AGL Upstream Investments Pty Ltd

Drilling Completion Report - Denham Court, Menangle Park and Glenlee

Camden Gas Project

27 November 2014

PARSONS BRINCKERHOFF

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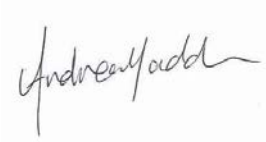
Approved by:	Andrea Madden	Date: 27/11/2014	Signature: 

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Glossary

Acidity	Base neutralising capacity.
Alkalinity	Acid neutralising capacity.
Alluvium	Unconsolidated sediments (clays, sands, gravels and other materials) deposited by flowing water. Deposits can be made by streams on river beds, floodplains, and alluvial fans.
Alluvial aquifer	Permeable zones that store and produce groundwater from unconsolidated alluvial sediments. Shallow alluvial aquifers are generally unconfined aquifers.
Ammonia	A compound of nitrogen and hydrogen (NH_3) that is a common by-product of animal waste and landfills but is also found naturally in reduced environments. Ammonia readily converts to nitrate in soils and streams.
Anion	An ion with a negative charge – usually non-metal ions when disassociated and dissolved in water.
Aquatic ecosystem	The stream channel, lake or estuary bed, water, and (or) biotic communities and the habitat features that occur therein.
Aquifer	Rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water.
Aquifer properties	The characteristics of an aquifer that determine its hydraulic behaviour and its response to abstraction.
Aquifer, confined	An aquifer that is overlain by low permeability strata. The hydraulic conductivity of the confining bed is significantly lower than that of the aquifer.
Aquifer, semi-confined	An aquifer overlain by a low-permeability layer that permits water to slowly flow through it. During pumping, recharge to the aquifer can occur across the leaky confining layer – also known as a leaky artesian or leaky confined aquifer.
Aquifer, unconfined	Also known as a water table aquifer. An aquifer in which there are no confining beds between the zone of saturation and the surface. The water table is the upper boundary of an unconfined aquifer.
Aquitard	A low permeability unit that can store groundwater and also transmit it slowly from one formation to another. Aquitards retard but do not prevent the movement of water to or from adjacent aquifers.
Australian Height Datum (AHD)	The reference point (very close to mean sea level) for all elevation measurements, and used for correlating depths of aquifers and water levels in bores.
Baseline sampling	A period of regular water quality and water level measurements that are carried out over a period long enough to determine the variability in groundwater conditions.

Beneficial aquifer	An aquifer with a water resource of sufficient quality and quantity to provide either ecosystem protection, raw water for drinking water supply, and agricultural or industrial water.
Blowout	The uncontrolled release of formation fluids and gases encountered during borehole drilling.
BoP	Blowout preventer, a large series of valves used to seal, control and monitor blowouts of formation fluids and gasses.
Bore	A structure drilled below the surface to obtain water from an aquifer or series of aquifers.
Boundary	A lateral discontinuity or change in the aquifer resulting in a significant change in hydraulic conductivity, storativity or recharge.
Carbon-13 (^{13}C)	A natural, stable isotope of carbon and one of the environmental isotopes. It makes up about 1.109% of all naturally occurring carbon on Earth.
Carbon-14 (^{14}C)	Or radiocarbon is a radioactive isotope of carbon. Its nucleus contains six (6) protons and eight (8) neutrons. Its presence in organic materials is used in radiocarbon dating. It occurs naturally and has a relative abundance up to one part per trillion (0.0000000001%) of all naturally-occurring carbon on Earth. Carbon-14 is one of the most important nuclides in groundwater studies because its half-life of 5,730 years covers a critical time scale of ~500 to 50,000 years, which is ideal for dating regional and intermediate flow systems.
Cation	An ion with a positive charge – usually metal ions when disassociated and dissolved in water.
Claystone	A non-fissile rock of sedimentary origin composed primarily of clay-sized particles (less than 0.004 mm).
Coal	A sedimentary rock derived from the compaction and consolidation of vegetation or swamp deposits to form a fossilised carbonaceous rock.
Coal seam	A layer of coal within a sedimentary rock sequence.
Coal seam gas (CSG)	Coal seam gas is a form of natural gas (predominantly methane) that is extracted from coal seams.
Concentration	The amount or mass of a substance present in a given volume or mass of sample, usually expressed as milligram per litre (water sample) or micrograms per kilogram (sediment sample).
Conceptual model	A simplified and idealised representation (usually graphical) of the physical hydrogeologic setting and the hydrogeological understanding of the essential flow processes of the system. This includes the identification and description of the geologic and hydrologic framework, media type, hydraulic properties, sources and sinks, and important aquifer flow and surface-groundwater interaction processes.
Confining layer	Low permeability strata that may be saturated but will not allow water to move through it under natural hydraulic gradients.

Datalogger	A digital recording instrument that is inserted in monitoring and pumping bores to record pressure measurements and water level variations.
Detection limit	The concentration below which a particular analytical method cannot determine, with a high degree of certainty, a concentration.
Deuterium (^{2}H)	Also called heavy hydrogen, a stable isotope of hydrogen with a natural abundance of one atom in 6,500 of hydrogen. The nucleus of deuterium, called a deuteron, contains one proton and one neutron, where a normal hydrogen nucleus has just one proton.
Dual permeability aquifer	An aquifer in which groundwater flow is through both the primary porosity of the rock matrix and the secondary porosity of fractures and fissures.
Electrical Conductivity (EC)	A measure of a fluid's ability to conduct an electrical current and is an estimation of the total ions dissolved. It is often used as a measure of water salinity.
Facies	An assemblage or association of mineral, rock, or fossil features reflecting the environment and conditions of origin of the rock. It refers to the appearance and peculiarities that distinguish a rock unit from associated or adjacent units.
Falling head test	A hydraulic test on a monitoring bore or piezometer that involves a sudden rise in water level (i.e. a volume of water is quickly added to the water column and the rate of water level decline is measured). Also called a slug test or slug-in test.
Fault	A fracture in rock along which there has been an observable amount of displacement. Faults are rarely single planar units; normally they occur as parallel to sub-parallel sets of planes along which movement has taken place to a greater or lesser extent. Such sets are called fault or fracture zones.
Global Meteoric Water Line (GMWL)	A line that defines the relationship between oxygen-18 (^{18}O) and deuterium (^{2}H) in fresh surface waters and precipitation from a number of global reference sites.
Groundwater	The water contained in interconnected pores or fractures located below the water table in the saturated zone.
Groundwater level	The water level measured in a bore; this may be at or close to the water table in unconfined aquifers, or represent the average piezometric level across the screened interval in confined aquifers.
Groundwater age classification	Groundwater ages are commonly referred to as: ▪ Modern <100 years ▪ Sub-modern 100-1,000 years ▪ Old >1,000 years
Groundwater flow	The movement of water through openings in sediment and rock within the zone of saturation.
Groundwater flow	The movement of water through openings in sediment and rock within the zone of saturation.

Groundwater system	A system that is hydrogeologically more similar than different in regard to geological province, hydraulic characteristics and water quality, and may consist of one or more geological formations.
Hydraulic conductivity	The rate at which water of a specified density and kinematic viscosity can move through a permeable medium (notionally equivalent to the permeability of an aquifer to fresh water).
Hydraulic head	A specific measurement of water pressure above a datum. It is usually measured as a water surface elevation, expressed in units of length. In an aquifer, it can be calculated from the depth to water in a monitoring bore. The hydraulic head can be used to determine a hydraulic gradient between two or more points.
Hydrochemistry	Chemical characterisation of water (both surface water and groundwater).
Hydrogeology	The study of the interrelationships of geologic materials and processes with water, especially groundwater.
Hydrology	The study of the occurrence, distribution, and chemistry of all surface waters.
Ion	An ion is an atom or molecule where the total number of electrons is not equal to the total number of protons, giving it a net positive or negative electrical charge.
Isotope	One of multiple forms of an element that has a different number of neutrons than other atoms of that element. Some isotopes are unstable or undergo radioactive decay, while others are ‘stable isotopes’.
Lithology	The study of rocks and their depositional or formational environment on a large specimen or outcrop scale.
Local Meteoric Water Line (LMWL)	A line that defines the local relationship between oxygen-18 (^{18}O) and deuterium (^{2}H) in fresh surface waters and precipitation. In this report the LMWL used is for the Sydney region.
Major ions	Constituents commonly present in concentrations exceeding 10 milligram per litre. Dissolved cations generally are calcium, magnesium, sodium, and potassium; the major anions are sulphate, chloride, fluoride, nitrate, and those contributing to alkalinity, most generally assumed to be bicarbonate and carbonate.
Methane (CH_4)	An odourless, colourless, flammable gas, which is the major constituent of natural gas. It is used as a fuel and is an important source of hydrogen and a wide variety of organic compounds.
MicroSiemens per centimetre (µS/cm)	A measure of water salinity commonly referred to as EC (see also Electrical Conductivity). Most commonly measured in the field with calibrated field meters.
Monitoring bore	A non-pumping bore, is generally of small diameter that is used to measure the elevation of the water table and/or water quality. Bores generally have a short well screen against a single aquifer through which water can enter.
Oxidising conditions	Conditions in which a species loses electrons and is present in oxidised form.

Oxygen-18 (^{18}O)	A natural, stable isotope of oxygen and one of the environmental isotopes. It makes up about 0.2 % of all naturally-occurring oxygen on Earth.
Percent modern carbon (pMC)	The activity of ^{14}C is expressed as percent modern carbon (pMC) where 100 pMC corresponds to 95 % of the ^{14}C concentration of NBS oxalic acid standard (close to the activity of wood grown in 1890).
Permeability	The property or capacity of a porous rock, sediment, clay or soil to transmit a fluid. It is a measure of the relative ease of fluid flow under unequal pressure. The hydraulic conductivity is the permeability of a material for water at the prevailing temperature.
Permeable material	Material that permits water to move through it at perceptible rates under the hydraulic gradients normally present.
Permian	The last period of the Palaeozoic era that finished approximately 252 million years before present.
pH	Potential of Hydrogen; the logarithm of the reciprocal of hydrogen-ion concentration in gram atoms per litre; provides a measure on a scale from 0 to 14 of the acidity or alkalinity of a solution (where 7 is neutral, greater than 7 is alkaline and less than 7 is acidic).
Porosity	The proportion of open space within an aquifer, comprised of intergranular space, pores, vesicles and fractures.
Porosity, primary	The porosity that represents the original pore openings when a rock or sediment formed.
Porosity, secondary	The porosity caused by fractures or weathering in a rock or sediment after it has been formed.
Perched aquifer	A perched aquifer occurs above the regional water table, where groundwater is situated above unsaturated rock formations as a result of an impermeable layer.
Quaternary	The most recent geological period extending from approximately 2.6 million years ago to the present day.
Quality assurance	Evaluation of quality-control data to allow quantitative determination of the quality of chemical data collected during a study. Techniques used to collect, process, and analyse water samples are evaluated.
Recharge	The process which replenishes groundwater, usually by rainfall infiltrating from the ground surface to the water table and by river water reaching the water table or exposed aquifers. The addition of water to an aquifer.
Recharge area	A geographic area that directly receives infiltrated water from surface and in which there are downward components of hydraulic head in the aquifer. Recharge generally moves downward from the water table into the deeper parts of an aquifer then moves laterally and vertically to recharge other parts of the aquifer or deeper aquifer zones.
Recovery	The difference between the observed water level during the recovery period after cessation of pumping and the water level measured immediately before pumping stopped.

Redox potential (ORP or Eh)	The redox potential is a measure (in volts) of the affinity of a substance for electrons – its electronegativity – compared with hydrogen (which is set at 0). Substances more strongly electronegative than (i.e. capable of oxidising) hydrogen have positive redox potentials. Substances less electronegative than (i.e. capable of reducing) hydrogen have negative redox potentials. Also known as oxidation-reduction potential and Eh.
Redox reaction	Redox reactions, or oxidation-reduction reactions, are a family of reactions that are concerned with the transfer of electrons between species, and are mediated by bacterial catalysis. Reduction and oxidation processes exert an important control on the distribution of species like O_2, Fe^{2+}, H_2S and CH_4 etc. in groundwater.
Reducing conditions	Conditions in which a species gains electrons and is present in reduced form.
Salinity	The concentration of dissolved salts in water, usually expressed in EC units or milligrams of total dissolved solids per litre (mg/L TDS) or units of electrical conductivity (EC).
Salinity classification	Fresh water quality – water with a salinity <800 µS/cm. Marginal water quality – water that is more saline than freshwater and generally waters between 800 and 1,600 µS/cm. Brackish quality – water that is more saline than freshwater and generally waters between 1,600 and 4,800 µS/cm. Slightly saline quality – water that is more saline than brackish water and generally waters with a salinity between 4,800 and 10,000 µS/cm. Moderately saline quality – water that is more saline than brackish water and generally waters between 10,000 and 20,000 µS/cm. Saline quality – water that is almost as saline as seawater and generally waters with a salinity greater than 20,000 µS/cm. Seawater quality – water that is generally around 55,000 µS/cm.
Sandstone	Sandstone is a sedimentary rock composed mainly of sand-sized minerals or rock grains (predominantly quartz).
Screen	A type of bore lining or casing of special construction, with apertures designed to permit the flow of water into a bore while preventing the entry of aquifer or filter pack material.
Sedimentary rock aquifer	These occur in consolidated sediments such as porous sandstones and conglomerates, in which water is stored in the intergranular pores, and limestone, in which water is stored in solution cavities and joints. These aquifers are generally located in sedimentary basins that are continuous over large areas and may be tens or hundreds of metres thick. In terms of quantity, they contain the largest volumes of groundwater.
Shale	A laminated sedimentary rock in which the constituent particles are predominantly of clay size.
Siltstone	A fine-grained rock of sedimentary origin composed mainly of silt-sized particles (0.004 to 0.06 mm).

Stable isotope	Stable isotopes are atoms of the same element that have different masses due to differences in the number of neutrons they contain. Stable isotopes are not subject to radioactive decay, meaning they do not breakdown over time.
Standing water level (SWL)	The height to which groundwater rises in a bore after it is drilled and completed, and after a period of pumping when levels return to natural atmospheric or confined pressure levels.
Stratigraphy	The depositional order of sedimentary rocks in layers.
Surface water-groundwater interaction	This occurs in two ways: (1) streams gain water from groundwater through the streambed when the elevation of the water table adjacent to the streambed is greater than the water level in the stream; and (2) streams lose water to groundwater through streambeds when the elevation of the water table is lower than the water level in the stream.
Tertiary	Geologic time at the beginning of the Cainozoic era, 65 to 2.6 million years ago, after the Cretaceous and before the Quaternary.
Total Dissolved Solids (TDS)	A measure of the salinity of water, usually expressed in milligrams per litre (mg/L). See also EC.
Tritium (^{3}H)	A short-lived isotope of hydrogen with a half-life of 12.43 years. It is commonly used to identify the presence of modern recharge. Tritium is produced naturally in small amounts owing to the interaction of cosmic radiation with atmospheric oxygen and nitrogen in the troposphere, and is also produced by thermonuclear explosions.
Water quality	Term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.
Water quality data	Chemical, biological, and physical measurements or observations of the characteristics of surface and ground waters, atmospheric deposition, potable water, treated effluents, and waste water and of the immediate environment in which the water exists.
Well	Pertaining to a gas exploration well or gas production well.
Well control	The practices and methods used to prevent and/or manage the influx of formation fluids in the borehole (blowouts). This is often via the use of a BoP and drill muds.

Abbreviations

AGL	AGL Upstream Investments Pty Ltd
ANSTO	Australian Nuclear Science and Technology Organisation
ARTC	Australian Rail Track Corporation
BoM	Bureau of Meteorology
BoP	Blowout preventer
BTEX	Benzene, toluene, ethyl benzene and xylenes
CDFM	Cumulative deviation from mean
CEMP	Construction and Environment Management Plan
CGP	Camden Gas Project
CSG	Coal seam gas
DIC	Dissolved inorganic carbon
DRE	Division of Resources and Energy
DO	Dissolved oxygen
EC	Electrical Conductivity
GMWL	Global Meteoric Water Line
HESP	Health, Environment and Safety Plan
JSA	Job Safety Analyses
LMWL	Local Meteoric Water Line
LOR	Limit of reporting
NOW	NSW Office of Water
NUDLC	National Uniform Drillers Licencing Committee
ORP	Oxidation reduction potential
PAH	Polycyclic aromatic hydrocarbons
PEL	Petroleum Exploration Licence
PPE	Personal protective equipment
QA/QC	Quality assurance/quality control
SCA	Sydney Catchment Authority
SMP	Safety Management Plan

SWMS	Safe Work Method Statements
TDS	Total dissolved solids
TPH	Total recoverable hydrocarbons
VPDB	Vienna PeeDee Belemnite
VSMOW	Vienna Standard Mean Ocean Water

Units

°C	degrees Celsius
m	metres
mAHD	metres Australian Height Datum
mbgl	metres below ground level
mbtoc	metres below top of casing
mg/L	milligrams per litre
µg/L	micrograms per litre
mL	millilitres
ML/day	megalitres per day
µS/cm	microSiemens per centimetre
mV	millivolt
‰	per mil
pMC	percent modern carbon
TU	tritium unit
yrs BP	years before present

Executive Summary

AGL Upstream Investments Pty Ltd (AGL) owns and operates the Camden Gas Project (CGP) located in the Macarthur region, 65 km southwest of Sydney, NSW. The CGP has been producing natural gas from coal seams for the Sydney region since 2001 and currently consists of 144 gas wells (of which, approximately 96 were operational at June 2014). The target coal seams are the Bulli and Balgownie Coal Seams within the Illawarra Coal Measures at depths of approximately 550–700 m below ground level (mbgl).

This report details the completion of three nested groundwater monitoring sites (a combined total of 11 monitoring bores) within the CGP between October 2011 and February 2014. This drilling program comprised the establishment of one perched groundwater monitoring bore, one alluvial groundwater monitoring bore, one monitoring bore in the Triassic shale, and eight monitoring bores at different depths in the Hawkesbury Sandstone. Following the completion of each monitoring bore, in situ pressure transducers (dataloggers) were installed, hydraulic conductivity testing performed and baseline groundwater quality testing undertaken.

Initial groundwater level monitoring indicates groundwater level trends vary depending on the lithology, depth of the screened interval, and proximity to rainfall recharge:

- Denham Court site: groundwater levels are deep, around 80 mbgl in the Ashfield Shale and around 40 mbgl in the Hawkesbury Sandstone, and there is currently no apparent influence from rainfall.
- Menangle Park site: groundwater levels in the alluvium and Hawkesbury Sandstone are shallow (<10 mbgl) and all bores show a response to rainfall (decreasing with depth), which is also reflected in the river level.
- Glenlee site: groundwater levels in the Hawkesbury Sandstone are shallow (<15 mbgl) and there is currently no apparent influence from rainfall over the short monitoring period (three months). There is an apparent downward hydraulic gradient at this site.

Groundwater quality monitoring indicates:

- Denham Court site: groundwater within the Ashfield Shale is characterised as moderately saline. Dissolved metal concentrations are generally low. Dissolved gases were detected. Benzene and TPH were detected at low concentrations. No phenolic compounds or PAH were detected. Groundwater within the Hawkesbury Sandstone is characterised as slightly to moderately saline. Dissolved metal concentrations are generally low. Dissolved methane and ethane were detected. Toluene was detected at decreasing concentration over the monitoring period. Phenolic compounds and PAHs were generally not detected. Low concentrations of TPH were detected.
- Menangle Park site: groundwater within the alluvium and Hawkesbury Sandstone is characterised as fresh to marginal. Dissolved metal concentrations are generally low. Methane was detected in all monitoring bores except at MPMB01, with relatively low concentrations at MPMB02. Minor detections of hydrocarbons were present during at least one monitoring event at all monitoring bores.
- Glenlee site: groundwater within the Hawkesbury Sandstone is slightly saline. Dissolved metal concentrations are generally low. Dissolved methane, propane and ethene were detected in all bores. Phenol was detected at GLMB02 and GLMB03. Toluene, xylenes and TPH were detected.
- Groundwater in all monitoring bores is of meteoric origin and methane is of thermogenic origin. Isotope analysis indicates that the groundwater in the Ashfield Shale is 7,300 yrs BP and the Hawkesbury Sandstone ranges from 2,800 yrs BP (MPMB02) to >40,000 yrs BP (RMB02). The groundwater age does not always increase with depth, which is likely a result of preferential flow paths in relatively permeable (aquifer) versus less permeable (aquitard) layers within the multilayered system of sub-aquifers.

1. Introduction

AGL Upstream Investments Pty Ltd (AGL) owns and operates the Camden Gas Project (CGP) located in the Macarthur region, 65 km southwest of Sydney, NSW. The CGP has been producing natural gas from coal seams for the Sydney region since 2001 and currently consists of 144 gas wells (of which, approximately 96 were operational in June 2014) within the Stage 1 and Stage 2 areas. A proposal for the expansion of the project into Stage 3 (Northern Expansion) was suspended in 2013. The target coal seams are the Bulli and Balgownie Coal Seams within the Illawarra Coal Measures at depths of approximately 550–700 m below ground level (mbgl).

