in the shallow aquifer was 'stable' or 'decreasing'. No 'increasing' trends were identified. Free cyanide concentrations remained below the site criteria of 0.007 mg/L aside from at wells PUMP, W7M and W3S.
- An 'increasing' trend was identified for pH in two wells in the deep aquifer – W5D and G2. The pH levels in both wells remain indicative of natural levels at the site.
- An 'increasing' trend was identified for soluble fluoride in two wells in the deep aquifer – W2D and G2. Well W2D is the most leachate impacted well, with fluoride concentrations at 1200 mg/L. Fluoride concentrations in well G2 remain below levels identified in leachate impacted groundwater.
- The trend for free cyanide in the deep aquifer was 'stable', except for W2D which had a 'decreasing' trend.
- The most leachate impacted well remains W2D, in the deep aquifer on Section 1. Fluoride concentrations in this well have more than doubled over the twenty-one monitoring rounds from 682 mg/L to a peak of 1700 mg/L in March 2017. Since March 2017, fluoride concentrations have reduced to 1200 mg/L.
- Fluoride concentrations in the deep aquifer down-gradient of Section 1 remain low, indicating a semi-continuous connection between the shallow and deep aquifer;
- Groundwater data from the two pairs of shallow and deep wells adjacent to Swamp Creek, the nearest surface water receptor, show no impact from the leachate plume. This result is

anticipated based on the location of high plasticity clays, which limit the migration of the leachate plume in this direction toward Swamp Creek.

Monitoring of groundwater and operation of the toe leachate interception trench is proposed to continue until remediation of the Capped Waste Stockpile is completed.

9. REFERENCES

ANZG (2018) Guidelines for Fresh and Marine Water Quality

ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality

ENVIRON (March 2013) Tier 2 Ecological Risk Assessment, Kurri Kurri Aluminium Smelter

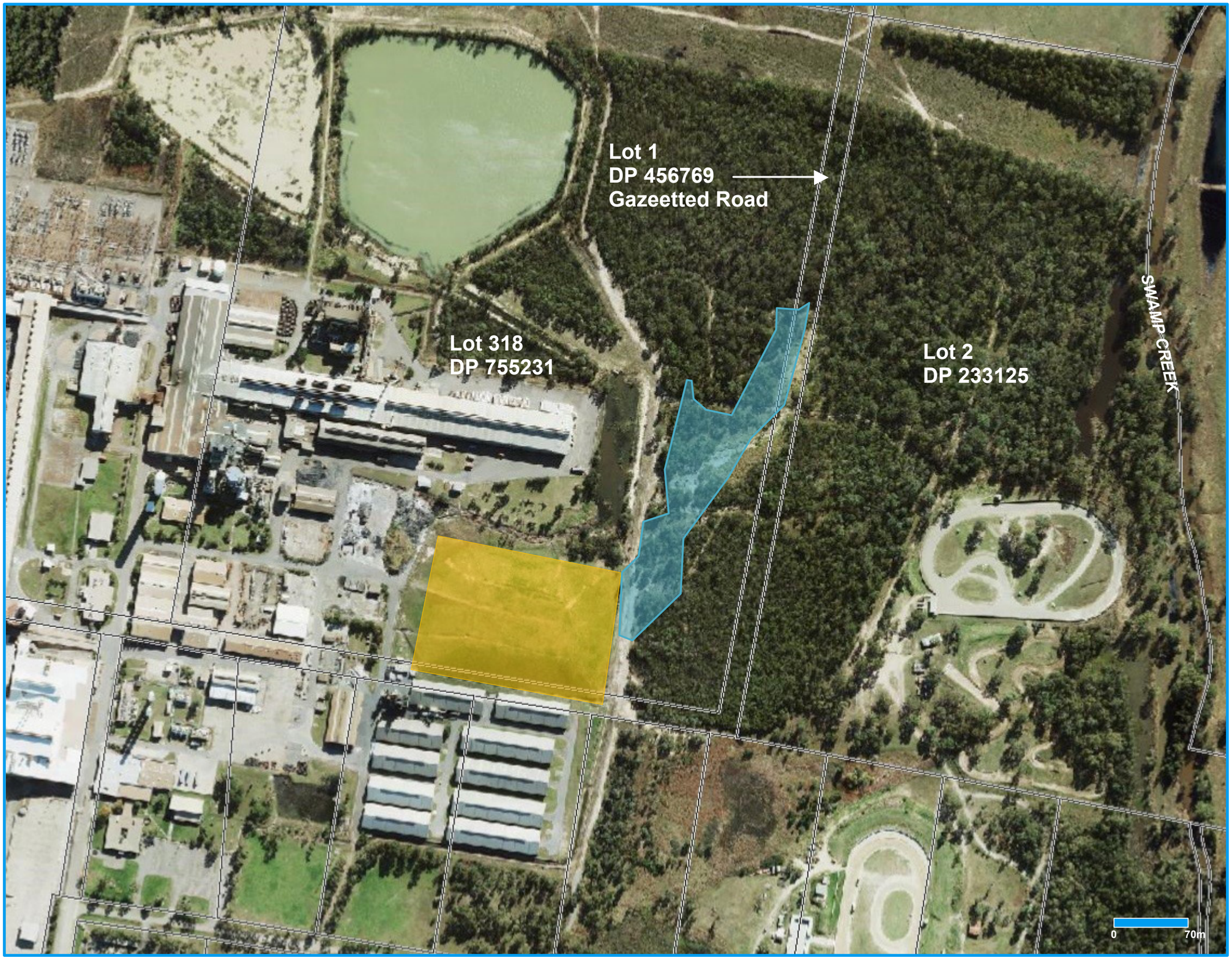
ENVIRON (February 2015) Groundwater Fate and Transport Modelling, Leachate Plume – Capped Waste Stockpile, Hydro Aluminium Smelter Kurri Kurri, NSW

ENVIRON (June 2016) Hydro Aluminium Kurri Kurri Smelter, Capped Waste Stockpile, 12 Month Groundwater Monitoring Report

ENVIRON (September 2016) Plume Delineation Report, Capped Waste Stockpile

NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination

Ramboll (April 2016) Hydro Aluminium Smelter, Capped Waste Stockpile, 2015 Annual Groundwater Monitoring Report



Legend

- Leachate Plume
- Capped Waste Stockpile



RAMBOLL

Figure 1 | Site Locality Plan

2018 Annual Groundwater Monitoring Report

A3
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Legend

- Leachate Plume
- Capped Waste Stockpile
- Leachate Interception Trench
- Wells for Quarterly Sampling

RAMBOLL

Figure 2 | Groundwater Monitoring Well Network

2018 Annual Groundwater Monitoring Report

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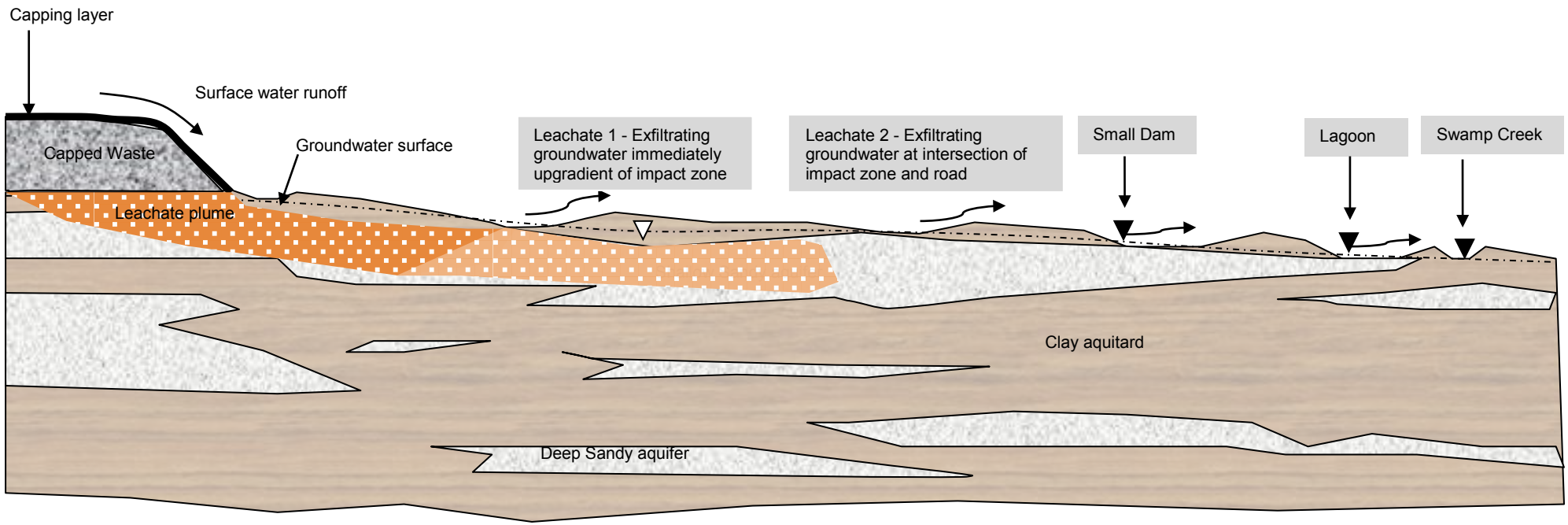
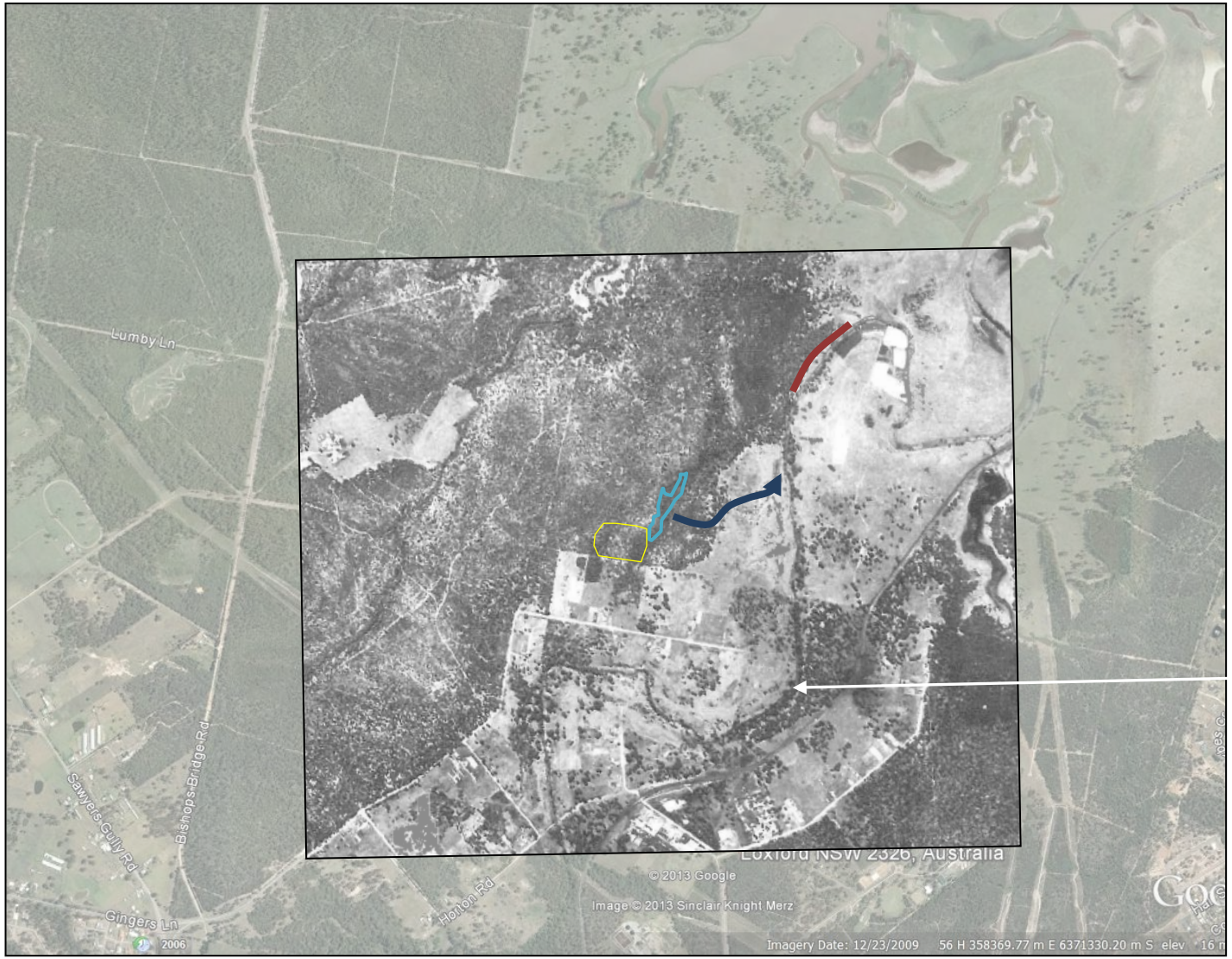
APPENDIX 1
ATTACHMENTS



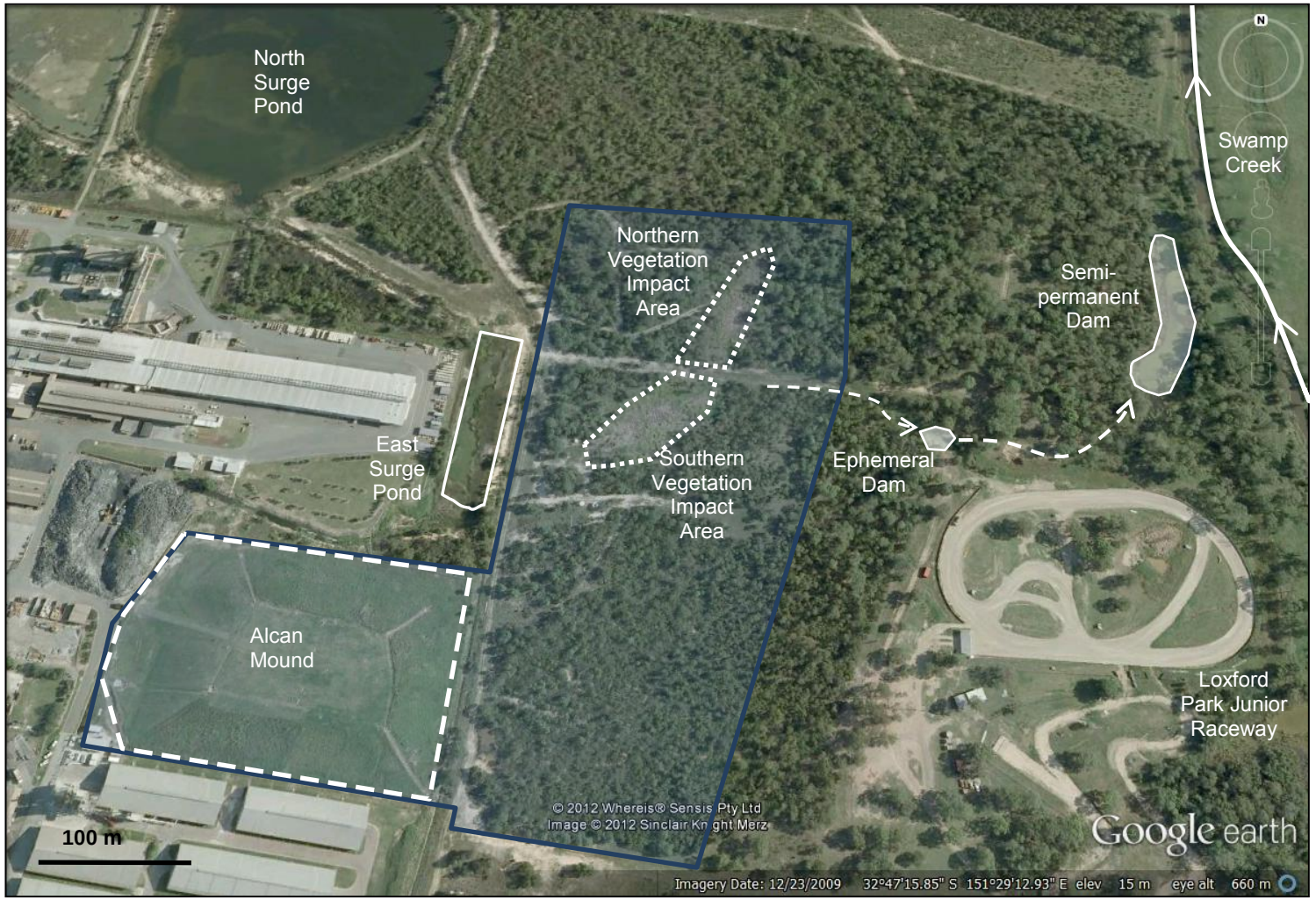
Hydro Aluminium Kurri Kurri: 2018 12 Month GME Summary	Conceptual Plume Cross Section

RAMBOLL

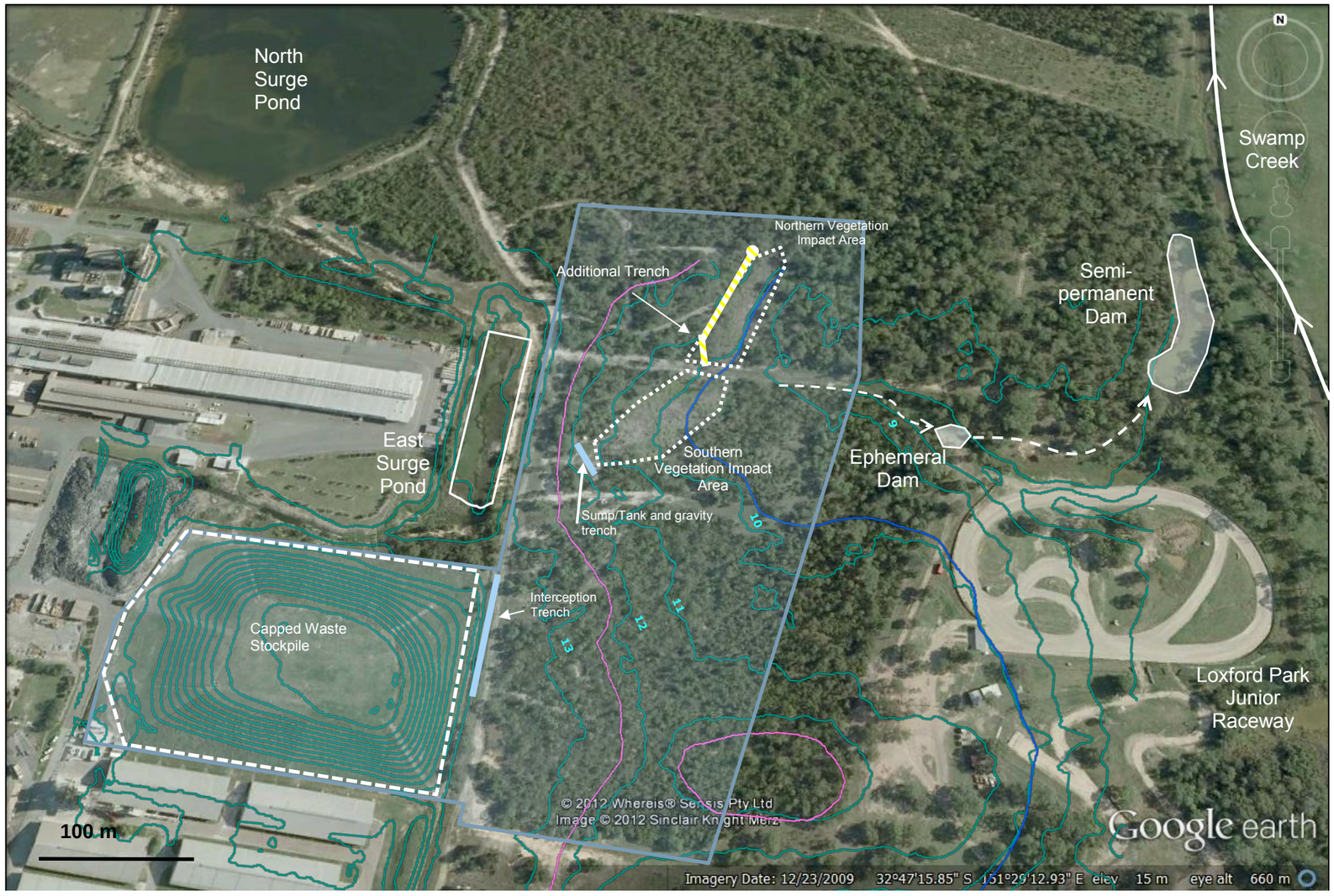
JOB NO: 318000375 DATE: Feb 2019 ATTACHMENT 1



Hydro Aluminium Kurri Kurri: 2018 12 Month GME Summary	1961 Aerial Photograph showing Plume Location
RAMBOLL JOB NO: 318000375 DATE: Feb 2019	ATTACHMENT 2



Hydro Aluminium Kurri Kurri: 2018 12 Month GME Summary	Overland Flow Path of Leachate
RAMBOLL JOB NO: 318000375 DATE: Feb 2019	ATTACHMENT 3



13 Topographic Contours mAHD (based on 1m Lidar)

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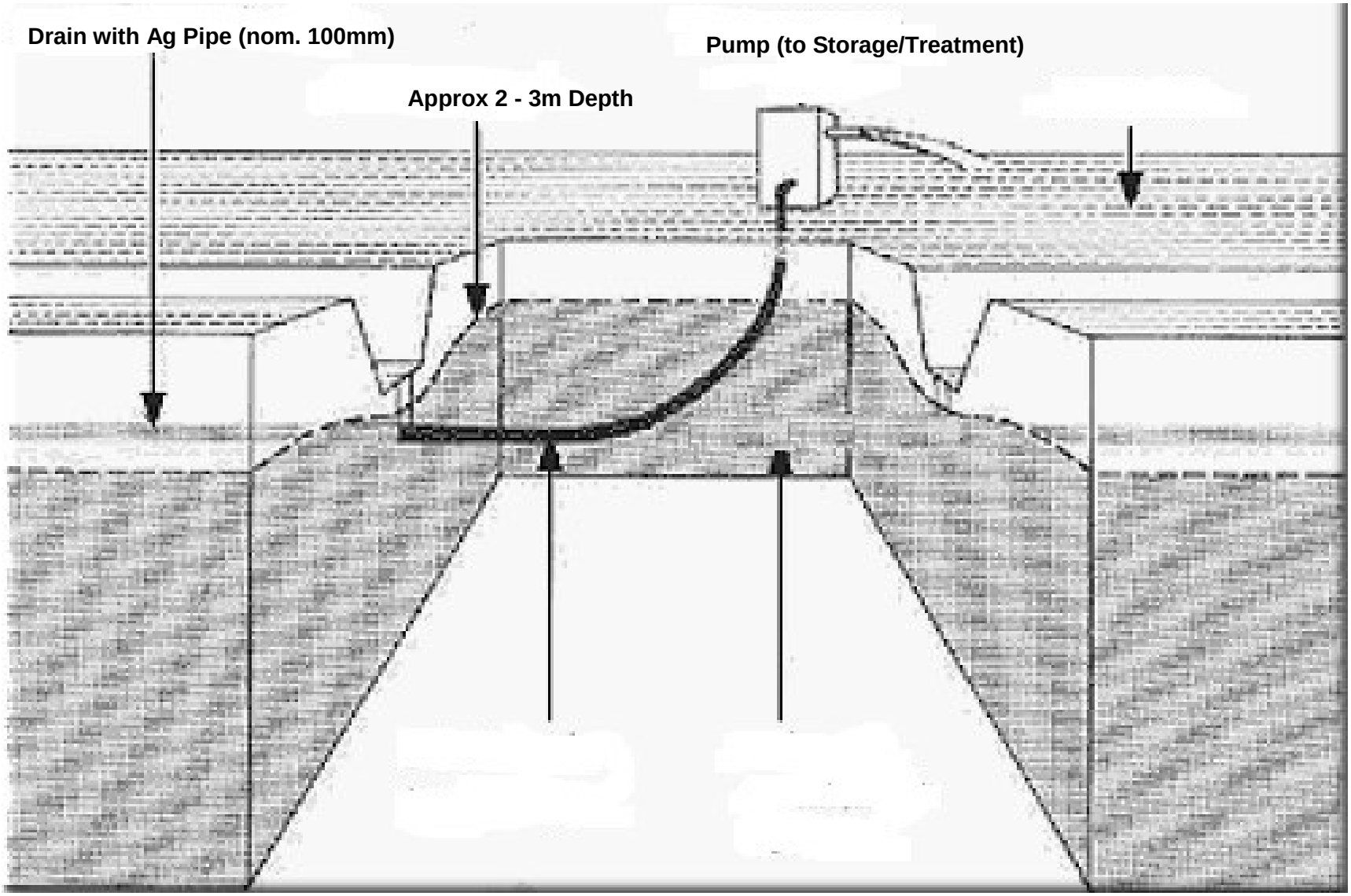
Hydro Aluminium Kurri Kurri: 2018 12 Month GME Summary		Capped Waste Stockpile, Location of Leachate Interception Trenches
RAMBOLL	JOB NO: 318000375	DATE: Feb 2019	Attachment 4



Hydro Aluminium Kurri Kurri: 2018 12 Month GME Summary	Conceptual Cross Section of Leachate Interception Trench

RAMBOLL

JOB NO: 318000375 DATE: Feb 2019 ATTACHMENT 5

APPENDIX 2
QA/QC REVIEW

A quality assurance assessment for the 2018 reporting period is presented in Table A, B and C below and covers the four Groundwater Monitoring Events (GMEs) completed in March, June, September and December 2018.

Table A: QA/QC – Sampling and Analysis Methodology Assessment

Sampling Methodology	Ramboll Assessment
Sampling Pattern and Locations	Prior to the commencement of the GMEs, the leachate plume originating from the Capped Waste Stockpile was delineated through staged fieldwork and reported in ENVIRON (2013) 'Plume Delineation Report, Alcan Mound'. From the delineation work, 19 new groundwater wells were installed on five sections along the length of the plume to assist with groundwater monitoring. The five sections are approximately 60 m apart and extend from the toe of the Capped Waste Stockpile to the leading edge of the leachate plume. Groundwater wells target both the shallow and deep aquifer. Groundwater wells located on five sections were selected for the 2018 GMEs. Each section provides a cross section of the leachate plume at different length along the known location of the plume. One of the wells, W3SA, was destroyed in the April 2015 storm and has not been replaced. Another well, W4D, was also damaged in this storm but was able to be sampled until the October 2016 GME. This well can no longer be sampled and has not been replaced. In 2016, an additional two shallow and deep pairs of wells (F5/F6 and G5/G6) were added to the monitoring network. These wells are located adjacent to Swamp Creek, the nearest surface water receptor.
Sampling Density	Twenty-nine groundwater wells were selected for sampling for the 2018 GMEs on five sections along the length of the leachate plume and adjacent to the nearest surface water receptor. As the leachate plume is approximately 300 m in length, there is one section per 60 m.
Sample depths	Both shallow groundwater (leachate plume) and the deep aquifer were sampled as part of the 2018 GMEs.
Sample Collection Method	For the 2018 GMEs, groundwater samples were collected using low flow methods (peristaltic pump and LDPE tubing). Groundwater samples were collected directly into laboratory-supplied bottles. Disposable gloves were worn during sample collection.
Decontamination Procedures	Dedicated disposable tubing was used to collect the groundwater samples. A short piece of silicone tubing was retained in the peristaltic pump and used for all wells. This tubing was decontaminated between sampling locations by washing with a solution of Decon90 and potable water.
Sample handling and containers	All groundwater samples were placed into laboratory-supplied bottles that were prepared with the required preservatives by the laboratory. Groundwater samples were placed on ice following collection and during transportation to the laboratory.
Chain of Custody	Samples were transported to the laboratory under chain of custody conditions. The chain of custody forms were signed by the laboratory on receipt of the samples.
Detailed description of field screening protocols	A water quality meter was used to collect field data, including temperature, pH, electrical conductivity, reduction/ oxidation potential and dissolved oxygen.

Table A: QA/QC – Sampling and Analysis Methodology Assessment

Sampling Methodology	Ramboll Assessment
	These parameters were recorded during purging until they stabilised, with subsequent readings within 10% of each other.
Calibration of field equipment	The water quality meter was hired from a rental company who calibrated the equipment prior to hire. Calibration certificates were provided by the rental company and are included in Appendix 5.
Sampling Logs	Field parameter sheets for the 2018 GMEs are included in Appendix 2.

Table B: QA/QC – Field and Lab Quality Assurance and Quality Control

Field and Lab QA/QC	Ramboll Comments
Field quality control samples	In general, intra-laboratory duplicate groundwater samples were analysed at a rate of 10% and inter-laboratory duplicate groundwater samples were analysed at a rate of 5% during the 2018 GMEs. At least one rinsate blank sample was collected per GME. A summary of the field quality control samples collected during the 2018 GMEs is outlined below.
Field quality control results	Intra- and inter-laboratory duplicate results for each GME are presented in Table C. March 2018 -June 2018: Relative Percent Differences (RPDs) for fluoride, total cyanide, free cyanide and aluminum were less than 30 % for intra- and inter-laboratory duplicate pairs. June 2018: RPDs for fluoride, total cyanide and free cyanide were less than 30 % for intra- and inter-laboratory duplicate pairs. The RPD for dissolved aluminum in the inter-laboratory duplicate pair W1D/QA102 exceeded 30 % due to low dissolved aluminum concentrations close to the detection limit. September 2018: RPDs for total cyanide and total aluminum in inter-laboratory duplicate pairs G2/QA103 were 50% and 40% respectfully. December 2018: RPDs for fluoride and free cyanide were less than 30 % for intra- and inter-laboratory duplicate pairs. The RPD for total cyanide exceeded 30 % in the intra- and inter-laboratory duplicate pairs W1D/QA102 and W1D/QA103 due to low total cyanide concentrations close to the detection limit. The RPD for total aluminum in the inter-laboratory duplicate pairs W1D/QA103

GME	Intra-lab Dups	Inter-lab Dups	Rinsate Blanks
Mar 2018	DUP1, DUP2	TRIP1	BLANK
Jun 2018	QA101, QA103	QA102	QC101
Sep 2018	QA101, QA103	QA102	QC101
Dec 2018	QA101, QA102	QA103	QC101

Table B: QA/QC – Field and Lab Quality Assurance and Quality Control	
Field and Lab QA/QC	**Ramboll Comments**
	exceeded 30 % due to the presence of suspended particles which contributes to sample heterogeneity during analysis. Rinsate blank results were all less than the limits of reporting for all 2018 sampling rounds.
NATA registered laboratory and NATA endorsed methods	Envirolab was used as the primary laboratory and ALS was used as the secondary laboratory. The laboratory certificates are NATA stamped.
Analytical methods	Summary analytical methods were included in the laboratory test certificates.
Holding times	Review of the COCs and laboratory certificates indicate that holding times were met.
Practical Quantitation Limits (PQLs)	PQLs for all groundwater analytes were below the site assessment criteria.
Laboratory quality control samples	Laboratory quality control samples including duplicates, laboratory control samples, matrix spikes, surrogate spikes and blanks were undertaken by the laboratories at appropriate frequencies.
Laboratory quality control results	The results for laboratory soil duplicates, laboratory control samples, matrix spikes and surrogates were acceptable, aside from the following: March 2018 and September 2018: Matrix spike recoveries for metals in water performed by the primary laboratory could not be determined due to high concentrations of the element/s in the sample. However, Envirolab reported that an acceptable recovery was obtained for the laboratory control sample. December 2018: Matrix spike recoveries for metals and cyanide in water performed by the primary laboratory could not be determined due to high concentrations of the element in the sample. However, Envirolab reported that an acceptable recovery was obtained for the laboratory control sample.

