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Bringelly Brickworks Groundwater Management Plan

GLOSSARY AND ABBREVIATIONS

BoM	Australian Bureau of Meteorology
CoA	Conditions of Approval for SSD_5684 MOD 1,
CSR	CSR Limited
DP&E	Department of Planning & Environment
DPIE Water	Department of Planning, Industry & Environment- Water
EIS	Bringelly Brickworks Quarry Extension Environmental Impact Statement (Golder and Associates 2013)
EMS	Environmental Management Strategy
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
GDE	Groundwater Dependant Ecosystems
GWMP	Groundwater Management Plan
NOW	NSW Office of Groundwater (Now DPIE Groundwater)
OEH	NSW Office of Environment & Heritage
PIRMP	Pollution Incident Response Management Plan
PGH	PGH Bricks
POEO Act	Protection of the Environment Operations Act 1997
RTS	Bringelly Brickworks Quarry Extension Response to Submissions
Secretary, the	The Secretary of the DP&E
SSD	State Significant Development
TSP	Total Suspended Particulate Matter
VGT	VGT – Environmental Compliance Solutions Pty Ltd – Approved Consultant
WMS	Work method statements
GWMP	Groundwater Management Plan

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INTRODUCTION

1.1 Context

This Groundwater Management Plan (GWMP or Plan) forms part of the Environmental Management Strategy (EMS) for the Bringelly Brickworks (the facility). The Plan has been prepared following the approval of the Bringelly Brickworks Extension Project (SSD_5684) on 3 March 2015 and a Section 96(1A) modification application (MOD1), which was determined on 31 October 2016.

This GWMP has been prepared to address the requirements of the CoA as updated following the determination of MOD1, the mitigation measures listed in the Bringelly Brickworks Quarry Extension Environmental Impact Statement (EIS) and all applicable legislation, licenses and permits.

All relevant environmental plans were prepared and submitted to the DP&E in 2017, this plan represents an updated draft to reflect required amendments and onsite procedures.

1.2 Background

Bringelly Brickworks (the facility) is a clay/shale quarry and brick making facility located at 60 Greendale Road, Bringelly, on Lot 100 in DP 1203966 and comprises an area of approximately 104 hectares in the Camden Local Government Area. The facility has been in operation since 1968, and in its original form it had the capacity to process approximately 51,500 tonnes of bricks per annum.

In 1991, Boral Bricks (NSW) Pty Limited (the then owners) undertook to upgrade the facility with new technology and increase production to ensure the continued economic viability of the site due to the age of the manufacturing plant and machinery. The Council of the Municipality of Camden, as the approving authority at the time, approved the Development Application on 13 September 1991 (Council ref. DA 91/1194). From 1991 until 2013, the Bringelly Brickworks facility operated under this approval, which permitted (among other things) quarry extraction up to 200,000 tonnes per annum, the receipt of up to 96,000 tonnes of supplementary materials and brick production up to 160,000 tonnes per annum.

In 2013, an Environmental Impact Statement (EIS) was prepared to assess the environmental impacts of an increase in production at the facility and continued extraction of the quarry to meet the anticipated demand for its brick products ('Bringelly Brickworks Extension Project', Application No. SSD_5684). The project was determined to be State Significant Development (SSD) under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and Clause 8 *State Environmental Planning Policy (State and Regional Development) 2011* (State and Regional Development SEPP).

A ground water quality assessment was completed as part of the EIS for the project by specialist water quality consultants, Golder and Associates (2013). This assessment provided a quantitative assessment of potential water quality impacts associated with the project.

The EIS was publicly exhibited from 6 November 2013 to 9 December 2013. The Department of Planning, Industry & Environment (DPIE) received 12 submissions during this period, including 11 from public authorities and 1 submission from the general public who objected to the project due to its potential impacts. While none of the government authorities objected to the project, most raised concerns about its potential impacts and/or made recommendations for managing these impacts.

An initial Response to Submissions (RTS) to the DPIE prepared and submitted in February 2014. However, following receipt of the RTS, DPIE received further correspondence from 7 public authorities which necessitated further consultation between PGH, DPIE and the relevant government authorities.

This plan has been drafted by VGT and PGH Bricks and Pavers Pty Ltd (PGH) and prepared to comply with the requirements of the modified SSD_5684.

1.3 GWMP Approval

This GWMP has been prepared in consultation with the NSW Environment Protection Authority (EPA) who provided comments (refer to Annexure to this report- Water Management Consultation and Correspondence).

This GWMP has also been prepared in consultation with Department of Planning, Industry and Environment-Water (DPIE-Water) who provided comments (refer to Annexure to this report- Water Management Consultation and Correspondence).

The Conditions of Approval relevant to this GWMP and how they are met by this plan are outlined in *Table 3*.

This GWMP must have also been endorsed by the Plant Manager and National Environmental Manager prior to submission to the Secretary of the DPIE.

The GWMP is required to be submitted to the Secretary of the DPIE for approval prior to commencing the development approved in SSD_5684 MOD 1, unless the Secretary agrees otherwise.

1.4 Consultation

Condition 18.b), Schedule 3 of the Project Approval requires that the Groundwater Management Plan be prepared in consultation with the Environment Protection Authority (EPA) and the NSW Department of Planning, Industry and Environment- Water (DPIE Water). A draft copy of this Plan will be provided to each of these agencies for comment prior to submission of a final draft to the Department of Planning for approval. Telephone and Email consultation has been undertaken with representatives from EPA and DPIE Water to support the development of this Plan.

In summary, the EPA stated in their correspondence that they do not approve or endorse the Plan as their role is to set environmental objectives for environmental management, not to be directly involved in the development of strategies to achieve those objectives.

A previous draft plan has been submitted the DPIE post approval and comments were provided (see Annexure to this report- Water Management Consultation and Correspondence). An amended draft plan was submitted in August 2019 and further comments were in turn received from DPIE. The table below summarises these comments relevant to groundwater management of the Site that require actions and where addressed in this report.

Table 1. ***DPIE Post Approval Environmental Management Plan Comments***

Relevant Consent Condition	Comment (from Appendix A)	Where Addressed in this Report
A Groundwater Management Plan, which includes:		
• baseline data on groundwater levels, yield and quality in surrounding aquifers;	See Section 5.4 – Please tabulate baseline groundwater quality. Not Satisfied. See Section 6– Reference is made to Tables 5 and 6. These tables do not appear in the document. Please include the data or amend. Not Satisfied.	Section 5.6 Section 5.2
• groundwater assessment and performance criteria, including trigger levels for investigating potentially adverse groundwater impacts;		
• a program to monitor: o groundwater inflows to the quarry pit; and	See Section 8 – Please include a program to monitor inflows to the quarry pit (even if they are predicted to be minimal). Not Satisfied.	Section 6
o impacts of the development on surrounding aquifers;	See Section 8 – Please include a program to monitor impacts on surrounding aquifers (even if impacts are unlikely or predicted to be minimal) Not Satisfied.	Section 6
• an analysis of the monitoring results to determine long-term water levels within the quarry void; and • a plan to respond to any exceedances of the performance criteria.	See Section 9 – Further response beyond investigating the source of pollutant required. Not Satisfied.	Section 8
Other Comments		
Please update all references of “NOW” to “DPIE Water”.		Whole Document
The Department requires clear statements i.e. replace “should” references with “will” etc. Not Satisfied.		Whole Document
Several tables are mislabelled or omitted from the document. Not Satisfied		Tables
Table 13 has been cut off. Please amend. Not Satisfied.		Tables

A draft report was also submitted to Natural Resources Access Regulator (NRAR) and the following comments were provided in correspondence dated 13 November 2018 (see Annexure to this report- Water Management Consultation and Correspondence).

Table 2. ***NRAR Groundwater Management Plan Comments***

Comment	Where Addressed in this Report
The Groundwater Management Plan must include all monitoring data gathered to date in summary tabulated form (e.g. minimum, average, maximum, standard deviation) in the body of the document. Raw data collations are to be provided & plotted as appendices or as a supplementary document and accompany the report in electronic form (e.g. MS Excel spreadsheets). Sufficient data to establish baseline conditions and typical fluctuations over several seasons is needed to meet this requirement.	Section 5, Appendix B, Appendix C.
Where monitoring bores have been determined to be 'dry', or otherwise damaged, destroyed or rendered non-functional, the Groundwater Management Plan must set out a program (including nominated drilling depths and a schedule for the completion of the works) to reinstate the installation at each location if required.	Section 7
The Groundwater Management Plan must include an updated project planning diagram, illustrating potential quarrying activities (i.e. development stages and intended extraction activity) and nominating replacement monitoring bore locations where there is a possibility of existing installations being damaged, destroyed or removed by ongoing site operations.	Figure 6
The Groundwater Management Plan must include water level elevations of all water bodies on the site, together with groundwater elevations measured on the same day, and provide a discussion of the relative levels in respect of hydraulic gradients and flow directions in the body of the document. Section diagrams illustrating the relative elevations of the existing (and any proposed) quarry pits and groundwater levels need to be included to support the calculations of groundwater take volumes.	Section 5, Section 7, Figure 4, Figure 5
The Groundwater Management Plan must provide a tabulated summary of all dates (as well as descriptions of the advice received) when consultation with DPIE- Water staff occurred to demonstrate Condition 18(b) has been met.	See Annexure to this report- Water Management Consultation and Correspondence.
The Groundwater Management Plan must clearly describe the trigger levels for investigating potentially adverse groundwater impacts that are to be applied to the groundwater monitoring bores relating to both changes in levels and quality to demonstrate that the relevant part of Condition 18(f) has been met.	Section 8
The Groundwater Management Plan must clearly describe the program to monitor the groundwater inflows to the existing quarry pit and the impacts of the development on surrounding aquifers to demonstrate that the relevant part of Condition 18(f) has been met.	Section 6,Section 7
The Groundwater Management Plan must clearly describe the analysis of the monitoring results to determine long-term water levels within the quarry void to demonstrate that the relevant part of Condition 18(f) has been met.	Section 5, Section 7, Section 10.6
The Groundwater Management Plan will need to include a reconsideration of the response to any exceedances of the performance criteria required under the relevant part of Condition 18(f) to incorporate the analyses of measured site data and specific trigger levels determined for the groundwater monitoring bores.	Section 8, Section 10
The Groundwater Management Plan must clearly set out a quantification of the range of groundwater take under different seasonal conditions (i.e. wet and dry months) and detail the calculations used to derive the volumes to demonstrate compliance with the licensing provisions of the Water Management Act 2000 and the requirements of the NSW Aquifer Interference Policy 2012.	Section 7
The Groundwater Management Plan must clearly set out a strategy for obtaining licensed entitlement from the Sydney Basin Central Groundwater Source to account for the calculated take.	Section 3.4, Section 7

Comment	Where Addressed in this Report
The Groundwater Management Plan must include a precise schedule for the revision, reporting and review of the Groundwater Management Plan on a regular basis or as a result of a change in the site operations.	Section 10.6
A suitably credentialed hydrogeological consultant must prepare the revised Groundwater Management Plan and the Water Management Plan in accordance with Condition 18(a).	Appendix D

PURPOSE AND OBJECTIVES

2.1 Purpose

The purpose of this Plan is to describe how PGH proposes to manage potential impacts to groundwater generated by the facility. This document has been prepared to satisfy the SSD_5684 MOD1 conditions of consent requiring a Groundwater Management Plan.

2.2 Objectives

The key objective of the GWMP is to ensure that impacts to the downstream environment are minimised.

To achieve this objective, PGH will undertake the following:

- Ensure appropriate environmental controls and procedures are implemented to minimise the potential for adverse groundwater quality impacts to identified sensitive receivers and the local community;
- Manage groundwater quality impacts, if they occur, through a systematic analysis of mitigation strategies;
- Ensure environmental management measures identified in *Table 11* are implemented to address the relevant CoA outlined in *Table 3*;
- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in S*ection 3* of this GWMP: and
- Develop a set of performance criteria and appropriate environmental management measures for the site.

ENVIRONMENTAL REQUIREMENTS

3.1 Relevant Legislation and Guidelines

3.1.1 Legislation

Legislation relevant to Groundwater quality management includes:

- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Protection of the Environment Operations Act 1997 (POEO Act);
- Water Act 1912;
- Water Management Act 2000;
- Sydney Water Act 1994;
- Protection of the Environment Operations Regulation 2000; and
- The Water Sharing Plan for the Greater Metropolitan Region Unregulated River Groundwater Sources 2011.

3.1.2 Guidelines and Standards

The main guidelines, specifications and policy documents relevant to this GWMP include:

- Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales (Gazette no 54 of 12 March 2004 p 1150);
- Managing Urban Stormwater, Volume 2E, Mine and Quarries (Department of Environment and Climate Change, New South Wales, June 2008);
- DECC Managing Urban Stormwater - Soils and Construction V1 (2004); and
- The Australian and New Zealand Environment Conservation Council Guidelines (ANZECC guidelines).

3.2 Minister's Consent Conditions

This document has been prepared to satisfy the SSD_5684 MOD 1 conditions of consent requiring a Groundwater Management Plan. The Conditions of Approval relevant to this GWMP are listed in *Table 3*. A cross reference is also included to indicate where the condition is addressed in this GWMP or other environmental management documents.

Table 3. ***Conditions of Approval relevant to the GWMP***

Condition	Requirement	Where Addressed in this plan
Groundwater Management Plan (Condition 18)	The Applicant shall prepare and implement; (f) a Groundwater Management Plan for the development to the satisfaction of the Secretary, which includes: • baseline data on Groundwater levels, yield and quality in surrounding aquifers; • Groundwater assessment and performance criteria, including trigger levels for investigating potentially adverse Groundwater impacts; • a program to monitor: o Groundwater inflows to the quarry pit; and o impacts of the development on surrounding aquifers; • an analysis of the monitoring results to determine long-term Groundwater levels within the quarry void; and • A plan to respond to any exceedances of the performance criteria.	GWMP (This plan) Section 5 Section 5.2 Section 7 Section 6 Section 5.2 Section 8

3.3 Licenses and permits

The Environment Protection Authority (EPA) issued the Brickworks with licence number 1808. No groundwater monitoring requirements are listed in the Licence.

3.4 Water Access Licence

The Water Management Act 2000 identifies basic landholder rights and when access licenses are required. The harvestable water right is defined in terms of and equivalent dam capacity, the Maximum Harvestable Right Dam Capacity (MHRDC). Schedule 1 of the Water Management Regulation exempts certain classes of dam including those dams solely for the capture, containment and recirculation of drainage and/or effluent, consistent with best management practice or required by a public authority to prevent the contamination of a water source. Therefore, as the on-site dams are used solely for the capture, containment and reticulation of drainage, consistent with best management practice to prevent impacts to Thompsons Creek, the dams are exempt from the need to obtain a licence under the WM Act.

The site does however have 3 surface water access licences;

1. WAL 26259 = 150 ML
2. WAL 26257 = 6.5 ML
3. WAL 25987 = 152.5 ML

In addition there are 4 groundwater bores (drilled in the EIS) licenced in perpetuity for monitoring under 10BL605770. Only 3 of these are functioning.

Although the site has not currently encountered groundwater, future stages may intercept groundwater and approval is being sought for future take of groundwater prior to extraction below the groundwater level. Predicted inflows to the void from the EIS ranged from 0.1 to 1.0L/s.

EXISTING ENVIRONMENT

4.1 Site Location and Overview

The project site is currently used for quarrying, brick production and associated activities. The brickworks and quarry are located on an approximately 385.55 hectare property owned by PGH Limited, which is located at 60 Greendale Road, within the Camden local government area and is approximately 55 km southwest of the Sydney central business district (Refer to *Figure 1*).

The brick making facility along with various administration buildings, a finished brick storage yard, staff car park and internal road network is generally contained within the northern part of the project site (refer to *Figure 2*), and is set back approximately 200 m from Greendale Road.

Existing quarrying activities have substantially altered the natural landform, with various voids and elevated stockpiles present in the active, north-western part of the project site. Other significant landforms on the site include the raw material stockpiles to the south of the brickworks, as well as unusable materials stockpiles along the western boundary of the site. The underlying topography of the operational footprint on the project site is relatively flat, and the land slopes to the south toward Thompsons Creek.

The southern portion of the project site, adjacent to Thompsons Creek, is leased for the agistment of stock and grazing.

GROUNDWATER ASSESSMENT

5.1 Background

The project site is located within the 'Hawkesbury Nepean Water Management Area' and within the 'Sydney Basin Central Groundwater Source'. The Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 applies to the project. The project site sits within the Hawkesbury-Nepean Catchment, which is the largest catchment area in the Sydney area (approximately 21,400 square kilometers).

Bringelly sits in a region of interbedded sedimentary rocks (siltstone, claystone, lam mite and sandstone) known as the Middle Triassic Wianamatta Group. The group is made up of three main formations: Bringelly Shale, Minchinbury Sandstone and Ashfield Shale. The upper unit is the Bringelly Shale, a formation dominated by claystone and siltstone with thin laminate horizons and minor sandstone. This is underlain by Minchinbury Sandstone, a 3–6 metre thick quartz lithic sandstone; followed by the Ashfield Shale which comprises sandstone-siltstone laminate and sideritic claystone.

The Wianamatta Group is underlain by Hawkesbury Sandstone. The project site is underlain by the lower 75 metres to 150 metres of the Bringelly Shale which comprises claystone, siltstone, laminate and sandstone. The base of the sequence in this area is defined by the Cobbity Claystone, a thin (maximum six centimetres) persistent layer of weathered tuff. Alluvium (sands and gravels, fined-grained sand, silt and clay) derived from surrounding rocks are present along streams such as Thompsons Creek and Bardwell Gully.

The quarry is located on the Blacktown landscape is categorised by shallow to podsolic on crests grading to yellow on located on South Creek soil landscape structured plastic clays soil landscape, overlaying Wianamatta Group shales. This soil moderately deep, hardsetting, mottled textured with red and brown lower slopes. The area to the east of the quarry and brickworks consists of layered alluvial soils, structured loams and structured plastic clays.

The quarry area of the site has an elevated topography with the highest point towards the northwest corner at 113 m AHD. A constructed ridge runs along the western boundary north to south of the site which gently slopes downwards towards the east — south east. The lowest point runs along the eastern side of the site and is characterised by Thompson Creek. The general direction of overland flow is towards Thompsons Creek downstream of Dam 6.

The hydrogeology of the project site is mainly controlled by its geology. Hydrostratigraphy units within the Wianamatta Group comprise the Bringelly Shale, Minchinbury Sandstone and Ashfield Shale Units. The Bringelly Shale unit can be characterised as low permeability, majority of groundwater flow via fractures and bedding planes, a layered aquifer system with limited inter-connection between zones, the groundwater potentiometric surface generally follows topography.

There are no high priority GDEs springs or national parks located within the project site. South Creek is categorized as a GDE category 'Reliant on surface expression of groundwater (rivers, springs, wetlands) and the zone along the creek is rated as area of 'high' vulnerability rating based on the vulnerability mapping from NSW Atlas. South Creek is located approximately 2.5 kilometres to the east of the project site. Results of the search for groundwater dependent ecosystems from the National Atlas of GDEs indicated the following GDEs (Category 'Reliant on subsurface groundwater – vegetation') within the project site: Cumberland Shale Hills Woodland, Cumberland Shale Plains Woodland and Cumberland River Flat Forest[1].

5.2 Initial Groundwater Assessment

Once the monitoring bores were installed and developed, water level and in-situ physio-chemical parameters were measured and recorded. Samples were collected for laboratory analysis after these initial parameters were recorded. Both data sets are tabulated in *Appendix A.*

Sampling was conducted at each monitoring bore within the scope of this project using disposable bailers and samples were retained in approved sampling bottles for shipping to the selected laboratory. Best practice is to purge 3 well volumes prior to sampling to ensure that the water being sampled is truly representative of that produced by the aquifer. In the case of GWO3 and GWO4 the ingress of groundwater was very slow so to ensure that adequate purging could be carried out, Boral site staff commenced the purging process using dedicated bailers prior to Golder mobilising to site for the water quality sampling event. Records of purged water volumes were

kept. The well volumes were calculated in advance of the purging process, using standard formulas for litre volumes of water per linear metre of 50mm monitoring bore casing and screen in HQ boreholes. The volumes that were required to be purged are calculated in *Table 4* below.

Table 4. ***Volume of Groundwater to be purged from the EIS***

Table 2: Volume of groundwater to be purged based on three well volumes

Borehole	SWL[1] (mbtoc)	Date Measured	TDB[2] (mbgs)	Sump length (m)	Screen length (m)	Height of water column in well (m)	Well volume (litres)	Volume to be purged* (litres)	Actual purged volume (litres)
GW01	11.2	24/04/2013	40	3	18	29.36	89.32	267.96	207
GW02	10.76	24/04/2013	40	3	18	29.86	90.32	270.96	270
GW03	32.24	24/04/2013	40	1	15	8.36	29.232	87.696	87
GW04	39.81	24/04/2013	42	3	18	2.79	5.58	16.74	34.5

[1] – Static Water Level

[2] – Total Depth of Borehole

* Based on 3.7 litres per linear metre of screen and 2 litres per linear metre of casing.

Golder staff completed the remainder of the purging process while on site for the sampling event. A calibrated water quality meter was used to observe the field parameters during the purging process and purging was carried out until stability was observed in the parameters. A decontaminated sampling bucket was used to collect the bore water during sampling. Field records of the water quality sampling event including recorded insitu water quality parameters and SWLs can be found in the Golders report (see *Appendix A*).

As a QNQC on the water quality sampling methodology field blank samples were also taken and trip blanks provided by the laboratory were kept with the samples during transportation and storage. Duplicate samples were taken at GWO2 to act as a QAJQC on the laboratory procedures. Samples were stored in cooler boxes with ice bricks to preserve the samples and transported to the ALS laboratory within the allowable handling times for the selected parameters. The results of the water quality sampling are presented in Appendix A.

Results indicate that GWO4 is a dry hole, and GWO3 has partial saturation within the screened zone. Hydraulic conductivity values for GWO3 and GWO4 were found to be $1.915x10^{-9}$ m/s and $2.55x10^{-10}$ m/s, respectively, consistent with marine clays and shales1. GWO1 and GWO2 demonstrate hydraulic conductivities, k, of $2.628x10^{-7}$m/s and 2.288x1 10^{-7} m/s, respectively. These values are consistent with sandstone formations. All bores had elevated levels of Zinc. The groundwater quality analysis results establish baseline readings for the long-term monitoring of groundwater characteristics.

5.3 Groundwater Levels

Groundwater levels varied from 60 to 76 metres AHD in the area. A weathered unit overlies the Bringelly Shale and perched shallow groundwater can occur within this layer at places. Groundwater depths (metres below ground surface) on site range between 11 to 40 metres. *Figure 3* shows the locations of the bores.

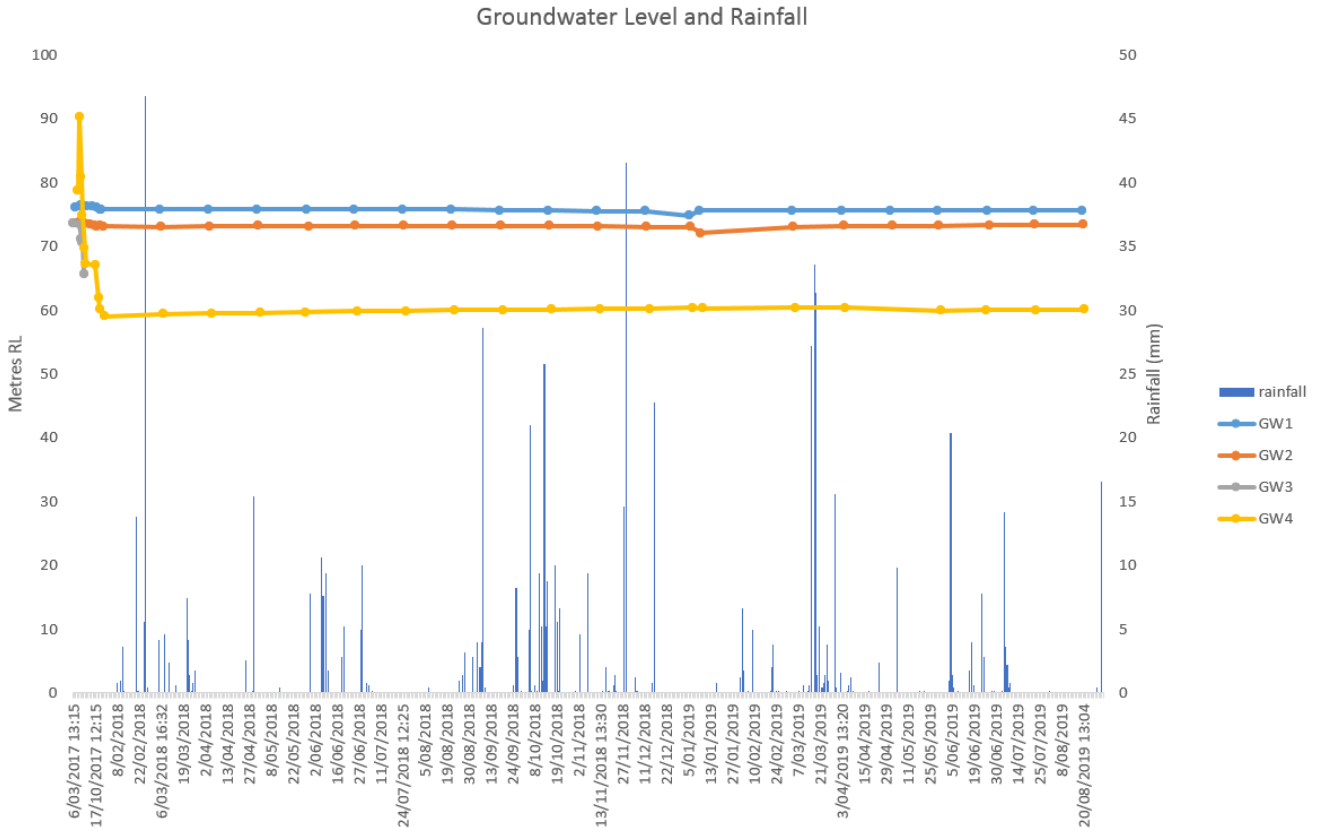
Table 5. ***Surveyed co-ordinates and elevations for groundwater monitoring bores***

Bore Location ID	Easting	Northing	Elevation(mAHD)	Depth (metres below ground surface)
GW01	289202	6242112.1	88	11
GW02	289502.1	6242101.8	83.55	10.07
GW03	289628.5	6241630.2	87	26.19
GW04	289214.9	6241594.5	99	39.53

Note: GW3 is not functioning and GW4 groundwater levels are generally very low or even dry.

Monitoring has been undertaken since the installation of the bores and the levels appear to be fairly consistent as shown in the graph below.

Graph 1: Groundwater Levels



Rainfall appears to have little impact on the levels in the bores. To date there has been no regular measurement of water levels within the Main Pit although the most recent survey suggest that the pit water level is at approximately 69m RL. Notwithstanding this lack of measurement, there have been periods where the Main Pit has been dewatered and this does not appear to impact the bore levels indicating there is little linkage between the pit water and the surrounding groundwater.

From the cross-sectional plots of the bores and the Main Pit it (see *Figure 4*) appears that groundwater is lowest in the south and below the Main Pit level, and rises to the north (see *Figure 5*). In an eastward direction the levels appear to gradually decrease. This is consistent with the hydraulic gradient discussed in the EIS of flows from the north toward the south east, towards the South Creek locality to the east of the site. It is evident that the Main Pit has not progressed to the groundwater level and no groundwater seepage has been noted to date, therefore groundwater inflow measurements cannot be undertaken at this stage.

5.4 Groundwater Yields

As the Bringelly Shale formation within the project area is very low yielding and of low quality and does not have high environmental values. The Bringelly Shale groundwater is not considered to be 'high productive' water source based on the NSW Aquifer Interference Policy criteria.

Groundwater inflows to the pit were estimated in the EIS for a low hydraulic conductivity scenario and a high hydraulic conductivity scenario. The flows ranged from 0.1 to 1.0L/s with an annual estimated inflow of 1.5ML/year for the low hydraulic conductivity scenario at the final stage of the pit extraction. The pit has not currently extended below the groundwater level and no inflows or seepage have been observed on the site.

5.5 Groundwater Quantity

The Bringelly brick making facility utilises approximately **15,000KL per annum** of Potable water. The site also has a capacity of over 400,000m^3 of dam storage onsite in order to utilise harvested stormwater for processing and dust control. No Groundwater is expected to be extracted by the project for use in the brickmaking process.

5.6 Groundwater Quality

Baseline groundwater quality samples were initially analysed against trigger values for toxicants in freshwater for the protection of 95% of species in the column 'ANZECC 2000 Freshwater 95% and reported in the EIS by Golder and Associates (2013) and reproduced in the table below. The water quality results also indicate levels of zinc exceeding the ANZECC 2000 Trigger Values for the Protection of Freshwater Aquatic Ecosystems (95% Level of Protection).

Table 6. ***Groundwater Quality from the EIS***

Analyte	Unit	ANZECC 2000 Stock Water Guideline	ANZECC 2000 Freshwater 95%	GW01	GW02	GW02 Duplicate	GW03	GW04
pH				8.49	8.04	8.02	7.62	8.04
Electrical Conductivity @ 25°C	µS/cm			15200	22000	22200	15200	2020
Total Dissolved Solids @180°C	mg/L	4000		8880	13600	13300	9220	2350
Redox Potential	mV			51	92.5	120	75.7	32
Dissolved Oxygen	mg/L			7.4	7.4	7.2	4.2	1.9
Turbidity	NTU			48.5	68.6	61.4	451	12400
Alkalinity								
Hydroxide Alkalinity as $CaCO_3$	mg/L			<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L			29	<1	<1	<1	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L			219	393	388	274	327
Total Alkalinity as $CaCO_3$	mg/L			248	393	388	274	327
Dissolved Major Anions								
Chloride	mg/L			4740	7600	7620	4720	412
Sulfate as $SO4^{2-}$	mg/L	1000		6	<1	<1	10	31
Dissolved Major Cations								
Calcium	mg/L	1000		143	284	306	207	12
Magnesium	mg/L			138	238	255	77	2
Sodium	mg/L			2700	4680	4710	2850	433
Potassium	mg/L			57	54	57	57	9
Reactive Phosphorus as P	mg/L			0.02	0.04	0.04	0.04	<0.01
Nitrite as N	mg/L			<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L		0.7	0.01	0.01	<0.01	<0.01	<0.01
Nitrite and Nitrate as N (NOx)	mg/L			0.01	0.01	<0.01	<0.01	<0.01
Dissolved Metals								
Arsenic	mg/L	0.5	0.013	0.004	0.001	0.001	0.005	0.005
Cadmium	mg/L	0.01	0.0002	<0.0001	0.0001	<0.0001	<0.0001	0.0005
Chromium	mg/L	1	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	1	0.0014	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	mg/L	0.1	0.0034	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.002	0.0006	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	1	0.011	0.001	0.001	<0.001	0.002	0.003
Zinc	mg/L	20	0.008	0.013	0.085	0.1	0.05	0.166
Ionic Balance								
Total Anions	meq/L		139	222	223	139	18.8	139
Total Cations	meq/L		137	239	242	142	19.8	137
Ionic Balance			0.52	3.56	4.26	1.15	2.62	0.52

Monitoring data to date has been summarised in the tables below and is reproduced in full in Appendix C.

Table 7. ***GW1 Groundwater Quality Summary***

Analyte	Units	Average	Minimum	Maximum	Standard Deviation
pH	pH units	7.1	6.9	7.4	0.12
Conductivity	µS/cm	21,100	17,000	23,300	1,270
Chloride	mg/L	7,480	6,100	8,700	745
Sulphate	mg/L	26	5	130	44
Total Alkalinity	mg/L	473	330	570	75
Sodium	mg/L	5,120	4,200	6,300	724
Potassium	mg/L	60	44	75	11
Calcium	mg/L	282	220	330	36
Magnesium	mg/L	284	220	320	36
Dissolved Oxygen	mg/L	1.6	0.5	3.8	0.8
TDS (by calculation)	mg/L	13,000	10,600	14,600	887
Redox Potential	mV	191	103	269	37
Total Nitrogen	mg/L	9.5	7.4	11.0	1.0
Nitrate	mg/L	0.001	<0.001	0.056	0.018
Nitrite	mg/L	0.002	<0.001	0.018	0.006
Ammonia	mg/L	8.0	6.1	9.3	1.2
Fluoride	mg/L	0.1	0.1	0.2	0
Total Phosphorus	mg/L	0.3	<0.05	0.8	0.5
Reactive Phosphorus	mg/L	0.047	0.007	0.085	0.024
Arsenic	mg/L	0.001	<0.001	0.005	0.002
Barium	mg/L	28	2	58	19
Beryllium	mg/L	<0.0005	<0.0005	<0.0005	0
Cadmium	mg/L	<0.0001	<0.0001	0.0001	0.00003
Chromium	mg/L	<0.001	<0.001	<0.001	0
Cobalt	mg/L	<0.001	<0.001	0.001	0.0004
Copper	mg/L	<0.001	<0.001	0.003	0.001
Manganese	mg/L	0.14	0.10	0.20	0.04
Nickle	mg/L	0.001	<0.001	0.003	0.001
Lead	mg/L	<0.001	<0.001	<0.001	0
Vanadium	mg/L	<0.001	<0.001	<0.001	0
Zinc	mg/L	0.035	0.002	0.061	0.021
Iron	mg/L	2.7	1.1	4.3	1.5
Benzene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Toluene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Ethyl Benzene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Xylene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C6-C9)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C10-C14)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C15-C28)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C29-C36)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C6-C10)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C10-C16)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C16-C34)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C34-C40)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
PAH	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Total Phenolics	µg/L	Not Detected	Not Detected	Not Detected	Not Detected

Table 8. ***GW2 Groundwater Quality Summary***

Analyte	Units	Average	Minimum	Maximum	Standard Deviation
pH	pH units	7.0	6.9	7.7	0.16
Conductivity	µS/cm	19,400	1,730	22,200	3,550
Chloride	mg/L	7,230	6,600	8,100	548
Sulphate	mg/L	<1	<1	<1	0
Total Alkalinity	mg/L	474	430	510	25
Sodium	mg/L	5,170	4,300	6,000	700
Potassium	mg/L	54	38	64	9
Calcium	mg/L	574	230	290	23
Magnesium	mg/L	223	160	260	32
Dissolved Oxygen	mg/L	1.5	0.6	4.5	0.9
TDS (by calculation)	mg/L	11,700	1,080	13,600	3,000
Redox Potential	mV	202	100	302	43
Total Nitrogen	mg/L	8.6	6.8	11.0	1.4
Nitrate	mg/L	0.003	<0.001	0.020	0.007
Nitrite	mg/L	0.002	<0.001	0.015	0.005
Ammonia	mg/L	7.5	6.1	11.0	1.5
Fluoride	mg/L	0.1	0.1	0.2	0.1
Total Phosphorus	mg/L	0.1	<0.1	0.2	0.1
Reactive Phosphorus	mg/L	0.085	<0.001	0.160	0.043
Arsenic	mg/L	0.002	<0.001	0.010	0.004
Barium	mg/L	63	54	72	6.0
Beryllium	mg/L	<0.0005	<0.0005	<0.0005	0
Cadmium	mg/L	<0.0001	<0.0001	0.0001	0.00003
Chromium	mg/L	<0.001	<0.001	<0.001	0
Cobalt	mg/L	<0.001	<0.001	0.002	0.001
Copper	mg/L	<0.001	<0.001	<0.001	0
Manganese	mg/L	0.08	0.03	0.22	0.07
Nickle	mg/L	<0.001	<0.001	0.001	0.0003
Lead	mg/L	<0.001	<0.001	<0.001	0
Vanadium	mg/L	<0.001	<0.001	<0.001	0
Zinc	mg/L	0.047	0.017	0.089	0.022
Iron	mg/L	2.0	0.8	5.5	2.0
Benzene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Toluene	µg/L	1	<1	6	2.0
Ethyl Benzene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Xylene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C6-C9)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C10-C14)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C15-C28)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C29-C36)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C6-C10)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C10-C16)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C16-C34)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C34-C40)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
PAH	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Total Phenolics	µg/L	Not Detected	Not Detected	Not Detected	Not Detected

Table 9. ***GW3 Groundwater Quality Summary***

Analyte	Units	Average	Minimum	Maximum	Standard Deviation
pH	pH units	7.3	7.0	7.6	0.25
Conductivity	µS/cm	16,400	12,400	17,800	2,680
Chloride	mg/L	5,150	3,900	6,400	1,770
Sulphate	mg/L	14	14	14	0
Total Alkalinity	mg/L	225	200	250	35
Sodium	mg/L	4,200	3,500	4,900	990
Potassium	mg/L	58	50	66	11
Calcium	mg/L	215	170	260	64
Magnesium	mg/L	81	64	98	24
Dissolved Oxygen	mg/L	2.8	1.8	4.3	1.1
TDS (by calculation)	mg/L	10,300	7,730	11,200	1,690
Redox Potential	mV	178	143	222	33
Total Nitrogen	mg/L	8.9	8.4	9.3	0.6
Nitrate	mg/L	0.010	<0.001	0.020	0.014
Nitrite	mg/L	0.003	<0.001	0.006	0.004
Ammonia	mg/L	8.0	7.3	8.7	1.0
Fluoride	mg/L	<0.1	<0.1	<0.1	0
Total Phosphorus	mg/L	0.2	0.2	0.2	0
Reactive Phosphorus	mg/L	0.19	0.10	0.27	0.12
Arsenic	mg/L	0.003	0.002	0.004	0.001
Barium	mg/L	44	29	58	20.5
Beryllium	mg/L	<0.0005	<0.0005	<0.0005	0
Cadmium	mg/L	<0.0001	<0.0001	0.0001	0
Chromium	mg/L	<0.001	<0.001	<0.001	0
Cobalt	mg/L	0.004	0.003	0.005	0.001
Copper	mg/L	<0.001	<0.001	<0.001	0
Manganese	mg/L	0.57	0.37	0.77	0.28
Nickle	mg/L	0.001	<0.001	0.002	0.001
Lead	mg/L	<0.001	<0.001	<0.001	0
Vanadium	mg/L	<0.001	<0.001	<0.001	0
Zinc	mg/L	0.024	0.019	0.029	0.007
Iron	mg/L	2.0	1.3	2.6	0.9
Benzene	µg/L	4	<1	7	4.9
Toluene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Ethyl Benzene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Xylene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C6-C9)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C10-C14)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C15-C28)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C29-C36)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C6-C10)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C10-C16)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C16-C34)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C34-C40)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
PAH	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Total Phenolics	µg/L	Not Detected	Not Detected	Not Detected	Not Detected

Table 10. ***GW4 Groundwater Quality Summary***

Analyte	Units	Average	Minimum	Maximum	Standard Deviation
pH	pH units	7.5	7.1	7.9	0.26
Conductivity	µS/cm	10,200	475	38,700	13,000
Chloride	mg/L	513	21	860	438
Sulphate	mg/L	14	11	17	3
Total Alkalinity	mg/L	367	220	440	127
Sodium	mg/L	607	93	950	454
Potassium	mg/L	9	8	10	1
Calcium	mg/L	13	4	26	12
Magnesium	mg/L	5	2	9	4
Dissolved Oxygen	mg/L	1.9	0.9	4.5	1.2
TDS (by calculation)	mg/L	6,400	297	24,200	8,100
Redox Potential	mV	204	74	313	76
Total Nitrogen	mg/L	2.4	1.5	3.4	1.0
Nitrate	mg/L	<0.001	<0.001	<0.001	0
Nitrite	mg/L	<0.001	<0.001	<0.001	0
Ammonia	mg/L	1.10	0.007	1.90	0.981
Fluoride	mg/L	-	-	-	-
Total Phosphorus	mg/L	0.6	0.6	0.6	0
Reactive Phosphorus	mg/L	0.16	0.09	0.22	0.07
Arsenic	mg/L	0.005	0.002	0.009	0.004
Barium	mg/L	0.81	0.34	1.50	0.61
Beryllium	mg/L	<0.0005	<0.0005	<0.0005	0
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	0
Chromium	mg/L	<0.001	<0.001	<0.001	0
Cobalt	mg/L	<0.001	<0.001	<0.001	0
Copper	mg/L	0.003	<0.001	0.009	0.005
Manganese	mg/L	0.097	0.006	0.250	0.133
Nickle	mg/L	0.001	<0.001	0.003	0.002
Lead	mg/L	<0.001	<0.001	<0.001	0
Vanadium	mg/L	<0.001	<0.001	<0.001	0
Zinc	mg/L	0.005	0.003	0.007	0.002
Iron	mg/L	0.23	0.13	0.34	0.11
Benzene	µg/L	3	<1	6	3.1
Toluene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Ethyl Benzene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Xylene	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C6-C9)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C10-C14)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C15-C28)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C29-C36)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (C6-C10)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C10-C16)	µg/L	<50	<50	50	29
TPH (>C16-C34)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
TPH (>C34-C40)	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
PAH	µg/L	Not Detected	Not Detected	Not Detected	Not Detected
Total Phenolics	µg/L	Not Detected	Not Detected	Not Detected	Not Detected

Monitoring for GW1 and GW2 has been undertaken for a number of years however data for GW3 and GW4 is limited due to the destruction of GW3 and the low yields of groundwater available for testing in GW4.