Parsons Brinckerhoff was engaged to investigate the hydrogeological environment. Groundwater investigations have progressed in two phases:

- Phase 1: desktop study to assess the groundwater in the CGP and develop a conceptual hydrogeological model (Parsons Brinckerhoff, 2011).
- Phase 2: field investigations and baseline monitoring.

This report presents the completion details for 11 monitoring bores constructed in the CGP area between October 2011 and February 2014 and the initial site data (water levels, water quality and isotopes) at each of the established sites up to May 2014. This work was carried out as part of the Phase 2 groundwater investigations.

1.1 Scope of works

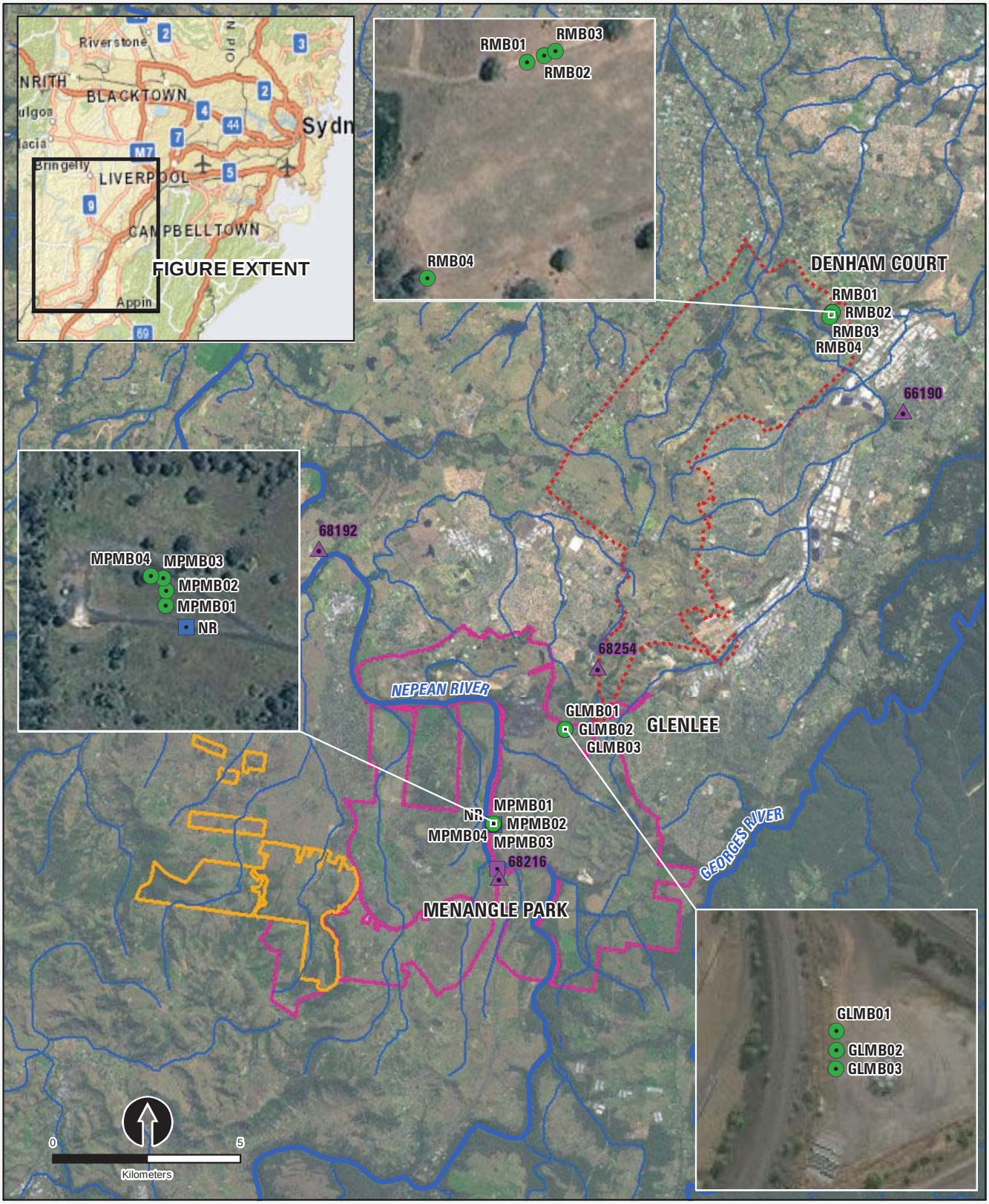
In 2011 AGL engaged Parsons Brinckerhoff to undertake Phase 2 groundwater investigations to confirm the likely conceptual model and connectivity (if any) of the different groundwater systems across CGP area. Installation of a dedicated water monitoring network and the collection of baseline water level and water quality attributes for each of the groundwater systems commenced in May 2011.

The investigations comprised the installation of a groundwater monitoring network of three nested sites (a combined total of 11 monitoring bores), and subsequent groundwater quality and level monitoring at AGL's Denham Court (four bores), Menangle Park (four bores) and Glenlee (three bores) sites (Figure 1.1). The objective of the drilling was to establish dedicated monitoring bores in the shallow unconsolidated material, the surface alluvium, the shallow Ashfield Shale aquifer, and the main water supply (Hawkesbury Sandstone) to characterise the water level and water quality of the shallow groundwater systems of the region, in areas within and remote from the currently operating CGP.

The CGP drilling program comprised:

- Establishment of one alluvial groundwater monitoring bore at one site (MPMB01), targeting the Nepean River alluvium.
- Establishment of one monitoring bore targeting (potential) perched groundwater , at one site (RMB04),
- Establishment of three nested groundwater monitoring sites throughout the project area targeting the first major water cuts in the Ashfield Shale (Denham Court site only) as well as the upper, middle and lower Hawkesbury Sandstone (two bores at the Denham Court site, three bores at the Menangle Park site and three bores at the Glenlee site).
- Installation of in situ pressure transducers (dataloggers) at groundwater monitoring bores.
- Hydraulic conductivity testing (rising and falling head tests) at all groundwater monitoring bores with sufficient water across the screen.

- Baseline groundwater quality testing, including: field parameters, major cations and anions, dissolved metals, nutrients, dissolved methane, hydrocarbons and isotopes.
- A report outlining the construction details for the monitoring bores and initial results of water quality and water level monitoring.



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Camden Gas Project areas

- Stage 1
- Stage 2
- Proposed Stage 3 – application suspended

- Groundwater monitoring bore
- Surface water sampling location
- BoM weather station
- BoM surface water gauging station
- Rivers
- Streams

Figure 1.1: Groundwater monitoring locations – Camden Gas Project

2. Site characterisation

2.1 Site locations and topography

All three sites are located within the Camden-Campbelltown area, NSW, within the CGP area (Stage1, 2 and 3 – **Error! Reference source not found.**). The Denham Court site is located to the north, outside of the existing CGP area, and the Menangle Park and Glenlee sites are located within the existing CGP wellfield. The region consists of broad river-flat floodplains, gently undulating hills (typically <5%), ridgelines, and a small number of steep slopes (Hazelton and Tille, 1990).

2.1.1 Denham Court

The Denham Court site is located on private property on Denham Court Road, Denham Court. Three bores are located in an open paddock along the north-western boundary (RMB01, RMB02 and RMB03). One monitoring bore (RMB04) is located in the south western corner of the paddock. The main site dips towards the south west and is surrounded by undulating hills. The approximate elevation of the Denham Court site is 73 metres to Australian Height Datum (mAHD).

2.1.2 Menangle Park

The Menangle Park site is located on the eastern side of the Nepean River, south west of Menangle Park Paceway. The site dips moderately to the west towards the river and has an approximate elevation of 66 mAHD. The Menangle Park site is located approximately 40 m to the east of two of AGL's CGP operating coal seam gas (CSG) wells.

2.1.3 Glenlee

The Glenlee site is located within the Australian Rail Track Corporation (ARTC) rail corridor, between two siding lines and the main Southern Highlands rail line. The site dips to the south and the area is surrounded by a gently undulating landscape. The monitoring bores are located along the western boundary of the ARTC site. The site has an elevation of approximately 86 mAHD. The Glenlee site is located approximately 30 m east of three CSG wells (of which two are currently operating and one is suspended).

2.2 Surface hydrology

The CGP straddles two catchment areas: the Hawkesbury Nepean Catchment and the Sydney Metropolitan Catchment.

The major surface hydrology features in the CGP are the Nepean River and tributaries, which meanders in a south to north direction, within the project area and the Georges River, which flows north-east, to the south-east of the project area.

An open gravity water supply canal, part of the Upper Canal system, runs across the centre of the suspended Northern Expansion area. The Upper Canal is a system of canals, aqueducts and tunnels built between 1880 and 1888 to transfer up to 680 megalitres per day (ML/day) from the Metropolitan dams to Prospect Reservoir, supplying several localities en route. It is lined for the most part by dry rubble masonry, concrete or rubble cement and remains in good condition. The canal system is currently operated by the Sydney Catchment Authority (SCA) and remains an important component of the Sydney bulk water supply. A groundwater resource drilling investigation carried out adjacent to the Upper Canal just west of Appin by the SCA (SCA, 2005) identified minor seepage at shallow depths due to leakage from the canal system.

Small farm dams are common in the non-urban areas to provide water for stock, and irrigation purposes on gardens and rural lands. Dams are replenished by rainfall and runoff, although some seepage flow through weathered soil profiles occurs after long wet periods. Dams and seepage flows are not related to the regional groundwater systems. There are no known springs in the project area.

2.3 Land use

The majority of the land holdings in the CGP area are privately owned. The land uses include rural and agricultural, and urban and industrial (e.g. coal washery).

2.4 Rainfall

The nearest Bureau of Meteorology (BoM, 2014) weather station, with consistent climate measurements, is located at Camden Airport (BoM site number 68192), approximately 4 km south west of the suspended Northern Expansion Area. Mean temperatures at Camden Airport range from 17.2°C in July to 29.4°C in January (based on records from 1971 to 2013). The average annual rainfall is 788.1 mm (based on records from 1943 to 2013). On average, July receives the least rain, with a mean rainfall of 37.9 mm, while February receives the most rain, with a mean of 101.6 mm. A BoM weather station with shorter climate measurements is present in the vicinity of each groundwater monitoring site:

- Denham Court: 066190 Ingleburn station
- Menangle Park: 068216 Menangle Bridge
- Glenlee: 068254 Mount Annan Botanic Garden

Rainfall data from these weather stations are used in the analysis of the groundwater levels in Section 5.

2.5 Geological setting

The CGP is part of the Southern Coalfields of the Sydney Geological Basin. The Basin is primarily a Permo-Triassic sedimentary rock sequence (Parkin, 2002) and is underlain by undifferentiated sediments of Carboniferous and Devonian age. The stratigraphy of the CGP in the Camden-Campbelltown area is summarised in Table 2.1.

The Illawarra Coal Measures is the economic sequence of interest for CSG development in the area, and consists of interbedded sandstone, shale and coal seams, with a thickness of approximately 300 m. The upper sections of the Permian Illawarra Coal Measures (Sydney Subgroup) contain the major coal seams: Bulli Coal Seam, Balgownie Coal Seam, Wongawilli Coal Seam, and Tongarra Coal Seam. The primary seams targeted for CSG production are the Bulli and Balgownie Coal Seams, both of which are approximately 2-5 m thick within the CGP.

The Illawarra Coal Measures are overlain by the Triassic sandstones, siltstones and claystones of the Narrabeen Group and the Hawkesbury Sandstone. Overlying the Hawkesbury Sandstone is the Triassic Wianamatta Group which comprises the majority of the surficial geology (where thin alluvial deposits are not present).

Structurally, the CGP area and surrounds are dominated by the north-northeast plunging Camden Syncline, which is a broad and gentle warp structure (Alder *et al.*, 1991 and Bray *et al.,* 2010). The Camden Syncline is bounded in the west and truncated in the southwest by the north-south trending Nepean Structural Zone, part of the Lapstone Structural Complex.

The CGP is relatively unaffected by major faulting apart from a set of NW-NNW trending faults associated with the Lapstone Monocline Structure (Alder *et al.*, 1991 and Blevin *et al.*, 2007). These faults have been

identified from exploration and 2D seismic studies as high-angle, low to moderate displacement normal faults (Blevin *et al.,* 2007). Many of these features intersect coal seams but very few, if any, affect the entire stratigraphic sequence displaying no expression at surface.

Table 2.1 Summary of regional Permo-Triassic geological stratigraphy

Period	Group	Sub-group	Formation	Description	Average thickness (m)[a]
Quaternary			Alluvium	Quartz and lithic 'fluvial' sand, silt and clay.	<20
Tertiary			Alluvium	High level alluvium.	
Triassic	Wianamatta Group		Bringelly Shale	Shale, carbonaceous claystone, laminate, lithic sandstone, rare coal.	80 (top eroded)
			Minchinbury Shale	Fine to medium-grained lithic sandstone.	
			Ashfield Shale	Black to light grey shale and laminate (Bembrick *et al*., 1987).	
			Mittagong Formation	Dark grey to grey alternating beds of shale laminate, siltstone and quartzose sandstone (Alder *et al.,* 1991).	11
			Hawkesbury Sandstone	Massive or thickly bedded quartzose sandstone with siltstone, claystone and grey shale lenses up to several metres thick (Bowman, 1974; Moffitt, 2000).	173
	Narrabeen Group	Gosford Sub-group	Newport Formation	Fine-grained sandstone (less than 3 m thick) interbedded with light to dark grey, fine-grained sandstones, siltstones and minor claystones (Bowman, 1974).	35
			Garie Formation	Cream, massive, kaolinite-rich pelletal claystone, which grades upwards to grey, slightly carbonaceous claystone containing plant fossils at the base of the Newport Formation (Moffitt, 2000).	8
		Clifton Subgroup	Bald Hill Claystone	Massive chocolate coloured and cream pelletal claystones and mudstones, and occasional fine-grained channel sand units (Moffitt, 2000).	34
			Bulgo Sandstone	Thickly bedded sandstone with intercalated siltstone and claystone bands up to 3 m thick (Moffitt, 2000).	251
			Stanwell Park Claystone	Red-green-grey shale and quartz sandstone (Moffitt, 1999).	36
			Scarborough Sandstone	Quartz-lithic sandstone, pebbly in part (Moffitt, 1999).	20
			Wombarra Claystone	Grey shale and minor quartz-lithic sandstone (Moffitt, 1999).	32
Permian	Illawarra Coal Measures	Sydney Subgroup	Bulli Coal Seam	Coal interbedded with shale, quartz-lithic sandstone, conglomerate, chert, torbante seams and occasionally carbonaceous mudstone (Moffitt, 2000).	4
			Loddon Sandstone		12
			Balmain Coal Member		24
			Balgownie Coal Seam		2

Period	Group	Sub-group	Formation	Description	Average thickness (m)[a]
			(Remaining Sydney Subgroup)		?
		Cumberland Subgroup			-
	Shoalhaven Group			Sandstone, siltstone, shale, polymictic conglomerate, claystone; rare tuff, carbonate, evaporate.	-
Palaeozic	Lachlan Fold Belt			Intensely folded and faulted slates, phyllites, quartzite sandstones and minor limestones of Ordovician to Silurian age (Moffitt, 2000).	-

(a) Average thickness from available information on all wells within CGP (AGL, 2013a).

2.6 Hydrogeological setting

The Southern Coalfield is located within the Sydney Basin sedimentary rock groundwater system.

Alluvium occurs along the floodplain of the Nepean River and its tributaries. The alluvium deposits are generally thin, discontinuous (except along the Nepean River) and relatively permeable. The unconfined aquifers within the alluvium are responsive to rainfall and stream flow and form a minor beneficial aquifer.

The Ashfield Shale (which outcrop across the majority of the CGP) is generally of low permeability and yield; however small aquifer zones are sometimes present. Water is typically brackish to saline, especially in low relief areas of western Sydney (due to the marine depositional environment of the shales) (Old,1942). Average bore yields are 1.3 litres per second (L/s) (AGL, 2013a).

The Hawkesbury Sandstone and Narrabeen Group form part of an extensive partially confined to confined, regional aquifer system within the Sydney Basin sequence. The Hawkesbury Sandstone is more widely exploited for groundwater than the overlying and underlying formations, being of generally higher yield, better water quality and either outcropping or buried to shallow depths over the basin. Groundwater flow within the Hawkesbury Sandstone and Narrabeen Group aquifers at a regional scale has a major horizontal component, due to the alternation of sheet and massive facies, with some vertical leakage. The Hawkesbury Sandstone and Narrabeen Group are characterised by dual porosity, whereby the primary porosity is imparted by connected void space between sand grains and the secondary porosity is due to the interconnected rock defects such as joints, fractures, faults and bedding planes. Superior bore yield in the sandstone aquifers is often associated with major fractures or a high fracture zone density, and yields of up to 40 L/s have been recorded in bores intercepting these zones within deformed areas of the Sydney Basin (McLean and Ross, 2009). Typically within the CGP area, bore yields rarely exceed 2 L/s (SCA, 2007 and Ross, 2014).

There are a lack of major fracturing and fault systems intersecting the Hawkesbury Sandstone within the CGP. Yields in the Hawkesbury Sandstone are highest and salinities are freshest south of the Nepean River due to the proximity to recharge areas. North of the Nepean River, the groundwater within the Hawkesbury Sandstone has a higher salinity, becoming moderately saline. Groundwater is used for irrigation and domestic use to the south and immediately to the north of the Nepean River; however, further north of the river, groundwater quality is typically only suitable for stock (AGL, 2013a).

The coal seams present in the Illawarra Coal Measures are both regionally and locally minor water bearing zones. Due to the greater depth of burial of the coal measures and fine-grained nature of the sedimentary rocks, the permeability is generally lower than the overlying sandstone aquifers. Recharge to the Permian

water bearing zones is likely to occur where the formations are outcropping, which is remote (and to the south) to the CGP. Salinity of the water bearing zones is typically brackish to moderately saline.

Within the CGP, there is limited rainfall recharge to the Ashfield Shale with most rainfall generating runoff and overland flow. Some leakage through the Ashfield Shale into the Hawkesbury Sandstone is expected where there is adequate fracture spacing, however, it is anticipated that most recharge to the sandstone aquifers occurs via lateral groundwater through-flow from upgradient and updip areas to the south. There is insufficient data within the CGP to define local flow paths and natural discharge zones; however, regionally, groundwater flow is predominantly towards the north or northeast, eventually discharging via the Georges, Parramatta or Hawkesbury River systems, and ultimately offshore to the east. Recharge to the Permian water bearing zones is likely to occur where the formations are outcropping, which is remote (and to the south) from the CGP. Locally, there may be a small base flow or interflow discharge component to local stream headwaters during wet periods; however groundwater-surface water interactions are not well defined within the area (Parsons Brinckerhoff, 2011).

3. Drilling program

Parsons Brinckerhoff was the Principal Contractor for the entire site investigation program and provided project management services and management of subcontractors.

3.1 Health, safety and environment

Onsite health, safety and environmental risks were managed through a health, environment and safety plan (HESP) (Parsons Brinckerhoff, 2013b), construction and environment management plan (CEMP) (Parsons Brinckerhoff, 2013c), and safety management plan (SMP) (Parsons Brinckerhoff, 2013d); these documents were prepared in advance of the drilling program and were reviewed and approved by AGL's safety team. Highland Drilling (nominated drilling contractors for the works) provided safe work methods statements (SWMS) (Highland Drilling, 2013a) and job safety analyses (JSA) (Highland Drilling, 2013b) covering works relating to the drilling and construction of the boreholes; these documents were also reviewed and approved by AGL.

All Highland Drilling and Parsons Brinckerhoff staff and site visitors were required to undergo a drill site induction during which they were given an overview of the commitments included in the HESP, SMP and CEMP and how these applied to their specific duties.

3.1.1 Health, environment and safety plan

Parsons Brinckerhoff developed a comprehensive site specific HESP for the supervision of drilling work and groundwater monitoring activities at the Camden sites: *Health, Environment and Safety Plan (HESP) AGL – Camden Gas Project* (Parsons Brinckerhoff, 2013b). This plan details the planned field tasks and the associated risk, and introduced risk mitigation measures to manage the risks. Measures include: risk elimination, substitution and implementation of controls, training and use of personal protective equipment (PPE).