Table C: Intra and Inter Laboratory Duplicate for 2018GMEs

March 2018 results										
Sample Type	Intra-lab duplicate			Inter-lab duplicate			Intra-lab duplicate			Blank
mg/L	**F6**	**DUP1**	**RPD %**	**G5**	**TRIP1**	**RPD %**	**G5**	**DUP2**	**RPD %**	**BLANK**
Fluoride	0.9	1	11	0.2	0.2	0	0.2	0.2	0	<0.1
Total Cyanide	0.024	0.023	4	<0.004	<0.004	NC	<0.004	<0.004	NC	<0.004
Free Cyanide	<0.004	<0.004	NC	<0.004	<0.004	NC	<0.004	<0.004	NC	<0.004
Aluminium	0.16	0.13	20.7	0.19	0.17	11	0.19	0.15	24	<0.1
June 2018 results										
Sample Type	Intra-lab duplicate			Inter-lab duplicate			Intra-lab duplicate			Blank
mg/L	**E5D**	**QA101**	**RPD %**	**W1D**	**QA102**	**RPD %**	**W1D**	**QA103**	**RPD %**	**QC101**

Fluoride	14	14	0	5.1	5.9	15	5.1	5.1	0	<0.1
Total Cyanide	1.6	1.7	6	0.69	0.532	26	0.69	0.72	4	<0.004
Free Cyanide	<0.004	<0.004	NC	<0.004	<0.005	NC	<0.004	<0.004	NC	<0.004
Dissolved Aluminium	<0.01	<0.01	NC	0.14	0.1	33	0.14	0.14	0	<0.01
Total Aluminium	4.1	3.80	7.6	0.88	0.58	41	0.88	0.93	6	<0.01
September 2018 results										
Sample Type	Intra-lab duplicate			Inter-lab duplicate			Intra-lab duplicate			Blank
mg/L	**W3D**	**QA101**	**RPD %**	**G2**	**QA102**	**RPD %**	**G2**	**QA103**	**RPD %**	**QC101**
Fluoride	0.1	0.1	0	0.4	0.4	0	0.4	0.4	0	<0.1
Total Cyanide	<0.004	<0.004	NC	0.006	0.006	0	0.006	0.01	**50**	<0.004
Free Cyanide	<0.004	<0.004	NC	<0.004	<0.004	NC	<0.004	<0.004	NC	<0.004
Dissolved Aluminium	0.91	1	9	<0.01	<0.01	NC	<0.01	<0.01	NC	<0.01
Total Aluminium	0.9	0.95	5.4	0.57	0.49	15	0.57	0.37	**43**	<0.01
December 2018 results										
Sample Type	Intra-lab duplicate			Inter-lab duplicate			Intra-lab duplicate			Blank
mg/L	**E5D**	**QA101**	***RPD %***	**W1D**	**QA103**	***RPD %***	**W1D**	**QA102**	***RPD %***	**QC101**
Fluoride	11	11	*0*	4.8	5.7	*17*	4.8	4.8	*0*	<0.1
Total Cyanide	0.81	0.82	*1*	0.67	0.171	***119***	0.67	0.45	***39***	<0.004
Free Cyanide	<0.004	<0.004	*NC*	<0.004	<0.004	*NC*	<0.004	<0.004	*NC*	<0.004
Dissolved Aluminium	0.03	0.02	***40***	0.25	<0.01	*NC*	0.25	0.21	*17*	<0.01
Total Aluminium	0.72	0.6	*18.2*	0.43	0.76	***55***	0.43	0.51	*17*	<0.01

APPENDIX 3
2013-2018 GME HISTORICAL DATA

Table A: Depth to Water in Shallow Wells (m AHD)

Date	W1S	W2S	E5	PUMP	W7S	W7M	E4	A7	W3S	W4S	E11	W5S	N8	N9	W6S	G5	G6
July 2013	11.89	12.49	12.21	12.49	12.61	12.22	11.93	10.28	9.97	9.52	8.06	9.19	9.18	9.22	7.85	NS	NS
Nov 2013	11.98	12.62	12.05	12.35	12.97	12.14	12.09	10.60	10.31	9.86	7.74	9.27	8.74	9.31	7.65*	NS	NS
Feb 2014	11.37	-	11.80	11.86	-	11.57	10.53	9.81	9.28	-	7.48	-	8.46	8.48*	7.64*	NS	NS
Jun 2014	11.28*	-	-	11.04	12.06*	10.60*	11.51	10.06	9.83	9.51*	7.72	9.05	8.80	9.01	7.65*	NS	NS
Nov 2014	-	-	11.53*	11.30	11.96*	11.09	11.28	9.92	9.55	9.51*	7.76	8.79*	8.73	8.87	7.65*	NS	NS
Feb 2015	11.22	-	-	11.26	-	10.92	11.31	10.02	9.90	-	7.54	8.99	8.65	9.00	7.69	NS	NS
June 2015	11.53	12.06*	11.90	11.95	-	11.94	12.07	10.49	10.29	9.74	8.7	9.32	9.35	9.69	8.12	NS	NS
Sept 2015	11.21	11.80*	11.61	11.70	-	11.61	11.65	10.22	10.05	9.73	8.15	9.29	9.19	9.38	8.01*	NS	NS
Dec 2015	11.32*	-	-	11.65	-	11.52	11.73	10.00	9.64	-	9.89	-	9.09	9.06	7.82	NS	NS
Apr 2016	11.30	-	11.75	11.93	-	11.67	11.44	10.00	9.62	-	7.94	-	9.03	8.83	-	4.59	2.59
Jul 2016	-	-	11.60	11.84	-	11.58	11.39	9.93	9.76	9.72	7.64	9.06	8.61	9.25	-	4.69	2.45
Oct 2016	-	-	-	11.84	-	11.56	11.38	9.86	9.60	-	7.55	-	8.64	-	7.63	4.93	2.45
Dec 2016		-	-	11.66	-	11.39	11.11	9.70	*7.18*	-	7.41	-	8.38	-	-	4.73	*3.21*
Mar 2017	-	-	-	11.54	-	11.28	11.11	9.80	9.70	-	7.40	-	8.22	9.14	-	4.69	2.17
June 2017	-	-	-	11.74	-	11.46	-	9.97	9.90	-	7.56	-	8.56	9.35	-	4.6	2.28
Sep 2017	-	-	-	11.57	-	11.30	11.01	9.67	8.98	-	7.33	-	8.16	8.82	-	4.29	2.04
Dec 2017	-	-	-	11.41	-	11.13	10.81	9.58	-	-	7.20	-	7.75	-	-	4.29	1.86
Mar 2018	-	-	-	11.30	-	11.02	10.83	9.63	9.58	-	7.11	-	7.87	9.02	-	3.99	1.55
June 2018	-	-	-	11.77	-	11.48	11.33	10.00	9.87	-	7.56	-	8.29	9.22	7.59	4.41	1.7
Sep 2018	-	-	-	11.57	-	11.30	11.12	9.82	9.52	-	7.4	-	8.18	8.97	7.6	4.19	1.55
Dec 2018	-	12.14	-	11.52	-	11.27	11.06	9.99	9.90	-	7.46	-	8.28	9.17	-	4.32	1.49

*Well pumped dry during purging, no sample collected; NS Not Sampled

- Well dry

Results in *italics* are considered not reliable

Table B: pH in Shallow Wells

Date	W1S	W2S	E5	PUMP	W7S	W7M	E4	A7	W3S	W4S	E11	W5S	N8	N9	W6S	G5	G6
July 2013	7.22	7.33	9.54	7.45	7.29	9.81	9.91	9.63	8.53	-	9.36	7.37	6.36	9.16	8.87	NS	NS
Nov 2013	7.17	6.82	9.37	7.24	7.1	9.87	9.79	9.47	8.82	9.13	9.36	7.37	6.38	8.9	-	NS	NS
Feb 2014	6.84	-	9.78	9.65	-	10.1	9.94	9.67	7.61	-	9.33	-	6.48	-	-	NS	NS
Jun 2014	6.90	-	-	10.14	-	10.12	9.84	9.66	8.89	-	9.41	7.39	6.53	9.17	8.79	NS	NS
Nov 2014	-	-	-	10.01	-	9.78	9.4	9.24	7.68	-	9.32	-	6.39	8.91	-	NS	NS
Feb 2015	6.66	-	-	9.95	-	9.44	8.84	8.56	6.38	-	8.86	6.55	6.11	8.46	7.27	NS	NS
June 2015	6.83	-	9.14	9.87	-	9.82	9.46	9.45	7.53	9.13	7.97	7.26	6.49	7.22	8.72	NS	NS
Sept 2015	6.86	-	9.42	10.22	-	9.91	9.62	9.8	7.53	9.07	9.23	7.2	6.69	7.34	8.98	NS	NS
Dec 2015	-	-	-	10.27	-	9.7	10.57	10.71	Dry	-	8.65	-	6.74	7.7	8.67	NS	NS
Apr 2016	7.21	-	9.48	10.13	-	9.99	9.73	9.75	7.46	-	9.2	-	6.59	6.61	-	6.36	3.6
Jul 2016	-	-	-	10.22	-	9.95	9.83	9.37	7.02	5.11	9.29	7.29	6.63	8.11	-	6.77	3.82
Oct 2016	-	-	-	9.98	-	10.17	9.94	9.57	7.01	-	9.41	-	6.92	8.54	-	6.72	4.04
Dec 2016	-	-	-	9.72	-	9.68	9.53	9.15	6.4	-	9.1	-	6.4	-	-	5.88	3.79
Mar 2017	-	-	-	9.56	-	9.61	9.53	9.12	7.4	-	8.7	-	6.54	8.61	-	5.73	3.66
June 2017	-	-	-	9.2	-	10.1	-	9.49	7.66	-	9.07	7.79	6.78	9.32	-	5.96	4.55
Sep 2017	-	-	-	9.9	-	9.8	9.59	2.65	7	-	3.51	-	6.76	-	-	6.15	4.21
Dec 2017	-	-	-	9.6	-	9.6	9.46	9.27	6.99	-	8.83	-	6.67	8.6	-	5.77	3.86
Mar 2018	-	-	-	9.73	-	9.61	9.32	8.96	7.19	-	8.62	-	6.45	8.65	-	5.8	3.66
June 2018	-	-	-	9.17	-	9.7	9.62	9.36	6.91	8.26	9.02	-	6.71	8.72	-	6.23	3.6
Sep 2018	-	-	-	13.68	-	13.24	9.29	9.75	7.14	-	10.45	-	10.53	12.9	-	7.63	3.88
Dec 2018	-	7.47	-	9.55	-	9.63	9.27	9.06	6.8	-	7.7	-	6.51	8.72	-	5.64	3.81

- Well dry; NS Not Sampled

Table C: Soluble Fluoride Concentrations in Shallow Wells (mg/L)

Date	W1S	W2S	E5	PUMP	W7S	W7M	E4	A7	W3S	W4S	E11	W5S	N8	N9	W6S	G5	G6
July 2013	53	115	495	79	34	878	699	436	237	-	102	35	0.27	85	195	NS	NS
Nov 2013	69	58	410	51	31	650	650	420	310	480	160	61	0.17	200	-	NS	NS
Feb 2014	42	-	450	280	-	730	650	410	210	-	190	-	0.26	-	-	NS	NS
Jun 2014	-	-	-	550	-	-	590	380	270	-	160	100	0.27	170	-	NS	NS
Nov 2014	-	-	-	930	-	910	380	410	210	-	150	-	0.29	210	-	NS	NS
Feb 2015	66	-	-	740	-	840	340	550	250	-	230	93	0.35	210	200	NS	NS
June 2015	120	-	410	200	-	810	260	500	230	490	7.4	88	0.90	24	180	NS	NS
Sept 2015	38	-	350	680	-	670	280	400	200	400	110	70	0.30	25	-	NS	NS
Dec 2015	-	-	-	360	-	540	300	320	160	-	96	-	0.40	9	180	NS	NS
Apr 2016	39	-	330	570	-	640	330	330	190	-	120	-	<10	-	-	<10	<10
Jul 2016	-	-	-	280	-	870	570	320	170	-	120	62	0.4	140	-	0.4	<0.1
Oct 2016	-	-	-	85	-	1100	550	360	150	-	130	-	0.6	-	-	<0.1	<0.1
Dec 2016	-	-	-	88	-	1000	450	380	130	-	200	-	0.4	-	-	0.3	<0.1
Mar 2017	-	-	-	210	-	220	670	500	180	-	230	-	1	200	-	0.6	<0.1
June 2017	-	-	-	60	-	750	-	400	62	-	99	50	0.4	160	-	0.3	0.4
Sep 2017	-	-	-	180	-	760	380	390	99	-	130	-	0.4	150	-	0.3	0.4
Dec 2017	-	-	-	160	-	780	380	400	-	-	110	-	0.4	-	-	0.3	0.5
Mar 2018	-	-	-	220	-	770	410	190	180	-	120	-	0.4	200	-	0.2	0.4
June 2018	-	-	-	62	-	810	350	390	120	160	120	-	0.5	140	-	0.4	0.4
Sep 2018	-	-	-	N/A	-	860	380	450	96	-	130	-	0.4	170	-	1.3	0.4
Dec 2018	Dry	92	Dry	250	Dry	820	410	410	100	Dry	49	Dry	0.4	160	Dry	0.2	0.7

- Well dry; NS Not Sampled

Table D: Total Cyanide Concentrations in Shallow Wells (mg/L)

Date	W1S	W2S	E5	PUMP	W7S	W7M	E4	A7	W3S	W4S	E11	W5S	N8	N9	W6S	G5	G6
July 2013	1.7	0.41	42	17.1	0.096	63	130	96	34	-	17	1.7	4	4.5	19	NS	NS
Nov 2013	0.98	0.49	43	0.76	0.45	78	140	88	38	41	17	1.7	0.34	12	-	NS	NS
Feb 2014	0.87	-	43	6.2	-	86	130	90	36	-	21	-	0.44	-	-	NS	NS
Jun 2014	-	-	-	-	37	-	160	89	53	-	32	2	0.54	13	-	NS	NS
Nov 2014	-	-	-	120	-	200	65	110	41	-	17	-	0.53	21	-	NS	NS
Feb 2015	15	-	-	58	-	130	41	78	25	-	7.7	9.3	6.6	13	12	NS	NS
June 2015	1.1	-	69	9.3	-	180	25	100	24	330	0.49	2.3	0.69	1.2	14	NS	NS
Sept 2015	-	-	-	110	-	100	99	66	28	34	9.4	3	0.6	0.95	-	NS	NS
Dec 2015	-	-	-	48	-	83	35	62	19	7.4	-	0.63	1.2	-	19	NS	NS
Apr 2016	1.5	-	-	140	-	140	45	38	20	-	15	-	<0.004	-	-	<0.004	<0.004
Jul 2016	-	-	-	38	-	250	160	63	21	-	16	3.5	0.75	18	-	<0.004	<0.004
Oct 2016	-	-	-	4.7	-	200	95	73	12	-	9.9	-	0.47	-	-	<0.04	<0.04
Dec 2016	-	-	-	4.3	-	250	69	85	17	-	31	-	0.5	-	-	<0.04	<0.04
Mar 2017	-	-	-	15	-	180	63	70	18	-	17	-	0.81	14	-	<0.04	<0.04
June 2017	-	-	-	2.6	-	73	-	39	14	-	5.2	5.3	<0.04	6.2	-	<0.04	<0.04
Sep 2017	-	-	-	7.7	-	110	45	72	13	-	9.6	-	0.41	5.9	-	<0.004	<0.004
Dec 2017	-	-	-	11	-	140	63	56	-	-	9.7	-	0.45	35	-	<0.004	<0.004
Mar 2018	-	-	-	20	-	140	61	15	20	-	7.4	-	0.54	15	-	<0.004	<0.004
June 2018	-	-	-	4.1	-	190	69	87	24	12	10	-	0.67	6.7	-	<0.004	<0.004
Sep 2018	-	-	-	44	-	160	41	80	14	-	8	-	0.56	7.2	-	0.01	<0.004
Dec 2018	-	3.9	-	14	-	130	48	54	15	-	0.65	-	0.6	7.4	-	<0.004	<0.004

- Well dry; NS Not Sampled

Table E: Free Cyanide Concentrations in Shallow Wells (mg/L)

Date	W1S	W2S	E5	PUMP	W7S	W7M	E4	A7	W3S	W4S	E11	W5S	N8	N9	W6S	G5	G6
July 2013	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nov 2013	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Feb 2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Jun 2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nov 2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Feb 2015	0.004	-	-	0.021	-	0.02	<0.004	11	<0.004	-	0.005	<0.004	<0.004	<0.004	0.019	NS	NS
June 2015	<4	-	<0.8	<0.08	-	<2	<0.4	<2	<0.4	<4	<0.004	<4	<0.4	<0.4	<0.4	NS	NS
Sept 2015	-	-	-	0.029	-	<0.4	<0.04	<0.020	<0.02	<40	<0.004	<0.02	<0.02	<0.02	Dry	NS	NS
Dec 2015	-	-	-	0.1	-	0.21	0.032	0.19	0.023	-	0.033	-	0.005	<0.004	0.058	NS	NS
Apr 2016	-	-	-	0.01	-	0.013	0.004	<0.004	0.007	-	<0.004	-	<0.004	-	-	<0.004	<0.004
Jul 2016	-	-	-	0.018	-	0.072	0.049	0.026	0.005	-	0.009	-	0.004	<0.004	-	0.006	<0.004
Oct 2016	-	-	-	<0.004	-	Dry	0.045	0.032	0.014	-	0.016	-	<0.004	-	-	<0.004	<0.004
Dec 2016	-	-	-	0.006	-	0.007	<0.004	<0.004	<0.004	-	0.004	-	<0.004	-	-	<0.004	<0.004
Mar 2017	-	-	-	0.006	-	0.09	0.029	0.039	0.007	-	0.015	-	0.006	<0.004	-	<0.004	<0.004
June 2017	-	-	-	<0.004	-	0.007	-	<0.004	<0.004	-	<0.004	<0.004	<0.004	<0.004	-	<0.004	<0.004
Sep 2017	-	-	-	<0.005	-	0.005	0.008	<0.005	<0.005	-	<0.005	-	<0.005	<0.005	-	<0.004	<0.004
Dec 2017	-	-	-	0.009	-	0.006	<0.004	<0.004	-	-	<0.004	-	<0.004	<0.004	-	<0.004	<0.004
Mar 2018	-	-	-	<0.004	-	<0.004	<0.004	<0.004	<0.004	-	<0.004	-	<0.004	<0.004	-	<0.004	<0.004
June 2018	-	-	-	<0.004	-	0.008	<0.004	0.007	0.007	<0.004	<0.004	-	<0.004	0.004	-	<0.004	<0.004
Sep 2018	-	-	-	0.01	-	0.017	<0.004	0.009	0.004	-	<0.004	-	<0.004	<0.004	-	<0.004	<0.004
Dec 2018	-	0.01	-	0.009	-	0.007	0.006	<0.004	0.008	-	<0.004	-	<0.004	<0.004	-	<0.004	<0.004

- Well dry; NS Not Sampled; NA Not analysed

Table F: Total Aluminium Concentrations in Shallow Wells (mg/L)

Date	W1S	W2S	E5	PUMP	W7S	W7M	E4	A7	W3S	W4S	E11	W5S	N8	N9	W6S	G5	G6
July 2013	121	91.5	0.33	58.1	415	11.4	0.379	0.208	11.7	-	23	13	0.102	14.7	60.1	NS	NS
Nov 2013	130	33	0.52	60	42	2.3	0.89	4.7	2.6	3.6	23	13	12	62	-	NS	NS
Feb 2014	27	-	2.5	17	-	45	0.4	0.7	7.1	-	4	-	0.11	-	-	NS	NS
Jun 2014	-	-	-	-	210	-	3.2	0.26	9.2	-	7.8	15	0.3	9	-	NS	NS
Nov 2014	-	-	-	310	-	21	35	0.71	5.3	-	3.6	-	91	130	-	NS	NS
Feb 2015	120	-	-	370	-	0.99	46	1.7	34	-	5	22	1.8	8	3.5	NS	NS
June 2015	1200	-	3	120	-	32	49	2.7	4.4	2.3	2.5	7	29	14	7.7	NS	NS
Sept 2015	-	-	-	610	-	8.7	53	0.61	24	13	11	31	5.3	22	-	NS	NS
Dec 2015	-	-	-	97	-	7.8	18	0.72	92	-	2.7	-	3.4	0.89	22	NS	NS
Apr 2016	15	-	-	280	-	4.4	14	14	15	-	7.6	-	34	-	-	1.8	28
Jul 2016	-	-	-	93	-	0.08	9.9	2.9	6.9	-	23	10	0.47	5.5	-	24	0.78
Oct 2016	-	-	-	90	-	6.2	2.6	2.1	21	-	22	-	1.6	-	-	0.14	0.13
Dec 2016	-	-	-	120	-	11	36	3	90	-	15	-	1	-	-	0.17	29
Mar 2017	-	-	-	740	-	3.4	12	25	48	-	89	-	34	-	-	6.2	25
June 2017	-	-	-	39	-	1.3	-	3.7	15	-	5.6	6.2	3.9	1.6	-	3.6	23
Sep 2017	-	-	-	160	-	1.2	32	5.9	110	-	120	-	25	-	-	4.9	21
Dec 2017	-	-	-	45	-	3.6	37	4.1	-	-	49	-	4	-	-	0.26	27
Mar 2018	-	-	-	82	-	10	37	8.9	80	-	4.4	-	5.1	0.54	-	0.19	27
June 2018	-	-	-	46	-	0.76	13	24	16	71	4.9	-	4.3	17	-	0.9	25
Sep 2018	-	-	-	23	-	6.6	22	4.4	23	-	9.3	-	0.22	0.95	-	0.04	23
Dec 2018	-	37	-	5.4	-	0.31	1.7	1	21	-	6.4	-	0.35	0.28	-	0.21	25

- Well dry; NS Not Sampled

Table G: Depth to Water in Deep Wells (m AHD)

Date	W1D	W2D	E5D	W3D	W4D	W5D	N2	G2	W6D	F5	F6
July 2013	10.85	12.19	11.69	5.61	5.54	5.39	4.99	5.63	5.13	NS	NS
Nov 2013	10.91	12.31	11.63	-	5.46	5.32	4.86	6.50	5.11	NS	NS
Feb 2014	9.33	11.79	11.56	-	5.44	5.30	4.79	6.55	5.19	NS	NS
Jun 2014	8.70	11.46	11.61	5.53	5.46	5.36	4.90	6.55	5.20	NS	NS
Nov 2014	9.11	11.18	11.56	5.46	5.37	5.32	4.96	6.49	5.12	NS	NS
Feb 2015	-	10.46	11.61	5.50	5.94	5.31	5.92	6.48	5.09	NS	NS
June 2015	8.51	11.96	11.57	5.59	-	5.45	5.08	6.62	5.30	NS	NS
Sept 2015	8.02	11.68	11.52	5.68	-	5.52	5.12	6.68	5.40	NS	NS
Dec 2015	8.58	11.57	11.72	-	-	5.30	5.15	5.71	5.39	NS	NS
Apr 2016	9.41	11.75	11.65	-	-	5.47	5.12	6.71	5.37	4.95	2.84
Jul 2016	8.75	11.60	11.99	-	-	5.38	5.99	6.55	5.16	4.86	2.68
Oct 2016	-	11.66	11.42	-	-	5.31	5.05	6.55	5.17	4.93	2.75
Dec 2016	8.72	11.48	11.46	-	-	5.34	4.97	6.50	5.13	4.73	2.62
Mar 2017	8.56	11.30	11.28	-	-	5.19	4.79	6.35	4.96	4.67	2.46
June 2017	8.37	11.52	11.23	-	-	5.17	4.78	6.34	4.95	4.76	2.53
Sep 2017	7.87	11.30	11.19	-	-	5.14	5.70	6.34	4.95	4.46	2.28
Dec 2017	7.88	10.81	4.98	5.16	-	4.98	4.52	6.14	4.74	4.30	1.90
Mar 2018	7.80	10.93	11.20	5.02	-	4.83	4.32	6.04	4.59	3.82	1.78
June 2018	8.69	11.58	11.29	5.01	-	5.27	4.36	6.03	4.61	4.41	1.93
Sep 2018	8.51	11.37	11.23	4.92	-	4.72	4.22	5.99	4.51	4.19	1.82
Dec 2018	8.57	11.33	11.67	4.94	-	4.75	4.24	5.96	4.56	4.16	1.77

- Well dry at time of sampling

Table H: pH in Deep Wells

Date	W1D	W2D	E5D	W3D	W4D	W5D	N2	G2	W6D	F5	F6
July 2013	6.98	10.09	7.22	5.91	6.02	6.02	3.26	6.04	6.49	NS	NS
Nov 2013	6.62	9.9	7.29	-	5.7	6.32	6.54	6.09	6.11	NS	NS
Feb 2014	6.7	10.13	7.53	-	5.7	6.1	4.01	6.09	5.75	NS	NS
Jun 2014	6.71	10.10	7.44	4.38	5.4	6.11	3.94	6.1	5.83	NS	NS
Nov 2014	6.63	9.94	8.32	3.56	5.36	6.11	3.54	6.03	5.54	NS	NS
Feb 2015	-	9.99	6.8	3.29	4.69	5.34	3.34	5.7	8.22	NS	NS
June 2015	6.82	10.11	7.23	4.89	-	-	6.61	6.01	5.84	NS	NS
Sept 2015	6.79	10.27	7.23	3.62	5.18	6.32	5.81	6.04	5.81	NS	NS
Dec 2015	*8.48*	10.34	7.18	-	*9.9*	*8.37*	*8.09*	7.84	5.5	NS	NS
Apr 2016	6.73	10.42	7.1	-	6.08	6.4	6.75	6.11	5.79	7.38	6.99
Jul 2016	6.82	10.29	7.27	-	-	5.7	6.37	6.09	5.58	5.58	6.67
Oct 2016	7.02	10.40	7.42	-	3.89	6.52	5.33	6.32	6.17	5.19	7.06
Dec 2016	6.78	10.02	7	-	-	6.37	4.67	6.22	5.96	4.46	6.56
Mar 2017	6.67	10.07	7.08	-	-	6.21	4.59	5.71	5.88	4.11	6.29
June 2017	7.3	9.37	7.97	-	-	6.94	5.37	6.08	6.19	5.08	7.08
Sep 2017	6.95	10.08	7.16	-	-	6.93	3.98	6.16	5.9	4.21	6.75
Dec 2017	6.78	10.1	7	4.72	-	6.13	4.31	6.19	5.9	4.57	6.68
Mar 2018	6.91	10.14	6.97	4.16	-	6.5	3.63	6.05	5.65	4.3	6.88
June 2018	7.07	10.18	7.29	3.75	-	6.1	4.41	6.05	5.7	4.46	6.67
Sep 2018	7.12	13.74	12.79	3.94	-	10.2	2.8	6.42	10.47	4.35	7.85
Dec 2018	6.76	9.87	6.95	4.53	-	6.72	4.18	6.53	6.65	5.02	6.66

-Well dry at time of sampling;

NS Not Sampled

Italics Unreliable data from December 2015 sampling event

Table I: Soluble Fluoride in Deep Wells (mg/L)

Date	W1D	W2D	E5D	W3D	W4D	W5D	N2	G2	W6D	F5	F6
July 2013	39	682	1.21	1.23	1.48	20	0.43	0.28	1.19	NS	NS
Nov 2013	5.4	790	40	-	1.7	0.51	6.2	0.28	0.25	NS	NS
Feb 2014	3.5	880	44	-	1.3	0.59	1.9	0.25	0.21	NS	NS
Jun 2014	5.1	930	23	0.19	0.41	0.65	1.4	0.28	0.4	NS	NS
Nov 2014	3.3	1080	12	0.41	1.6	0.53	0.74	0.28	0.19	NS	NS
Feb 2015	-	1279	18	0.22	1.1	0.44	0.49	0.28	0.3	NS	NS
June 2015	4.4	1300	16	0.3	-	Dry	8.1	0.3	0.1	NS	NS
Sept 2015	3.5	1300	14	0.3	0.2	0.4	1.4	0.3	0.1	NS	NS
Dec 2015	2.6	1300	16	-	-	0.5	1.4	0.3	Dry	NS	NS
Apr 2016	<10	1300	19	-	-	<10	15	<10	<10	<10	<10
Jul 2016	3.1	1400	18	-	-	0.5	8.6	0.3	0.2	<0.1	0.6
Oct 2016	3.3	1500	15	-	<0.1	0.5	1.3	0.3	0.1	<0.1	0.5
Dec 2016	3.4	1400	16	-	-	0.5	0.8	0.3	0.1	<0.1	0.5
Mar 2017	3.9	1700	22	-	-	0.4	0.5	0.4	1.4	<0.1	0.5
June 2017	4.4	1300	19	-	-	0.6	1	0.2	0.3	0.2	0.5
Sep 2017	4.8	1300	14	-	-	0.5	2.1	0.3	0.1	0.2	0.5
Dec 2017	4.2	1200	14	0.3	-	0.4	2.4	0.4	0.2	0.2	0.6
Mar 2018	4.7	1200	16	0.3	-	0.5	2.1	0.3	0.3	0.2	0.9
June 2018	5.1	1200	14	0.5	-	0.4	1.5	0.3	<0.1	0.2	0.5
Sep 2018	4.5	1200	12	0.1	-	0.6	1.3	0.4	0.2	0.2	1
Dec 2018	4.8	1200	11	0.1	-	0.6	1.4	0.3	0.2	0.2	0.6

-Well dry at time of sampling; NS Not Sampled

Table J: Total Cyanide in Deep Wells (mg/L)

Date	W1D	W2D	E5D	W3D	W4D	W5D	N2	G2	W6D	F5	F6
July 2013	1.3	170	4.4	0.038	0.16	0.025	<0.004	<0.004	0.013	NS	NS
Nov 2013	0.67	160	14	-	0.13	0.039	0.077	0.028	0.016	NS	NS
Feb 2014	0.54	170	17	-	0.011	0.069	0.005	<0.004	0.01	NS	NS
Jun 2014	0.57	240	8.8	0.005	<0.004	0.016	0.004	<0.004	0.017	NS	NS
Nov 2014	1.3	260	4.4	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	NS	NS
Feb 2015	1.3	200	6.8	0.08	0.007	0.005	0.009	<0.004	0.008	NS	NS
June 2015	0.77	270	2.9	0.013	-	-	0.021	<0.004	<0.004	NS	NS
Sept 2015	0.77	290	1.2	0.008	-	0.005	0.05	<0.004	<0.004	NS	NS
Dec 2015	0.71	290	3	-	-	0.008	0.032	<0.004	-	NS	NS
Apr 2016	0.61	360	1.9	-	-	0.033	0.97	0.046	0.007	<0.004	<0.004
Jul 2016	0.76	290	1.6	-	-	0.007	0.91	<0.004	<0.004	<0.004	<0.004
Oct 2016	0.53	220	0.94	-	-	0.005	0.047	<0.004	0.009	0.021	<0.004
Dec 2016	0.73	360	1.2	-	-	0.009	0.12	<0.004	0.005	<0.004	<0.004
Mar 2017	0.77	330	5.5	-	-	<0.004	0.029	<0.004	0.043	<0.004	<0.004
June 2017	0.23	330	1.6	-	-	0.018	0.02	<0.004	<0.004	<0.004	<0.004
Sep 2017	17	300	2.1	-	-	<0.004	0.043	<0.004	<0.004	<0.004	<0.004
Dec 2017	0.21	200	0.7	<0.004	-	<0.004	0.054	<0.004	<0.004	<0.004	<0.004
Mar 2018	0.34	300	0.6	<0.004	-	<0.004	0.054	<0.004	0.01	<0.004	0.024
June 2018	0.69	330	1.6	0.036	-	0.004	0.013	0.005	0.005	0.013	<0.004
Sep 2018	0.59	280	1.2	<0.004	-	0.01	0.01	0.006	0.006	<0.004	0.032
Dec 2018	0.67	330	0.81	<0.004	-	<0.004	0.005	<0.004	<0.004	<0.004	0.005

- Well dry at time of sampling; NS Not Sampled

Table K: Free Cyanide in Deep Wells (mg/L)

Date	W1D	W2D	E5D	W3D	W4D	W5D	N2	G2	W6D	F5	F6
July 2013	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS	NS
Nov 2013	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS	NS
Feb 2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS	NS
Jun 2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS	NS
Nov 2014	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS	NS
Feb 2015	-	0.03	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	NS	NS
June 2015	<0.2	<4	<0.4	<0.004	-	-	<0.004	<0.004	-	NS	NS
Sept 2015	<0.02	0.058	<0.02	<0.004	-	<0.004	<0.004	<0.02	<0.004	NS	NS
Dec 2015	-	0.88	<0.004	-	-	<0.004	<0.004	<0.004	<0.004	NS	NS
Apr 2016	<0.004	0.21	<0.004	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Jul 2016	<0.004	0.11	<0.004	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Oct 2016	<0.004	0.11	<0.004	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Dec 2016	<0.004	0.12	<0.004	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mar 2017	<0.004	0.15	<0.004	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
June 2017	<0.004	0.012	<0.004	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Sep 2017	<0.005	0.01	<0.004	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Dec 2017	<0.004	0.006	<0.004	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mar 2018	<0.004	<0.004	<0.004	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
June 2018	<0.004	0.007	<0.004	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Sep 2018	<0.004	0.029	<0.004	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Dec 2018	<0.004	0.009	<0.004	<0.004	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004

-Well dry at time of sampling; NS Not Sampled; NA Not analysed

Table L: Total Aluminium in Deep Wells (mg/L)

Date	W1D	W2D	E5D	W3D	W4D	W5D	N2	G2	W6D	F5	F6
July 2013	21.2	2.86	1.697	0.7	0.794	0.323	5.771	0.115	1.087	NS	NS
Nov 2013	0.9	0.6	1.5	-	0.48	0.04	3	0.1	0.06	NS	NS
Feb 2014	2.4	0.67	110	-	0.19	0.02	4.6	0.04	0.04	NS	NS
Jun 2014	2.4	1.4	2.2	0.58	0.27	0.02	4.5	1.2	1.2	NS	NS
Nov 2014	0.26	44	3.3	0.72	0.5	0.05	6.7	2.1	0.5	NS	NS
Feb 2015	0.26	0.03	3.4	0.76	0.35	0.16	28	2.9	0.12	NS	NS
June 2015	4	0.19	2.1	0.81	-	Dry	3.4	2	0.19	NS	NS
Sept 2015	0.95	0.03	2.1	0.04	-	0.99	2.4	4.1	0.74	NS	NS
Dec 2015	0.4	3.5	4.3	-	-	0.54	9.1	1.8	-	NS	NS
Apr 2016	1.5	0.06	3.6	-	-	0.39	24	9.6	0.08	2.2	0.57
Jul 2016	0.66	0.09	2.7	-	-	0.23	3.2	1.2	0.08	2.1	0.7
Oct 2016	0.87	0.92	1.9	-	-	0.14	3.7	1.6	0.17	0.89	0.15
Dec 2016	18	31	4.2	-	-	0.05	5.9	1.2	-	2.3	0.12
Mar 2017	89	1	64	-	-	0.01	23	1.2	1.1	2.3	0.33
June 2017	120	0.08	2.8	-	-	0.05	10	6.6	0.09	4.6	0.08
Sep 2017	4.1	1.6	5	-	-	0.02	23	1.8	25	2.9	0.11
Dec 2017	1.4	0.28	2.2	1.4	-	0.2	5.7	1.7	2.7	3.2	7.6
Mar 2018	0.46	1.1	3.4	1.2	-	0.03	5.2	0.5	0.47	3	0.16
June 2018	0.88	0.71	4.1	1.5	-	0.16	6.9	2.4	19	2.2	0.06
Sep 2018	0.38	0.39	2.2	0.9	-	0.09	4.7	0.57	0.96	2.1	0.03
Dec 2018	0.43	1	0.72	1	-	0.04	5	1.5	2.4	2	0.05

-Well dry at time of sampling; NS Not Sampled

APPENDIX 4
FIELD PARAMETER FORMS

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: W2S**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 2.40	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
	DRY						

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: W2D**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 3.10	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 6.39	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX mV	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
10.14	22	0.83	-387	38.4	91.6	1	
10.14	22	0.64	-388	38.4	67.9	2	reddish tea
10.14	22	0.61	-387	37.9	68.6	3	brown

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** PUMP
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements

Depth to water: (from top of casing) m 3.0	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 3.51	

Well Purging

Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
9.73	22.4	0.29	-317	6.05		1	
9.73	22.4	0.28	-316	6.04	Over	2	Brown,
9.73	22.4	0.20	-315	6.04	range	3	turbid

Sampling

Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments

Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** WFS
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 2.33	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
	DRY						

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** WTM
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 3.30	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 3.73	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX mV	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
9.61	22.9	0.92	-218	20.79	112.2	1	
9.61	22.9	0.54	-225	20.79	111.6	2	Tea brown
9.65	22.9	0.50		20.8	111.6	3	
Samples collected were half filled. Will return tomorrow to complete sampling							

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** ES
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 2.60	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
		DRY					

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** E5D
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements

Depth to water: (from top of casing) m 2.98	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): ~~11.88~~ 5.44m	

Well Purging

Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
6.98	24.7	1.24	-145	14.57 mS	39.8	1	Light yellow
6.97	24.7	1.08	-145	14.64	39.5	2	
6.97	24.7	1.05	-145	14.68	38.9	3	

Sampling

Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments

Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** G2
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 8.30	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 13.51	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
6.06	24.2	1.07	-29	5.3	220	1	
6.05	24.1	1.07	-28	5.3	219	2	Faint
6.05	24.0	1.06	-29	5.3	219	3	yellow

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: N9**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 2.51	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 2.80	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
8.65	24.7	0.44	-279	10.87	62.9	1	
8.65	24.7	0.45	-279	10.88	63.0	2	Tea
8.65	24.7	0.45	-279	10.89	62.9	3	brown
	Well purged dry will return Tomorrow for sampling.						
	Collected sample on the 14/3 @ 9.34 am.						