There is minimal variation in the quality of groundwater to date from GW1 and GW2. Early detection of Toluene in GW2 (August 2017) has not been repeated in subsequent sampling rounds and may be due to the installation of the bore. Benzene was also detected in an early sampling round in August 2017, however the bore was subsequently destroyed. It is suspected that it is also a consequence of the installation process. GW4 indicated the presence of Total Petroleum Hydrocarbons (>C10-C16 fraction) in November 2017 but due to the low recharge rate it has not been possible to sample since that time. Similarly it is likely a consequence of the bore installation process. No PAH or Phenolic compounds have been detected in any of the bores.

Monitoring of the bores will continue in order to establish baseline data. This data will be used to establish baseline data and compared to groundwater monitoring conducted once the MOD1 extension development commences.

5.7 Surrounding Aquifers

The regional groundwater system is recharged by rainfall recharge and discharge via evaporation, evapotranspiration and discharge to creeks to the creeks to the east of the project site and to the Hawkesbury-Nepean system to the north. There are no existing registered groundwater bores within the project site based on search results of the NSW Office of Water groundwater bore database and NSW Natural Resource Atlas and NSW Groundwater Database (Water Data Transfer Format and Hydstra)

5.8 Groundwater Management on Site

The project sites groundwater management site plan is shown in *Figure 3.*

6 Groundwater Impacts

6.1 Potential Impacts

The impact of the project on groundwater levels is expected to be localised, and limited mainly to the vicinity of the quarry pit. There will be no impact to groundwater flow system when the excavation depth of the quarry pit extension is above the groundwater levels. The predictive modelling results indicated a negligible change in groundwater regional flow direction as a result of the proposed activities. It is not envisaged that the groundwater seepage into the open cut quarry areas could potentially induce groundwater flow from neighbouring strata (from the underlying sandstone aquifers).

The modelled total groundwater inflow to the final quarry pit is estimated to be 0.1-1 litres per second with a likely inflow of 0.1 litres per second (assuming a low hydraulic conductivity). If there is water ponding in the pit during the time quarrying ceases then groundwater may actually be recharged during this time and groundwater withdrawn during quarrying is recharged during the time the pit is allowed to fill. It is envisaged that the actual groundwater loss per year during the quarry expansion is less than the estimated annual inflows based on a conservative modelling approach.

There is no measureable groundwater impact expected on Thompsons Creek, Bardwell Gully and South Creek as a result of the quarry pit extension. Thompsons Creek is fed from rural, residential and urban drainage and demonstrates poor water quality. Bardwell Gully, a drainage channel on the site's northern boundary, flows north under Greendale Road and into Thompsons Creek.

The depth to groundwater level is generally observed at being 10 to 26 metres below ground surface. It is inferred that the groundwater does not provide base flow to these creeks. It is envisaged that the pit dewatering will not have impact on Thompsons Creek and Bardwell Gully.

The groundwater vulnerability mapping indicated that South Creek is a GDE category 'Reliant on surface expression of groundwater' (NSW Natural Resource Atlas, accessed June 2013) and it is inferred that the base flow condition occurs at South Creek. Increased salinity close to watercourses and drainage lines has been observed, probably reflecting discharge of deep groundwater from the Bringelly Shale. The modelled drawdown does not extend to the South Creek in Scenario A and is less than 0.2 metres at South Creek in Scenario B; therefore, the impact on this receptor is considered to be low.

6.1.1 Potential impact on groundwater quality

There is the potential for spills and contamination by metals and hydrocarbons from the machinery, waste disposal, waste oil used in maintenance of equipment and fuel storage areas; however, adequate bunding and immediate clean-up of spills which is standard practice and/or a legislated requirement at the project site should prevent contamination of shallow strata and subsequent leakage to the groundwater system. The site has a very low hydraulic conductivity and any spills would not be expected to spread.

6.1.2 Potential impacts on registered bores

There are 4 registered groundwater bores within the project site. Based on the extent of the predicted drawdown in the Bringelly Shale formation associated with the project, no private groundwater users have been identified as being affected or potentially affected by the project.

6.1.3 Impact on groundwater dependent ecosystems

There are no identified 'high priority' GDEs within or surrounding the project area. Within the project site, there are no river base flows, no karst or cave ecosystems, no known springs that are fed by groundwater around which groundwater dependent ecosystems have developed. No GDEs category 'Subterranean' were identified within the project site based on information from the Australian National Atlas of GDEs. Results of the search for groundwater dependent ecosystems from the National Atlas of GDEs indicated the following GDEs Category 'Reliant on subsurface groundwater – vegetation': Cumberland Shale Hills Woodland, Cumberland Shale Plains Woodland and Cumberland River Flat Forest. These woodlands are likely to be supported by localised perched water near the surface or rainfall. The likelihood of this receptor being impacted because of the loss of quantity of deeper groundwater in Bringelly Shale (10 to 26 metres below ground surface) due to quarry operations is low as the drawdown caused by the project is limited and that the slight lowering in groundwater table is not likely to stress

the woodland. Where terrestrial ecosystems (vegetation) are rainfall dependant and not connected to the groundwater system, the quarrying and associated dewatering would have no impact on this receptor. It is envisaged that the baseflow in South Creek will not be affected by the potential groundwater drawdown at the quarry pit extension; therefore, any GDE that may occurs in the South Creek will not be impacted by the project.

6.1.4 Post-operation recovery of groundwater levels

During the post-operation stage, the groundwater will slowly enter the open pit and eventually an equilibrium water level will be reached over time. It is anticipated that the surface water runoff will fill the open pit at the cessation of operations and the pit water may represent a source of fresh water recharging the local groundwater if the pit water level is higher than the groundwater level. It is likely that no long term impact on post operation groundwater levels would be observed at any significant distance from the pit.

Monitoring and Maintenance

7.1 Groundwater Quality

Groundwater will be sampled monthly at the licenced Groundwater Bore locations. Samples will be analysed monthly for depth to water level, temperature, pH, conductivity, dissolved oxygen and redox potential. Quarterly monitoring of the bores will also include the parameters listed in *Section 5.6* and include nutrients, major cations and anions, metals, BTEX, PAH, Phenolics and Fluoride.

The levels in the perimeter bores will be monitored along with rainfall and pit water levels in order to determine and changes that may indicate an impact to surrounding aquifers i.e. a change of more than 30% to the previously recorded levels.

Where appropriate, trends in groundwater quality and levels will be graphically represented. All sampling data is recorded and reported on the PGH website and in the EPL Annual return.

The results of all monitoring will assist in the compilation of the Annual Rehabilitation Report (ARR) to the DPIE-Resources and Geoscience and to the DPIE in the Annual Report.

7.2 Groundwater Inflows

Any visible flows observed during excavation activities will be measured by capturing a measured volume over a known time period; for example, the time taken for a 25L bucket to be filled. If the seepage is too small to be collected, it shall be recorded using photography and GPS location. The dates and period of time for which the flow is observed will also be recorded. If the flow rate changes during the time period observed, the rate will be measured again. Measurements will be undertaken monthly across a range of seasonal variations i.e wet and dry months.

This data coupled with rainfall and evaporation from the preceding 12 months will be used to update the Site Water Balance (as described in the Soil and Water Management Plan). Any differences between the predicted model and the actual results would also be used to estimate the groundwater inflows.

Any calculations undertaken to estimate the groundwater take will be included in any reports to DPIE as outlined in *Section 10.6*. The reports will demonstrate compliance with the Water Management Act 2000 and the requirements of the NSW Aquifer Interference Policy 2012, in particular compliance with any WAL obtained for groundwater take.

7.3 Groundwater Bore Maintenance

Bores will be inspected each month for damage or any other fault that may render the bore inoperable. The area around the bore will be kept clear of vegetation and objects that may interfere with access. Missing caps will be replaced and the bores will be painted in highly visible paint or otherwise visible identified so as to minimise accidental destruction by vehicle impact.

If a bore is identified as 'dry' (e.g. not deep enough to strike groundwater) or otherwise damaged, destroyed or rendered non-functional, the bore will be assessed as to the relevance to the groundwater monitoring program. The bore may be replaced or relocated if the assessment determines that data is required from that point to continue the monitoring and assessment program. Bore abandonment may be appropriate in some instances such as encroachment of mining. If appropriate, replacement/relocation of such bore will be completed prior to commencement of mining within that area.

Drilling depths of the bores is determined by the expected groundwater levels within the target location. As the depth of the void increases, there may be localised changes to the groundwater levels, particularly as mining progresses below the current groundwater table. The bores should be of sufficient depth to encounter groundwater and this would be confirmed by the contract drillers at the time of installation.

In the case of GW3 where the bore has been destroyed, it has been determined that whilst background data is still being monitored, that the bore will not be re-established at this stage. Prior to the MOD1 development proceeding and mining progresses within the extension areas, the re-installment of the bore will be reviewed. GW4 is very slow to recharge and does not provide sufficient volumes for analytical testing but it still provides useful data regarding the depth of the groundwater. It will also be reviewed once the MOD1 extension commences.

7.4 Mine Staging and Groundwater Bore Location

Prior to the opening of a new Cell, monitoring bore locations will be reviewed and new bores will be installed at appropriate locations. Bores will be located in order to provide up gradient and down gradient profiles of the groundwater around the active cells. Background monitoring of existing and new bores will be conducted for a minimum of 1 year prior to the opening up of any new Cells.

As shown in *Figure 6*, the existing bores are located around the perimeter of the current void. GW1 and GW2 are outside the mining extension area in the north (Cell D) and are unlikely to require relocation. GW3 may require relocation prior to mining commencing within Cell G and GW4 will require relocation prior to mining in Cell F. Conceptual locations of future bores are also shown on *Figure 6.*

8 Performance Criteria

Table 11. ***Performance Criteria and Trigger Action Response Plan***

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
Groundwater levels at the site are consistent with the baseline hydrological conditions of the surrounding environment	Monitored Groundwater levels from the site to be as close as possible to the natural levels expected pre-development.	Significant changes to or loss of aquifers harms GDEs downstream.	Significant drop (>30%) in measured Groundwater Levels.	Review Groundwater management procedures and continue monitoring. Review of data and site by qualified hydrologist. Assess impact to GDE's by ecologist and investigate remediation measures if required.	Annual review report
Groundwater quality at the site is consistent with the baseline hydrological conditions of the surrounding environment	Monitored Groundwater quality from the site to be as close as possible to the natural levels expected pre-development.	Significant changes to the water quality of the groundwater harms GDE's downstream.	Electrical conductivity (Ec) of the bores changes by more than 30% from the historical average value. Metal levels change greater than 30% when compared to previous recordings. Petroleum Hydrocarbons are greater than 10 mg/L or change of greater than 30% over background readings	Review Groundwater management procedures and continue monitoring. Review of data and site by qualified hydrologist. Assess impact to GDE's by ecologist and investigate remediation measures if required.	Annual review report

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
	Fuel and oil storage is bunded and spill kits are accessible. No spills of hydrocarbons occur.	Releases of hydrocarbons changes quality of Groundwater and harms ecological communities downstream.	Hydrocarbon spill of sufficient volume occurs that has not been contained and contaminants observed to enter the Groundwater management system.	All hydrocarbon spills are to be cleaned up. • Procedures for handling hydrocarbons to be revised and updated if required. • Staff and contractors to be re-trained in the handling of hydrocarbons. • Groundwater bores are to be sampled and tested for the presence of Hydrocarbons. • Groundwater/contamination expert advice to be sought if hydrocarbons present in groundwater. • PIRMP to be activated	PIRMP Spill Response Training Annual review report & photographic evidence/ Managing Urban Storm Groundwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP & GWMP
Constructed Groundwater Bores are installed and functional.	Constructed Groundwater Bores blocked.	Inability to monitor Groundwater	Groundwater Bore observed to be blocked during inspection or sampling.	Clean / repair blocked or damaged bores where possible. Investigate installation of a new bore if restoration not possible.	Annual review report & photographic evidence

Objective	Performance Indicator	Potential Adverse Outcome	Trigger Level	Actions to be Implemented	Evidence/ Reference
Surface water (mixed with groundwater inflows from the mine void) discharged from the site is consistent with the baseline ecological and geomorphic conditions of the surrounding environment. Note: Minor groundwater inflows will only occur as extraction proceeds below the groundwater level. No groundwater is discharged directly nor is it discharged through the bores.	Water quality monitoring of the water to be discharged does not meet the EPL criteria.	Significant changes to quality of water to be discharged, particularly elevated conductivity due to Groundwater influx, harms ecological communities downstream.	Water to be discharged does not meet the EPL criteria quality parameters outside the EPL criteria of pH between 6.5 and 8.5, Conductivity <1450µS/cm.	• Cease discharge offsite if occurring. • Consult with groundwater expert and surface water expert to determine measures to be implemented to meet EPL discharge guidelines. • Consult with ecologist to investigate remediation measure to downstream environment if required.	PIRMP Annual review report & photographic evidence/ Managing Urban Storm Groundwater- Soils and Construction- Volume 2E Mines and Quarries & SWMP & GWMP, EPL

9 Environmental Management Measures

Specific Groundwater management measures identified in the EIS and CoA have been interpreted and generally reproduced in *Table 12*. The management measures identified in this table are to be implemented to mitigate or manage impacts identified. Relevant responsibility and references for each have been identified in the corresponding columns below.

Table 12. ***Environmental Management Measures***

#	Management Measure	Responsibility	Frequency	Reference
General				
G1	An environmental consultant with appropriate qualifications for the task will be engaged to help review the Groundwater Management Plan and measures for the Project.	Environmental Consultant Environmental Manager Operations Manager	As required	Appropriately Qualified Consultant Correspondence
G2	All relevant individuals will read the GWMP with any engineering plans and any other plans or written instructions issued in relation to development at the project site.	Operations Manager Site Engineers Contractors	As required	GWMP (This Plan)
G3	Implement Groundwater Management Procedures and regularly review to ensure relevance and compliance with internal and external requirements.	Operations Manager Site Engineers Contractors	At least annually	Groundwater Management Procedures
G4	Inform all subcontractors of their responsibilities in minimising the potential for any groundwater quality impacts, spills etc. through site induction and toolbox talks.	Environmental Manager Operations Manager	At least annually	Induction
G5	Annual Review of this plan and relevant procedures	Operations Manager Environmental Manager	At least annually	GWMP (This Plan)

#	Management Measure	Responsibility	Frequency	Reference
Groundwater Management				
GW1	Undertake Groundwater quality, flow and consumption monitoring as per the requirements of the EPL and this Plan	Environmental Manager Site Engineer Site Staff & Contractors	Monthly	EPL, GWMP (This Plan) ENVIZY
GW2	Routine maintenance and inspection of Bores, including water level checks. Blocked or damaged bores may need to be repaired where required.	Operations Manager Site Engineer Site Staff & Contractors	As required	GWMP (This Plan)
GW3	Activities with the potential to reduce or contaminate local Groundwater quality (including refuelling, vehicle servicing, concrete washout, storage of fuels and hazardous materials,) will be undertaken within appropriately bunded areas.	Operations Manager Site Engineer Site Staff & Contractors	As required	Groundwater Management Procedures / PIRMP
GW4	All Fuel and oil storage will be appropriately bunded with spill kits are accessible. All hydrocarbon spills are to be cleaned up and reported as per PIRMP. Procedures for handling hydrocarbons and spills to be revised and updated if required.	Environmental Manager Operations Manager Site Engineer Site Staff & Contractors	As required	GWMP (This Plan)
GW5	Staff and contractors to be trained in the handling of hydrocarbons, spills and PIRMP annually.	Environmental Manager Operations Manager Site Engineer Site Staff & Contractors	Annually	GWMP (This Plan)/Induction/ Spill Training

10 Compliance Management

10.1 Inspections

Monthly inspections and daily visual observations by the Plant Manager (or delegate) of Groundwater quality conditions and controls will occur throughout the operational lifetime of the facility.

10.2 Training

All employees and contractors working on site will undergo site induction training, which will cover issues relating to Groundwater quality management, including:

- Existence and requirements of this Plan;
- Relevant legislation;
- Bringelly Brickworks operational hours;
- Location of Spill kits;
- All other Groundwater quality management measures that need to be implemented to minimise impact to and ground Groundwater;
- Location of Groundwater monitoring bores; and
- Incident and Complaints reporting.

10.3 Complaints & Enquiries Procedure

All community inquiries and complaints related to the facility's activities will be referred to a community information line (02 4774 8751). A postal address, PGH Bricks, Locked Bag 1345, North Ryde BC NSW 1670) and email address has been provided for receipt of complaints and enquiries. Information to be recorded will include location of complainant, time of occurrence of alleged complaint, perceived source, prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint.

An initial response acknowledging a complaint will be provided within 24 hours of a complaint being received. A further detailed response, including steps taken to resolve the issue(s) that led to the complaint, will be provided within 10 days. All reasonable endeavours will be made to resolve and close off complaints. The complainants will be kept informed of when they will receive a response.

Information on all complaints received, including how they were addressed, whether resolution was reached and whether mediation was required or used will be included in a complaint register.

Complaints and the subsequent action(s) taken by PGH will be reported at each subsequent Community Consultative Committee meeting.

10.4 Incident Management

PGH will immediately notify the Secretary and any relevant agencies when an incident has occurred. More specifically, where the following conditions are not met a Groundwater incident shall be raised and reported accordingly:

1. On review of Groundwater quality monitoring data, an exceedance is recorded above the criteria stipulated in *Section 8*; and
2. Within seven days of the declaration of an incident, a report documenting the facts of the incident must be submitted to the Secretary. This report is to document the findings of the incident investigation, attempt to identify the cause and nature of the exceedance.

Note, the trigger levels stipulated in *Section 8* will be further refined as more background data becomes available.

10.5 Audit

Audits (both internal and external) and reporting will be undertaken to assess the effectiveness of environmental controls, compliance with this GWMP, CoA and other relevant approvals, licenses and guidelines.

10.6 Reporting

The effectiveness of the Groundwater management system will be assessed in an annual review and audits as required by consent conditions. Additional reviews will be undertaken in the form of an Annual Rehabilitation Report (ARR) as required by the Mine Lease conditions and an Annual Review submitted to DPIE- Resources and Geoscience and DPIE respectively. In addition Groundwater usage and quality data will be provided in the EPL Annual Return (if required), DPIE- Water through any WAL licensing requirements and internally through ENVIZY.

These reviews will report on the progress towards performance criteria as outlined in *Table 11*. Where an action response has been implemented, details of the action and any results obtained will be included in the ARR. The ARR's will be submitted to the DPIE-RG until the Mining Lease has been relinquished.

The annual reviews and Audits (routinely conducted every 3 years after the initial 12 monthly audit) will be submitted to the Secretary.

As part of the measurement of the effectiveness of the Groundwater management system, PGH will assess the following:

- Groundwater imported, Groundwater use, volumes stored and any discharges from the site and report results or changes to the balance;
- Groundwater quality results for compliance and trends;
- Identifying non-compliances and actions taken to ensure compliance;
- Discrepancies between the predicted and actual impacts of the development; and
- Measures that may be undertaken to improve the environmental performance of the development.

11 Review and Improvement

Continuous improvement of this GWMP will be achieved through the ongoing evaluation of environmental management performance against environmental policies, objectives and targets.

The continuous improvement process is designed to:

- Identify areas of opportunity for improvement of environmental management and performance;
- Determine the cause or causes of non-conformances and deficiencies;
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies;
- Verify the effectiveness of the corrective and preventative actions;
- Document any changes in procedures resulting from process improvement; and
- Make comparisons with objectives and targets.

Inspections, monitoring, auditing and management reviews may result in the need to update or revise this GWMP.

12 References

1. Golder and Associates - Groundwater impact assessment (2013)
2. Hyder Consulting - Bringelly Brickworks and Quarry Expansion ENVIRONMENTAL IMPACT STATEMENT Volumes 1 & 2 -5 September 2013
3. Kleinfelder Groundwater Management Plan PGH Bricks & Pavers Bringelly - 28 October 2016
4. DECC, 2008, the Blue Book – Volume 2D.
5. Landcom, 2004, Managing Urban Storm Groundwater: Soils and Construction – Volume 1 and 2 (4th edition).
6. Western Sydney Regional Organisation of Councils, 2004, Draft Salinity Code of Practice.
7. DPIE-Water Guidelines for Controlled Activities.
8. ANZECC Guidelines for Fresh and Marine Groundwater Quality.
9. ANZECC Guidelines for Groundwater Quality Monitoring and Reporting.
10. Groundwater Management Act 2000.

Appendix A: Figures

Plan of:	Bringelly Clay Mine Groundwater Management Plan - Site Location	***Location:***	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	***Source:***	nearmap - Image Date 12/01/2019 & Google Maps 2019	***Our Ref:***	8006_BR_GMP_C001_V0_F1.cdr
Figure:	ONE	***Council:***	Camden Council	***Survey:***	N/A	***Plan By:***	JD
Sheet:	1 of 1	***Tenure:***	ML 1731	***Projection:***	N/A	***Project Manager:***	TO
Version/Date:	V0 10/09/2019	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	N/A	***Office:***	Thornton

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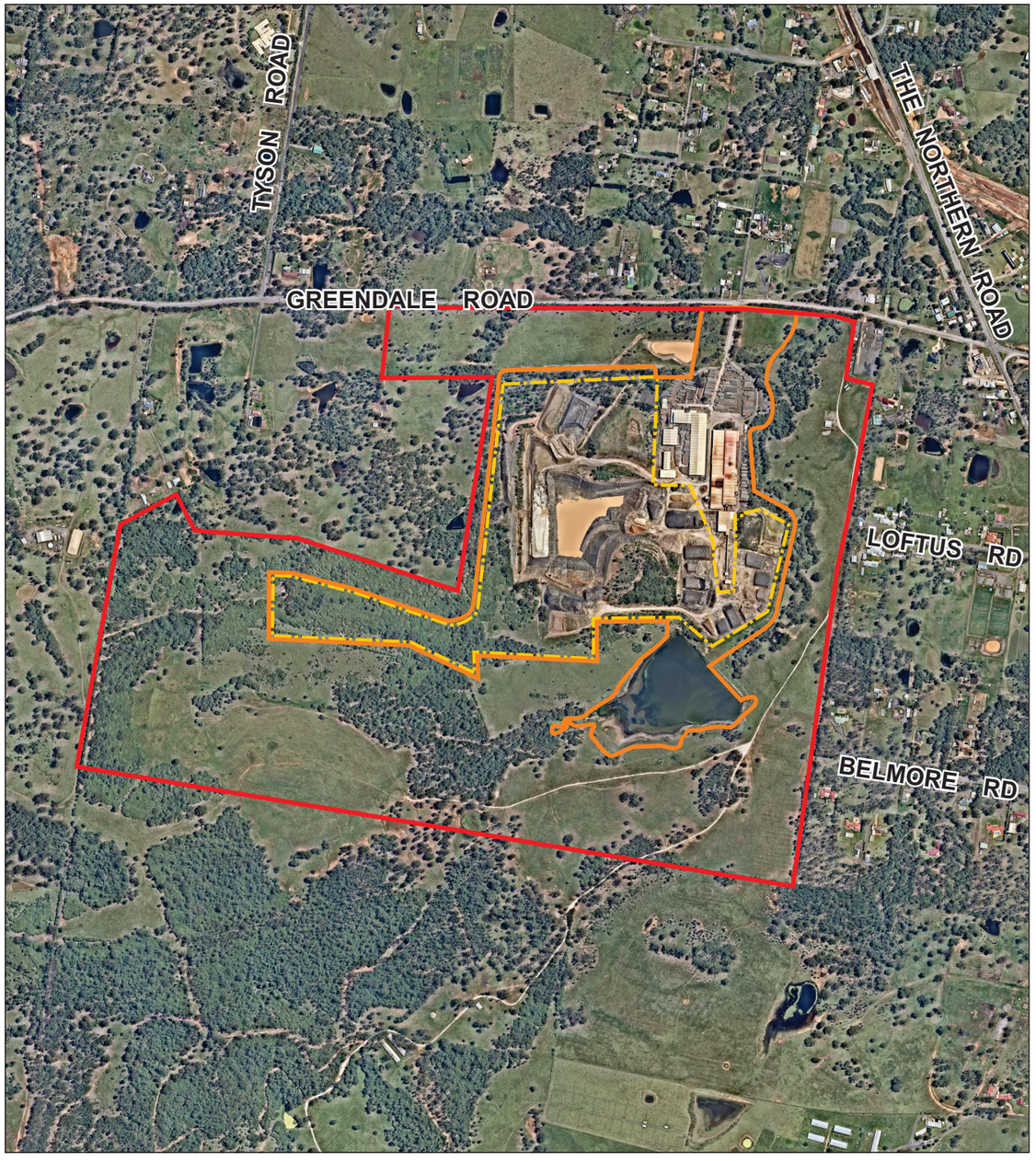

Approx Scale: 0 5 10km

Approx Scale: 0 250m

Legend

- Cadastral Boundary
- Project Approval Boundary
- Authority Boundary *(ML 1731)*

Plan of:	Bringelly Clay Mine Groundwater Management Plan - Site Layout	***Location:***	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	***Source:***	Photomapping 2015 & nearmap - Image Date 12/01/2019	***Our Ref:***	8006_BR_GMP_C002_V0_F2.cdr
Figure:	TWO	***Council:***	Camden Council	***Survey:***	Photomapping 2015	***Plan By:***	TO/JD
Sheet:	1 of 1	***Tenure:***	ML 1731	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V0 10/09/2019	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton

N

0 30 60 90 120 150m

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288400 E 288600 E TYSON ROAD 288800 E 289000 E 289200 E 289400 E 289600 E MEDWAY RD 289800 E 290000 E 290200 E

GREENDALE ROAD

6242200 N 6242000 N 6241800 N 6241600 N 6241400 N

Barkwell Gully GW01 GW02 GW03 GW04 Dam 1 Dam 2 Dam 3 Dam 4 Dam 5 Dam 6 Quarry Pit Sump Pooled Water Thompsons Creek

Raw Material Stockpile Area Brick Storage Area Brick Storage Area Existing Brickworks Raw Material Stockpile Area Raw Material Stockpile Area Raw Material Stockpile Area Raw Material Stockpile Area Box Feeder

A A'

LOFTUS RD BELMORE RD

LEGEND	
	Cadastral Boundary
	Authority Boundary *(ML 1731)*
	Project Approval Boundary
	Water Management
	Road
	Contour
GW04	Groundwater Bore Location
A A'	Cross Section A-A'

Plan of:	Bringelly Clay Mine Groundwater Management Plan - Existing Water Management	***Location:***	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	***Source:***	Photomapping 2015 & nearmap - Image Date 12/01/2019	***Our Ref:***	8006_BR_GMP_C003_V0_F3.cdr
Figure:	THREE	***Council:***	Camden Council	***Survey:***	Photomapping 2015	***Plan By:***	TO/JD
Sheet:	1 of 1	***Tenure:***	ML 1731	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V0 11/09/2019	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton

N

0 30 60 90 120 150m

vgt
Environmental Compliance Solutions Pty Ltd

288400 E 288600 E 288800 E 289000 E 289200 E 289400 E 289600 E 289800 E 290000 E 290200 E

6242200 N 6242000 N 6241800 N 6241600 N 6241400 N

GREENDALE ROAD
TYSON ROAD
MEDWAY RD
LOFTUS RD
BELMORE RD
Bardwell Gully
Thompsons Creek
Thompsons Ck

EPL1
EPL5
Water Treatment & Monitoring Point
GW01
GW02
GW03
GW04
Dam 1
Dam 2
Dam 4
Dam 5
Dam 6
Cell A
Cell B
Cell C
Cell D
Cell E
Cell F
Cell G
Cell H
Raw Material Stockpile Area
Brick Storage Area
Existing Brickworks
Box Feeder
Quarry Pit Sump Dam 3
Pooled Water
Proposed New Dam (7) Extent

LEGEND

Feature/Domain			
	Project Approval Boundary		Direction of Flow *(Clean Water)*
	Major/Minor Road		Clean Water Diversion System
	River/Major Drainage Line	Mining Tenement	
	Proposed New Dam 7		Authority Boundary *(ML 1731)*
	Direction of Flow *(Dirty Water)*		Area of Disturbance
	Stormwater Pipe	Primary Domains *(Operational)*	
	Pump Line		Water Management
E	Transmission Line	Catchments	
GW04	Groundwater Bore Location		Dam 1 Catchment
	Extraction Point for Dust Control		Dam 2 Catchment
EPL	Discharge Point *(EPL)*		Dam 3 Catchment
	Water Treatment & Monitoring Point		Dam 4 & 5 Catchment
	Contour		Dam 6 Catchment

VGT Environmental Compliance Solutions Pty Ltd 4/30 Glenwood Drive, Thornton NSW 2322 PO Box 2335, Greenhills NSW 2323 ph: (02) 4028 6412 email: mail@vgt.com.au www.vgt.com.au ABN: 26 621 943 888

Plan of:	Bringelly Clay Mine Groundwater Management Plan - Cross Section	***Location:***	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	***Source:***	Photomapping 2015 & Landair 2017	***Our Ref:***	8006_BR_GMP_C002_V0_F2.cdr
Figure:	FOUR	***Council:***	Camden Council	***Survey:***	Photomapping 2015 & Landair 2017	***Plan By:***	SK/JD
Sheet:	1 of 1	***Tenure:***	ML 1731	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V0 10/09/2019	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	N/A	***Office:***	Thornton

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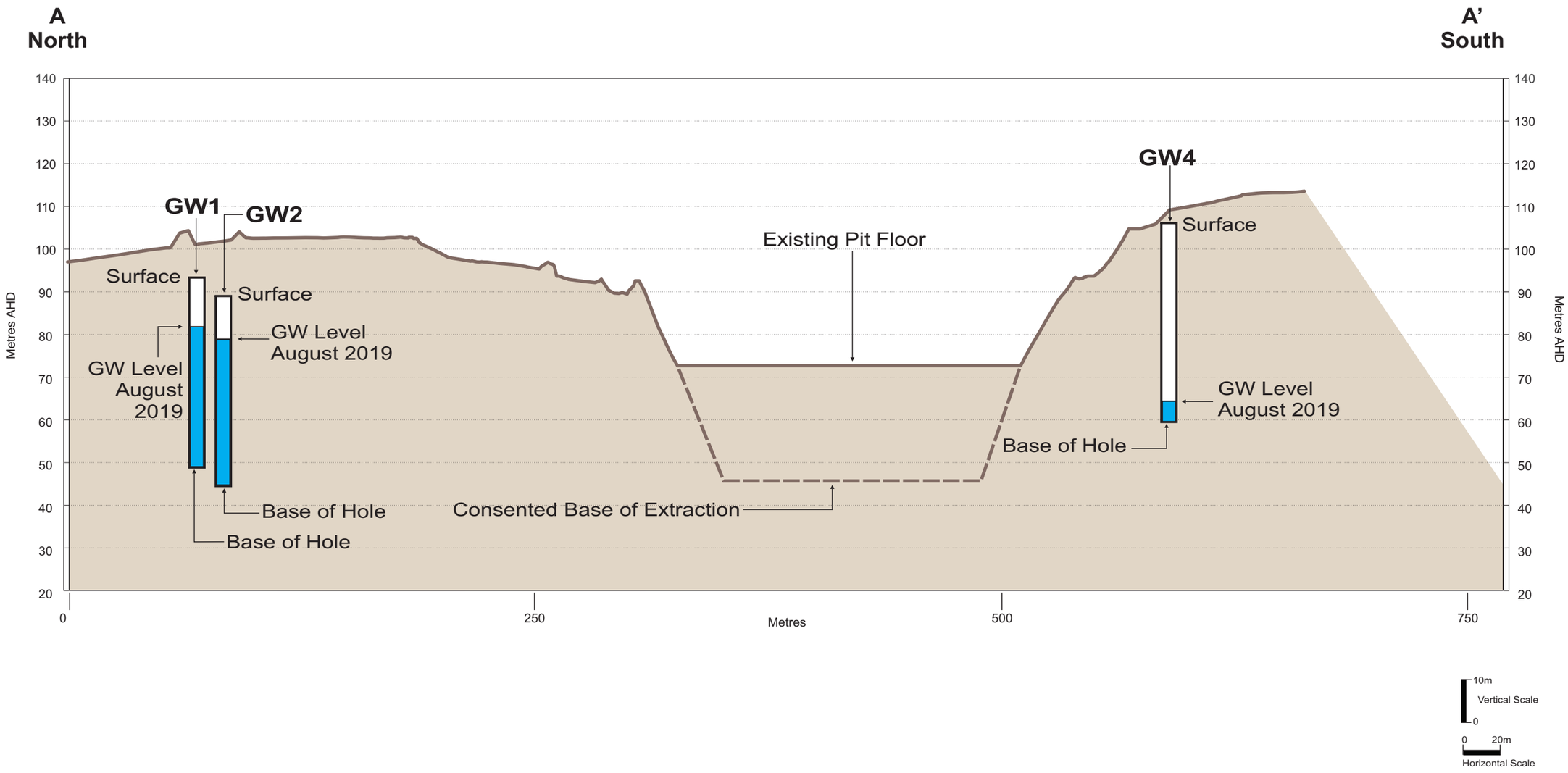

Legend

- Existing Ground Level
- Consented Base of Extraction
- Approximate Groundwater Level
- Groundwater Well

Plan of:	Bringelly Clay Mine Groundwater Management Plan - Groundwater Contours	***Location:***	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	***Source:***	Photomapping 2015 & nearmap - Image Date 12/01/2019	***Our Ref:***	8006_BR_GMP_C005_V0_F5.cdr
Figure:	FIVE	***Council:***	Camden Council	***Survey:***	Photomapping 2015	***Plan By:***	TO/JD
Sheet:	1 of 1	***Tenure:***	ML 1731	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V0 120/09/2019	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton

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288400 E 288600 E TYSON ROAD 288800 E 289000 E 289200 E 289400 E 289600 E MEDWAY RD 289800 E 290000 E 290200 E

GREENDALE ROAD

6242200 N 6242000 N 6241800 N 6241600 N 6241400 N

Bardwell Gully

GW01 GW02 GW04

75 70 65

Dam 1 Dam 2 Dam 3 Dam 4 Dam 5 Dam 6

Brick Storage Area Brick Storage Area

Existing Brickworks

Raw Material Stockpile Area Raw Material Stockpile Area Raw Material Stockpile Area Raw Material Stockpile Area

Quarry Pit Sump

Box Feeder

Thompsons Creek Thompsons Creek Thompsons Ck

LOFTUS RD BELMORE RD

LEGEND	
	Cadastral Boundary
	Authority Boundary *(ML 1731)*
	Project Approval Boundary
	Road
GW01	Groundwater Bore
	Groundwater Contour *(1m)*
	Groundwater Contour *(5m)*

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Plan of:	Bringelly Clay Mine Groundwater Management Plan - Mine Stages & Conceptual Bore Locations	***Location:***	Bringelly Clay Mine Off Greendale Road, Bringelly, NSW	***Source:***	Photomapping 2015 & nearmap - Image Date 12/01/2019	***Our Ref:***	8006_BR_GMP_C006_V0_F6.cdr
Figure:	SIX	***Council:***	Camden Council	***Survey:***	Photomapping 2015	***Plan By:***	TO/JD
Sheet:	1 of 1	***Tenure:***	ML 1731	***Projection:***	MGA	***Project Manager:***	TO
Version/Date:	V0 12/09/2019	***Client:***	PGH Bricks & Pavers Pty Ltd	***Contour Interval:***	1m	***Office:***	Thornton

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vgt Environmental Compliance Solutions Pty Ltd

288400 E 288600 E 288800 E 289000 E 289200 E 289400 E 289600 E 289800 E 290000 E 290200 E

6242200 N 6242000 N 6241800 N 6241600 N 6241400 N

GREENDALE ROAD

TYSON ROAD

MEDWAY RD

LOFTUS RD

BELMORE RD

Bardwell Gully

Thompsons Creek

Thompsons Ck

EPL1

EPL5

Water Treatment & Monitoring Point

GW01 GW02 GW03 GW04

Dam 1 Dam 2 Dam 3 Dam 4 Dam 5 Dam 6

Pooled Water

Quarry Pit Sump

CELL A CELL B CELL C CELL D CELL E CELL F CELL G CELL H CELL I

Raw Material Stockpile Area

Brick Storage Area

Existing Brickworks

Box Feeder

Proposed New Dam (7) Extent

PRL001

LEGEND

Feature/Domain		Feature/Domain *(Cont.)*	
	Project Approval Boundary		Extraction Point for Dust Control
	Major/Minor Road	EPL	Discharge Point *(EPL)*
	River/Major Drainage Line		Water Treatment & Monitoring Point
	Proposed New Dam 7	CELL1	Mine Staging Cells
	Water Management		
E	Transmission Line	Mining Tenement	
	Contour		Authority Boundary *(ML 1731)*
GW04	Groundwater Bore Location *(Existing)*		Area of Disturbance
	Groundwater Bore Location *(Proposed)*		

Appendix B: Groundwater Assessment Fieldwork Factual Report

11 November 2013

BORAL BRINGELLY BRICKS

Groundwater Assessment Fieldwork Factual Report

Submitted to:
Kate Jackson (Boral)
Ashley Turner (Boral)

REPORT

Report Number. 137626001-004-R-Rev0

Distribution:

Kate Jackson (Boral)
Ashley Turner (Boral)
Ursula O'Donnell (Hyder Consulting)

Golder Associates

Record of Issue

Company	Client Contact	Version	Date Issued	Method of Delivery
Boral	Kate Jackson	RevA (Draft)	28/06/2013	Electronic
Boral	Kate Jackson	Rev 0	11/11/2013	Electronic

Executive Summary

Between April and May 2013, Golder Associates Pty Ltd (Golder) conducted a hydrogeological field program designed to provide Boral Bringelly with an installed groundwater monitoring network. The purpose of the monitoring network is to facilitate the groundwater assessment to satisfy the Director General's Requirements for the purposes of the Environmental Impact Study (EIS) for the expansion of quarry works. The monitoring network also facilitates the ongoing monitoring of groundwater conditions at the Boral Bringelly site.