3.1.2 Safety management plan

The installation of the monitoring bores was conducted in accordance with the SMP which was developed by Parsons Brinckerhoff in collaboration with Highland Drilling and approved by AGL (Parsons Brinckerhoff, 2013c). The SMP should be read in conjunction with the following AGL and Highland Drilling documents which together cover the health, safety and environmental working procedures for AGL's CGP:

- Upstream Gas Golden Rules (AGL, 2010).
- Health and Safety Management Plan Camden Project NSW (AGL, 2012b).
- Emergency Response Plan for AGL Camden Gas Project (AGL, 2011).
- Standard Work Method Statement and Risk Analysis - Camden Gas Project, Groundwater Investigations (Highland Drilling, 2013a).
- Job Safety Analysis – Camden Gas Project, Groundwater Investigations (Highland Drilling, 2013b).

All fieldwork undertaken at the Camden drill sites was covered by the aforementioned documents including subsequent testing, and groundwater monitoring and sampling. These documents aim to ensure that the health, safety and welfare of Parsons Brinckerhoff employees and subcontractors are upheld through systematically identifying and documenting hazards, and assessing and controlling the associated risks.

Prior to the commencement of the field program, a desktop risk assessment for the drilling and construction of each borehole was undertaken, as per the requirements of the SMP. Taking into consideration the

borehole depth and the likely strata to be drilled through (i.e. faults and/or producing coal seams) the bores were assessed to be medium or low risk. The risk rating determines the construction method and level of well control required (i.e. the practices used to prevent and/or manage the influx of formation fluids/gas in the borehole (blowouts)). This is often via the use of a Blowout Preventer (BoP) and drill muds. No monitoring bores were assessed to be high risk at the time therefore no BoP was required while drilling.

3.1.3 Construction and environment management plan

All site operations were undertaken in accordance with the environmental management systems as detailed in the site specific CEMP (Parsons Brinckerhoff, 2013c).

A detailed water management plan was a critical part of the CEMP detailing the control measures for the management of produced (drilling) waters and elimination of discharges to adjacent land and surface water receivers. To assist in managing the reuse of lower salinity groundwater and the disposal of higher salinity groundwater and drilling mud, a water management plan was prepared. To mitigate potential environmental impacts, AGL's water management plan (AGL, 2012a and 2013b) was implemented as part of the CEMP site activities as follows:

- All water utilised during the drilling process was supplied by AGL.
- All groundwater produced during the drilling operations was contained in above ground storage tanks. If the capacity of the tanks reached 80%, work on that bore ceased until excess water levels in the tanks could be reduced.
- The water management plan, allowed for the reuse and disposal of groundwater generated during air rotary drilling onsite:
  - if the electrical conductivity (EC) was below 3,000 µS/cm, water could be directly used for dust suppression or used in farm dams within the same property
  - if the EC was between 3,000 and 6,000 µS/cm, water could be discharged to farm dams located off the floodplain (within the same property), and could only be used for dust suppression onsite if blended with other waters to ensure that the EC was below 3,000 µS/cm
  - any produced water with an EC greater than 6,000 µS/cm could be transported offsite to a wastewater recycling facility.
- All cuttings produced during drilling were also contained in above ground tanks and were dried and used for internal farm track maintenance (AGL, 2012a and 2013b).

Water from the drill pads and access tracks constructed was diverted away by sand bag bunds, silt fencing, and other control structures so as to direct water onto adjacent grassed areas and not erode the drill pads, fire trail and track areas.

3.1.4 Wellsite Permit to Work System

The internationally recognised Wellsite Permit to Work System (www.wellsite.org.au) was utilised in the CGP groundwater drilling program. The system provides the means to manage field safety aspects in a systematic, formalised and auditable manner. As a standardised work planning mechanism, the Wellsite Permit to Work System was used for all non-routine tasks where a health and safety plan did not exist (including hot works), thus forcing the individual to undertake a documented work plan and assessment of the risks.

3.2 Groundwater monitoring bore drilling and construction

Between October 2011 and February 2014, 11 groundwater monitoring bores were drilled and constructed in the CGP area. Test (monitoring bore) licences under the Water Act 1912 were obtained by AGL prior to the monitoring bore drilling program (Table 3.1).

The drilling and completion of the groundwater monitoring bores was carried out in accordance with the NSW Office of Water (NOW) bore licence conditions and followed a detailed design and specification compliant with the *National Uniform Drillers Licencing Committee (NUDLC) 2012, Minimum Construction Requirements for Water Bores in Australia, Edition 3.*

Table 3.1 Monitoring bore licences

NOW Licence No.	No. of bores	Local bore ID	Site location	Lot	DP	Bore type	Construction date
10BL604845	3	RMB01 RMB02 RMB03	Denham Court	23	585290	Monitoring	October 2011
10BL605381	1	RMB04	Denham Court	23	585290	Monitoring	June 2013
10BL605366	4	MPMB01 MPMB02 MPMB03 MPMB04	Menangle Park	10	1022204	Monitoring	May - June 2013
10BL605472	3	GLMB01 GLMB02 GLMB03	Glenlee	12	1041381	Monitoring	February 2014

The drilling of all bores was undertaken by Highland Drilling, using a rotary drilling rig under the supervision of a Parsons Brinckerhoff hydrogeologist. The target depth of all boreholes was confirmed by the supervising Parsons Brinckerhoff hydrogeologist.

The following sub-sections provide a summary of the ground conditions encountered at each site. Table 3.2 summarises the bore drilling and construction details. The geological bore logs for each monitoring bore are presented in Appendix A.

Table 3.2 Groundwater monitoring bore drilling and construction details

Monitoring bore	Borehole diameter (mm)	Predominant drill bit	Depth of surface casing (mbgl)	Total depth (mbgl)	Screened interval (mbgl)	Screened interval (mAHD)	Screened formation	Lithology	Construction details
RMB01	140	Down hole hammer	5.5	84.0	69.0 – 81.0	3.4 – -8.6	Wianamatta Group, Ashfield Shale	Siltstone	50 mm class 18 uPVC, screwed casing
RMB02	140	Down hole hammer	5.5	150.0	135.0 – 147.0	-62.2 – -74.2	Upper Hawkesbury Sandstone	Sandstone	50 mm class 18 uPVC, screwed casing
RMB03	140	Down hole hammer	5.4	300.0	290.0 – 299.0	-217.0 – -226.0	Lower Hawkesbury Sandstone	Sandstone	50 mm galvanised / stainless steel, screwed casing
RMB04	102	Auger	2.0	8.5	4.5 – 7.5	57.4 – 54.4	Wianamatta Group, Ashfield Shale	Clay / siltstone	50 mm class 18 uPVC, screwed casing
MPMB01	203	Blade	5.0	18.5	10.0 – 16.0	56.7 – 50.7	Nepean alluvium	Clay	50 mm class 18 uPVC, screwed casing
MPMB02	140	Down hole hammer	18.0	42.0	27.4 – 39.4	39.2 – 27.2	Upper Hawkesbury Sandstone	Sandstone	50 mm class 18 uPVC, screwed casing
MPMB03	140	Down hole hammer	19.0	108.5	97.0 – 106.0	-30.6 – -39.6	Middle Hawkesbury Sandstone	Sandstone	50 mm class 18 uPVC, screwed casing
MPMB04	140	Down hole hammer	19.0	192.6	182.6 – 191.6	-116.4 – -125.4	Lower Hawkesbury Sandstone	Sandstone	50 mm galvanised / stainless steel, screwed casing
GLMB01	127	Polycrystalline Diamond	10.0	102.2	87.0 – 99.0	-0.9 – -12.9	Upper Hawkesbury Sandstone	Sandstone	50 mm class 18 uPVC, screwed casing
GLMB02	140	Down hole hammer	5.5	190.3	168.0 – 180.0	-81.9 – -93.9	Middle Hawkesbury Sandstone	Sandstone	50 mm galvanised / stainless steel, screwed casing
GLMB03	127	Polycrystalline Diamond	9.3	228.3	212.0 – 224.0	-126 – -138.1	Lower Hawkesbury Sandstone	Sandstone	50 mm galvanised / stainless steel, screwed casing

mbgl = metres below ground level; mAHD = metres Australian Height Datum.

3.2.1.1 Denham Court site

- Triassic shale monitoring bore: RMB01 intersected weathered clay and grey to dark grey siltstone and some minor very fine to fine grained sandstone. A minor groundwater seep was encountered.
- Triassic sandstone monitoring bores: the Ashfield Shale was encountered from ground level to approximately 90 mbgl, followed by the Mittagong Formation from 90 mbgl and the Hawkesbury Sandstone from 96 mbgl in both monitoring bores. The Hawkesbury Sandstone is characterised by very fine to coarse grained quartz sandstone varying in colour, with interbedded siltstone and finer grained sandstone and shale lenses. Groundwater was encountered in the Hawkesbury Sandstone (starting at approximately 108 - 114 mbgl) and minimal flows were recorded throughout (a maximum value of 0.9 L/s when airlifting at RMB03). No fractures were encountered during drilling and therefore groundwater flow is assumed to be via primary permeability.
- RMB04 intersected highly weathered soil and clay, and fresh shale at the base of the bore. No groundwater was intersected during drilling

3.2.1.2 Menangle Park

- Quaternary alluvial monitoring bore: MPMB01 intersected a deep soil horizon with increasing clay content with depth and weathered clay and coarse gravel at the base of the borehole. Groundwater was not encountered during drilling.
- Triassic sandstone monitoring bores: the Quaternary alluvium was encountered to 18 mbgl, followed by the Mittagong Formation up to approximately 25 mbgl. The Ashfield shale was minimal or absent at the Menangle Park site. The Hawkesbury Sandstone was typically intersected at 25 mbgl and typically ranged from very fine to coarse grained quartz sandstone, usually white to light-medium grey in colour, with some darker grey interbedded siltstone and finer grained shale lenses. Groundwater was first encountered at approximately 42-60 mbgl and flows were up to 14.3 L/s when airlifted (MPMB04 at approximately 100 mbgl).

3.2.1.3 Glenlee site

- Triassic sandstone monitoring bores: groundwater was encountered in the Hawkesbury Sandstone from 78 mbgl and flows were up to 2.9 L/s (GLMB03 at approximately 210 mbgl).

3.2.2 Airlifting

Airlift development was continuous during drilling and the boreholes were further developed at termination until the discharge water was free of sediment and the water quality field parameters stabilised.

3.2.3 Logging

A detailed geological log of the lithology recorded at one metre intervals was produced, and instantaneous water flow was recorded at the end of each drill rod (every 6 m) where applicable. Water quality field parameters measured (using a calibrated YSI water quality meter) were: pH, EC, temperature, total dissolved solids (TDS), dissolved oxygen (DO) and oxidation reduction potential (ORP). These parameters are shown on the geological bore logs provided for each monitoring bore in Appendix A.

3.2.4 Borehole construction

Following drilling of the bores to the target depth/formation, a Parsons Brinckerhoff hydrogeologist finalised the specifications and design of the groundwater monitoring bore installations in consultation with an AGL hydrogeologist (Table 3.2 and Figure 3.1).

The screen length in all bores targeted the most productive water bearing zone. A washed and graded (3 - 5 mm) gravel filter pack was installed in the annulus around the screen and extended 1.5 - 5 m above the screened section in all bores. Coated bentonite pellets were then installed above the gravel pack (2 - 3 m thick). The bentonite seal ensures hydraulic isolation of the screened section preventing any flow of groundwater through the annulus of the bore column. The annulus was then backfilled or grouted to surface from the bentonite seal (Appendix A).

Following the construction of each bore, the site was reinstated and a lockable steel monument welded over the bores and surrounded at its base by a concrete slab.

3.2.5 Survey

The groundwater monitoring bore locations were surveyed by registered surveyors (SMEC Pty Ltd) to Map Grid of Australia (MGA), a UTM grid coordinate system based on the Geocentric Datum of Australia 1994. The bores were also surveyed for surface elevation to AHD. The survey results are detailed in Table 3.3.

Table 3.3 Monitoring bore coordinates and elevations

Monitoring Bore	Survey date	Easting[a]	Northing[a]	Ground level (mAHD)	Top of casing (mAHD)
RMB01	09/03/2012	300465.860	6237305.080	72.420	72.940
RMB02	09/03/2012	300474.930	6237308.700	72.800	73.340
RMB03	09/03/2012	300481.290	6237310.920	73.000	73.540
RMB04	12/07/2013	300412.627	6237189.692	61.926	62.463
MPMB01	12/07/2013	291426.371	6223648.178	66.672	67.196
MPMB02	12/07/2013	291426.853	6223656.095	66.626	67.129
MPMB03	12/07/2013	291425.335	6223662.800	66.418	66.971
MPMB04	12/07/2013	291418.472	6223664.149	66.203	66.912
GLMB01	11/05/2014	293339.716	6226185.480	86.143	86.628
GLMB02	11/05/2014	293339.606	6226177.342	86.051	86.603
GLMB03	11/05/2014	293339.428	6226169.251	85.887	86.435

(a) Grid system: MGA56.

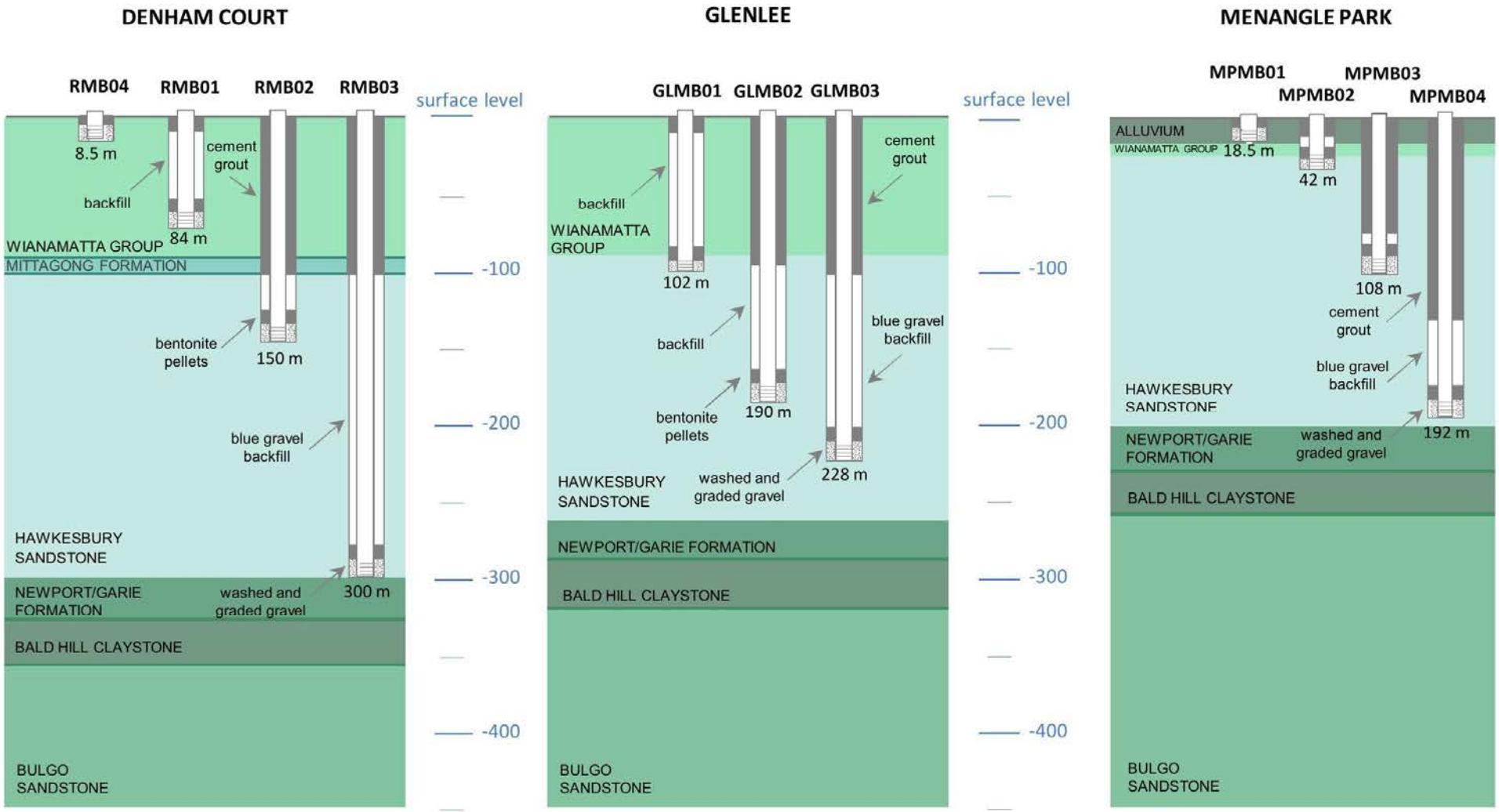

Figure 3.1 Nested groundwater monitoring bores at the Denham Court, Glenlee and Menangle Park sites

4. Permeability testing

Falling and rising head ('slug') tests were conducted at all new monitoring bores to estimate the horizontal hydraulic conductivity of each screened water bearing zone. Hydraulic conductivity is the permeability of the formation with respect to the porous flow of water.

A falling head test is achieved by introducing a volume of water or solid 'slug' to displace the water column within the monitoring bore causing the water level to instantaneously rise and flow from the bore into the aquifer via the screen. A rising head test is the opposite, where a volume of water (or a solid slug) is instantaneously removed from the groundwater monitoring bore, causing the water level to fall, drawing water into the bore from the aquifer. The time it takes for the water level in the bore to recover to pre-test levels is related to the permeability of the host formation. Rising and falling head tests sometimes produce slightly different results and therefore each bore is tested three times (falling, rising, then falling again).

At the commencement of the test, the standing water level (SWL) was measured from a fixed reference point at the top of casing and the datalogger programmed between 0.125 second to 1 second intervals to measure rapid changes in water level within the bore.

Test data were processed and analysed using the appropriate Bouwer and Rice (Bouwer 1989), or Hvorslev (1951) method with AQTESOLV Version 4.5. Results are presented as estimates of hydraulic conductivity (as m/day) in Table 4.1. The AQTESOLV reports are included in Appendix B.

Table 4.1 Hydraulic conductivity estimates

Monitoring bore	Screened section (mbgl)	Lithology	Formation	Hydraulic conductivity (m/day)
RMB01	69.0 – 81.0 (12 m)	Siltstone	Wianamatta Group - Ashfield Shale	Insufficient water across screen to test
RMB02	135.0 – 147.0 (12 m)	Sandstone	Upper Hawkesbury Sandstone	0.0009 - 0.0016
RMB03	290.0 – 299.0 (9 m)	Sandstone	Lower Hawkesbury Sandstone	Insufficient water across screen to test
RMB04	4.5 – 7.5 (3 m)	Clay / siltstone	Wianamatta Group - Ashfield Shale	Insufficient water across screen to test
MPMB01	10.0 – 16.0 (6 m)	Clay	Alluvium	0.15
MPMB02	27.4 – 39.4 (12 m)	Sandstone	Upper Hawkesbury Sandstone	0.05 – 0.06
MPMB03	97.0 – 106.0 (9 m)	Sandstone	Middle Hawkesbury Sandstone	0.69
MPMB04	182.6 – 191.6 (9 m)	Sandstone	Lower Hawkesbury Sandstone	0.005
GLMB01	87.0 – 99.0 (12 m)	Sandstone	Upper Hawkesbury Sandstone	0.007 – 0.013
GLMB02	168.0 – 180.0 (12 m)	Sandstone	Middle Hawkesbury Sandstone	0.01 – 0.02
GLMB03	212.0 – 224.0 (12 m)	Sandstone	Lower Hawkesbury Sandstone	0.006

5. Groundwater levels

This section presents the initial baseline groundwater level monitoring results. Hydrographs showing groundwater levels and rainfall from the start of monitoring until the end of May 2014 are presented in Figure 5.1, Figure 5.2 and Figure 5.3. Individual hydrographs for each monitoring bore are included in Appendix C.

The hydrographs for each site are plotted with rainfall from the closest BoM weather station data (Denham Court: 066190 Ingleburn station, Menangle Park: 068216 Menangle Bridge and Glenlee: 068254 Mount Annan Botanic Garden). Data from the BoM stream gauge located at 068216 are also presented for comparison with the Menangle Park monitoring bores site. The gauge is located approximately 1 km to the south of the MPMB site and should be used for trend comparison only (Figure 5.2).

Following the completion of each monitoring bore, *in situ* pressure transducers (Solinist Levelogger (M30) dataloggers) were suspended from a galvanised steel wire in the water column and programmed to record a groundwater level every six hours. To verify the level recorded by the dataloggers, manual measurements are recorded quarterly using an electronic dip meter.

Barometric loggers installed above the water table at monitoring bores RMB01 and MPMB01 record changes in atmospheric pressure. Data from these loggers are used to correct for the effects of changing barometric pressure on water levels in the monitoring bores. Initial manual groundwater level measurements following bore installation are presented in Table 5.1. Groundwater level monitoring is continuing and was reviewed in the 2013-2014 Groundwater and Surface Water Monitoring Status Report issued in October 2014 (Parsons Brinckerhoff, 2014d).