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: WGD**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 5.70	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 8.77	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC µS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
5.64	24.5	3.06	-20	1163	76.3	1	
5.65	24.5	3.30	-21	1173	76.4	2	Colourless
5.65	24.5	3.30	-20	1175	76.5	3	with Particles

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** WG5
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 3.09	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 3.10	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
		DRY					

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: N8**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 4.28	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 5.4	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
6.46	27.7	0.39	-109	8.29	226	1	
6.45	27.7	0.35	-108	8.33	226	2	Brown
6.44	27.7	0.35	-108	8.33	226	3	

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** E11
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 3.73	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 5	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
8.62	24.6	0.67	-210	8.95	1264	1	
8.62	24.6	0.66	-208	8.97	1263	2	~~Faint~~
8.62	24.6	0.67	-208	8.99	1264	3	Yellow

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** N2
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 4.53	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 5.65	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC ms	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
3.79		1.30	88	6.18	32.7	1	
3.78		1.30	89	6.19	32.7	2	Colourless
3.63		1.30	88	6.19	33	3	With
3.63		1.31	88.1	6.18	33	4	particles

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** FG
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 14.9	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 15.70	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
6.88	23.8	0.87	84	8.21	3.3	1	
6.88	23.8	0.90	84	8.23	3.0	2	Colourless,
6.88	23.8	0.90	84	8.22	3.0	3	clear

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? (Y) / N Duplicate Number: DUP1
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 13/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** G6
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 5.0	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 7.22.	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
3.66	23.3	1.2	-9	8.19	12.4	1	
3.65	23.3	1.19	-10	8.19	12.9	2	Colourless with particles
3.66	23.3	1.16	-9	8.20	12.8	3	
	Rusted particles fell into the well.						

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** W55
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 1.62	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
		DRY					
has always been dry							

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: W5D**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 5.74	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 9.60m,	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX mV	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
6.55	21.6	4.54	64	4.84	12.9	1	
6.50	21.6	4.52	64	4.85	13.0	2	Clear
6.50	21.6	4.52	64	4.84	13.0	3	water
							with few
							particles

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** G5
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 3.60	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 11.55	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
5.85	20.4	0.88	-47	6.05	4.0	1	Colourless with few particles
5.80	20.4	0.88	-47	6.05	4.0	2	
5.80	20.4	0.88	-47	6.05	4.0	3	

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? (Y) / N Duplicate Number: DUP2
Triplicate Taken? (Y) / N Triplicate Number: TRIP1
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: F5**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 3.51	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 7.35	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC ms	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
4.36	20.8	0.88	-66	8.68	139.9	1	Colourless
4.3	20.8	0.74	-66	8.68	139.9	2	With
4.3	20.8	0.74	-66	8.68	139.8	3	Particles

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: A7**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 2.69	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 4.29	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
8.96	22.6	0.24	-347	5.51	63.2	1	
8.96	22.6	0.23	-349	5.52	63.2	2	Tea brown
8.96	22.6	0.23	-347	5.51	63.2	3	

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** W3D
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 6.27m	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 10.13	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX mV	EC uS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
4.17	25	1.12	77	2178	6.6	1	
4.16	25	1.11	78	2184	6.5	2	Slightly
4.16	25	1.12	77	2184	6.6	3	turbid colourless ~~not~~

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 11/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** W35
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 1.47m	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 2.55	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°c)	D.O.	REDOX	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
7.2	30.6	2.14	192	6.19	12.5	1	murky brown
7.19	30.6	2.13	192	6.18	11.5	2	
7.19	30.6	2.13	192	6.18	11.5	3	

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: MW45**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 1.09	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 1.10	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
	DRY						

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 17/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** ~~DUP~~ MW5
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 2.41	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
	DRY						

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** WID
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m 5.31	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 10.38	

Well Purging	
Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
6.91	32.8	1.02	-94	9.0	7.5	1	
6.91	32.8	1.03	-94	9.0	7.5	2	Light
6.91	32.8	1.02	-94	9.0	7.5	3	brown
				9.0			
				9.0			
				9.0			

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number: E4**
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements

Depth to water: (from top of casing) m 2.98	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC): 3.39	

Well Purging

Purge Method:	
Volume in Casing: L	Purge Volume: 3L
Start Purge:	End Purge:

pH	TEMP (°C)	D.O.	REDOX	EC mS	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
9.32	25	0.17	-314	13.89	21	1	
9.32	25	0.17	-314	14.02	21	2	Brown
9.32	25	0.17	-314	14.03	21	3	

Sampling

Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments

Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date: 14/03/18**
Project: Quarterly Groundwater Monitoring	**Sample Number:** Blank
Location: Hydro	**Sampler: Nwakamma Ahubelem**

Field Measurements	
Depth to water: (from top of casing) m	Measurement device: Dip Meter
Stickup:	Measurement Device:
Well Depth (from TOC):	

Well Purging							
Purge Method:							
Volume in Casing: L				Purge Volume: 3L			
Start Purge:				End Purge:			
pH	TEMP (°C)	D.O.	REDOX	EC	Turbidity	LITRES REMOVED	Comments (colour, odour, etc)
		Blank					
			Sample				

Sampling			
Sampling Method:			
Type: Well / River / Surface water / Blank			
Start Sampling:		Finish Sampling:	
Sample Appearance, eg colour, sediment:			
Pre-Sampling:	pH:	Spec.Cond:	Temp:
Pre-Sampling:	pH:	Spec.Cond:	Temp:

Miscellaneous Field Comments
Well Head Integrity:
Field Filtered ? Y / N Ease of filtering?
Weather Condition:
Duplicate Taken? Y / N Duplicate Number:
Triplicate Taken? Y / N Triplicate Number:
QA/QC Taken? Y / N QA/QC Number:

RAMBOLL ENVIRON

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 28/6/17
Project: GW Monitoring	**Well Number:** 2182 A7
Location: Hydro	**Sampler(s):** NG

Field Measurements			
Organic vapours in well:	ppm	Measurement device:	
Depth to Groundwater:	2.32 m	Measurement Device:	
Correction:	m		
Groundwater Elevation :	m		
Depth to Immiscible Layer:	m	Measurement Device:	
Thickness to Immiscible Layer:	m		
Well Depth:	4.30 m		
Thickness to Groundwater Column:	m		

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
11:59	19.38	17077	9.39	5.16	-278.7	15485	dark brown/orange very
12:00	18.88	17973	9.37	0.12	-359.9	11786	strong H2S odour
12:01	18.26	18282	9.36	-0.01	-398.2	11879	"
12:02	18.12	18289	9.36	-0.01	-398.8	11882	"
12:03	18.12	18286	9.36	-0.01	-396.3	11889	"

Miscellaneous Field Comments

Well Head Integrity:	2.36
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	Aluminium
Weather Condition:	sunny
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	28/6/18
Project:	GW Monitoring	**Well Number:**	W3D
Location:	Hy NO	**Sampler(s):**	NG

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	6.28	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	10.20	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: | End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
12 35	19.17	2548	4 12	1 40	361	1656	clear some odour
12.36	19 10	2557	4 09	1 13	366	1663	"
12.37	19 04	2567	3.99	0.96	383	1668	"
12.38	19 01	2580	3 75	1 01	397	1677	"

Miscellaneous Field Comments

Well Head Integrity:	6 58
Duplicate:	
Triplicate:	
Rinsate:	N/A
Samples Filtered	
Weather Condition:	Sunny
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	28/6/18
Project:	GW Monitoring	**Well Number:**	W35
Location:	Hydro	**Sampler(s):**	NC

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	1.48	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	2.53	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
12.18	17.99	7741	6.88	1.70	-96	5031	brown, turbid
12.20	17.36	7816	6.86	0.80	232	5088	"
12.21	17.32	7739	6.86	0.45	260	5030	"
2.22	16.74	7753	6.87	0.42	272	5007	"
12.23	16.61	7714	6.91	0.42	288	5006	"

Miscellaneous Field Comments

Well Head Integrity:	1.68
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	N/A
Weather Condition:	Sunny
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3R000375	**Date:** 28/6/18
Project: GW Monitoring	**Well Number:** F5
Location: Hydro	**Sampler(s):** NS

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	3.22	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	7.36	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: 11:26. End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
11:28	17.54	9950	4.63	1.83	321	6501	H2S
11:29	17.56	10030	4.48	1.51	322	6524	"
11:30	17.63	10067	4.47	1.00	328	6542	"
11:31	17.82	10042	4.46	0.60	342	6522	"
11:32	17.85	10040	4.46	0.54	347	6528	"
11:33	17.89	10030	4.46	0.50	349	6518	"

Miscellaneous Field Comments	
Well Head Integrity:	3.51
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	
Weather Condition:	Sunny.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3[illegible]375	**Date:** 27/6/18.
Project: GW Monitoring	**Well Number:** W65
Location: Hydro.	**Sampler(s):** NG.

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater: 3.10	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 3.11	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
	DRY						
28/6/18							
W45							
DTW	-	0.87					
DTB							

Miscellaneous Field Comments

Well Head Integrity:

Duplicate:

Triplicate:

Rinsate:

Samples Filtered

Weather Condition:

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	28/6/18
Project:	GW Monitoring	**Well Number:**	W45
Location:	Hydro	**Sampler(s):**	NC

Field Measurements			
Organic vapours in well:	ppm	Measurement device:	
Depth to Groundwater:	0.87 m	Measurement Device:	
Correction:	m		
Groundwater Elevation :	m		
Depth to Immiscible Layer:	m	Measurement Device:	
Thickness to Immiscible Layer:	m		
Well Depth:	1.11 m		
Thickness to Groundwater Column:	m		

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
1.09	19.20	10790	8.26	6.17	391	7020	dark brown, orange odour
1.10	16.43	11078	8.26	5.01	385	7232	"
1.11	15.90	11177	8.26	4.74	376	7289	"
1.12	14.85	11409	8.26	4.35	373	7416	"
1.13	14.40	11550	8.24	4.22	374	7509	"

Miscellaneous Field Comments

Well Head Integrity:	1.00.
Duplicate:	
Triplicate:	
Rinsate:	
Samples Filtered	
Weather Condition:	
Other:	

due to shallow well - sampled as purging

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	28/6/18
Project:	GW Monitoring	**Well Number:**	E4
Location:	Hydro	**Sampler(s):**	NG

Field Measurements			
Organic vapours in well:	ppm	Measurement device:	
Depth to Groundwater: 2.48	m	Measurement Device:	
Correction:	m		
Groundwater Elevation :	m		
Depth to Immiscible Layer:	m	Measurement Device:	
Thickness to Immiscible Layer:	m		
Well Depth: 3.41	m		
Thickness to Groundwater Column:	m		

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
1.57	18.74	14955	9.65	6.75	55.3	9812	brown/orange, strong
1.58	18.35	15206	9.63	1.86	47.9	9884	H_2S odour
1.59	18.08	15199	9.62	0.24	39.9	9873	"
2.00	17.95	15187	9.62	0.04	35.7	9871	"
2.01	17.84	15132	9.62	0.01	31.2	9835	"
2.02	17.81	15132	9.62	0.0	29.5	9829	"

Miscellaneous Field Comments

Well Head Integrity:	2.53
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	Sunny
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	28/6/18
Project:	GW monitoring	**Well Number:**	W1D
Location:	Hydro	**Sampler(s):**	NG.

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	4.42	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	10.40	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
1.34	18.97	11296	7.07	0.75	147	7342	yellow H_2S odour
1.35	19.00	11319	7.07	0.54	176	7357	"
1.36	18.99	11330	7.07	0.50	.95	7364	"

Miscellaneous Field Comments

Well Head Integrity:	4.56
Duplicate:	QA103
Triplicate:	QA102
Rinsate:	acid.
Samples Filtered	metals.
Weather Condition:	sunny.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 28/6/18.
Project: GW Monitoring	**Well Number:** W15
Location: Hydro.	**Sampler(s):** NC

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater: DRY	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 2.43	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: | End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
		DRY					

Miscellaneous Field Comments

Well Head Integrity:
Duplicate:
Triplicate:
Rinsate:
Samples Filtered
Weather Condition:
Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 28/6/18.
Project: GW Monitoring	**Well Number:** G5
Location: Hydro	**Sampler(s):** NA

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater: 3.18	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 11.37	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
11:13	18.29	8999	6.29	1.47	64.9	5882	clear, some particles
11:14	18.26	9109	6.27	1.04	85.2	5933	
11:15	18.21	9133	6.26	0.80	105.4	5940	
11:16	18.12	9116	6.23	0.58	109	5923	

Miscellaneous Field Comments

Well Head Integrity:	3.35
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	sunny
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 28/6/19
Project: GW Monitoring	**Well Number:** F6
Location: Hydro	**Sampler(s):** NG

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater: 4.75	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 15.45	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
10.45	16.78	9723	6.83	4.44	52.5	6310	clear, no odour
10.46	16.82	9908	6.74	2.88	64.6	6463	"
10.47	17.14	9993	6.68	1.17	75.4	6495	"
10.48	17.28	10011	6.67	0.75	87.1	6506	"
10.49	17.39	10005	6.67	0.61	93.0	6500	"
10.50	17.54	9967	6.67	0.52	104.6	6476	"

Miscellaneous Field Comments

Well Head Integrity:	4.93
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	alkalinity
Weather Condition:	sunny
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	218000375	**Date:**	28/6/18.
Project:	GW Monitoring	**Well Number:**	G6
Location:	Hydro.	**Sampler(s):**	NG

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	4.85	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	7.15	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
10:23	17.23	9608	3.64	4.48	283	6367	clear, no odour
10:24	17.19	9946	3.62	3.01	291	6480	"
10:25	17.22	10003	3.61	2.10	297	6510	"
10:26	7.14	10030	3.60	1.56	303	6528	"
10:27	17.45	10044	3.60	1.19	306	6526	"

Miscellaneous Field Comments

Well Head Integrity:	
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	sunny
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375.	**Date:** 28/6/18.
Project: GW Monitoring	**Well Number:** N2
Location: Hydro	**Sampler(s):** NG

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	4.49	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	5.61	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
9.51	15.81	7602	4.83	3.47	452	4965	light brown, no odour
9.52	15.92	7667	4.78	2.58	456	4984	"
9.53	16.29	7694	4.68	1.47	462	4996	"
9.54	16.56	7699	4.61	1.02	469	5000	"
9.55	16.74	7685	4.53	0.92	475	4988	"
9.56	16.79	7671	4.45	0.88	481	4991	"
9.57	16.86	7667	4.41	0.84	485	4980	"

Miscellaneous Field Comments

Well Head Integrity:	4.67
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	overcast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 218000375	**Date:** 28/8/18
Project: GW Monitoring	**Well Number:** WSD
Location: Hydro	**Sampler(s):** NG

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater: 5.30	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 10.54	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 9:04 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
9:05	14.84	6114	6.36	7.82	155	4174	clear, some particles, no odour
9:06	15.16	6626	6.13	2.83	186	4396	"
9:07	15.30	6764	6.14	1.95	202	4428	"
9:08	15.57	6883	6.13	1.20	234	4483	"
9:09	16.16	6927	6.11	0.88	269	4476	"
9:10	16.42	6858	6.10	0.73	294	4449	"
9:11	16.77	6832	6.10	0.72	301	4439	"

Miscellaneous Field Comments

Well Head Integrity:	
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	overcast
Other:	

RAMBOLL

WS05 - dry - 1.70. DTB.

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 28/6/18
Project: GW Monitoring	**Well Number:** E11
Location: Hydro	**Sampler(s):** NC

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater: 3.28	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 4.84	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
8:29	14.86	13645	8.99	1.52	211	8854	light brown, H2S odour
8:30	15.08	13599	8.79	1.25	217	9844	
8:31	15.42	13568	9.01	1.00	221	8807	
8:32	15.85	13508	9.01	0.92	222	8767	
8:33	16.06	13460	9.02	0.72	224	8739	

Miscellaneous Field Comments

Well Head Integrity:	3.30
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	All dissolved
Weather Condition:	
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 218000375	**Date:** 28/6/18
Project: GW Monitoring	**Well Number:** N8.
Location: Hydro.	**Sampler(s):** NG

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater: 3.86	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 5.33	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
8:06	15.57	10351	6.69	0.86	-26.4	6694	light brown, some odour
8:07	16.02	10160	6.69	0.71	-18.1	6585	"
8:08	16.33	10158	6.70	0.58	-14.0	6405	"
8:09	16.40	10162	6.70	0.59	-13.2	6612	"
8:10	16.42	10191	6.71	0.43	-14.8	6634	"

Miscellaneous Field Comments

Well Head Integrity:	4 10
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium.
Weather Condition:	
Other:	

could not filter - 4th @ 16.

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 27/6/18
Project: GW Monitoring	**Well Number:** WGD
Location: Hydro.	**Sampler(s):** NG

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater: 5.68	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 8.71	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
3:55	17.02	1362	5.71	1.76	274	885	1.4 brown turbid water
3:57	17.10	1361	5.70	1.32	289	884	" "
3:58	17.21	1358	5.70	0.87	306	882	"
3:59	17.36	1355	5.70	0.77	321	880	"
4:00	17.41	1358	5.70	0.72	331	880	"

Miscellaneous Field Comments

Well Head Integrity:	5.74
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	27/6/18
Project:	GW Monitoring	**Well Number:**	N9
Location:	Hydro	**Sampler(s):**	NG

Field Measurements			
Organic vapours in well:	ppm	Measurement device:	
Depth to Groundwater:	2.31 m	Measurement Device:	
Correction:	m		
Groundwater Elevation :	m		
Depth to Immiscible Layer:	m	Measurement Device:	
Thickness to Immiscible Layer:	m		
Well Depth:	2.78 m		
Thickness to Groundwater Column:	m		

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
3:25	17.72	9540	8.72	6.14	374	6213	light brown, some odour
3:26	17.81	9603	8.72	4.03	377	6267	" "
3:27	16.73	9711	8.72	2.70	365	6323	"
3:28	16.16	9755	8.72	2.55	357	6362	"

Miscellaneous Field Comments

Well Head Integrity:	2.46
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	alkalinity
Weather Condition:	OVercast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 27/6/18
Project: GW Monitoring	**Well Number:** G2
Location: Hydro	**Sampler(s):** NG

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	8.31	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	13.42	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
3.00	18.11	6288	6.05	2.42	205	4087	clear, no odour
3.01	18.10	6314	6.04	1.45	214	4104	"
3.02	18.11	6328	6.04	1.03	226	4117	"
3.03	18.12	6347	6.04	0.81	241	4125	"
3.04	18.12	6366	6.05	0.76	256	4137	"
* DO kept dropping.							

Miscellaneous Field Comments

Well Head Integrity:	8.33
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	overcast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	27/6/18.
Project:	GW Monitoring	**Well Number:**	ES1
Location:	Hydro.	**Sampler(s):**	NG

Field Measurements			
Organic vapours in well:	ppm	Measurement device:	
Depth to Groundwater:	2.89 m	Measurement Device:	
Correction:	m		
Groundwater Elevation :	m		
Depth to Immiscible Layer:	m	Measurement Device:	
Thickness to Immiscible Layer:	m		
Well Depth:	5.44 m		
Thickness to Groundwater Column:	m		

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
2.27	19.06	16385	7.33	3.78	215	10669	light brown, some odour
2.28	19.28	16549	7.32	1.96	252	10765	"
2.29	19.39	16600	7.31	1.47	261	10792	"
2.30	19.46	16596	7.31	1.35	289	10786	"
2.31	19.50	16593	7.30	1.23	309	10786	"
2.32	19.56	16590	7.29	1.15	321	10778	"

Miscellaneous Field Comments

Well Head Integrity:	3.10
Duplicate:	QA101
Triplicate:	N/A
Rinsate:	N/A.
Samples Filtered	aluminium.
Weather Condition:	overcast.
Other:	

couldn't filter, unpreserved - filter @ lab.

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 22/6/18
Project: GW Monitoring	**Well Number:** ES
Location: Hydro.	**Sampler(s):** NC

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater:	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 2.95	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
	DRY.						

Miscellaneous Field Comments

Well Head Integrity:
Duplicate:
Triplicate:
Rinsate:
Samples Filtered
Weather Condition:
Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375.	**Date:**	27/6/18.
Project:	GW Monitoring	**Well Number:**	W7M
Location:	Hydro.	**Sampler(s):**	NG

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	2.84	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	3.73	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: | End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. ~~uS/cm~~ or mS/cm)	pH	DO (~~mg/L~~ or ppm)	Redox (mV)	TDS (mg/L or ~~ppm~~)	Comments (appearance, odour, etc)
1.57	18.28	16692	9.23	1.97	213	10854	Light brown turbid, no odour
1.58	18.17	16651	9.23	0.76	212	10748	"
2.00	18.00	17614	9.36	1.31	195	11561	"
2.01	17.99	21580	9.67	1.01	132	14170	"
2.02	18.01	22072	9.70	0.75	130	14388	"
2.03	18.07	22184	9.70	0.53	129	14457	"

Miscellaneous Field Comments

Well Head Integrity:	3.10
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	27/8/14.
Project:	GW Monitoring	**Well Number:**	W75
Location:	Hexham	**Sampler(s):**	NG.

Field Measurements			
Organic vapours in well:	ppm	Measurement device:	
Depth to Groundwater:	m	Measurement Device:	
Correction:	m		
Groundwater Elevation :	m		
Depth to Immiscible Layer:	m	Measurement Device:	
Thickness to Immiscible Layer:	m		
Well Depth: 2.32.	m		
Thickness to Groundwater Column:	m		

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: | End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
	DRY.						

Miscellaneous Field Comments

Well Head Integrity:
Duplicate:
Triplicate:
Rinsate:
Samples Filtered
Weather Condition:
Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 218000375	**Date:** 27/6/18.
Project: GW Monitoring	**Well Number:** PUMP
Location: Hydro.	**Sampler(s):** NG

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	2.53	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	3.50.	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
							turbid.
1.35	19.07	1384	9.06	4.29	354	900.5	light brown, no odour
1.36	18.87	1396	9.08	2.96	365	909.1	"
1.37	18.01	1398	9.08	2.68	365	910.2	"
1.38	17.59	1415	9.09	2.21	371	917.9	"
1.39	17.53	1416	9.12	2.20	372	9251	"
1.40	17.46	1435	9.17	2.16	367	943.5	"

Miscellaneous Field Comments

Well Head Integrity:	2.61.
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	overcast.
Other:	

- coolant filled - unpreserved bottle - filter @ lab.

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	27/6/18.
Project:	GW Monitoring	**Well Number:**	W2D
Location:	[redacted] Hydro	**Sampler(s):**	NG

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater:	2.45	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth:	6.37	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
1.10	19.23	43208	10.20	0.04	104.5	35436	dark brown, odour
1.12	19.55	42918	10.26	0.01	107.4	38389	"
1.13	19.94	42606	10.19	0.00	107.3	38487	"
1.14	19.95	42646	10.19	-0.00	105.0	38510	"
1.15	20.07	42492	10.18	-0.00	101.4	38516	"

Miscellaneous Field Comments

Well Head Integrity:	2.55 reduced flow ~2.90
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	Overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	**Date:**
Project:	**Well Number:** W2 S
Location:	**Sampler(s):**

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater:	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth: 2.39	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: | End Sampling:

Sample Appearance:

TIME	TEMP (°c)	SPEC. COND. (µS/cm or mS/cm)	pH	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Comments (appearance, odour, etc)
		DRY					

Miscellaneous Field Comments

Well Head Integrity:
Duplicate:
Triplicate:
Rinsate:
Samples Filtered
Weather Condition:
Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	**Date:** 26/9/18
Project: GME	**Well Number:** A7
Location: Buffer zone.	**Sampler(s):** JK.

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.50	m	Measurement Device:
Correction:	1.03	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	4.30	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 11.25 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
11.27	16.0	9.6	18499	0.03	-402.5		0.2	slightly brown/yellow
11.28	15.9	9.49	18540	0.04	-419.2		0.1	odour rotten egg.
11.29	15.9	9.51	18565	0.04	-423.9		0.1	"
11.30	15.9	9.53	18835	0.04	-426.9		0.1	"
11.31	15.8	9.61	18566	0.04	-429.2		0.1	"
11.32	15.8	9.75	18570	0.04	-431.3		0.1	"

Miscellaneous Field Comments

Well Head Integrity: 2.54

Duplicate:

Replicate:

Blank:

Samples Filtered

Weather Condition:

Other:

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	25/9/18
Project:	GME	**Well Number:**	E11
Location:	Buffer zone.	**Sampler(s):**	JK.

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.44	m	Measurement Device:
Correction:	0.88	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	4.83	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: 1.13pm End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
1.15	17.5	-0.54	13240	1.3	488.6		0.2	slightly brown.
1.16	17.2	1.5	13278	0.6	229.7		0.3	"
1.17	17.1	4.65	13263	0.5	88.3		0.35	
1.18	17.1	6.23	13252	0.4	5.6		0.4	
1.19	17.1	7.7	13247	0.33	-59.9		0.45	
1.20	17.1	9.43	13240	0.31	-158.2		0.5	
1.22	17.1	10.28	13459	0.2	-187.5		0.55	
1.23	17.1	10.45	13587	0.19	-199.3		0.6	

Miscellaneous Field Comments

Well Head Integrity:	3.49 at 1.20pm
Duplicate:	NA
Triplicate:	NA
Rinsate:	NA
Samples Filtered	aluminium.
Weather Condition:	overcast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 25/9/18
Project: GME	**Well Number:** ESD
Location: Buffer Zone	**Sampler(s):** NG / JK.

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.95	m	Measurement Device:
Correction:	0.84	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	~~2~~ 5.43	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 10.10 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
10.12	18.2	12.60	15907	1.37	-251.3		~~0.3~~ 0.2	brown
10.14	18.1	12.76	16028	0.78	-265.4		0.3	brown
10.15	18.0	12.79	16030	0.60	-270.0		0.4	brown.
10.16	18.0	12.78	16026	0.46	-273.4		0.5	brown.
10.17	18.0	12.79	16016	0.40	-275.6		0.6	brown.

Miscellaneous Field Comments

Well Head Integrity: 3.05 pump rate lowest capacity

Duplicate:

Triplicate:

Rinsate:

Samples Filtered aluminium

Weather Condition: overcast.

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:**
Project: GME	**Well Number:** E4
Location: Buffer zone	**Sampler(s):** JK.

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.69	m	Measurement Device:
Correction:	0.77	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	3.90	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 9.14 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
9.16	15.9	9.32	13256	1.40	224.1		0.2	slightly brown/yellow
9.17	15.9	9.28	13286	1.24	227.1		0.3	"
9.18	15.9	9.29	13294	1.21	226.0		0.4	" turbid

Miscellaneous Field Comments

Well Head Integrity: 2.77

Duplicate: NA

Triplicate: NA

Rinsate: NA

Samples Filtered aluminium -

Weather Condition:

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 25/9/18.
Project: GME	**Well Number:** ES
Location: Buffer Zone.	**Sampler(s):** NG / JK

Field Measurements		
Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater (TOC): DRY.	m	Measurement Device:
Correction: 0.60	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth (TOC): 2.57.	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)

Miscellaneous Field Comments

Well Head Integrity:

Duplicate:

Triplicate:

Rinsate:

Samples Filtered

Weather Condition:

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	**Date:**
Project:	**Well Number:** FS
Location:	**Sampler(s):**

Field Measurements

Organic vapours in well:	ppm		Measurement device:
Depth to Groundwater (TOC):	3.44	m	Measurement Device:
Correction:	0.58	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	7.37	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 3.21 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
3.22	16.4	5.23	9725	5.26	61.2		0.1	clear
3.23	16.3	4.59	10000	2.27	119.0		0.2	
3.24	16.3	4.41	10087	0.83	166.1		0.3	
3.25	16.4	4.38	10101	0.79	185.0		0.35	
3.26	16.4	4.37	10099	0.70	203		0.4	
3.27	16.6	4.37	10114	0.64	225.2		0.5	
3.28	16.7	4.36	10123	0.61	249.1		0.55	
3.29	16.7	4.35	10126	0.57	257.5		0.6	

Miscellaneous Field Comments

Well Head Integrity: 3.70

Duplicate: NA

Triplicate: NA

Rinsate: QC 101

Samples Filtered aluminium

Weather Condition: rainy.

Other:

RAME

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 319000375	**Date:** 26/9/18
Project: GME	**Well Number:** F6
Location: Buffer Zone	**Sampler(s):** NC/SK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	4.86	m	Measurement Device:
Correction:	0-71	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	15-44	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 6:00 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
6:01	16.8	7.74	9593	2.94	200.9		0.1	clear, no odour
6:02	17.1	7.80	9739	2.58	196.4		0.2	"
6:03	17.1	7.83	9825	2.50	194.7		0.3	"
6:04	17.2	7.85	9861	2.42	192.4		0.4	"

Miscellaneous Field Comments

Well Head Integrity:	5.21 Lowest purging rate.
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	rain
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 25/9/18
Project: GME	**Well Number:** G2
Location: Buffer Zone.	**Sampler(s):** NG / JK.