The hydrogeological field program consisted of the following:

- Geological logging of soil and rock sampled from boreholes at selected locations around the Bringelly site - GW01, GW02, GW03 and GW04 (please refer to Figure 5 below below),
- The drilling, installation and development of the four groundwater monitoring bores GW01, GW02, GW03 and GW04,
- Hydraulic permeability testing (Falling Head Tests) of monitoring bores at GW01, GW02, GW03 and GW04
- A single round of groundwater quality sampling of the four monitoring bores,
- Training of Boral environmental staff for the continued monitoring of groundwater levels and sampling.

The results of the hydraulic testing were analysed in AQTESOLV to ascertain transmissive characteristics (hydraulic conductivity) of the screened geological formations in each of the four monitoring bores. Results indicate that GW04 is a dry hole, and GW03 has partial saturation within the screened zone. Hydraulic conductivity values for GW03 and GW04 were found to be 1.915×10^{-9} m/s and 2.55×10^{-10} m/s, respectively, consistent with marine clays and shales[1]. GW01 and GW02 demonstrate hydraulic conductivities, k, of 2.628×10^{-7} m/s and 2.288×10^{-7} m/s, respectively. These values are consistent with sandstone formations[1].

The groundwater quality analysis results establish baseline readings for the long-term monitoring of groundwater characteristics.

[1] R. Allan Freeze, John A. Cherry, 1979: *Groundwater*, Prentice-Hall of Australia Pty Ltd, Sydney, 1979, p.29

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APPENDIX E
Guidelines for Water Quality Sampling

APPENDIX F
Water Quality Sampling Field Sheets

APPENDIX G
Limitations

1.0 INTRODUCTION

This report presents the methodology and factual results of a hydrogeological field program carried out as part of the Boral Bringelly Bricks groundwater assessment. The groundwater assessment was for the purposes of satisfying the Director General's Requirements (DGR) as part of an Environmental Impact Study (EIS) for the expansion of the quarry works at Bringelly. The work has been undertaken in general accordance with Golder Associates Pty Ltd (Golder) Proposal *137626001-001-R-Rev0*, dated March 2013.

Boral Bricks Bringelly is a clay quarry and building products manufacturing site located on Greendale Road, Bringelly, approximately 60km southwest of Central Sydney in New South Wales. The brickworks produces approximately 160,000 tonnes of bricks per year. The quarry however is only mined for approximately 6-8 weeks of the year.

This report presents the factual results of the fieldwork program and is not intended to be interpretive.

1.1 Site Setting

Bringelly sits in a region of interbedded sedimentary rocks (siltstone, claystone, laminite and sandstone) known as the Middle Triassic Wianamatta Group. The group is made up of three main formations: Bringelly Shale, Minchinbury Sandstone and Ashfield Shale

The quarry is located on the Blacktown soil landscape, overlaying Wianamatta Group shales. This soil landscape is categorised by shallow to moderately deep, hardsetting, mottled textured with red and brown podsolic on crests grading to yellow on lower slopes. The area to the east of the quarry and brickworks is located on South Creek soil landscape which consists of layered alluvial soils, structured loams and structured plastic clays.

The quarry area of the site has an elevated topography with the highest point towards the northwest corner at 113 m AHD. A constructed ridge runs along the western boundary north to south of the site which gently slopes downwards towards the east – south east. The lowest point runs along the eastern side of the site and is characterised by Thompson Creek. The general direction of overland flow is towards Thompsons Creek downstream of Dam 6.

2.0 FIELD WORK PROGRAM

The field work program was carried out in essentially five stages:

- Drilling and geological logging of four HQ sized boreholes
- Monitoring bore installation
- Monitoring bore development
- Hydraulic testing
- Water quality sampling

The locations of the monitoring bores were agreed upon by both Golder and Boral prior to mobilising to site in line with recommendations made by Golder in the preceding site visit report (*137626001-001-R-Rev0-Boral Bringelly Brickworks Site Visit Report*). Access to the locations was determined by Boral site staff and updated co-ordinates were provided to Golder by the Boral site contact Michael Gow on arrival to site on the first day of the field work program.

2.1 Drilling and Geological Logging of HQ Boreholes

Drilling of boreholes for the installation of standpipe piezometers was carried out between the 3rd and the 15th of April 2013. The process involved rotary core drilling of four boreholes.

The drilling contractor Statewide Drilling Pty Ltd deployed an Edson 200 Light Multipurpose Drill-rig for the rotary diamond core drilling of the boreholes. After wash-boring to approximately three meters, a 100mm PVC casing was installed temporarily to prevent unstable material near the surface from collapsing into the hole during drilling. The holes were then rotary diamond cored in size HQ (96mm) in 1.5 metre core runs.

Figure 1: Rotary core drilling of monitoring bore GW04

During the drilling process Golder field staff logged the recovered core for geological and hydrogeological purposes. Each core run was surveyed for lithographical classification using AS1726 – 1993 (the Australian Standard for Geotechnical Site Investigations) and for features that could indicate the presence of groundwater and potential permeable rock and soil intervals. Photos of each core box were taken for the recovered core in its wet state and are provided in APPENDIX A of this report. The borehole log reports developed from field logging sheets are also provided in APPENDIX B. The software gINT was used as a presentation tool for our geological logging.

Each of the monitoring bores were drilled to 40 metres, with the exception of GW04 where, due the presence of sandstone at the bottom of the borehole, it was decided to drill an additional two metres in order to capture the sandstone within the screened section of the well and maximise the potential for intersecting saturated groundwater zones.

2.2 Monitoring Bore Installation

After drilling was completed on each monitoring bore the 50mm PVC blank casing and screens were assembled and lowered into the hole using the plug and clamp method. This involved attaching Golder's custom built hoist plug to the wireline of the drill rig while the HQ clamp sits at the opening to the borehole on the foot of the drill rig as shown in Figure 2. The plug facilitates the lowering of the strings of PVC into the borehole by screwing the lengths of PVC onto the plug. The wireline and winch can then be used to carry out the lifting and the PVC can be lowered through the clamp in a controlled fashion as shown in Figure 3. Once a length has been lowered into the hole, the clamp is tightened onto the surface casing to hold the PVC in place while the next string is lifted.

All bores were installed with a sump for the purposes of catching possible sediment build-up in the monitoring bores. The sump consists of a length of 50mm diameter class 18 PVC blank casing with a screw on bottom cap. The screen section is made up of 50mm diameter, 3m lengths of class 18 PVC screen with 0.4mm horizontal slots and the monitoring bore is finished to the surface with 50mm diameter, 3m lengths of class 18 PVC blank casing. All PVC casings and screens used had threaded screw fittings to connect together. Construction diagrams of each of the monitoring bores are provided as part of APPENDIX B.

Figure 2: Monitoring bore installation using clamp

Figure 3: Monitoring bore installation using hoist plug on GW03

Once the PVC was installed successfully the top length of casing was cut in order to leave a height of approximately 0.5 metres above the ground surface. With the PVC in place the drilling rig was then moved to the next drill site by the offsider while the drilling supervisor installed the gravel pack in the annulus. The 2mm gravel pack was installed slowly to reduce the risk of bridging and voids being created to approximately 1 metre above the top of the PVC screening on each well. The depth to which the gravel pack reached in the annulus was monitored using a weighted tape measure. The gravel pack was then sealed using a 1 metre bentonite plug. The remaining annulus of each monitoring bore was then grouted to ground surface with a water-cement-bentonite powder slurry. The steel monument was then cemented in place over the top of the casing. A removable push-on PVC cap was placed on the top of the casing to protect the monitoring bore from contamination from the surface. Figure 4 below shows the above ground completion of the monitoring bore at GW01, including steel monument cover and PVC push on cap.

Figure 4: Surface completion of monitoring bore GW01

All the monitoring bores were installed using the same methodology. Completion specifications of the installed monitoring bores are included in the borehole log reports in APPENDIX B as installation diagrams. Details and locations of the four monitoring bores are provided in Table 1 and Figure 5 below.

Table 1: Monitoring bore details

Bore ID	Coordinates*		Surface Elevation (mAHD)[1]	Bore Size	Casing Depth (mbGS)[2]	Top of Casing (maGS)[3]	Installation Date	Casing Diameter (mm)	Screen Length (m)	TDB (m)[4]	Location
	Easting	Northing									
GW01	289202.0	6242112.1	87.6	HQ	19	0.56	12/04/2013	50	18	40	In paddock outside of quarry boundary to the NW
GW02	289502.1	6242101.8	83.55	HQ	19	0.62	15/04/2013	50	18	40	Adjacent to the paddock entrance gate at the NE of the quarry
GW03	289628.5	6241630.2	86.8	HQ	24	0.6	6/04/2013	50	15	40	At the foot of hill to the W of the stockpile yard
GW04	289214.9	6241594.5	99.1	HQ	21	0.6	9/04/2013	50	18	42	On elevated ground to the SW corner of the quarry pit

* Coordinates and elevations are provided by Mepstead & Associates Pty Ltd

1 mAHD – metres above Australian Height Datum

2 mbGS – metres below Ground Surface

3 maGS – metres above Ground Surface

4 TDB – Total Depth of Borehole

Figure 5: Locations of groundwater monitoring bores

2.3 Monitoring Bore Well Development

Subsequent to the installation of monitoring bores, all bores that are found to be producing water are required to be developed using a suitable method under the Minimum Construction Requirements for Water Bores in Australia (3rd Edition, February 2012). Bore development is carried out to improve the bores efficiency for water production, improve specific capacity, stabilise aquifer material, and control the amount of suspended solids. The process agitates the gravel pack around the screened sections of the monitoring bore construction and draws fine material, which could potentially clog the monitoring bore or inhibit water production, through the screen. These fines are then removed in the development process or allowed settle in the sump of the monitoring bore.

Upon completion of drilling and installation of the monitoring bores, the drillers were contracted further by Boral to drill exploratory boreholes in the quarry pit and other selected locations. From discussions between Statewide Drilling and Golder it was agreed that Statewide Drilling would develop the wells by airlifting under the supervision of Golder field staff. This was planned to be carried out at the end of the exploratory drilling program using a hired air compressor and air line. However, due to rainfall, conditions in the pit had deteriorated and the Statewide Drilling support truck was no longer able to access the drilling site in order to supply water to the rig. As a result the drillers were forced to demobilise to their workshop in Melbourne to acquire a rubber track mounted support truck to complete the drilling program. It was agreed that Statewide Drilling would also return with well development equipment so that there was no need to hire equipment.

Golder field staff returned to site on the 24th of April 2013 to oversee the well development of the installed monitoring bores by Statewide Drilling personnel. As previously mentioned airlifting was chosen as the method of development. Statewide Drilling provided the following for the development process:

- an Atlas Copco XAS 125 trailer mounted diesel air compressor (see Figure 6)
- approx. 55m of air line piping
- a custom made PVC T-piece to fix to the top of the well casing to direct water flow to the side (see Figure 7

Figure 6: Portable air compressor used for airlifting well development

Airlifting involves the injection of air into a saturated bore such that slugs of water are transported irregularly to the top of the well casing. The air pressure on the compressor is adjusted to create a surging action to improve the effectiveness of the development. The surges of aerated water provide the agitation to the gravel pack in the annulus between the screen and the aquifer.

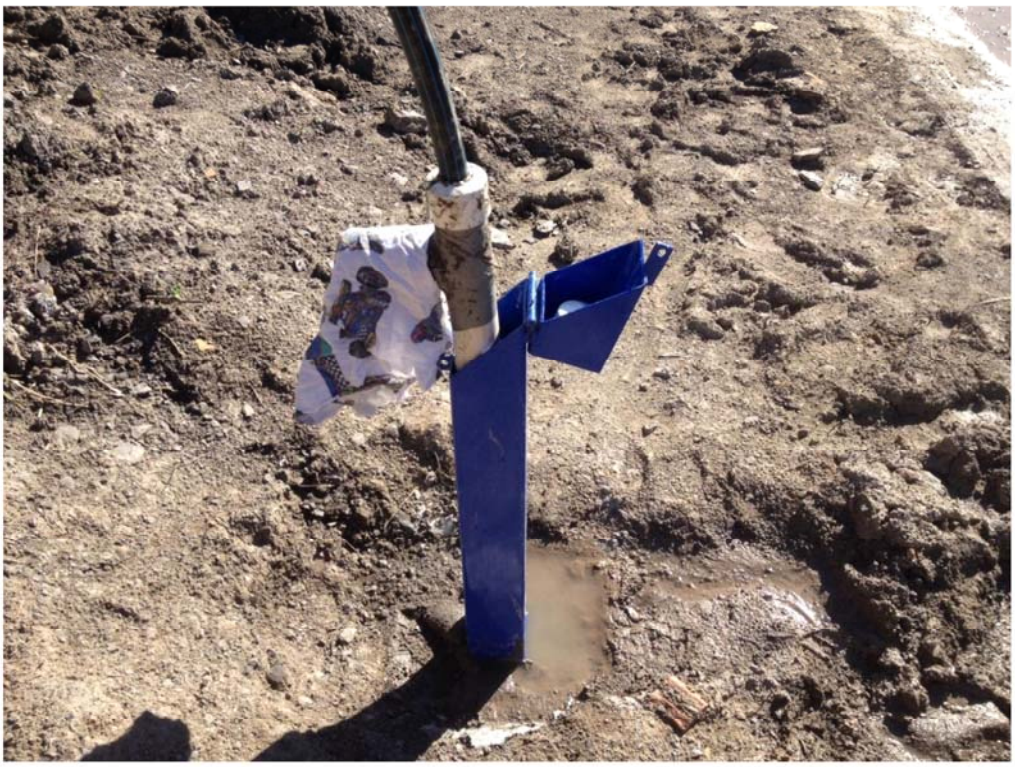

Figure 7: PVC T-piece and air line for well development by airlifting

For boreholes GW03 and GW04, which were found to contain little water, it was necessary to introduce water into the well in order for the bores to be developed effectively. A water cube was secured to the tray of the Golder vehicle in order to facilitate this. GW03 was filled to the top of the casing whereas, due to apparent permeability, GW04 was filled to 3.06 m below top of casing.

The development process and observations are summarised in Table 2 below.

Table 2: Summary of monitoring bore development

Bore ID	Estimate of volume purged (L)	Number of surge cycles	Appearance/Comments
GW01	470	21	Water purged initially brown turning pale grey and silty, cleared slowly. Purged water was noted to be saline.
GW02	450	17	Water purged initially reddish brown, turning pale grey and silty, cleared slowly.
GW03	120	7	Introduced water to top of casing, water purged initially grey, more water added after 3rd air lift cycle, water purged cleared after 5th surge cycle
GW04	210	12	Introduced water to 3.06 m below top of casing initially, total of 206 litres added in several stages between air lift cycles, water purged cleared after 10th surge cycle

2.4 Hydraulic Testing

Once the monitoring bores had been suitably developed and recovered to Standing Water Level (SWL) hydraulic testing was carried out in order to ascertain the hydraulic conductivity of the screened geological formations. Falling Head Tests (FHTs) were chosen as a method to test hydraulic conductivity. This involves the rapid introduction of a volume of water into the well and monitoring the recovery of the well to SWL using a water level data logger.

Falling Head Tests were carried out on GW01 and GW02 on the 24th of April following development.

For monitoring bores GW03 and GW04 the SWLs were found to be sitting well below the top of the screened section. The FHT methodology used for these monitoring bores deviated from traditional FHT methodology because of this and the results are for indicative purposes only. Directly after the bore development monitoring bores GW03 and GW04 had not yet recovered to Static Water Levels. For this reason it was decided to carry out hydraulic testing on these holes in conjunction with the water quality sampling fieldwork. Falling Head Tests were carried out on GW03 and GW04 on the 30th of May.

2.4.1 Falling Head Test Methodology

Falling Head Tests were carried out by:

- Lowering the water level troll into the monitoring bore to a known depth,
- Rapidly introducing a slug of water until full water return to surface was achieved. an IBC (Intermediate Bulk Container) water cube mounted on the back of the Golder site vehicle was used to facilitate this,
- Recovery is monitored by a 10 metre Mini-Diver water level datalogger,
- Regularly checking the water level in the bore with a water level meter during the test to monitor recovery progress,
- Withdrawing the water level troll once the hole has recovered and downloading the data to the field laptop for analysis.

In the cases of GW03 and GW04, the tight nature of the formations in the screened sections of the monitoring bores meant that the recovery of the holes was very slow; therefore hydraulic testing was carried out for a maximum of 2.5 hours to provide indicative results that could be analysed.

2.4.2 Hydraulic testing analysis and results

The results of the falling head tests were analysed using AQTESOLV aquifer test analysis software. Due to the tight nature of the screened formations in GW03 and GW04 the hydraulic testing for these holes deviated from the traditional saturation method used for Falling Head Tests. Therefore the results of the analysis for these holes are indicative only. The AQTESOLV software uses the change in pressure head monitored by the level troll datalogger during the falling head tests to produce a curve which can then be matched to mathematical models (type curves) to estimate the hydraulic properties of the aquifer being tested. The results of the analysis are presented in Table 3 below.

Table 3: Falling head test analysis results

Bore ID	Test type	Date Tested	SWL (mbtoc)	Screened Length (m)	Screened Formations	Hydraulic Conductivity (m/s)	Method
GW01	FHT	24/04/2013	11.79	18	Mudstone, laminite (siltstone, mudstone, sandstone), siltstone, sandstone	$2.628x10^{-7}$	Hvorslev
GW02	FHT	24/04/2013	10.69	18	Laminite (siltstone, mudstone, sandstone), siltstone, sandstone, claystone	$2.288x10^{-7}$	Hvorslev
GW03	FHT	30/05/2013	26.79	15	Laminite (siltstone, mudstone, sandstone), siltstone, claystone, sandstone	$1.915x10^{-9}$	Hvorslev
GW04*	FHT	30/05/2013	40.13	18	Mudstone, siltstone, laminite (siltstone, mudstone, sandstone), sandstone	$2.55x10^{-10}$	Hvorslev

FHT – Falling head test

* Values for hydraulic conductivity for GW04 are intended for indicative purposes only

The analysis is provided in APPENDIX C.

2.5 Water Quality Sampling

Once the monitoring bores were installed and developed, water level and in-situ physico-chemical parameters were measured and recorded. Samples were collected for laboratory analysis after these initial parameters were recorded. Both data sets are tabulated in Table 5and Table 6 below. Golder field staff returned to site on the 30th of May to carry out this task. ALS Laboratory were engaged by Golder to carry out the analysis of the groundwater samples.

Sampling was conducted at each monitoring bore within the scope of this project using disposable bailers and samples were retained in approved sampling bottles for shipping to the selected laboratory. Best practice is to purge 3 well volumes prior to sampling to ensure that the water being sampled is truly representative of that produced by the aquifer. In the case of GW03 and GW04 the ingress of groundwater was very slow, so to ensure that adequate purging could be carried out, Boral site staff commenced the purging process using dedicated bailers prior to Golder mobilising to site for the water quality sampling event. Records of purged water volumes were kept. The well volumes were calculated in advance of the purging process, using standard formulas for litre volumes of water per linear metre of 50mm monitoring bore casing and screen in HQ boreholes. The volumes that were required to be purged are calculated in Table 4 below.

Table 4: Volume of groundwater to be purged based on three well volumes

Borehole	SWL[1] (mbtoc)	Date Measured	TDB[2] (mbgs)	Sump length (m)	Screen length (m)	Height of water column in well (m)	Well volume (litres)	Volume to be purged* (litres)	Actual purged volume (litres)
GW01	11.2	24/04/2013	40	3	18	29.36	89.32	267.96	207
GW02	10.76	24/04/2013	40	3	18	29.86	90.32	270.96	270
GW03	32.24	24/04/2013	40	1	15	8.36	29.232	87.696	87
GW04	39.81	24/04/2013	42	3	18	2.79	5.58	16.74	34.5

[1] – Static Water Level

[2] – Total Depth of Borehole

* Based on **3.7** litres per linear metre of screen and **2** litres per linear metre of casing.

Golder staff completed the remainder of the purging process while on site for the sampling event. A calibrated water quality meter was used to observe the field parameters during the purging process and purging was carried out until stability was observed in the parameters. A decontaminated sampling bucket was used to collect the bore water during sampling. Field records of the water quality sampling event including recorded insitu water quality parameters and SWLs are provided in APPENDIX F of this report.

As a QA/QC on the water quality sampling methodology field blank samples were also taken and trip blanks provided by the laboratory were kept with the samples during transportation and storage. Duplicate samples were taken at GW02 to act as a QA/QC on the laboratory procedures. Samples were stored in cooler boxes with ice bricks to preserve the samples and transported to the ALS laboratory within the allowable handling times for the selected parameters. An interpretative quality control report provided by the laboratory is supplied as part of APPENDIX D.

The results of the water quality sampling are presented in Table 5 and Table 6

presents the laboratory water quality analyses and also provides the trigger values for toxicants in freshwater for the protection of 95% of species in the column 'ANZECC 2000 Freshwater 95%'. It should be noted that the values highlighted in grey for GW04 indicated elevated concentrations of semi-volatile Total Petroleum Hydrocarbons (TPH) which may be evidence that the bore is producing very little water and that some residual polymers used during drilling may remain in the sump of the well. The water quality results also indicate levels of zinc exceeding the *ANZECC 2000 Trigger Values for the Protection of Freshwater Aquatic Ecosystems (95% Level of Protection).*

Table 5: Insitu water quality parameters

Hole ID	Purged by	Date Time	Volume Purged (L)	Conductivity (mS)	Temp (°C)	pH	Redox Potential (mV)	Dissolved Oxygen (ppm)	Turbidity (NTU)	Comments
GW01	Boral	17/05/2013 12:00	107	-	-	-	-	-	-	No field parameters recorded
	Golder	30/05/2013 16:50	20	13.21	18.2	8.81	32	3.14	232	Clear, no odour
	Golder	30/05/2013 17:16	30	13.27	18.4	8.7	29	2.98	-	Clear, no odour
	Golder	30/05/2013 17:35	25	13.37	18.6	8.65	25	2.81	-	Clear, no odour
	Golder	30/05/2013 17:52	20	13.32	18.9	8.57	24	2.76	-	Clear, no odour
	Golder	30/05/2013 17:55	5	13.37	18.9	8.54	23	2.8	125	Clear, no odour
GW02	Boral	16/05/2013 14:30	105	-	-	-	-	-	-	No field parameters recorded
	Boral	20/05/2013 15:10	110	-	-	-	-	-	-	No field parameters recorded
	Golder	30/05/2013 15:32	20	18.91	20.1	7.53	-130	2.97	-	Clear, non turbid
	Golder	30/05/2013 15:49	10	19.23	19.8	7.68	-127	3.12	-	Clear, non turbid
	Golder	30/05/2013 15:57	10	19.29	19.8	7.7	-114	3.14	-	Clear, non turbid
	Golder	30/05/2013 16:08	10	19.47	19.6	7.74	-107	3.28	-	Clear, non turbid
	Golder	30/05/2013 16:11	5	19.55	19.6	7.76	-103	3.39	-	Clear, non turbid
GW03	Boral	20/05/2013 12:00	2	-	-	-	-	-	-	No field parameters recorded
	Golder	30/05/2013 12:34	15	13.26	20.5	6.84	-122	1.67	-	Mildly turbid, light brown, sulphurous odour

Hole ID	Purged by	Date Time	Volume Purged (L)	Conductivity (mS)	Temp (°C)	pH	Redox Potential (mV)	Dissolved Oxygen (ppm)	Turbidity (NTU)	Comments
	Golder	30/05/2013 12:46	15	13.16	20.5	7.05	-128	1.71	668	Mildly turbid, light brown, sulphurous odour
	Golder	30/05/2013 13:01	17	13.14	20.4	7.05	-123	1.59	516	Mildly turbid, light brown, sulphurous odour
	Golder	30/05/2013 13:23	20	13.34	20.1	7.02	-111	1.84	770	Mildly turbid, light brown, sulphurous odour
	Golder	30/05/2013 13:38	18	13.52	20.2	7.06	-96	1.47	639	Mildly turbid, clearing, sulphurous odour
GW04	Boral	16/05/2013 14:50	10	-	-	-	-	-	-	No field parameters recorded
	Boral	20/05/2013 11:00	12	-	-	-	-	-	-	No field parameters recorded
	Golder	23/05/2013 10:25	8	-	-	-	-	-	-	Brown, turbid, no field parameters recorded
	Golder	30/05/2013 10:36	3	1.87	21.3	7.03	109	1.26	-	Brown, turbid
	Golder	30/05/2013 10:51	1	1.9	21.2	7.15	110	1.25	-	Brown, turbid
	Golder	30/05/2013 11:03	0.5	1.92	21.3	7.2	105	1.22	479	Brown, turbid

Table 6: Laboratory Water Quality Analysis Results

Type	Analyte	GW01	GW02	Duplicate of GW02	GW03	GW04	Field Blank	ANZECC 2000 Freshwater 95%	
Ionic Balance	Total Anions	139	222	223	139	18.8	<0.01		meq/L
	Total Cations	137	239	242	142	19.8	<0.01		meq/L
	Ionic Balance	0.52	3.56	4.26	1.15	2.62			
Major Cations - Dissolved	Calcium	143	284	306	207	12	<1		mg/L
	Magnesium	138	238	255	77	2	<1		mg/L
	Sodium	2700	4680	4710	2850	433	<1		mg/L
	Potassium	57	54	57	57	9	<1		mg/L
Dissolved Metals	Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0006	mg/L
	Nickel	0.001	0.001	<0.001	0.002	0.003	<0.001	0.011	mg/L
	Lead	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0034	mg/L
	Arsenic	0.004	0.001	0.001	0.005	0.005	<0.001	0.013	mg/L
	Zinc	0.013	0.085	0.1	0.05	0.166	<0.005	0.008	mg/L
	Cadmium	<0.0001	0.0001	<0.0001	<0.0001	0.0005	<0.0001	0.0002	mg/L
	Chromium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	mg/L
	Copper	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0014	mg/L
TPH - Semivolatile Fraction	C10 - C14 Fraction	<50	<50	<50	<50	290	<50		µg/L
	>C10 - C16 Fraction	<100	<100	<100	<100	500	<100		µg/L
	C15 - C28 Fraction	<100	<100	<100	100	1120	<100		µg/L
	>C16 - C34 Fraction	<100	<100	<100	180	1110	<100		µg/L
	C29 - C36 Fraction	<50	<50	<50	100	260	<50		µg/L
	>C34 - C40 Fraction	<100	<100	<100	<100	110	<100		µg/L

Type	Analyte	GW01	GW02	Duplicate of GW02	GW03	GW04	Field Blank	ANZECC 2000 Freshwater 95%	
	C10 - C36 Fraction (sum)	<50	<50	<50	200	1670	<50		µg/L
	>C10 - C40 Fraction (sum)	<100	<100	<100	180	1720	<100		µg/L
TPH Volatiles/BTEX	1.2-Dichloroethane-D4	85.7	86.3	82.2	79	83.6	85.5		%
	Benzene	<1	<1	<1	4	2	<1	950	µg/L
	C6 - C10 Fraction	<20	<20	<20	30	20	<20		µg/L
	C6 - C9 Fraction	<20	<20	<20	30	<20	<20		µg/L
	C6 - C10 Fraction minus BTEX (F1)	<20	<20	<20	<20	<20	<20		µg/L
	Toluene	<2	<2	<2	13	4	<2		µg/L
	Toluene-D8	103	103	102	98.6	105	99.4		%
	4-Bromcfluorobenzene	93.4	99.7	88.7	94.6	101	96.1		%
	Ethylbenzene	<2	<2	<2	<2	<2	<2		µg/L
	meta- & para-Xylene	<2	<2	<2	2	4	<2		µg/L
	ortho-Xylene	<2	<2	<2	<2	<2	<2		µg/L
	Total Xylenes	<2	<2	<2	2	4	<2		µg/L
	Sum of BTEX	<1	<1	<1	19	10	<1		µg/L
	Naphthalene	<5	<5	<5	<5	<5	<5		µg/L
Pesticides	alpha-BHC	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	DEF	86.4	83.1	80.1	81.6	71.6	84.2		%
	Dibromo-DDE	116	99.8	94.2	98.2	74.4	92.8		%
	Dichlorvos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Demeton-S-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Hexachlorobenzene (HCB)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L

Type	Analyte	GW01	GW02	Duplicate of GW02	GW03	GW04	Field Blank	ANZECC 2000 Freshwater 95%	
	beta-BHC	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Monocrotophos	<2	<2	<2	<2	<2	<2		µg/L
	Dimethoate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.15	µg/L
	gamma-BHC	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	delta-BHC	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Diazinon	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.01	µg/L
	Chlorpyrifos-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Heptachlor	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Aldrin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Parathion-methyl	<2	<2	<2	<2	<2	<2		µg/L
	Heptachlor epoxide	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Malathion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.05	µg/L
	Fenthion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	trans-Chlordane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	alpha-Endosulfan	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Chlorpyrifos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.01	µg/L
	cis-Chlordane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Parathion	<2	<2	<2	<2	<2	<2	0.004	µg/L
	Dieldrin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Pirimphos-ethyl	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	4.4`-DDE	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Chlorfenvinphos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L

Type	Analyte	GW01	GW02	Duplicate of GW02	GW03	GW04	Field Blank	ANZECC 2000 Freshwater 95%	
	Endrin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	beta-Endosulfan	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Bromophos-ethyl	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	4.4`-DDD	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Fenamiphos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Endrin aldehyde	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Prothiofos	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Endosulfan sulfate	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Ethion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	4.4`-DDT	<2	<2	<2	<2	<2	<2		µg/L
	Carbophenothion	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Azinphos Methyl	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.02	µg/L
	Endrin ketone	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Methoxychlor	<2	<2	<2	<2	<2	<2		µg/L
	Total Chlordane (sum)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Sum of DDD + DDE + DDT	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Sum of Aldrin + Dieldrin	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
PAH/Phenols	2-Fluorobiphenyl	72.2	77.6	66.8	73.7	56.8	52.8		%
	Naphthalene (Ex SVOC)	<1	1	<1	1	1.4	<1	16	µg/L
	Anthracene-d10	83.5	83.8	79.2	82.2	65.9	71.3		%
	Phenol-d6	29.3	32.1	29	31.7	25.4	20.6	320	%
	2-Chlorophenol-D4	58.8	64.2	58.2	64.2	49	46.5	490	%

Type	Analyte	GW01	GW02	Duplicate of GW02	GW03	GW04	Field Blank	ANZECC 2000 Freshwater 95%	
	4-Terphenyl-d14	83.5	80.7	79.2	79.5	62.9	79.9		%
	Acenaphthylene	<1	<1	<1	<1	<1	<1		µg/L
	2.4.6-Tribromophenol	62.1	54	55.8	74.4	65.4	39.1		%
	Acenaphthene	<1	<1	<1	<1	<1	<1		µg/L
	Fluorene	<1	<1	<1	<1	<1	<1		µg/L
	Phenanthrene	<1	<1	<1	<1	<1	<1		µg/L
	Anthracene	<1	<1	<1	<1	<1	<1		µg/L
	Fluoranthene	<1	<1	<1	<1	<1	<1		µg/L
	Pyrene	<1	<1	<1	<1	<1	<1		µg/L
	Benz(a)anthracene	<1	<1	<1	<1	<1	<1		µg/L
	Chrysene	<1	<1	<1	<1	<1	<1		µg/L
	Benzo(b)fluoranthene	<1	<1	<1	<1	<1	<1		µg/L
	Benzo(k)fluoranthene	<1	<1	<1	<1	<1	<1		µg/L
	Benzo(a)pyrene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
	Indeno(1.2.3.cd)pyrene	<1	<1	<1	<1	<1	<1		µg/L
	Dibenz(a.h)anthracene	<1	<1	<1	<1	<1	<1		µg/L
	Benzo(g.h.i)perylene	<1	<1	<1	<1	<1	<1		µg/L
	Sum of polycyclic aromatic hydrocarbons	<0.5	1	<0.5	1	1.4	<0.5		µg/L
	Benzo(a)pyrene TEQ (WHO)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		µg/L
Polychlorinated Biphenyls (PCB)	Decachlorobiphenyl	115	103	112	101	77	94		%
	Total Polychlorinated biphenyls	<1	<1	<1	<1	<1	<1		µg/L
Alkalinity	Hydroxide Alkalinity as CaCO3	<1	<1	<1	<1	<1	<1		mg/L

Type	Analyte	GW01	GW02	Duplicate of GW02	GW03	GW04	Field Blank	ANZECC 2000 Freshwater 95%	
	Carbonate Alkalinity as CaCO3	29	<1	<1	<1	<1	<1		mg/L
	Bicarbonate Alkalinity as CaCO3	219	393	388	274	327	<1		mg/L
	Total Alkalinity as CaCO3	248	393	388	274	327	<1		mg/L
pH by PC Titrator	pH Value	8.49	8.04	8.02	7.62	8.04	6.33		pH Unit
Reactive Phosphorus as P-By Discrete Analyser	Reactive Phosphorus as P	0.02	0.04	0.04	0.04	<0.01	<0.01		mg/L
Redox Potential	Redox Potential	51	92.5	120	75.7	32	123		mV
	pH Redox	8.3	7.7	7.8	7.3	7.9	6.1		pH Unit
Total Dissolved Solids (High Level)	Total Dissolved Solids @180°C	8880	13600	13300	9220	2350	<10		mg/L
Turbidity	Turbidity	48.5	68.6	61.4	451	12400	<0.1		NTU
Nitrite as N	Nitrite as N	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/L
Oxygen - Dissolved	Dissolved Oxygen	7.4	7.4	7.2	4.2	1.9	9.6		mg/L
Nitrate as N	Nitrate as N	0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.7	mg/L
Chloride	Chloride	4740	7600	7620	4720	412	<1		mg/L
Sulfate (Turbidimetric) as SO4 2-	Sulfate as SO4 - Turbidimetric	6	<1	<1	10	31	<1		mg/L
Conductivity	Electrical Conductivity @ 25°C	15200	22000	22200	15200	2020	<1		µS/cm
Nitrite and Nitrate as N (NOx)	Nitrite + Nitrate as N	0.01	0.01	<0.01	<0.01	<0.01	<0.01		mg/L

The certificate of analysis, quality control, and chain of custody documentation provided by the laboratory are presented in APPENDIX D.

Training was given to Boral environmental staff to carry out subsequent groundwater monitoring events. Further instruction is provided in the document 'Guidelines for Water Quality Sampling' in APPENDIX E.