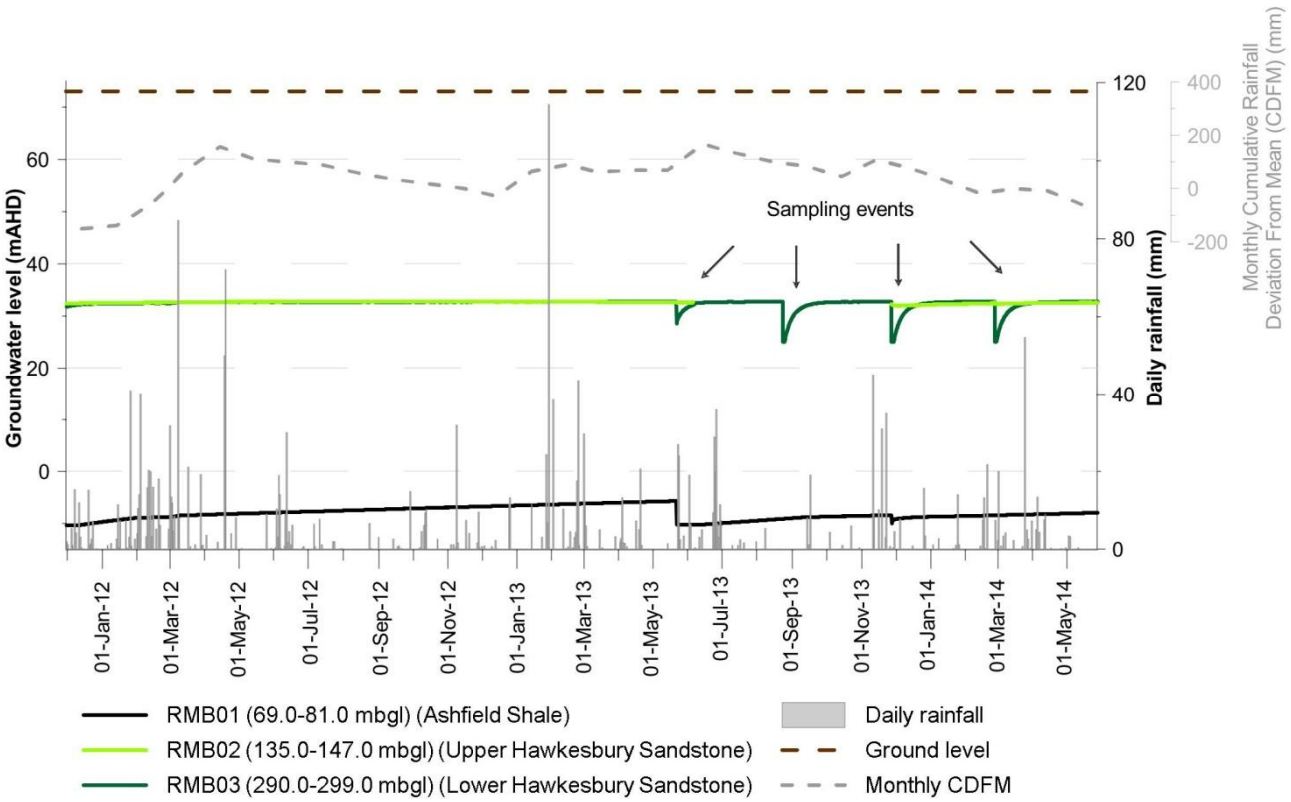

Figure 5.1 Groundwater levels at the Denham Court site

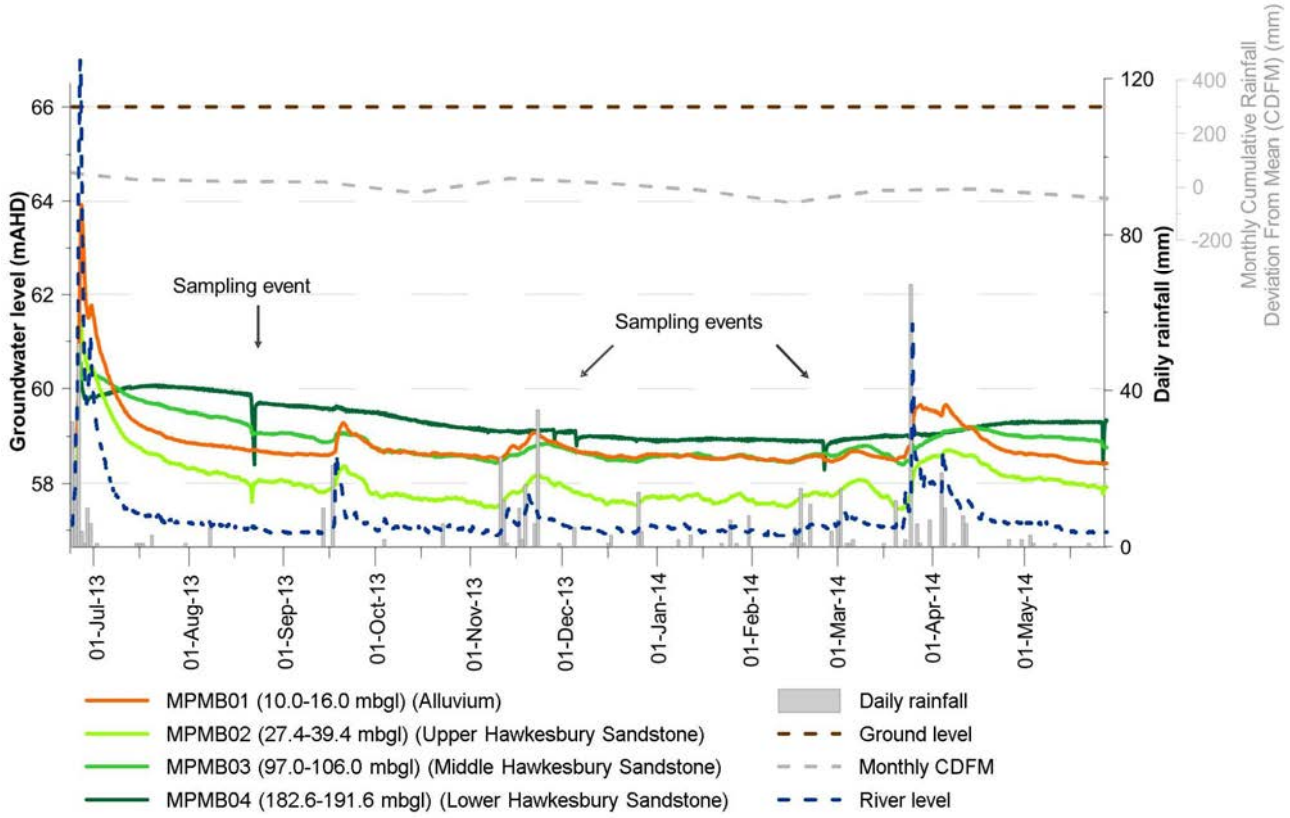

Figure 5.2 Groundwater levels and Nepean river levels at the Menangle Park site

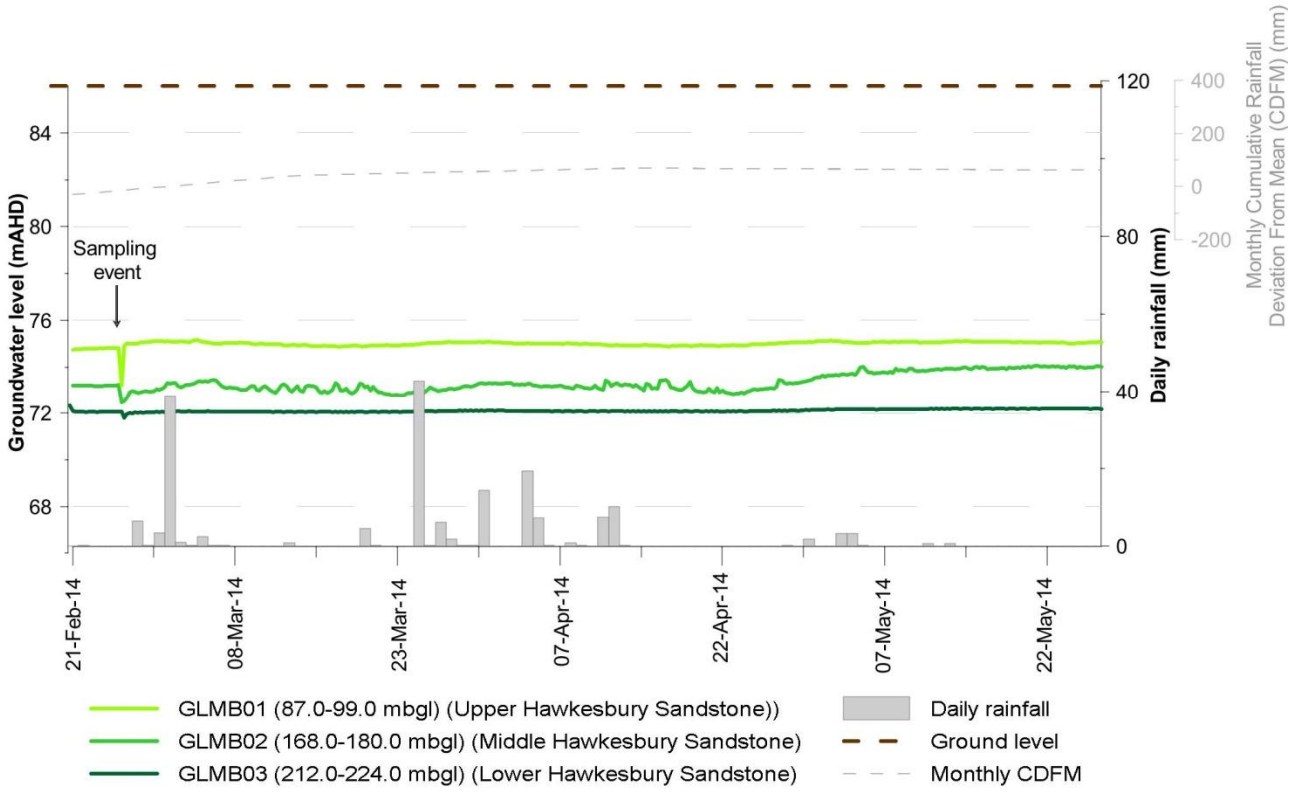

Figure 5.3 Groundwater levels at the Glenlee site

Table 5.1 Initial manual groundwater levels at Camden Gas Project monitoring bores

Monitoring bore	Date	Formation	Ground elevation (mAHD)	Groundwater level (mbtoc)	Groundwater level (mAHD)
RMB01	01/11/2011	Wianamatta Group, Ashfield Shale	72.42	81.23	-8.29
RMB02	01/11/2011	Upper Hawkesbury Sandstone	72.80	41.33	32.01
RMB03	01/11/2011	Lower Hawkesbury Sandstone	73.00	41.25	32.29
RMB04	24/06/2013	Wianamatta Group, Ashfield Shale	61.93	dry	dry
MPMB01	24/06/2013	Alluvium	66.67	8.93	58.27
MPMB02	24/06/2013	Upper Hawkesbury Sandstone	66.63	9.28	57.85
MPMB03	24/06/2013	Middle Hawkesbury Sandstone	66.42	8.36	58.61
MPMB04	24/06/2013	Lower Hawkesbury Sandstone	66.20	9.95	56.96
GLMB01	19/02/2014	Upper Hawkesbury Sandstone	86.14	11.92	74.71
GLMB02	19/02/2014	Middle Hawkesbury Sandstone	86.05	12.82	73.78
GLMB03	19/02/2014	Lower Hawkesbury Sandstone	85.89	14.36	72.08

5.1 Denham Court site

The groundwater level at RMB01 in the Ashfield Shale has been monitored since November 2011. The groundwater level is deep (~80 mbgl) and shows no apparent influence from rainfall over the monitoring period (Figure 5.1).

A gradual increase in the groundwater level (~4.75 m) is observed between November 2011 and May 2013. A sudden fall in groundwater level (~4.45 m) at the end of May 2013 is the result of the quarterly sampling event, when the bore was purged dry. The slow recovery from purging (~0.01 m in 15 days) indicates that the Ashfield Shale has very low permeability.

Groundwater levels at RMB02 and RMB03 in the Hawkesbury Sandstone at the Denham Court site have been monitored since November 2011. The groundwater levels are deep (~40 mbgl) however, are above the base of the Ashfield Shale indicating confining conditions. Groundwater piezometric levels are comparable in the upper and lower Hawkesbury Sandstone (Figure 5.1). The groundwater levels remained fairly constant with fluctuations of less than ~0.5 m throughout the monitoring period. Sudden falls and slow recovery in groundwater level are visible at RMB03 after each sampling event. The slow recovery from purging at RMB03 suggests that this screened section of the lower Hawkesbury Sandstone has low permeability.

No apparent response to individual rainfall events is visible in the Hawkesbury Sandstone at the Denham Court site.

No perched groundwater has been observed at RMB04 since monitoring begun in June 2013.

5.2 Menangle Park site

The groundwater levels at the Menangle Park site have been monitored since June 2013. This site is located close to the Nepean River; river levels (BoM station 068216, 1 km to the south, upstream) have also been included in the hydrograph for comparison (Figure 5.2).

The groundwater level in the alluvium and in the Hawkesbury Sandstone is shallow (less than 10 mbgl) and shows a direct response to rainfall and flood events in the period of monitoring (12 months) at MPMB01, MPMB02 and MPMB03 (Figure 5.2). The response to rainfall and flooding events is minimal at MPMB04. A blockage was encountered at MPMB04 at 147 mbgl in June 2013 (Parsons Brinckerhoff, 2013f), preventing sampling but not affecting the groundwater level logging. The blockage (a slight deflect to the inside of the casing) was removed on 28 November 2013.

The initial response to the high rainfall and flooding event in June 2013 is followed by a decrease in groundwater levels over a period of four months at MPMB01, MPMB02 and MPMB03. The groundwater levels at these monitoring bores increased in response to the rainfall events in November 2013 and in March and April 2014, after which they stabilised. The Nepean River level similarly responds to rainfall (Figure 5.2). The river level is usually lower than the level in the alluvium and Hawkesbury Sandstone units, indicating the river is a gaining river at the Menangle Park site during the monitoring period, except for short periods during extremely high rainfall events (May 2013 and March 2014), when recharge to the groundwater is likely to occur.

There is an apparent upward hydraulic gradient within the sandstone at this site except during high rainfall recharge events. The similar response to rainfall and flooding events between the alluvial monitoring bore and the Hawkesbury Sandstone monitoring bores indicates connectivity between the two formations at this location, which is expected given the lack of a substantial confining layer (shale) between the formations.

5.3 Glenlee site

Groundwater levels at the Hawkesbury Sandstone monitoring bores at the Glenlee site have been monitored since February 2014. The groundwater levels are shallow (less than 15 mbgl) and there is no apparent influence from rainfall over the short monitoring period. Groundwater levels have been stable over the monitoring period (three months) at GLMB01 and GLMB03 and show a slight increase at GLMB02 from April 2014 onwards. There is an apparent downward hydraulic gradient at this site. The erratic nature of the data at GLMB02 is currently being investigated and logger failure is suspected.

6. Groundwater quality

6.1 Groundwater sampling methodology

Groundwater sampling was undertaken on six occasions as detailed in Table 6.1.

Table 6.1 Sampling program

Sampling event	Denham Court	Menangle Park	Glenlee	Reference report
November 2011	√[a]			Parsons Brinckerhoff (2012)
May 2013	√[a]			Parsons Brinckerhoff (2013e)
August 2013	√[b]	√[c]		Parsons Brinckerhoff (2013f)
November 2013	√[d]	√		Parsons Brinckerhoff (2014a)
February 2014	√[b]	√	√	Parsons Brinckerhoff (2014b)
May 2014	√[b]	√	√	Parsons Brinckerhoff (2014c)

(a) RMB01 not sampled due to insufficient water in monitoring bore.
(b) RMB01 and RMB04 not sampled due to insufficient water in monitoring bores.
(c) MPMB04 not sampled due to blockage in monitoring bore (Parsons Brinckerhoff, 2013f).
(d) RMB04 not sampled due to insufficient water in monitoring bore.

6.1.1 Sampling techniques

Two methods were used to obtain groundwater quality samples from the monitoring bores. The methods were selected based on the permeability of the screened formation of each bore which was determined during hydraulic conductivity testing. Higher yielding bores were purged and sampled using a submersible pump. Lower yielding bores and selected deeper bores with high purge volumes were sampled using a low flow pump. In summary:

- A submersible 12V pump was used in monitoring bores MPMB01 and MPMB02 (and RMB04 although there was never water present).
- A micro-purge™ low flow sampling pump was used in monitoring bores: RMB01, RMB02, RMB03, MPMB03, MPMB04, GLMB01, GLMB02 and GLMB03.

Where a submersible pump was used, a minimum of three well volumes was purged from the monitoring bore prior to sampling to allow a representative groundwater sample to be collected. Water quality parameters were measured during and following purging to monitor water quality changes and to indicate representative groundwater suitable for sampling and analysis.

The micro-purge™ system allows groundwater to be drawn into the pump intake directly from the screened portion of the aquifer, eliminating the need to purge relatively large volumes of groundwater from these bores. Water quality parameters were monitored during the micro-purge™ pumping to ensure that a representative groundwater sample was collected.

Physiochemical parameters (pH, EC, temperature, TDS, DO and ORP) were measured during and following purging using a calibrated hand-held water quality meter.

6.1.2 Chemical analysis of water

Groundwater samples collected in the field were analysed for a broad chemical suite designed specifically to assess the chemical characteristics of the different water bearing zones at the monitoring sites. Table 6.2 details the groundwater analytical suite.

Table 6.2 Groundwater analytical suite

Category	Parameters	
Physiochemical parameters (measured in field)	Temperature EC DO	pH ORP TDS
General parameters	EC[a] TDS	pH[a]
Major ions	Calcium Magnesium Sodium Potassium	Chloride Bicarbonate Sulphate Fluoride Silica
Metals and minor/trace elements	Aluminium Antimony[a] Arsenic Barium Boron Bromine Beryllium Cadmium Cobalt Copper Cyanide[a]	Iron Lead Manganese Molybdenum Mercury[b] Nickel Selenium Strontium Zinc Uranium Vanadium
Nutrients	Ammonia Phosphorus (total) Phosphorus (reactive)	Nitrite Nitrate Total organic carbon (TOC)
Hydrocarbons	Phenol compounds Polycyclic aromatic hydrocarbons (PAH)	Total petroleum hydrocarbons (TPH) Benzene, toluene, ethyl benzene and xylenes (BTEX)
Dissolved gases	Methane Ethene Ethane Propene	Propane Butene Butane
Isotopes[c]	Oxygen-18 (^{18}O) Deuterium (^{2}H) Tritium (^{3}H) Radiocarbon (^{14}C)	Carbon-13 dissolved organic carbon ($^{13}C_{DIC}$) Carbon-13 methane ($^{13}C_{CH4}$) and deuterium methane ($^{2}H_{CH4}$)

(a) For samples collected from the November 2011 sampling event onwards.

(b) For samples collected from the August 2013 sampling event onwards.

(c) Isotope analysis is undertaken once at each monitoring bore during the first sampling event. Isotope analysis has been repeated at the Denham Court site due to contrasting results obtained during the initial sampling. No isotope analysis was undertaken at the alluvial monitoring bore MPMB01.

Groundwater samples for laboratory analysis were collected in the sample bottles specified by the laboratory, with appropriate preservation where required. Samples undergoing dissolved metal analysis were filtered through 0.45 µm filters in the field prior to collection.

The samples were sent to the following laboratories under appropriate chain-of-custody protocols (documentation and laboratory results are provided in Appendices E-J):

- Australian Laboratory Service (ALS) Environmental Pty Ltd, Smithfield, Sydney – chemistry analysis. NATA certified laboratory (Appendix E).
- GNS Stable Isotope Laboratory, Lower Hutt, New Zealand – oxygen-18 and deuterium analysis (Appendix F).
- Rafter Radiocarbon Laboratory, Lower Hutt, New Zealand – carbon-14 analysis (Appendix G).
- Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights – tritium analysis (Denham Court and Menangle Park sites samples) (Appendix H).
- GNS Tritium and Water Dating Laboratory Lower Hutt, New Zealand – tritium analysis (Glenlee site samples) (Appendix I).
- UC Davis Stable Isotope Facility, Davis, California, USA – carbon-13 (^{13}CDIC) and methane isotope analysis (^{13}C-CH_4 and ^{2}H-CH_4) (Appendix J).

6.1.3 Quality assurance

6.1.3.1 Field QA/QC

The field sampling procedures conformed to Parsons Brinckerhoff's quality assurance/quality control protocols to prevent cross-contamination and preserve sample integrity. The following QA/QC procedures were applied:

- samples were collected in clearly labelled bottles with appropriate preservation solutions
- samples were delivered to the laboratories within the specified holding times
- unstable parameters were analysed in the field (physiochemical parameters).