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	13.30	m	Measurement Device:
Correction:	0.76	m	
Groundwater Elevation :	8.41	m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):		m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)

Miscellaneous Field Comments

Well Head Integrity:

Duplicate:

Triplicate:

Rinsate:

Samples Filtered

Weather Condition:

Other: Exceeds pump limits. resample with new pump

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	26/9/18
Project:	GME	**Well Number:**	GW
Location:	Buffer Zone.	**Sampler(s):**	

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	8.35	m	Measurement Device:
Correction:	0.74	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	13.43	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: 5.15 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
5:16	16.9	6.37	5975	1.11	62		0.2	light brown, no odour
5:17	17.3	6.41	6201	0.61	55.4		0.3	"
5:18	17.4	6.41	6264	0.58	53.2		0.4	"
5:19	17.5	6.42	6306	0.56	50.9		0.5	"

Miscellaneous Field Comments

Well Head Integrity:	8.47
Duplicate:	QA102
Triplicate:	QA103
Rinsate:	N/A.
Samples Filtered	aluminium
Weather Condition:	rain.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	**Date:** 26/9/18
Project:	**Well Number:** G5
Location:	**Sampler(s):** JL / NG

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.40	m	Measurement Device:
Correction:	0.58	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	11.33	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 3.04 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
3.06	16.2	8.03	2001	1.08	97.4		0.2	clear
3.07	16.4	7.79	2009	0.81	96.0		0.3	"
3.08	16.4	7.70	2023	0.72	94.4		0.4	"
3.09	16.3	7.65	2030	0.69	93.7		0.5	"
3.10	16.4	7.63	2033	0.67	92.1		0.6	"

Miscellaneous Field Comments

Well Head Integrity:	3.58
Duplicate:	NA
Triplicate:	NA
Rinsate:	NA
Samples Filtered	aluminium
Weather Condition:	rainy
Other:	

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 38000375	**Date:** 26/9/18
Project: GME.	**Well Number:** C6
Location: Buffer Zone.	**Sampler(s):** NC

Field Measurements			
Organic vapours in well:	monument	ppm	Measurement device:
Depth to Groundwater (TOC):	5.00	m	Measurement Device:
Correction:	0.56 none	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	7.14	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 5.45 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
5:47	16.8	3.77	9466	2.53	185.0		0.2	clear, no odour
5:48	17.2	3.83	9673	1.08	213.5		0.3	"
5:49	17.2	3.85	9778	0.90	222.4		0.4	"
5:50	17.2	3.87	9861	0.77	228.9		0.4	"
5:51	17.3	3.88	9891	0.62	233.9		0.5	"
5:52	17.3	3.88	9899	0.61	233		0.5	"

Miscellaneous Field Comments

Well Head Integrity:	5.60
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	~~not~~ aluminium
Weather Condition:	rain
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	25/9/18
Project:	GME	**Well Number:**	N2
Location:	Buffer zone.	**Sampler(s):**	JK / NG.

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	4.63	m	Measurement Device:
Correction:	0.85	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	5.37	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 3.08 End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
3.11	16.6	3.84	7586	7.08	134.6		0.2	clear / slightly brown
3.12	16.3	3.68	7611	6.91	165.5		0.25	
3.13	16.2	3.61	7626	7.08	199.8		0.3	
3.14	16.2	3.54	7625	6.99	241.7		0.35	
3.15	16.2	3.16	7622	10.02	348.9		0.4	
3.17	16.3	8.80	7645	0.24	-29.3		0.45	not pumping water
3.18	16.4	2.54	7643	7.70	357.4		0.5	
3.19	16.1	2.74	7681	7.20	348.6		0.55	at end.
3.20	16.0	2.80	7660	7.0	333.8			during sampling

Miscellaneous Field Comments

Well Head Integrity:	4 x 4 5m at end.
Duplicate:	NA
Triplicate:	NA
Rinsate:	NA
Samples Filtered	aluminium
Weather Condition:	overcast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000375	**Date:**	25/9/18
Project:	GME	**Well Number:**	N8
Location:	Buffer Zone.	**Sampler(s):**	JK.

Field Measurements			
Organic vapours in well:	ppm	Measurement device:	
Depth to Groundwater (TOC):	3.97 m	Measurement Device:	
Correction:	1.0 m		
Groundwater Elevation :	m		
Depth to Immiscible Layer:	m	Measurement Device:	
Thickness to Immiscible Layer:	m		
Well Depth (TOC):	4.~~00~~97 m		
Thickness to Groundwater Column:	m		

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 2.24. End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
2.27	20.1	10.27	673	5.49	-113.8		—	start.
2.28	17.8	10.12	10153	1.60	-159.6		0.1	slightly brown/yellow
2.29	17.7	10.28	10155	1.23	-171.4		0.15	
2.31	17.6	10.99	10160	0.79	-190.9		0.20	
2.34	17.3	10.53	10196	0.75	-195.0		0.25	brown/yellow.

Miscellaneous Field Comments

Well Head Integrity:	4.31 at end. pump at lowest capacity.
Duplicate:	NA sampled during stabalisation
Triplicate:	NA to eliminate over purge.
Rinsate:	NA
Samples Filtered	aluminium
Weather Condition:	overcast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 25/9/18
Project: GME	**Well Number:** N9
Location: Buffer Zone	**Sampler(s):** NH / JK

Field Measurements			
Organic vapours in well:	ppm		Measurement device:
Depth to Groundwater (TOC):	2.56	m	Measurement Device:
Correction:	0.73	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	2.84	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 11.21 End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
11.27	15.7	12.91	10718	0.81	-259.0		0.1	Odour, brown
11.28	15.5	12.57	10737	0.53	-276.9		0.2	brown.
11.29	15.5	12.75	10755	0.50	-284.1		0.25	brown
11.30	15.5	12.87	10777	0.53	-286.0		0.3	brown, sediment
11.31	15.6	12.92	10776	1.73	-285.9		0.35	
11.32	15.9	12.94	10817	1.90	-289.5		0.4	Strong H_2S odour.
11.33	16.1	12.92	10797	3.18	-285.1		0.45	
11.34	16.3	12.90	10679	3.76	-282.7		0.5	

Miscellaneous Field Comments

Well Head Integrity:	Purged dry.
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium.
Weather Condition:	Sunny
Other:	Samples collected while well stabalises.

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000275	**Date:** 25/9/18
Project: Hydro 44 AME	**Well Number:** PUMP
Location: Buffer Zone	**Sampler(s):**

Field Measurements

Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater (TOC): 2.73	m	Measurement Device:
Correction: 0.77	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth (TOC): 3.43	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 9.12. End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
9:14	16.8	10.87	6385	1.47	-224.2		0.5	light brown/grey, H_2S odour
9:15	16.6	12.85	6219	0.76	-288.2		0.75	"
9:16	16.7	13.19	6124	0.55	-304.9		0.8	"
9:17	16.7	13.25	5811	0.42	-322.5		0.9	"
9.18	16.8	13.46	11040	0.24	-335.1		1	"
9.19	16.9	13.60	11707	0.21	-346.2		1.1	"
9.20	16.9	13.67	11703	0.20	-351.4		1.2	"
9.21	16.9	13.68	11670	0.19	-352.0		1.5	"

Miscellaneous Field Comments

Well Head Integrity:	2.80 @ end.
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	overcast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	**Date:** 26/9/18
Project: GME	**Well Number:** W1D
Location: Buffer zone.	**Sampler(s):** JK.

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	4.60	m	Measurement Device:
Correction:	0.49	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	10.36	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: 8.51 End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
8.52	17.4	6.96	10712	1.3	163.5		0.3	slightly brown/yellow
8.53	17.4	7.03	10694	1.16	158.6		0.5	"
8.54	17.4	7.08	10745	1.04	153.5		0.6	"
8.55	17.5	7.09	10762	0.89	149.2		0.7	"
8.56	17.6	7.12	10772	0.82	146.4		0.8	

Miscellaneous Field Comments

Well Head Integrity:	5.03 pump at lowest capacity.
Duplicate:	NA
Triplicate:	NA
Rinsate:	NA
Samples Filtered	aluminium
Weather Condition:	overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000 573	**Date:** 26/9/18
Project: GME	**Well Number:** W15
Location: Buffer zone.	**Sampler(s):** JK.

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):		m	Measurement Device:
Correction:	0.55	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	2.43	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
DRY								

Miscellaneous Field Comments

Well Head Integrity:
Duplicate:
Triplicate:
Rinsate:
Samples Filtered
Weather Condition:
Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	318000775	**Date:**	25/9/18
Project:	Hydro 1/4 GME	**Well Number:**	W20
Location:	Buffer Zone	**Sampler(s):**	NG

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.66	m	Measurement Device:
Correction:	0.63	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	4.75	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
8:51	18.2	13.72	41041	~~4.27~~ 0.32	-341.3		1.5	dark brown
8:52	18.3	13.74	41058	0.3	-342.6		0.5	"
8:53	18.4	13.74	41055	0.27	-343.6		0.5	"

Miscellaneous Field Comments

Well Head Integrity: 3.32 reduced pumping to lowest rate. head and 375

Duplicate: N/A

Triplicate: N/A

Rinsate: N/A

Samples Filtered dissolved

Weather Condition: overcast

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375.	**Date:** 25/9/18
Project: Hydro Quarterly GME	**Well Number:** W25
Location: Buffer Zone	**Sampler(s):** NG

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	DLY	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	2.37	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)

Miscellaneous Field Comments

Well Head Integrity:

Duplicate:

Triplicate:

Rinsate:

Samples Filtered

Weather Condition:

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

. Number:	**Date:** 25/9/18
roject:	**Well Number:** W3D
Location:	**Sampler(s):** N. [illegible]

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	6.37	m	Measurement Device:
Correction:	0.64	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	9.98	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 4:30 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
4:33	16.6	3.90	2601	1.50	302.3		0.5	light brown, some odour
4:34	16.6	3.92	2606	1.16	310.9		0.6	"
4:35	16.7	3.93	2607	0.99	328.0		0.7	"
4:36	16.8	3.94	2613	0.90	335.8		0.8	"
4:37	16.8	3.94	2627	0.67	345.3		0.9	"
4:38	16.6	3.94	2629	0.64	351.8		1	"

Miscellaneous Field Comments

Well Head Integrity:	7.01 head kept dropping, on lowest pumping rate.
Duplicate:	QA101
Triplicate:	N/A.
Rinsate:	N/A
Samples Filtered	Aluminium
Weather Condition:	raining
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:		**Date:**	
Project:	GME	**Well Number:**	W35
Location:	Buffer zone	**Sampler(s):**	JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	1.83	m	Measurement Device:
Correction:	0.70	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	2.53	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 9:50 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
4:52	14.4	7.00	7623	1.18	207.1		0.2	brown, turbid, no odour
4:53	14.4	7.03	7627	093	209.3		0.3	"
4.54	14.4	7.06	7631	0.77	2212		0.5	"
4.55	14.4	7.11	7607	0.68	238.7		0.6	"
4:56	14.4	7.14	7573	0.63	251.3		0.7	"
* started sampling at 4:55 → head kept dropping. On lowest pumping rate.								

Miscellaneous Field Comments

Well Head Integrity:	1.92 head kept dropping. On lowest pumping rate
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	aluminium
Weather Condition:	rain
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000 375	**Date:** 25/9/18
Project: CME	**Well Number:** WTS
Location: Buffer zone.	**Sampler(s):** [redacted] JK.

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	1.10	m	Measurement Device:
Correction:	0.58	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	1.11	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
	DRY							

Miscellaneous Field Comments

Well Head Integrity:

Duplicate:

Triplicate:

Rinsate:

Samples Filtered

Weather Condition:

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 25/9/18
Project: GME	**Well Number:** WSD
Location: Buffer Zone.	**Sampler(s):** JK.

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	5.85	m	Measurement Device:
Correction:	1.22	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	~~10.30~~ 10.52	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 1.46 End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
1.53	18.8	10.15	6378	3.45	-157.6		0.1	slightly brown / clear
1.54	18.7	10.15	6275	2.39	-161.2		0.15	"
1.55	18.7	10.16	6147	2.10	-165.1		0.2	"
1.56	18.6	10.25	6130	1.86	-170.4		0.25	"
1.57	18.6	10.20	6086	1.88	-172.8		0.30	"

Miscellaneous Field Comments

Well Head Integrity:	6.33 pump on slowest capacity
Duplicate:	NA
Triplicate:	NA
Rinsate:	NA
Samples Filtered	aluminium
Weather Condition:	overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 25/9/18
Project: GME	**Well Number:** WSS
Location: Buffer zone	**Sampler(s):** UK.

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	1.70	m	Measurement Device:
Correction:	1.2	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	1.70	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: | End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
DRY.								

Miscellaneous Field Comments

Well Head Integrity:

Duplicate:

Triplicate:

Rinsate:

Samples Filtered

Weather Condition:

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375.	**Date:** 25/9/18
Project: Hydro Yd CME	**Well Number:** W6D
Location: Buffer Zone.	**Sampler(s):** NG / JK.

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	5.78	m	Measurement Device:
Correction:	0.7	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	8.74.	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 12.44. End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
12.45	19.2	9.5	1363	5.38	-90.6		40.1	slightly brown/clear.
12.46	18.8	9.93	1379	4.5	-109.6		0.15	"
12.47	18.6	10.15	1382	4.16	-119.4		0.2	"
12.48	18.5	10.38	1391	3.85	-130.0		0.25	"
12.49	18.4	10.47	1395	3.73	-133.4		0.3	

Miscellaneous Field Comments

Well Head Integrity:	5.94.
Duplicate:	NA
Triplicate:	NA
Rinsate:	NA
Samples Filtered	aluminium.
Weather Condition:	overcast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 25/9/18
Project: GME	**Well Number:** W65
Location: Buffer Zone.	**Sampler(s):** L

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.09	m	Measurement Device:
Correction:	1.6	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	3.10	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
	DRY							

Miscellaneous Field Comments

Well Head Integrity:
Duplicate:
Triplicate:
Rinsate:
Samples Filtered
Weather Condition:
Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 25/9/18
Project: Hydro to GME	**Well Number:** U7M4
Location: Buffer Zone.	**Sampler(s):** NG/JK.

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.02	m	Measurement Device:
Correction:	0.64.	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	3.73	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☒ Peristaltic ☐ Bailer

Start Sampling: 9.46 End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
9.49	17.5	10.80	18507	1.34	-159.4		0.2	brown, no odour
9.50	17.4	11.97	19920	0.31	-212.9		0.3	"
9.51	17.6	12.48	20681	1.39	-248.0		0.4	"
9.52	17.6	12.90	22768	1.56	-270.0		0.5	"
9.53	17.8	13.03	23394	1.34	-277.4		0.6	"
9.54	17.5	13.17	26155	0.59	-289.9		0.6	"
9.55	17.6	13.24	26691	0.60	-292.9		0.7	"
9.56	17.6	13.24	26975	1.08	-295.4		0.7	"

Miscellaneous Field Comments

Well Head Integrity:	3.29
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	for aluminium
Weather Condition:	Sunny
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number:	31800	**Date:**	25/9/18
Project:	Hydro Tu GME	**Well Number:**	W7S
Location:	Buffer Zone -	**Sampler(s):**	NG/JK

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	DRY	m	Measurement Device:
Correction:	0.63	m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	2.32	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: | End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)

Miscellaneous Field Comments

Well Head Integrity:

Duplicate:

Triplicate:

Rinsate:

Samples Filtered

Weather Condition:

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3180003 75	**Date:** 18/12/18
Project: GME	**Well Number:** E4.
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater (TOC): 2.75	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth (TOC): 3.90	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
9.47	21.5	7.14	18160	0.45	-315.5	11752.0	~0.1	slightly brown, no odour
9.48	20.9	9.22	~~17585~~ 18020	0.32	-327.7	11784.5	~0.1	" " "
9.49	20.7	9.24	17971	0.26	-330.2	11505.0	~0.1	" " "
9.50	20.7	9.26	17620	0.32	-333.8	11355.0	~0.1	" " "
9.51	20.9	9.27	17212	0.29	-333.8	11180.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity: 2.91 pump at lowest capacity.

Duplicate: N/A

Triplicate: N/A

Rinsate: ~~N/A~~ QC101

Samples Filtered metals

Weather Condition: Overcast.

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 19/12/18
Project: GME	**Well Number:** A7
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.33	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	4.31	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
7.42	20.4	8.93	19006	—	-490.7	12356.50	~0.1	Brown, sulphidic odour
7.43	20.3	8.99	18995	—	-493.8	12337.0	~0.1	" " "
7.44	20.2	9.04	18975	—	-496.0	12330.5	~0.1	" " "
7.45	20.2	9.06	18962	—	-498.0	12330.5	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	2.45 pump at lowest capacity
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A.
Samples Filtered	metals
Weather Condition:	Overcast.
Other:	

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3180003 75	**Date:** 18/12/18
Project: GME	**Well Number:** PUMP
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.78	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	3.46.	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
7.51	23.0	9.68	6604	0.52	-234.6	4303.0	~0.1	clear to slightly brown no odour
7.52	22.9	9.60	7012	0.51	-255.2	4550.0	~0.1	" " "
7.53	22.9	9.59	6891	0.72	-259.7	4426.5	~0.1	" " "
7.54	22.9	9.57	6609	0.36	-260.8	4225.0	~0.1	" " "
7.55	23.0	9.56	6365	0.34	-261.9	4127.5	~0.1	" " "
7.56	23.0	9.55	6334	0.29	-262.4	4114.5	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	2.86
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	Overcast
Other:	

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** W2D
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.70	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	6.37	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
7.25	21.5	9.87	41179	17.1.17	-314.5	26721.5	~0.1	Brown, slight 'burnt' odour
7.26	21.3	9.88	41044	0.64	-345.0	26663.0	~0.1	" "
7.27	21.4	9.88	40998	0.51	-356.8	26637.0	~0.1	" "
7.28	21.4	9.87	40973	0.42	-364.0	26630.0	~0.1	" "
7.29	21.5	9.87	40961	0.36	-371.0	26630.5	~0.1	" "

Miscellaneous Field Comments

Well Head Integrity:	3.34 - pump at lowest capacity
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals.
Weather Condition:	Overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** W25
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:	ppm	Measurement device:	YSI Pro Plus
Depth to Groundwater (TOC):	2.09 m	Measurement Device:	
Correction:	m		
Groundwater Elevation :	m		
Depth to Immiscible Layer:	m	Measurement Device:	
Thickness to Immiscible Layer:	m		
Well Depth (TOC):	2.38 m		
Thickness to Groundwater Column:	m		

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance: clear to slightly brown

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
7.03	23.2	7.8	2281	8.49	240.1	1664.0		clear, no odour
7.04	23.5	7.62	2545	8.27	250.4	1651.0		" " "
7.05	23.5	7.53	2527	8.19	256.2	1638.0		" " "
7.06	23.6	7.47	2509	8.13	258.6	1631.5		" " "

Miscellaneous Field Comments

Well Head Integrity:	Well pumped dry - lowest capacity
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	Metals
Weather Condition:	Overcast.
Other:	

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** N8
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.87	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	5.34	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance: slightly brown, slight odour.

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
10.19	22.7	6.71	10028	0.38	-122.7	6500.0	~0.1	slightly brown, very slight sulphid
10.20	22.5	6.61	10000	0.38	-117.7	6493.5	~0.1	" odour " "
10.21	22.0	6.56	10007	0.58	-115.5	6490.0	~0.1	" " "
10.22	21.8	6.53	9950	0.79	-113.3	6461.0	~0.1	" " "
10.23	21.3	6.51	9937	0.89	-112.5	6491.5	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	1.35 - well pump at lowest capacity
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	Overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** WBD
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:	ppm	Measurement device:
Depth to Groundwater (TOC): 5.783	m	Measurement Device:
Correction:	m	
Groundwater Elevation :	m	
Depth to Immiscible Layer:	m	Measurement Device:
Thickness to Immiscible Layer:	m	
Well Depth (TOC): 8.77	m	
Thickness to Groundwater Column:	m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance: clear, slightly turbid.

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
9.54	21.6	8.62	1384	3.24	12.6	890.5	~0.1	clear, no odour
9.55	20.9	7.81	1347	3.02	34.5	871.0	~0.1	" " "
9.56	20.8	7.39	1336	2.73	42.3	864.5	~0.1	" " "
9.57	21.1	7.04	1325	3.10	49.2	858.0	~0.1	" " "
9.58	21.6	6.78	1322	3.68	54.0	858.0	~0.1	" " "
9.59	22.0	6.65	1322	6.37	57.2	858.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity: 5.92 pump at lowest capacity

Duplicate: N/A

Triplicate: N/A

Rinsate: N/A

Samples Filtered metals

Weather Condition: Overcast

Other:

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3180003 75	**Date:** 18/12/18
Project: GME	**Well Number:** W7m
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.05	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	3.72	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
8.14	22.5	9.18	19089	1.47	12.9	12428	~0.1	slightly brown, slight odour
8.15	22.7	9.13	19280	0.81	4.5	12569.5	~0.1	" " "
8.16	22.8	9.23	20917	1.72	-78.2	13611.0	~0.1	" " "
8.17	22.9	9.24	20960	2.52	-69.0	13884.0	~0.1	" " "
8.18	22.7	9.33	27074	2.77	-75.8	18038.0	~0.1	" " "
8.19	22.2	9.56	29768	2.89	-128.1	19422	~0.1	" " "
8.20	22.1	9.61	29957	2.83	-148.5	19493.0	~0.1	" " "
8.21	22.0	9.63	30032	2.77	-157.4	19526.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	3.97 pump at lowest capacity
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	Over cast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** 66
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	5.06	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	7.15	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
1.25	22.5	4.70	9961	5.86	91.0	6461.0	~0.1	clear, no odour
1.26	22.2	4.18	9899	5.21	92.8	6422.0	~0.1	" " "
1.27	22.3	4.07	9855	5.19	92.3	6402.5	~0.1	" " "
1.28	22.4	3.97	9877	5.32	91.7	6435.0	~0.1	" " "
1.29	22.1	3.87	9923	5.41	83.9	6448.0	~0.1	" " "
1.30	21.9	3.81	9886	5.33	88.3	6415.5	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	Metals
Weather Condition:	Overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3180003375	**Date:** 18/12/18
Project: GME	**Well Number:** ESD
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.51	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	5.44	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
8.41	22.1	7.13	16017	0.88	-98.9	10406.5	~0.1	slightly brown, no odour
8.42	22.2	7.02	15995	1.16	-101.7	10400.0	~0.1	" " "
8.43	22.1	6.98	16000	1.23	-102.4	10413.0	~0.1	" " "
8.44	22.1	6.95	16028	1.53	-102.1	10913.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	2.75 at end sampling pump at lowest cap.
Duplicate:	QA101
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	Overcast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** E11
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.38	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	4.84	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
10.45	20.3	7.71	6222	1.35	44.8	4043.0	~0.1	clear, no odour
10.46	20.2	7.70	6193	1.25	41.0	4017.0	~0.1	" " "
10.47	20.2	7.70	6176	0.96	39.2	4010.5	~0.1	" " "
10.48	20.2	7.70	6171	1.0	38.6	4017.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	3.33
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	Metals
Weather Condition:	Overcast
Other:	

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3180003375	**Date:** 18/12/18
Project: GME	**Well Number:** G2.
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	8.38	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	13.46	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance: clear to slightly brown, slightly turbid.

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
9.12	20.9	7.38	6358	1.08	25.3	4127.5	~0.1	clear, no odour
9.13	20.4	7.00	6324	0.90	28.2	4101.5	~0.1	" " "
9.14	20.2	6.82	6308	0.83	29.5	4095.0	~0.1	" " "
9.15	20.1	6.66	6291	0.66	30.7	4088.5	~0.1	" " "
9.16	20.1	6.53	6280	0.61	31.3	4082.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	Good - 8.40.
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	Over cast.
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** N9
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	2.36	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	2.82	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

	TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
	9.33	22.4	9.30	7041	3.33	-275.4	7501.0	~0.1	clear, slightly brown, sulphidic odour
*	9.34	20.0	8.87	11334	0.29	-324.7	7358.0	~0.1	" " "
	9.35	19.9	8.80	11295	0.24	-327.4	7319.0	~0.1	" " "
	9.36	19.8	8.75	11186	0.21	-324.1	7267.0	~0.1	" " "
	9.37	19.8	8.72	11146	0.16	-309.9	7241.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	2.59 after sampling
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	Metals
Weather Condition:	Overcast
* Other:	Sampled during stabalisation, well historically purged dry

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** WSD
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	5.82	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	10.53	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
11.25	21.1	7.48	6015	0.98	55.1	3900.0	~0.1	clear, no odour
11.26	20.8	7.22	5968	0.67	62.6	3874.0	~0.1	" " "
11.27	20.7	7.01	5958	0.98	68.2	3867.5	~0.1	" " "
11.28	20.6	6.83	5955	0.39	76.4	3874.0	~0.1	" " "
11.29	20.6	6.72	5944	0.37	79.1	3861.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	6.54 pump at lowest capacity
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	Metals
Weather Condition:	Overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3180003 75	**Date:** 18/12/18
Project: GME	**Well Number:** F6
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements			
Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	4.91	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	15.60	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance: Clear, slight sulphidic odour.

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
1.05	23.4	7.30	10144	1.64	-99.4	6565.0	~0.1	Clear, ~~no odour~~
1.06	22.4	6.97	10056	0.92	-113.6	6519.5	~0.1	" " "
1.07	22.0	6.81	9978	0.72	-119.8	6480.5	~0.1	" " "
1.08	21.8	6.71	9965	0.61	-125.6	6480.5	~0.1	" " "
1.09	21.6	6.66	9945	0.60	-130.2	6454.5	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	5.46 pump at lowest capacity.
Duplicate:	
Triplicate:	
Rinsate:	
Samples Filtered	
Weather Condition:	
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3180003375	**Date:** 18/12/18
Project: GME	**Well Number:** G5
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.27	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	11.37	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
1.51	22.5	7.21	5837	1.55	-50.3	3958.50	~0.1	Clear, very slight sulph odour
1.52	21.9	6.99	6697	0.82	-31.7	4413.5	~0.1	" " "
1.53	21.7	6.13	6913	0.53	-30.4	4491.5	~0.1	" " "
1.54	21.8	5.90	6922	0.55	-25.3	4504.5	~0.1	" " "
1.55	21.6	5.83	6889	0.44	-24.1	4478.5	~0.1	" " "
1.56	21.6	5.72	6820	0.36	-21.6	4426.5	~0.1	" " "
1.57	21.8	5.64	6758	0.32	-20.4	4394.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	3.86 pump at lowest capacity.
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	Metals
Weather Condition:	Overcast.
Other:	

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 18/12/18
Project: GME	**Well Number:** NZ
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	4.61	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	5.61	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
12.37	21.8	5.41	7703	2.60	361.7	4992.0	~0.1	clear, no odour
12.38	20.8	4.78	7604	~~2.6~~ 1.95	415.3	4940.0	~0.1	" " "
12.39	20.6	4.52	7595	1.89	414.5	4933.5	~0.1	" " "
12.40	20.3	4.28	7584	1.89	432.0	4927.0	~0.1	" " "
12.41	20.3	4.18	7572	1.84	439.8	4920.5	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	5.10 pump at lowest capacity
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	overcast
Other:	

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 19/12/18
Project: GME	**Well Number:** F5
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	3.47	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	7.40	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☐ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
7.06	20.2	6.24	10325	1.10	-9.3	6701.5	~0.1	clear, very slight sulph odour.
7.07	20.0	5.67	10274	1.04	-8.9	6675.5	~0.1	" " "
7.08	20.0	5.45	10258	0.86	-10.6	6669.0	~0.1	" " "
7.09	19.9	5.28	10258	0.76	-8.4	6669.0	~0.1	" " "
7.10	19.8	5.15	10248	0.78	-8.0	6656.0	~0.1	" " "
7.11	19.9	5.02	10214	0.84	-7.5	6656.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	3.67 Pump at lowest capacity.
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	Overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 3180003375	**Date:** 19/12/18
Project: GME	**Well Number:** W3D
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	6.35	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	9.99	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
8.11	19.6	5.76	2669	0.83	-4.3	1729.0	~0.1	clear, no odour
8.12	19.4	5.41	2664	0.61	11.8	1729.0	~0.1	" " "
8.13	19.6	4.93	2647	0.49	34.9	1722.5	~0.1	" " "
8.14	19.7	4.72	2644	0.48	47.5	1716.0	~0.1	" " "
8.15	19.7	4.53	2644	0.51	64.3	1716.0	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	7.01 pump at lowest capacity
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	Metals
Weather Condition:	Overcast
Other:	

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 19/12/18
Project: GME	**Well Number:** W35
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	1.45	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	2.54.	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°c)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
8.38	20.4	6.53	7532	2.96	219.4	4901.0	~0.1	slightly brown, no odour
8.39	20.3	6.61	7546	3.33	243.5	4907.5	~0.1	" " "
8.40	20.2	6.66	7554	4.22	266.1	4907.5	~0.1	" " "
8.41	20.2	6.80	7554	4.66	271.4	4907.5	~0.1	" " "

Miscellaneous Field Comments

Well Head Integrity:	1.59
Duplicate:	N/A
Triplicate:	N/A
Rinsate:	N/A
Samples Filtered	metals
Weather Condition:	Overcast
Other:	Well sampled during stabalisation - historically purged dry.

RAMBOLL

Low Flow Groundwater Sampling Field Parameter Form

Ref. Number: 318000375	**Date:** 19/12/18
Project: GME	**Well Number:** W11
Location: Buffer Zone	**Sampler(s):** JK

Field Measurements

Organic vapours in well:		ppm	Measurement device:
Depth to Groundwater (TOC):	4.54	m	Measurement Device:
Correction:		m	
Groundwater Elevation :		m	
Depth to Immiscible Layer:		m	Measurement Device:
Thickness to Immiscible Layer:		m	
Well Depth (TOC):	10.42.	m	
Thickness to Groundwater Column:		m	

Well Sampling

Method: ☐ Micro-Purge ☑ Peristaltic ☐ Bailer

Start Sampling: End Sampling:

Sample Appearance:

TIME	TEMP (°C)	pH (pH units)	SPEC. COND. (µS/cm or mS/cm)	DO (mg/L or ppm)	Redox (mV)	TDS (mg/L or ppm)	Litres Removed (L)	Comments (appearance, odour, etc)
9.11	20.1	7.05	11179	0.63	-126.1	7267.0	~0.1	Clear, slightly brown, slight
9.12	20.3	6.86	11111	0.41	-131.7	7247.0	~0.1	Sulphidic odour
9.13	20.1	6.83	11184	0.37	-129.4	7280.0	~0.1	" " " "
9.14	19.9	6.79	11228	0.31	-120.0	7286.5	~0.1	" " " "
9.15	19.9	6.76	11165	0.32	-115.9	7254.0	~0.1	" " " "

Miscellaneous Field Comments

Well Head Integrity:	
Duplicate:	QA102
Triplicate:	QA103
Rinsate:	N/A
Samples Filtered	Metals
Weather Condition:	Overcast
Other:	

RAMBOLL

APPENDIX 5
LABORATORY REPORTS

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

ENVIROLAB GROUP

Client: Ramboll Environ	**Client Project Name / Number / Site etc (ie report title):** Hydro Groundwater Plume Monitoring - 318000375
Contact person: Nwakamma Ahubelem	**PO No.:**
Project Mgr: Kirsty Greenfield	**Envirolab Quote No. :**
Sampler: Nwakamma Ahubelem	**Date results required:**
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	**Or choose:** standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 **Mob:** 0406 167 636	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	**Lab comments:** Highly contaminated
Email: nahubelem@ramboll.com; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required					Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium		Provide as much information about the sample as you can
1 1	BLANK		14/3/18	WATER	X	X	X	X		
2 2	DUP1		13/3/18	WATER	X	X	X	X		
3 3	DUP2		14/3/18	WATER	X	X	X	X		
4 —	TRIP1		14/3/18	WATER	X	X	X	X		Forward to ALS
5 4	F5		14/3/18	WATER	X	X	X	X		
6 5	W3D		14/3/18	WATER	X	X	X	X		
7 6	G2		13/3/18	WATER	X	X	X	X		
8 7	G6		13/3/18	WATER	X	X	X	X		
9 8	G5		14/3/18	WATER	X	X	X	X		
10 9	W6D		13/3/18	WATER	X	X	X	X		
11 10	W5D		14/3/18	WATER	X	X	X	X		
12 11	N8		13/3/18	WATER	X	X	X	X		
13 12	F6		13/3/18	WATER	X	X	X	X		
14 13	N2		13/3/18	WATER	X	X	X	X		
15 14	~~W1D S-M7~~	W1D JYH	14/3/18	WATER	X	X	X	X		
16 15	E5D		13/3/18	WATER	X	X	X	X		

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 187385
Date Received: 15/3/18 16/3/18
Time Received: 1120
Received by: M7
Temp: Cool/Ambient 8.7
Cooling: Icepack
Security: Intact/Broken/None

Relinquished by (company):	Ramboll	**Received by (company):** ES
Print Name:	Nwakamma Ahubelem	**Print Name:** M7
Date & Time:	14/3/2018	**Date & Time:** 15/3/18 16/3/18 11:20
Signature:		**Signature:**

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: 8.7 (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

Client: Ramboll Environ	**Client Project Name / Number / Site etc (ie report title):** Hydro Groundwater Plume Monitoring - 318000375
Contact person: Nwakamma Ahubelem	**PO No.:**
Project Mgr: Kirsty Greenfield	**Envirolab Quote No. :**
Sampler: Nwakamma Ahubelem	**Date results required:**
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	**Or choose:** standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 **Mob:** 0406 167636	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	**Lab comments:** Highly contaminated
Email: nahubelem@ramboll.com; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required													Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium										Provide as much information about the sample as you can
16 17	W3S		14/3/18	WATER	X	X	X	X										
17 18	E11		13/3/18	WATER	X	X	X	X										
18 19	PUMP		13/3/18	WATER	X	X	X	X										
19 20	N9		13/3/18	WATER	X	X	X	X										
20 21	A7		14/3/18	WATER	X	X	X	X										
21 22	E4		14/3/18	WATER	X	X	X	X										
22 23	W7M		13/3/18	WATER	X	X	X	X										
23 24	W2D		13/3/18	WATER	X	X	X	X										

Relinquished by (company):	Ramboll Environ	**Received by (company):**	ES
Print Name:	Nwakamma Ahubelem	**Print Name:**	
Date & Time:	14/3/2018	**Date & Time:**	15/3/18 / 16/3/18
Signature:		**Signature:**	

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: 8.7 (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book

Envirolab Services Pty Ltd
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12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 187395

Client Details

Client	Ramboll Australia Pty Ltd
Attention	Nwakamma Ahubelem, Kirsty Greenfield
Address	PO Box 560, North Sydney, NSW, 2060

Sample Details

Your Reference	**Hydro GW Plume Monitoring - 318000375**
Number of Samples	23 Water
Date samples received	15/03/18 & 16/03/18
Date completed instructions received	16/03/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	23/03/2018
Date of Issue	03/04/2018
Reissue Details	This report replaces R00 created on 23/03/2018 due to: Reanalysis of the Aluminium results

NATA Accreditation Number 2901. This document shall not be reproduced except in full.

Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Loren Bardwell, Senior Chemist
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		187395-1	187395-2	187395-3	187395-4	187395-5
Your Reference	UNITS	BLANK	DUP1	DUP2	F5	W3D
Date Sampled		14/03/2018	13/03/2018	14/03/2018	14/03/2018	14/03/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Fluoride, F	mg/L	<0.1	1	0.2	0.2	0.3
Total Cyanide	mg/L	<0.004	0.023	<0.004	<0.004	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Miscellaneous Inorganics						
Our Reference		187395-6	187395-7	187395-8	187395-9	187395-10
Your Reference	UNITS	G2	G6	G5	W6D	W5D
Date Sampled		13/03/2018	13/03/2018	14/03/2018	13/03/2018	14/03/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Fluoride, F	mg/L	0.3	0.4	0.2	0.3	0.5
Total Cyanide	mg/L	<0.004	<0.004	<0.004	0.01	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Miscellaneous Inorganics						
Our Reference		187395-11	187395-12	187395-13	187395-14	187395-15
Your Reference	UNITS	N8	F6	N2	W1D	E5D
Date Sampled		13/03/2018	13/03/2018	13/03/2018	14/03/2018	13/03/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Fluoride, F	mg/L	0.4	0.9	2.1	4.7	16
Total Cyanide	mg/L	0.54	0.024	0.054	0.34	0.60
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Miscellaneous Inorganics						
Our Reference		187395-16	187395-17	187395-18	187395-19	187395-20
Your Reference	UNITS	W3S	E11	PUMP	N9	A7
Date Sampled		14/03/2018	13/03/2018	13/03/2018	13/03/2018	14/03/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018	19/03/2018	19/03/2018
Fluoride, F	mg/L	180	120	220	200	190
Total Cyanide	mg/L	20	7.4	20	15	15
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Miscellaneous Inorganics				
Our Reference		187395-21	187395-22	187395-23
Your Reference	UNITS	E4	W7M	W2D
Date Sampled		14/03/2018	13/03/2018	13/03/2018
Type of sample		Water	Water	Water
Date prepared	-	19/03/2018	19/03/2018	19/03/2018
Date analysed	-	19/03/2018	19/03/2018	19/03/2018
Fluoride, F	mg/L	410	770	1,200
Total Cyanide	mg/L	61	140	300
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004

All metals in water - total						
Our Reference		187395-1	187395-2	187395-3	187395-4	187395-5
Your Reference	UNITS	BLANK	DUP1	DUP2	F5	W3D
Date Sampled		14/03/2018	13/03/2018	14/03/2018	14/03/2018	14/03/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	23/03/2018	23/03/2018	23/03/2018	23/03/2018	23/03/2018
Date analysed	-	23/03/2018	23/03/2018	23/03/2018	23/03/2018	23/03/2018
Aluminium-Total	µg/L	<10	130	150	2,900	1,200

All metals in water - total						
Our Reference		187395-6	187395-7	187395-8	187395-9	187395-10
Your Reference	UNITS	G2	G6	G5	W6D	W5D
Date Sampled		13/03/2018	13/03/2018	14/03/2018	13/03/2018	14/03/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	23/03/2018	23/03/2018	23/03/2018	23/03/2018	23/03/2018
Date analysed	-	23/03/2018	23/03/2018	23/03/2018	23/03/2018	23/03/2018
Aluminium-Total	µg/L	510	27,000	190	470	30

All metals in water - total						
Our Reference		187395-11	187395-12	187395-13	187395-14	187395-15
Your Reference	UNITS	N8	F6	N2	W1D	E5D
Date Sampled		13/03/2018	13/03/2018	13/03/2018	14/03/2018	13/03/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	23/03/2018	23/03/2018	23/03/2018	23/03/2018	23/03/2018
Date analysed	-	23/03/2018	23/03/2018	23/03/2018	23/03/2018	23/03/2018
Aluminium-Total	µg/L	5,100	160	5,200	460	3,400

All metals in water - total						
Our Reference		187395-16	187395-17	187395-18	187395-19	187395-20
Your Reference	UNITS	W3S	E11	PUMP	N9	A7
Date Sampled		14/03/2018	13/03/2018	13/03/2018	13/03/2018	14/03/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	23/03/2018	23/03/2018	23/03/2018	23/03/2018	23/03/2018
Date analysed	-	23/03/2018	23/03/2018	23/03/2018	23/03/2018	23/03/2018
Aluminium-Total	µg/L	80,000	4,400	82,000	540	8,900

All metals in water - total				
Our Reference		187395-21	187395-22	187395-23
Your Reference	UNITS	E4	W7M	W2D
Date Sampled		14/03/2018	13/03/2018	13/03/2018
Type of sample		Water	Water	Water
Date prepared	-	23/03/2018	23/03/2018	23/03/2018
Date analysed	-	23/03/2018	23/03/2018	23/03/2018
Aluminium-Total	µg/L	37,000	10,000	1,100

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-026	Fluoride determined by ion selective electrode (ISE) in accordance with APHA latest edition, 4500-F-C.
Metals-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	187395-2
Date prepared	-			19/03/2018	1	19/03/2018	19/03/2018		19/03/2018	19/03/2018
Date analysed	-			19/03/2018	1	19/03/2018	19/03/2018		19/03/2018	19/03/2018
Fluoride, F	mg/L	0.1	Inorg-026	<0.1	1	<0.1	<0.1	0	90	98
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	102	79
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	95	97

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	187395-7
Date prepared	-			[NT]	11	19/03/2018	19/03/2018		19/03/2018	19/03/2018
Date analysed	-			[NT]	11	19/03/2018	19/03/2018		19/03/2018	19/03/2018
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	11	0.4	0.4	0	94	75
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	11	0.54	0.52	4	88	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	11	<0.004	<0.004	0	92	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	187395-12
Date prepared	-			[NT]	21	19/03/2018	19/03/2018		[NT]	19/03/2018
Date analysed	-			[NT]	21	19/03/2018	19/03/2018		[NT]	19/03/2018
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	21	410	410	0	[NT]	99
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	21	61	62	2	[NT]	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	21	<0.004	<0.004	0	[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	187395-17
Date prepared	-			[NT]	[NT]	[NT]	[NT]	[NT]	[NT]	19/03/2018
Date analysed	-			[NT]	[NT]	[NT]	[NT]	[NT]	[NT]	19/03/2018
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]	98

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	187395-22
Date prepared	-			[NT]	[NT]	[NT]	[NT]	[NT]	[NT]	19/03/2018
Date analysed	-			[NT]	[NT]	[NT]	[NT]	[NT]	[NT]	19/03/2018
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]	99
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]	93
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]	95

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	187395-22
Date prepared	-			23/03/2018	21	23/03/2018	23/03/2018		23/03/2018	23/03/2018
Date analysed	-			23/03/2018	21	23/03/2018	23/03/2018		23/03/2018	23/03/2018
Aluminium-Total	µg/L	10	Metals-022	<10	21	37000	37000	0	105	#

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	187395-5
Date prepared	-			[NT]	4	23/03/2018	23/03/2018		23/03/2018	23/03/2018
Date analysed	-			[NT]	4	23/03/2018	23/03/2018		23/03/2018	23/03/2018
Aluminium-Total	µg/L	10	Metals-022	[NT]	4	2900	3000	3	110	#

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	14	23/03/2018	23/03/2018		[NT]	[NT]
Date analysed	-			[NT]	14	23/03/2018	23/03/2018		[NT]	[NT]
Aluminium-Total	µg/L	10	Metals-022	[NT]	14	460	440	4	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

All metals in water - total:
Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

ENVIROLAB GROUP

Client: Ramboll Environ	Client Project Name / Number / Site etc (ie report title): Hydro Groundwater Plume Monitoring - 318000375
Contact person: Nwakamma Ahubelem	PO No.:
Project Mgr: Kirsty Greenfield	Envirolab Quote No. :
Sampler: Nwakamma Ahubelem	Date results required:
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	Or choose: standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 Mob: 0406 167 636	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	Lab comments: Highly contaminated
Email: nahubelem@ramboll.com; kgreenfield@ramboll.com	

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12 Ashley St, Chatswood, NSW 2067
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Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Environmental Division Sydney
Work Order Reference
ES1808261
Telephone : + 61-2-8784 8555

Sample information

Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	Comments: Provide as much information about the sample as you can
1 1	BLANK		14/3/18	WATER	X	X	X	X	
2 2	DUP1		13/3/18	WATER	X	X	X	X	
3 3	DUP2		14/3/18	WATER	X	X	X	X	
4 —	TRIP1 (1)		14/3/18	WATER	X	X	X	X	
5 4	F5		14/3/18	WATER	X	X	X	X	Forward to ALS
6 5	W3D		14/3/18	WATER	X	X	X	X	
7 6	G2		13/3/18	WATER	X	X	X	X	
8 7	G6		13/3/18	WATER	X	X	X	X	
9 8	G5		14/3/18	WATER	X	X	X	X	
10 9	W6D		13/3/18	WATER	X	X	X	X	
11 10	W5D		14/3/18	WATER	X	X	X	X	
12 11	N8		13/3/18	WATER	X	X	X	X	
13 12	F6		13/3/18	WATER	X	X	X	X	
14 13	N2		13/3/18	WATER	X	X	X	X	
15 14	W1D S-M7		14/3/18	WATER	X	X	X	X	
16 15	E5D		13/3/18	WATER	X	X	X	X	

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200
Job No: 187375
Date Received: 15/3/18 / 16/3/18
Time Received: 1600
Received by: M7
Temp: Cool/Ambient 8.7
Cooling: Icepack
Security: Intact/Broken/None

Relinquished by (company): Ramboll ELS	Received by (company): ELS	*Lab use only:*
Print Name: Nwakamma Ahubelem JACK EMBLEN	Print Name: M7	Samples Received: Cool or Ambient (circle one)
Date & Time: 14/3/2018 19/03/18 12:40	Date & Time: 15/3/18 16/3/18 1600	Temperature Received at: 8.7 (if applicable)
Signature:	Signature:	Transported by: Hand delivered / courier

Form: 302 - Chain of Custody-Client, Issued 16/03/10, Version 4, Page 1 of 1.

Rec: [signature] 19/3/18 1600 10-3

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ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1808261**	Page	: 1 of 2
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Contact	: Sepan Mahamad
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING 318000375	Date Samples Received	: 19-Mar-2018 16:00
Order number	:	Date Analysis Commenced	: 21-Mar-2018
C-O-C number	: ----	Issue Date	: 26-Mar-2018 11:12
Sampler	: NWAKAMMA AHUBELEM		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

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

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

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

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

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**TRIP1**	----	----	----	----
				Client sampling date / time	14-Mar-2018 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**ES1808261-001**	--------	--------	--------	--------
					Result	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	10	µg/L		**170**	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser									
Free Cyanide	----	0.004	mg/L		<0.004	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1808261**	Page	: 1 of 3
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Contact	: Sepan Mahamad
Address	: PO BOX 560 NORTH SYDNEY NSW, AUSTRALIA 2060	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING 318000375	Date Samples Received	: 19-Mar-2018
Order number	:	Date Analysis Commenced	: 21-Mar-2018
C-O-C number	: ----	Issue Date	: 26-Mar-2018
Sampler	: NWAKAMMA AHUBELEM		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 1514180)									
ES1808074-001	Anonymous	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.11	0.11	0.00	0% - 50%
ES1808184-001	Anonymous	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.02	0.02	0.00	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 1510659)									
ES1808261-001	TRIP1	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1510657)									
ES1808286-008	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
ES1808261-001	TRIP1	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 1519393)									
ES1808590-007	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.2	51.0	No Limit
ES1808590-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020T: Total Metals by ICP-MS (QCLot: 1514180)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	97.1	82	120
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 1510659)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	106	88	128
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1510657)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	107	73	133
EK040P: Fluoride by PC Titrator (QCLot: 1519393)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	109	82	116

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 1510659)							
ES1808261-001	TRIP1	EK025SF: Free Cyanide	----	0.2 mg/L	79.5	70	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1510657)							
ES1808261-001	TRIP1	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	75.3	70	130
EK040P: Fluoride by PC Titrator (QCLot: 1519393)							
ES1808261-001	TRIP1	EK040P: Fluoride	16984-48-8	5 mg/L	107	70	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1808261**	Page	: 1 of 4
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Telephone	: +61-2-8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING 318000375	Date Samples Received	: 19-Mar-2018
Site	: ----	Issue Date	: 26-Mar-2018
Sampler	: NWAKAMMA AHUBELEM	No. of samples received	: 1
Order number	:	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Total Metals by ICP-MS - Suite A	0	3	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

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

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

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

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

Method / *Container* / Client Sample ID(s)	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unspecified (EG020A-T)							
TRIP1	**14-Mar-2018**	**22-Mar-2018**	10-Sep-2018	✓	**22-Mar-2018**	10-Sep-2018	✓
EK025SF: Free CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK025SF)							
TRIP1	**14-Mar-2018**	**----**	----	----	**21-Mar-2018**	28-Mar-2018	✓
EK026SF: Total CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK026SF)							
TRIP1	**14-Mar-2018**	**----**	----	----	**21-Mar-2018**	28-Mar-2018	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
TRIP1	**14-Mar-2018**	**----**	----	----	**23-Mar-2018**	11-Apr-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

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

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Fluoride by PC Titrator	EK040P	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	3	**66.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Fluoride by PC Titrator	EK040P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Fluoride by PC Titrator	EK040P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Fluoride by PC Titrator	EK040P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	0	3	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Free CN by Segmented Flow Analyser	EK025SF	WATER	In house: Referenced to ASTM D7237: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C / ASTM D7511. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

ENVIROLAB GROUP

Client: Ramboll	**Client Project Name / Number / Site etc (ie report title):** Hydro Groundwater Plume Monitoring - 318000375
Contact person: NG	**PO No.:**
Project Mgr: Kirsty Greenfield	**Envirolab Quote No. :**
Sampler: NG	**Date results required:**
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	**Or choose:** standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 **Mob:** 0432184301	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	**Lab comments:** Highly contaminated
Email: ngilbert@ramboll.com; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required													Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium									Provide as much information about the sample as you can
1	W1D		28-06-18	WATER	X	X	X	X	X									
2	QA102		28-06-18	WATER	X	X	X	X	X									please send to ALS
3	QA103		28-06-18	WATER	X	X	X	X	X									
4	E4		28-06-18	WATER	X	X	X	X	X									
5	W4S		28-06-18	WATER	X	X	X	X	X									
6	W3S		28-06-18	WATER	X	X	X	X	X									
7	W3D		28-06-18	WATER	X	X	X	X	X									
8	F5		28-06-18	WATER	X	X	X	X	X									
9	A7		28-06-18	WATER	X	X	X	X	X									
10	G5		28-06-18	WATER	X	X	X	X	X									
11	F6		28-06-18	WATER	X	X	X	X	X									
12	G6		28-06-18	WATER	X	X	X	X	X									
13	N2		28-06-18	WATER	X	X	X	X	X									
14	W5D		28-06-18	WATER	X	X	X	X	X									

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 145230

Date Received: 27/6/18
Time Received: 10:45
Received By: MT
Temp: Cool/Ambient 13.4
Cooling: Ice/icepack
Security: Intact/Broken/None

Relinquished by (company):	Ramboll	**Received by (company):**	ES
Print Name:	NATALIE GILBERT	**Print Name:**	MT
Date & Time:		**Date & Time:**	27/6/18 10:45
Signature:		**Signature:**	

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: 13.4 (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book

ENVIROLAB GROUP

Client: Ramboll	**Client Project Name / Number / Site etc (ie report title):** Hydro Groundwater Plume Monitoring - 318000375	**Envirolab Services** 12 Ashley St, Chatswood, NSW 2067 Phone: 02 9910 6200 Fax :02 9910 6201 E-mail: ahie@envirolabservices.com.au Contact: Aileen Hie
Contact person: NG	**PO No.:**	
Project Mgr: Kirsty Greenfield	**Envirolab Quote No. :**	
Sampler: NG	**Date results required:**	**Envirolab Services WA t/a MPL** 16-18 Hayden Crt, Myaree WA 6154 Phone: 08 9317 2505 Fax :08 9317 4163 E-mail: lab@mpl.com.au Contact: Joshua Lim
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	**Or choose:** standard / same day / 1 day / 2 day / 3 day *Note: Inform lab in advance if urgent turnaround is required - surcharge applies*	
Phone: (02) 49625444 **Mob:** 0432184301	**Lab comments:** Highly contaminated	
Fax:		
Email: ngilbert@ramboll.com; kgreenfield@ramboll.com		

Sample information					Tests Required													Comments
Envirolab Sample ID	Client Sample ID or information 195230	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium									Provide as much information about the sample as you can
14 1	E11		27-06-18	WATER	X	X	X	X	X									
15 2	N8		27-06-18	WATER	X	X	X	X	X									
16 3	W6D		27-06-18	WATER	X	X	X	X	X									
17 4	N9		27-06-18	WATER	X	X	X	X	X									
18 5	G2		27-06-18	WATER	X	X	X	X	X									
19 6	E5D		27-06-18	WATER	X	X	X	X	X									
20 7	W7M		27-06-18	WATER	X	X	X	X	X									
21 8	PUMP		27-06-18	WATER	X	X	X	X	X									
22 9	W2D		27-06-18	WATER	X	X	X	X	X									
23 10	QA101		27-06-18	WATER	X	X	X	X	X									
24 11	QC101		27-06-18	WATER	X	X	X	X	X									
25 12	(Extra) TS		16/6/18															
13																		
14																		

Relinquished by (company): Ramboll	**Received by (company):** EL	***Lab use only:***
Print Name: NATALIE GILBERT	**Print Name:** MT	**Samples Received:** Cool or Ambient (circle one)
Date & Time:	**Date & Time:** 21/7/18 10245	**Temperature Received at:** 13.4 (if applicable)
Signature:	**Signature:**	**Transported by:** Hand delivered / courier

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 195230

Client Details

Client	Ramboll Australia Pty Ltd
Attention	Natalie Gilbert, Kirsty Greenfield
Address	PO Box 560, North Sydney, NSW, 2060

Sample Details

Your Reference	**Hydro GW Plume Monitoring - 318000375**
Number of Samples	25 Water
Date samples received	02/07/2018
Date completed instructions received	02/07/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	09/07/2018
Date of Issue	09/07/2018

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Jaimie Loa-Kum-Cheung, Senior Chemist
Priya Samarawickrama, Senior Chemist

Authorised By



Jacinta Hurst, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		195230-1	195230-2	195230-3	195230-4	195230-5
Your Reference	UNITS	W1D	QA103	E4	W4S	W3S
Date Sampled		28/06/2018	28/06/2018	28/06/2018	28/06/2018	28/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Fluoride, F	mg/L	5.0	5.1	350	160	120
Total Cyanide	mg/L	0.69	0.72	69	12	24
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	0.007

Miscellaneous Inorganics						
Our Reference		195230-6	195230-7	195230-8	195230-9	195230-10
Your Reference	UNITS	W3D	F5	A7	G5	F6
Date Sampled		28/06/2018	28/06/2018	28/06/2018	28/06/2018	28/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Fluoride, F	mg/L	0.5	0.2	390	0.4	0.5
Total Cyanide	mg/L	0.036	0.013	87	<0.004	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	0.007	<0.004	<0.004

Miscellaneous Inorganics						
Our Reference		195230-11	195230-12	195230-13	195230-14	195230-15
Your Reference	UNITS	G6	N2	W5D	E11	N8
Date Sampled		28/06/2018	28/06/2018	28/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Fluoride, F	mg/L	0.4	1.5	0.4	120	0.5
Total Cyanide	mg/L	<0.004	0.013	0.004	10	0.67
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Miscellaneous Inorganics						
Our Reference		195230-16	195230-17	195230-18	195230-19	195230-20
Your Reference	UNITS	W6D	N9	G2	E5D	W7M
Date Sampled		27/06/2018	27/06/2018	27/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Fluoride, F	mg/L	<0.1	140	0.3	14	810
Total Cyanide	mg/L	0.005	6.7	0.005	1.6	190
Free Cyanide in Water	mg/L	<0.004	0.004	<0.004	<0.004	0.008

Miscellaneous Inorganics					
Our Reference		195230-21	195230-22	195230-23	195230-24
Your Reference	UNITS	PUMP	W2D	QA101	QC101
Date Sampled		27/06/2018	27/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Fluoride, F	mg/L	62	1,200	14	<0.1
Total Cyanide	mg/L	4.1	330	1.7	<0.004
Free Cyanide in Water	mg/L	<0.004	0.007	<0.004	<0.004

All metals in water - total						
Our Reference		195230-1	195230-2	195230-3	195230-4	195230-5
Your Reference	UNITS	W1D	QA103	E4	W4S	W3S
Date Sampled		28/06/2018	28/06/2018	28/06/2018	28/06/2018	28/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Total	µg/L	860	930	13,000	71,000	16,000

All metals in water - total						
Our Reference		195230-6	195230-7	195230-8	195230-9	195230-10
Your Reference	UNITS	W3D	F5	A7	G5	F6
Date Sampled		28/06/2018	28/06/2018	28/06/2018	28/06/2018	28/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Total	µg/L	1,500	2,200	24,000	900	60

All metals in water - total						
Our Reference		195230-11	195230-12	195230-13	195230-14	195230-15
Your Reference	UNITS	G6	N2	W5D	E11	N8
Date Sampled		28/06/2018	28/06/2018	28/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Total	µg/L	25,000	6,900	160	4,900	4,300

All metals in water - total						
Our Reference		195230-16	195230-17	195230-18	195230-19	195230-20
Your Reference	UNITS	W6D	N9	G2	E5D	W7M
Date Sampled		27/06/2018	27/06/2018	27/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Total	µg/L	19,000	17,000	2,400	4,100	760

All metals in water - total					
Our Reference		195230-21	195230-22	195230-23	195230-24
Your Reference	UNITS	PUMP	W2D	QA101	QC101
Date Sampled		27/06/2018	27/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Total	µg/L	46,000	710	3,800	<10

All metals in water-dissolved						
Our Reference		195230-1	195230-2	195230-3	195230-4	195230-5
Your Reference	UNITS	W1D	QA103	E4	W4S	W3S
Date Sampled		28/06/2018	28/06/2018	28/06/2018	28/06/2018	28/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Dissolved	µg/L	120	140	1,000	380	1,300

All metals in water-dissolved						
Our Reference		195230-6	195230-7	195230-8	195230-9	195230-10
Your Reference	UNITS	W3D	F5	A7	G5	F6
Date Sampled		28/06/2018	28/06/2018	28/06/2018	28/06/2018	28/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Dissolved	µg/L	1,300	1,500	370	<10	<10

All metals in water-dissolved						
Our Reference		195230-11	195230-12	195230-13	195230-14	195230-15
Your Reference	UNITS	G6	N2	W5D	E11	N8
Date Sampled		28/06/2018	28/06/2018	28/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Dissolved	µg/L	26,000	3,100	<10	30	20

All metals in water-dissolved						
Our Reference		195230-16	195230-17	195230-18	195230-19	195230-20
Your Reference	UNITS	W6D	N9	G2	E5D	W7M
Date Sampled		27/06/2018	27/06/2018	27/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Dissolved	µg/L	<10	100	<10	<10	160

All metals in water-dissolved					
Our Reference		195230-21	195230-22	195230-23	195230-24
Your Reference	UNITS	PUMP	W2D	QA101	QC101
Date Sampled		27/06/2018	27/06/2018	27/06/2018	27/06/2018
Type of sample		Water	Water	Water	Water
Date prepared	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Date analysed	-	03/07/2018	03/07/2018	03/07/2018	03/07/2018
Aluminium-Dissolved	µg/L	90	770	<10	<10

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-026	Fluoride determined by ion selective electrode (ISE) in accordance with APHA latest edition, 4500-F-C.
Metals-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	195230-2
Date prepared	-			03/07/2018	1	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Date analysed	-			03/07/2018	1	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Fluoride, F	mg/L	0.1	Inorg-026	<0.1	1	5.0	5.1	2	105	109
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	0.69	0.69	0	96	81
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	92	101

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	195230-12
Date prepared	-			[NT]	11	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Date analysed	-			[NT]	11	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	11	0.4	0.4	0	104	[NT]
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	11	<0.004	<0.004	0	98	76
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	11	<0.004	<0.004	0	98	87

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	195230-22
Date prepared	-			[NT]	21	03/07/2018	03/07/2018		[NT]	03/07/2018
Date analysed	-			[NT]	21	03/07/2018	03/07/2018		[NT]	03/07/2018
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	21	62	62	0	[NT]	110
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	21	4.1	5.1	22	[NT]	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	21	<0.004	<0.004	0	[NT]	[NT]

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	195230-2
Date prepared	-			03/07/2018	1	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Date analysed	-			03/07/2018	1	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Aluminium-Total	µg/L	10	Metals-022	<10	1	860	880	2	101	100

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	195230-22
Date prepared	-			[NT]	11	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Date analysed	-			[NT]	11	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Aluminium-Total	µg/L	10	Metals-022	[NT]	11	25000	25000	0	98	96

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	03/07/2018	03/07/2018		[NT]	[NT]
Date analysed	-			[NT]	21	03/07/2018	03/07/2018		[NT]	[NT]
Aluminium-Total	µg/L	10	Metals-022	[NT]	21	46000	47000	2	[NT]	[NT]

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	195230-9
Date prepared	-			03/07/2018	1	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Date analysed	-			03/07/2018	1	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Aluminium-Dissolved	µg/L	10	Metals-022	<10	1	120	140	15	109	110

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	195230-21
Date prepared	-			[NT]	13	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Date analysed	-			[NT]	13	03/07/2018	03/07/2018		03/07/2018	03/07/2018
Aluminium-Dissolved	µg/L	10	Metals-022	[NT]	13	<10	<10	0	106	106

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	20	03/07/2018	03/07/2018		[NT]	[NT]
Date analysed	-			[NT]	20	03/07/2018	03/07/2018		[NT]	[NT]
Aluminium-Dissolved	µg/L	10	Metals-022	[NT]	20	160	170	6	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

Client: Ramboll	**Client Project Name / Number / Site etc (ie report title):** Hydro Groundwater Plume Monitoring - 318000375
Contact person: NG	**PO No.:**
Project Mgr: Kirsty Greenfield	**Envirolab Quote No. :**
Sampler: NG	**Date results required:**
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	**Or choose:** standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 **Mob:** 0432184301	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	**Lab comments:** Highly contaminated
Email: ngilbert@ramboll.com; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required														Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium										Provide as much information about the sample as you can
1 1	W1D		28-06-18	WATER	X	X	X	X	X										
① AC 2	QA102		28-06-18	WATER	X	X	X	X	X										please send to ALS
2 3	QA103		28-06-18	WATER	X	X	X	X	X										
3 4	E4		28-06-18	WATER	X	X	X	X	X										
4 5	W4S		28-06-18	WATER	X	X	X	X	X										
5 6	W3S		28-06-18	WATER	X	X	X	X	X										
6 7	W3D		28-06-18	WATER	X	X	X	X	X										
7 8	F5		28-06-18	WATER	X	X	X	X	X										
8 9	A7		28-06-18	WATER	X	X	X	X	X										
9 10	G5		28-06-18	WATER	X	X	X	X	X										
10 11	F6		28-06-18	WATER	X	X	X	X	X										
11 12	G6		28-06-18	WATER	X	X	X	X	X										
12 13	N2		28-06-18	WATER	X	X	X	X	X										
13 14	W5D		28-06-18	WATER	X	X	X	X	X										

Environmental Division
Sydney
Work Order Reference
ES1819378

Telephone : +61-2-8784 8555

Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 195230
Date Received: 2/7/18
Time Received: 10:45
Received By: MT
Temp: Cool/Ambient 13.4
Cooling: Icepack
Security: Intact/Broken/None

Relinquished by (company):	Ramboll	ELS	**Received by (company):** ELS
Print Name:	NATALIE GILBERT	JACK GINBLEN	**Print Name:** MT
Date & Time:		02/07/18 12:50	**Date & Time:** 2/7/18 10:45
Signature:			**Signature:**

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: 13.4 (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book

Re: MGould - ALS 2.6.18 17:10

ES1819378

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1819378**	Page	: 1 of 2
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Contact	: Sepan Mahamad
Address	: Eastpoint Complex | Suite 19B, Level 2 50 Glebe Road PO Box 435 THE JUNCTION NSW 2291	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Project	: Hydro Groundwater Plume Monitoring - 318000375	Date Samples Received	: 02-Jul-2018 17:10
Order number	:	Date Analysis Commenced	: 03-Jul-2018
C-O-C number	: ----	Issue Date	: 06-Jul-2018 16:58
Sampler	: NATALIE GILBERT		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

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

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

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

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

- EK025SF: LOR raised for Free Cyanide due to sample matrix.