2.5.1 Surveying of Monitoring Bore Locations

The survey of the installed groundwater monitoring bores was carried out by Mepstead and Associates Pty Ltd at the request of Boral. These co-ordinates and elevations were provided to Golder for the purposes of the groundwater assessment. The co-ordinates and elevations of the monitoring bores determined in this survey are provided in Table 7.

Table 7: Surveyed co-ordinates and elevations for groundwater monitoring bores

Hole ID	Easting (m)	Northing (m)	Elevation (mAHD)
GW01	289202.0	6242112.1	87.6
GW02	289502.1	6242101.8	83.55
GW03	289628.5	6241630.2	86.8
GW04	289214.9	6241594.5	99.1

2.5.2 Issues with GW03

During the purging of groundwater in monitoring bore GW03 Boral staff encountered problems in getting the bailer to sink and fill with water. Golder staff recommended that Boral fix some weights to the top of the bailer in order to help the bailer sink in the bore water. Boral engaged their workshop staff and fabricated a custom steel weight to fit to the top of the bailer to achieve this. However, possibly due to chaffing of the string on the steel weight, the bailer recovery string failed and the bailer was subsequently lost down the hole.

Efforts by Golder field staff to recover the bailer were unsuccessful as the modified metal sleeve covered the bracket that was to be latched onto. It is suspected that the bailer with attached steel weight have sunk into the sump of the well. These lead weights and steel fitting may alter water quality results in the future and should be noted.

2.6 Water Levels

The standing water levels for the monitoring bores have been established based on water levels taken by Golder field staff on the 30th May 2013 during the water quality sampling event at the end of the fieldwork program. This ensured that the holes with tight formations were given the maximum possible time to recover to static. The water levels are presented in Table 8 below.

Discounting GW04, the SWLs for GW01, GW02 and GW03 holes demonstrate the expected trend following the surface topography with the lowest water level in the south-eastern corner of the site towards Thompson's Creek. Inflow of water into the existing quarry pit may be affecting the water level in GW04 as it is located close to the highwall in the southwest corner of the pit. It is also possible that a SWL has not yet been established in GW04 due to very slow recovery as a result of the tight formation in the screened section of the monitoring bore. It is recommended that water levels are monitored, or alternatively a water level datalogger be installed in GW04 to monitor water levels.

Table 8: Standing Water Levels

Hole ID	SWL (mbtoc[1])	SWL (mbgs[2])	SWL (mAHD[3])	Date Measured
GW01	11.79	11.23	76.37	30/05/2013
GW02	10.69	10.07	73.48	30/05/2013
GW03	26.79	26.19	60.61	30/05/2013
GW04*	40.13	39.53	59.57	30/05/2013

[1] mbtoc – metres below top of casing

[2] mbgs – metres below ground surface

[3] mAHD – metres Australian Height Datum

*There is some uncertainty regarding the SWL for GW04. Initial groundwater levels measured by Golder field staff over the course of the fieldwork program suggest that the hole is dry or recovering extremely slowly. Groundwater quality sampling results for GW04 (refer to Table 8 above) also demonstrate elevated levels of hydrocarbons, which may indicate the presence of drilling fluids.

3.0 RECOMMENDATIONS

It is recommended that Boral develop and implement a regular water quality sampling and water level monitoring program in order to establish records of water quality and identify outliers in any key parameters. Recommendations and guidelines for carrying out groundwater sampling are provided in the Technical Memo in APPENDIX E of this report. This document has been prepared as a methodology to assist Boral environmental staff in implementing an ongoing groundwater monitoring program.

It is recommended that further efforts are made to recover the lost equipment in GW03 since the metals in the weights attached to the bailer may affect long term concentrations of certain metals in groundwater.

4.0 LIMITATIONS

Your attention is drawn to the document - "Limitations", which is included in APPENDIX G of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Report Signature Page

GOLDER ASSOCIATES PTY LTD

Shaun Troon
Senior Hydrogeologist

Dr. Detlef Bringmeier
Principal Hydrogeologist

ST/DB/cg

A.B.N. 64 006 107 857

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APPENDIX A

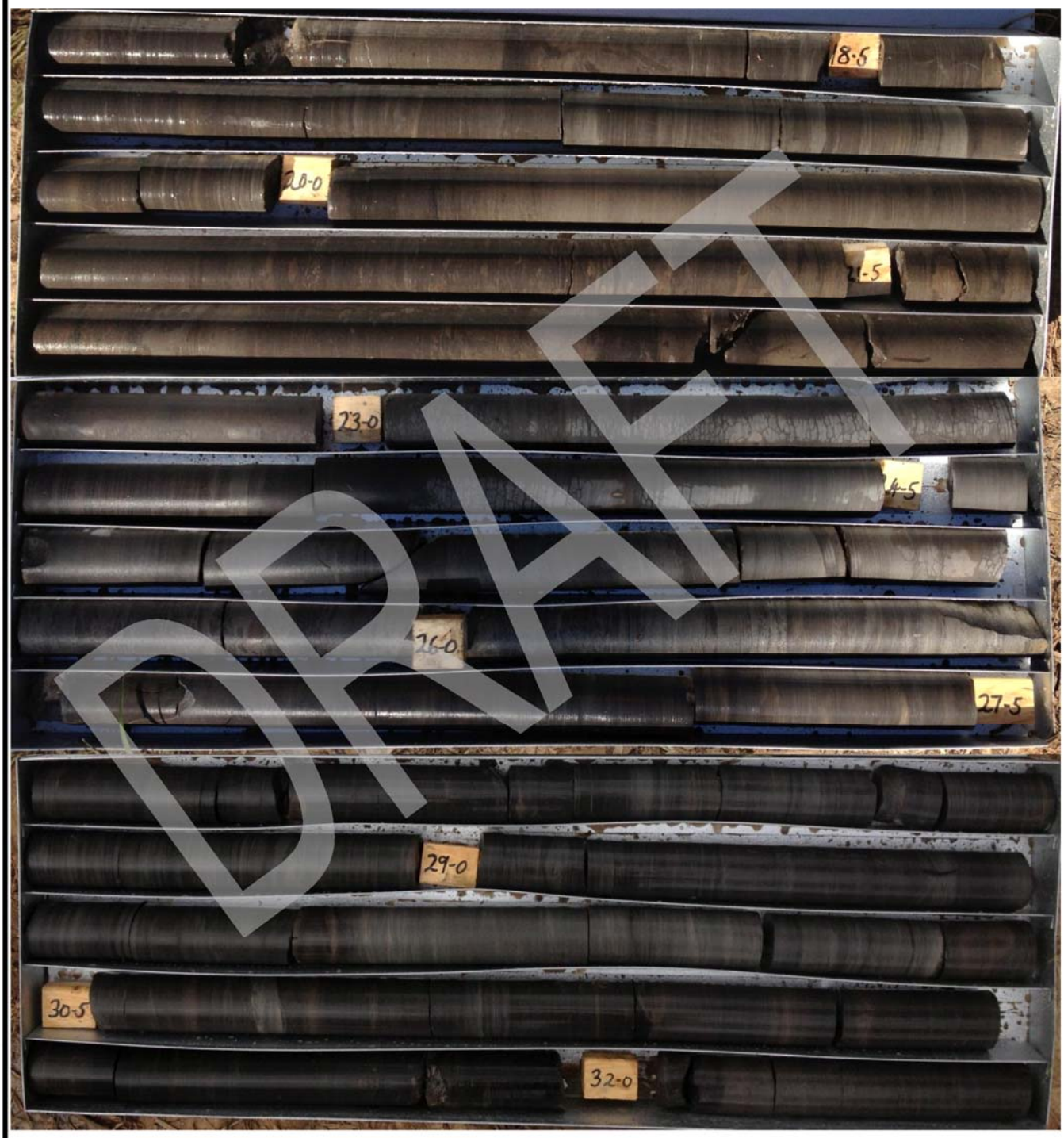
Core Box Photos

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment			
	DRAWN: CG	DATE: April2013	TITLE: **GW01**			
	CHECKED: SMT	DATE: April2013				
	SCALE: Not to Scale		PROJECT No: 137626001	FIGURE No: A1	REV No: A	A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment		
	DRAWN: CG	DATE: April2013	TITLE: **GW01**		
	CHECKED: SMT	DATE: April2013			
	SCALE: Not to Scale		PROJECT No: 137626001	FIGURE No	REV No: A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment
	DRAWN: CG	DATE: April2013	TITLE: GW01
	CHECKED: SMT	DATE: April2013	
	SCALE: Not to Scale		PROJECT No: 137626001 / FIGURE No / REV No / A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment			
	DRAWN: CG	DATE: April2013	TITLE: **GW02**			
	CHECKED: SMT	DATE: April2013				
	SCALE: Not to Scale		PROJECT No: 137626001	FIGURE No: A1	REV No: A	A4



Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment
	DRAWN: CG	DATE: April2013	TITLE: GW02
	CHECKED: SMT	DATE: April2013	
	SCALE: Not to Scale		PROJECT No: 137626001 / FIGURE No / REV No / A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment		
	DRAWN: CG	DATE: April2013	TITLE: GW02		
	CHECKED: SMT	DATE: April2013			
	SCALE: Not to Scale		PROJECT No: 137626001	FIGURE No	REV No: A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment		
	DRAWN: CG	DATE: April2013	TITLE: **GW03**		
	CHECKED: SMT	DATE: April2013			
	SCALE: Not to Scale		PROJECT No: 137626001	FIGURE No: A1	REV No: A — A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment
	DRAWN: CG	DATE: April2013	TITLE: GW03
	CHECKED: SMT	DATE: April2013	
	SCALE: Not to Scale		PROJECT No: 137626001 / FIGURE No / REV No / A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment		
	DRAWN: CG	DATE: April2013	TITLE: **GW03**		
	CHECKED: SMT	DATE: April2013			
	SCALE: Not to Scale		PROJECT No: 137626001	FIGURE No	REV No: A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment
	DRAWN: CG	DATE: April2013	TITLE: GW04
	CHECKED: SMT	DATE: April2013	
	SCALE: Not to Scale		PROJECT No: 137626001 / FIGURE No: A1 / REV No: A / A4

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment
	DRAWN: CG	DATE: April2013	TITLE: **GW04**
	CHECKED: SMT	DATE: April2013	
	SCALE: Not to Scale		PROJECT No: 137626001 / FIGURE No / REV No / **A4**

Golder Associates	CLIENT: Boral Ltd		PROJECT: Boral Bringelly Groundwater Assessment
	DRAWN: CG	DATE: April2013	TITLE: GW04
	CHECKED: SMT	DATE: April2013	
	SCALE: Not to Scale		PROJECT No: 137626001 / FIGURE No / REV No / A4

APPENDIX B

Borehole Logs and Monitoring Bore Design

REPORT OF BOREHOLE: GW01

SHEET: 1 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289202.00 m E 6242112.10 m N MGA94 56
SURFACE RL: 87.60 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 10/4/13
CHECKED: SK DATE: 1/5/13

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
WB			0	87.60					Silty CLAY high plasticity, pale brown, trace organics, dry			
				3.00								
HQ3			3	84.60	3.00-3.50 m C 3.00-3.50 m				MUDSTONE / SILTSTONE fine grained, layered, pale grey with iron staining, low strength, highly weathered			
				3.50								
				84.10	3.50-5.00 m C 3.50-5.00 m				MUDSTONE fine grained, pale grey / dark grey and black with orange layers, low strength, highly weathered			
			4									
			5		5.00-6.50 m C 5.00-6.50 m							
			6									
				6.50								
				81.10	6.50-8.00 m C 6.50-8.00 m				SILTSTONE fine grained, pale grey, low strength, highly weathered, heavily fractured			
				6.90								
			7	80.70					SILTSTONE fine grained, layered, pale grey to dark grey wiht orange staining, low strength, highly weathered			
			8		8.00-9.50 m C 8.00-9.50 m							
				9.00								
			9	78.60					heavily fractured with clay in fractures			
					9.50-11.00 m C 9.50-10.00 m							
				10.00								
			10									

REPORT OF BOREHOLE: GW01

SHEET: 2 OF 5

CLIENT:	Boral	COORDS: 289202.00 m E 6242112.10 m N MGA94 56		DRILL RIG:	
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 87.60 m DATUM: AHD		CONTRACTOR: Statewide Drilling	
LOCATION:		INCLINATION: -90°		LOGGED: AB	DATE: 10/4/13
JOB NO:	137626001	HOLE DEPTH: 40.00 m		CHECKED: SK	DATE: 1/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HQ3			10	77.60	9.50-11.00 m				MUDSTONE fine grained, layered, dark grey to black, low strength, moderately weathered			
			11		11.00-12.50 m C 11.00-12.50 m							
			12		12.50-14.00 m C 12.50-14.00 m							
				12.90 74.70					SANDSTONE medium grained, layered, pale grey, medium strength, moderately weathered			
			13	13.35 74.25					MUDSTONE fine grained, layered, dark grey, medium strength, moderately weathered, more fractures			
			14		14.00-15.50 m C 14.00-15.50 m							
			15		15.50-17.00 m C 15.50-17.00 m							
			16									
			17		17.00-18.00 m C 17.00-18.00 m							
			18		18.00-19.50 m C 18.00-19.50 m							
			19									
			20	20.00	19.50-20.00 m C 19.50-20.00 m							

REPORT OF BOREHOLE: GW01

SHEET: 3 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289202.00 m E 6242112.10 m N MGA94 56
SURFACE RL: 87.60 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 10/4/13
CHECKED: SK DATE: 1/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HQ3			20	67.60	20.00-21.50 m C 20.00-21.50 m				MUDSTONE fine grained, layered, dark grey, medium strength, moderately weathered, more fractures			
				20.75								
			21	66.85					LAMINITE (sandstone, siltstone, mudstone), pale grey to black			
				21.35								
				66.25	21.50-23.00 m C 21.50-23.00 m				MUDSTONE fine grained, layered, medium strength, slightly weathered			
			22									
			23		23.00-24.50 m C 23.00-24.50 m							
				23.60								
				64.00					LAMINITE (mudstone, sandstone and siltstone), fine to medium grained, pale grey, dark grey and black, medium to high strength, slightly weathered			
			24		24.50-26.00 m C 24.50-26.00 m							
				25.00								
			25	62.60					SILTSTONE fine grained, layered, pale grey, high strength, slightly weathered to fresh			
				25.85								
				26.00					MUDSTONE fine grained, layered, black, high strength, slightly weathered to fresh			
			26	61.60	26.00-27.50 m C 26.00-27.50 m				SILTSTONE fine grained, layered, pale grey, high strength, slightly weathered to fresh			
			27									
				27.20								
				60.40	27.50-29.00 m C 27.50-29.00 m				MUDSTONE fine grained, layered			
			28									
				28.75								
				58.85					SANDSTONE medium grained, layered, pale grey, high strength, slightly weathered to fresh			
			29		29.00-30.50 m							
				29.35								
				58.25					LAMINITE (mudstone, siltstone, sandstone), fine to medium grained, layered, pale grey / dark grey and black, medium to high strength, slightly weathered to fresh			
			30									

REPORT OF BOREHOLE: GW01

SHEET: 4 OF 5

CLIENT:	Boral	COORDS: 289202.00 m E 6242112.10 m N MGA94 56	DRILL RIG:		
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 87.60 m DATUM: AHD	CONTRACTOR: Statewide Drilling		
LOCATION:		INCLINATION: -90°	LOGGED: AB	DATE: 10/4/13	
JOB NO:	137626001	HOLE DEPTH: 40.00 m	CHECKED: SK	DATE: 1/5/13	

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HQ3			30	30.25	29.00-30.50 m C 29.00-30.50 m							
				57.35	C 29.00-30.50 m 30.50-32.00 m C 30.50-32.00 m				MUDSTONE fine grained, layered, dark grey / black			
			31									
			32	32.25								
				55.35					LAMINITE (sandstone, siltstone, mudstone), fine to medium grained, layered, pale grey / dark grey and black, high strength, slightly weathered to fresh			
			33	33.50								
				54.10	33.50-35.00 m C 33.50-35.00 m				LAMINITE (mudstone, siltstone, minor sandstone), fine to medium grained, black / dark grey / dark brown and pale grey, high to very high strength, fresh			
			34									
			35	35.00								
				52.60	35.00-36.50 m C 35.00-36.50 m				LAMINITE (sandstone, siltstone, mudstone), fine to medium grained, high to very high strength, fresh			
			36	36.00								
				51.60					MUDSTONE (minor siltstone and sandstone), fine grained, amorphous, layered, very high strength, fresh			
				36.50								
				51.10	36.50-38.00 m C 36.50-38.00 m				MUDSTONE fine grained, amorphous, black, medium to high strength, slightly weathered to fresh			
			37	37.50								
				50.10					SILTSTONE fine grained, amorphous, dark grey, high strength, fresh			
				37.90								
				38.00					MUDSTONE fine grained, amorphous, black, high strength, slightly weathered to fresh			
			38	49.60	38.00-39.50 m C 38.00-39.50 m				MUDSTONE fine grained, black, medium to high strength, slightly to extremely weathered			
				38.86								
				48.75					SILTSTONE fine grained, amorphous, dark grey, highly weathered, fresh (layered)			
			39	39.50								
				48.10	39.50-40.00 m				MUDSTONE			
				39.70	C 39.50-40.00 m				(minor siltstone), fine grained, amorphous, black / dark brown, highly weathered, fresh (layered)			
				47.90								
				39.95								
			40									

REPORT OF BOREHOLE: GW01

SHEET: 5 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289202.00 m E 6242112.10 m N MGA94 56
SURFACE RL: 87.60 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 10/4/13
CHECKED: SK DATE: 1/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			40						SANDSTONE (minor siltstone, mudstone), medium grained, amorphous, pale grey, highly weathered, fresh (layered)			
									MUDSTONE (minor siltstone), fine grained, amorphous, black / dark brown, highly weathered, fresh (layered)			
			41						END OF BOREHOLE @ 40.00 m Monitoring well installed			
			42									
			43									
			44									
			45									
			46									
			47									
			48									
			49									
			50									

REPORT OF STANDPIPE INSTALLATION: GW01

SHEET: 1 OF 1

CLIENT:	Boral	COORDS: 289202.00 m E 6242112.10 m N MGA94 56	DRILL RIG:
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 87.60 m DATUM: AHD	CONTRACTOR: Statewide Drilling
LOCATION:		INCLINATION: -90°	LOGGED: AB DATE: 10/4/13
JOB NO:	137626001	HOLE DEPTH: 40.00 m	CHECKED: SK DATE: 1/5/13

Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	END OF BOREHOLE @ 40.00 m Monitoring well installed
WB		0			SILTY CLAY	0.00, RL87.60
		2	3.00			
			3.50		MUDSTONE / SILTSTONE	
		4			MUDSTONE	
		6	6.50		SILTSTONE	
		8			SILTSTONE	
			10.00		MUDSTONE	
		10				
		12	12.90			
			13.35		SANDSTONE	
		14			MUDSTONE	
		16				
		18				17.00, RL70.60 18.00, RL69.60 19.00, RL68.60
			20.00			
HQ3		20	20.75		MUDSTONE	
			21.35		LAMINITE	
		22			MUDSTONE	
			23.60		LAMINITE	
		24	25.00		SILTSTONE	
			25.85		MUDSTONE	
		26			SILTSTONE	
			27.20		MUDSTONE	
		28	28.75		SANDSTONE	
			29.35		LAMINITE	
		30	30.25		MUDSTONE	
			32.25		LAMINITE	
		32	33.50		LAMINITE	
		34	35.00		LAMINITE	
			36.00		MUDSTONE	
		36	36.50		MUDSTONE	37.00, RL50.60
			37.50		SILTSTONE	
		38	38.85		MUDSTONE	
			39.50		MUDSTONE	
					SILTSTONE	40.00, RL47.60
		40			MUDSTONE	
					SANDSTONE	
		42			MUDSTONE	

Protective Casing and Steel Monument Cover

50 mm diameter blank casing

Grout Backfill

Bentonite Pellets

Factory Slotted Screen (37 m bgl to 19 m bgl)

Filter Pack Sand (2 mm, 40 mbgl to 18 mbgl)

3.0 m Slump

This report of standpipe installation must be read in conjunction with accompanying notes and abbreviations. It has been prepared for hydrogeological purposes only, without attempt to assess geotechnical properties or possible contamination. Any reference to geotechnical properties or potential contamination are for information only and do not necessarily indicate the presence or absence of the properties stated.

GAP gINT FN. F17 RL1

REPORT OF BOREHOLE: GW02

SHEET: 1 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289502.10 m E 6242101.80 m N MGA94 56
SURFACE RL: 83.55 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 2/5/13

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX			0	83.55					Sandy CLAY rounded, medium plasticity, brown			
				3.60 79.95								
				3.80 79.75					Sandy CLAY rounded, medium plasticity, dark brown			
			4						Clayey GRAVEL medium grained, brown, medium plasticity, with some sand			
				4.50 79.05					Silty CLAY medium plasticity, pale grey, medium plasticity silt, trace sand			
			5	*5.00* 78.55					CLAYSTONE fine grained, amorphous / layered, grey with brown staining, very low strength, extremely weathered			Crushed zones (decomposed seams) at 5.4 m and 6.0 m
			6									Vertical fracture with iron staining 6.9 m - 7.8 m
				6.50 77.05					LAMINITE (siltstone, claystone), fine grained, amorphous, layered, grey, medium strength, distinctly weathered			
				6.90 76.65					SANDSTONE (minor siltstone), fine to medium grained, pale grey with brown staining, amorphous, layered, distinctly weathered			
			8	*8.00* 75.55					SILTSTONE (minor claystone), fine grained amorphous, layered, grey with some brown staining, low strength, distinctly to slightly weathered			Decomposed seams at 8.03 m and 8.13 m (lenses)
			10									

REPORT OF BOREHOLE: GW02

SHEET: 2 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289502.10 m E 6242101.80 m N MGA94 56
SURFACE RL: 83.55 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 2/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX			10						SILTSTONE (minor claystone), fine grained amorphous, layered, grey with some brown staining, low strength, distinctly to slightly weathered			
			11									Decomposed seams at 11.5 m, 12.04 m, 12.08 m, 12.24 m and 12.3 m, occasional brown lenses
			12									
			13									Partially decomposed seam
			14	14.00 69.55					MUDSTONE fine grained, amorphous, layered, dark grey, very high strength, slightly weathered to fresh			Apparent porous / textured zone (no colour change)
			15									
			16									
			17									
			18									Possible core loss
			19	19.17 64.38					LAMINITE (mudstone, siltstone, sandstone), fine to medium grained, amorphous, layered, black / grey / pale grey, high strength, slilghtly weathered, bedded			Vertical fracture
			20									

REPORT OF BOREHOLE: GW02

SHEET: 3 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289502.10 m E 6242101.80 m N MGA94 56
SURFACE RL: 83.55 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 2/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX			20	20.18 63.37					SILTSTONE fine grained, amorphous, layered, grey, high strength, fresh, bedded			
				20.90 62.65					LAMINITE (mudstone, siltstone, sandstone), fine to medium grained, black / dark grey / pale grey, high strength, fresh, bedded			Intrusions, brown lenses
			21	21.75 61.80					SILTSTONE (minor mudstone), fine grained, grey / dark grey / black, high strength, fresh, bedded			
			22									Vertical black intrusion
			23	23.10 60.45					LAMINITE (sandstone, siltstone, minor mudstone), fine to medium grained, amorphous, layered, pale grey / grey / black, high strength, fresh, bedded			
			24									Brown layers to 26.25 m
				24.50 59.05					SANDSTONE (minor siltstone, mudstone), fine to medium grained, black, with some brown, high strength, slightly weathered to fresh, bedded			
			25									Brown lenses / staining 25.25 m - 25.5 m and 25.8 m - 26.0 m
			26	26.70 56.85					LAMINITE (siltstone, sandstone, mudstone), fine to medium grained, amorphous, layered, high strength, fresh, bedded			
			27									
			28									Some brown staining in core
			29									
				29.85 53.70								Vertical fractures and weathered at
			30									

REPORT OF BOREHOLE: GW02

SHEET: 4 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289502.10 m E 6242101.80 m N MGA94 56
SURFACE RL: 83.55 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 2/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX			30	30.40 53.15					SANDSTONE (minor siltstone and mudstone), fine to medium grained, amorphous, layered, pale grey / grey / black, high strength, slightly weathered to fresh			29.84 m Suspected joint at 30.16 m planar slickensided
			31						LAMINITE (siltstone, sandstone, mudstone), fine to medium grained, amorphous, layered, grey / pale grey / black, high strength, slightly weathered to fresh, bedded			Bands of sandstone at 30.66 m, 30.7 m and 30.9 m - 30.95 m
			32	32.07 51.48					SILTSTONE fine grained, amorphous, layered, grey, very high strength, fresh			Joint / fracture at 32.19 m, no infill, planar, slickensided
				32.49 32.66 50.89					CLAYSTONE fine grained, amorphous, layered, black, very high strength, fresh			
				32.91					SILTSTONE fine grained, amorphous, layered, black, very high strength, fresh			
			33	50.64					SANDSTONE medium grained, amorphous, pale grey, high to very high strength, fresh			Joint / fracture at 32.97 m, no infill, planar, slickensided
				33.81 33.94					LAMINITE (siltstone, sandstone, mudstone), fine to medium grained, amorphous, layered, pale brown / pale grey / black, high to very high strength, fresh, bedded			
			34	49.61					SILTSTONE fine grained, amorphous, grey, very high strength, fresh			
				34.35 49.20 34.60 48.95					CLAYSTONE (minor siltstone), fine grained, amorphous, layered, black with grey, very high strength, fresh			
				35.00					SILTSTONE fine grained, amorphous, layered, black with grey, very high strength, fresh			
			35	48.55					CLAYSTONE (minor siltstone), fine grained, amorphous, layered, black with grey, very high strength, fresh			
									LAMINITE (claystone, siltstone), fine grained, amorphous, layered, black / grey, very high strength, fresh			
			36	36.40 36.50					SANDSTONE (minor siltstone, claystone), fine grained, amorphous, pale grey / pale brown / black, high strength, slightly weathered to fresh			
				36.64 46.91 36.94					SANDSTONE (minor siltstone, claystone), fine grained, amorphous, pale grey / pale brown / black, high strength, slightly weathered to fresh			
			37	46.61					CLAYSTONE (minor siltstone, grey), fine grained, amorphous, layered, black, fresh, bedded			
				38.00					LAMINITE (sandstone, siltstone, claystone), fine tlo medium grained, amorphous, layered, pale grey / grey / brown / black, medium strength, slightly weathered, bedded			
			38	45.55					CLAYSTONE fine grained, amorphous, layered, black, (minor siltstone, grey), high strength, fresh			
				38.86 39.03					LAMINITE (sandstone, siltstone, claystone), fine grained, amorphous, layered, pale grey changing to dark grey, medium strength, fresh			
			39	44.52					CLAYSTONE (minor siltstone) fine grained, amorphous, layered, black / grey, high strength, fresh, bedded			
				39.79 43.76					SANDSTONE			
			40									

REPORT OF BOREHOLE: GW02

SHEET: 5 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289502.10 m E 6242101.80 m N MGA94 56
SURFACE RL: 83.55 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 2/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			40						(minor siltstone, claystone), medium grained, pale grey / pale brown / black, medium strength, slightly weathered END OF BOREHOLE @ 40.00 m Monitoring well installed			
			41									
			42									
			43									
			44									
			45									
			46									
			47									
			48									
			49									
			50									

REPORT OF STANDPIPE INSTALLATION: GW02

Golder Associates

SHEET: 1 OF 2

CLIENT:	Boral	COORDS: 289502.10 m E 6242101.80 m N MGA94 56	DRILL RIG:
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 83.55 m DATUM: AHD	CONTRACTOR: Statewide Drilling
LOCATION:		INCLINATION: -90°	LOGGED: AB DATE: 16/4/13
JOB NO:	137626001	HOLE DEPTH: 40.00 m	CHECKED: SK DATE: 2/5/13

Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	END OF BOREHOLE @ 40.00 m Monitoring well installed
EX		0			SANDY CLAY	0.00, RL83.55 Protective Casing and Steel Monument Cover
		2				
			3.60			
		4	4.50		SANDY CLAY	
			5.00		CLAYEY GRAVEL	
		6			SILTY CLAY	50 mm diameter blank casing
			6.50		CLAYSTONE	
					LAMINITE	
			8.00		SANDSTONE	
		8			SILTSTONE	
		10				
		12				Grout Backfill
			14.00			
		14			MUDSTONE	
		16				16.00, RL67.55
		18				18.00, RL65.55 Bentonite Seal
			19.17			19.00, RL64.55
					LAMINITE	
		20	20.18		SILTSTONE	
			20.90		LAMINITE	
			21.75		SILTSTONE	
		22	23.10		LAMINITE	
		24	24.50		SANDSTONE	Factory Slotted Screen (37 m bgl to 19 m bgl)
		26	26.70		LAMINITE	
		28				
			29.80			
		30	30.40		SANDSTONE	Filter Pack Sand (2 mm, 40 mbgl to 18 mbgl)
					LAMINITE	
		32	32.07			
			32.49		SILTSTONE	
			33.81		CLAYSTONE	
		34			SILTSTONE	
					SANDSTONE	
					LAMINITE	
		36	36.40		SILTSTONE	
					CLAYSTONE	37.00, RL46.55
					SILTSTONE	
		38	38.00		CLAYSTONE	
			38.86		LAMINITE	3.0 m Slump
			39.79		SANDSTONE	
		40			SANDSTONE	40.00, RL43.55
					CLAYSTONE	
		42			LAMINITE	

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GAP gINT FN. F17 RL1

REPORT OF STANDPIPE INSTALLATION: GW02

SHEET: 2 OF 2

CLIENT:	Boral	COORDS: 289502.10 m E 6242101.80 m N MGA94 56	DRILL RIG:
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 83.55 m DATUM: AHD	CONTRACTOR: Statewide Drilling
LOCATION:		INCLINATION: -90°	LOGGED: AB DATE: 16/4/13
JOB NO:	137626001	HOLE DEPTH: 40.00 m	CHECKED: SK DATE: 2/5/13

Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	END OF BOREHOLE @ 40.00 m Monitoring well installed
		42			CLAYSTONE	
					LAMINITE	
		44			CLAYSTONE	
					SANDSTONE	
		46				
		48				
		50				
		52				
		54				
		56				
		58				
		60				
		62				
		64				
		66				
		68				
		70				
		72				
		74				
		76				
		78				
		80				
		82				
		84				

REPORT OF BOREHOLE: GW03

SHEET: 1 OF 4

CLIENT:	Boral	COORDS: 289628.50 m E 6241630.20 m N MGA94 56	DRILL RIG:
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 86.80 m DATUM: AHD	CONTRACTOR: Statewide Drilling
LOCATION:		INCLINATION: -90°	LOGGED: AB DATE: 3/4/13
JOB NO:	137626001	HOLE DEPTH: 40.00 m	CHECKED: SK DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0	86.80					CLAYSTONE fine grained, laminated, black, very low strength, distinctly weathered			
				0.50								
				86.30					Silty CLAY high plasticity, dark brown, trace fine sand, dry			
			1									
				1.50								
				85.30					changing to pale grey			
			2									
				3.00								
			3	83.80					CLAYSTONE fine grained, laminated, dark brown, low to very low strength, highly weathered to extremely weathered			
				3.20								
				83.50					Sandy CLAY medium plasticity, dark brown, (highly weathered claystone)			
									CLAYSTONE fine grained, laminated (with clay bands <1 mm), black, low to very low strength, distinctly weathered			
			4									
				4.60								
				82.20					fewer laminations, increased strength			
				5.00								
			5	81.80					fewer laminations			
			6									
				6.50								
				80.30					fine grained, laminated, black / dark grey, low to medium strength, slightly to distinctly weathered			
			7									
				8.00								
			8	78.80					fine grained, laminated, black / dark grey, low to medium strength, slightly to distinctly weathered, layered			
				8.70								
				78.10					SILTSTONE / SANDSTONE fine to medium grained, laminated, pale grey, medium strength, slightly weathered			
			9									
				9.40								
				77.40					LAMINITE			
				10.00								
			10									

REPORT OF BOREHOLE: GW03

SHEET: 2 OF 4

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289628.50 m E 6241630.20 m N MGA94 56
SURFACE RL: 86.80 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 3/4/13
CHECKED: SK DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			10	76.80					CLAYSTONE fine grained, laminated, black, medium strength, slightly weathered			
				11.00 75.80					(shale), fine grained, laminated, black dark grey, medium strength			
			12	12.10 74.70					becoming more shale			
			13	13.00 73.80					becoming more shale			
			14	14.00 72.80					becoming more shale			
			15									
				15.50 71.30					fine grained, laminated, black / dark grey			
			16	16.00 70.80					becoming coarser sand, grey			
				16.90 69.90					with shale streak			
			17	69.80					with shale streak			
			18									
				18.75 68.05					SANDSTONE fine to medium grained, massive, pale grey, medium strength, slightly weathered			
			19	19.50 67.30					CLAYSTONE with shale streak			
			20	20.00								

REPORT OF BOREHOLE: GW03

SHEET: 3 OF 4

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289628.50 m E 6241630.20 m N MGA94 56
SURFACE RL: 86.80 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 3/4/13
CHECKED: SK DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			20	66.80					CLAYSTONE with shale streak, fine grained, black / dark grey, medium to high strength, slightly weathered to fresh			
			21	*21.90* 64.90					coarse with intrusions			
			22	*22.40* 64.40					? with siltstone			
			23	*23.00* 63.80					LAMINITE (siltstone, claystone), layered, black / dark grey, medium strength, slightly weathered			
			24									
			25									
				25.50 61.30					CLAYSTONE with chert			
			26	*26.00* 60.80					LAMINITE (claystone, siltstone, sandstone, minor bands), mostly fine grained, pale grey / dark grey and black, medium to high strength, slightly weathred to fresh			
			27									
			28									
			29									
			30	*30.00*								

REPORT OF BOREHOLE: GW03

SHEET: 4 OF 4

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289628.50 m E 6241630.20 m N MGA94 56
SURFACE RL: 86.80 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 40.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 3/4/13
CHECKED: SK DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			30	56.80					LAMINITE (siltstone, sandstone, claystone), fine to medium grained, pale grey / dark grey and black, layered			
				30.90								
			31	55.90					SILTSTONE / CLAYSTONE fine grained, black			
				31.10								
				55.70					SANDSTONE coarse grained, massive, pale grey			
				31.70								
				55.10					CLAYSTONE / SILTSTONE layered			
			32	32.00								
				54.80					CLAYSTONE fine grained, black, layered, high strength, fresh			
				32.60								
				32.80					SILTSTONE with micro vesicles, pale grey, layered, high strength, fresh			
				54.00					CLAYSTONE fine grained, black, layered, high strength, fresh			
			33									
			34									
				35.00								
			35	51.80					SILTSTONE			
				35.60								
				51.20					LAMINITE with sandstone (primary), and black mudstone			
			36	36.05								
				50.75					SANDSTONE medium, layered mudstone streaks, pale grey			
				36.50								
				50.30					SILTSTONE with streaks of mudstone, black, layered, high strength, fresh			
			37									
				37.30								
				49.50					SANDSTONE medium grained, layered, pale grey with black mudstone streaks, high strength, fresh			
				38.00								
			38	48.80					SILTSTONE medium grained, layered, pale grey with black mudstone streaks, high strength, fresh			
				38.80								
				48.00					SANDSTONE medium grained, layered, mudstone streaks, pale grey, high strength, fresh			
			39									
									END OF BOREHOLE @ 40.00 m Monitoring well installed			
			40									

REPORT OF STANDPIPE INSTALLATION: GW03

Golder Associates

SHEET: 1 OF 1

CLIENT:	Boral	COORDS: 289628.50 m E 6241630.20 m N MGA94 56	DRILL RIG:
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 86.80 m DATUM: AHD	CONTRACTOR: Statewide Drilling
LOCATION:		INCLINATION: -90°	LOGGED: AB DATE: 3/4/13
JOB NO:	137626001	HOLE DEPTH: 40.00 m	CHECKED: SK DATE: 3/5/13

Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	END OF BOREHOLE @ 40.00 m Monitoring well installed
		0	0.50		CLAYSTONE	0.00, RL86.80 — Protective Casing and Steel Monument Cover
		2			SILTY CLAY	
			3.00		CLAYSTONE	
		4			SANDY CLAY	
					CLAYSTONE	50 mm diameter blank casing
		6				
		8	8.70			
			9.40		SILTSTONE / SANDSTONE	
			10.00		LAMINITE	
		10			CLAYSTONE	
		12				Grout Backfill
		14				
		16				
		18	18.75			
			19.50		SANDSTONE	
			20.00		CLAYSTONE	
		20			CLAYSTONE	
		22				22.00, RL64.80 — Bentonite Seal
			23.00		LAMINITE	23.00, RL63.80
		24				
			25.50			
		26	26.00		CLAYSTONE	
					LAMINITE	
		28				Factory Slotted Screen (24 m bgl to 39 m bgl)
			30.00			
		30	30.90		LAMINITE	
			31.70		SILTSTONE / CLAYSTONE	
		32			SANDSTONE	
			32.60		CLAYSTONE / SILTSTONE	
					CLAYSTONE	
		34			SILTSTONE	Filter Pack Sand (2 mm, 40 mbgl to 24 mbgl)
			35.00		CLAYSTONE	
			35.60		SILTSTONE	
		36	36.05		LAMINITE	
			36.50		SANDSTONE	
			37.30		SILTSTONE	37.00, RL49.80
			38.00		SANDSTONE	
		38			SILTSTONE	1.0 m Slump
			38.80		SANDSTONE	38.85, RL47.95
			40.00			
		40				
		42				