6.1.3.2 Laboratory QA/QC

The laboratories conduct their own internal QA/QC program to assess the repeatability of the analytical procedures and instrument accuracy. These programs include analysis of laboratory sample duplicates, spike samples, certified reference standards, surrogate standards/spikes and laboratory blanks.

6.2 Groundwater quality results

Groundwater quality results are compared against the ANZECC (2000) guidelines for freshwater ecosystems (south-east Australia – lowland rivers) because rivers are the ultimate receiving waters for groundwater discharge. However these water guidelines are often naturally exceeded in catchments with rocks deposited in marine environments, and should not be considered as water quality objectives or thresholds.

Groundwater quality monitoring was undertaken between November 2011 and February 2014. Summary tables with minimum, maximum and average concentrations are presented in this chapter for each site. Full water quality results are presented in Appendix D.

The major ion characteristics of groundwater samples are shown in a piper diagram in Figure 6.1. A piper diagram is a graphical representation of the chemistry of a water sample and can be used to graphically show the relative concentrations of major ions (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, HCO_3^{-}, CO_3^{2-} and SO_4^{2-}).

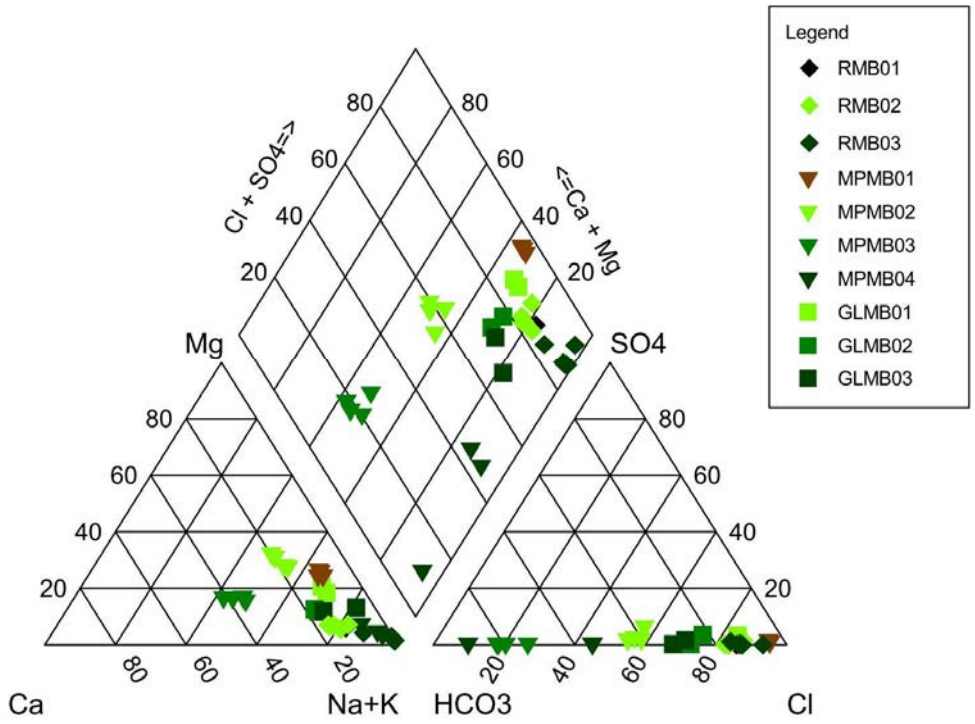

Figure 6.1 Piper diagram displaying major ion chemistry for all sampling events

The piper diagram indicates groundwater is typically dominated by sodium and chloride, with bicarbonate and magnesium also dominant at the Menangle Park site. Bicarbonate can be more dominant than chloride at Menangle Park (deeper bores).

6.2.1 Denham Court site

A summary of water quality results for the Denham Court monitoring bores is presented in Table 6.3.

Since monitoring began, insufficient water was present in monitoring bore RMB04 to allow for a representative sample to be collected.

Table 6.3 Water quality summary for the Denham Court monitoring bores

Parameters	Units	LOR	ANZECC 2000[a]	RMB01 (n = 1)	RMB02 (n = 6)	RMB03 (n = 6)
General parameters						
pH (field)	pH units	0.01	6.5 - 8.0[b]	6.97	**6.35** – 6.78 (6.57)	7.42 – **9.70 (9.19)**
pH (lab)				7.18	7.06 – 7.55 (7.27)	**9.37 – 9.52 (9.42)**
EC (field)	µS/cm	1	125 – 2,200[b]	**12,788**	**9,517 – 10,636 (10,129)**	**5,713 – 8,173 (7,604)**
EC (lab)				**13,000**	**10,400 – 10,700 (10,500)**	**7,970 – 8,360 (8,210)**
Temperature	°C	0.01	-	24.41	18.22 – 27.55 (21.54)	18.48 – 23.83 (20.35)
DO	% sat	0.01	80 - 110%[b]	**31.9**	**1.9 – 10.6 (5.5)**	**1.8 – 10.2 (5.1)**
TDS (field)	mg/L	1	–	8,312	6,188 – 6,917 (6,587)	3,759 – 5,316 (4,951)

Parameters	Units	LOR	ANZECC 2000[a]	RMB01 (n = 1)	RMB02 (n = 6)	RMB03 (n = 6)
TDS (lab)				na	5,720 – 6,560 (6,195)	3,720 – 4,710 (4,388)
Suspended solids	mg/L	1	–	74	2 – 18 (6)	3 – 80 (18)
Redox	mV	–	–	-100.1	-419 – -10.2 (-163.7)	-245.2 – -118.7 (-174)
Water type[c]				Na-Cl	Na-Cl	Na-Cl
Major ions						
Hydroxide alkalinity as $CaCO_3$	mg/L	1	–	<1	<1	<1
Carbonate alkalinity as $CaCO_3$	mg/L	1	–	<1	<1	<1 – 295 (215)
Bicarbonate alkalinity as $CaCO_3$	mg/L	1	–	937	743 – 886 (839)	228 – 606 (305)
Total alkalinity as $CaCO_3$	mg/L	1	–	937	743 – 886 (839)	474 – 606 (519)
Calcium	mg/L	1	–	284	2,800 – 3,980 (3,177)	2,280 – 2,490 (2,387)
Magnesium	mg/L	1	–	88	<1 - 86 (17)	<1 - 39 (9)
Sodium	mg/L	1	–	2,250	192 - 385 (302)	2 - 121 (25)
Potassium	mg/L	1	–	43	79 - 95 (84)	12 - 40 (24)
Chloride	mg/L	1	–	3,990	1,670 – 2,170 (1,867)	1,560 – 2,090 (1,743)
Sulphate	mg/L	1	–	<1	33 - 42 (37)	20 - 26 (23)
Silica	mg/L	0.1	–	14.7	10.3 - 15.6 (11.6)	5.9 – 10.0 (6.9)
Total cyanide	mg/L	0.004	0.007	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	–	0.3	0.1 - 0.2 (0.2)	0.3 - 0.4 (0.34)
Dissolved metals						
Aluminium	mg/L	0.01	0.055	0.04	<0.01 - 0.02 (0.01)	<0.01 - 0.02 (0.013)
Antimony	mg/L	0.001	–	<0.001	<0.001	<0.001 - 0.001 (0.001)
Arsenic	mg/L	0.001	0.013 (As V)	0.002	<0.001 - 0.009 (0.002)	<0.001 - 0.006 (0.002)
Barium	mg/L	0.001	–	37.2	1.18 – 39.8 (32.7)	5.41 - 7.42 (6.17)
Beryllium	mg/L	0.001	ID	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.001	<0.001	<0.001	<0.001 - 0.001 (0.001)
Cobalt	mg/L	0.001	ID	<0.001	<0.001 - 0.044 (0.008)	<0.001 - 0.006 (0.001)
Copper	mg/L	0.001	0.0014	**0.054**	<0.001 - **0.074 (0.013)**	<0.001 - **0.107 (0.019)**
Lead	mg/L	0.001	0.0034	<0.001	<0.001	<0.001 - 0.002 (0.001)

Parameters	Units	LOR	ANZECC 2000[a]	RMB01 (n = 1)	RMB02 (n = 6)	RMB03 (n = 6)
Manganese	mg/L	0.001	1.9	0.082	0.027 - 0.116 (0.050)	<0.001 - 0.085 (0.016)
Mercury	mg/L	0.0001	0.0006	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	ID	0.002	<0.001 - 0.001 (0.001)	0.004 - 0.014 (0.007)
Nickel	mg/L	0.001	0.011	0.004	0.001 - 0.009 (0.003)	<0.001 - **0.018** (0.004)
Selenium	mg/L	0.01	0.011 (total)	<0.01	<0.01	<0.01
Strontium	mg/L	0.001	–	13.4	8.0 - 10.8 (9.3)	1.82 - 5.78 (2.81)
Uranium	mg/L	0.001	ID	0.002	<0.001 - 0.016 (0.003)	<0.001
Vanadium	mg/L	0.01	ID	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	0.008	**0.062**	0.002 - **0.624 (0.124)**	**0.013 - 12.00 (2.53)**
Boron	mg/L	0.05	0.37	0.12	<0.05 - 0.06 (0.01)	0.08 - 0.17 (0.15)
Iron	mg/L	0.05	ID	5.23	0.29 - 6.11 (4.79)	<0.005 - 0.62 (0.15)
Bromine	mg/L	0.1	ID	9.8	6.4 - 7.9 (7.2)	4.9 - 6.6 (5.5)
Nutrients						
Ammonia as N	mg/L	0.01	0.02[b]	**5.24**	**3.97 - 4.57 (4.34)**	**2.77 - 3.88 (3.45)**
Nitrite as N	mg/L	0.01	–	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	0.7	0.06	<0.01 - 0.02 (0.01)	<0.01 - 0.02 (0.01)
Total phosphorus	mg/L	0.01	0.05[b]	<0.10	<0.01 - **0.13** (0.05)	0.005 - 0.03 (0.02)
Reactive phosphorus	mg/L	0.01	0.02[b]	**0.10**	<0.01 - **0.10 (0.06)**	<0.01 - 0.02 (0.01)
Total organic carbon	mg/L	1	–	124	<1 - 9 (3)	17 - 28 (23)
Gases						
Methane	µg/L	10	–	3,200	7,650 – 37,600 (15,815)	13,100 – 42,000 (24,400)
Ethene	µg/L	10	–	<10	<10	<10
Ethane	µg/L	10	–	136	<10 – 21 (10)	<10 – 19 (9)
Propene	µg/L	10	–	<10	<10	<10
Propane	µg/L	10	–	196	<10	<10
Butene	µg/L	10	–	<10	<10	<10
Butane	µg/L	10	–	<10	<10	<10
Phenolic compounds						
Phenol	µg/L	1	320	<1	<1	<1 – 1.2 (0.7)
3-4 Methylphenol	µg/L	1	-	<2	<2	<2 – 3.8 (1.8)
BTEX						
Benzene	µg/L	1	950	11	<1	<1
Toluene	µg/L	2	ID	<2	<2 – 23 (5.5)	<2 – 74 (33)

Parameters	Units	LOR	ANZECC 2000[a]	RMB01 (n = 1)	RMB02 (n = 6)	RMB03 (n = 6)
Ethylbenzene	µg/L	2	ID	<2	<2	<2
Meta- & para-Xylene	µg/L	2	ID	<2	<2	<2
Ortho-Xylenes	µg/L	2	350	<2	<2	<2
TPH						
C_6-C_9	µg/L	20	–	40	<20 – 50 (17)	<20 - 140 (63)
C_{10}-C_{14}	µg/L	50	–	<50	<50	<50 - 120 (67)
C_{15}-C_{28}	µg/L	100	–	190	<100 – 460 (98)	<100 - 410 (172)
C_{29}-C_{36}	µg/L	50	–	<50	<50	<50 - 150 (46)

(a) ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: 95% protection levels (trigger values).

(b) ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: trigger values for lowland rivers in south-east Australia.

(c) Calculated using AQUACHEM.

BOLD indicates a value outside of the ANZECC (2000) guideline range.

ID indicates insufficient data for trigger value to be established.

na indicates “not analysed”.

Bracketed values are the average. Average values calculated using half the detection limit when concentrations were below detection limits.

6.2.1.1 Field parameters and major ions

Groundwater in the Ashfield Shale at RMB01 is moderately saline (13,000 µS/cm). Groundwater from the Ashfield Shale, which is part of the Wianamatta Shale Group, is typically saline. The high salinity values are due to connate seawater trapped during deposition of the sediment (Old, 1942). Values up to 31,750 mg/L (TDS) have been recorded in groundwaters from the shale (Woolley, 1991) within the Sydney Basin. The pH conditions at RMB01 are neutral and redox conditions reducing.

Groundwater salinity in the Hawkesbury Sandstone at the Denham Court site is slightly to moderately saline (7,970 µS/cm at RMB03 to 10,700 µS/cm at RMB02). The pH conditions range from near neutral at RMB02 to alkaline at RMB03. Redox conditions are reducing.

The water type for the Denham Court monitoring bores is sodium and chloride dominant (Figure 6.1). The water types did not change over the monitoring period.

6.2.1.2 Dissolved metals

The major findings of dissolved metal analysis for the Ashfield Shale groundwater at the Denham Court site are as follows:

- Antimony, beryllium, cadmium, chromium, cobalt, lead, mercury, selenium and vanadium were below the laboratory limit of reporting (LOR).
- Aluminium, arsenic, manganese, nickel and boron were detected but did not exceed the ANZECC (2000) guideline values.
- Copper and zinc concentrations were detected at concentrations that exceeded the ANZECC (2000) guidelines for freshwater ecosystems.
- Barium, molybdenum, strontium, uranium, iron and bromine were detected.

The major findings of dissolved metal analysis for the Hawkesbury Sandstone at the Denham Court site are as follows:

- Antimony, beryllium, cadmium, chromium, mercury, selenium and vanadium were below or at the laboratory limit of reporting (LOR) for all monitoring events.
- Aluminium, arsenic, manganese, lead and boron were detected however they were below the ANZECC (2000) guideline values.
- Copper, nickel and zinc concentrations were detected and above the ANZECC (2000) guideline.
- Barium, cobalt, molybdenum, strontium, uranium, iron and bromine were detected at both monitoring bores.

Elevated concentrations of barium, molybdenum, strontium and zinc are not uncommon for groundwater in the Hawkesbury Sandstone (Parsons Brinckerhoff 2006 and 2013a).

6.2.1.3 Nutrients

The major findings for nutrients in the Ashfield Shale were as follows:

- Ammonia and reactive phosphorous concentrations exceeded the ANZECC (2000) guidelines.
- Nitrate concentrations are low and below the ANZECC (2000) guideline.
- Total organic carbon was 124 mg/L.

The major findings for nutrients in the Hawkesbury Sandstone were as follows:

- Ammonia, total phosphorous and reactive phosphorous concentrations exceeded the ANZECC (2000) guidelines.
- Nitrate concentrations are low and below the ANZECC (2000) guideline.

6.2.1.4 Dissolved gases

The major findings for dissolved gasses at the Denham Court site were as follows:

- Dissolved methane, ethane and propane were detected in groundwater from the Ashfield Shale monitoring bore.
- Dissolved methane was detected in groundwater from the Hawkesbury Sandstone monitoring bores at varying concentrations. Ethane was also detected in February and May 2014.

6.2.1.5 Hydrocarbons

The major findings for hydrocarbons in the Ashfield Shale were as follows:

- Phenolic compounds and PAHs were below laboratory LORs.
- Benzene was detected at low concentrations.
- Low concentrations of TPH (C_6-C_9 and C_{15}-C_{28}) were detected.

The major findings for hydrocarbons in the Hawkesbury Sandstone were as follows:

- Phenolic compounds were below the laboratory LORs, with the exception of minor detections at RMB03 in May and August 2013.
- PAHs were below the laboratory LOR.
- Toluene was detected at varying concentrations at both monitoring bores.

- TPH (C_6-C_9 and C_{15}-C_{28}) were detected at RMB02, together with TPH (C_{10}-C_{14}) at RMB03.

It is not unusual to see anomalous detections of some hydrocarbons (and trace metals) in the first few sampling events after bore installation, most likely due to influence from grout, pipe coatings and/or drilling additives. However, dissolved hydrocarbons can occur naturally in groundwater, particularly in areas associated with coal or oil resources. It is expected that these compounds will naturally degrade over time. Future trends will be monitored.

6.2.2 Menangle Park site

A summary of the water quality of the monitoring bores at the Menangle Park site is provided in Table 6.4.

Table 6.4 Water quality summary for the Menangle Park monitoring bores

Parameters	Units	ANZECC 2000[a]	MPMB01 (n=4)	MPMB02 (n=4)	MPMB03 (n=4)	MPMB4 (n=3)
General parameters						
pH (field)	pH units	6.5 - 8.0[b]	**4.78 – 5.54 (5.16)**	**5.72 – 6.44 (6.23)**	**6.30** - 7.09 (6.85)	**9.61 - 9.84 (9.75)**
pH (lab)			**5.45 - 5.86 (5.64)**	6.64 - 7.00 (6.82)	7.35 - 7.71 (7.50)	**8.72 - 9.45 (9.12)**
EC (field)	µS/cm	125 – 2,200[b]	902 – 980 (931)	874 – 937 (899)	1,020 – 1,144 (1,078)	929 – 1,216 (1,058)
EC (lab)			924 – 940 (933)	890 – 938 (908)	1,060 – 1,070 (1,067)	992 – 1,090 (1,044)
Temperature	°C	-	18.16 – 21.46 (20.18)	18.88 – 25.70 (22.30)	17.3 - 20.26 (18.99)	19.39 - 21.39 (20.19)
DO	% sat	80-110%[b]	**7.5 – 19.8 (13.8)**	**5.6 – 20.0 (11.0)**	**1.4 - 35.3 (10.2)**	**0.8 - 22.5 (8.0)**
TDS (field)	mg/L	–	586 – 637 (606)	568 – 609 (584)	663 - 747 (703)	605 - 790 (688)
TDS (lab)			464 – 619 (537)	392 – 465 (428)	550 - 619 (579)	541 - 718 (602)
Suspended solids	mg/L	–	49 – 114 (95)	3 – 80 (39)	2.5 - 8 (4.8)	70 – 26,600 (8,918)
Redox	mV	–	59.2 – 153.7 (108.7)	-380.2 – -88.9 (-174.8)	-413.6 – -144.3 (-241.4)	-215.5 – -34.1 (-123.7)
Water type[c]			Na-Mg-Cl	Na-Mg-Cl-HCO_3	Na-Mg-HCO_3-Cl	Na-Cl-HCO_3-CO_3
Major ions						
Hydroxide alkalinity as $CaCO_3$	mg/L	–	<1	<1	<1	<1
Carbonate alkalinity as $CaCO_3$	mg/L	–	<1	<1	<1	76 - 126 (100)
Bicarbonate alkalinity as $CaCO_3$	mg/L	–	14 – 18 (16)	165 - 200 (178)	416 - 493 (450)	167 - 1,960 (777)
Total alkalinity as $CaCO_3$	mg/L	–	14.0 – 18.0 (16.3)	165 - 200 (178.3)	416 - 493 (450)	282 - 2,060 (878)
Chloride	mg/L	–	262 – 294 (278)	172 - 182 (176)	74 - 109 (85)	163 - 172 (167)
Sulphate	mg/L	–	3 – 6 (4)	7 – 27 (13)	<1	<1 - 2 (1)