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**QA102**	----	----	----	----
				Client sampling date / time	28-Jun-2018 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**ES1819378-001**	--------	--------	--------	--------
					Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	10	µg/L		**100**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	10	µg/L		**580**	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser									
Free Cyanide	----	0.004	mg/L		<0.005	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		**0.532**	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**5.9**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1819378**	Page	: 1 of 3
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Contact	: Sepan Mahamad
Address	: Eastpoint Complex | Suite 19B, Level 2 50 Glebe Road PO Box 435 THE JUNCTION NSW 2291	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Project	: Hydro Groundwater Plume Monitoring - 318000375	Date Samples Received	: 02-Jul-2018
Order number	:	Date Analysis Commenced	: 03-Jul-2018
C-O-C number	: ----	Issue Date	: 06-Jul-2018
Sampler	: NATALIE GILBERT		
Site	: ----		
Quote number	: EN/222/17		
No. of samples received	: 1		
No. of samples analysed	: 1		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1779010)									
ES1819471-003	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES1819196-045	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.19	0.20	0.00	0% - 50%
EG020T: Total Metals by ICP-MS (QC Lot: 1778070)									
ES1819435-001	Anonymous	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.37	0.37	0.00	0% - 20%
ES1819345-001	Anonymous	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 1771055)									
ES1819378-001	QA102	EK025SF: Free Cyanide	----	0.004	mg/L	<0.005	<0.005	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1771053)									
ES1819301-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
ES1819309-011	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 1776304)									
ES1819352-004	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	2.5	2.5	0.00	0% - 20%
ES1819530-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.1	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1779010)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	93.2	80	116
EG020T: Total Metals by ICP-MS (QCLot: 1778070)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	106	82	120
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 1771055)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	117	88	128
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1771053)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	114	73	133
EK040P: Fluoride by PC Titrator (QCLot: 1776304)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	99.6	82	116

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 1771055)							
ES1819378-001	QA102	EK025SF: Free Cyanide	----	0.2 mg/L	100	70	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1771053)							
ES1819301-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	88.5	70	130
EK040P: Fluoride by PC Titrator (QCLot: 1776304)							
ES1819352-004	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	107	70	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1819378**	Page	: 1 of 4
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Telephone	: +61-2-8784 8555
Project	: Hydro Groundwater Plume Monitoring - 318000375	Date Samples Received	: 02-Jul-2018
Site	: ----	Issue Date	: 06-Jul-2018
Sampler	: NATALIE GILBERT	No. of samples received	: 1
Order number	:	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Dissolved Metals by ICP-MS - Suite A	0	4	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	0	8	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

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

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

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

Matrix: **WATER**

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

Method / *Container* / Client Sample ID(s)	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
QA102	**28-Jun-2018**	**----**	----	----	**05-Jul-2018**	25-Dec-2018	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
QA102	**28-Jun-2018**	**05-Jul-2018**	25-Dec-2018	✓	**05-Jul-2018**	25-Dec-2018	✓
EK025SF: Free CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK025SF)							
QA102	**28-Jun-2018**	**----**	----	----	**03-Jul-2018**	12-Jul-2018	✓
EK026SF: Total CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK026SF)							
QA102	**28-Jun-2018**	**----**	----	----	**03-Jul-2018**	12-Jul-2018	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
QA102	**28-Jun-2018**	**----**	----	----	**04-Jul-2018**	26-Jul-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

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

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	0	4	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	0	8	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Free CN by Segmented Flow Analyser	EK025SF	WATER	In house: Referenced to ASTM D7237: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C / ASTM D7511. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

Client: Ramboll	Client Project Name / Number / Site etc (ie report title): Hydro Groundwater Plume Monitoring - 318000375
Contact person: NG/JK	PO No.:
Project Mgr: Kirsty Greenfield	Envirolab Quote No. :
Sampler: NG/JK	Date results required:
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	Or choose: standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 Mob: 0421330255	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	Lab comments: Highly contaminated
Email: jkirsch@ramboll.com; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information						Tests Required												Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium									Provide as much information about the sample as you can
1 1	A7		26/09/2018	WATER	X	X	X	X	X									
2 2	E11		25/09/2018	WATER	X	X	X	X	X									
3 3	E5D		25/09/2018	WATER	X	X	X	X	X									
4 4	E4		25/09/2018	WATER	X	X	X	X	X									
5	N,R (lev) E5		25/09/2018	WATER	X	X	X	X	X									
5 6	F5		26/09/2018	WATER	X	X	X	X	X									
6 7	F6		26/09/2018	WATER	X	X	X	X	X									
7 8	G2		26/09/2018	WATER	X	X	X	X	X									
8 9	G5		26/09/2018	WATER	X	X	X	X	X									
9 10	G6		26/09/2018	WATER	X	X	X	X	X									
10 11	N2		25/09/2018	WATER	X	X	X	X	X									
11 12	N8		25/09/2018	WATER	X	X	X	X	X									
12 13	N9		25/09/2018	WATER	X	X	X	X	X									
13 14	PUMP		25/09/2018	WATER	X	X	X	X	X									

ENVIROLAB GROUP
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph: (02) 9910 6200

Job No: 202389
Date Received: 5/10/18
Time Received: 12:00
Received By: [illegible]
Temp: Cool/Ambient
Cooling: ice/icepack
Security: Intact/Broken/None

Relinquished by (company):	Ramboll	Received by (company): [illegible]
Print Name:	JORDYN KIRSCH	Print Name: [illegible]
Date & Time:		Date & Time: 5/10/18
Signature:		Signature:

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

ENVIROLAB GROUP

Client: Ramboll	**Client Project Name / Number / Site etc (ie report title):** Hydro Groundwater Plume Monitoring - 318000375	**Envirolab Services** 12 Ashley St, Chatswood, NSW 2067 Phone: 02 9910 6200 Fax :02 9910 6201 E-mail: ahie@envirolabservices.com.au Contact: Aileen Hie
Contact person: NG/JK	**PO No.:**	
Project Mgr: Kirsty Greenfield	**Envirolab Quote No. :**	
Sampler: NG/JK	**Date results required:**	
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	**Or choose:** standard / same day / 1 day / 2 day / 3 day	**Envirolab Services WA t/a MPL** 16-18 Hayden Crt, Myaree WA 6154 Phone: 08 9317 2505 Fax :08 9317 4163 E-mail: lab@mpl.com.au Contact: Joshua Lim
Phone: (02) 49625444 **Mob:** 0432184301	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*	
Fax:	**Lab comments:** Highly contaminated	
Email: jkirsch@ramboll.com; kgreenfield@ramboll.com		

Sample information					Tests Required													Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium									Provide as much information about the sample as you can
14 15	W1D		26/09/2018	WATER	X	X	X	X	X									
16	N.R (dup) W1S		26/09/2018	WATER	X	X	X	X	X									
15 17	W2D		25/09/2018	WATER	X	X	X	X	X									
18	N.R (dup) W2S		25/09/2018	WATER	X	X	X	X	X									
16 19	W3D		26/09/2018	WATER	X	X	X	X	X									
17 20	W3S		25/09/2018	WATER	X	X	X	X	X									
21	N.R (dup) W4S		25/09/2018	WATER	X	X	X	X	X									
18 22	W5D		25/09/2018	WATER	X	X	X	X	X									
23	N.R (dup) W5S		25/09/2018	WATER	X	X	X	X	X									
19 24	W6D		25/09/2018	WATER	X	X	X	X	X									
25	N.R (dup) W6S		25/09/2018	WATER	X	X	X	X	X									
20 26	W7M		25/09/2018	WATER	X	X	X	X	X									
27	N.R (dup) W7S		25/09/2018	WATER	X	X	X	X	X									
21 28	QA101		26/09/2018	WATER	X	X	X	X	X									

Relinquished by (company): Ramboll	**Received by (company):** ENS	***Lab use only:*** 202389
Print Name: JORDYN KIRSCH	**Print Name:** Kevin Ng	**Samples Received:** Cool or Ambient (circle one)
Date & Time:	**Date & Time:** 5/10/18	**Temperature Received at:** (if applicable)
Signature:	**Signature:**	**Transported by:** Hand delivered / courier

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

Client: Ramboll	**Client Project Name / Number / Site etc (ie report title):** Hydro Groundwater Plume Monitoring - 318000375
Contact person: NG/JK	**PO No.:**
Project Mgr: Kirsty Greenfield	**Envirolab Quote No. :**
Sampler: NG/JK	**Date results required:**
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	**Or choose:** standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 **Mob:** 0421330255	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	**Lab comments:** Highly contaminated
Email: jkirsch@ramboll; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required													Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium									Provide as much information about the sample as you can
22 29	QA102		26/09/2018	WATER	X	X	X	X	X									
30	QA103		26/09/2018	WATER	X	X	X	X	X									please send to ALS
23 31	QC101		26/09/2018	WATER	X	X	X	X	X									

Relinquished by (company):	Ramboll	**Received by (company):**	3/10
Print Name:	JORDYN KIRSCH	**Print Name:**	Kevin Ing
Date & Time:		**Date & Time:**	5/10/18
Signature:		**Signature:**	

Lab use only: 202389
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 202389

Client Details

Client	Ramboll Australia Pty Ltd
Attention	Kirsty Greenfield, J Kirsch
Address	PO Box 560, North Sydney, NSW, 2060

Sample Details

Your Reference	**Hydro GW Plume Monitoring - 318000375**
Number of Samples	23 Water
Date samples received	05/10/2018
Date completed instructions received	05/10/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	12/10/2018
Date of Issue	12/10/2018

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Long Pham, Team Leader, Metals
Priya Samarawickrama, Senior Chemist

Authorised By

Jacinta Hurst, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		202389-1	202389-2	202389-3	202389-4	202389-5
Your Reference	UNITS	A7	E11	E5D	E4	F5
Date Sampled		26/09/2018	25/09/2018	25/09/2018	25/09/2018	26/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Fluoride, F	mg/L	450	130	12	380	0.2
Total Cyanide	mg/L	80	8.0	1.2	41	<0.004
Free Cyanide in Water	mg/L	0.009	<0.004	<0.004	<0.004	<0.004

Miscellaneous Inorganics						
Our Reference		202389-6	202389-7	202389-8	202389-9	202389-10
Your Reference	UNITS	F6	G2	G5	G6	N2
Date Sampled		26/09/2018	26/09/2018	26/09/2018	26/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Fluoride, F	mg/L	1.0	0.4	1.3	0.4	1.3
Total Cyanide	mg/L	0.032	0.006	0.01	<0.004	0.01
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Miscellaneous Inorganics						
Our Reference		202389-11	202389-12	202389-13	202389-14	202389-15
Your Reference	UNITS	N8	N9	PUMP	W1D	W2D
Date Sampled		25/09/2018	25/09/2018	25/09/2018	26/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Fluoride, F	mg/L	0.4	170	[NA]	4.5	1,200
Total Cyanide	mg/L	0.56	7.2	44	0.59	280
Free Cyanide in Water	mg/L	<0.004	<0.004	0.010	<0.004	0.029

Miscellaneous Inorganics						
Our Reference		202389-16	202389-17	202389-18	202389-19	202389-20
Your Reference	UNITS	W3D	W3S	W5D	W6D	W7M
Date Sampled		26/09/2018	25/09/2018	25/09/2018	25/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Fluoride, F	mg/L	0.1	96	0.6	0.2	860
Total Cyanide	mg/L	<0.004	14	0.010	0.006	160
Free Cyanide in Water	mg/L	<0.004	0.004	<0.004	<0.004	0.017

Miscellaneous Inorganics				
Our Reference		202389-21	202389-22	202389-23
Your Reference	UNITS	QA101	QA102	QC101
Date Sampled		26/09/2018	26/09/2018	26/09/2018
Type of sample		Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018
Fluoride, F	mg/L	0.1	0.4	<0.1
Total Cyanide	mg/L	<0.004	0.006	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004

All metals in water - total						
Our Reference		202389-1	202389-2	202389-3	202389-4	202389-5
Your Reference	UNITS	A7	E11	E5D	E4	F5
Date Sampled		26/09/2018	25/09/2018	25/09/2018	25/09/2018	26/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018
Aluminium-Total	µg/L	4,400	9,300	2,200	22,000	2,100

All metals in water - total						
Our Reference		202389-6	202389-7	202389-8	202389-9	202389-10
Your Reference	UNITS	F6	G2	G5	G6	N2
Date Sampled		26/09/2018	26/09/2018	26/09/2018	26/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018
Aluminium-Total	µg/L	30	570	40	23,000	4,700

All metals in water - total						
Our Reference		202389-11	202389-12	202389-13	202389-14	202389-15
Your Reference	UNITS	N8	N9	PUMP	W1D	W2D
Date Sampled		25/09/2018	25/09/2018	25/09/2018	26/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018
Aluminium-Total	µg/L	220	950	23,000	380	390

All metals in water - total						
Our Reference		202389-16	202389-17	202389-18	202389-19	202389-20
Your Reference	UNITS	W3D	W3S	W5D	W6D	W7M
Date Sampled		26/09/2018	25/09/2018	25/09/2018	25/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	10/10/2018	10/10/2018	10/10/2018	10/10/2018	10/10/2018
Aluminium-Total	µg/L	900	23,000	90	960	6,600

All metals in water - total				
Our Reference		202389-21	202389-22	202389-23
Your Reference	UNITS	QA101	QA102	QC101
Date Sampled		26/09/2018	26/09/2018	26/09/2018
Type of sample		Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	10/10/2018	10/10/2018	10/10/2018
Aluminium-Total	µg/L	950	490	<10

All metals in water-dissolved						
Our Reference		202389-1	202389-2	202389-3	202389-4	202389-5
Your Reference	UNITS	A7	E11	E5D	E4	F5
Date Sampled		26/09/2018	25/09/2018	25/09/2018	25/09/2018	26/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Aluminium-Dissolved	µg/L	200	20	10	420	1,900

All metals in water-dissolved						
Our Reference		202389-6	202389-7	202389-8	202389-9	202389-10
Your Reference	UNITS	F6	G2	G5	G6	N2
Date Sampled		26/09/2018	26/09/2018	26/09/2018	26/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Aluminium-Dissolved	µg/L	<10	<10	<10	22,000	3,800

All metals in water-dissolved						
Our Reference		202389-11	202389-12	202389-13	202389-14	202389-15
Your Reference	UNITS	N8	N9	PUMP	W1D	W2D
Date Sampled		25/09/2018	25/09/2018	25/09/2018	26/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Aluminium-Dissolved	µg/L	30	100	460	140	520

All metals in water-dissolved						
Our Reference		202389-16	202389-17	202389-18	202389-19	202389-20
Your Reference	UNITS	W3D	W3S	W5D	W6D	W7M
Date Sampled		26/09/2018	25/09/2018	25/09/2018	25/09/2018	25/09/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Aluminium-Dissolved	µg/L	910	1,100	<10	<10	140

All metals in water-dissolved				
Our Reference		202389-21	202389-22	202389-23
Your Reference	UNITS	QA101	QA102	QC101
Date Sampled		26/09/2018	26/09/2018	26/09/2018
Type of sample		Water	Water	Water
Date prepared	-	09/10/2018	09/10/2018	09/10/2018
Date analysed	-	09/10/2018	09/10/2018	09/10/2018
Aluminium-Dissolved	µg/L	1,000	<10	<10

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjsuted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hyperchlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-026	Fluoride determined by ion selective electrode (ISE) in accordance with APHA latest edition, 4500-F-C.
Metals-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	202389-2
Date prepared	-			09/10/2018	1	09/10/2018	09/10/2018		09/10/2018	09/10/2018
Date analysed	-			09/10/2018	1	09/10/2018	09/10/2018		09/10/2018	09/10/2018
Fluoride, F	mg/L	0.1	Inorg-026	<0.1	1	450	430	5	97	109
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	80	80	0	102	109
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	0.009	0.009	0	102	82

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	202389-22
Date prepared	-			[NT]	11	09/10/2018	09/10/2018		09/10/2018	09/10/2018
Date analysed	-			[NT]	11	09/10/2018	09/10/2018		09/10/2018	09/10/2018
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	11	0.4	0.4	0	93	99
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	11	0.56	0.59	5	100	81
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	11	<0.004	<0.004	0	101	100

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	09/10/2018	09/10/2018		[NT]	[NT]
Date analysed	-			[NT]	21	09/10/2018	09/10/2018		[NT]	[NT]
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	21	0.1	0.1	0	[NT]	[NT]
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	21	<0.004	<0.004	0	[NT]	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	21	<0.004	<0.004	0	[NT]	[NT]

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	202389-9
Date prepared	-			09/10/2018	7	09/10/2018	09/10/2018		09/10/2018	09/10/2018
Date analysed	-			10/10/2018	7	10/10/2018	10/10/2018		10/10/2018	10/10/2018
Aluminium-Total	µg/L	10	Metals-022	<10	7	570	600	5	99	#

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	202389-20
Date prepared	-			[NT]	10	09/10/2018	09/10/2018		09/10/2018	09/10/2018
Date analysed	-			[NT]	10	10/10/2018	10/10/2018		10/10/2018	10/10/2018
Aluminium-Total	µg/L	10	Metals-022	[NT]	10	4700	4600	2	98	#

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	19	09/10/2018	09/10/2018		[NT]	[NT]
Date analysed	-			[NT]	19	10/10/2018	10/10/2018		[NT]	[NT]
Aluminium-Total	µg/L	10	Metals-022	[NT]	19	960	900	6	[NT]	[NT]

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	202389-6
Date prepared	-			09/10/2018	5	09/10/2018	09/10/2018		09/10/2018	09/10/2018
Date analysed	-			09/10/2018	5	09/10/2018	09/10/2018		09/10/2018	09/10/2018
Aluminium-Dissolved	µg/L	10	Metals-022	<10	5	1900	1900	0	113	105

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	202389-18
Date prepared	-			[NT]	16	09/10/2018	09/10/2018		10/10/2018	09/10/2018
Date analysed	-			[NT]	16	09/10/2018	09/10/2018		10/10/2018	09/10/2018
Aluminium-Dissolved	µg/L	10	Metals-022	[NT]	16	910	920	1	101	100

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	19	09/10/2018	09/10/2018		[NT]	[NT]
Date analysed	-			[NT]	19	09/10/2018	09/10/2018		[NT]	[NT]
Aluminium-Dissolved	µg/L	10	Metals-022	[NT]	19	<10	<10	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

All metals in water - total - # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

CHAIN OF CUSTODY - Client

Envirolab

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Client: Ramboll	Client Project Name / Number / Site etc (ie report title): Hydro Groundwater Plume Monitoring - 318000375
Contact person: NG/JK	PO No.:
Project Mgr: Kirsty Greenfield	Envirolab Quote No. :
Sampler: NG/JK	Date results required:
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	Or choose: standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 Mob: 0421330255	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	Lab comments: Highly contaminated
Email: jkirsch@ramboll; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required															Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium											Provide as much information about the sample as you can
22 29	QA102		26/09/2018	WATER	X	X	X	X	X											
30	QA103		26/09/2018	WATER	X	X	X	X	X											please send to ALS
23 31	QC101		26/09/2018	WATER	X	X	X	X	X											

Environmental Division
Sydney
Work Order Reference
ES1829739
Telephone : +61-2-8784 8555

Relinquished by (company): Ramboll	ELS	Received by (company):	
Print Name: JORDYN KIRSCH	K-Gore	Print Name:	Kevin Ng
Date & Time:	8/10/18 11:30	Date & Time:	5/10/18
Signature:		Signature:	

Lab use only: 202389
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book

Rec - [illegible] 08/10/18 1600 123c

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1829739**	Page	: 1 of 2
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Contact	: Sepan Mahamad
Address	: Eastpoint Complex | Suite 19B, Level 2 50 Glebe Road PO Box 435 THE JUNCTION NSW 2291	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING - 318000375	Date Samples Received	: 08-Oct-2018 16:00
Order number	: ----	Date Analysis Commenced	: 09-Oct-2018
C-O-C number	: ----	Issue Date	: 12-Oct-2018 12:31
Sampler	: NG/JK		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Raymond Commodore	Instrument Chemist	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

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

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

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

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

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**QA103**	----	----	----	----
				Client sampling date / time	26-Sep-2018 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**ES1829739-001**	--------	--------	--------	--------
					Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	10	µg/L		<10	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.37**	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser									
Free Cyanide	----	0.004	mg/L		<0.004	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		**0.010**	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	100	µg/L		**400**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1829739**	Page	: 1 of 3
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Contact	: Sepan Mahamad
Address	: Eastpoint Complex | Suite 19B, Level 2 50 Glebe Road PO Box 435 THE JUNCTION NSW 2291	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49344354	Telephone	: +61-2-8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING - 318000375	Date Samples Received	: 08-Oct-2018
Order number	: ----	Date Analysis Commenced	: 09-Oct-2018
C-O-C number	: ----	Issue Date	: 12-Oct-2018
Sampler	: NG/JK		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Raymond Commodore	Instrument Chemist	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 1973729)									
ES1829702-001	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EN1806453-001	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.01	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 1975505)									
ES1829480-001	Anonymous	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	4.24	4.17	1.68	0% - 20%
ES1829986-005	Anonymous	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.39	0.41	5.12	0% - 20%
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 1970563)									
ES1829734-001	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 1970560)									
ES1829675-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 1972010)									
ES1829519-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	2.4	2.5	0.00	0% - 20%

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 1973729)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	93.0	80	116
EG020T: Total Metals by ICP-MS (QCLot: 1975505)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	102	82	120
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 1970563)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	112	88	128
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1970560)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	111	73	133
EK040P: Fluoride by PC Titrator (QCLot: 1972010)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	106	82	116

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 1970563)							
ES1829734-001	Anonymous	EK025SF: Free Cyanide	----	0.2 mg/L	102	70	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 1970560)							
ES1829675-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	97.7	70	130
EK040P: Fluoride by PC Titrator (QCLot: 1972010)							
ES1829519-001	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	127	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1829739**	Page	: 1 of 4
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Telephone	: +61-2-8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING - 318000375	Date Samples Received	: 08-Oct-2018
Site	: ----	Issue Date	: 12-Oct-2018
Sampler	: NG/JK	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Dissolved Metals by ICP-MS - Suite A	0	4	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	0	11	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

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

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

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

Matrix: **WATER**

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

Method / *Container* / Client Sample ID(s)	*Sample Date*	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	*Date analysed*	*Due for analysis*	*Evaluation*
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
QA103	**26-Sep-2018**	**----**	----	----	**10-Oct-2018**	25-Mar-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
QA103	**26-Sep-2018**	**11-Oct-2018**	25-Mar-2019	✓	**11-Oct-2018**	25-Mar-2019	✓
EK025SF: Free CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK025SF)							
QA103	**26-Sep-2018**	**----**	----	----	**09-Oct-2018**	10-Oct-2018	✓
EK026SF: Total CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK026SF)							
QA103	**26-Sep-2018**	**----**	----	----	**09-Oct-2018**	10-Oct-2018	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
QA103	**26-Sep-2018**	**----**	----	----	**09-Oct-2018**	24-Oct-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

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

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	4	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	4	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	0	4	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	4	**25.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	0	11	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Free CN by Segmented Flow Analyser	EK025SF	WATER	In house: Referenced to ASTM D7237: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C / ASTM D7511. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

CoC 19/12/18 15:41

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP

Client: Ramboll	Client Project Name / Number / Site etc (ie report title): Hydro Groundwater Plume Monitoring - 318000375
Contact person: NG/JK	PO No.:
Project Mgr: Kirsty Greenfield	Envirolab Quote No. :
Sampler: JK	Date results required:
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	Or choose: standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 Mob: 0421330255	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	Lab comments: Highly contaminated
Email: jkirsch@ramboll.com; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required													Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium									Provide as much information about the sample as you can
1	A7		19/12/2018	WATER	X	X	X	X	X									
2	E11		18/12/2018	WATER	X	X	X	X	X									
3	E5D		18/12/2018	WATER	X	X	X	X	X									
4	E4		18/12/2018	WATER	X	X	X	X	X									
5	F5		19/12/2018	WATER	X	X	X	X	X									
6	F6		18/12/2018	WATER	X	X	X	X	X									
7	G2		18/12/2018	WATER	X	X	X	X	X									
8	G5		18/12/2018	WATER	X	X	X	X	X									
9	G6		18/12/2018	WATER	X	X	X	X	X									
10	N2		18/12/2018	WATER	X	X	X	X	X									
11	N8		18/12/2018	WATER	X	X	X	X	X									
12	N9		18/12/2018	WATER	X	X	X	X	X									
13	PUMP		18/12/2018	WATER	X	X	X	X	X									
14	W1D		19/12/2018	WATER	X	X	X	X	X									

ENVIROLAB GROUP
Envirolab Services
12 Ashley St
Chatswood NSW 2067
Ph (02) 9910 6200

Job No: 205784
Date Received: 27/12/18
Time Received: 10'45
Received By: MT
Temp: Cool/Ambient
Cooling: Ice/Gel Pack 10.9
Security: Intact/Broken/None

Relinquished by (company): Ramboll	Received by (company): ES
Print Name: JORDYN KIRSCH	Print Name: Ming Yan Zo.
Date & Time:	Date & Time: 27/12/18 10:45
Signature:	Signature:

Lab use only:
Samples Received: (Cool) or Ambient (circle one)
Temperature Received at: 10.9 (if applicable)
Transported by: Hand delivered / courier

CoC: 19/12 15:41

ENVIROLAB GROUP

Client: Ramboll	Client Project Name / Number / Site etc (ie report title): Hydro Groundwater Plume Monitoring - 318000375
Contact person: NG/JK	PO No.:
Project Mgr: Kirsty Greenfield	Envirolab Quote No. :
Sampler: NG/JK	Date results required:
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	Or choose: standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 Mob: 0432184301	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	Lab comments: Highly contaminated
Email: jkirsch@ramboll.com; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required														Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium										Provide as much information about the sample as you can
15	W2D		18/12/2018	WATER	X	X	X	X	X										
16	W2S		18/12/2018	WATER	X	X	X	X	X										
17	W3D		19/12/2018	WATER	X	X	X	X	X										
18	W3S		19/12/2018	WATER	X	X	X	X	X										
19	W5D		18/12/2018	WATER	X	X	X	X	X										
20	W6D		18/12/2018	WATER	X	X	X	X	X										
21	W7M		18/12/2018	WATER	X	X	X	X	X										
22	QA101		18/12/2018	WATER	X	X	X	X	X										
23	QA102		19/12/2018	WATER	X	X	X	X	X										
ALS — 24	QA103		19/12/2018	WATER	X	X	X	X	X										please send to ALS
(24) 25	QC101		19/12/2018	WATER	X	X	X	X	X										
26																			
27																			
28																			

Relinquished by (company):	Ramboll	Received by (company): ENL
Print Name:	JORDYN KIRSCH	Print Name: 27/12/18 @ 10:40
Date & Time:		Date & Time: Ming Yan Zo
Signature:		Signature:

205784

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
ph 02 9910 6200 fax 02 9910 6201
customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 208784

Client Details

Client	Ramboll (Newcastle) Australia Pty Ltd
Attention	J Kirsch
Address	Suite 18, Level 2, 50 Glebe Rd, The Junction, NSW, 2291

Sample Details

Your Reference	**Hydro GW Plume Monitoring - 318000375**
Number of Samples	24 Water
Date samples received	27/12/2018
Date completed instructions received	27/12/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	09/01/2019
Date of Issue	14/01/2019
Reissue Details	This report replaces R00 created on 09/01/2019 due to: amendment to the cyanide results for samples 207874-11,13,14 and 15

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Long Pham, Team Leader, Metals
Nick Sarlamis, Inorganics Supervisor

Authorised By



Jacinta Hurst, Laboratory Manager

Miscellaneous Inorganics						
Our Reference		208784-1	208784-2	208784-3	208784-4	208784-5
Your Reference	UNITS	A7	E11	E5D	E4	F5
Date Sampled		19/12/2018	18/12/2018	18/12/2018	18/12/2018	19/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	28/12/2018	28/12/2018	28/12/2018	28/12/2018	28/12/2018
Date analysed	-	28/12/2018	28/12/2018	28/12/2018	28/12/2018	28/12/2018
Fluoride, F	mg/L	410	49	11	410	0.2
Total Cyanide	mg/L	54	0.65	0.81	48	<0.004
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	0.006	<0.004

Miscellaneous Inorganics						
Our Reference		208784-6	208784-7	208784-8	208784-9	208784-10
Your Reference	UNITS	F6	G2	G5	G6	N2
Date Sampled		18/12/2018	18/12/2018	18/12/2018	18/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	28/12/2018	28/12/2018	28/12/2018	28/12/2018	28/12/2018
Date analysed	-	28/12/2018	28/12/2018	28/12/2018	28/12/2018	28/12/2018
Fluoride, F	mg/L	0.6	0.3	0.2	0.7	1.4
Total Cyanide	mg/L	0.005	<0.004	<0.004	<0.004	0.005
Free Cyanide in Water	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004

Miscellaneous Inorganics						
Our Reference		208784-11	208784-12	208784-13	208784-14	208784-15
Your Reference	UNITS	N8	N9	PUMP	W1D	W2D
Date Sampled		18/12/2018	18/12/2018	18/12/2018	19/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	28/12/2018	28/12/2018	28/12/2018	28/12/2018	03/01/2019
Date analysed	-	28/12/2018	28/12/2018	28/12/2018	28/12/2018	03/01/2019
Fluoride, F	mg/L	0.4	160	250	4.8	1,200
Total Cyanide	mg/L	0.60	7.4	14	0.67	330
Free Cyanide in Water	mg/L	<0.004	<0.004	0.009	<0.004	0.009

Miscellaneous Inorganics						
Our Reference		208784-16	208784-17	208784-18	208784-19	208784-20
Your Reference	UNITS	W2S	W3D	W3S	W5D	W6D
Date Sampled		18/12/2018	19/12/2018	19/12/2018	18/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Date analysed	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Fluoride, F	mg/L	92	0.1	100	0.6	0.2
Total Cyanide	mg/L	3.9	<0.004	15	<0.004	<0.004
Free Cyanide in Water	mg/L	0.01	<0.004	0.008	<0.004	<0.004

Miscellaneous Inorganics					
Our Reference		208784-21	208784-22	208784-23	208784-24
Your Reference	UNITS	W7M	QA101	QA102	QC101
Date Sampled		18/12/2018	18/12/2018	19/12/2018	19/12/2018
Type of sample		Water	Water	Water	Water
Date prepared	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Date analysed	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Fluoride, F	mg/L	820	11	4.8	<0.1
Total Cyanide	mg/L	130	0.82	0.45	<0.004
Free Cyanide in Water	mg/L	0.007	<0.004	<0.004	<0.004

All metals in water - total						
Our Reference		208784-1	208784-2	208784-3	208784-4	208784-5
Your Reference	UNITS	A7	E11	E5D	E4	F5
Date Sampled		19/12/2018	18/12/2018	18/12/2018	18/12/2018	19/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Date analysed	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Aluminium-Total	µg/L	1,000	6,400	720	1,700	2,000

All metals in water - total						
Our Reference		208784-6	208784-7	208784-8	208784-9	208784-10
Your Reference	UNITS	F6	G2	G5	G6	N2
Date Sampled		18/12/2018	18/12/2018	18/12/2018	18/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Date analysed	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Aluminium-Total	µg/L	50	1,500	210	25,000	5,000

All metals in water - total						
Our Reference		208784-11	208784-12	208784-13	208784-14	208784-15
Your Reference	UNITS	N8	N9	PUMP	W1D	W2D
Date Sampled		18/12/2018	18/12/2018	18/12/2018	19/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Date analysed	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Aluminium-Total	µg/L	350	280	5,400	430	1,000

All metals in water - total						
Our Reference		208784-16	208784-17	208784-18	208784-19	208784-20
Your Reference	UNITS	W2S	W3D	W3S	W5D	W6D
Date Sampled		18/12/2018	19/12/2018	19/12/2018	18/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Date analysed	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Aluminium-Total	µg/L	37,000	1,000	21,000	40	2,400

All metals in water - total					
Our Reference		208784-21	208784-22	208784-23	208784-24
Your Reference	UNITS	W7M	QA101	QA102	QC101
Date Sampled		18/12/2018	18/12/2018	19/12/2018	19/12/2018
Type of sample		Water	Water	Water	Water
Date prepared	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Date analysed	-	03/01/2019	03/01/2019	03/01/2019	03/01/2019
Aluminium-Total	µg/L	310	600	510	<10

All metals in water-dissolved						
Our Reference		208784-1	208784-2	208784-3	208784-4	208784-5
Your Reference	UNITS	A7	E11	E5D	E4	F5
Date Sampled		19/12/2018	18/12/2018	18/12/2018	18/12/2018	19/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Date analysed	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Aluminium-Dissolved	µg/L	250	100	30	800	1,700

All metals in water-dissolved						
Our Reference		208784-6	208784-7	208784-8	208784-9	208784-10
Your Reference	UNITS	F6	G2	G5	G6	N2
Date Sampled		18/12/2018	18/12/2018	18/12/2018	18/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Date analysed	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Aluminium-Dissolved	µg/L	<10	10	30	23,000	3,900

All metals in water-dissolved						
Our Reference		208784-11	208784-12	208784-13	208784-14	208784-15
Your Reference	UNITS	N8	N9	PUMP	W1D	W2D
Date Sampled		18/12/2018	18/12/2018	18/12/2018	19/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Date analysed	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Aluminium-Dissolved	µg/L	60	80	1,900	250	690

All metals in water-dissolved						
Our Reference		208784-16	208784-17	208784-18	208784-19	208784-20
Your Reference	UNITS	W2S	W3D	W3S	W5D	W6D
Date Sampled		18/12/2018	19/12/2018	19/12/2018	18/12/2018	18/12/2018
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Date analysed	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Aluminium-Dissolved	µg/L	11,000	1,000	3,200	<10	20

All metals in water-dissolved					
Our Reference		208784-21	208784-22	208784-23	208784-24
Your Reference	UNITS	W7M	QA101	QA102	QC101
Date Sampled		18/12/2018	18/12/2018	19/12/2018	19/12/2018
Type of sample		Water	Water	Water	Water
Date prepared	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Date analysed	-	02/01/2019	02/01/2019	02/01/2019	02/01/2019
Aluminium-Dissolved	µg/L	220	20	210	<10

Method ID	Methodology Summary
Inorg-014	Cyanide - free, total, weak acid dissociable by segmented flow analyser (in line dialysis with colourimetric finish). Solids/Filters and sorbents are extracted in a caustic media prior to analysis. Impingers are pH adjsuted as required prior to analysis. Cyanides amenable to Chlorination - samples are analysed untreated and treated with hyperchlorite to assess the potential for chlorination of cyanide forms. Based on APHA latest edition, 4500-CN_G,H.
Inorg-026	Fluoride determined by ion selective electrode (ISE) in accordance with APHA latest edition, 4500-F-C.
Metals-022	Determination of various metals by ICP-MS.