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GAP gINT FN. F17 RL1

REPORT OF BOREHOLE: GW04

SHEET: 1 OF 5

CLIENT:	Boral	COORDS: 289214.90 m E 6241594.50 m N MGA94 56		DRILL RIG:	
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 99.10 m DATUM: AHD		CONTRACTOR: Statewide Drilling	
LOCATION:		INCLINATION: -90°		LOGGED: AB	DATE: 16/4/13
JOB NO:	137626001	HOLE DEPTH: 42.00 m		CHECKED: SK	DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			0	99.10					Silty CLAY high plasticity, brown, dry			
			1									
			2									
			3									
			4	4.10 95.00 4.30 94.80 4.50					SILTSTONE fine grained, layered, pale grey, medium strength, distinctly weathered			
				94.60					becoming finer grained			
			5						SILTSTONE fine grained, layered, black with red layers, medium strength, distinctly weathered			
				5.40 93.70					MUDSTONE / SILTSTONE fine grained, layered, dark to pale grey, medium strength, distinctly weathered, fractures with iron staining			
			6									
				6.65 92.45					SILTSTONE fine grained, layered, pale grey, low strength, distinctly to highly weathered, fractures with iron staining			
			7	7.00 92.10					MUDSTONE fine grained, layered, dark grey, medium strength, slightly weathered			
			8	8.00 91.10					LAMINITE (siltstone, mudstone). fine grained, layered, medium strength, slightly weathered			
			9									
				9.50 89.60					SILTSTONE fine grained, layered, dark grey / black, medium to high strength, slightly weathered			
			10									

REPORT OF BOREHOLE: GW04

SHEET: 2 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289214.90 m E 6241594.50 m N MGA94 56
SURFACE RL: 99.10 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 42.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			10						SILTSTONE fine grained, layered, dark grey / black, medium to high strength, slightly weathered			
			11									
			12									
				12.95 86.15								
			13						SANDSTONE medium grained, layered, pale grey, medium strength, slightly weathered, streaks of black siltstone			
				13.90 85.20								
			14	85.10					SILTSTONE fine grained, layered, black, medium strength, slightly weathered			
				14.40 84.70					black / dark grey, medium strength, slightly weathered			
									SILTSTONE / MUDSTONE fine grained, layered, black, medium strength, slightly weathered to fresh, shale streaks			
			15									
				16.00 83.10					fractures are planar and smooth along layer			
			16									
				17.00								
			17	17.15 81.95					MUDSTONE fine grained, layered, black, medium strength, slightly weathered to fresh			
									SILTSTONE fine grained, layered, black / dark grey, medium strength, slightly weathered, planar fractures along layers			
			18									
			19									
				19.50 19.65 79.45					MUDSTONE fine grained, layered, black, high strength, slightly weathered to fresh, with more fractures			
			20									

REPORT OF BOREHOLE: GW04

SHEET: 3 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289214.90 m E 6241594.50 m N MGA94 56
SURFACE RL: 99.10 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 42.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			20						SILTSTONE			
				20.50 78.60					becoming more coarse, slightly weathered			
			21									
				21.40 77.70					MUDSTONE fine grained, layered, black, high strength, minor shale intrusion (<1 mm lenses)			
				21.60 77.50					SILTSTONE fine grained, layered, dark grey, high strength, slightly weathered to fresh, with some minor shale intrusions (<1 mm lenses)			
			22									
			23									
				23.55 75.55					MUDSTONE fine grained, layered, black, high strength, with some minor shale intrusions and minor fractures			
			24									
			25									
				25.25 73.85					change to pale grey			
				26.00 73.10					becoming pale grey with shale intrusions (<1 mm)			
			26									
			27									
				27.25 71.85					becoming dark grey			
				27.50 71.60					SILTSTONE fine grained, layered, dark grey / black, high strength, slightly weathered to fresh			
			28									
				28.45 70.65					becoming coarse grained, with medium grained ? intrusion (10-20 mm), layered, dark grey / black, high strength, slightly weathered to fresh			
				29.00 70.10					MUDSTONE fine grained			
			29									
				29.35 29.53					SANDSTONE			
				69.49					MUDSTONE			
				29.90 69.20					SANDSTONE			
			30						LAMINITE			

REPORT OF BOREHOLE: GW04

SHEET: 4 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289214.90 m E 6241594.50 m N MGA94 56
SURFACE RL: 99.10 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 42.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			30						successive layers of siltstone, mudstone, shale? (<1 mm) MUDSTONE with shale streaks and with sandstone streaks			
				30.50								
				30.70 68.40					SILTSTONE with shale streaks and intrusions			
			31						MUDSTONE with shale intrusion			
				31.10 68.00					LAMINITE predominantly siltstone with thin layer of sandstone			
			32									
				32.70 66.40					with sandstone layers (2-15 mm) increasing with depth			
			33									
			34									
				34.40 64.70					SILTSTONE			
			35	*35.05* 64.05					becoming coarse grained			
			36									
				36.28 62.82					LAMINATE (siltstone, shale, sandstone), sandstone layers increasing with depth			
			37									
				38.00 61.10					SANDSTONE medium grained, layered and cemented, pale grey			
			38									
			39									
				39.20 59.90					MUDSTONE fine to medium grained, layered and cemented, high strength, fresh			
				39.75 59.35					LAMINATE			
			40									

REPORT OF BOREHOLE: GW04

SHEET: 5 OF 5

CLIENT: Boral
PROJECT: Bringelly Groundwater Assessment
LOCATION:
JOB NO: 137626001

COORDS: 289214.90 m E 6241594.50 m N MGA94 56
SURFACE RL: 99.10 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 42.00 m

DRILL RIG:
CONTRACTOR: Statewide Drilling
LOGGED: AB DATE: 16/4/13
CHECKED: SK DATE: 3/5/13

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
			40						LAMINATE			
			41									
			42	57.10					END OF BOREHOLE @ 42.00 m Monitoring well installed			
			43									
			44									
			45									
			46									
			47									
			48									
			49									
			50									

REPORT OF STANDPIPE INSTALLATION: GW04

Golder Associates

SHEET: 1 OF 1

CLIENT:	Boral	COORDS: 289214.90 m E 6241594.50 m N MGA94 56	DRILL RIG:
PROJECT:	Bringelly Groundwater Assessment	SURFACE RL: 99.10 m DATUM: AHD	CONTRACTOR: Statewide Drilling
LOCATION:		INCLINATION: -90°	LOGGED: AB DATE: 16/4/13
JOB NO:	137626001	HOLE DEPTH: 42.00 m	CHECKED: SK DATE: 3/5/13

Drilling				Field Material Description		Instrumentation Details
METHOD	WATER	DEPTH (metres)	DEPTH RL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	END OF BOREHOLE @ 42.00 m Monitoring well installed
		0			SILTY CLAY	0.00, RL99.10
		2				
		4	4.10		SILTSTONE	
			5.40		SILTSTONE	
		6	6.65		MUDSTONE / SILTSTONE	
					SILTSTONE	
		8	8.00		MUDSTONE	
			9.50		LAMINITE	
		10			SILTSTONE	
		12	12.95			
			13.90		SANDSTONE	
		14			SILTSTONE	
					SILTSTONE / MUDSTONE	
		16	17.00			
					MUDSTONE	
		18			SILTSTONE	
			19.50			19.00, RL80.10
		20			MUDSTONE	20.00, RL79.10
			21.40		SILTSTONE	21.00, RL78.10
		22			MUDSTONE	
			23.55		SILTSTONE	
		24			MUDSTONE	
		26				
			27.50			
		28			SILTSTONE	
			29.00			
					MUDSTONE	
		30	30.50		SANDSTONE	
					MUDSTONE	
					SANDSTONE	
		32			LAMINITE	
					MUDSTONE	
					SILTSTONE	
		34	34.40		MUDSTONE	
					LAMINITE	
		36	36.28		SILTSTONE	
					LAMINATE	
		38	38.00			
			39.20		SANDSTONE	39.00, RL60.10
			39.75		MUDSTONE	
		40			LAMINATE	
						42.00, RL57.10
		42	42.00			
			57.10			
		44				

Protective Casing and Steel Monument Cover

50 mm diameter blank casing

Grout Backfill

Bentonite Seal

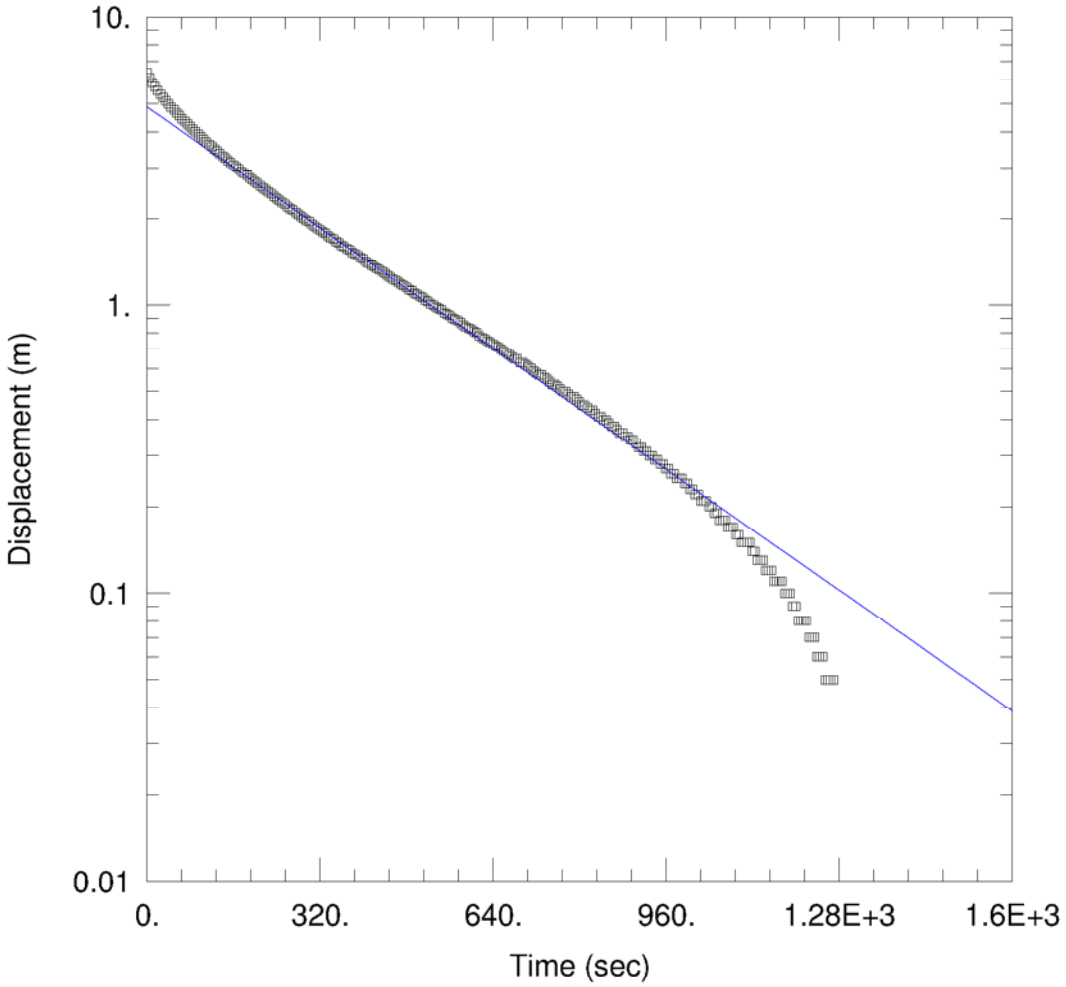
Factory Slotted Screen (21 m bgl to 39 m bgl)

Filter Pack Sand (2 mm, 42 mbgl to 22 mbgl)

3.0 m Slump

APPENDIX C

Hydraulic Testing Plots



WELL TEST ANALYSIS

Data Set: C:\Users\skumarapeli\Documents\Boral FHT\GW01.aqt
Date: 06/12/13 Time: 14:30:18

PROJECT INFORMATION

Company: Golder
Client: Boral
Project: 137626001
Location: Bringelly
Test Well: GW01
Test Date: 24/04/2013

AQUIFER DATA

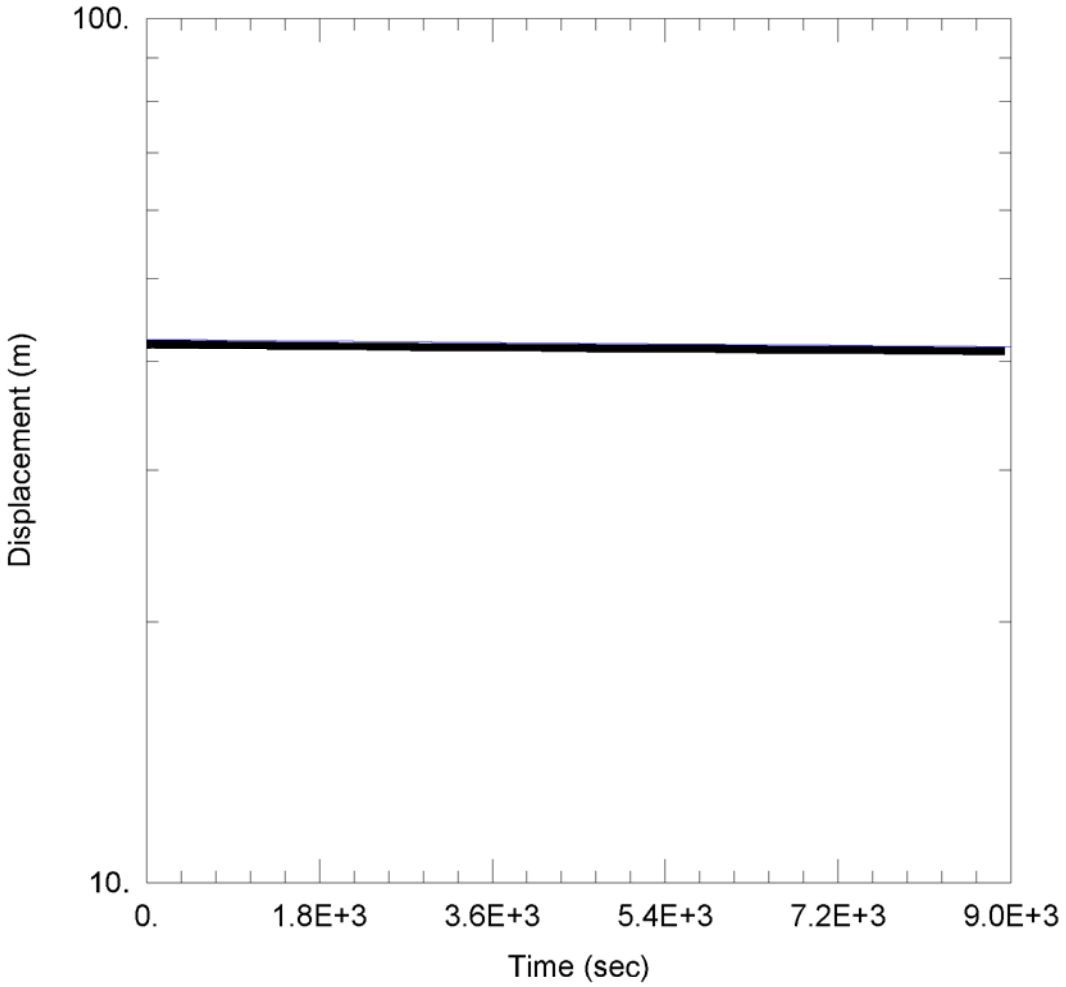
Saturated Thickness: 19. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GW01)

Initial Displacement: 6.41 m
Total Well Penetration Depth: 25.98 m
Casing Radius: 0.025 m
Static Water Column Height: 25.98 m
Screen Length: 19. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.628E-7 m/sec
y0 = 4.87 m



WELL TEST ANALYSIS

Data Set: \...\GW04.aqt
Date: 06/27/13 Time: 09:41:05

PROJECT INFORMATION

Company: Golder
Client: Boral
Project: 137626001
Location: Bringelly
Test Well: GW04
Test Date: 30/05/2013

AQUIFER DATA

Saturated Thickness: 22. m Anisotropy Ratio (Kz/Kr): 1.

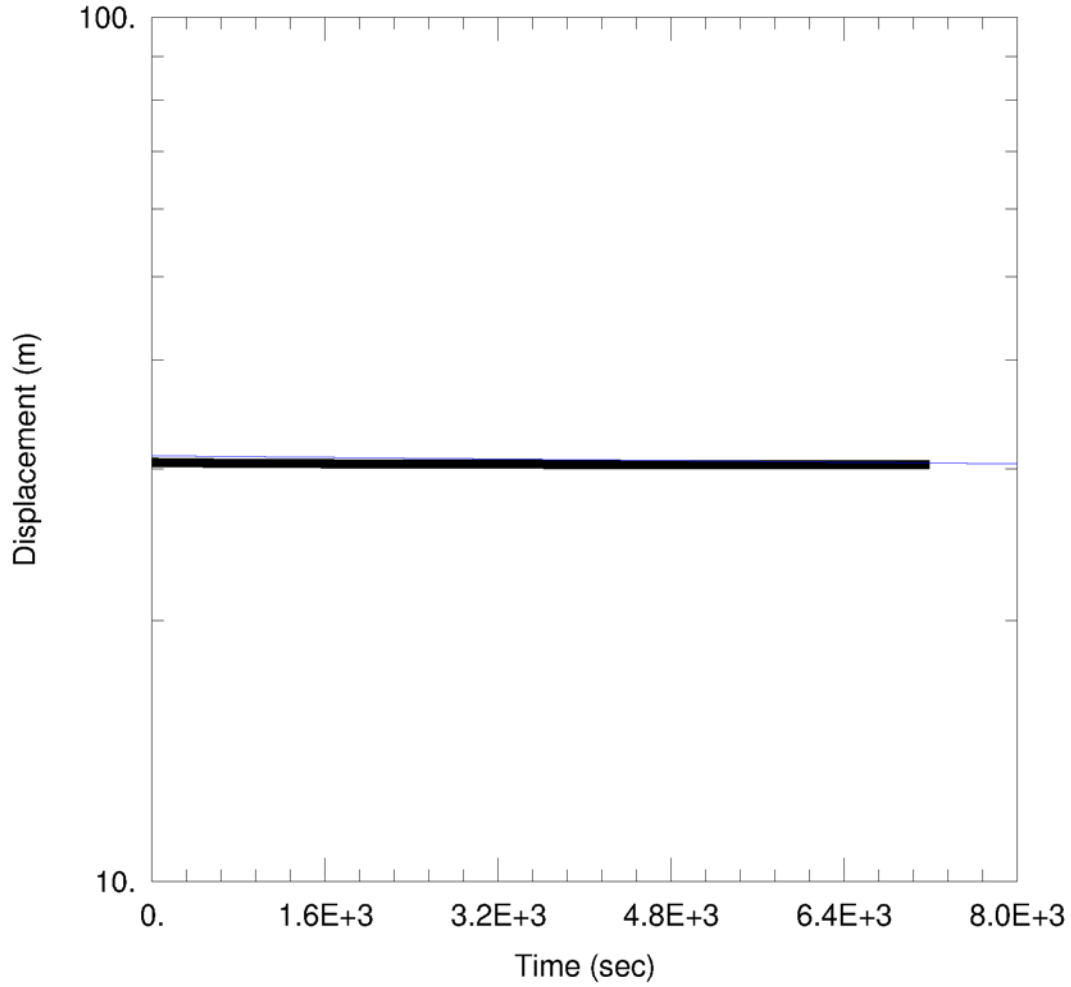
WELL DATA (GW04)

Initial Displacement: 42. m
Total Well Penetration Depth: 18. m
Casing Radius: 0.025 m
Static Water Column Height: 0. m
Screen Length: 18. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 2.55E-10 m/sec y0 = 42.53 m



WELL TEST ANALYSIS

Data Set: C:\Users\skumarapeli\Documents\Boral FHT\GW03.aqt
Date: 06/12/13 Time: 14:29:09

PROJECT INFORMATION

Company: Golder
Client: Boral
Project: 137626001
Location: Bringelly
Test Well: GW03
Test Date: 30/05/2013

AQUIFER DATA

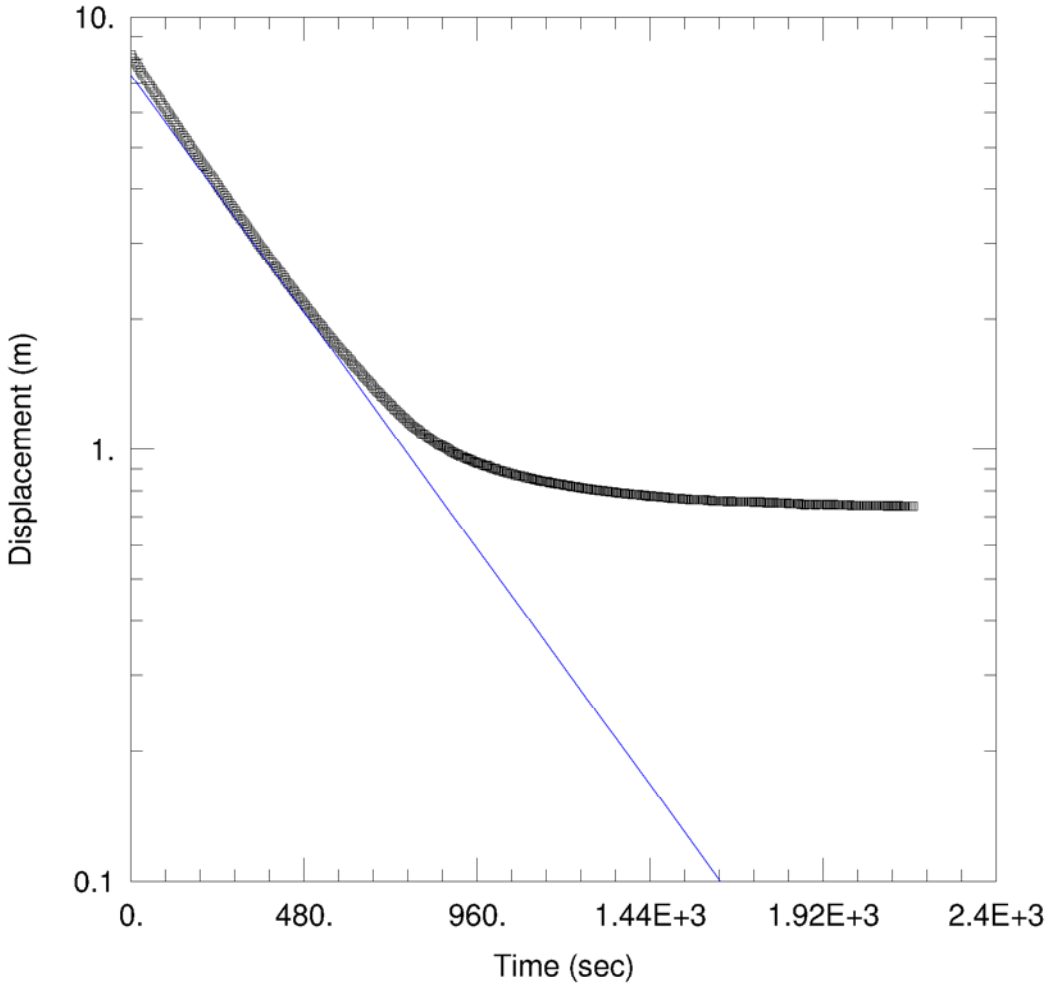
Saturated Thickness: 30.6 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GW03)

Initial Displacement: 30.52 m
Total Well Penetration Depth: 1.87 m
Casing Radius: 0.025 m
Static Water Column Height: 1.87 m
Screen Length: 1.87 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.915E-9 m/sec
y0 = 31.04 m



WELL TEST ANALYSIS

Data Set: C:\Users\skumarapeli\Documents\Boral FHT\GW02.aqt
Date: 06/12/13 Time: 14:30:47

PROJECT INFORMATION

Company: Golder
Client: Boral
Project: 137626001
Location: Bringelly
Test Well: GW02
Test Date: 24/04/2013

AQUIFER DATA

Saturated Thickness: 19. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GW02)

Initial Displacement: 8.17 m
Total Well Penetration Depth: 25.71 m
Casing Radius: 0.025 m
Static Water Column Height: 28.83 m
Screen Length: 19. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.288E-7 m/sec
y0 = 7.329 m

APPENDIX D

Certificate of Analysis, QA/QC and Chain of Custody Documentation

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1312344**	Page	: 1 of 13
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Sydney
Contact	: MR SHAUN TROON	Contact	: Client Services
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: stroon@golder.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 07 3721 5400	Telephone	: +61-2-8784 8555
Facsimile	: +61 07 3721 5401	Facsimile	: +61-2-8784 8500
Project	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 30-MAY-2013
Sampler	: ST	Issue Date	: 06-JUN-2013
Site	: ----		
		No. of samples received	: 6
Quote number	: SY/187/13	No. of samples analysed	: 6

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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.

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

- **TDS by method EA-015 may bias high for sample #1 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.**

Signatories

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

Signatories	Position	Accreditation Category
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
		Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
		Sydney Organics
Raymond Commodor	Instrument Chemist	Sydney Inorganics
Wisam Marassa	Inorganics Coordinator	Sydney Inorganics

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-GW04	BORAL-GW02	BORAL-GW05	BORAL-GW03	BORAL-GW01
				Client sampling date / time	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10
Compound	CAS Number	LOR	Unit		ES1312344-001	ES1312344-002	ES1312344-003	ES1312344-004	ES1312344-005
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		8.04	8.04	6.33	7.62	8.49
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		2020	22000	<1	15200	15200
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		2350	13600	----	9220	8880
Total Dissolved Solids @180°C	----	10	mg/L		----	----	<10	----	----
EA045: Turbidity									
Turbidity	----	0.1	NTU		12400	68.6	<0.1	451	48.5
EA075: Redox Potential									
Redox Potential	----	0.1	mV		32.0	92.5	123	75.7	51.0
pH Redox	----	0.01	pH Unit		7.9	7.7	6.1	7.3	8.3
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	29
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		327	393	<1	274	219
Total Alkalinity as CaCO3	----	1	mg/L		327	393	<1	274	248
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		31	<1	<1	10	6
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		412	7600	<1	4720	4740
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		12	284	<1	207	143
Magnesium	7439-95-4	1	mg/L		2	238	<1	77	138
Sodium	7440-23-5	1	mg/L		433	4680	<1	2850	2700
Potassium	7440-09-7	1	mg/L		9	54	<1	57	57
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		0.005	0.001	<0.001	0.005	0.004
Cadmium	7440-43-9	0.0001	mg/L		0.0005	0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L		0.003	0.001	<0.001	0.002	0.001
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L		0.166	0.085	<0.005	0.050	0.013

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-GW04	BORAL-GW02	BORAL-GW05	BORAL-GW03	BORAL-GW01
				Client sampling date / time	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10
Compound	CAS Number	LOR	Unit		ES1312344-001	ES1312344-002	ES1312344-003	ES1312344-004	ES1312344-005
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	**0.01**	<0.01	<0.01	**0.01**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	**0.01**	<0.01	<0.01	**0.01**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	**0.04**	<0.01	**0.04**	**0.02**
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**18.8**	**222**	<0.01	**139**	**139**
Total Cations	----	0.01	meq/L		**19.8**	**239**	<0.01	**142**	**137**
Ionic Balance	----	0.01	%		**2.62**	**3.56**	----	**1.15**	**0.52**
EP025: Oxygen - Dissolved (DO)									
Dissolved Oxygen	----	0.1	mg/L		**1.9**	**7.4**	**9.6**	**4.2**	**7.4**
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	----	1	µg/L		<1	<1	<1	<1	<1
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
beta-BHC	319-85-7	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
gamma-BHC	58-89-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
delta-BHC	319-86-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor	76-44-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Aldrin	309-00-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Dieldrin	60-57-1	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDE	72-55-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin	72-20-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Client sample ID	BORAL-GW04	BORAL-GW02	BORAL-GW05	BORAL-GW03	BORAL-GW01
				Client sampling date / time	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10
					ES1312344-001	ES1312344-002	ES1312344-003	ES1312344-004	ES1312344-005
EP068A: Organochlorine Pesticides (OC) - Continued									
4.4`-DDD	72-54-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
4.4`-DDT	50-29-3	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Methoxychlor	72-43-5	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
^ Total Chlordane (sum)	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of DDD + DDE + DDT	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Demeton-S-methyl	919-86-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Monocrotophos	6923-22-4	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
Dimethoate	60-51-5	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Diazinon	333-41-5	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Parathion-methyl	298-00-0	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
Malathion	121-75-5	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Fenthion	55-38-9	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Chlorpyrifos	2921-88-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Parathion	56-38-2	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
Pirimphos-ethyl	23505-41-1	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Chlorfenvinphos	470-90-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Bromophos-ethyl	4824-78-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Fenamiphos	22224-92-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Prothiofos	34643-46-4	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Ethion	563-12-2	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Carbophenothion	786-19-6	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Azinphos Methyl	86-50-0	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		1.4	1.0	<1.0	1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-GW04	BORAL-GW02	BORAL-GW05	BORAL-GW03	BORAL-GW01
				Client sampling date / time	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10
Compound	CAS Number	LOR	Unit		ES1312344-001	ES1312344-002	ES1312344-003	ES1312344-004	ES1312344-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Phenanthrene	85-01-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	205-99-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		1.4	1.0	<0.5	1.0	<0.5
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	<0.5
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	30	<20
C10 - C14 Fraction	----	50	µg/L		290	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L		1120	<100	<100	100	<100
C29 - C36 Fraction	----	50	µg/L		260	<50	<50	100	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		1670	<50	<50	200	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft									
C6 - C10 Fraction	----	20	µg/L		20	<20	<20	30	<20
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L		<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L		500	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		1110	<100	<100	180	<100
>C34 - C40 Fraction	----	100	µg/L		110	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		1720	<100	<100	180	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		2	<1	<1	4	<1
Toluene	108-88-3	2	µg/L		4	<2	<2	13	<2
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		4	<2	<2	2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-GW04	BORAL-GW02	BORAL-GW05	BORAL-GW03	BORAL-GW01
				Client sampling date / time	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10	30-MAY-2013 11:10
Compound	CAS Number	LOR	Unit		ES1312344-001	ES1312344-002	ES1312344-003	ES1312344-004	ES1312344-005
EP080: BTEXN - Continued									
^ Total Xylenes	1330-20-7	2	µg/L		4	<2	<2	2	<2
^ Sum of BTEX	----	1	µg/L		10	<1	<1	19	<1
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		77.0	103	94.0	101	115
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.1	%		74.4	99.8	92.8	98.2	116
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		71.6	83.1	84.2	81.6	86.4
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		25.4	32.1	20.6	31.7	29.3
2-Chlorophenol-D4	93951-73-6	0.1	%		49.0	64.2	46.5	64.2	58.8
2.4.6-Tribromophenol	118-79-6	0.1	%		65.4	54.0	39.1	74.4	62.1
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		56.8	77.6	52.8	73.7	72.2
Anthracene-d10	1719-06-8	0.1	%		65.9	83.8	71.3	82.2	83.5
4-Terphenyl-d14	1718-51-0	0.1	%		62.9	80.7	79.9	79.5	83.5
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		83.6	86.3	85.5	79.0	85.7
Toluene-D8	2037-26-5	0.1	%		105	103	99.4	98.6	103
4-Bromofluorobenzene	460-00-4	0.1	%		101	99.7	96.1	94.6	93.4

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-DUP	----	----	----	----
				Client sampling date / time	30-MAY-2013 11:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1312344-006	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		8.02	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		22200	----	----	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		13300	----	----	----	----
EA045: Turbidity									
Turbidity	----	0.1	NTU		61.4	----	----	----	----
EA075: Redox Potential									
Redox Potential	----	0.1	mV		120	----	----	----	----
pH Redox	----	0.01	pH Unit		7.8	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		388	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		388	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<1	----	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		7620	----	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		306	----	----	----	----
Magnesium	7439-95-4	1	mg/L		255	----	----	----	----
Sodium	7440-23-5	1	mg/L		4710	----	----	----	----
Potassium	7440-09-7	1	mg/L		57	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		0.100	----	----	----	----
EG035F: Dissolved Mercury by FIMS									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-DUP	----	----	----	----
				Client sampling date / time	30-MAY-2013 11:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1312344-006	----	----	----	----
EG035F: Dissolved Mercury by FIMS - Continued									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.04**	----	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**223**	----	----	----	----
Total Cations	----	0.01	meq/L		**242**	----	----	----	----
Ionic Balance	----	0.01	%		**4.26**	----	----	----	----
EP025: Oxygen - Dissolved (DO)									
Dissolved Oxygen	----	0.1	mg/L		7.2	----	----	----	----
EP066: Polychlorinated Biphenyls (PCB)									
Total Polychlorinated biphenyls	----	1	µg/L		<1	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L		<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L		<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-DUP	----	----	----	----
				Client sampling date / time	30-MAY-2013 11:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1312344-006	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
4.4`-DDD	72-54-8	0.5	µg/L		<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	----	----	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDT	50-29-3	2.0	µg/L		<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	----	----	----	----
Methoxychlor	72-43-5	2.0	µg/L		<2.0	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L		<0.5	----	----	----	----
Monocrotophos	6923-22-4	2.0	µg/L		<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L		<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		<0.5	----	----	----	----
Parathion-methyl	298-00-0	2.0	µg/L		<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L		<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L		<0.5	----	----	----	----
Parathion	56-38-2	2.0	µg/L		<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L		<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L		<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L		<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L		<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L		<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L		<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L		<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L		<0.5	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L		<1.0	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-DUP	----	----	----	----
				Client sampling date / time	30-MAY-2013 11:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1312344-006	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Phenanthrene	85-01-8	1.0	µg/L		<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L		<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L		<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L		<1.0	----	----	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L		<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L		<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		<50	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft									
C6 - C10 Fraction	----	20	µg/L		<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L		<20	----	----	----	----
>C10 - C16 Fraction	----	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		<100	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		<2	----	----	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	----	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	----	----	----	----
ortho-Xylene	95-47-6	2	µg/L		<2	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BORAL-DUP	----	----	----	----
				Client sampling date / time	30-MAY-2013 11:10	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1312344-006	----	----	----	----
EP080: BTEXN - Continued									
^ Total Xylenes	1330-20-7	2	µg/L		<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP066S: PCB Surrogate									
Decachlorobiphenyl	2051-24-3	0.1	%		112	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.1	%		94.2	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		80.1	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		29.0	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%		58.2	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%		55.8	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		66.8	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%		79.2	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		79.2	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		82.2	----	----	----	----
Toluene-D8	2037-26-5	0.1	%		102	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		88.7	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP066S: PCB Surrogate			
Decachlorobiphenyl	2051-24-3	24.8	143
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	30	120
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	26.8	129
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	15.9	102
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20.4	112
Anthracene-d10	1719-06-8	29.6	118
4-Terphenyl-d14	1718-51-0	21.5	126
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Environmental Division

INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: **ES1312344**	Page	: 1 of 10
Client	: GOLDER ASSOCIATES	Laboratory	: Environmental Division Sydney
Contact	: MR SHAUN TROON	Contact	: Client Services
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: stroon@golder.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 07 3721 5400	Telephone	: +61-2-8784 8555
Facsimile	: +61 07 3721 5401	Facsimile	: +61-2-8784 8500
Project	: ----	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	: ----		
C-C-C number	: ----	Date Samples Received	: 30-MAY-2013
Sampler	: ST	Issue Date	: 06-JUN-2013
Order number	: ----		
		No. of samples received	: 6
Quote number	: SY/187/13	No. of samples analysed	: 6

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

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reportec represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

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
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
BORAL-GW04, BORAL-GW02, BORAL-GW05, BORAL-GW03, BORAL-GW01, BORAL-DUP	**30-MAY-2013**	---	30-MAY-2013	----	**30-MAY-2013**	30-MAY-2013	✓
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
BORAL-GW04, BORAL-GW02, BORAL-GW05, BORAL-GW03, BORAL-GW01, BORAL-DUP	**30-MAY-2013**	---	27-JUN-2013	----	**30-MAY-2013**	27-JUN-2013	✓
EA015: Total Dissolved Solids							
Clear Plastic Bottle - Natural (EA015H)							
BORAL-GW04, BORAL-GW02, BORAL-GW05, BORAL-GW03, BORAL-GW01, BORAL-DUP	**30-MAY-2013**	---	06-JUN-2013	----	**03-JUN-2013**	06-JUN-2013	✓
EA045: Turbidity							
Clear Plastic Bottle - Natural (EA045)							
BORAL-GW04, BORAL-GW02, BORAL-GW05, BORAL-GW03, BORAL-GW01, BORAL-DUP	**30-MAY-2013**	----	----	----	**31-MAY-2013**	01-JUN-2013	✓
EA075: Redox Potential							
Clear Plastic Bottle - Natural (EA075)							
BORAL-GW04, BORAL-GW02, BORAL-GW05, BORAL-GW03, BORAL-GW01, BORAL-DUP	**30-MAY-2013**	----	----	----	**30-MAY-2013**	30-MAY-2013	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
BORAL-GW04, BORAL-GW02, BORAL-GW05, BORAL-GW03, BORAL-GW01, BORAL-DUP	**30-MAY-2013**	---	13-JUN-2013	----	**30-MAY-2013**	13-JUN-2013	✓

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
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	---	27-JUN-2013	----	**31-MAY-2013**	27-JUN-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
ED045G: Chloride Discrete analyser								
Clear Plastic Bottle - Natural (ED045G)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	---	27-JUN-2013	----	**31-MAY-2013**	27-JUN-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Natural (ED093F)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	---	06-JUN-2013	----	**31-MAY-2013**	06-JUN-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Natural (EG020A-F)								
BORAL-GW02,	BORAL-DUP	**30-MAY-2013**	---	26-NOV-2013	----	**01-JUN-2013**	26-NOV-2013	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
BORAL-GW04,	BORAL-GW05,	**30-MAY-2013**	---	26-NOV-2013	----	**01-JUN-2013**	26-NOV-2013	✓
BORAL-GW03,	BORAL-GW01							
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Natural (EG035F)								
BORAL-GW02,	BORAL-DUP	**30-MAY-2013**	---	27-JUN-2013	----	**03-JUN-2013**	27-JUN-2013	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
BORAL-GW04,	BORAL-GW05,	**30-MAY-2013**	---	27-JUN-2013	----	**03-JUN-2013**	27-JUN-2013	✓
BORAL-GW03,	BORAL-GW01							
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	---	01-JUN-2013	----	**31-MAY-2013**	01-JUN-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	---	27-JUN-2013	----	**31-MAY-2013**	27-JUN-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	---	01-JUN-2013	----	**31-MAY-2013**	01-JUN-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							