Parameters	Units	ANZECC 2000[a]	MPMB01 (n=4)	MPMB02 (n=4)	MPMB03 (n=4)	MPMB4 (n=3)
Calcium	mg/L	–	14 – 16 (15)	28 - 33 (31)	75 - 94 (84)	5 - 14 (8)
Magnesium	mg/L	–	23 – 25 (24.5)	27 - 33 (30)	20 - 23 (22)	4 - 9 (6)
Sodium	mg/L	–	115 – 129 (120)	92 - 101 (96.5)	104 - 116 (109.5)	181 – 208 (195)
Potassium	mg/L	–	1 – 2 (1.5)	3 - 4 (3.8)	14 - 17 (15)	16 - 19 (18)
Silica	mg/L	–	16.3 - 19.7 (18.1)	12.9 - 13.3 (13.1)	8.8 - 9.9 (9.2)	2.6 – 4.0 (3.5)
Total cyanide	mg/L	0.007	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	–	<0.1	<0.1	<0.1	0.4 - 0.6 (0.5)
Dissolved metals						
Aluminium	mg/L	0.055	0.01 – 0.05 (0.03)	0.03	<0.001 - 0.15 (0.061)	0.02
Antimony	mg/L	–	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.013 (As V)	<0.001	0.002 – 0.008 (0.004)	0.012 - **0.035 (0.026)**	0.003 - **0.016** (0.007)
Barium	mg/L	–	0.70 – 0.75 (0.72)	0.43 – 0.51 (0.46)	3.04 - 4.04 (3.47)	0.76 - 0.95 (0.87)
Beryllium	mg/L	ID	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0002	<0.001 – 0.001 (<0.001)	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	ID	0.042 – 0.044 (0.043)	0.002 – 0.010 (0.005)	0.003 - 0.009 (0.005)	<0.001
Copper	mg/L	0.0014	**0.003 – 0.016 (0.011)**	0.001 **– 0.003 (0.0015)**	<0.001 - **0.010 (0.003)**	<0.001 - **0.002 (0.002)**
Lead	mg/L	0.0034	0.002 **– 0.009 (0.005)**	<0.0001 **– 0.013** (0.0003)	<0.001 - 0.002 (0.001)	<0.001
Manganese	mg/L	1.9	0.479 – 0.504 (0.489)	0.148 – 0.278 (0.201)	0.047 - 0.329 (0.124)	<0.01 - 0.02 (0.014)
Mercury	mg/L	0.0006	<0.001 – 0.002 (<0.001)	<0.001	<0.001	<0.001
Molybdenum	mg/L	ID	<0.001	<0.001 – 0.007 (0.002)	<0.001 - 0.004 (0.001)	0.006 - 0.010 (0.008)
Nickel	mg/L	0.011	**0.016 – 0.018 (0.017)**	0.001 – 0.010 (0.005)	0.002 - 0.013 (0.006)	<0.001 - 0.003 (0.001)
Selenium	mg/L	0.011 (total)	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	–	0.152 – 0.169 (0.160)	0.324 – 0.368 (0.358)	0.843 - 1.150 (1.013)	0.248 - 0.304 (0.272)
Uranium	mg/L	ID	<0.001	<0.001 – 0.002 (0.001)	<0.001	<0.001
Vanadium	mg/L	ID	<0.01	<0.01	<0.01	<0.01

Parameters	Units	ANZECC 2000[a]	MPMB01 (n=4)	MPMB02 (n=4)	MPMB03 (n=4)	MPMB4 (n=3)
Zinc	mg/L	0.008	**0.057 – 0.103 (0.077)**	0.009 - 0.059 (0.0278)	0.006 - **0.031 (0.019)**	0.039 - 0.055 (0.045)
Boron	mg/L	0.37	<0.05 – 0.16 (<0.05)	<0.05 - 0.1 (0.027)	<0.05	<0.05 – 0.07 (0.03)
Iron	mg/L	ID	<0.05 – 0.08 (<0.05)	3.11 - 3.96 (3.56)	0.83 - 2.63 (1.45)	<0.05
Bromine	mg/L	ID	0.6 – 0.8 (0.7)	0.3 - 0.7 (0.48)	0.2 - 0.3 (0.25)	0.4 - 0.6 (0.5)
Nutrients						
Ammonia as N	mg/L	0.02[b]	0.01 – **0.04 (0.02)**	**0.08 - 0.10 (0.09)**	**0.76 - 0.95 (0.89)**	**0.80 – 1.00 (0.90)**
Nitrite as N	mg/L	–	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.7	0.09 – 0.16 (0.13)	<0.01 - 0.02 (0.001)	<0.01 - 0.02 (0.013)	<0.01 - 0.02 (0.01)
Total phosphorus	mg/L	0.05[b]	0.02 – **0.10 (0.06)**	0.02 - **0.53 (0.17)**	0.01 - 0.03 (0.02)	0.02 - **2.18 (0.74)**
Reactive phosphorus	mg/L	0.02[b]	<0.01	<0.01	<0.01	<0.01 - 0.02 (0.01)
Total organic carbon	mg/L	–	2 – 5 (3)	1 - 7 (3)	<1	15 - 25 (18)
Gases						
Methane	µg/L	–	<10	20 – 83 (48)	14,700 – 35,900 (29,300)	8,560 – 27,300 (19,953)
Ethene	µg/L	–	<10	<10	<10	<10
Ethane	µg/L	–	<10	<10	<10	<10
Propene	µg/L	–	<10	<10	<10	<10
Propane	µg/L	–	<10	<10	<10	<10
Butene	µg/L	–	<10	<10	<10	<10
Butane	µg/L	–	<10	<10	<10	<10
Phenolic compounds						
Phenol	µg/L	320	<1.0	<1.0	<1.0	9.3 - 11.6 (10.4)
PAH						
Naphthalene	µg/L	16	<1.0 – **18.5** (7.6)	<1.0 – 14.1 (5.2)	<1.0	<1.0
Acenaphthene	µg/L	ID	<1.0 – 14.9 (7.1)	<0.1 - 13.7 (5.6)	<1.0	<1.0
Fluorene	µg/L	ID	<1.0 – 11.1 (5.5)	<1.0 - 10.6 (4.5)	<1.0	<1.0
Phenanthrene	µg/L	ID	<1.0 – 15.3 (7.6)	<1.0 - 14.2 (6.4)	<1.0	<1.0
Anthracene	µg/L	ID	<1.0 – 2.2 (1.1)	<1.0 - 1.7 (0.8)	<1.0	<1.0
Fluoranthene	µg/L	ID	<1.0 – 1.6 (1.0)	<1.0 - 1.7 (1.0)	<1.0	<1.0
Sum of PAHs	µg/L	ID	<0.5 – 62.3 (28.5)	<0.5 - 56.0 (21.9)	<1.0	<1.0

Parameters	Units	ANZECC 2000[a]	MPMB01 (n=4)	MPMB02 (n=4)	MPMB03 (n=4)	MPMB4 (n=3)
BTEX						
Benzene	µg/L	950	<1	<1	<1	<1 – 2 (2)
Toluene	µg/L	ID	<2 – 8 (3)	<2 – 6 (2)	<2 – 14 (5)	1 – 84 (32)
Ethylbenzene	µg/L	ID	<2	<2	<2	<2 – 17 (6)
Meta & para Xylene	µg/L	ID	<2	<2	<2	<2 – 16 (6)
Ortho-Xylenes	µg/L	350	<2	<2	<2	<2
TPH						
C_6-C_9	µg/L	–	<20	<20	<20 – 40 (18)	<20 – 130 (77)
C_{10}-C_{14}	µg/L	–	<50 – 800 (343)	<50 – 470 (200)	<50	<50 – 60 (48)
C_{15}-C_{28}	µg/L	–	<100 – 190 (113)	<100 – 290 (110)	<100	<100 – 1,760 (667)
C_{29}-C_{36}	µg/L	–	<50	<50	<50	<50 – 1,060 (382)

(a) ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: 95% protection levels (trigger values).

(b) ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: trigger values for lowland rivers in south-east Australia.

(c) Calculated using AQUACHEM.

BOLD indicates a value outside of the ANZECC (2000) guideline range.

ID indicates insufficient data for trigger value to be established.

na indicates “not analysed”.

Bracketed values are the average. Average values calculated using half the detection limit when concentrations were below detection limits.

6.2.2.1 Field parameters and major ion chemistry

Groundwater salinity at the Menangle Park site (within the alluvium and Hawkesbury Sandstone) is characterised as fresh to marginal (890 µS/cm at MPMB02 to 1,090 µS/cm at MPMB04). The pH conditions range from acidic at MPMB01 and MPMB02, to neutral at MPMB03 and alkaline at MPMB04. Redox conditions range from strongly reducing (MPMB02) to oxidising (MPMB01).

The water type for the Menangle Park monitoring site is sodium, magnesium and chloride dominant in the alluvium, and sodium, chloride and carbonate/bicarbonate dominant in the Hawkesbury Sandstone (Figure 6.1). The water types did not change over the monitoring period.

6.2.2.2 Dissolved metals

The major findings of dissolved metal analysis for the Menangle Park monitoring bores are as follows:

- Dissolved metal concentrations are typically low.
- Antimony, beryllium, cadmium, chromium, mercury, selenium and vanadium were at or below the laboratory LOR.
- Aluminium, manganese and boron were detected at most monitoring bores but did not exceed the ANZECC (2000) guideline values.
- Arsenic, copper, lead, nickel and zinc were detected at concentrations that exceeded the ANZECC (2000) guidelines for freshwater ecosystems during at least one monitoring event.
- Barium, cobalt, molybdenum, strontium, uranium, iron and bromine were detected during at least one monitoring event at most bores.

Acidic pH conditions are likely causing the mobilisation of trace metals in alluvial sediments. The dissolved metal concentrations are considered natural and not unusual for the Hawkesbury Sandstone.

6.2.2.3 Nutrients

The major findings for nutrients are as follows:

- Ammonia was generally detected at concentrations exceeding the ANZECC (2000) guideline at all monitoring bores.
- Nitrate concentrations were low and below the ANZECC (2000) guideline.
- Total phosphorous exceeded the ANZECC (2000) guideline at all monitoring bores, with the exception of MPMB03, where concentrations were below the guideline.

Nutrient concentrations were found to be generally increasing with depth.

6.2.2.4 Dissolved gases

Dissolved methane was detected at all Menangle Park monitoring bores except at MPMB01, with relatively low concentrations at MPMB02 (up to 83 µg/L). Dissolved methane was detected at elevated concentrations at MPMB03 (up to 35,900 µg/L) and MPMB04 (up to 27,300 µg/L).

6.2.2.5 Hydrocarbons

The major findings for the hydrocarbons at the Menangle Park monitoring bores are as follows:

- Concentrations of phenolic compounds were below the laboratory LOR at MPMB01, MPMB02 and MPMB03. Phenol was detected at low concentrations at MPMB04 throughout the monitoring period; all other phenolic compounds were below the laboratory LORs.
- Concentrations of PAHs were below the laboratory LORs at MPMB03 and MPMB04 for the entire monitoring period. Naphthalene, acenaphthene, fluorene, anthracene and fluoranthene were detected in November 2013 and May 2014 at MPMB01 and MPMB02; naphthalene was above the ANZECC (2000) guideline value (16 µg/L) at MPMB01 in November 2013.
- Low concentrations of toluene were detected during at least one sampling event at all monitoring bores. Concentrations were the highest at MPMB04 (84 µg/L). No other BTEX compounds were detected, with the exception of minor detections at MPMB04 in February 2014.
- Low concentrations of TPH (C_6-C_9) were detected at MPMB03 in August 2013. Low concentrations of TPH (C_{10}-C_{28}) were detected at MPMB01 and MPMB02 in November 2013 and May 2015; higher concentrations of TPH (C_6-C_{40}) were detected at MPMB04 during most monitoring events.

It is not unusual to see anomalous detections of some hydrocarbons (and trace metals) in the first few sampling events after bore installation, most likely due to influence from grout, pipe coatings and/or drilling additives. However, this site is a former sand and gravel quarry that has been subsequently backfilled, and the observed groundwater chemistry is likely the result of these previous land use activities. In addition, dissolved hydrocarbons can occur naturally in groundwater, particularly in areas associated with coal or oil resources. Future trends will be monitored.

6.2.3 Glenlee monitoring bores

A summary of water quality results for the Glenlee monitoring bores are presented in Table 6.5.

Table 6.5 Water quality summary for the Glenlee monitoring bores

Parameters	Units	ANZECC 2000[a]	GLMB01 (n = 2)	GLMB02 (n = 2)	GLMB03 (n = 2)
General parameters					
pH (field)	pH units	6.5 - 8.0[b]	6.71 - 6.77 (6.74)	6.86 - 7.03 (6.95)	7.62 - 8.17 (7.90)
pH (lab)			7.32 - 7.89 (7.61)	7.46 - 7.83 (7.65)	**8.29 - 8.33 (8.31)**
EC (field)	µS/cm	125 – 2,200[b]	**8,950 – 9,075 (9,013)**	**6,655 – 6,768 (6,712)**	**5,453 – 6,233 (5,843)**
EC (lab)			**9,330 – 9,360 (9,345)**	**6,840 – 7,000 (6,920)**	**5,570 – 6,550 (6,060)**
Temperature	°C	-	19.90 - 20.99 (20.45)	20.98 - 21.58 (21.28)	20.13 - 21.43 (20.78)
DO	% sat	80-110%[b]	**2.1 - 7.8 (5.0)**	**1.6 - 10.3 (6.0)**	**4.1 - 4.9 (4.5)**
TDS (field)	mg/L	–	5,775 – 5,904 (5,840)	4,326 – 4,409 (4,368)	3,544 – 4,119 (3,832)
TDS (lab)			4,010 – 5,650 (4,830)	3,400 – 4,000 (3,700)	2,820 – 3,700 (3,260)
Suspended solids	mg/L	–	2.5 - 5 (3.8)	25 - 25 (25)	2.5 – 8.0 (5.3)
Redox	µS/cm	–	-218.3 – -137.2 (-178)	-213.3 – -211.7 (-213)	-235.2 – -232 (-234)
Water type[c]			Na-Cl	Na-Cl	Na-Cl-HCO_3
Major ions					
Hydroxide alkalinity as $CaCO_3$	mg/L	–	<1	<1	<1
Carbonate alkalinity as $CaCO_3$	mg/L	–	<1	<1	<1 – 16 (8)
Bicarbonate alkalinity as $CaCO_3$	mg/L	–	529 - 574 (552)	646 - 829 (738)	756 - 816 (786)
Total alkalinity as $CaCO_3$	mg/L	–	529 - 574 (552)	646 - 829 (738)	772 - 816 (794)
Calcium	mg/L	–	2,630 – 2,880 (2,755)	1,590 – 1,600 (1,595)	1,240 – 1,410 (1,325)
Magnesium	mg/L	–	134 - 138 (136)	<1 - 98 (49)	<1 - 40 (20)
Sodium	mg/L	–	197 - 224 (211)	210 - 249 (230)	49 - 210 (130)
Potassium	mg/L	–	223 - 230 (227)	92 - 106 (99)	78 - 99 (89)
Chloride	mg/L	–	1,390 – 1,670 (1,530)	979 - 1230 (1,105)	910 – 1,160 (1,035)
Sulphate	mg/L	–	28 - 30 (29)	26 - 30 (28)	30 - 33 (32)
Silica	mg/L	–	11.7 - 11.7 (12)	20.0 - 22.9 (21)	12.1 - 12.9 (13)
Total cyanide	mg/L	0.007	<0.004	<0.004	<0.004
Fluoride	mg/L	–	0.2 - 0.2 (0.2)	0.2 - 0.3 (0.3)	0.2 - 0.3 (0.3)
Dissolved metals					
Aluminium	mg/L	0.055	<0.01 - 0.02 (0.013)	<0.01	<0.01
Antimony	mg/L	–	<0.001	<0.001	<0.001
Arsenic	mg/L	0.013 (As V)	0.004 - 0.009 (0.007)	0.006 - 0.012 (0.009)	0.011 - **0.037 (0.024)**
Barium	mg/L	–	0.351 - 1.81 (1.08)	1.03 - 8.54 (4.79)	2.26 - 5.67 (3.97)

Parameters	Units	ANZECC 2000[a]	GLMB01 (n = 2)	GLMB02 (n = 2)	GLMB03 (n = 2)
Beryllium	mg/L	ID	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0002	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	ID	0.002 - 0.006 (0.004)	<0.001	0.002 - 0.008 (0.005)
Copper	mg/L	0.0014	<0.001	<0.001	<0.001
Lead	mg/L	0.0034	<0.001	<0.001	<0.001
Manganese	mg/L	1.9	0.442 - 0.558 (0.500)	0.897 - 1.160 (1.029)	0.024 - 0.350 (0.187)
Mercury	mg/L	0.0006	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	ID	<0.001	<0.001	0.004 - 0.017 (0.011)
Nickel	mg/L	0.011	0.002 - 0.002 (0.002)	<0.001	0.003 - 0.010 (0.007)
Selenium	mg/L	0.011 (total)	<0.01	<0.01	<0.01 - 0.01 (0.008)
Strontium	mg/L	–	5.15 - 5.34 (5.245)	4.42 - 4.43 (4.425)	3.32 - 4.27 (3.795)
Uranium	mg/L	ID	0.001 - 0.003 (0.002)	<0.001 - 0.003 (0.002)	<0.001
Vanadium	mg/L	ID	<0.01	<0.01	<0.01
Zinc	mg/L	0.008	**0.018 - 0.024 (0.021)**	<0.005 - 0.006 (0.004)	**0.075 - 2.530 (1.300)**
Boron	mg/L	0.37	<0.05	<0.05 - 0.06 (0.043)	<0.05
Iron	mg/L	ID	2.20 – 3.56 (2.88)	1.5 - 3.1 (2.3)	0.44 - 1.60 (1.02)
Bromine	mg/L	ID	7.1 – 7.5 (7.3)	4.4 - 4.6 (4.5)	3.6 - 4.3 (4.0)
Nutrients					
Ammonia as N	mg/L	0.02b	**2.4- 2.5 (2.45)**	**1.74 - 1.90 (1.82)**	**2.24 - 2.36 (2.30)**
Nitrite as N	mg/L	–	<0.01	<0.01	<0.001
Nitrate as N	mg/L	0.7	<0.01 - 0.01 (0.01)	0.01 - 0.02 (0.02)	<0.01 - 0.02 (0.01)
Total phosphorus	mg/L	0.05[b]	0.04 - 0.05 (0.05)	**0.10 - 0.15 (0.13)**	0.03 - 0.04 (0.04)
Reactive phosphorus	mg/L	0.02[b]	<0.01	<0.01 - **0.06 (0.03)**	<0.01
Total organic carbon	mg/L	–	<1	<1 - 25 (13)	<1 - 18 (9)
Gases					
Methane	µg/L	–	21,000 – 35,600 (28,300)	13,500 – 16,200 (14,850)	19,800 – 33,500 (26,650)
Ethene	µg/L	–	<10	<10	<10
Ethane	µg/L	–	1,950 – 3,410 (2,680)	816 – 2,480 (1,648)	371 – 2,360 (1,366)
Propene	µg/L	–	<10	<10	<10
Propane	µg/L	–	544 - 804 (674)	190 - 336 (263)	69 - 293 (181)
Butene	µg/L	–	<10	<10	<10

Parameters	Units	ANZECC 2000[a]	GLMB01 (n = 2)	GLMB02 (n = 2)	GLMB03 (n = 2)
Butane	µg/L	–	89 - 115 (102)	14 – 36 (25)	<10 - 15 (10)
Phenolic compounds					
Phenol	µg/L	320	<1	<1 – 10.9 (5.7)	1.8 – 10.9 (6.4)
3-&4-Methylphenol	µg/L	-	<2	<2 – 2.2	<2
PAH	µg/L	–	<LORs	<LORs	<LORs
BTEX					
Benzene	µg/L	950	<1	<1	<1
Toluene	µg/L	ID	<2 – 68 (35)	19 – 71 (45)	23 – 109 (66)
Ethylbenzene	µg/L	ID	<2	<2	<1
Meta & para-Xylene	µg/L	ID	<2	2 – 3 (2.5)	2 – 3 (2.5)
Ortho-Xylenes	µg/L	350	<2	<2	<2
TPH					
C_6-C_9	µg/L	–	110 – 120 (115)	100 – 150 (125)	50 – 160 (105)
C_{10}-C_{14}	µg/L	–	<50	<50 – 60 (43)	<50
C_{15}-C_{28}	µg/L	–	<100	<100	<100
C_{29}-C_{36}	µg/L	–	<50	<50	<50

(a) ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: 95% protection levels (trigger values).

(b) ANZECC (2000) guidelines for the protection of freshwater aquatic ecosystems: trigger values for lowland rivers in south-east Australia.

(c) Calculated using AQUACHEM.

BOLD indicates a value outside of the ANZECC (2000) guideline range.

ID indicates insufficient data for trigger value to be established.

na indicates “not analysed”.

Bracketed values are the average. Average values calculated using half the detection limit when concentrations were below detection limits.

6.2.3.1 Field parameters and major ion chemistry

Groundwater salinity at the Glenlee site (within the Hawkesbury Sandstone) is characterised as slightly saline (5,570 µS/cm at GLMB03 to 9,360 µS/cm at GLMB01). The pH conditions range from near neutral at GLMB01 and GLMB02 to slightly alkaline at GLMB03. Redox conditions are reducing at all monitoring bores.

The water type for the Glenlee monitoring bores is sodium and chloride dominant, together with bicarbonate at GLMB03 (Figure 6.1).

6.2.3.2 Dissolved metals

The major findings of dissolved metal analysis for the Glenlee monitoring bores are as follows:

- Dissolved metal concentrations are typically low.
- Antimony, beryllium, cadmium, chromium, copper, lead, mercury and vanadium were below the laboratory LOR for all monitoring events.
- Aluminium, manganese, nickel, selenium and boron were detected in at least one of the monitoring bores but did not exceed the ANZECC (2000) guideline values.

- Arsenic and zinc were detected at concentrations that exceeded the ANZECC (2000) guidelines for freshwater ecosystems in at least one monitoring bore.
- Barium, cobalt, molybdenum, strontium, uranium, iron and bromine were detected at most monitoring bores.