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	208784-2
Date prepared	-			03/01/2019	1	28/12/2018	28/12/2018		03/01/2019	03/01/2019
Date analysed	-			03/01/2019	1	28/12/2018	28/12/2018		03/01/2019	03/01/2019
Fluoride, F	mg/L	0.1	Inorg-026	<0.1	1	410	420	2	108	98
Total Cyanide	mg/L	0.004	Inorg-014	<0.004	1	54	55	2	103	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	<0.004	1	<0.004	<0.004	0	99	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	208784-3
Date prepared	-			[NT]	2	28/12/2018	28/12/2018		03/01/2019	03/01/2019
Date analysed	-			[NT]	2	28/12/2018	28/12/2018		03/01/2019	03/01/2019
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	2	49	[NT]		110	[NT]
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	2	0.65	0.66	2	102	80
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	2	<0.004	<0.004	0	101	86

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	208784-6
Date prepared	-			[NT]	5	28/12/2018	28/12/2018		[NT]	03/01/2019
Date analysed	-			[NT]	5	28/12/2018	28/12/2018		[NT]	03/01/2019
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	5	0.2	[NT]		[NT]	[NT]
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	5	<0.004	<0.004	0	[NT]	#
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	5	<0.004	<0.004	0	[NT]	84

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	208784-22
Date prepared	-			[NT]	11	28/12/2018	28/12/2018		[NT]	03/01/2019
Date analysed	-			[NT]	11	28/12/2018	28/12/2018		[NT]	03/01/2019
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	11	0.4	0.4	0	[NT]	102
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	11	0.60	[NT]		[NT]	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	11	<0.004	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	03/01/2019	03/01/2019		[NT]	[NT]
Date analysed	-			[NT]	21	03/01/2019	03/01/2019		[NT]	[NT]
Fluoride, F	mg/L	0.1	Inorg-026	[NT]	21	820	820	0	[NT]	[NT]
Total Cyanide	mg/L	0.004	Inorg-014	[NT]	21	130	[NT]		[NT]	[NT]
Free Cyanide in Water	mg/L	0.004	Inorg-014	[NT]	21	0.007	[NT]		[NT]	[NT]

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	208784-5
Date prepared	-			03/01/2019	2	03/01/2019	03/01/2019		03/01/2019	03/01/2019
Date analysed	-			03/01/2019	2	03/01/2019	03/01/2019		03/01/2019	03/01/2019
Aluminium-Total	µg/L	10	Metals-022	<10	2	6400	7100	10	108	#

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W4	208784-19
Date prepared	-			[NT]	10	03/01/2019	03/01/2019		03/01/2019	03/01/2019
Date analysed	-			[NT]	10	03/01/2019	03/01/2019		03/01/2019	03/01/2019
Aluminium-Total	µg/L	10	Metals-022	[NT]	10	5000	4400	13	106	97

QUALITY CONTROL: All metals in water - total						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	20	03/01/2019	03/01/2019		[NT]	[NT]
Date analysed	-			[NT]	20	03/01/2019	03/01/2019		[NT]	[NT]
Aluminium-Total	µg/L	10	Metals-022	[NT]	20	2400	2500	4	[NT]	[NT]

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	208784-2
Date prepared	-			02/01/2019	1	02/01/2019	02/01/2019		02/01/2019	02/01/2019
Date analysed	-			02/01/2019	1	02/01/2019	02/01/2019		02/01/2019	02/01/2019
Aluminium-Dissolved	µg/L	10	Metals-022	<10	1	250	240	4	113	116

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W4	208784-22
Date prepared	-			[NT]	11	02/01/2019	02/01/2019		02/01/2019	02/01/2019
Date analysed	-			[NT]	11	02/01/2019	02/01/2019		02/01/2019	02/01/2019
Aluminium-Dissolved	µg/L	10	Metals-022	[NT]	11	60	60	0	115	113

QUALITY CONTROL: All metals in water-dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	02/01/2019	02/01/2019		[NT]	[NT]
Date analysed	-			[NT]	21	02/01/2019	02/01/2019		[NT]	[NT]
Aluminium-Dissolved	µg/L	10	Metals-022	[NT]	21	220	200	10	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Report Comments

All metals in water - total - # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

CYANIDE # Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

ENVIROLAB GROUP

ENVIROLAB GROUP

Client: Ramboll	Client Project Name / Number / Site etc (ie report title): Hydro Groundwater Plume Monitoring - 318000375
Contact person: NG/JK	PO No.:
Project Mgr: Kirsty Greenfield	Envirolab Quote No. :
Sampler: NG/JK	Date results required:
Address: Level 2 Suite 18, 50 Glebe Road, The Junction	Or choose: standard / same day / 1 day / 2 day / 3 day
Phone: (02) 49625444 Mob: 0432184301	*Note: Inform lab in advance if urgent turnaround is required - surcharge applies*
Fax:	Lab comments: Highly contaminated
Email: jkirsch@ramboll.com; kgreenfield@ramboll.com	

Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Phone: 02 9910 6200 Fax :02 9910 6201
E-mail: ahie@envirolabservices.com.au
Contact: Aileen Hie

Envirolab Services WA t/a MPL
16-18 Hayden Crt, Myaree WA 6154
Phone: 08 9317 2505 Fax :08 9317 4163
E-mail: lab@mpl.com.au
Contact: Joshua Lim

Sample information					Tests Required									Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	Soluble Fluoride	Total Cyanide	Free Cyanide	Total Aluminium	dissolved aluminium					Provide as much information about the sample as you can
15	W2D		18/12/2018	WATER	X	X	X	X	X					
16	W2S		18/12/2018	WATER	X	X	X	X	X					
17	W3D		19/12/2018	WATER	X	X	X	X	X					
18	W3S		19/12/2018	WATER	X	X	X	X	X					
19	W5D		18/12/2018	WATER	X	X	X	X	X					
20	W6D		18/12/2018	WATER	X	X	X	X	X					
21	W7M		18/12/2018	WATER	X	X	X	X	X					
22	QA101		18/12/2018	WATER	X	X	X	X	X					
23	QA102		19/12/2018	WATER	X	X	X	X	X					
24	QA103		19/12/2018	WATER	X	X	X	X	X					
25	QC101		19/12/2018	WATER	X	X	X	X	X					
26														
27														
28														

Environmental Division
Sydney
Work Order Reference
ES1900100
Telephone : +61-2-8784 8555

please send to ALS

Relinquished by (company):	Ramboll	ELS
Print Name:	JORDYN KIRSCH	JYH
Date & Time:		2/1/19 1200
Signature:		

Received by (company):	ELS
Print Name:	27/12 rs 10165
Date & Time:	Ming Yan Zo
Signature:	

Lab use only:
Samples Received: Cool or Ambient (circle one)
Temperature Received at: (if applicable)
Transported by: Hand delivered / courier

205784
Ward
02019 1500

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1900100**	Page	: 1 of 2
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Contact	: Sepan Mahamad
Address	: Eastpoint Complex | Suite 19B, Level 2 50 Glebe Road PO Box 435 THE JUNCTION NSW 2291	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49344354	Telephone	: +61 2 8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING - 318000375	Date Samples Received	: 02-Jan-2019 15:00
Order number	: ----	Date Analysis Commenced	: 03-Jan-2019
C-O-C number	: ----	Issue Date	: 09-Jan-2019 19:58
Sampler	: NG/JK		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

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

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

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

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

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**QA103**	----	----	----	----
				Client sampling date / time	19-Dec-2018 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**ES1900100-001**	--------	--------	--------	--------
					Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	10	µg/L		<10	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	10	µg/L		**760**	----	----	----	----
EK025SF: Free CN by Segmented Flow Analyser									
Free Cyanide	----	0.004	mg/L		<0.004	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		**0.171**	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**5.7**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1900100**	Page	: 1 of 3
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Contact	: Sepan Mahamad
Address	: Eastpoint Complex | Suite 19B, Level 2 50 Glebe Road PO Box 435 THE JUNCTION NSW 2291	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49344354	Telephone	: +61 2 8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING - 318000375	Date Samples Received	: 02-Jan-2019
Order number	: ----	Date Analysis Commenced	: 03-Jan-2019
C-O-C number	: ----	Issue Date	: 09-Jan-2019
Sampler	: NG/JK		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 1		
No. of samples analysed	: 1		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

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

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2122472)									
ES1900093-008	Anonymous	EG020A-F: Aluminium	7429-90-5	0.01	mg/L	0.03	0.02	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2124080)									
ES1900100-001	QA103	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	760 µg/L	0.76	0.00	0% - 20%
ES1900174-001	Anonymous	EG020A-T: Aluminium	7429-90-5	0.01	mg/L	0.02	0.03	43.2	No Limit
EK025SF: Free CN by Segmented Flow Analyser (QC Lot: 2122325)									
ES1900033-001	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.00	No Limit
ES1900033-011	Anonymous	EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK026SF: Total CN by Segmented Flow Analyser (QC Lot: 2122323)									
ES1900033-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
ES1900033-011	Anonymous	EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 2121861)									
ES1900095-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
ES1900088-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	1.4	1.4	0.00	0% - 50%

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2122472)								
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	91.4	80	116
EG020T: Total Metals by ICP-MS (QCLot: 2124080)								
EG020A-T: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	95.0	82	120
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 2122325)								
EK025SF: Free Cyanide	----	0.004	mg/L	<0.004	0.2 mg/L	110	88	128
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 2122323)								
EK026SF: Total Cyanide	57-12-5	0.004	mg/L	<0.004	0.2 mg/L	113	73	133
EK040P: Fluoride by PC Titrator (QCLot: 2121861)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	98.6	82	116

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EK025SF: Free CN by Segmented Flow Analyser (QCLot: 2122325)							
ES1900033-001	Anonymous	EK025SF: Free Cyanide	----	0.2 mg/L	94.7	70	130
EK026SF: Total CN by Segmented Flow Analyser (QCLot: 2122323)							
ES1900033-001	Anonymous	EK026SF: Total Cyanide	57-12-5	0.2 mg/L	102	70	130
EK040P: Fluoride by PC Titrator (QCLot: 2121861)							
ES1900057-001	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	94.2	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1900100**	Page	: 1 of 5
Client	: **RAMBOLL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: KIRSTY GREENFIELD	Telephone	: +61 2 8784 8555
Project	: HYDRO GROUNDWATER PLUME MONITORING - 318000375	Date Samples Received	: 02-Jan-2019
Site	: ----	Issue Date	: 09-Jan-2019
Sampler	: NG/JK	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK025SF: Free CN by Segmented Flow Analyser						
Opaque plastic bottle - NaOH						
QA103	----	----	----	04-Jan-2019	02-Jan-2019	**2**
EK026SF: Total CN by Segmented Flow Analyser						
Opaque plastic bottle - NaOH						
QA103	----	----	----	04-Jan-2019	02-Jan-2019	**2**

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Matrix Spikes (MS)					
Dissolved Metals by ICP-MS - Suite A	0	9	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	0	12	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

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

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

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

Matrix: **WATER**

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

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
QA103	**19-Dec-2018**	**----**	----	----	**04-Jan-2019**	17-Jun-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
QA103	**19-Dec-2018**	**07-Jan-2019**	17-Jun-2019	✓	**07-Jan-2019**	17-Jun-2019	✓
EK025SF: Free CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK025SF)							
QA103	**19-Dec-2018**	**----**	----	----	**04-Jan-2019**	02-Jan-2019	×
EK026SF: Total CN by Segmented Flow Analyser							
Opaque plastic bottle - NaOH (EK026SF)							
QA103	**19-Dec-2018**	**----**	----	----	**04-Jan-2019**	02-Jan-2019	×

Matrix: **WATER**

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

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
QA103	**19-Dec-2018**	**----**	----	----	**03-Jan-2019**	16-Jan-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

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

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	0	9	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Free CN by Segmented Flow Analyser	EK025SF	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Cyanide by Segmented Flow Analyser	EK026SF	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	0	12	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Free CN by Segmented Flow Analyser	EK025SF	WATER	In house: Referenced to ASTM D7237: Using an automated segmented flow analyser, a sample at high pH (sodium hydroxide preserved) is buffered to pH 6.0. The hydrogen cyanide present passes across a gas dialysis membrane into an acceptor stream consisting of 0.01 M sodium hydroxide. The acceptor stream mixes with a buffer at pH 5.2 and reacts with chloramine-T to form cyanogen chloride. Cyanogen chloride reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour, measured at 600nm. This method is compliant with NEPM (2013) Schedule B(3)
Total Cyanide by Segmented Flow Analyser	EK026SF	WATER	In house: Referenced to APHA 4500-CN C / ASTM D7511. Sodium hydroxide preserved samples are introduced into an automated segmented flow analyser. Complex bound cyanide is decomposed in a continuously flowing stream, at a pH of 3.8, by the effect of UV light. A UV-B lamp (312 nm) and a decomposition spiral of borosilicate glass are used to filter out UV light with a wavelength of less than 290 nm thus preventing the conversion of thiocyanate into cyanide. The hydrogen cyanide present at a pH of 3.8 is separated by gas dialysis. The hydrogen cyanide is then determined photometrically, based on the reaction of cyanide with chloramine-T to form cyanogen chloride. This then reacts with 4-pyridine carboxylic acid and 1,3-dimethylbarbituric acid to give a red colour which is measured at 600 nm. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

APPENDIX 6
CALIBRATION CERTIFICATES

ThermoFisher SCIENTIFIC

The world leader in serving science

RENTALS

Equipment Certification Report – TPS 90FLT Water Quality Meter

This Water Quality Meter has been performance checked and calibrated as follows:

Sensor	Concentration	Span 1	Span 2	Traceability Lot #	Pass?
pH	7.00pH/ 4.00pH	7.00 pH	4.00 pH	3007652/312725	☑
Conductivity	12.88mS/cm	0.00 mS/cm	12.88 mS/cm	312392	☑
TDS	36.0ppk	0 ppk	36 ppk	313394	☑
Dissolved Oxygen	Sodium Sulphite / Air	0.00 ppm in Sodium Sulphite	8.77 ppm Saturation in Air	5656 (SS) 306207 (DI)	☑
Turbidity	360 NTU	0 NTU	360 NTU	311757	☑
Redox (ORP)**240mV	☐	Electrode operability test 240mV +/- 10%. Actual: 238 mV		311901(A) 311902 (B)	

☑ Battery Status 7.8 (min 7.2V)
☑ Electrical Safety Tag attached (AS/NZS 3760)

☑ Temperature 23.8 °C
☑ Electrodes Cleaned and checked

Tag No: 000325

Valid to: 14/03/2018

Date: 08/03/2018

Signed: [signature]

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $30 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Returned	Item
☑	☐	90FLMV Unit. Ops check/Battery status: 8.0
☑	☐	pH sensor with wetting cap, 5m
☑	☐	Conductivity/TDS/Temperature K=10 sensor, 5m
☑	☐	Dissolved oxygen YSI5739 sensor with wetting cap, 5m
☑	☐	Turbidity sensor, 5m
☑	☐	Power supply 240V to 12V DC 200mA
☑	☐	Instruction Manual
☑	☐	Quick Guide
☑	☐	Storage solution for pH and ORP sensors
☑	☐	Carry Case
☑	☐	Check to confirm electrical safety (tag must be valid)

Date: 08/03/2018

Signed: [signature]

TFS Reference	CS008437	Return Date:	/ /
Customer Reference		Return Time:	
Equipment ID	90FLTSD	Condition on return:	
Equipment Serial No.	44340		

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RENTALS

EQUIPMENT CERTIFICATION REPORT

Geotech PERISTALTIC PUMP

This Electric Pump has been checked as follows:

Cleaned	Description
☑	Clean and check all components
☐	Check Pump operation

Date: 25 Jun 18

Checked by: Horia Moga

Signature:

Test & Tag # 000559, 2/8/18

Please check that the following items are received and all items are returned. Please clean equipment before returning. **A minimum $30 service/repair charge applies to any unclean or damaged items**

Sent	Received	Returned	Description
☑	☐	☐	Solinst Peristaltic Model 410 Pump
☑	☐	☐	Instruction Sheet
☑	☐	☐	1.5m Lead with Alligator Clips
☑	☐	☐	5/8" Medical Grade Silicone Tubing (pump head)
☑	☐	☐	2 Hose Clamps
☑	☐	☐	Durable Plastic Transporting Case
☑	☐	☐	Packing Foam
☑	☐	☐	12.6, 13.3V Batteries + Battery charger.

Processors Signature/ Initials

CLIENT'S REF: Job No: CS09086

CLIENT'S REF: P/O No: 3180003375

QUOTE NO.:

ID: GP2WA2

SERIAL NO.:

RETURN DATE: / / CONDITION ON RETURN:

TIME:

ThermoFisher SCIENTIFIC

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RENTALS

Equipment Certification Report – In-situ SmarTroll Water Quality Meter

This Water Quality Meter has been performance checked and calibrated as follows:

Sensor	Concentration	Span 1	Span 2	Traceability Lot #	Pass?
pH	pH 7.00 / pH 4.00	7.00 pH	4.00 pH	3109335 / 3189962	☑
Conductivity	12,880 uS/cm	— uS/cm	12880 uS/cm	316592	☑
Dissolved Oxygen	Sodium Sulphite / Air	0.0 % in Sodium Sulphite	100.0 % Saturation in Air	5656(SS) 308207(DI)	☑
Redox (ORP) *	Electrode operability test	240mV +/- 10%	240 mV	316292(A) 317841(B)	☑

☑ Battery Status 100%
☑ Electrical Safety Tag attached (AS/NZS 3760)

☑ Temperature 21.3 °C
☑ Electrodes Cleaned and checked

Tag No: SMART21

Valid to: 04/08/2018

Date: 25/06/2018

Signed: [signature]

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $30 cleaning / service / repair charge may be applied to any unclean or damaged items. Items not returned will be billed for at the full replacement cost.

Sent	Returned	Item
☑	☐	iPod Touch 5 with waterproof casing
☑	☐	pH sensor/Redox (ORP) sensor
☑	☐	Conductivity/TDS sensor
☑	☐	Dissolved oxygen sensor
☑	☐	Red caps for probe and Bluetooth battery pack
☑	☐	Connector cable 9 m
☑	☐	Bluetooth Battery Pack Serial #: 396994
☑	☐	Spare 4 AA batteries
☑	☐	AC charger with USB cable
☑	☐	Car changer with USB cable
☑	☐	Instruction Manual
☑	☐	Quick Guide
☑	☐	Calibration cup with vented cap and sponge
☑	☐	Storage cap with sponge
☑	☐	SS Protective Shroud
☑	☐	SmarTROLL MP Flow Cell
☑	☐	Check to confirm electrical safety (tag must be valid)
☐	☐	_____

Date: 25/06/2018

Signed: [signature]

TFS Reference	CS0090886	Return Date:	/ /
Customer Reference		Return Time:	
Equipment ID	SMART-21	Condition on return:	
Equipment Serial No.	392890		

Oil / Water Interface Meter

Instrument Geotech Interface Meter (60M)
Serial No. 3911

Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Compartment	✓	
	Capacity above 7.9v	✓	
Probe	Cleaned/Decon.	✓	
	Operation	✓	
Connectors	Condition	✓	
		✓	
Tape Check	Cleaned	✓	
Connectors	Checked for cuts	✓	
Instrument Test	At surface level	✓	

Certificate of Calibration

This is to certify that the above instrument has been cleaned and tested.

Calibrated by: Maria Orlova

Calibration date: 13-Dec-18

Next calibration due: 11-Feb-19

Multi Parameter Water Meter

Instrument YSI Quatro Pro Plus
Serial No. 18G103119

airmet
Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH	✓	
	2. mV	✓	
	3. EC	✓	
	4. D.O	✓	
	5. Temp	✓	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. pH 10.00		pH 10.00		318140	pH 9.50
2. pH 7.00		pH 7.00		317272	pH 6.72
3. pH 4.00		pH 4.00		320612	pH 3.92
4. mV		234mV		325420/324357	233.5mV
5. EC		2.76mS		320325	2.75mS
6. D.O		0.00ppm		10175	0.04ppm
7. Temp		21°C		MultiTherm	20.6°C

Calibrated by: Sarah Lian

Calibration date: **14/12/2018**

Next calibration due: **13/01/2019**

APPENDIX 7
HISTORICAL GROUNDWATER FLOW DIRECTION

Shallow Wells



Groundwater contours in the shallow aquifer, July 2013



Groundwater contours in the shallow aquifer, November 2013



Groundwater contours in the shallow aquifer, February 2014



Groundwater contours in the shallow aquifer, June 2014



Groundwater contours in the shallow aquifer, November 2014



Groundwater contours in the shallow aquifer, February 2015



Groundwater contours in the shallow aquifer, June 2015



Groundwater contours in the shallow aquifer, September 2015



Groundwater contours in the shallow aquifer, December 2015



Groundwater contours in the shallow aquifer, April 2016



Groundwater contours in the shallow aquifer, July 2016



Groundwater contours in the shallow aquifer, October 2016



Groundwater contours in the shallow aquifer, December 2016



Groundwater contours in the shallow aquifer, March 2017



Groundwater contours in the shallow aquifer, June 2017



Groundwater contours in the shallow aquifer, September 2017



Groundwater contours in the shallow aquifer, December 2017

Deep Wells



Groundwater contours in the deep aquifer, July 2013



Groundwater contours in the deep aquifer, November 2013



Groundwater contours in the deep aquifer, February 2014



Groundwater contours in the deep aquifer, June 2014



Groundwater contours in the deep aquifer, November 2014



Groundwater contours in the deep aquifer, February 2015



Groundwater contours in the deep aquifer, June 2015



Groundwater contours in the deep aquifer, September 2015



Groundwater contours in the deep aquifer, December 2015



Groundwater contours in the deep aquifer, April 2016



Groundwater contours in the deep aquifer, July 2016



Groundwater contours in the deep aquifer, October 2016



Groundwater contours in the deep aquifer, December 2016



Groundwater contours in the deep aquifer, March 2017



Groundwater contours in the deep aquifer, June 2017



Groundwater contours in the deep aquifer, September 2017



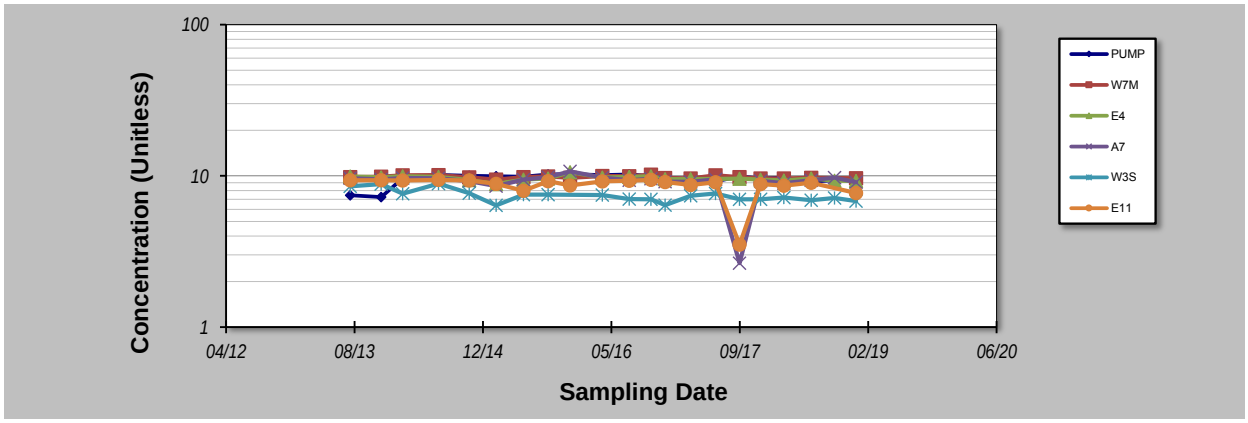
Groundwater contours in the deep aquifer, December 2017

APPENDIX 8
MANN-KENDALL ANALYSIS

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	30-Jan-19	Job ID:	318000375
Facility Name:	Hydro Kurri Kurri	Constituent:	pH
Conducted By:	J.Kirsch	Concentration Units:	Unitless

Sampling Point ID:	PUMP	W7M	E4	A7	W3S	E11	
Sampling Event	Sampling Date	PH CONCENTRATION (Unitless)						
1	29-Jul-13	7.45	9.81	9.91	9.63	8.53	9.36	
2	26-Nov-13	7.24	9.87	9.79	9.47	8.82	9.36	
3	18-Feb-14	9.65	10.1	9.94	9.67	7.61	9.33	
4	7-Jul-14	10.14	10.12	9.84	9.66	8.89	9.41	
5	4-Nov-14	10.01	9.78	9.4	9.24	7.68	9.32	
6	17-Feb-15	9.95	9.44	8.84	8.56	6.38	8.86	
7	3-Jun-15	9.87	9.82	9.46	9.45	7.53	7.97	
8	7-Sep-15	10.22	9.91	9.62	9.8	7.53	9.23	
9	2-Dec-15	10.27	9.7	10.57	10.71		8.65	
10	5-Apr-16	10.13	9.99	9.73	9.75	7.46	9.2	
11	19-Jul-16	10.22	9.95	9.83	9.37	7.02	9.29	
12	12-Oct-16	9.98	10.17	9.94	9.57	7.01	9.41	
13	6-Dec-16	9.72	9.68	9.53	9.15	6.4	9.1	
14	15-Mar-17	9.56	9.61	9.53	9.12	7.4	8.7	
15	20-Jun-17	9.2	10.1		9.49	7.66	9.07	
16	21-Sep-17	9.9	9.8	9.59	2.65	7	3.51	
17	12-Dec-17	9.6	9.6	9.46	9.27	6.99	8.83	
18	13-Mar-18	9.73	9.61	9.32	8.96	7.19	8.62	
19	28-Jun-18	9.17	9.7	9.62	9.36	6.91	9.02	
20	26-Sep-18			9.29	9.75	7.14		
21	19-Dec-18	9.55	9.63	9.27	9.06	6.8	7.7	
22								
23								
24								
25								
Coefficient of Variation:		0.09	0.02	0.04	0.17	0.09	0.15	
Mann-Kendall Statistic (S):		-31	-47	-68	-55	-99	-94	
Confidence Factor:		83.3%	93.2%	98.6%	94.8%	100.0%	99.9%	
Concentration Trend:		Stable	Prob. Decreasing	Decreasing	Prob. Decreasing	Decreasing	Decreasing	



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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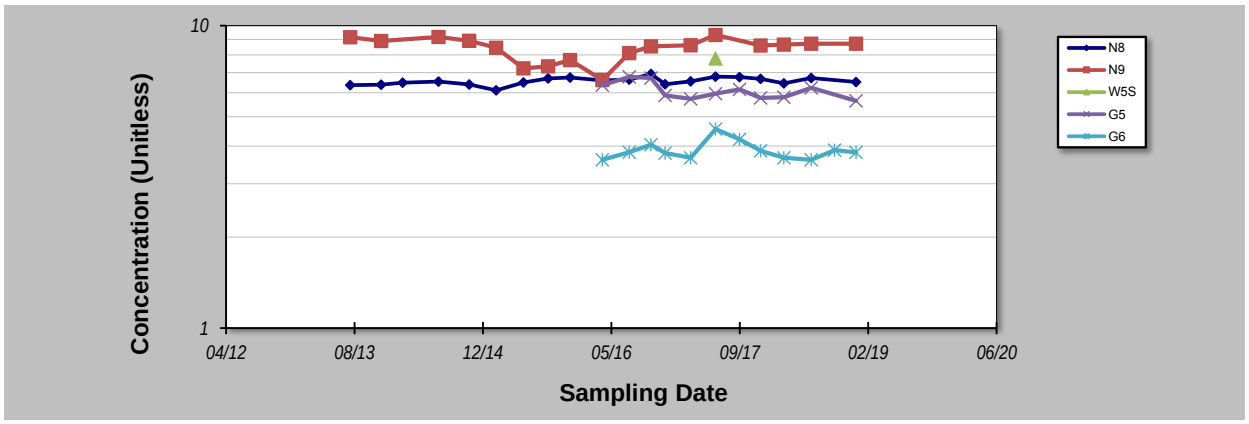
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **J.Kirsch**
Job ID: **318000375**
Constituent: **pH**
Concentration Units: **Unitless**

Sampling Point ID:	N8	N9	W5S	G5	G6		
Sampling Event	Sampling Date	PH CONCENTRATION (Unitless)						
1	29-Jul-13	6.36	9.16					
2	26-Nov-13	6.38	8.9					
3	18-Feb-14	6.48						
4	7-Jul-14	6.53	9.17					
5	4-Nov-14	6.39	8.91					
6	17-Feb-15	6.11	8.46					
7	3-Jun-15	6.49	7.22					
8	7-Sep-15	6.69	7.34					
9	2-Dec-15	6.74	7.7					
10	5-Apr-16	6.59	6.61		6.36	3.6		
11	19-Jul-16	6.63	8.11		6.77	3.82		
12	12-Oct-16	6.92	8.54		6.72	4.04		
13	6-Dec-16	6.4			5.88	3.79		
14	15-Mar-17	6.54	8.61		5.73	3.66		
15	20-Jun-17	6.78	9.32	7.79	5.96	4.55		
16	21-Sep-17	6.76			6.15	4.21		
17	12-Dec-17	6.67	8.6		5.77	3.86		
18	13-Mar-18	6.45	8.65		5.8	3.66		
19	28-Jun-18	6.71	8.72		6.23	3.6		
20	26-Sep-18					3.88		
21	19-Dec-18	6.51	8.72		5.64	3.81		
22								
23								
24								
25								
Coefficient of Variation:		0.03	0.09		0.06	0.07		
Mann-Kendall Statistic (S):		70	7		-23	0		
Confidence Factor:		98.8%	59.6%		95.7%	47.3%		
Concentration Trend:		Increasing	No Trend		Decreasing	Stable		



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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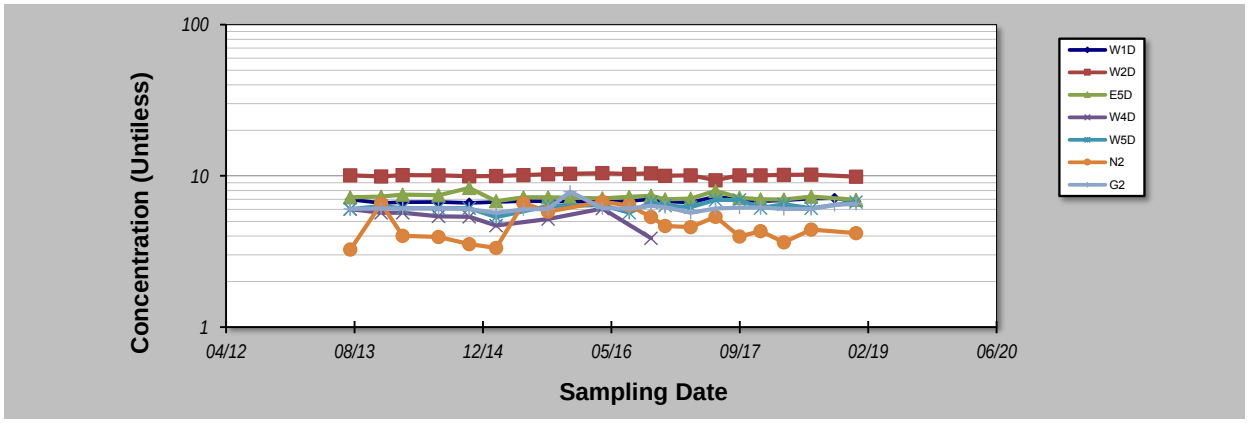
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	30-Jan-19	Job ID:	318000375
Facility Name:	Hydro Kurri Kurri	Constituent:	pH
Conducted By:	J. Kirsch	Concentration Units:	Untiless

Sampling Point ID:	W1D	W2D	E5D	W4D	W5D	N2	G2
Sampling Event	Sampling Date	PH CONCENTRATION (Untiless)						
1	29-Jul-13	6.98	10.09	7.22	6.02	6.02	3.26	6.04
2	26-Nov-13	6.62	9.9	7.29	5.7	6.32	6.54	6.09
3	18-Feb-14	6.7	10.13	7.53	5.7	6.1	4.01	6.09
4	7-Jul-14	6.71	10.1	7.44	5.4	6.11	3.94	6.1
5	4-Nov-14	6.63	9.94	8.32	5.36	6.11	3.54	6.03
6	17-Feb-15		9.99	6.8	4.69	5.34	3.34	5.7
7	3-Jun-15	6.82	10.11	7.23			6.61	6.01
8	7-Sep-15	6.79	10.27	7.23	5.18	6.32	5.81	6.04
9	2-Dec-15		10.34	7.18				7.87
10	5-Apr-16	6.73	10.42	7.1	6.08	6.4	6.75	6.11
11	19-Jul-16	6.82	10.29	7.27		5.7	6.37	6.09
12	12-Oct-16	7.02	10.4	7.39	3.87	6.7	5.35	6.33
13	6-Dec-16	6.78	10.02	7		6.37	4.67	6.22
14	15-Mar-17	6.67	10.07	7.08		6.21	4.59	5.71
15	20-Jun-17	7.3	9.37	7.97		6.94	5.37	6.08
16	21-Sep-17	6.95	10.08	7.16		6.93	3.98	6.16
17	12-Dec-17	6.78	10.1	7		6.13	4.31	6.19
18	13-Mar-18	6.91	10.14	6.97		6.5	3.63	6.05
19	28-Jun-18	7.07	10.18	7.29		6.1	4.41	6.05
20	26-Sep-18	7.12						6.42
21	19-Dec-18	6.76	9.87	6.95		6.72	4.18	6.53
22								
23								
24								
25								
Coefficient of Variation:		0.03	0.02	0.05	0.13	0.06	0.24	0.07
Mann-Kendall Statistic (S):		59	13	-59	-19	54	-9	57
Confidence Factor:		97.9%	65.0%	97.1%	97.0%	97.8%	60.9%	95.4%
Concentration Trend:		Increasing	No Trend	Decreasing	Decreasing	Increasing	Stable	Increasing