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
EP025: Oxygen - Dissolved (DO)								
Clear Plastic Bottle - Natural (EP025)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	**----**	**----**	**----**	**30-MAY-2013**	30-MAY-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EP066: Polychlorinated Biphenyls (PCB)								
Amber Glass Bottle - Unpreserved (EP066)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	**31-MAY-2013**	06-JUN-2013	✓	**03-JUN-2013**	10-JUL-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EP068A: Organochlorine Pesticides (OC)								
Amber Glass Bottle - Unpreserved (EP068)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	**31-MAY-2013**	06-JUN-2013	✓	**03-JUN-2013**	10-JUL-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EP068B: Organophosphorus Pesticides (OP)								
Amber Glass Bottle - Unpreserved (EP068)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	**31-MAY-2013**	06-JUN-2013	✓	**03-JUN-2013**	10-JUL-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EP080/071: Total Petroleum Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP071)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	**31-MAY-2013**	06-JUN-2013	✓	**03-JUN-2013**	10-JUL-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM))								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	**31-MAY-2013**	06-JUN-2013	✓	**03-JUN-2013**	10-JUL-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EP080: BTEXN								
Amber VOC Vial - Sulfuric Acid (EP080)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	**31-MAY-2013**	13-JUN-2013	✓	**31-MAY-2013**	13-JUN-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
Amber VOC Vial - Sulfuric Acid (EP080)								
BORAL-GW04,	BORAL-GW02,	**30-MAY-2013**	**31-MAY-2013**	13-JUN-2013	✓	**31-MAY-2013**	13-JUN-2013	✓
BORAL-GW05,	BORAL-GW03,							
BORAL-GW01,	BORAL-DUP							

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(where) 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)							
Alkalinity by PC Titrator	ED037-P	2	16	**12.5**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	18	**11.1**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Conductivity by PC Titrator	EA010-P	2	11	**18.2**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	2	12	**16.7**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	4	25	**16.0**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	2	15	**13.3**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
pH by PC Titrator	EA005-P	1	6	**16.7**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	**16.7**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Redox Potential	EA075	1	6	**16.7**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	15	**13.3**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Turbidity	EA045	2	20	**10.0**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	16	**6.3**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Chloride by Discrete Analyser	ED045G	2	18	**11.1**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Conductivity by PC Titrator	EA010-P	1	11	**9.1**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	12	**8.3**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	25	**8.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	12	**8.3**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Pesticides by GCMS	EP068	1	6	**16.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Polychlorinated Biphenyls (PCB)	EP066	1	6	**16.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	**16.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Redox Potential	EA075	3	6	**50.0**	**15.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	2	15	**13.3**	**10.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071	1	14	**7.1**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Turbidity	EA045	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	18	**5.6**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement

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*	
Method Blanks (MB) - Continued							
Conductivity by PC Titrator	EA010-P	1	11	**9.1**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	12	**8.3**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Major Cations - Dissolved	ED093F	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	25	**8.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	12	**8.3**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Pesticides by GCMS	EP068	1	6	**16.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Polychlorinated Biphenyls (PCB)	EP066	1	6	**16.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	**16.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Total Dissolved Solids (High Level)	EA015H	1	15	**6.7**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
TPH - Semivolatile Fraction	EP071	1	14	**7.1**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Turbidity	EA045	1	20	**5.0**	**5.0**	✓	NEPM 1999 Schecule B(3) and ALS QCS3 requirement
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	18	**5.6**	**5.0**	✓	ALS QCS3 requirement
Dissolved Mercury by FIMS	EG035F	1	12	**8.3**	**5.0**	✓	ALS QCS3 requirement
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	25	**8.0**	**5.0**	✓	ALS QCS3 requirement
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.7**	**5.0**	✓	ALS QCS3 requirement
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	**16.7**	**5.0**	✓	ALS QCS3 requirement
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement
TPH Volatiles/BTEX	EP080	1	20	**5.0**	**5.0**	✓	ALS QCS3 requirement

Brief Method Summaries

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

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	APHA 21st ed. 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Conductivity by PC Titrator	EA010-P	WATER	APHA 21st ed., 2510 B This procedure determines conductivity by automated ISE. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Total Dissolved Solids (High Level)	EA015H	WATER	In-House, APHA 21st ed., 2540C A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Turbidity	EA045	WATER	APHA 21st ed., 2130 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Redox Potential	EA075	WATER	In House (Ion selective electrode)
Alkalinity by PC Titrator	ED037-P	WATER	APHA 21st ed., 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	APHA 21st ed., 4500-SO4 Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Chloride by Discrete Analyser	ED045G	WATER	APHA 21st ed., 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	Major Cations is determined based on APHA 21st ed., 3120; USEPA SW 846 - 6010 The ICPAES technique ionises the 0.45um filtered sample atoms emitting a characteristic spectrum. This spectrum is then compared against matrix matched standards for quantification. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2) Hardness parameters are calculated based on APHA 21st ed., 2340 B. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	(APHA 21st ed., 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020): Samples are 0.45 um 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.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	AS 3550, APHA 21st ed. 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45 um filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite as N by Discrete Analyser	EK057G	WATER	APHA 21st ed., 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrate as N by Discrete Analyser	EK058G	WATER	APHA 21st ed., 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	APHA 21st ed., 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	APHA 21st ed., 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	APHA 21st Ed. 1030F. The Ionic Balance is calculated based on the major Anions and Cations. The major anions include Alkalinity, Chloride and Sulfate which determined by PCT and DA. The Cations are determined by Turbi SO4 by DA. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Oxygen - Dissolved	EP025	WATER	APHA 21st ed., 4500-O G. Dissolved Oxygen Probe. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Polychlorinated Biphenyls (PCB)	EP066	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
Pesticides by GCMS	EP068	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TPH - Semivolatile Fraction	EP071	WATER	USEPA SW 846 - 8015A The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)
TPH Volatiles/BTEX	EP080	WATER	USEPA SW 846 - 8260B Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2)

Preparation Methods	Method	Matrix	Method Descriptions

Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (1999) Schedule B(3) (Appdx. 2). ALS default excludes sediment which may be resident in the container.

Summary of Outliers

Outliers : Quality Control Samples

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW 846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- **For all matrices, no Method Blank value outliers occur.**
- **For all matrices, no Duplicate outliers occur.**
- **For all matrices, no Laboratory Control outliers occur.**
- **For all matrices, no Matrix Spike outliers occur.**

Regular Sample Surrogates

- **For all regular sample matrices, no surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

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

Outliers : Frequency of Quality Control Samples

The following report highlights breaches in the Frequency of Quality Control Samples.

- **No Quality Control Sample Frequency Outliers exist.**

APPENDIX E

Guidelines for Water Quality Sampling

TECHNICAL MEMORANDUM

DATE 24 May 2013 **DOCUMENT No.** 137626001-005-M

TO Environmental Staff
Boral

CC Kate Jackson, Ashley Turner

FROM Shaun Troon **EMAIL** stroon@golder.com.au

GUIDELINES FOR GROUNDWATER QUALITY SAMPLING AT BORAL BRINGELLY

1.0 INTRODUCTION

This document provides guidelines on the technical procedure for groundwater quality sampling at Boral's Bringelly site. The methodology presented is intended to assist Boral environmental staff in the continual monitoring of groundwater quality and does not cover all possible sampling methods.

The methodology recommended is for three well volume purging and sampling.

2.0 EQUIPMENT LIST

The following equipment is required in order to carry out the sampling event under the methodology:

Purging Equipment

- Water level dip-meter (c. $50/day hire)
- Calibrated water quality meter (pH, temperature, electrical conductivity (EC), redox potential (Eh), dissolved oxygen (DO)) (c. $90/day hire)
- Purging and sampling device (e.g. disposable bailer, sampling pump, foot-valve) (box of bailers c.$180)

Sampling Equipment

- Sufficient bottles including preservative as per laboratory specifications. Allowance must be made for collection of quality assurance samples.
- Waterproof pen.
- Groundwater filters (pore size of around 0.45 µm), required for filtering of metals:
  - Disposable single use filter and vacuum pump. (box of Steri-cups c.$140)
  - In-line filter cartridges.
- Field sampling form
- Bore construction log (to assist with positioning of the pump and/or tubing in the well, and well volume calculation). These are supplied in Appendix B of this report.
- Sampling and purging records from a previous sampling event at the well. Provides a valuable source of information on how the well might behave and the range of groundwater parameters that might be expected.

Sample Delivery Equipment (usually provided by the laboratory)

- Cool box and ice or portable fridge
- Chain of custody form (COC).

Decontamination equipment

- Laboratory grade (phosphate free) detergent, tap water and deionised water.
- Buckets, scrubbing brush and disposable cleaning cloths.
- Waste collection and storage containers
- PPE for sampling (disposable nitrile gloves, site specific PPE requirements)

3.0 METHODOLOGY

3.1 Summary

Prior to groundwater sample collection, each monitoring well will be purged using a three well volume purging protocol to draw in groundwater from the aquifer.

At least three monitoring well volumes (i.e., standing volume of water in the monitoring well screen and casing) will be purged.

During purging, field measurements of water quality parameters (redox, temperature, pH, and specific conductivity) will be made at regular intervals. Purging beyond three volumes shall continue until field measurements stabilise. Groundwater samples will then be carefully dispensed into the appropriate sample containers.

3.2 Objective

The objective of this method is to obtain a representative sample. For consistency between sampling rounds, three well volumes of water should be removed.

3.3 Procedure

The following step wise method can be used to sample groundwater using three well volume method:

1) Review the well construction details (i.e. screened interval and filter pack position) and previous sampling records.

2) Inspect well for potential integrity issues (absence of fitted cap, damage or potential for surface water ingress).

3) Measure the initial depth to water preferably from the highest point on the top of casing or as per project requirements. Subtract this measurement from the total depth of the well shown on the construction logs.

4) Calculate the purge volume (i.e. three well volumes) – rules of thumb for 50mm diameter wells suggest 2 litres per linear metre of casing and 3.7 litres per linear metre of screened section and gravel pack (for a 100mm borehole) of the water column.

5) Lower the bailer, pump or footvalve:

   a) halfway through the water column if the water level is below the top of the filter pack or;

   b) to the middle of the screened interval if the water level is above the top of the filter pack.

6) Set up field equipment

7) Purge three monitoring well volumes from the monitoring well at a reasonably constant flow rate that is preferably less than 2 L/min. It is preferable to take water quality readings after purging each well

volume. If the well is low yielding (i.e. the three well volumes cannot be removed in a reasonable time frame such as a day) go to Step 8.

8) Record a final set of field measurements immediately before sampling.

9) Confirm that water quality parameters have stabilised as defined below:

- Temperature ± 0.5 °C
- pH: ± 0.1 units
- EC: ± 3 percent of reading
- DO (if required): ± 10%
- Eh (if required): ± 10 mV

If not, continue purging until field measurements stabilise.

Record a final set of field measurements immediately before sampling. Go to Step 10.

10) Commence filling bottles. Fill labelled bottles in the following order:

- Vials (no air bubbles)
- Bottles with no preservative (fill completely)
- Bottles with preservative (fill to top but do not overflow)
- Bottles for parameters that require filtration

Please refer to Figure 1 below for a process flow chart of the sampling procedure detailed in steps 1 – 10 above.

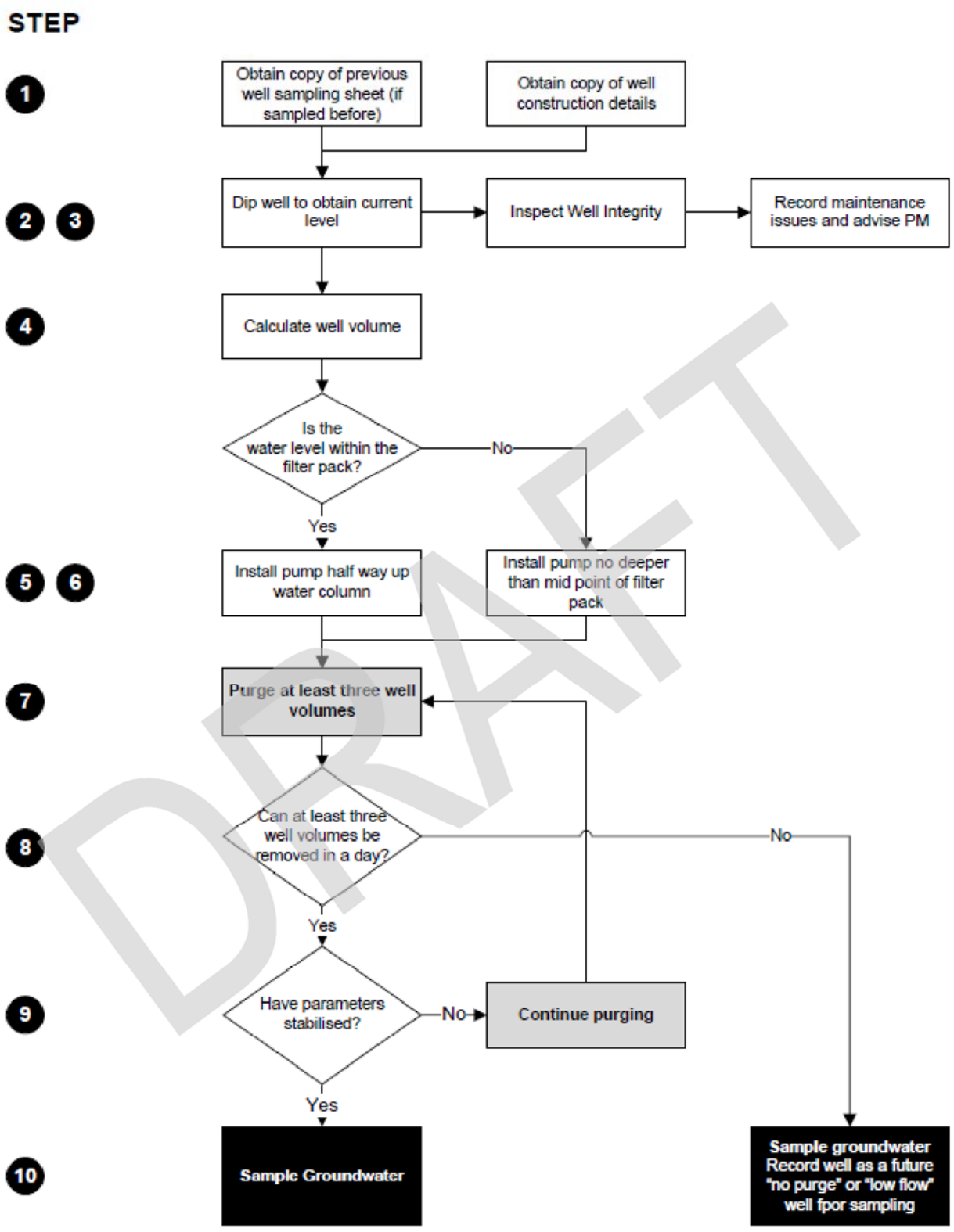


Figure 1: Process flow chart of three well volume purging and sampling procedure

4.0 ADDITIONAL CONSIDERATIONS

4.1 Health, Safety and Environment

The following table presents some key health and safety, and environmental considerations while carrying out a sampling event.

Table 1: Health, Safety and Environmental considerations for groundwater sampling

Step	Hazard	Risk control measures
Mobilisation to well and work zone set-up.	Strains and sprains of back and shoulders from repetitive lifting of equipment: ■ Loading and unloading of vehicles ■ Shifting of load in transit.	■ Vehicle selection. Where possible utilise vehicles which minimise manual handling risks (e.g. access from both sides and rear of the vehicle. ■ Position equipment to avoid awkward lifting. Frequently used equipment (pumps, generators, purge containers) should be positioned close to vehicle access points. ■ Where possible leave equipment in the vehicle and extending the length of tubing to connect directly. ■ Use lighter or smaller equipment (eskies, waste containers, pumps etc) where possible. ■ Whilst manually lifting equipment, use the correct posture (e.g., knees bent, straight back, items held close to body). ■ Personnel should not reach, step, lift and/or work beyond their own capacity. ■ Warm up and stretch the shoulders and back before lifting and take regular breaks from repetitive tasks. ■ Secure load to mitigate movement in transit.
Opening headworks, well gauging and monitoring	Physical hazards (e.g., pinch points, sharp edges, knuckle and knee scrapes). Removing / replacing well cover and cap.	■ Keep fingers away from pinch points. ■ Use cut resistant manual handling gloves and knee-pads or cushions when kneeling on hard surfaces.
	Bites and stings	■ Be wary for ants, spiders and other biting and stinging insects and animals when opening headworks.
	Cutting of tubing	■ Use tubing cutter, shears or secateurs to cut tubing. Open bladed knives must not be used. ■ Use cut resistant manual handling gloves.
	Exposure to contaminants	■ Use nitrile gloves when handling equipment in contact with groundwater.
Equipment Set Up	Strains and sprains of back and shoulders from purging water and handling purge water containers. Exposure to or release of	■ Use mechanic aids where possible. ■ Consider purging or syphoning directly into waste purging containers in the vehicle.

Step	Hazard	Risk control measures
	contaminated groundwater	■ Use smaller volume purge water containers. Select these based on your comfortable lifting capacity. Where possible do not exceed 10L containers. Consider using a smaller container to decant to a large vessel in your vehicle. ■ Use a mechanical purging method in preference to manual purging to eliminate the potential for repetitive strain injury. ■ Refer to 'Mobilisation to well and work zone set-up' step for other manual handling considerations. ■ Nitrile gloves, long pants and a long sleeve shirt, and safety glasses are to be worn.
Groundwater purging	Manual handling (occupational overuse)	Use a mechanical purging method in preference to manual purging to eliminate the potential for repetitive strain injury. ■ If using a foot-valve pump manually, consider: - Using two people to share the workload. - If operating at more than 10m depth, increase the frequency of task rotation and take additional breaks. - Positioning your body to reduce the strain during pumping. - Stretch prior to commencing the activity.
Sampling	Exposure to contaminated groundwater and sample bottle preservatives which can include concentrated acids, and alkalis.	■ Wear safety glasses and nitrile gloves to minimise exposure to groundwater and preservatives in sampling bottles. ■ Never assume sample bottle caps are firmly fastened in particular those containing preservatives. ■ In the event of exposure remove any contaminated clothing and wash skin thorough. ■ Place sample bottles within a spill containment tray. ■ Take care when filling sampling bottles and do not overfill bottles which contain chemical preservatives.

4.2 Bringelly Monitoring Bore Characteristics

The following details some additional information to consider for each of the groundwater monitoring bores on the Bringelly site:

Bore ID	Considerations
GW01	Hole demonstrates relatively fast recovery, possible to purge 3 well volumes and carry out sampling in a single event.
GW02	Hole demonstrates relatively fast recovery, possible to purge 3 well volumes and carry out sampling in a single event.
GW03	Recovery is slow, purging 3 well volumes requires several days. Weighted bailer stuck in the bottom of the bore. It should be noted that water quality results may be affected by metals in the weights.
GW04	Hole bails dry, high level of suspended solids. There is a possibility that this hole is dry and the water in the sump is residual from the drilling process. Water quality results and water levels should be closely monitored for changes.

4.3 Purging Equipment

Bailers

Bailers consist of a rigid plastic tube that is lowered into the well on rope or string and allowed to fill through the non-return valve system at its base. Once full of water, the bailer can be recovered via the rope.

Advantages: Low cost, simple to use, no power source required.

Disadvantages: Increased manual labour, aeration, degassing and turbulence can affect some analytes, risk of losing bailer in the well causing an obstruction

Foot-valves

Foot-valves are simple inertia based pumps consisting of a one way valve and polyethylene tubing. The valve is lowered into the water in the well and reciprocated up and down. During the downward stroke water enters the tube via the one way inlet valve. The valve is then closed by pressure from the water in the tube on the upward stroke. With each downward stroke more water enters the tube and rises up the tubing using momentum.

Advantages: Low cost

Disadvantages: Need to acuate manually or mechanically, pumping action agitates the bore which can introduce suspended material, low flow capacity

Sampling pumps

Sampling pumps come in a variety of mechanisms: gear drive, bladder, helical rotor, piston, peristaltic, gas lift. They should be variable flow to facilitate purging and sampling.

Advantages: Eliminates some manual labour, suited to purging larger volumes of water

Disadvantages: Higher cost specialised equipment, some mechanisms may affect some water quality analytes

4.3.1 Purging equipment recommendations

Due to issues encountered while using bailers for purging on the Boral Bringelly site, Golder recommend that Boral purchase a groundwater purging and sampling pump to facilitate the ongoing monitoring program. The use of a purpose built sampling pump eliminates the risk of losing bailers down the monitoring bores. With one disposable bailer already unrecoverable in GW03, there is a risk that another bailer lost in the well could render the bore redundant for the purpose of groundwater monitoring.

4.4 Sampling

4.4.1 Sampling QA/QC

Trip blanks

Trip blanks are used to monitor the potential for cross contamination of the volatile content of samples during transport and storage. Trip blanks are typically 40 ml vials filled with ultrapure water by the laboratory. These are sent from the laboratory with the empty sample containers and remain with the other samples throughout sampling, storage and the transportation process.

Field blanks

Field blanks are used to monitor for potential contamination of the groundwater sample induced during the sampling process, for example, contamination from field conditions such as dust. These blanks are taken under field conditions using purified water provided by a laboratory. The blank sample should replicate the actions taken to place the groundwater sample in the sample container from the equipment used. For example, poured directly from the laboratory provided purified water container into the relevant sample container (including preservatives). This should include filtration where required for a particular analysis.

Duplicate samples

Duplicate samples are taken to identify variation in analyte concentration between samples collected from the same sampling interval and the precision of the laboratory's analysis. Duplicates are provided to the laboratory in separate bottles and labeled as separate samples.

4.4.2 Sample Containers

The following considerations should be used for sample containers:

- Use only new, clean and undamaged sample bottles.
- Use the sample bottles supplied by the laboratory who will be conducting the analysis (laboratories use different preservatives which might interfere with the analysis and often report this as a non-conformance in accordance with their method).
- Take measures to avoid dusts or other contamination entering the bottles:
  - Keep sample containers in a closed box until required.
  - Keep the lids on the bottles during transport and setting up.
  - Only remove the lid immediately before filling.
  - Do not put the end of the hose into the bottle when filling.
- Fill the bottle to the brim.
- Make sure the bottle seal (often Teflon) is present in the lid before fitting the lid.

Sample bottles/containers are colour coded in accordance with the parameters being analysed. An example of the ALS Environmental sample colour coding is provided in Figure 2.

Test Parameter	Label Colour	Container Type (*Preservation*)
INORGANICS		
Alkalinity, EC, pH, Cations, Cl, SO4, Nitrite, Nitrate, Reactive P, TDS, DO, Turbidity, Redox Potential,	Green	1 x **1000ml** plastic (*none*)
NOx,	Purple	1 x **60ml** plastic (*Sulfuric acid*)
METALS		
Dissolved Heavy Metals **(Field Filtered)**	Red	1 x **60ml** plastic (*nitric acid*)
ORGANICS		
BTEX/TPH(C_6-C_9)	Purple*	2 x **40ml** Amber vials (*Sulfuric Acid*)
Standard level OC/OP/PCB, PAH, TPH (C_{10}-C_{36})	Orange *	1 x **100ml** Amber glass (*none*) for primary analysis. 2 x additional **100ml** Amber glass (*none*) for laboratory duplicates and matrix spikes.

Figure 2: Sample container colour coding provided by ALS Environmental

4.4.3 Field Filtering

A number of sample analyses require filtration – eg for dissolved trace metals. Filtration can be conducted by disposable using Steri-cups or similar. Figure 3 shows a hand vacuum pump and Steri-cup for field filtration.

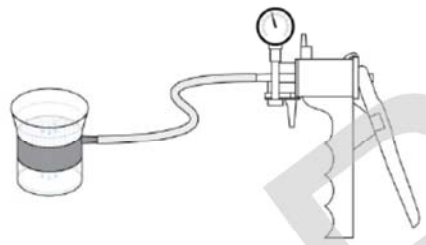


Figure 3: Steri-cup and hand vacuum pump

The cup is used by discharging the groundwater into the top chamber of the unit and attaching a hand pump to the nozzle on the side. A vacuum will be created by pumping the hand pump pulling the water through the filter in the bottom chamber. This bottom chamber is then unscrewed and poured into the relevant sample bottle.

The filter unit should have a filter paper size of 0.45 micron. Use a new disposable filter unit for each sample.

Where filtering is required, the must be filtered prior to placement in a bottle that contains a preservative. If the sample is not filtered because of site specific conditions, the sample must be placed in an unpreserved bottle and the analytical laboratory advised to filter the sample immediately upon sample receipt.

4.4.4 Sample Preservation and Transportation

- The National Association of Testing Authorities (NATA) approved laboratory being used for the sample analysis can advise on the approved holding times for each analytical method.
- All samples must be accompanied by a chain of custody during transport.
- Place labelled sample vessels securely in a chilled insulated container (cool box) or portable fridge.
- Use bubble wrap or polystyrene pieces to mitigate breakage of bottles during transport.
- Place vials in a zip-lock bag and wrap in bubble wrap. Do not place vials directly adjacent to ice/ freezer packs as they can freeze and shatter.

- Samples shall be shipped at a temperature no greater than 4°C. It is recommended that crushed ice always be used in the cool box. Alternatives such as freezer blocks or portable fridges can be used but sufficient blocks must be used to achieve the desired transport temperature. Always ensure that the ice or freezer blocks are in the cool box at the start of each day. It is important that samples are chilled from the outset. The state of the ice or freezer blocks needs to be checked and maintained during the day.
- Where practicable, samples shall be delivered to the laboratory at the end of each day of sampling under chain-of-custody conditions.
- Where storage overnight is required, used of dedicated sample fridges should be considered. Storage of samples in fridges used for food or drink is not acceptable.

5.0 EQUIPMENT SUPPLIERS

The following is a list of possible suppliers for the equipment and consumables required for the sampling methodology detailed in this document.

Equipment

(Purging and sampling pump hire, footvalves, disposable bailers, stericups, vacuum pumps, nitrile gloves, water quality meter hire, water level meter hire)

Thermo Fisher Scientific Inc.
Level 1,
4 Talavera Road,
North Ryde 2113
Telephone: 02 8817 4253 (Direct)

Air-Met Scientific Pty Ltd
Level 3,
18-26 Dickson Avenue,
Artarmon NSW 2064
Telephone Sales: 1800 000 744
Telephone Rental: 1300 137 067

Laboratories

(Laboratory analysis, sampling containers, eskies, Chain of Custody documentation)

ALS Environmental - Sydney
277-289 Woodpark Road
Sydney New South Wales
Australia 2164
Telephone: +61 2 8784 8555

Envirolab Services Pty Ltd - Sydney
12 Ashley Street,
Chatswood NSW
Australia 2067
Telephone: +61 2 9910 6200

Shaun Troon
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Dr Detlef Bringmeier
Principal Hydrogeologist

ST/DB/cg

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APPENDIX F

Water Quality Sampling Field Sheets

GROUNDWATER SAMPLING RECORD FORM
FOR THREE WELL VOLUME METHOD

Golder Associates

PROJECT INFORMATION

Project Number: 137626001
Client: BORAL
Site Location: BRINGELLY

Date: 30/5/2013
Sampled By: ST

GROUNDWATER WELL DATA

BORE ID	GW01

Information from file

Surveyed reference point	
Depth of well (from log)	40
Diameter of well (inc filter pack) (mm)	96
Height of filter pack (m)	22

Information recorded on site

Diameter of standpipe (mm)	50
Standpipe stick up (m)	0.56
Time	16:41
Depth to water (mbRP)	11.79
Total depth of well (mbRP)	40 mbgs
Thickness of sediment on base of well (m)	-
Height of water in standpipe (m)	28.77
Well volume (L)	88.14

Note:

Standard reference point is top of PVC standpipe
mbRP - metres below top of reference point

Interface probe used?	YES / NO
Depth to product (mbRP)	
Depth to water (mbRP)	
Thickness of product (m)	

Water column above filter pack, well volume wihtin 50mm standpipe is 2 litres/m

Estimation of Standing Well Volumes for 50 mm diameter standpipes, for height of water column within filter pack

Well diameter (standpipe plus filter pack)	100mm	115mm	120mm	125mm	150mm	200mm
Litres per lineal meter of water in bore	3.7	4.5	4.8	5.1	6.7	10.8

PURGING RECORD

Time	Volume Purged (L)	Conductivity (mS or µS)	Temp (°C)	pH	Redox Potential (mV)	Dissolved Oxygen (mg/L)	Appearance (colour, turbidity, odour, etc)	NTU
BORAL 17/5 12:00	107	—	—	—	—	—	—	
GOLDER30/5 16:50	20	13.21	18.2	8.81	32	3.14	clear, no odour	232
17:06	30	13.27	18.4	8.70	29	2.98	" "	
17:35	25	13.37	18.6	8.65	25	2.81	" "	
17:50	20	13.32	18.9	8.57	24	2.76	" "	
17:55	5	13.37	18.9	8.54	23	2.8	clear, no odour	125
Total vol. purged (L)	207		No. bore vol. purged	2.35		Purging Time (minutes)		

Depth to water at end of purging (mbRP) _____
Purging Method: Bailer

SAMPLING RECORD

Sampling method: Bailer
Time sampled: 18:00
Sample Appearance:
Colour _____
Odour _____
Sample Container and Preservation:

Sample ID. BORAL-GW01
Samples filtered for metals?: (Yes) / No
Turbidity Low / Medium / High
Hydrocarbon sheen? _____
Duplicate sample taken? / Dup ID.: _____

OBSERVATIONS

Weather Conditions: Temperature: 15 °C
Precipitation : NA

Notes:

GROUNDWATER SAMPLING RECORD FORM FOR THREE WELL VOLUME METHOD

Golder Associates

PROJECT INFORMATION

Project Number: 137626001
Client: BORAL
Site Location: BRINDELLA

Date: 30/5/2013
Sampled By: ST

GROUNDWATER WELL DATA

BORE ID: G-WO2

Information from file

Surveyed reference point	
Depth of well (from log)	40
Diameter of well (inc filter pack) (mm)	96
Height of filter pack (m)	22

Information recorded on site

Diameter of standpipe (mm)	50
Standpipe stick up (m)	0.62
Time	14:20
Depth to water (mbRP)	10.69
Total depth of well (mbRP)	40 mbgs
Thickness of sediment on base of well (m)	-
Height of water in standpipe (m)	29.93
Well volume (L)	90.46

Note:

Standard reference point is top of PVC standpipe
mbRP - metres below top of reference point

Interface probe used?	YES / NO
Depth to product (mbRP)	
Depth to water (mbRP)	
Thickness of product (m)	

Water column above filter pack, well volume wihtin 50mm standpipe is 2 litres/m

Estimation of Standing Well Volumes for 50 mm diameter standpipes, for height of water column within filter pack

Well diameter (standpipe plus filter pack)	100mm	115mm	120mm	125mm	150mm	200mm
Litres per lineal meter of water in bore	3.7	4.5	4.8	5.1	6.7	10.8

PURGING RECORD

Time	Volume Purged (L)	Conductivity (mS or µS)	Temp (°C)	pH	Redox Potential (mV)	Dissolved Oxygen (mg/L)	Appearance (colour, turbidity, odour, etc)
BORAL 14/5 14:30	105	-					
20/5 15:10	110	-					
SLDER 30/5 15:32	20	18.91	20.1	7.53	-130	2.97	Clear, non-turbid
15:49	10	19.23	19.8	7.68	-127	3.12	" "
15:57	10	19.29	19.8	7.70	-114	3.14	" "
16:08	10	19.47	19.6	7.74	-107	3.28	" "
16:11	5	19.55	19.6	7.76	-103	3.39	" "
Total vol. purged (L)		87	**No. bore vol. purged**		3	**Purging Time (minutes)**	

Depth to water at end of purging (mbRP)
Purging Method: BAILER

SAMPLING RECORD

Sampling method: BAILER
Time sampled: 16:40
Sample Appearance:
Colour
Odour
Sample Container and Preservation:

Sample ID. BORAL - G-WO2
Samples filtered for metals?: Yes / No
Turbidity (Low) / Medium / High
Hydrocarbon sheen? N/A
Duplicate sample taken? / Dup ID.: BORAL - DUP

OBSERVATIONS

Weather Conditions: Temperature: 17°C
Precipitation: NA

Notes: * Field Blank 'BORAL - G-WO5' taken at G-WO2
* Duplicate sample taken of G-WO2

GROUNDWATER SAMPLING RECORD FORM FOR THREE WELL VOLUME METHOD

Golder Associates

PROJECT INFORMATION

Project Number: 13762600i
Client: BORAL
Site Location: GRINGELLY

Date: 30/5/2013
Sampled By: ST

GROUNDWATER WELL DATA

BORE ID GWO3

Information from file

Surveyed reference point	
Depth of well (from log)	40
Diameter of well (inc filter pack) (mm)	96
Height of filter pack (m)	17

Note:

Standard reference point is top of PVC standpipe
mbRP - metres below top of reference point

Information recorded on site

Diameter of standpipe (mm)	50
Standpipe stick up (m)	0.6
Time	12:09
Depth to water (mbRP)	26.79 mbtoc
Total depth of well (mbRP)	40 mbgs
Thickness of sediment on base of well (m)	–
Height of water in standpipe (m)	13.81
Well volume (L)	49.4

Interface probe used?	YES / NO
Depth to product (mbRP)	
Depth to water (mbRP)	
Thickness of product (m)	

Water column above filter pack, well volume within 50mm standpipe is 2 litres/m

Estimation of Standing Well Volumes for 50 mm diameter standpipes, for height of water column within filter pack

Well diameter (standpipe plus filter pack)	100mm	115mm	120mm	125mm	150mm	200mm
Litres per lineal meter of water in bore	3.7	4.5	4.8	5.1	6.7	10.8

PURGING RECORD

Time	Volume Purged (L)	Conductivity (mS or µS)	Temp (°C)	pH	Redox Potential (mV)	Dissolved Oxygen (mg/L)	Appearance (colour, turbidity, odour, etc)
BORAL 17/5 12:00	2	–	–	–	–	–	–
GOLDER 30/5 12:34	15	13.26	20.5	6.84	-122	1.67	mildly turbid, light brown
12:46	15	13.16	20.5	7.05	-128	1.71	" " sulphurous odour
13:01	17	13.14	20.4	7.03	-123	1.59	" "
13:17	20	13.34	20.1	7.02	-111	1.84	" "
13:40	18	13.52	20.2	7.06	-96	1.47	" clearing
Total vol. purged (L)	87		No. bore vol. purged	3		Purging Time (minutes)	

Depth to water at end of purging (mbRP)
Purging Method:

SAMPLING RECORD

Sampling method: Bailer
Time sampled: 13:45
Sample Appearance:
Colour
Odour: Sulphur smell
Sample Container and Preservation:

Sample ID. BORAL-GWO3
Samples filtered for metals?: (Yes) / No
Turbidity: Low / (Medium) / High
Hydrocarbon sheen?
Duplicate sample taken? / Dup ID.:

OBSERVATIONS

Weather Conditions: Temperature:
Precipitation :

Notes: * purge volume calculated before site visit, hole recovering slowly
* Bailer stuck in hole 20/5/13

GROUNDWATER SAMPLING RECORD FORM
FOR THREE WELL VOLUME METHOD

Golder Associates

PROJECT INFORMATION

Project Number: 137626601
Client: BORAL
Site Location: BRINGELLY

Date: 30/5/13
Sampled By: ST

GROUNDWATER WELL DATA

BORE ID GW04

Information from file

Surveyed reference point	
Depth of well (from log)	42
Diameter of well (inc filter pack) (mm)	96
Height of filter pack (m)	22

Information recorded on site

Diameter of standpipe (mm)	50
Standpipe stick up (m)	0.6
Time	10:24
Depth to water (mbRP)	40.13 mbtoc
Total depth of well (mbRP)	42
Thickness of sediment on base of well (m)	-
Height of water in standpipe (m)	2.47m
Well volume (L)	4.94 (L)

Note:

Standard reference point is top of PVC standpipe
mbRP - metres below top of reference point

Interface probe used?	YES / NO
Depth to product (mbRP)	
Depth to water (mbRP)	
Thickness of product (m)	

Water column above filter pack, well volume wihtin 50mm standpipe is 2 litres/m

Estimation of Standing Well Volumes for 50 mm diameter standpipes, for height of water column within filter pack

Well diameter (standpipe plus filter pack)	100mm	115mm	120mm	125mm	150mm	200mm
Litres per lineal meter of water in bore	3.7	4.5	4.8	5.1	6.7	10.8

PURGING RECORD

	Time	Volume Purged (L)	Conductivity (mS or µS)	Temp (°C)	pH	Redox Potential (mV)	Dissolved Oxygen (mg/L)	Appearance (colour, turbidity, odour, etc)
BORAL 6/5	14:50	10	-	-	-	-	-	-
20/5	11:00	12	-	-	-	-	-	-
GOLDER 23/5	10:25	8	-	-	-	-	-	-
30/5	10:36	3	1.87	21.3	7.03	109	1.26	Brown, turbid
	10:51	1	1.9	21.2	7.15	110	1.25	" "
	11:03	0.5	1.92	21.3	7.20	105	1.22	" "
	Total vol. purged (L)	34.5		No. bore vol. purged	7		Purging Time (minutes)	

Depth to water at end of purging (mbRP) _____
Purging Method: _____

SAMPLING RECORD

Sampling method: Bailer
Time sampled: 11:10
Sample Appearance:
Colour: Brown
Odour: _____

Sample ID. BORAL-GW04
Samples filtered for metals?: Yes / No

Turbidity: Low / Medium / High
Hydrocarbon sheen? _____

Sample Container and Preservation:

Duplicate sample taken? / Dup ID.: _____

OBSERVATIONS

Weather Conditions: Temperature: _____
Precipitation : _____

Notes: * 4.5 litres bailed then dry
* possibly still drilling fluids. Check previous purge quantities, check SWL to see if bore recovered

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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	pH 7.00 / pH 4.01	7.00 pH	4.01 pH		☑
Conductivity	2.76 mS/cm	0.0 mS/cm	2.76 mS/cm		☑
TDS	36 ppk	0.0 ppk	36.0 ppk		☑
Dissolved Oxygen	Sodium Sulphite / Air	0.0 ppm in Sodium Sulphite	8.92 ppm Saturation in Air		☑
Turbidity	360 NTU	0.0 NTU	360 NTU		☑
Check only					
Redox (ORP) *	Electrode operability test	~~240~~ 238 mV +/- 10%	237 mV		☑

* This meter uses an Ag/AgCl ORP electrode. To convert readings to SHE (Standard Hydrogen Electrode), add 199mV to the mV reading.