The dissolved metal concentrations are considered natural and not unusual for the Hawkesbury Sandstone.

6.2.3.3 Nutrients

The major findings for nutrients are as follows:

- Ammonia concentrations exceeded the ANZECC (2000) guideline at all the monitoring bores.
- Nitrate concentrations were low and usually below the laboratory LOR at all monitoring bores.
- Total phosphorous was detected at all monitoring bores and concentrations exceeded the ANZECC (2000) guideline at GLMB02.
- Reactive phosphorous was detected at concentrations above the laboratory LOR at GLMB02 only, and concentrations exceeded the ANZECC (2000) guideline in May 2014.

Nutrient concentrations were found to be the highest in the middle Hawkesbury Sandstone.

6.2.3.4 Dissolved gases

Dissolved methane was detected at high concentrations in all monitoring bores (from 13,500 µg/L at GLMB02 to 35,600 µg/L at GLMB01).

Ethane, propane and butane were detected at all monitoring bores, at concentrations decreasing with depth.

6.2.3.5 Hydrocarbons

The major findings for the hydrocarbons at the Glenlee monitoring bores are as follows:

- Concentrations of phenolic compounds were below the laboratory LOR at GLMB01. Phenol was detected at low concentrations at GLMB02 in February 2014 and at GLMB03 during both sampling events; all other phenolic compounds were below the laboratory LORs.
- Concentrations of PAHs were below the laboratory LOR at all monitoring bores.
- Toluene was detected at all monitoring bores at concentrations increasing with depth. Meta & para-xylene was detected at GLMB02 and GLMB03 at low concentrations. No other BTEX compounds were detected.
- Low concentrations of TPH (C_6-C_9) were detected at all monitoring bores. Low concentrations of TPH (C_{10}-C_{14} and C_{29}-C_{36}) were detected at GLMB02 in February 2014.

It is not unusual to see anomalous detections of some hydrocarbons and trace metals in the first few sampling events after bore installation, most likely due to influence from grout, pipe coatings and/or drilling additives. However, dissolved hydrocarbons can occur naturally in groundwater, particularly in areas associated with coal or oil resources. It is expected that these compounds will naturally degrade over time. Future trends will be monitored.

6.2.4 Isotopes

6.2.4.1 Stable isotopes of water

Stable isotopes of water ($\delta^{18}O$ and $\delta^{2}H$) provide information about the origin of natural waters and the processes that have affected groundwater since it entered the groundwater system. Stable isotopes of water

values are compared to the Global Meteoric Water Line (GMWL) ($\delta^2H = 8.13\ \delta^{18}O + 10.8$) (Rozanski et al. 1993) and the Local Meteoric Water Line (LMWL) (Sydney region) ($\delta^2H = 8.3\ \delta^{18}O + 16.3$) (Crosbie et al. 2012) in Figure 6.2. The GMWL (as seen on Figure 6.2) provides an important key to the interpretation of oxygen-18 and deuterium data. It is a line that defines the relationship between oxygen-18 (^{18}O) and deuterium (^2H) in fresh surface waters and precipitation from a number of global reference sites. Water with an isotopic composition that lies on the MWL is assumed to have originated from the atmosphere and to be unaffected by other isotopic processes. Samples that plot significantly off the MWL can indicate modification by processes such as evaporation and interaction with rock minerals.

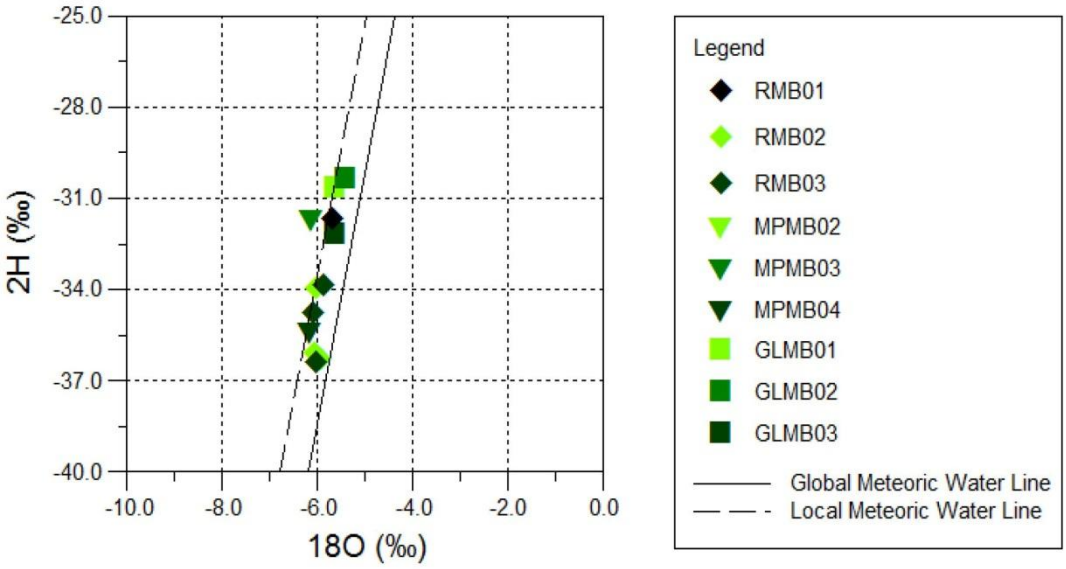

Figure 6.2 Deuterium versus oxygen-18 for Camden Gas Project monitoring bores

Stable isotopes of water results for the monitoring bore screened in the Triassic shale and in the Hawkesbury Sandstone are presented in Table 6.6.

Table 6.6 Stable isotope results

Bore ID	Sampling date	Oxygen-18 (‰)	Deuterium (‰)
RMB01	21/11/13	-5.66	-31.7
RMB02	03/11/11	-6.06	-36.1
	22/08/13	-5.91	-36.3
	21/11/13	-6.01	-34.0
RMB03	03/11/11	-6.03	-36.4
	22/08/13	-6.07	-34.8
	21/11/13	-5.86	-33.9
MPMB02	05/12/13	-6.11	-31.7
MPMB03	05/12/13	-6.38	-33.3
MPMB04	05/12/13	-6.13	-35.4
GLMB01	25/02/14	-5.60	-30.7
GLMB02	25/02/14	-5.39	-30.4
GLMB03	25/02/14	-5.61	-32.2

All samples plot between the GMWL and the LMWL, with the exception of MPMB03, indicating groundwater is of meteoric (rainfall) origin (Figure 6.2). The Glenlee site monitoring bores appear slightly more enriched than the Denham Court and Menangle Park sites. The results of the repeated sampling at RMB02 and RMB03 are consistent.

6.2.4.2 Radiogenic isotopes

Radiocarbon and tritium results are presented in Table 6.7. Carbon-13 of dissolved inorganic carbon (δ^{13}C-DIC) is also presented in Table 6.7.

Table 6.7 δ^{13}C-DIC, radiocarbon and tritium results

Bore ID	Sampling date	δ^{13}C (‰)	a^{14}C (pMC)	^{14}C age[a] (yrs BP)	^{14}C age[b] (yrs BP)	Tritium (TU)
RMB01	21/11/13	-1.47	24.55±0.11	11,218±35	7,300	0.050±0.03[c]
RMB02	03/11/11	5.40	1.18±0.05	35,620±370	33,800	na
	22/08/13	4.60	0.58±0.07	41,369±928	>40,000	0.030±0.02[c]
	21/11/13	4.98	0.34±0.10	45,612±2,372	>40,000	0.010±0.04[c]
RMB03	03/11/11	8.40	1.87±0.06	31,900±240	31,300	na
	22/08/13	17.36	10.57±0.09	17,992±66	15,600	0.060±0.03[c]
	21/11/13	18.80	11.26±0.10	17,484±69	16,100	0.070±0.03[c]
MPMB02	22/08/13	-17.04	50.64±0.17	5,403±26	2,800	0.010±0.03[c]
MPMB03	22/08/13	-1.85	3.92±0.08	25,964±155	24,600	0.030±0.02[c]
MPMB04	05/12/13	9.12	8.21±0.10	20,024±98	20,400	0.050±0.02[c]
GLMB01	25/02/14	-9.71	5.04±0.06	23,940±89	23,000	0.006±0.016
GLMB02	25/02/14	-10.44	26.08±0.09	10,733±26	10,200	0.049±0.047
GLMB03	25/02/14	-2.66	7.66±0.10	20,572±102	19,800	0.080±0.017

(a) Uncorrected radiocarbon age.

(b) Corrected radiocarbon age.

(c) This result is below the Minimum Detectable Activity (MDA) and Limit of Quantification (Quant Limit) and therefore has an unacceptable level of uncertainty. Hence the data should only be used as an indicator of true concentration.

na indicates “not analysed”.

Radiocarbon analysis of Hawkesbury Sandstone groundwater samples indicate relatively old groundwater (2,800 to >40,000 yrs BP). Groundwater in the Ashfield Shale is 7,300 yrs BP. Groundwater ages did not consistently increase with depth at any of the sites.

The repeated sampling at the Hawkesbury Sandstone monitoring bores at the Denham Court site indicates that the results from the first sampling event in 2011 are likely to have been slightly compromised due to residual water used in the drilling and bore completion remaining within the bore, and are therefore not considered to be representative of formation water.

The Hawkesbury Sandstone has been described as a thick multi-layered complex of sub-aquifers (including perched water tables) defined by more permeable sandstone horizons, which are connected to varying degrees by joints and bedding planes (McKibbin and Smith, 2000). While groundwater radiocarbon ages generally increase with sampling depth, it is expected that local deviations from this trend will occur as a result of preferential flow paths in relatively permeable (aquifer) versus less permeable (aquitard) layers within the multilayered system.

Tritium concentrations were below the quantification limit in the Ashfield Shale and were negligible in the Hawkesbury Sandstone. This is consistent with samples containing no modern water (<50 years).

6.2.4.3 Carbon and hydrogen isotopes of methane ($\delta^{13}C\text{-}CH_4$ and $\delta_2H\text{-}CH_4$)

Compound specific isotopes of dissolved methane (carbon-13 ($\delta^{13}C\text{-}CH_4$) and deuterium ($\delta^{2}H\text{-}CH_4$)) were analysed in the all the monitoring bores. Dissolved methane concentrations and isotope results are presented in Table 6.8 and in Figure 6.3.

Table 6.8 Dissolved methane concentrations and isotope results

Bore ID	Sampling date	CH_4 (µg/L)	δ^2H_{CH4} (‰)	$\delta^{13}C_{CH4}$ (‰)
RMB01	21/11/13	3,200	-199.2	-42.63
RMB02	03/11/11	10,100	na	na
	22/08/13	17,700	-95.4	-37.52
	21/11/13	8,240	-217.9	-46.01
RMB03	03/11/11	13,100	na	na
	22/08/13	18,600	-178.0	-31.64
	21/11/13	17,500	-246.2	-43.27
MPMB02	22/08/13	83	-160.1	-37.73
MPMB03	22/08/13	14,700	-139.8	-23.37
MPMB04	05/12/13	8,560	-245.0	-45.26
GLMB01	25/02/14	21,000	-178.0	-12.9
GLMB02	25/02/14	13,500	-218.7	-39.13
GLMB03	25/02/14	19,800	-223.3	-40.56

na indicates 'not analysed'.

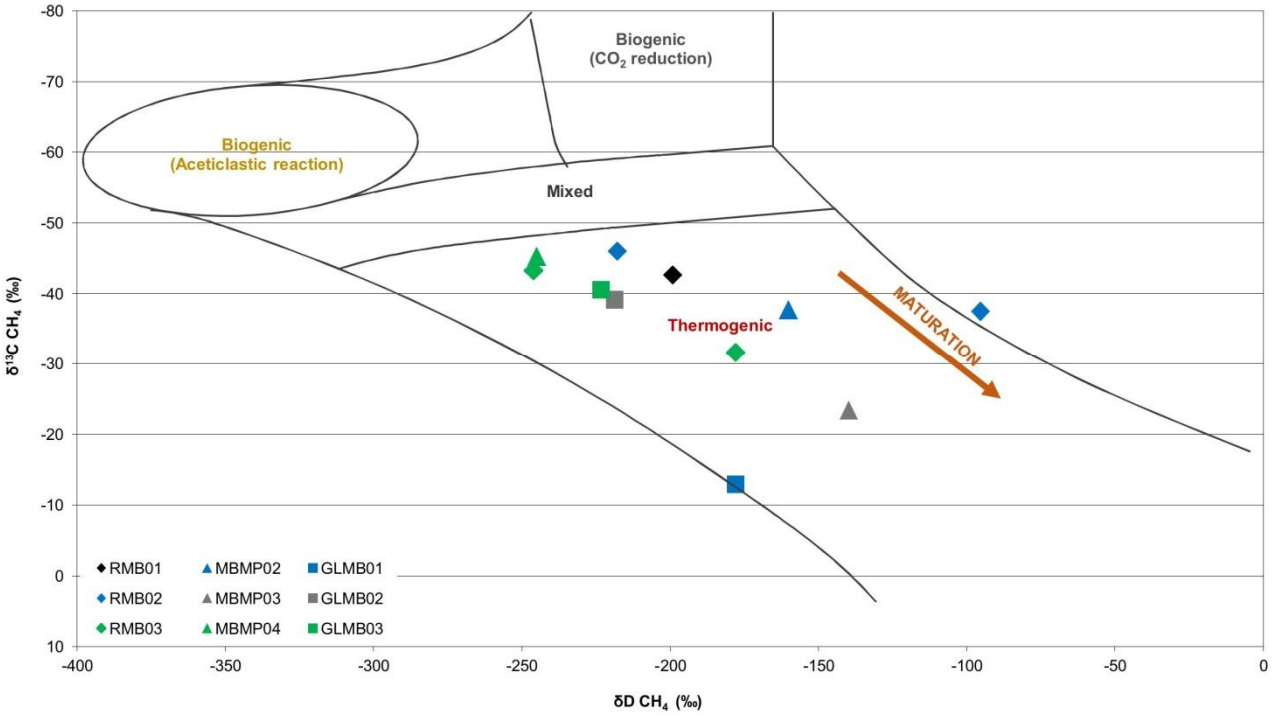

Figure 6.3 ^{13}C-CH_4 versus ^{2}H-CH_4 for Camden Gas Project monitoring bores

The results indicate the methane is of a thermogenic origin in all samples.

7. Conclusions

This drilling program comprised the establishment of three nested groundwater monitoring sites (a combined total of 11 monitoring bores) within the CGP between October 2011 and February 2014: one perched groundwater monitoring bore, one alluvial groundwater monitoring bore, one monitoring bore in the Triassic shale, and eight monitoring bores at different depths in the Hawkesbury Sandstone.

The main findings for this drilling program in regards to water levels are:

- Groundwater piezometric levels at the Denham Court site are deep, around 80 mbgl in the Ashfield Shale and around 40 mbgl in the Hawkesbury Sandstone, and there is currently no apparent influence from rainfall.
- Groundwater levels at the Menangle Park site in the alluvium and Hawkesbury Sandstone are shallow (<10 mbgl) and all bores show a response to rainfall and a similar response to the river levels (decreasing with depth). There is an apparent upward hydraulic gradient at this site except during high rainfall events. The similar response to rainfall and flooding events between the alluvial monitoring bore and the Hawkesbury Sandstone monitoring bores indicates connectivity between the two formations at this location, which is expected given the lack of a substantial confining layer (shale) between the formations.
- Groundwater levels at the Glenlee site in the Hawkesbury Sandstone are shallow (<15 mbgl) and there is currently no apparent influence from rainfall over the short monitoring period (three months). There is an apparent downward hydraulic gradient at this site.

The main findings for this drilling program in regards to water quality are:

- Denham Court site:
  - Groundwater within the Ashfield Shale is characterised as moderately saline. Dissolved metal concentrations are generally low with the exception of copper and zinc. Dissolved methane, ethane and propane were detected. Benzene was detected at low concentrations. No phenolic compounds or PAHs were detected. Low concentrations of TPH were detected.
  - Groundwater within the Hawkesbury Sandstone is characterised as slightly to moderately saline. Dissolved metal concentrations are generally low with the exception of various metals such as barium, strontium and zinc. Ammonia (as N) and reactive phosphorous concentrations exceed ANZECC (2000) guideline criteria. Dissolved methane and ethane were detected. Toluene was detected at decreasing concentration over the monitoring period. Phenolic compounds and PAHs were generally not detected. Low concentrations of TPH were detected.
- Menangle Park site: groundwater within the alluvium and Hawkesbury Sandstone is characterised as fresh to marginal. Groundwater pH range from acidic to alkaline. Dissolved metal concentrations are generally low with the exception of arsenic, copper, lead, nickel and zinc in at least one monitoring bore. Methane was detected in all monitoring bores except at MPMB01, with relatively low concentrations at MPMB02. Minor detections of hydrocarbons occurred at all monitoring bores.
- Glenlee site: groundwater within the Hawkesbury Sandstone is characterised as slightly saline. Groundwater pH conditions range from neutral to slightly alkaline. Dissolved metal concentrations are generally low with the exception of arsenic and zinc. Ammonia (as N) concentrations exceed the ANZECC (2000) guideline criteria at all bores. Dissolved methane, propane and ethene were detected in all bores. Phenol was detected at GLMB02 and GLMB03. Toluene, xylenes and TPH were detected at most bores. PAHs were not detected.
- Isotope data indicate that groundwater in all monitoring bores is of meteoric origin. Groundwater ranges in age from 2,800 yrs BP (MPMB02) to >40,000 yrs BP (RMB02) in the Hawkesbury Sandstone. The groundwater age does not always increase with depth, which is likely a result of preferential flow paths

in relatively permeable (aquifer) versus less permeable (aquitard) layers within the multilayered system of sub-aquifers.

- Methane isotope data indicates that methane is of thermogenic origin at all monitoring bores.

8. Statement of limitations

8.1 Scope of services

This report has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client (AGL) and Parsons Brinckerhoff (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

8.2 Reliance on data

In preparing the report, Parsons Brinckerhoff has relied upon data, surveys, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, Parsons Brinckerhoff has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Parsons Brinckerhoff will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Parsons Brinckerhoff.