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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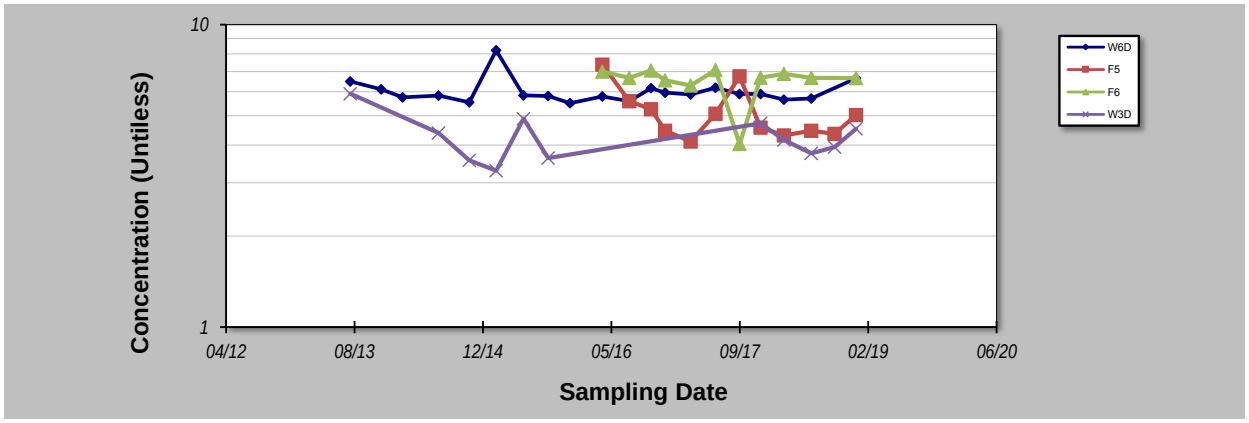
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	30-Jan-19	Job ID:	318000375
Facility Name:	Hydro Kurri Kurri	Constituent:	pH
Conducted By:	J.Kirsch	Concentration Units:	Untiless

Sampling Point ID:	W6D	F5	F6	W3D			
Sampling Event	Sampling Date	PH CONCENTRATION (Untiless)						
1	29-Jul-13	6.49			5.91			
2	26-Nov-13	6.11						
3	18-Feb-14	5.75						
4	7-Jul-14	5.83			4.38			
5	4-Nov-14	5.54			3.56			
6	17-Feb-15	8.22			3.29			
7	3-Jun-15	5.84			4.89			
8	7-Sep-15	5.81			3.62			
9	2-Dec-15	5.5						
10	5-Apr-16	5.79	7.38	6.99				
11	19-Jul-16	5.58	5.58	6.67				
12	12-Oct-16	6.17	5.25	7.05				
13	6-Dec-16	5.96	4.46	6.54				
14	15-Mar-17	5.88	4.11	6.29				
15	20-Jun-17	6.19	5.08	7.08				
16	21-Sep-17	5.9	6.75	4.03				
17	12-Dec-17	5.9	4.57	6.68	4.72			
18	13-Mar-18	5.65	4.3	6.88	4.16			
19	28-Jun-18	5.7	4.46	6.67	3.75			
20	26-Sep-18		4.35		3.94			
21	19-Dec-18	6.65	5.02	6.66	4.53			
22								
23								
24								
25								
Coefficient of Variation:		0.10	0.20	0.13	0.18			
Mann-Kendall Statistic (S):		3	-25	-10	-3			
Confidence Factor:		52.6%	95.0%	75.3%	56.0%			
Concentration Trend:		No Trend	Prob. Decreasing	Stable	Stable			



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
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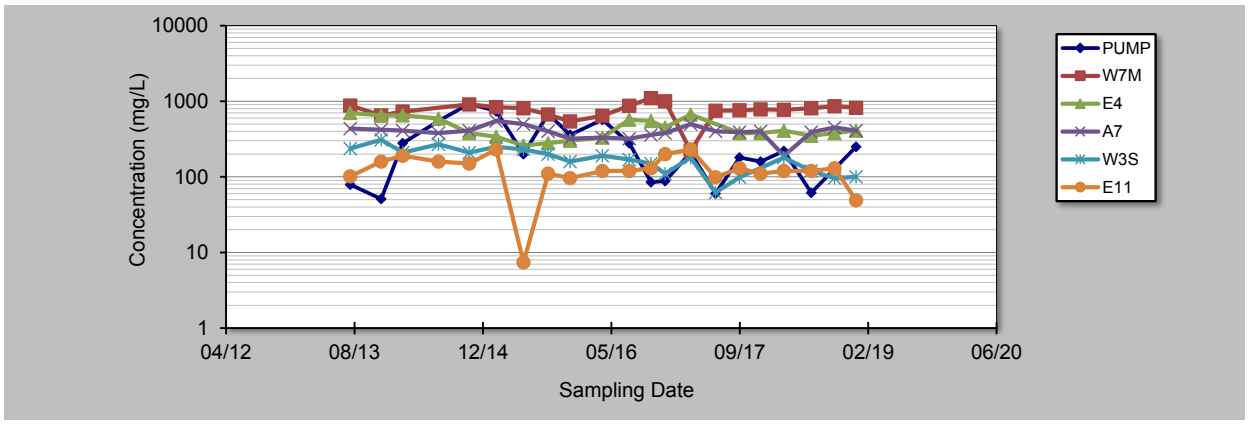
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **J. Kirsch**

Job ID: **318000375**
Constituent: **Soluble Fluoride**
Concentration Units: **mg/L**

Sampling Point ID:	PUMP	W7M	E4	A7	W3S	E11	
Sampling Event	Sampling Date	SOLUBLE FLUORIDE CONCENTRATION (mg/L)						
1	29-Jul-13	79	878	699	436	237	102	
2	26-Nov-13	51	650	650	420	310	160	
3	18-Feb-14	280	730	650	410	210	190	
4	7-Jul-14	550		590	380	270	160	
5	4-Nov-14	930	910	380	410	210	150	
6	17-Feb-15	740	840	340	550	250	230	
7	3-Jun-15	200	810	260	500	230	7.4	
8	7-Sep-15	680	670	280	400	200	110	
9	2-Dec-15	360	540	300	320	160	96	
10	5-Apr-16	570	640	330	330	190	120	
11	19-Jul-16	280	870	570	320	170	120	
12	12-Oct-16	85	1100	550	360	150	130	
13	6-Dec-16	88	1000	450	380	110	200	
14	15-Mar-17	210	220	670	500	180	230	
15	20-Jun-17	60	750		400	62	99	
16	21-Sep-17	180	760	380	390	99	130	
17	12-Dec-17	160	780	380	400		110	
18	13-Mar-18	220	770	410	190	180	120	
19	28-Jun-18	62	810	350	390	120	120	
20	26-Sep-18		860	380	450	96	130	
21	19-Dec-18	250	820	410	410	100	49	
22								
23								
24								
25								
Coefficient of Variation:		0.85	0.23	0.31	0.19	0.37	0.40	
Mann-Kendall Statistic (S):		-37	13	-32	-30	-132	-26	
Confidence Factor:		87.7%	65.0%	84.1%	80.7%	>99.9%	77.2%	
Concentration Trend:		Stable	No Trend	Stable	Stable	Decreasing	Stable	



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
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3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water* , 41(3):355-367, 2003.

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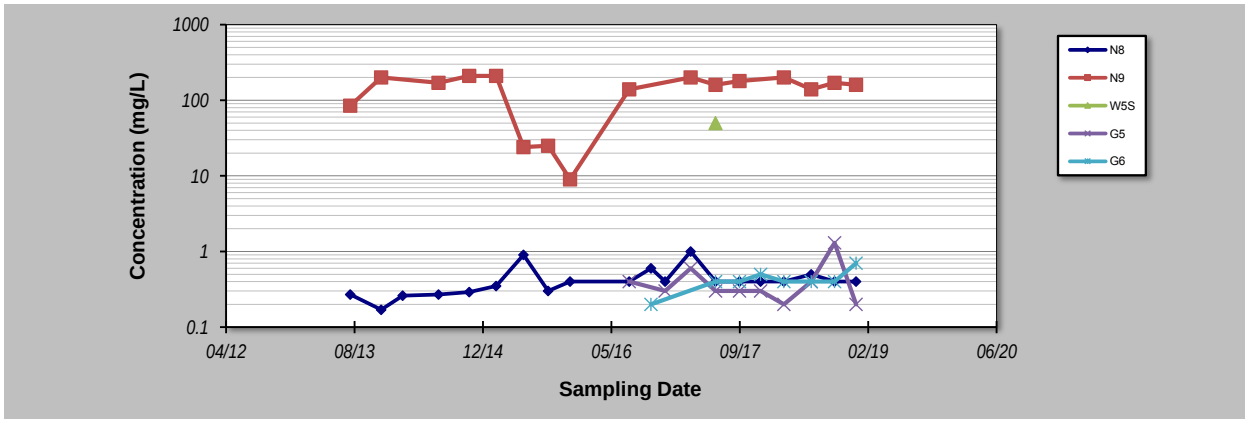
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **J. Kirsch**

Job ID: **318000375**
Constituent: **Soluble Fluoride**
Concentration Units: **mg/L**

Sampling Point ID:	N8	N9	W5S	G5	G6		
Sampling Event	Sampling Date	SOLUBLE FLUORIDE CONCENTRATION (mg/L)						
1	29-Jul-13	0.27	85					
2	26-Nov-13	0.17	200					
3	18-Feb-14	0.26						
4	7-Jul-14	0.27	170					
5	4-Nov-14	0.29	210					
6	17-Feb-15	0.35	210					
7	3-Jun-15	0.9	24					
8	7-Sep-15	0.3	25					
9	2-Dec-15	0.4	9					
10	5-Apr-16							
11	19-Jul-16	0.4	140		0.4			
12	12-Oct-16	0.6				0.2		
13	6-Dec-16	0.4			0.3			
14	15-Mar-17	1	200		0.6			
15	20-Jun-17	0.4	160	50	0.3	0.4		
16	21-Sep-17	0.4	180		0.3	0.4		
17	12-Dec-17	0.4			0.3	0.5		
18	13-Mar-18	0.4	200		0.2	0.4		
19	28-Jun-18	0.5	140		0.4	0.4		
20	26-Sep-18	0.4	170		1.3	0.4		
21	19-Dec-18	0.4	160		0.2	0.7		
22								
23								
24								
25								
Coefficient of Variation:		0.48	0.48		0.76	0.33		
Mann-Kendall Statistic (S):		89	-1		-7	12		
Confidence Factor:		99.8%	50.0%		70.0%	91.1%		
Concentration Trend:		Increasing	Stable		Stable	Prob. Increasing		



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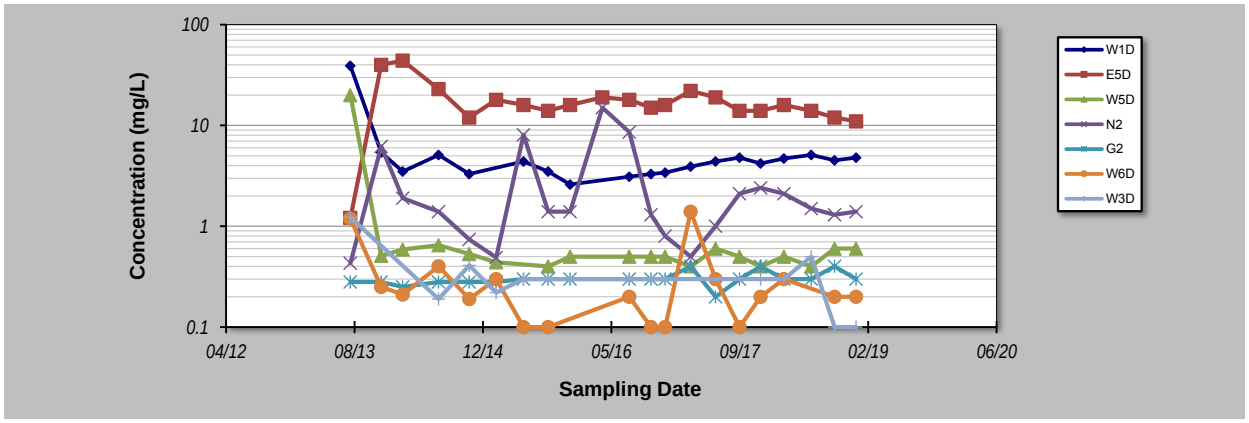
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **J.Kirsch**
Job ID: **318000375**
Constituent: **Soluble Fluoride**
Concentration Units: **mg/L**

Sampling Point ID:	W1D	E5D	W5D	N2	G2	W6D	W3D
Sampling Event	Sampling Date	SOLUBLE FLUORIDE CONCENTRATION (mg/L)						
1	29-Jul-13	39	1.21	20	0.43	0.28	1.19	1.23
2	26-Nov-13	5.4	40	0.51	6.2	0.28	0.25	
3	18-Feb-14	3.5	44	0.59	1.9	0.25	0.21	
4	7-Jul-14	5.1	23	0.65	1.4	0.28	0.4	0.19
5	4-Nov-14	3.3	12	0.53	0.74	0.28	0.19	0.41
6	17-Feb-15		18	0.44	0.49	0.28	0.3	0.22
7	3-Jun-15	4.4	16		8.1	0.3	0.1	0.3
8	7-Sep-15	3.5	14	0.4	1.4	0.3	0.1	0.3
9	2-Dec-15	2.6	16	0.5	1.4	0.3		
10	5-Apr-16		19		15			
11	19-Jul-16	3.1	18	0.5	8.6	0.3	0.2	
12	12-Oct-16	3.3	15	0.5	1.3	0.3	0.1	
13	6-Dec-16	3.4	16	0.5	0.8	0.3	0.1	
14	15-Mar-17	3.9	22	0.4	0.5	0.4	1.4	
15	20-Jun-17	4.4	19	0.6	1	0.2	0.3	
16	21-Sep-17	4.8	14	0.5	2.1	0.3	0.1	
17	12-Dec-17	4.2	14	0.4	2.4	0.4	0.2	0.3
18	13-Mar-18	4.7	16	0.5	2.1	0.3	0.3	0.3
19	28-Jun-18	5.1	14	0.4	1.5	0.3		0.5
20	26-Sep-18	4.5	12	0.6	1.3	0.4	0.2	0.1
21	19-Dec-18	4.8	11	0.6	1.4	0.3	0.2	0.1
22								
23								
24								
25								
Coefficient of Variation:		1.35	0.52	2.92	1.27	0.16	1.12	0.87
Mann-Kendall Statistic (S):		18	-65	-33	10	86	-24	-14
Confidence Factor:		72.2%	97.4%	86.7%	60.6%	99.8%	80.6%	84.0%
Concentration Trend:		No Trend	Decreasing	No Trend	No Trend	Increasing	No Trend	Stable



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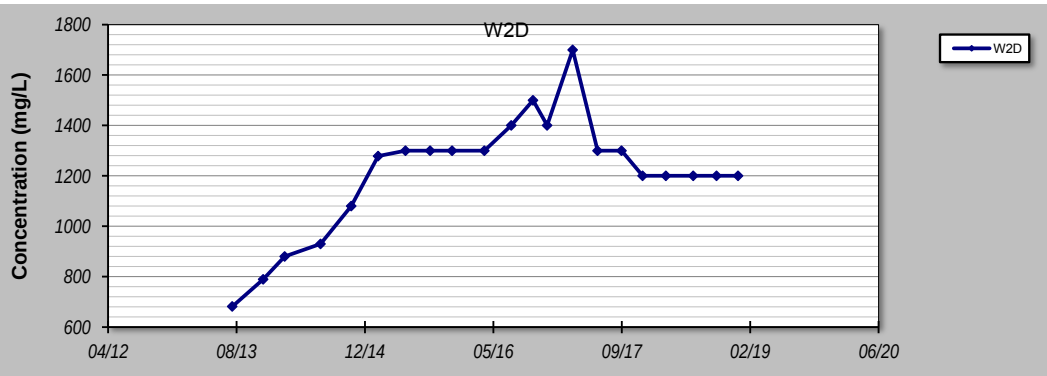
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **J.Kirsch**
Job ID: **318000375**
Constituent: **Soluble Fluoride**
Concentration Units: **mg/L**

Sampling Point ID: **W2D**

Sampling Event	Sampling Date	SOLUBLE FLUORIDE CONCENTRATION (mg/L)
1	29-Jul-13	682
2	26-Nov-13	790
3	18-Feb-14	880
4	7-Jul-14	930
5	4-Nov-14	1080
6	17-Feb-15	1279
7	3-Jun-15	1300
8	7-Sep-15	1300
9	2-Dec-15	1300
10	5-Apr-16	1300
11	19-Jul-16	1400
12	12-Oct-16	1500
13	6-Dec-16	1400
14	15-Mar-17	1700
15	20-Jun-17	1300
16	21-Sep-17	1300
17	12-Dec-17	1200
18	13-Mar-18	1200
19	28-Jun-18	1200
20	26-Sep-18	1200
21	19-Dec-18	1200
22		
23		
24		
25		
Coefficient of Variation:		0.19
Mann-Kendall Statistic (S):		56
Confidence Factor:		95.1%
Concentration Trend:		Increasing



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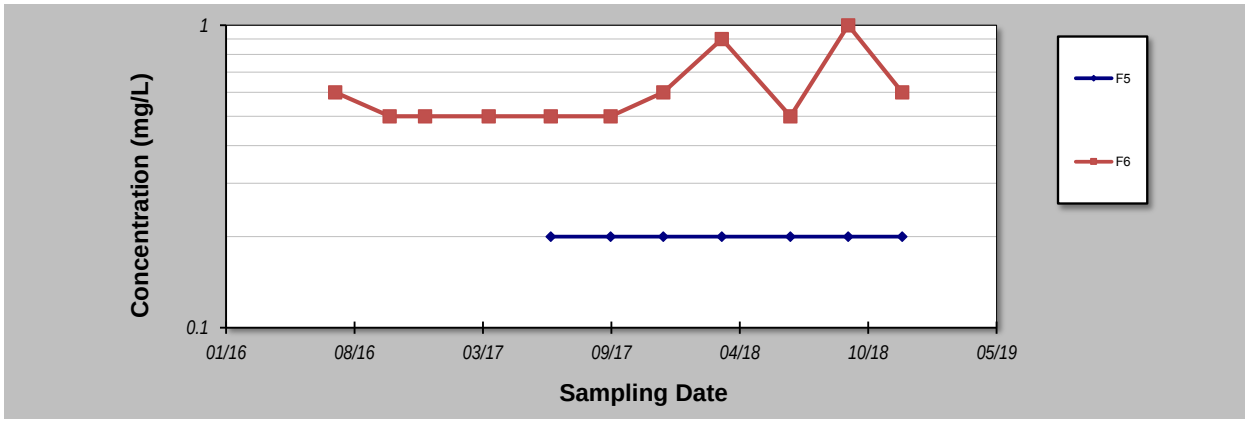
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **J.Kirsch**

Job ID: **318000375**
Constituent: **Soluble Fluoride**
Concentration Units: **mg/L**

Sampling Point ID:	F5	F6					
Sampling Event	Sampling Date	SOLUBLE FLUORIDE CONCENTRATION (mg/L)						
1	5-Apr-16							
2	19-Jul-16		0.6					
3	12-Oct-16		0.5					
4	6-Dec-16		0.5					
5	15-Mar-17		0.5					
6	20-Jun-17	0.2	0.5					
7	21-Sep-17	0.2	0.5					
8	12-Dec-17	0.2	0.6					
9	13-Mar-18	0.2	0.9					
10	28-Jun-18	0.2	0.5					
11	26-Sep-18	0.2	1					
12	19-Dec-18	0.2	0.6					
13								
14								
15								
16								
17								
18								
19								
20								
Coefficient of Variation:		0.00	0.29					
Mann-Kendall Statistic (S):		0	17					
Confidence Factor:		37.9%	89.1%					
Concentration Trend:		Stable	No Trend					



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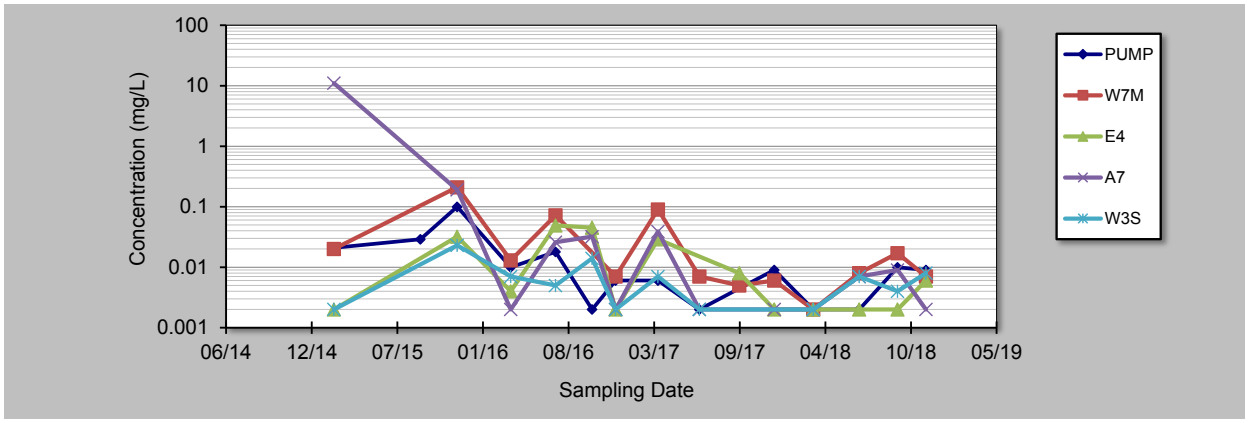
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **Joshua Blackwell**

Job ID: **318000375**
Constituent: **Free Cyanide**
Concentration Units: **mg/L**

Sampling Point ID:	PUMP	W7M	E4	A7	W3S		
Sampling Event	Sampling Date	FREE CYANIDE CONCENTRATION (mg/L)						
1	17-Feb-15	0.021	0.02	0.002	11	0.002		
2	3-Jun-15							
3	7-Sep-15	0.029						
4	2-Dec-15	0.1	0.21	0.032	0.19	0.023		
5	5-Apr-16	0.01	0.013	0.004	0.002	0.007		
6	19-Jul-16	0.018	0.072	0.049	0.026	0.005		
7	12-Oct-16	0.002		0.045	0.032	0.014		
8	6-Dec-16	0.006	0.007	0.002	0.002	0.002		
9	15-Mar-17	0.006	0.09	0.029	0.039	0.007		
10	20-Jun-17	0.002	0.007		0.002	0.002		
11	21-Sep-17		0.005	0.008				
12	12-Dec-17	0.009	0.006	0.002	0.002			
13	13-Mar-18	0.002	0.002	0.002	0.002	0.002		
14	28-Jun-18	0.002	0.008	0.002	0.007	0.007		
15	26-Sep-18	0.01	0.017	0.002	0.009	0.004		
16	1-Dec-18	0.009	0.007	0.006	0.002	0.008		
17								
18								
19								
20								
Coefficient of Variation:		1.58	1.66	1.25	3.50	0.89		
Mann-Kendall Statistic (S):		-36	-29	-21	-27	-3		
Confidence Factor:		97.3%	95.6%	88.6%	94.3%	55.4%		
Concentration Trend:		Decreasing	Decreasing	No Trend	Prob. Decreasing	Stable		



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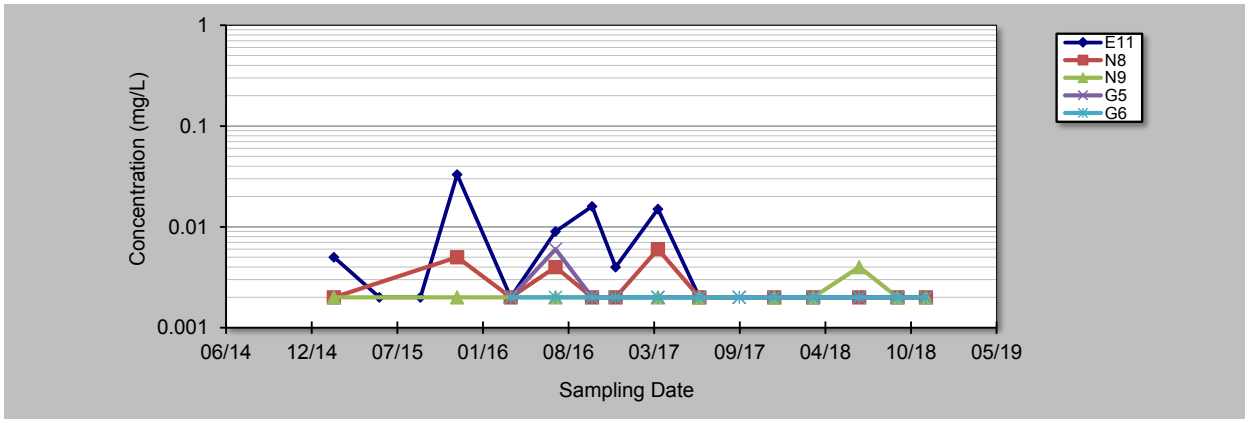
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **Joshua Blackwell**

Job ID: **318000375**
Constituent: **Free Cyanide**
Concentration Units: **mg/L**

Sampling Point ID:	E11	N8	N9	G5	G6		
Sampling Event	Sampling Date	FREE CYANIDE CONCENTRATION (mg/L)						
1	17-Feb-15	0.005	0.002	0.002				
2	3-Jun-15	0.002						
3	7-Sep-15	0.002						
4	2-Dec-15	0.033	0.005	0.002				
5	5-Apr-16	0.002	0.002		0.002	0.002		
6	19-Jul-16	0.009	0.004	0.002	0.006	0.002		
7	12-Oct-16	0.016	0.002		0.002	0.002		
8	6-Dec-16	0.004	0.002		0.002	0.002		
9	15-Mar-17	0.015	0.006	0.002	0.002	0.002		
10	20-Jun-17	0.002	0.002	0.002	0.002	0.002		
11	21-Sep-17				0.002	0.002		
12	12-Dec-17	0.002	0.002	0.002	0.002	0.002		
13	13-Mar-18	0.002	0.002	0.002	0.002	0.002		
14	28-Jun-18	0.002	0.002	0.004	0.002	0.002		
15	26-Sep-18	0.002	0.002	0.002	0.002	0.002		
16	1-Dec-18	0.002	0.002	0.002	0.002	0.002		
17								
18								
19								
20								
Coefficient of Variation:		1.31	0.51	0.29	0.49	0.00		
Mann-Kendall Statistic (S):		-27	-15	5	-9	0		
Confidence Factor:		89.9%	79.9%	63.6%	70.4%	47.3%		
Concentration Trend:		No Trend	Stable	No Trend	Stable	Stable		



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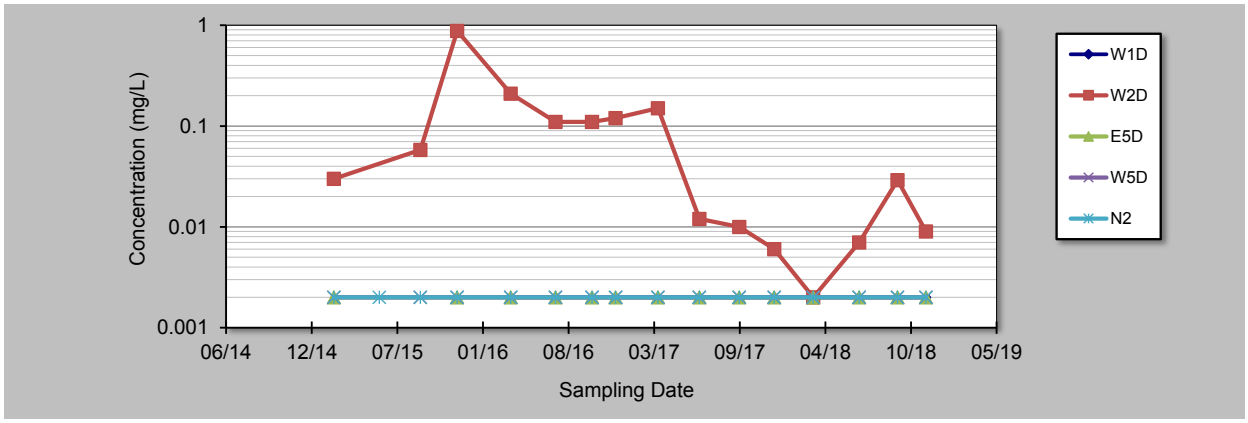
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date: **30-Jan-19**
Facility Name: **Hydro Kurri Kurri**
Conducted By: **Joshua Blackwell**

Job ID: **318000375**
Constituent: **Free Cyanide**
Concentration Units: **mg/L**

Sampling Point ID:	W1D	W2D	E5D	W5D	N2		
Sampling Event	Sampling Date	FREE CYANIDE CONCENTRATION (mg/L)						
1	17-Feb-15		0.03	0.002	0.002	0.002		
2	3-Jun-15					0.002		
3	7-Sep-15		0.058		0.002	0.002		
4	2-Dec-15		0.88	0.002	0.002	0.002		
5	5-Apr-16	0.002	0.21	0.002	0.002	0.002		
6	19-Jul-16	0.002	0.11	0.002	0.002	0.002		
7	12-Oct-16	0.002	0.11	0.002	0.002	0.002		
8	6-Dec-16	0.002	0.12	0.002	0.002	0.002		
9	15-Mar-17	0.002	0.15	0.002	0.002	0.002		
10	20-Jun-17	0.002	0.012	0.002	0.002	0.002		
11	21-Sep-17		0.01	0.002	0.002	0.002		
12	12-Dec-17	0.002	0.006	0.002	0.002	0.002		
13	13-Mar-18	0.002	0.002	0.002	0.002	0.002		
14	28-Jun-18	0.002	0.007	0.002	0.002	0.002		
15	26-Sep-18	0.002	0.029	0.002	0.002	0.002		
16	1-Dec-18	0.002	0.009	0.002	0.002	0.002		
17								
18								
19								
20								
Coefficient of Variation:		0.00	1.90	0.00	0.00	0.00		
Mann-Kendall Statistic (S):		0	-48	0	0	0		
Confidence Factor:		45.1%	99.1%	47.8%	48.0%	48.2%		
Concentration Trend:		Stable	Decreasing	Stable	Stable	Stable		



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2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
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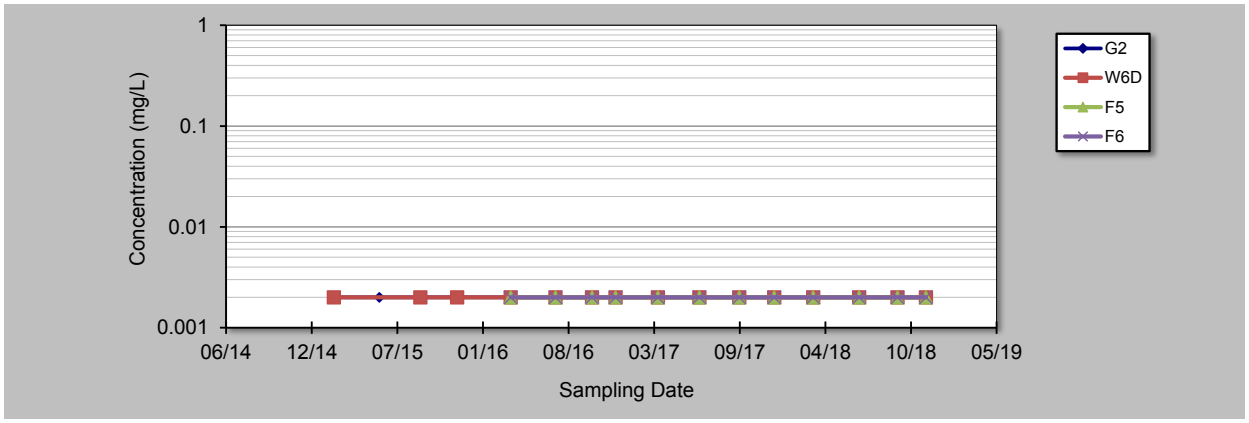
GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	30-Jan-19	Job ID:	318000375
Facility Name:	Hydro Kurri Kurri	Constituent:	Free Cyanide
Conducted By:	Joshua Blackwell	Concentration Units:	mg/L

Sampling Point ID:	G2	W6D	F5	F6			
Sampling Event	Sampling Date	FREE CYANIDE CONCENTRATION (mg/L)						
1	17-Feb-15	0.002	0.002					
2	3-Jun-15	0.002						
3	7-Sep-15		0.002					
4	2-Dec-15	0.002	0.002					
5	5-Apr-16	0.002	0.002	0.002	0.002			
6	19-Jul-16	0.002	0.002	0.002	0.002			
7	12-Oct-16	0.002	0.002	0.002	0.002			
8	6-Dec-16	0.002	0.002	0.002	0.002			
9	15-Mar-17	0.002	0.002	0.002	0.002			
10	20-Jun-17	0.002	0.002	0.002	0.002			
11	21-Sep-17	0.002	0.002	0.002	0.002			
12	12-Dec-17	0.002	0.002	0.002	0.002			
13	13-Mar-18	0.002	0.002	0.002	0.002			
14	28-Jun-18	0.002	0.002	0.002	0.002			
15	26-Sep-18	0.002	0.002	0.002	0.002			
16	1-Dec-18	0.002	0.002	0.002	0.002			
17								
18								
19								
20								
Coefficient of Variation:		0.00	0.00	0.00	0.00			
Mann-Kendall Statistic (S):		0	0	0	0			
Confidence Factor:		48.0%	48.0%	47.3%	47.3%			
Concentration Trend:		Stable	Stable	Stable	Stable			



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
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