☑ Battery Status 8.0 (min 7.2V)
☐ Electrical Safety Tag attached (AS/NZS 3760)

☑ Temperature 20.8 °C
☑ Electrodes Cleaned and checked

Tag No: _____

Valid to: _____

Date: 22/05/2013

Signed: _____

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
☑	☐	Redox (ORP) sensor with wetting cap, 5m
☑	☐	Turbidity sensor, 5m
☑	☐	Power supply 240V to 12V DC 200mA
☑	☐	Instruction Manual
☑	☐	Quick Guide
☑	☐	Syringe with storage solution for pH and ORP sensors
☑	☐	Carry Case
☐	☐	Check to confirm electrical safety (tag must be valid)

Date: 22/05/2013

Signed: _____

TFS Reference	3571R	Return Date:	/ /
Customer Reference		Return Time:	
Equipment ID	90FLT SE	Condition on return:	
Equipment Serial No.	U4341		

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RENTALS

EQUIPMENT CERTIFICATION REPORT

HERON DIPPER-T WATER LEVEL METER

This Water Level Meter has been performance checked as follows:

Cleaned/Tested	Description
☑	Probe
☑	Tape/Reel
☑	Performance Test & Battery Voltage Check (8.60 v) 8.0v Minimum

Date: 22/05/2013

Checked by: Mieks

Signature: [signature]

Please check that the following items are received and that all items are returned. Please clean equipment before returning. **A minimum $30 cleaning / service / repair charge may be applied to any unclean or damaged items.**

Sent	Received	Returned	Description
☑	☐	☐	Water Level Meter Operation Check
☑	☐	☐	Water Level Meter: 30m
☑	☐	☐	Plastic Box
☑	☐	☐	Spare 9V Battery
☑	☐	☐	Probe Cleaning Brush
☑	☐	☐	Instruction leaflet

_____ MS Processors Signature/ Initials

QUOTE NO: 35718

ID: DT100SA

SERIAL NO: 15538

RETURN DATE: ____/____/____

TIME: _____

CLIENT'S REF: P/O No: _____

CLIENT'S REF: Job No: _____

CONDITION ON RETURN: _____

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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	pH 7.00 / pH 4.01	7.00 pH	4.01 pH		☑
Conductivity	2.76 mS/cm	0.0 mS/cm	2.76 mS/cm		☑
TDS	36 ppk	0.0 ppk	36.0 ppk	—	☐ N/A
Dissolved Oxygen	Sodium Sulphite / Air	0.0 ppm in Sodium Sulphite	8.71 ppm Saturation in Air		☑
Turbidity	360 NTU	0.0 NTU	360 NTU		☑
Check only					
Redox (ORP) *	Electrode operability test	~~240~~ 236 mV +/- 10%	236 mV		☑

* This meter uses an Ag/AgCl ORP electrode. To convert readings to SHE (Standard Hydrogen Electrode), add 199mV to the mV reading.

☑ Battery Status 8.0 (min 7.2V)
☐ Electrical Safety Tag attached (AS/NZS 3760)

☑ Temperature 21.7 °C
☑ Electrodes Cleaned and checked

Tag No: _____

Valid to: _____

Date: 29/09/2013

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
☑	☐	Redox (ORP) sensor with wetting cap, 5m
☑	☐	Turbidity sensor, 5m
☑	☐	Power supply 240V to 12V DC 200mA
☑	☐	Instruction Manual
☑	☐	Quick Guide
☑	☐	Syringe with storage solution for pH and ORP sensors
☑	☐	Carry Case
☐	☐	Check to confirm electrical safety (tag must be valid)

Date: 29/09/2013

Signed: [signature]

TFS Reference	35843	Return Date:	/ /
Customer Reference		Return Time:	
Equipment ID	90FLT SL	Condition on return:	
Equipment Serial No.	U8973		

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RENTALS

Equipment Report – Solinst Model 101 Water Level Meter

This Meter has been performance checked / calibrated* as follows:

Cleaned/Tested	**Pass?**
Probe	✓
Tape/Reel	✓

☑ Performance Test & Battery Voltage Check (9.0 v) 8.0v minimum

Date: 24/05/2013 Checked by: Dave O'Neill

Signed: [signature]

Please check that the following items are received and that all items are cleaned and decontaminated before return. A minimum $20 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	Received	Returned	Item
☑	☐	☐	Water Level Meter
☑	☐	☐	Water Level Meter Tape Guide
☑	☐	☐	Spare 9V Battery
☑	☐	☐	Operating guide
☑	☐	☐	Probe Cleaning Brush
☐	☐	☐	Decon
☑	☐	☐	Carry Bag / Box
☐	☐	☐	

Processors Signature/ Initials [signature]

Quote Reference	35843	Condition on return
Customer Ref		
Equipment ID	S101505A	
Equipment serial no.	28902	
Return Date	/ /	
Return Time		

APPENDIX G

Limitations

LIMITATIONS

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Golder Associates

Appendix C: Groundwater Monitoring

Reference	Sample Description	Date	Cap Height	Depth	Temperature	pH	Electrical Conductivity	TDS by Calculation	Dissolved Oxygen	Oxidation Reduction Potential~	Chloride*	Sulphate*	Total Alkalinity* as CaCO3	Fluoride, F*	Sodium*	Potassium*	Calcium*
4228/1	GW1	5/05/2017	0.66	10.77	20.0	7.4	17,000	10,606	1.5	112	6,100	130	570		5,100.00	66	220
4228/2	GW2	5/05/2017	0.62	9.16	19.5	7.0	19,300	12,062	0.8	176	6,900	<1	460		5,600.00	64	230
4228/3	GW3	5/05/2017	0.45	13	20.2	7.0	12,400	7,731	4.3	167	3,900	14	200		3,500.00	50	170
4228/4	GW4	5/05/2017	0.65	8.1	19.1	7.4	475	297	4.5	313	21	11	220		93	8	26
4463/1	GW1	27/06/2017	0.66	10.57	19.0	7.3	20,600	12,875	1.5	162							
4463/2	GW2	27/06/2017	0.62	9.09	19.0	7.0	21,200	13,250	0.9	180							
4463/3	GW3	27/06/2017	0.45	15.15	19.9	7.2	17,700	11,056	2.3	178							
4463/4	GW4	27/06/2017	0.65	17.49	19.1	7.7	15,000	9,400	1	185							
4605/1	GW1	25/07/2017	0.66	10.6	19.7	7.2	22,500	14,100	1.6	173							
4605/2	GW2	25/07/2017	0.62	9.18	19.1	7.1	21,100	13,200	0.9	203							
4605/3	GW3	25/07/2017	0.45	15.8	20.0	7.3	17,800	11,200	1.8	222							
4605/4	GW4	25/07/2017	0.65	23.58	19.9	7.6	16,000	10,000	1.8	263							
4692/1	GW1	22/08/2017	0.66	10.65	19.3	7.2	20700	12900	2.5	103	7500	43	530		5800	66	260
4692/2	GW2	22/08/2017	0.62	9.3	20.0	6.9	20600	12900	0.8	100	7600	<1	510		6000	59	280
4692/3	GW3	22/08/2017	0.45	20.7	21.5	7.6	17800	11100	2.8	143	6400	<1	250		4900	66	260
4692/4	GW4	22/08/2017	0.65	28.82	19.2	7.5	2780	1737.5	1.6	163	660	17	440		780	8	4
3920/1	GW1	6/03/2017	0.66	10.85													
3920/2	GW2	6/03/2017	0.62	9.25													
3920/3	GW3	6/03/2017	0.45	12.77													
3920/4	GW4	6/03/2017	0.65	19.61													
4804/1	GW1	19/09/2017	0.66	10.7	20.0	7.1	20506	12816	1.05	173							
4804/2	GW2	19/09/2017	0.62	9.49	18.9	7.7	1730	1081	4.45	302							
4804/4	GW4	19/09/2017	0.65	31.08	20.8	7.1	2580	1612	2.31	264							
4883/1	GW1	17/10/2017	0.66	10.67	20.1	7.1	21000	13125	0.95	205							
4883/2	GW2	17/10/2017	0.62	9.7	19.9	7.0	20000	12500	1.62	182							
4883/3	GW3	17/10/2017															
4883/4	GW4	17/10/2017	0.65	31.39	20.4	7.2	2760	1725	0.87	156							
5041/1	GW1	14/11/2017	0.66	10.93	20.4	7.1	21500	13437	0.7	153	8700	5	470		6300	72	300
5041/2	GW2	14/11/2017	0.62	9.8	19.7	7.0	20200	12625	1.67	113	8100	<1	470		5900	64	290
5041/4	GW4	14/11/2017	0.65	36.57	22.3	7.9	3600	2250	1.13	74	860	13	440		950	10	8.6
5163/1	GW1	12/12/2017	0.66	11.03	21.5	7.0	21700	13562	1.71	184							
5163/2	GW2	12/12/2017	0.62	9.77	21.2	6.9	20500	12812	2.32	201							
5163/4	GW4	12/12/2017	0.65	38.34	22.4	7.3	38700	24187	1.61	214							
5271/1	GW1	9/01/2018	0.66	11.04	21.5	7.0	21000	13125	3.83	158							
5271/2	GW2	9/01/2018	0.62	9.8	20.8	7.0	20000	12500	1.79	153							
5271/4	GW4	9/01/2018	0.65	39.39													
5349/1	GW1	6/02/2018															
5349/2	GW2	6/02/2018															
5349/3	GW3	6/02/2018															
5349/4	GW4	6/02/2018															
5447/1	GW1	6/03/2018	0.66	11	20.3	7.0	19,300		1.1	205							
5447/2	GW2	6/03/2018	0.62	9.83	20.1	6.9	18,700		1.8	235							
5447/3	GW3	6/03/2018															
5447/4	GW4	6/03/2018	0.65	39.05													
5598/1	GW1	3/04/2018	0.66	11	20.2	6.9	21,200		0.5	253							
5598/2	GW2	3/04/2018	0.62	9.8	19.9	6.9	19,700		0.7	243							
5598/3	GW3	3/04/2018															

Reference	Sample Description	Date	Cap Height	Depth	Temperature	pH	Electrical Conductivity	TDS by Calculation	Dissolved Oxygen	Oxidation Reduction Potential~	Chloride*	Sulphate*	Total Alkalinity* as CaCO3	Fluoride, F*	Sodium*	Potassium*	Calcium*
5598/4	GW4	3/04/2018	0.65	38.93													
5793/1	GW1	1/05/2018	0.66	11.01	20.1	7.0	21,400		1.2	197							
5793/2	GW2	1/05/2018	0.62	9.74	20.0	6.9	20,000		1.4	187							
5793/4	GW4	1/05/2018	0.65	38.84													
5878/1	GW1	29/05/2018	0.66	11.1	20.2	7.0	21,400		0.9	198	7,000	5	420	0.2	5,900	75	330
5878/2	GW2	29/05/2018	0.62	9.79	19.7	7.0	19,600		1.2	218	6,600	<1	480	0.1	6,000	62	290
5878/3	GW3	29/05/2018															
5878/4	GW4	29/05/2018	0.65	38.72													
6041/1	GW1	26/06/2018	0.66	11.08	20.0	7.3	21,000		1.5	180							
6041/2	GW2	26/06/2018	0.62	9.7	19.3	7.0	20,700		1.2	192							
6041/3	GW3	26/06/2018															
6041/4	GW4	26/06/2018	0.65	38.62													
6186/1	GW1	24/07/2018	0.66	11.1	20.1	7.0	22,900		1.2	225							
6186/2	GW2	24/07/2018	0.62	9.7	19.6	7.0	21,500		1.1	213							
6186/3	GW3	24/07/2018															
6186/4	GW4	24/07/2018	0.65	38.53													
6289/1	GW1	21/08/2018	0.66	11.13	19.7	7.1	22,400		1.6	192	7,600	6	420	0.1	4,400	55	280
6289/2	GW2	21/08/2018	0.62	9.7	19.7	7.3	22,200		0.6	160	7,400	<1	430	0.2	4,300	52	280
6289/4	GW4	21/08/2018	0.65	38.44													
6400/1	GW1	18/09/2018	0.66	11.22	19.7	7.0	23,000		0.9	194							
6400/2	GW2	18/09/2018	0.62	9.72	19.3	7.0	21,200		0.8	195							
6400/3	GW3	18/09/2018															
6400/4	GW4	18/09/2018	0.65	38.38													
6487/1	GW1	16/10/2018	0.66	11.27	21.6	7.1	22,800		1.9	181							
6487/2	GW2	16/10/2018	0.62	9.73	19.7	7.2	21,100		0.6	168							
6487/3	GW3	16/10/2018															
6487/4	GW4	16/10/2018	0.65	38.31													
6660/1	GW1	13/11/2018	0.66	11.35	19.3	7.1	20,800		2.2	174	7,900	7	470	0.1	4,600	57	300
6660/2	GW2	13/11/2018	0.62	9.79	18.7	7.1	19,400		2.1	224	7,700	<1	450	0.1	4,500	49	280
6660/4	GW4	13/11/2018	0.65	38.24													
6802/1	GW1	11/12/2018	0.66	11.35	20.1	6.9	20,600		1.1	221							
6802/2	GW2	11/12/2018	0.62	9.83	19.4	6.9	19,100		1.2	268							
6802/4	GW4	11/12/2018	0.65	38.17													
6884/1	GW1	8/01/2019	0.66	11.32	20.5	6.9	20,300		0.9	269							
6884/2	GW2	8/01/2019	0.62	10.84	19.8	6.9	18,700		1.1	271							
6884/4	GW4	8/01/2019	0.65	38.11													
6988/1	GW1	5/01/2019	0.66	12.1	22.1	7.1	21,400		2.8	164	7,000	10	500	0.1	4,200	44	240
6988/2	GW2	5/01/2019	0.62	9.89	20.9	7.0	20,000		1.8	188	6,700	<1	490	0.1	4,600	38	240
6988/4	GW4	5/01/2019	0.65	38.07													
7097/1	GW1	5/03/2019	0.66	11.3	22.8	7.1	21,600		1.6	233							
7097/2	GW2	5/03/2019	0.62	9.93	19.7	7.0	19,300		1.4	201							
7097/4	GW4	5/03/2019	0.65	38.02													
7206/1	GW1	3/04/2019	0.66	11.25	21.7	7.1	21,100	13,200	2.3	208							
7206/2	GW2	3/04/2019	0.62	9.69	19.7	7.0	19,200	12,000	1	248							
7206/3	GW3	3/04/2019															
7206/4	GW4	3/04/2019	0.65	37.99													
7362/1	GW1	1/05/2019	0.66	11.23	20.0	7.1	20,300	12,700	1.2	209	7,400	5	550	0.1	4,900	53	290

Reference	Sample Description	Date	Cap Height	Depth	Temperature	pH	Electrical Conductivity	TDS by Calculation	Dissolved Oxygen	Oxidation Reduction Potential~	Chloride*	Sulphate*	Total Alkalinity* as CaCO3	Fluoride, F*	Sodium*	Potassium*	Calcium*
7362/2	GW2	1/05/2019	0.62	9.68	19.7	7.0	19,100	11,900	1.6	198	7,500	<1	500	0.1	4,900	46	290
7540/1	GW1	29/05/2019	0.66	11.21	19.5	7.0	20,400	12,700	1.5	192							
7540/2	GW2	29/05/2019	0.62	9.65	18.9	7.0	19,100	11,900	2.7	202							
7540/4	GW4	29/05/2019	0.65	38.46													
7638/1	GW1	26/06/2019	0.66	11.26	19.4	7.0	19,800	12,400	1.6	215							
7638/2	GW2	26/06/2019	0.62	9.62	19.0	7.2	18,800	11,700	1.2	215							
7638/4	GW4	26/06/2019	0.65	38.43													
7775/1	GW1	23/07/2019	0.66	11.28	18.9	7.2	19,900	12,400	3.7	171							
7775/2	GW2	23/07/2019	0.62	9.57	18.3	7.0	18,300	11,400	3.5	198							
7775/4	GW4	23/07/2019	0.65	38.36													
7895/1	GW1	20/08/2019	0.66	11.22	19.4	6.9	23,300	14,600	1.3	244	8,100	<1	330	0.1	4,900	50	320
7895/2	GW2	20/08/2019	0.62	9.59	19.1	7.2	21,800	13,600	1.1	222	6,600	<1	480	0.2	4,700	48	290
7895/4	GW4	20/08/2019	0.65	38.32													

Reference	Sample Description	Date	Magnesium*	Total Nitrogen*	Nitrate*	Nitrite*	Ammonia*	Reactive Phosphorus as P*	Arsenic*	Barium*	Beryllium*	Cadmium*	Chromium*	Cobalt*	Copper*
4228/1	GW1	5/05/2017	300	8.8	0.007	<0.005	6.1	0.05	0.005	2.2	<0.0005	<0.0001	<0.001	0.001	<0.001
4228/2	GW2	5/05/2017	220	8	<0.005	<0.005	7.7	0.05	<0.001	54	<0.0005	<0.0001	<0.001	<0.001	<0.001
4228/3	GW3	5/05/2017	64	8.4	0.02	0.006	7.3	0.1	0.002	29	<0.0005	<0.0001	<0.001	0.003	<0.001
4228/4	GW4	5/05/2017	9	1.5	0.073	<0.005	0.007	0.09	0.002	0.34	<0.0005	<0.0001	<0.001	<0.001	0.009
4463/1	GW1	27/06/2017													
4463/2	GW2	27/06/2017													
4463/3	GW3	27/06/2017													
4463/4	GW4	27/06/2017													
4605/1	GW1	25/07/2017													
4605/2	GW2	25/07/2017													
4605/3	GW3	25/07/2017													
4605/4	GW4	25/07/2017													
4692/1	GW1	22/08/2017	300	7.4	0.01	0.018	6.7	0.07	<0.001	5	<0.0005	<0.0001	<0.001	<0.001	<0.001
4692/2	GW2	22/08/2017	240	6.8	0.01	0.015	6.6	0.08	<0.001	63	<0.0005	<0.0001	<0.001	<0.001	<0.001
4692/3	GW3	22/08/2017	98	9.3	<0.005	<0.005	8.7	0.27	0.004	58	<0.0005	<0.0001	<0.001	0.005	<0.001
4692/4	GW4	22/08/2017	2	2.3	<0.005	<0.005	1.4	0.22	0.004	0.59	<0.0005	<0.0001	<0.001	<0.001	<0.001
3920/1	GW1	6/03/2017													
3920/2	GW2	6/03/2017													
3920/3	GW3	6/03/2017													
3920/4	GW4	6/03/2017													
4804/1	GW1	19/09/2017													
4804/2	GW2	19/09/2017													
4804/4	GW4	19/09/2017													
4883/1	GW1	17/10/2017													
4883/2	GW2	17/10/2017													
4883/3	GW3	17/10/2017													
4883/4	GW4	17/10/2017													
5041/1	GW1	14/11/2017	320	10	<0.005	<0.005	7.2	0.05	0.005	31	<0.0005	<0.0001	<0.001	0.001	<0.001
5041/2	GW2	14/11/2017	260	9.9	<0.005	<0.005	6.8	0.096	<0.001	65	<0.0005	<0.0001	<0.001	<0.001	<0.001
5041/4	GW4	14/11/2017	3.4	3.4	<0.005	<0.005	1.9	0.18	0.009	1.5	<0.0005	<0.0001	<0.001	<0.001	<0.001
5163/1	GW1	12/12/2017													
5163/2	GW2	12/12/2017													
5163/4	GW4	12/12/2017													
5271/1	GW1	9/01/2018													
5271/2	GW2	9/01/2018													
5271/4	GW4	9/01/2018													
5349/1	GW1	6/02/2018													
5349/2	GW2	6/02/2018													
5349/3	GW3	6/02/2018													
5349/4	GW4	6/02/2018													
5447/1	GW1	6/03/2018													
5447/2	GW2	6/03/2018													
5447/3	GW3	6/03/2018													
5447/4	GW4	6/03/2018													
5598/1	GW1	3/04/2018													
5598/2	GW2	3/04/2018													
5598/3	GW3	3/04/2018													

Reference	Sample Description	Date	Magnesium*	Total Nitrogen*	Nitrate*	Nitrite*	Ammonia*	Reactive Phosphorus as P*	Arsenic*	Barium*	Beryllium*	Cadmium*	Chromium*	Cobalt*	Copper*
5598/4	GW4	3/04/2018													
5793/1	GW1	1/05/2018													
5793/2	GW2	1/05/2018													
5793/4	GW4	1/05/2018													
5878/1	GW1	29/05/2018	260	10	<0.005	<0.005	8.9	0.052	0.001	55	<0.0005	0.0001	<0.001	<0.001	<0.001
5878/2	GW2	29/05/2018	240	7.6	<0.005	<0.005	6.1	0.097	<0.001	64	<0.0005	0.0001	<0.001	<0.001	<0.001
5878/3	GW3	29/05/2018													
5878/4	GW4	29/05/2018													
6041/1	GW1	26/06/2018													
6041/2	GW2	26/06/2018													
6041/3	GW3	26/06/2018													
6041/4	GW4	26/06/2018													
6186/1	GW1	24/07/2018													
6186/2	GW2	24/07/2018													
6186/3	GW3	24/07/2018													
6186/4	GW4	24/07/2018													
6289/1	GW1	21/08/2018	270	10	0.009	<0.005	9.3	0.048	<0.001	32	<0.0005	<0.0001	<0.001	<0.001	<0.001
6289/2	GW2	21/08/2018	200	11	<0.005	<0.005	11	0.16	0.006	70	<0.0005	<0.0001	<0.001	0.002	<0.001
6289/4	GW4	21/08/2018													
6400/1	GW1	18/09/2018													
6400/2	GW2	18/09/2018													
6400/3	GW3	18/09/2018													
6400/4	GW4	18/09/2018													
6487/1	GW1	16/10/2018													
6487/2	GW2	16/10/2018													
6487/3	GW3	16/10/2018													
6487/4	GW4	16/10/2018													
6660/1	GW1	13/11/2018	320	9.2	0.056	<0.005	7.7	0.046	<0.001	26	<0.0005	<0.0001	<0.001	<0.001	<0.001
6660/2	GW2	13/11/2018	240	7.3	0.02	<0.005	6.6	0.11	<0.001	63	<0.0005	<0.0001	<0.001	<0.001	<0.001
6660/4	GW4	13/11/2018													
6802/1	GW1	11/12/2018													
6802/2	GW2	11/12/2018													
6802/4	GW4	11/12/2018													
6884/1	GW1	8/01/2019													
6884/2	GW2	8/01/2019													
6884/4	GW4	8/01/2019													
6988/1	GW1	5/01/2019	250	11	0.02	<0.005	8.6	0.017	<0.001	17	<0.0005	<0.0001	<0.001	<0.001	0.003
6988/2	GW2	5/01/2019	200	9.2	<0.005	<0.005	6.9	<0.005	<0.001	55	<0.0005	<0.0001	<0.001	<0.001	<0.001
6988/4	GW4	5/01/2019													
7097/1	GW1	5/03/2019													
7097/2	GW2	5/03/2019													
7097/4	GW4	5/03/2019													
7206/1	GW1	3/04/2019													
7206/2	GW2	3/04/2019													
7206/3	GW3	3/04/2019													
7206/4	GW4	3/04/2019													
7362/1	GW1	1/05/2019	320	9.1	<0.005	<0.005	8.7	0.007	<0.001	25	<0.0005	<0.0001	<0.001	<0.001	<0.001

Reference	Sample Description	Date	Magnesium*	Total Nitrogen*	Nitrate*	Nitrite*	Ammonia*	Reactive Phosphorus as P*	Arsenic*	Barium*	Beryllium*	Cadmium*	Chromium*	Cobalt*	Copper*
7362/2	GW2	1/05/2019	250	8	<0.025	<0.025	7.4	0.081	<0.001	61	<0.0005	<0.0001	<0.001	<0.001	<0.001
7540/1	GW1	29/05/2019													
7540/2	GW2	29/05/2019													
7540/4	GW4	29/05/2019													
7638/1	GW1	26/06/2019													
7638/2	GW2	26/06/2019													
7638/4	GW4	26/06/2019													
7775/1	GW1	23/07/2019													
7775/2	GW2	23/07/2019													
7775/4	GW4	23/07/2019													
7895/1	GW1	20/08/2019	220	9.8	<0.005	<0.005	9.2	0.085	0.002	58	<0.0005	<0.0001	<0.001	<0.001	<0.001
7895/2	GW2	20/08/2019	160	9.3	<0.005	<0.005	8.8	0.093	0.01	72	<0.0005	<0.0001	<0.001	0.001	<0.001
7895/4	GW4	20/08/2019													

Reference	Sample Description	Date	Manganese*	Nickel*	Lead*	Vanadium*	Zinc*	Mercury*	Dissolved Iron*	Benzene*	Toluene*	Ethyl Benzene*	meta- & para-Xylenes*	ortho-Xylene*	Total Xylenes*
4228/1	GW1	5/05/2017	0.19	<0.001	<0.001	<0.00	0.002	<0.00005	2	<1	<1	<1	<2	<1	<1
4228/2	GW2	5/05/2017	0.033	<0.001	<0.001	<0.00	0.017	<0.00005	0.8	<1	<1	<1	<2	<1	<1
4228/3	GW3	5/05/2017	0.77	0.002	<0.001	<0.00	0.019	<0.00005	1.3	<1	<1	<1	<2	<1	<1
4228/4	GW4	5/05/2017	0.006	0.003	<0.001	0	0.006	<0.00005	0.21	<1	<1	<1	<2	<1	<1
4463/1	GW1	27/06/2017													
4463/2	GW2	27/06/2017													
4463/3	GW3	27/06/2017													
4463/4	GW4	27/06/2017													
4605/1	GW1	25/07/2017													
4605/2	GW2	25/07/2017													
4605/3	GW3	25/07/2017													
4605/4	GW4	25/07/2017													
4692/1	GW1	22/08/2017	0.16	0.001	<0.001	<0.001	0.006	<0.00005	1.1	<1	3	<1	<2	<1	<2
4692/2	GW2	22/08/2017	0.044	<0.001	<0.001	<0.001	0.033	<0.00005	1.1	<1	6	<1	<2	<1	<2
4692/3	GW3	22/08/2017	0.37	<0.001	<0.001	<0.001	0.029	<0.00005	2.6	7	<1	<1	<2	<1	<2
4692/4	GW4	22/08/2017	0.25	<0.001	<0.001	<0.001	0.003	<0.00005	0.13	6	<1	<1	<2	<1	<2
3920/1	GW1	6/03/2017													
3920/2	GW2	6/03/2017													
3920/3	GW3	6/03/2017													
3920/4	GW4	6/03/2017													
4804/1	GW1	19/09/2017													
4804/2	GW2	19/09/2017													
4804/4	GW4	19/09/2017													
4883/1	GW1	17/10/2017													
4883/2	GW2	17/10/2017													
4883/3	GW3	17/10/2017													
4883/4	GW4	17/10/2017													
5041/1	GW1	14/11/2017	0.2	<0.001	<0.001	<0.001	0.057	<0.00005	4.3	<1	<1	<1	<2	<1	<1
5041/2	GW2	14/11/2017	0.05	<0.001	<0.001	<0.001	0.035	<0.00005	1.5	<1	<1	<1	<2	<1	<1
5041/4	GW4	14/11/2017	0.036	<0.001	<0.001	<0.001	0.007	<0.00005	0.34	4	<1	<1	<2	<1	<1
5163/1	GW1	12/12/2017													
5163/2	GW2	12/12/2017													
5163/4	GW4	12/12/2017													
5271/1	GW1	9/01/2018													
5271/2	GW2	9/01/2018													
5271/4	GW4	9/01/2018													
5349/1	GW1	6/02/2018													
5349/2	GW2	6/02/2018													
5349/3	GW3	6/02/2018													
5349/4	GW4	6/02/2018													
5447/1	GW1	6/03/2018													
5447/2	GW2	6/03/2018													
5447/3	GW3	6/03/2018													
5447/4	GW4	6/03/2018													
5598/1	GW1	3/04/2018													
5598/2	GW2	3/04/2018													
5598/3	GW3	3/04/2018													

Reference	Sample Description	Date	Manganese*	Nickel*	Lead*	Vanadium*	Zinc*	Mercury*	Dissolved Iron*	Benzene*	Toluene*	Ethyl Benzene*	meta- & para-Xylenes*	ortho-Xylene*	Total Xylenes*
5598/4	GW4	3/04/2018													
5793/1	GW1	1/05/2018													
5793/2	GW2	1/05/2018													
5793/4	GW4	1/05/2018													
5878/1	GW1	29/05/2018	0.1	<0.001	<0.001	<0.001	0.052	<0.00005		<1	<1	<1	<2	<1	<2
5878/2	GW2	29/05/2018	0.044	<0.001	<0.001	<0.001	0.05	<0.00005		<1	<1	<1	<2	<1	<2
5878/3	GW3	29/05/2018													
5878/4	GW4	29/05/2018													
6041/1	GW1	26/06/2018													
6041/2	GW2	26/06/2018													
6041/3	GW3	26/06/2018													
6041/4	GW4	26/06/2018													
6186/1	GW1	24/07/2018													
6186/2	GW2	24/07/2018													
6186/3	GW3	24/07/2018													
6186/4	GW4	24/07/2018													
6289/1	GW1	21/08/2018	0.12	<0.001	<0.001	<0.001	0.03	<0.00005		<1	<1	<1	<2	<1	<2
6289/2	GW2	21/08/2018	0.17	<0.001	<0.001	<0.001	0.089	<0.00005		1	<1	<1	<2	<1	<2
6289/4	GW4	21/08/2018													
6400/1	GW1	18/09/2018													
6400/2	GW2	18/09/2018													
6400/3	GW3	18/09/2018													
6400/4	GW4	18/09/2018													
6487/1	GW1	16/10/2018													
6487/2	GW2	16/10/2018													
6487/3	GW3	16/10/2018													
6487/4	GW4	16/10/2018													
6660/1	GW1	13/11/2018	0.13	0.002	<0.001	<0.001	0.061	<0.00005		<1	<1	<1	<2	<1	<2
6660/2	GW2	13/11/2018	0.042	<0.001	<0.001	<0.001	0.042	<0.00005		<1	<1	<1	<2	<1	<2
6660/4	GW4	13/11/2018													
6802/1	GW1	11/12/2018													
6802/2	GW2	11/12/2018													
6802/4	GW4	11/12/2018													
6884/1	GW1	8/01/2019													
6884/2	GW2	8/01/2019													
6884/4	GW4	8/01/2019													
6988/1	GW1	5/01/2019	0.11	0.003	<0.001	<0.001	0.024	<0.00005		<1	<1	<1	<2	<1	<2
6988/2	GW2	5/01/2019	0.037	<0.001	<0.001	<0.001	0.059	<0.00005		<1	<1	<1	<2	<1	<2
6988/4	GW4	5/01/2019													
7097/1	GW1	5/03/2019													
7097/2	GW2	5/03/2019													
7097/4	GW4	5/03/2019													
7206/1	GW1	3/04/2019													
7206/2	GW2	3/04/2019													
7206/3	GW3	3/04/2019													
7206/4	GW4	3/04/2019													
7362/1	GW1	1/05/2019	0.12	<0.001	<0.001	<0.001	0.045	<0.00005	4.2	<1	<1	<1	<2	<1	<2

Reference	Sample Description	Date	Manganese*	Nickel*	Lead*	Vanadium*	Zinc*	Mercury*	Dissolved Iron*	Benzene*	Toluene*	Ethyl Benzene*	meta- & para-Xylenes*	ortho-Xylene*	Total Xylenes*
7362/2	GW2	1/05/2019	0.038	<0.001	<0.001	<0.001	0.066	<0.00005	0.92	<1	<1	<1	<2	<1	<2
7540/1	GW1	29/05/2019													
7540/2	GW2	29/05/2019													
7540/4	GW4	29/05/2019													
7638/1	GW1	26/06/2019													
7638/2	GW2	26/06/2019													
7638/4	GW4	26/06/2019													
7775/1	GW1	23/07/2019													
7775/2	GW2	23/07/2019													
7775/4	GW4	23/07/2019													
7895/1	GW1	20/08/2019	0.1	<0.001	<0.001	<0.001	0.041	<0.00005	1.8	<1	<1	<1	<2	<1	<2
7895/2	GW2	20/08/2019	0.22	0.001	<0.001	<0.001	0.031	<0.00005	5.5	<1	<1	<1	<2	<1	<2
7895/4	GW4	20/08/2019													

Reference	Sample Description	Date	Sum of BTEX*	Naphthalene*	C6-C9 Fraction*	C10-C14 Fraction*	C15-C28 Fraction*	C29-C36 Fraction*	C10-C36 Fraction (sum)*	C6-C10 Fraction*	C6-C10 Fraction (-BTEX)*	>C10-C16 Fraction*	>C16-C34 Fraction*	>C34-C40 Fraction*	>C10-C40 Fraction (sum)*
4228/1	GW1	5/05/2017	<2	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
4228/2	GW2	5/05/2017	<2	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
4228/3	GW3	5/05/2017	<2	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
4228/4	GW4	5/05/2017	<2	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
4463/1	GW1	27/06/2017													
4463/2	GW2	27/06/2017													
4463/3	GW3	27/06/2017													
4463/4	GW4	27/06/2017													
4605/1	GW1	25/07/2017													
4605/2	GW2	25/07/2017													
4605/3	GW3	25/07/2017													
4605/4	GW4	25/07/2017													
4692/1	GW1	22/08/2017	3	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
4692/2	GW2	22/08/2017	6	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
4692/3	GW3	22/08/2017	7	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
4692/4	GW4	22/08/2017	6	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
3920/1	GW1	6/03/2017													
3920/2	GW2	6/03/2017													
3920/3	GW3	6/03/2017													
3920/4	GW4	6/03/2017													
4804/1	GW1	19/09/2017													
4804/2	GW2	19/09/2017													
4804/4	GW4	19/09/2017													
4883/1	GW1	17/10/2017													
4883/2	GW2	17/10/2017													
4883/3	GW3	17/10/2017													
4883/4	GW4	17/10/2017													
5041/1	GW1	14/11/2017	<2	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
5041/2	GW2	14/11/2017	<2	<1	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
5041/4	GW4	14/11/2017	4	<1	<10	<50	<100	<100	<100	<10	<10	50	<100	<100	<100
5163/1	GW1	12/12/2017													
5163/2	GW2	12/12/2017													
5163/4	GW4	12/12/2017													
5271/1	GW1	9/01/2018													
5271/2	GW2	9/01/2018													
5271/4	GW4	9/01/2018													
5349/1	GW1	6/02/2018													
5349/2	GW2	6/02/2018													
5349/3	GW3	6/02/2018													
5349/4	GW4	6/02/2018													
5447/1	GW1	6/03/2018													
5447/2	GW2	6/03/2018													
5447/3	GW3	6/03/2018													
5447/4	GW4	6/03/2018													
5598/1	GW1	3/04/2018													
5598/2	GW2	3/04/2018													
5598/3	GW3	3/04/2018													

Reference	Sample Description	Date	Sum of BTEX*	Naphthalene*	C6-C9 Fraction*	C10-C14 Fraction*	C15-C28 Fraction*	C29-C36 Fraction*	C10-C36 Fraction (sum)*	C6-C10 Fraction*	C6-C10 Fraction (-BTEX)*	>C10-C16 Fraction*	>C16-C34 Fraction*	>C34-C40 Fraction*	>C10-C40 Fraction (sum)*
5598/4	GW4	3/04/2018													
5793/1	GW1	1/05/2018													
5793/2	GW2	1/05/2018													
5793/4	GW4	1/05/2018													
5878/1	GW1	29/05/2018	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
5878/2	GW2	29/05/2018	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
5878/3	GW3	29/05/2018													
5878/4	GW4	29/05/2018													
6041/1	GW1	26/06/2018													
6041/2	GW2	26/06/2018													
6041/3	GW3	26/06/2018													
6041/4	GW4	26/06/2018													
6186/1	GW1	24/07/2018													
6186/2	GW2	24/07/2018													
6186/3	GW3	24/07/2018													
6186/4	GW4	24/07/2018													
6289/1	GW1	21/08/2018	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
6289/2	GW2	21/08/2018	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
6289/4	GW4	21/08/2018													
6400/1	GW1	18/09/2018													
6400/2	GW2	18/09/2018													
6400/3	GW3	18/09/2018													
6400/4	GW4	18/09/2018													
6487/1	GW1	16/10/2018													
6487/2	GW2	16/10/2018													
6487/3	GW3	16/10/2018													
6487/4	GW4	16/10/2018													
6660/1	GW1	13/11/2018	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
6660/2	GW2	13/11/2018	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
6660/4	GW4	13/11/2018													
6802/1	GW1	11/12/2018													
6802/2	GW2	11/12/2018													
6802/4	GW4	11/12/2018													
6884/1	GW1	8/01/2019													
6884/2	GW2	8/01/2019													
6884/4	GW4	8/01/2019													
6988/1	GW1	5/01/2019	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
6988/2	GW2	5/01/2019	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
6988/4	GW4	5/01/2019													
7097/1	GW1	5/03/2019													
7097/2	GW2	5/03/2019													
7097/4	GW4	5/03/2019													
7206/1	GW1	3/04/2019													
7206/2	GW2	3/04/2019													
7206/3	GW3	3/04/2019													
7206/4	GW4	3/04/2019													
7362/1	GW1	1/05/2019	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100

Reference	Sample Description	Date	Sum of BTEX*	Naphthalene*	C6-C9 Fraction*	C10-C14 Fraction*	C15-C28 Fraction*	C29-C36 Fraction*	C10-C36 Fraction (sum)*	C6-C10 Fraction*	C6-C10 Fraction (-BTEX)*	>C10-C16 Fraction*	>C16-C34 Fraction*	>C34-C40 Fraction*	>C10-C40 Fraction (sum)*
7362/2	GW2	1/05/2019	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
7540/1	GW1	29/05/2019													
7540/2	GW2	29/05/2019													
7540/4	GW4	29/05/2019													
7638/1	GW1	26/06/2019													
7638/2	GW2	26/06/2019													
7638/4	GW4	26/06/2019													
7775/1	GW1	23/07/2019													
7775/2	GW2	23/07/2019													
7775/4	GW4	23/07/2019													
7895/1	GW1	20/08/2019	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
7895/2	GW2	20/08/2019	<2	<1.0	<10	<50	<100	<100	<100	<10	<10	<50	<100	<100	<100
7895/4	GW4	20/08/2019													

Reference	Sample Description	Date	Naphthalene*	Acenaphthlyene*	Acenaphthene*	Fluorene*	Phenanthrene*	Anthracene*	Fluoranthene*	Pyrene*	Benz(a)anthracene*	Chrysene*	Benzo(b)fluoranthene*	Benzo(k)fluoranthene*	Benzo(a)pyrene*
4228/1	GW1	5/05/2017	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0
4228/2	GW2	5/05/2017	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0
4228/3	GW3	5/05/2017	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0
4228/4	GW4	5/05/2017	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0
4463/1	GW1	27/06/2017													
4463/2	GW2	27/06/2017													
4463/3	GW3	27/06/2017													
4463/4	GW4	27/06/2017													
4605/1	GW1	25/07/2017													
4605/2	GW2	25/07/2017													
4605/3	GW3	25/07/2017													
4605/4	GW4	25/07/2017													
4692/1	GW1	22/08/2017	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
4692/2	GW2	22/08/2017	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
4692/3	GW3	22/08/2017	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
4692/4	GW4	22/08/2017	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1
3920/1	GW1	6/03/2017													
3920/2	GW2	6/03/2017													
3920/3	GW3	6/03/2017													
3920/4	GW4	6/03/2017													
4804/1	GW1	19/09/2017													
4804/2	GW2	19/09/2017													
4804/4	GW4	19/09/2017													
4883/1	GW1	17/10/2017													
4883/2	GW2	17/10/2017													
4883/3	GW3	17/10/2017													
4883/4	GW4	17/10/2017													
5041/1	GW1	14/11/2017													
5041/2	GW2	14/11/2017													
5041/4	GW4	14/11/2017													
5163/1	GW1	12/12/2017													
5163/2	GW2	12/12/2017													
5163/4	GW4	12/12/2017													
5271/1	GW1	9/01/2018													
5271/2	GW2	9/01/2018													
5271/4	GW4	9/01/2018													
5349/1	GW1	6/02/2018													
5349/2	GW2	6/02/2018													
5349/3	GW3	6/02/2018													
5349/4	GW4	6/02/2018													
5447/1	GW1	6/03/2018													
5447/2	GW2	6/03/2018													
5447/3	GW3	6/03/2018													
5447/4	GW4	6/03/2018													
5598/1	GW1	3/04/2018													
5598/2	GW2	3/04/2018													
5598/3	GW3	3/04/2018													

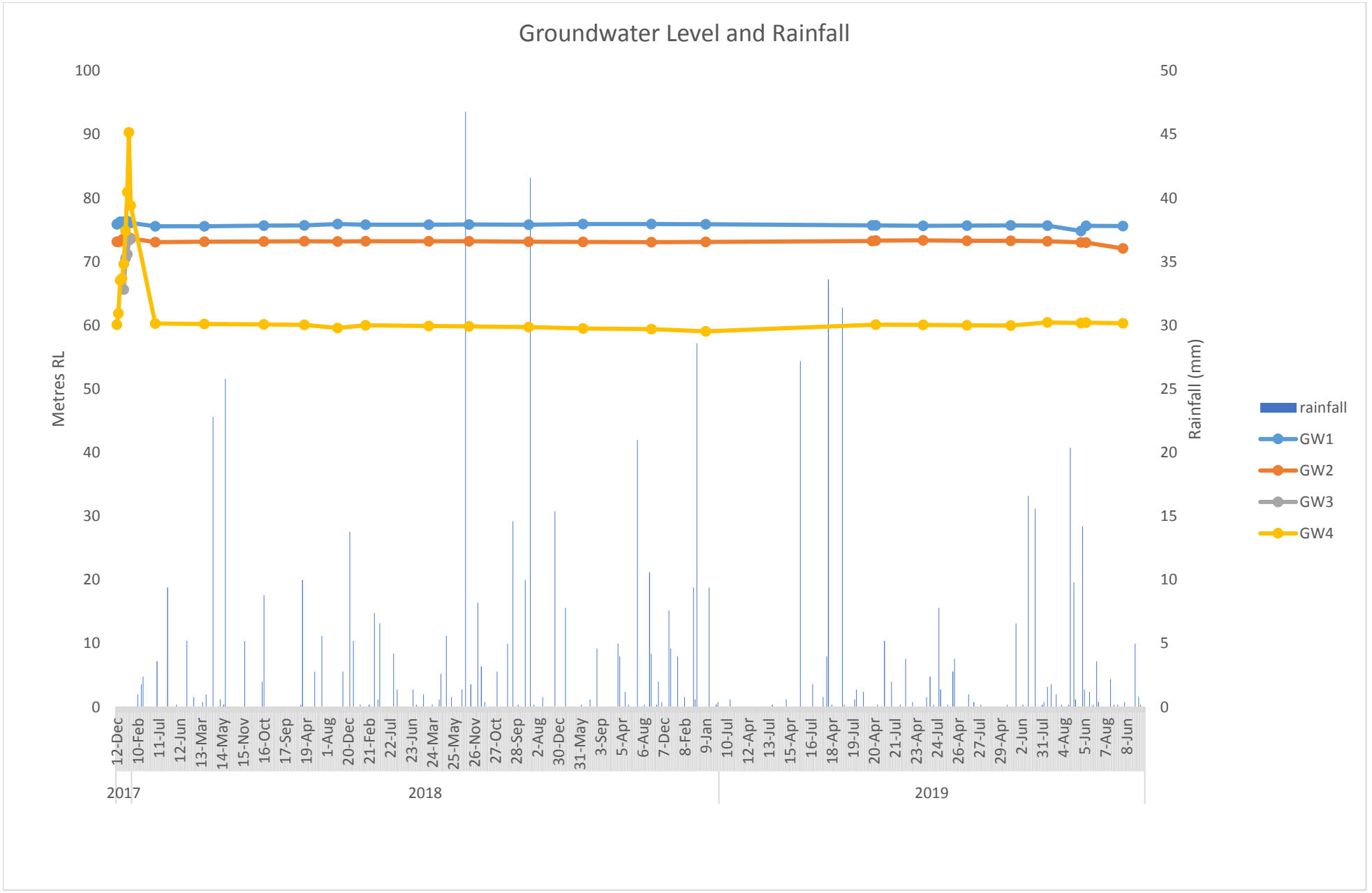
Reference	Sample Description	Date	Naphthalene*	Acenaphthlyene*	Acenaphthene*	Fluorene*	Phenanthrene*	Anthracene*	Fluoranthene*	Pyrene*	Benz(a)anthracene*	Chrysene*	Benzo(b)fluoranthene*	Benzo(k)fluoranthene*	Benzo(a)pyrene*
5598/4	GW4	3/04/2018													
5793/1	GW1	1/05/2018													
5793/2	GW2	1/05/2018													
5793/4	GW4	1/05/2018													
5878/1	GW1	29/05/2018	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<1	<1.0	<1.0
5878/2	GW2	29/05/2018	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<1	<1.0	<1.0
5878/3	GW3	29/05/2018													
5878/4	GW4	29/05/2018													
6041/1	GW1	26/06/2018													
6041/2	GW2	26/06/2018													
6041/3	GW3	26/06/2018													
6041/4	GW4	26/06/2018													
6186/1	GW1	24/07/2018													
6186/2	GW2	24/07/2018													
6186/3	GW3	24/07/2018													
6186/4	GW4	24/07/2018													
6289/1	GW1	21/08/2018	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<1	<1.0	<1.0
6289/2	GW2	21/08/2018	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<1	<1.0	<1.0
6289/4	GW4	21/08/2018													
6400/1	GW1	18/09/2018													
6400/2	GW2	18/09/2018													
6400/3	GW3	18/09/2018													
6400/4	GW4	18/09/2018													
6487/1	GW1	16/10/2018													
6487/2	GW2	16/10/2018													
6487/3	GW3	16/10/2018													
6487/4	GW4	16/10/2018													
6660/1	GW1	13/11/2018	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<1	<1.0	<1.0
6660/2	GW2	13/11/2018	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<1	<1.0	<1.0
6660/4	GW4	13/11/2018													
6802/1	GW1	11/12/2018													
6802/2	GW2	11/12/2018													
6802/4	GW4	11/12/2018													
6884/1	GW1	8/01/2019													
6884/2	GW2	8/01/2019													
6884/4	GW4	8/01/2019													
6988/1	GW1	5/01/2019	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<1	<1.0	<1.0
6988/2	GW2	5/01/2019	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50	<1	<1.0	<1.0
6988/4	GW4	5/01/2019													
7097/1	GW1	5/03/2019													
7097/2	GW2	5/03/2019													
7097/4	GW4	5/03/2019													
7206/1	GW1	3/04/2019													
7206/2	GW2	3/04/2019													
7206/3	GW3	3/04/2019													
7206/4	GW4	3/04/2019													
7362/1	GW1	1/05/2019	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50

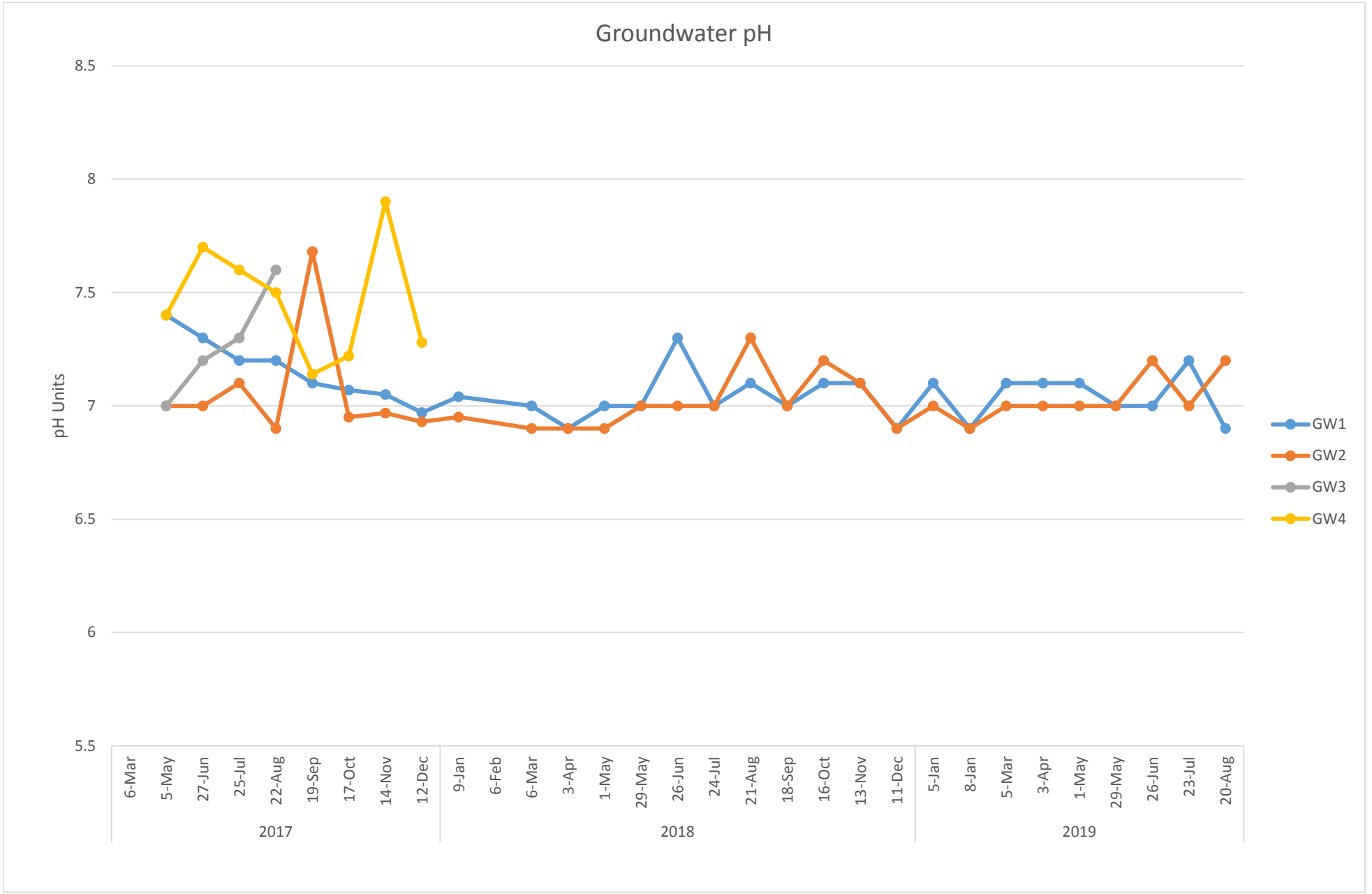
Reference	Sample Description	Date	Naphthalene*	Acenaphthlyene*	Acenaphthene*	Fluorene*	Phenanthrene*	Anthracene*	Fluoranthene*	Pyrene*	Benz(a)anthracene*	Chrysene*	Benzo(b)fluoranthene*	Benzo(k)fluoranthene*	Benzo(a)pyrene*
7362/2	GW2	1/05/2019	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50
7540/1	GW1	29/05/2019													
7540/2	GW2	29/05/2019													
7540/4	GW4	29/05/2019													
7638/1	GW1	26/06/2019													
7638/2	GW2	26/06/2019													
7638/4	GW4	26/06/2019													
7775/1	GW1	23/07/2019													
7775/2	GW2	23/07/2019													
7775/4	GW4	23/07/2019													
7895/1	GW1	20/08/2019	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50
7895/2	GW2	20/08/2019	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.50
7895/4	GW4	20/08/2019													

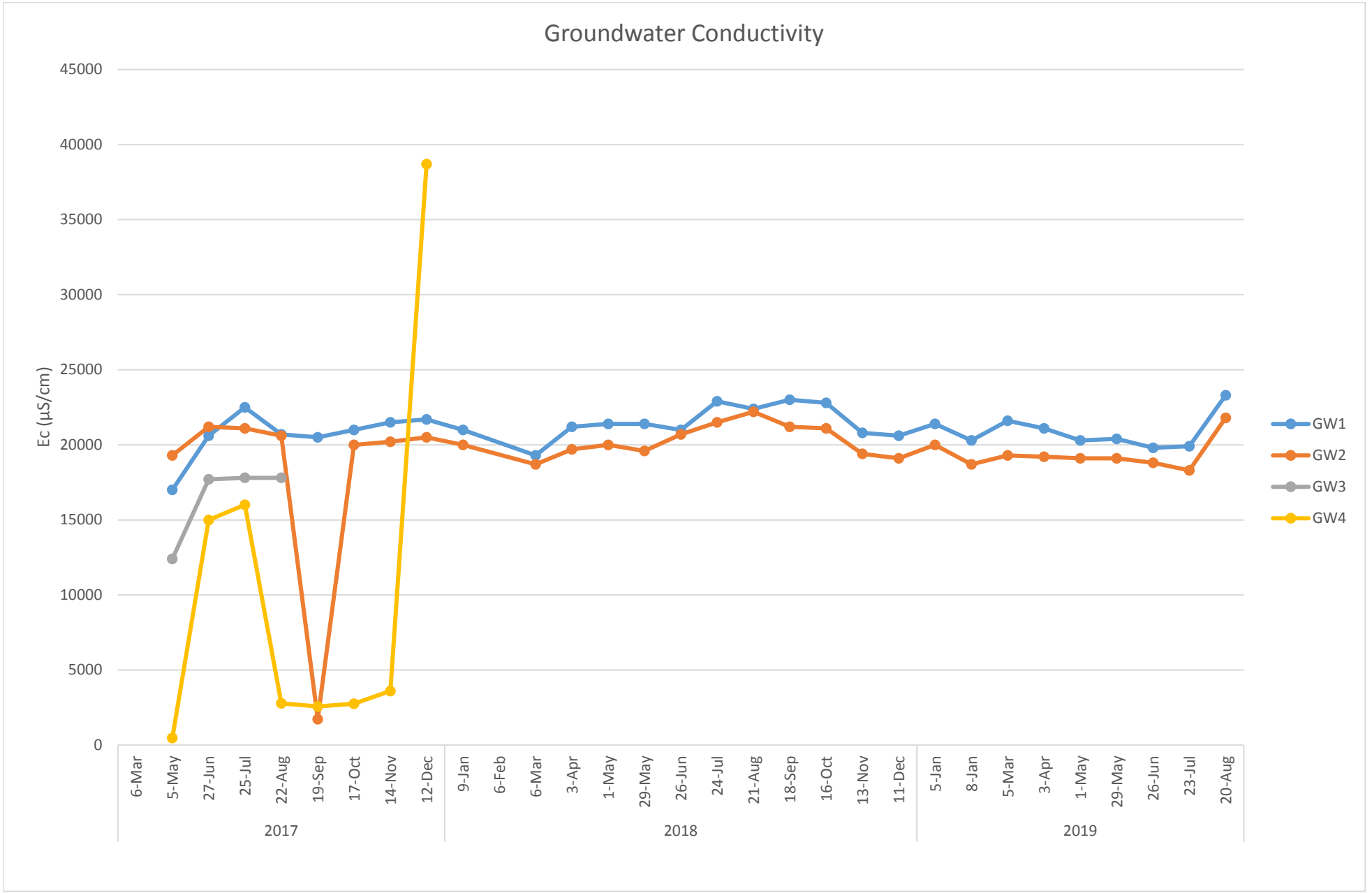
Reference	Sample Description	Date	Indeno(1.2.3.cd)pyrene*	Dibenz(a.h)anthracene*	Benzo(g.h.i)perylene*	Sum of PAHs	Fluoride*	Total Kjeldahl Nitrogen as N*	Total Phosphorus*	Total Phenolics*
4228/1	GW1	5/05/2017	<1.0	<1.0	<5.0	NIL (+)VE				
4228/2	GW2	5/05/2017	<1.0	<1.0	<5.0	NIL (+)VE				
4228/3	GW3	5/05/2017	<1.0	<1.0	<5.0	NIL (+)VE				
4228/4	GW4	5/05/2017	<1.0	<1.0	<5.0	NIL (+)VE				
4463/1	GW1	27/06/2017								
4463/2	GW2	27/06/2017								
4463/3	GW3	27/06/2017								
4463/4	GW4	27/06/2017								
4605/1	GW1	25/07/2017								
4605/2	GW2	25/07/2017								
4605/3	GW3	25/07/2017								
4605/4	GW4	25/07/2017								
4692/1	GW1	22/08/2017	<1	<1	<5	NIL (+)VE	0.2	7.3	<0.05	<0.05
4692/2	GW2	22/08/2017	<1	<1	<5	NIL (+)VE	0.1	6.8	<0.05	<0.05
4692/3	GW3	22/08/2017	<1	<1	<5	NIL (+)VE	0.2	9.3	0.2	<0.05
4692/4	GW4	22/08/2017	<1	<1	<5	NIL (+)VE	0.5	2.3	0.6	<0.05
3920/1	GW1	6/03/2017								
3920/2	GW2	6/03/2017								
3920/3	GW3	6/03/2017								
3920/4	GW4	6/03/2017								
4804/1	GW1	19/09/2017								
4804/2	GW2	19/09/2017								
4804/4	GW4	19/09/2017								
4883/1	GW1	17/10/2017								
4883/2	GW2	17/10/2017								
4883/3	GW3	17/10/2017								
4883/4	GW4	17/10/2017								
5041/1	GW1	14/11/2017								
5041/2	GW2	14/11/2017								
5041/4	GW4	14/11/2017								
5163/1	GW1	12/12/2017								
5163/2	GW2	12/12/2017								
5163/4	GW4	12/12/2017								
5271/1	GW1	9/01/2018								
5271/2	GW2	9/01/2018								
5271/4	GW4	9/01/2018								
5349/1	GW1	6/02/2018								
5349/2	GW2	6/02/2018								
5349/3	GW3	6/02/2018								
5349/4	GW4	6/02/2018								
5447/1	GW1	6/03/2018								
5447/2	GW2	6/03/2018								
5447/3	GW3	6/03/2018								
5447/4	GW4	6/03/2018								
5598/1	GW1	3/04/2018								
5598/2	GW2	3/04/2018								
5598/3	GW3	3/04/2018								

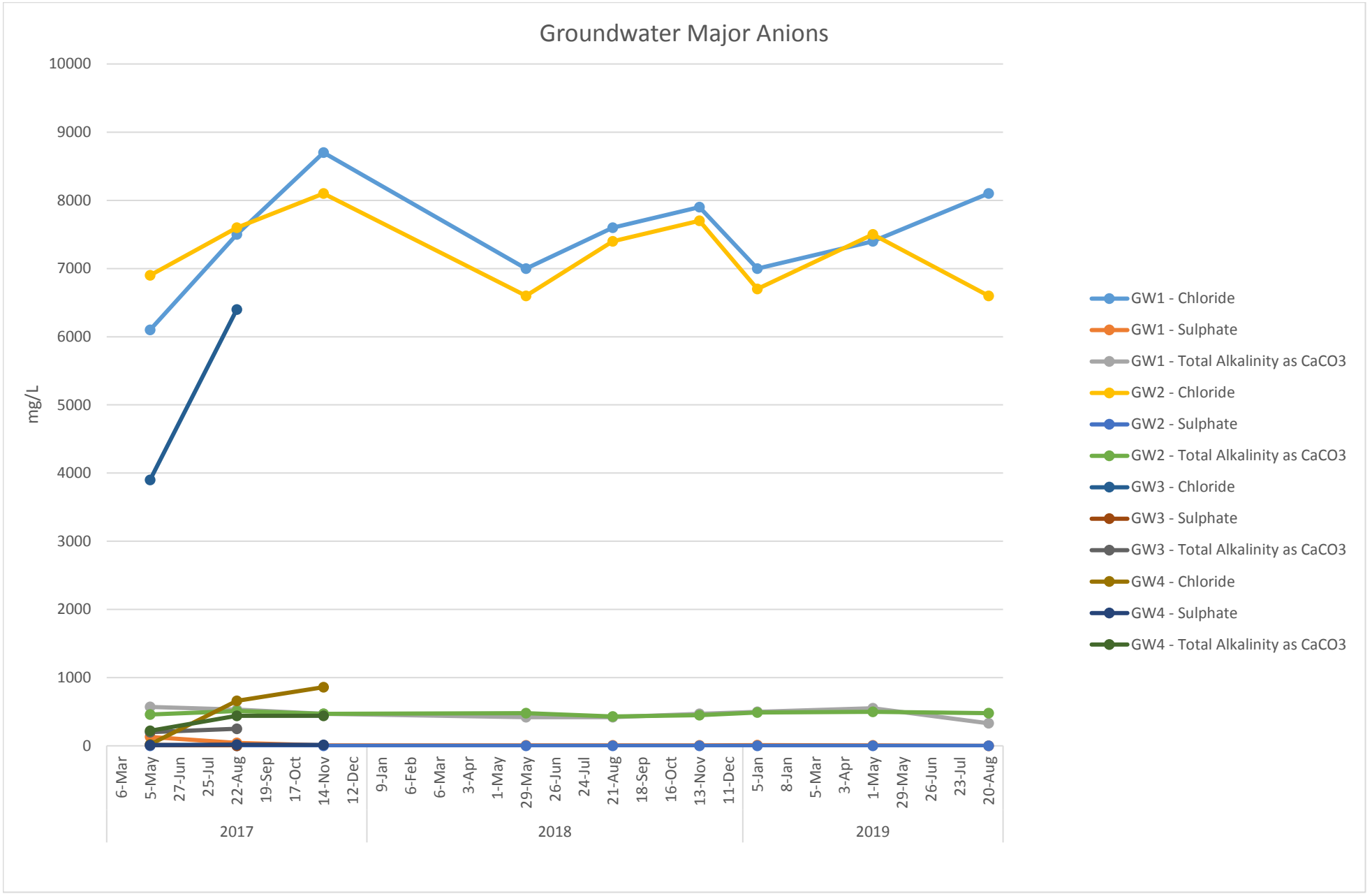
Reference	Sample Description	Date	Indeno(1.2.3.cd)pyrene*	Dibenz(a.h)anthracene*	Benzo(g.h.i)perylene*	Sum of PAHs	Fluoride*	Total Kjeldahl Nitrogen as N*	Total Phosphorus*	Total Phenolics*
5598/4	GW4	3/04/2018								
5793/1	GW1	1/05/2018								
5793/2	GW2	1/05/2018								
5793/4	GW4	1/05/2018								
5878/1	GW1	29/05/2018	<1.0	<1.0	NIL (+)VE	<0.0				
5878/2	GW2	29/05/2018	<1.0	<1.0	NIL (+)VE	<0.0				
5878/3	GW3	29/05/2018								
5878/4	GW4	29/05/2018								
6041/1	GW1	26/06/2018								
6041/2	GW2	26/06/2018								
6041/3	GW3	26/06/2018								
6041/4	GW4	26/06/2018								
6186/1	GW1	24/07/2018								
6186/2	GW2	24/07/2018								
6186/3	GW3	24/07/2018								
6186/4	GW4	24/07/2018								
6289/1	GW1	21/08/2018	<1.0	<1.0	NIL (+)VE	<0.0				
6289/2	GW2	21/08/2018	<1.0	<1.0	NIL (+)VE	<0.0				
6289/4	GW4	21/08/2018								
6400/1	GW1	18/09/2018								
6400/2	GW2	18/09/2018								
6400/3	GW3	18/09/2018								
6400/4	GW4	18/09/2018								
6487/1	GW1	16/10/2018								
6487/2	GW2	16/10/2018								
6487/3	GW3	16/10/2018								
6487/4	GW4	16/10/2018								
6660/1	GW1	13/11/2018	<1.0	<1.0	NIL (+)VE	<0.0				
6660/2	GW2	13/11/2018	<1.0	<1.0	NIL (+)VE	<0.0				
6660/4	GW4	13/11/2018								
6802/1	GW1	11/12/2018								
6802/2	GW2	11/12/2018								
6802/4	GW4	11/12/2018								
6884/1	GW1	8/01/2019								
6884/2	GW2	8/01/2019								
6884/4	GW4	8/01/2019								
6988/1	GW1	5/01/2019	<1.0	<1.0	NIL (+)VE	<0.0				
6988/2	GW2	5/01/2019	<1.0	<1.0	NIL (+)VE	<0.0				
6988/4	GW4	5/01/2019								
7097/1	GW1	5/03/2019								
7097/2	GW2	5/03/2019								
7097/4	GW4	5/03/2019								
7206/1	GW1	3/04/2019								
7206/2	GW2	3/04/2019								
7206/3	GW3	3/04/2019								
7206/4	GW4	3/04/2019								
7362/1	GW1	1/05/2019	<1.0	<1.0	<1.0	<0.50	0.1	9.1	<0.05	<0.1

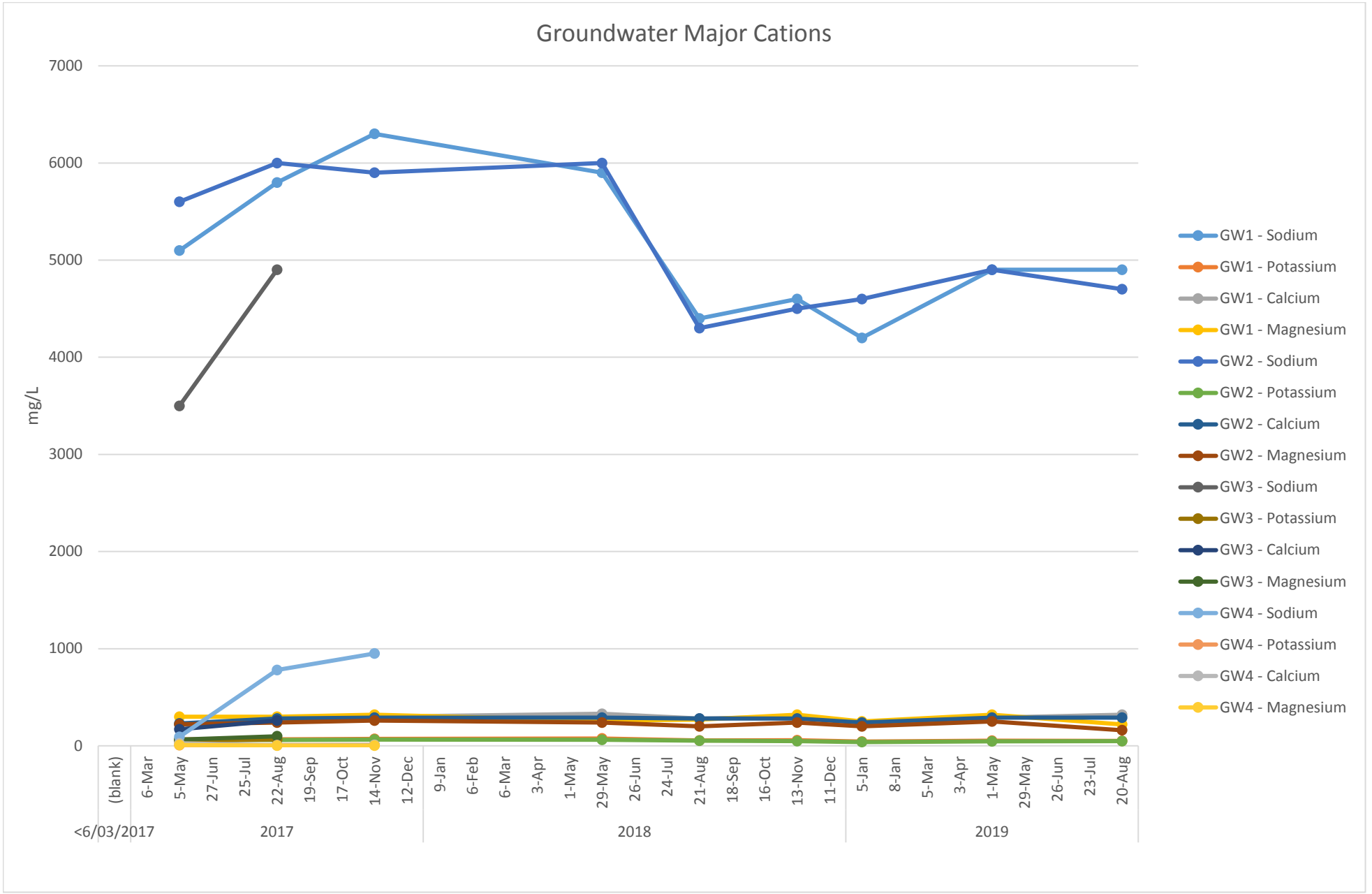
Reference	Sample Description	Date	Indeno(1.2.3.cd)pyrene*	Dibenz(a.h)anthracene*	Benzo(g.h.i)perylene*	Sum of PAHs	Fluoride*	Total Kjeldahl Nitrogen as N*	Total Phosphorus*	Total Phenolics*
7362/2	GW2	1/05/2019	<1.0	<1.0	<1.0	<0.50	0.1	8	<0.05	<0.1
7540/1	GW1	29/05/2019								
7540/2	GW2	29/05/2019								
7540/4	GW4	29/05/2019								
7638/1	GW1	26/06/2019								
7638/2	GW2	26/06/2019								
7638/4	GW4	26/06/2019								
7775/1	GW1	23/07/2019								
7775/2	GW2	23/07/2019								
7775/4	GW4	23/07/2019								
7895/1	GW1	20/08/2019	<1.0	<1.0	<1.0	<0.50	0.1	9.8	0.8	<0.1
7895/2	GW2	20/08/2019	<1.0	<1.0	<1.0	<0.50	0.2	9.3	0.2	<0.1
7895/4	GW4	20/08/2019								


Groundwater Level and Rainfall
Metres RL
Rainfall (mm)
100
90
80
70
60
50
40
30
20
10
0
50
45
40
35
30
25
20
15
10
5
0
rainfall
GW1
GW2
GW3
GW4
12-Dec
10-Feb
11-Jul
12-Jun
13-Mar
14-May
15-Nov
16-Oct
17-Sep
19-Apr
1-Aug
20-Dec
21-Feb
22-Jul
23-Jun
24-Mar
25-May
26-Nov
27-Oct
28-Sep
2-Aug
30-Dec
31-May
3-Sep
5-Apr
6-Aug
7-Dec
8-Feb
9-Jan
10-Jul
12-Apr
13-Jul
15-Apr
16-Jul
18-Apr
19-Jul
20-Apr
21-Jul
23-Apr
24-Jul
26-Apr
27-Jul
29-Apr
2-Jun
31-Jul
4-Aug
5-Jun
7-Aug
8-Jun
2017
2018
2019


Groundwater pH
pH Units
8.5
8
7.5
7
6.5
6
5.5
6-Mar
5-May
27-Jun
25-Jul
22-Aug
19-Sep
17-Oct
14-Nov
12-Dec
9-Jan
6-Feb
6-Mar
3-Apr
1-May
29-May
26-Jun
24-Jul
21-Aug
18-Sep
16-Oct
13-Nov
11-Dec
5-Jan
8-Jan
5-Mar
3-Apr
1-May
29-May
26-Jun
23-Jul
20-Aug
2017
2018
2019
GW1
GW2
GW3
GW4


Groundwater Conductivity
Ec (µS/cm)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
6-Mar
5-May
27-Jun
25-Jul
22-Aug
19-Sep
17-Oct
14-Nov
12-Dec
9-Jan
6-Feb
6-Mar
3-Apr
1-May
29-May
26-Jun
24-Jul
21-Aug
18-Sep
16-Oct
13-Nov
11-Dec
5-Jan
8-Jan
5-Mar
3-Apr
1-May
29-May
26-Jun
23-Jul
20-Aug
2017
2018
2019
GW1
GW2
GW3
GW4


Groundwater Major Anions
mg/L
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
6-Mar
5-May
27-Jun
25-Jul
22-Aug
19-Sep
17-Oct
14-Nov
12-Dec
9-Jan
6-Feb
6-Mar
3-Apr
1-May
29-May
26-Jun
24-Jul
21-Aug
18-Sep
16-Oct
13-Nov
11-Dec
5-Jan
8-Jan
5-Mar
3-Apr
1-May
29-May
26-Jun
23-Jul
20-Aug
2017
2018
2019
GW1 - Chloride
GW1 - Sulphate
GW1 - Total Alkalinity as CaCO3
GW2 - Chloride
GW2 - Sulphate
GW2 - Total Alkalinity as CaCO3
GW3 - Chloride
GW3 - Sulphate
GW3 - Total Alkalinity as CaCO3
GW4 - Chloride
GW4 - Sulphate
GW4 - Total Alkalinity as CaCO3


Groundwater Major Cations
7000
6000
5000
4000
3000
2000
1000
0
mg/L
(blank)
6-Mar
5-May
27-Jun
25-Jul
22-Aug
19-Sep
17-Oct
14-Nov
12-Dec
9-Jan
6-Feb
6-Mar
3-Apr
1-May
29-May
26-Jun
24-Jul
21-Aug
18-Sep
16-Oct
13-Nov
11-Dec
5-Jan
8-Jan
5-Mar
3-Apr
1-May
29-May
26-Jun
23-Jul
20-Aug
<6/03/2017
2017
2018
2019
GW1 - Sodium
GW1 - Potassium
GW1 - Calcium
GW1 - Magnesium
GW2 - Sodium
GW2 - Potassium
GW2 - Calcium
GW2 - Magnesium
GW3 - Sodium
GW3 - Potassium
GW3 - Calcium
GW3 - Magnesium
GW4 - Sodium
GW4 - Potassium
GW4 - Calcium
GW4 - Magnesium

Appendix D: Consultant Approval

Planning and Assessment
Energy and Resource Assessments
Contact: Jack Murphy
Phone: 8217 2016
Email: jack.murphy@planning.nsw.gov.au

Mr Greg Thomson
Director
VGT Environmental Compliance Solutions Pty Ltd
PO Box 2334
Greenhills NSW 2323

Dear Mr Thomson,

Bringelly Brickworks Extension (SSD 5684)
Appointment of a Suitably Qualified and Experienced Person

I refer to your letter dated 2 September 2019 requesting the Secretary's endorsement of a suitably qualified and experienced person to prepare the Water Management Plan for the Bringelly Brickworks Extension (SSD 5684).

The Department has reviewed the credentials of Ms Tara O'Brien of VGT Environmental Compliance Solutions Pty Ltd and agrees she is a suitably qualified person. In accordance with condition 18 of Schedule 3 of SSD 5684, the Secretary endorses Ms Tara O'Brien to prepare the above document.

Should you have any enquiries in relation to this matter, please contact Jack Murphy.

Yours sincerely,

Howard Reed 2.9.19
Howard Reed
Director Resource Assessments
as the Secretary's nominee