8.3 Environmental conclusions

In accordance with the scope of services, Parsons Brinckerhoff has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

8.4 Report for benefit of client

The report has been prepared for the benefit of the client (and no other party). Parsons Brinckerhoff assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Parsons Brinckerhoff or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Parties other than the client should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

8.5 Other limitations

Parsons Brinckerhoff will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

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Appendix A

Bore logs

BORE COMPLETION REPORT - RMB01

Project: AGL Camden Gas Project
Location: Denham Court
Easting: 300412.6 **Northing:** 6237189.7
Top of casing elevation: 72.9 mAHD (PVC casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.52 m

Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 26
Drilling method: Rotary Air **Total drilled depth:** 84.0m

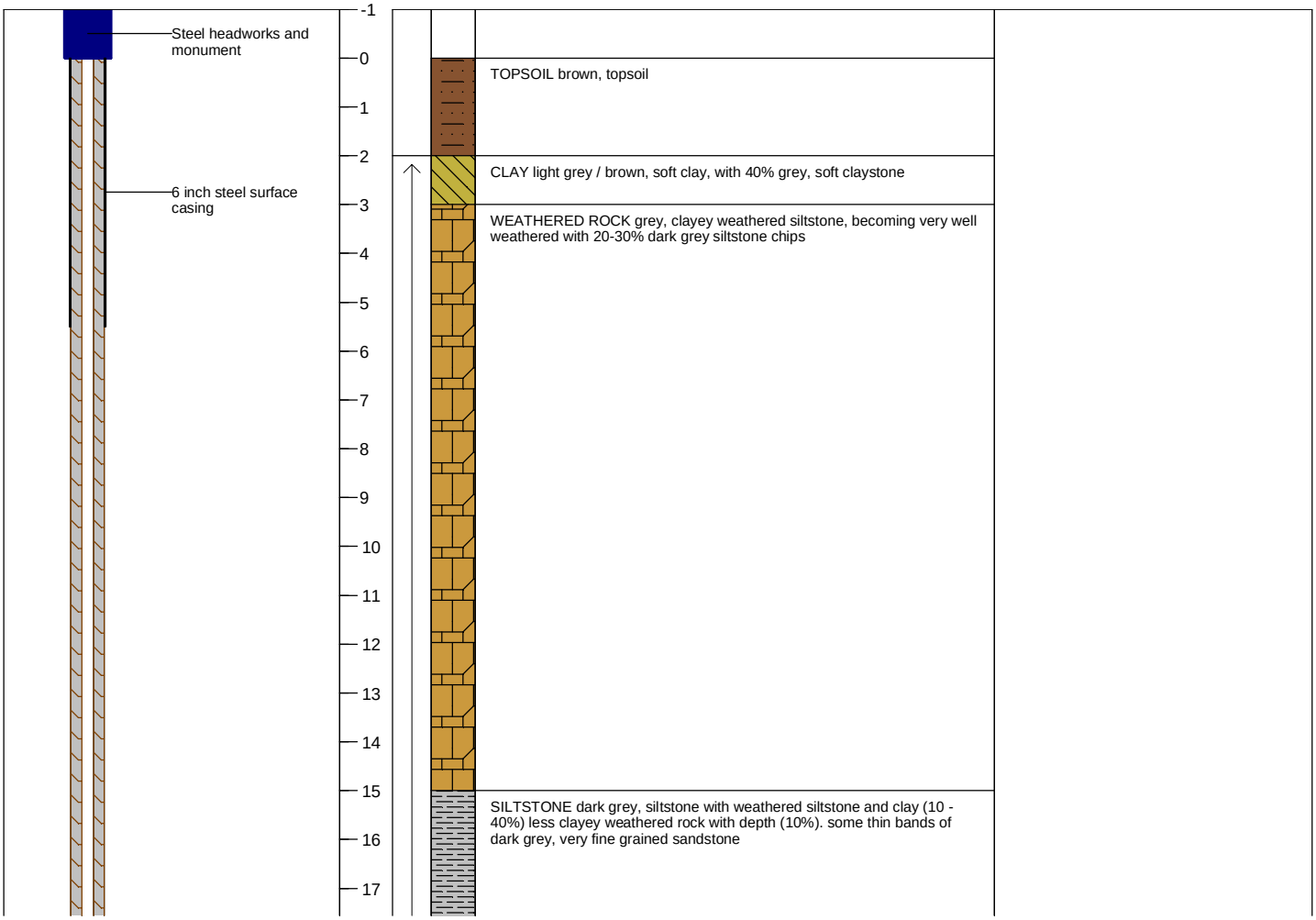
Borehole diameter:	203 mm	0.0 - 5.5 m	**Bit:** NA
Borehole diameter:	140 mm	5.5 - 84.0 m	**Bit:** DHH

Purpose of bore: Groundwater monitoring bore
Screened Formation: Ashfield Shale
Logged by: K. Maher
Start date: 13/10/11
Completion date: 13/10/11

Static WL: -8.3 mAHD 81.2 mbtoc
Water level date: 1/11/11

Plain casing: 0-69.0m: CLASS 18 50mm PVC
Screen: 69.0-81.0m: 50mm PVC Class 18 (0.5mm slot)
Sump: 81.0-84.0: 50mm PVC Class 18
Cement grout: 0-64.0m: 0.8m3
Gravel backfill: NA
Bentonite seal: 64.0 - 66.0m
Gravel pack: 66.0-84.0m: 5mm washed gravel
Bentonite plug: 81.0-84.0m

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY / GRAPHIC LOG	LITHOLOGY	WATER QUALITY



PARSONS BRINCKERHOFF

Drawing No.:	RMB01 - Bore Construction		
Revision:	A	Date drawn:	12/2/14
Drawn by:	K. Maher	Checked by:	J. Duggleby
Project No.	2114759B		

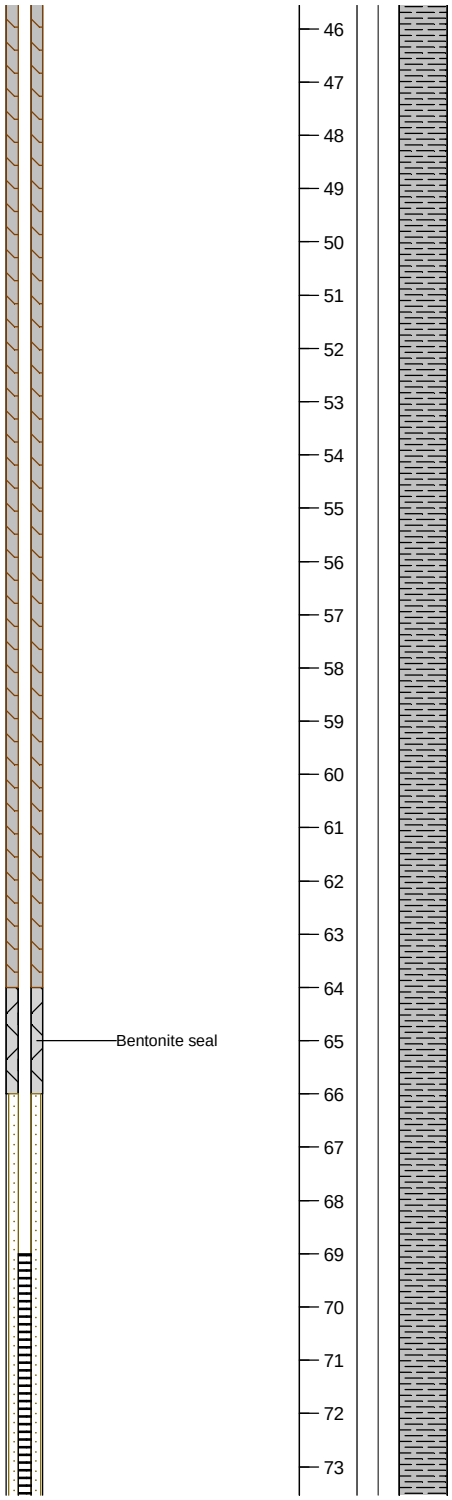
AGL

AGL Upstream Investments Pty Ltd
RMB01

BORE COMPLETION REPORT - RMB01

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
Cement grout 50mm blank PVC Class 18 casing (threaded) 5 1/2 inch diameter borehole	18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45	Ashfield Shale		SANDSTONE light grey, fine becoming very fine grained sandstone with some black carbonaceous staining. 20-30% weathered siltstone and clay SILTSTONE dark grey, siltstone with weathered siltstone and clay (10 - 40%) less clayey weathered rock with depth (10%). some thin bands of dark grey, very fine grained sandstone	

BORE COMPLETION REPORT - RMB01

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73				Not enough water to sample

PARSONS BRINCKERHOFF

Drawing No.: RMB01 - Bore Construction	
Revision: A	Date drawn: 12/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

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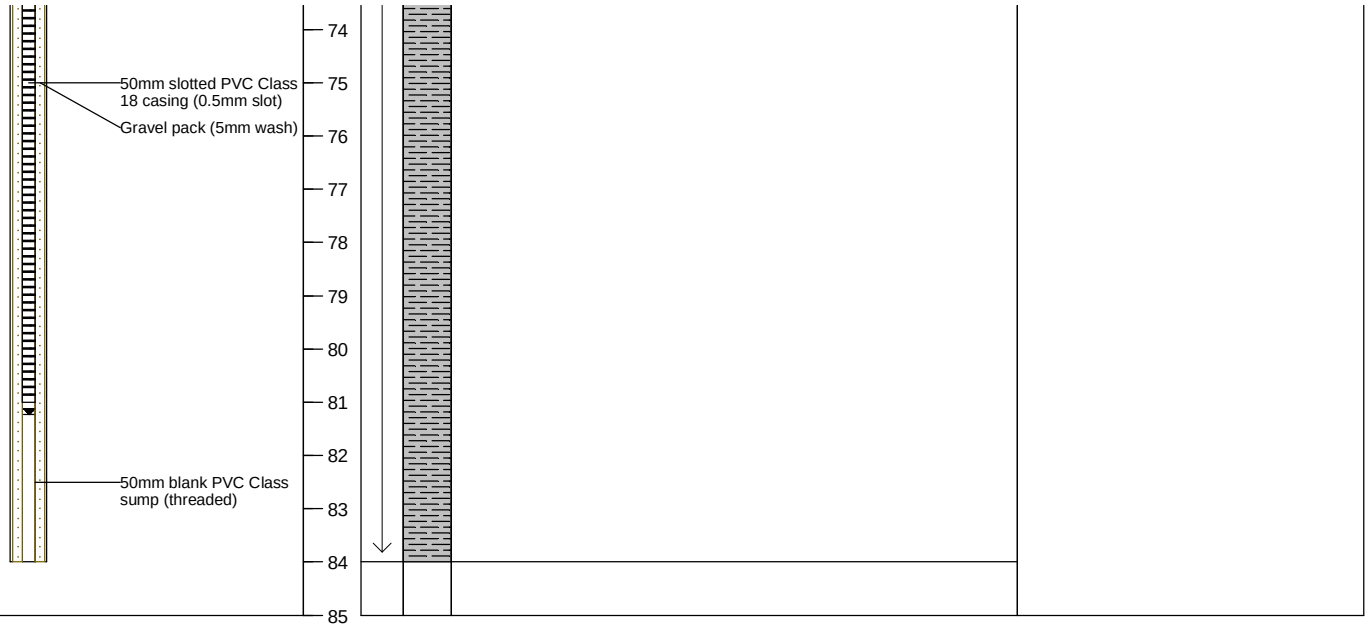
AGL Upstream Investments Pty Ltd
RMB01

BORE COMPLETION REPORT - RMB01

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY



PARSONS BRINCKERHOFF	Drawing No.: RMB01 - Bore Construction		AGL Upstream Investments Pty Ltd RMB01
	Revision: A	Date drawn: 12/2/14	
	Drawn by: K. Maher	Checked by: J. Duggleby	
	Project No. 2114759B		

BORE COMPLETION REPORT - RMB02

Project: AGL Camden Gas Project
Location: Denham Court
Easting: 300412.6 **Northing:** 6237189.7
Top of casing elevation: 73.3 mAHD (PVC casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.54 m

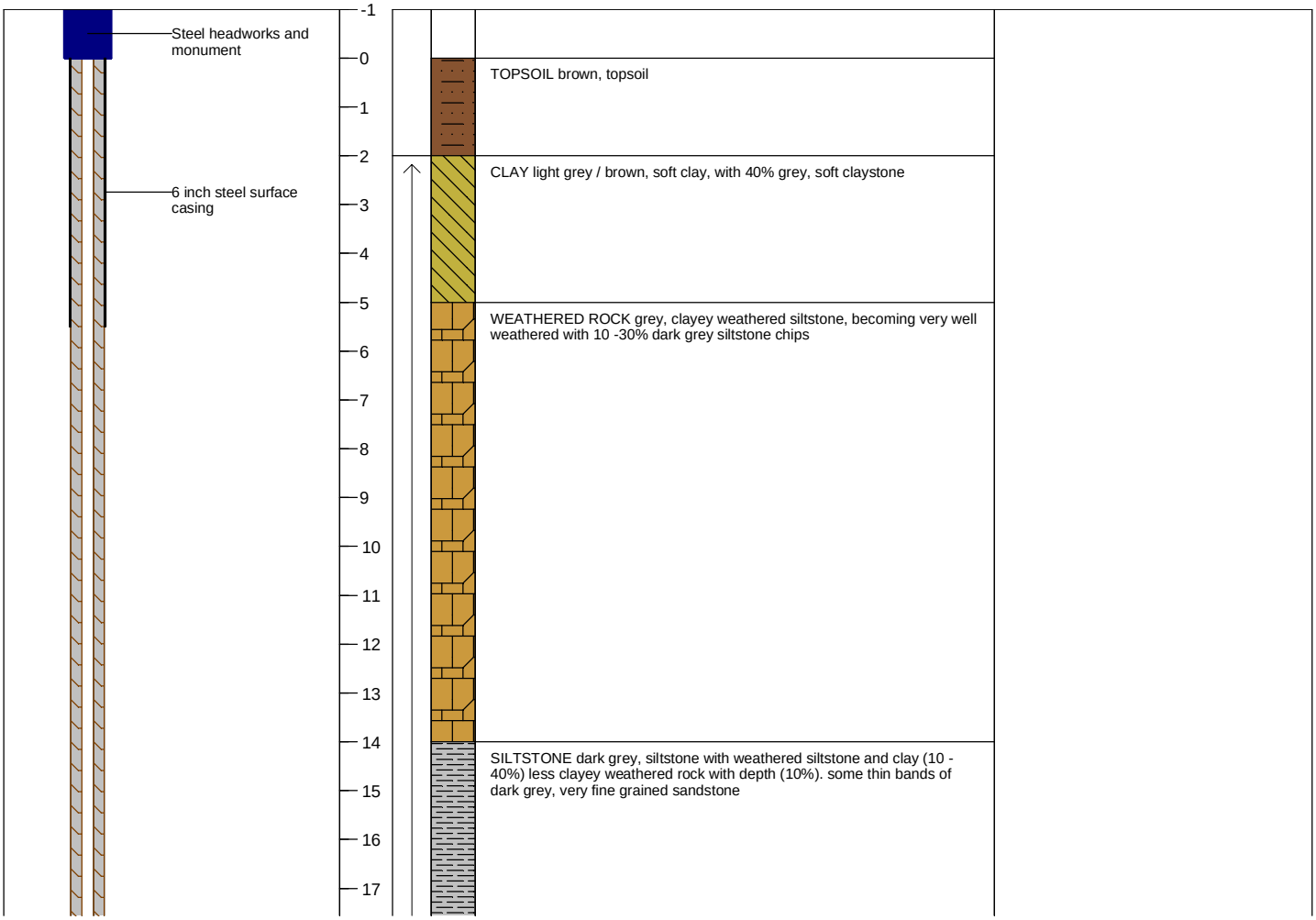
Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 26
Drilling method: Raotary Air **Total drilled depth:** 150 m

Borehole diameter:	203 mm	0.0 - 5.5 m	**Bit:** DHH
Borehole diameter:	140 mm	5.5 - 150 m	**Bit:** DHH

Purpose of bore: Groundwater monitoring bore
Screened Formation: Hawkesbury Sandstone
Logged by: K. Maher
Start date: 11/10/11
Completion date: 11/10/11

Static WL: 32.0 mAHD 41.3 mbtoc
Water level date: 1/11/11

Plain casing: 0-135.0m: CLASS 18 50mm PVC
Screen: 135.0-147.0m: 50mm PVC Class 18 (0.5mm slot)
Sump: 147.0-150.0: 50mm PVC Class 18
Cement grout: 0-132.0m: 1.7m3
Gravel backfill: NA
Bentonite seal: 130.0-132.0m
Gravel pack: 132.0-147.0m: 5mm washed gravel
Bentonite plug: 147.0-150.0m



PARSONS BRINCKERHOFF

Drawing No.:	RMB02 - Bore Construction		
Revision:	A	Date drawn:	12/2/14
Drawn by:	K. Maher	Checked by:	J. Duggleby
Project No.	2114759B		

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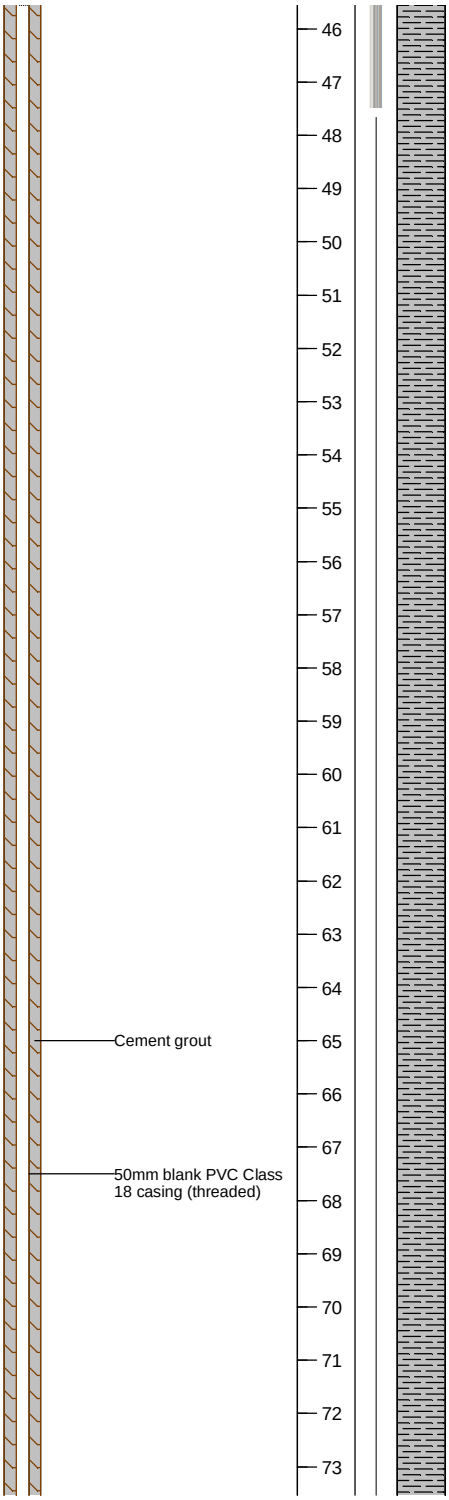
AGL Upstream Investments Pty Ltd
RMB02

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45			SANDSTONE light grey, fine becoming very fine grained sandstone with some black carbonaceous staining. 10 - 20% weathered siltstone and clay SILTSTONE dark grey, siltstone with weathered siltstone and clay (10 - 40%) less clayey weathered rock with depth (10%). some thin bands of dark grey, very fine grained sandstone	

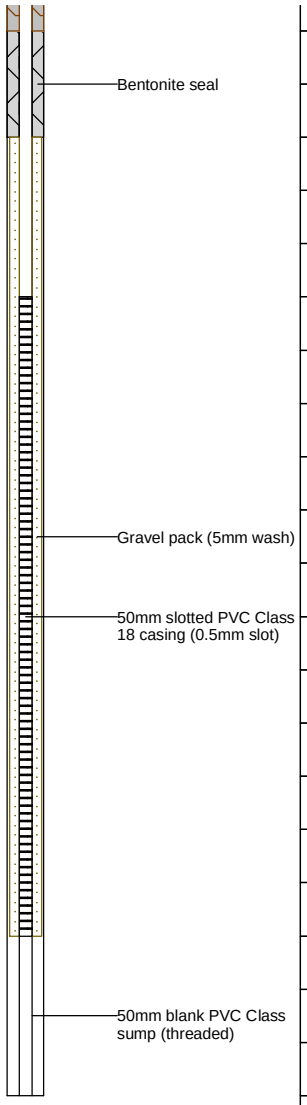
BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY



BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
5 1/2 inch diameter borehole	74				
	75				
	76				
	77				
	78				
	79				
	80				
	81				
	82				
	83				
	84				
	85				
	86				
	87				
	88				
	89				
	90				
	91	Mittagong Formation		SANDSTONE dark grey, very fine grained and light grey, fine grained sandstone, with 10 - 20% weathered sandstone and clay.	
	92				
	93				
	94				
	95				
	96			SANDSTONE white (some light grey), fine to medium grained, loosly consolidated silica cemented quartz sandstone, with 10 - 40% translucent, sub angular to sub rounded, moderatly sorted coarse quartz	
	97				
	98				
	99				
	100				
	101				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	102				
	103				
	104				
	105			SANDSTONE light grey , some black carbonaceous staining on the sandstone	
	106				
	107				
	108				
	109				
	110				
	111				
	112				
	113				
	114				Water Cut: 0.10L/s, Temp: 24.8°C, EC: 8008 µS/cm, TDS: 5.211 g/L, DO: 90.8 %, , pH: 8.04, ORP: -81.9 mV
	115				
	116				
	117				
	118				
	119				
	120				
	121				
	122	Hawkesbury Sandstone			
	123				
	124				
	125			SANDSTONE light brown, fine to medium grained, consolidated quartz sandstone, with 40% fine to medium grained, loosly consolidated white sandstone	
	126				Water Cut: 0.15L/s, Temp: 23.97°C, EC: 8689 µS/cm, TDS: 5.649 g/L, DO: 100.1 %, , pH: 8.15, ORP: -80.2 mV
	127				
	128				
	129				

BORE COMPLETION REPORT - RMB02

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151			SANDSTONE light brown, fine to medium grained, consolidated quartz sandstone, with 50% fine to medium grained, loosly consolidated white sandstone SANDSTONE dark grey, very fine grained sandtone, with 10% light grey, fine to medium grained sandstone	Water Cut: 0.15L/s, Temp: 21.58°C, EC: 9567 µS/cm, TDS: 6.125 g/L, DO: 110.0 %, , pH: 7.96, ORP: -70.0 mV Water Cut: 0.20L/s, Temp: 23.24°C, EC: 10559 µS/cm, TDS: 6.864 g/L, DO: 88.9 %, , pH: 7.90, ORP: -76.9 mV Water Cut: 0.20L/s, Temp: 24.42°C, EC: 10869 µS/cm, TDS: 6.99 g/L, DO: 92.4 %, , pH: 9.96, ORP: -84.3 mV

PARSONS BRINCKERHOFF

Drawing No.: RMB02 - Bore Construction	
Revision: A	Date drawn: 12/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

AGL Upstream Investments Pty Ltd

RMB02

BORE COMPLETION REPORT - RMB03

Project: AGL Camden Gas Project
Location: Denham Court
Easting: 300412.6 **Northing:** 6237189.7
Top of casing elevation: 73.54 mAHD (Gal casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.54 m

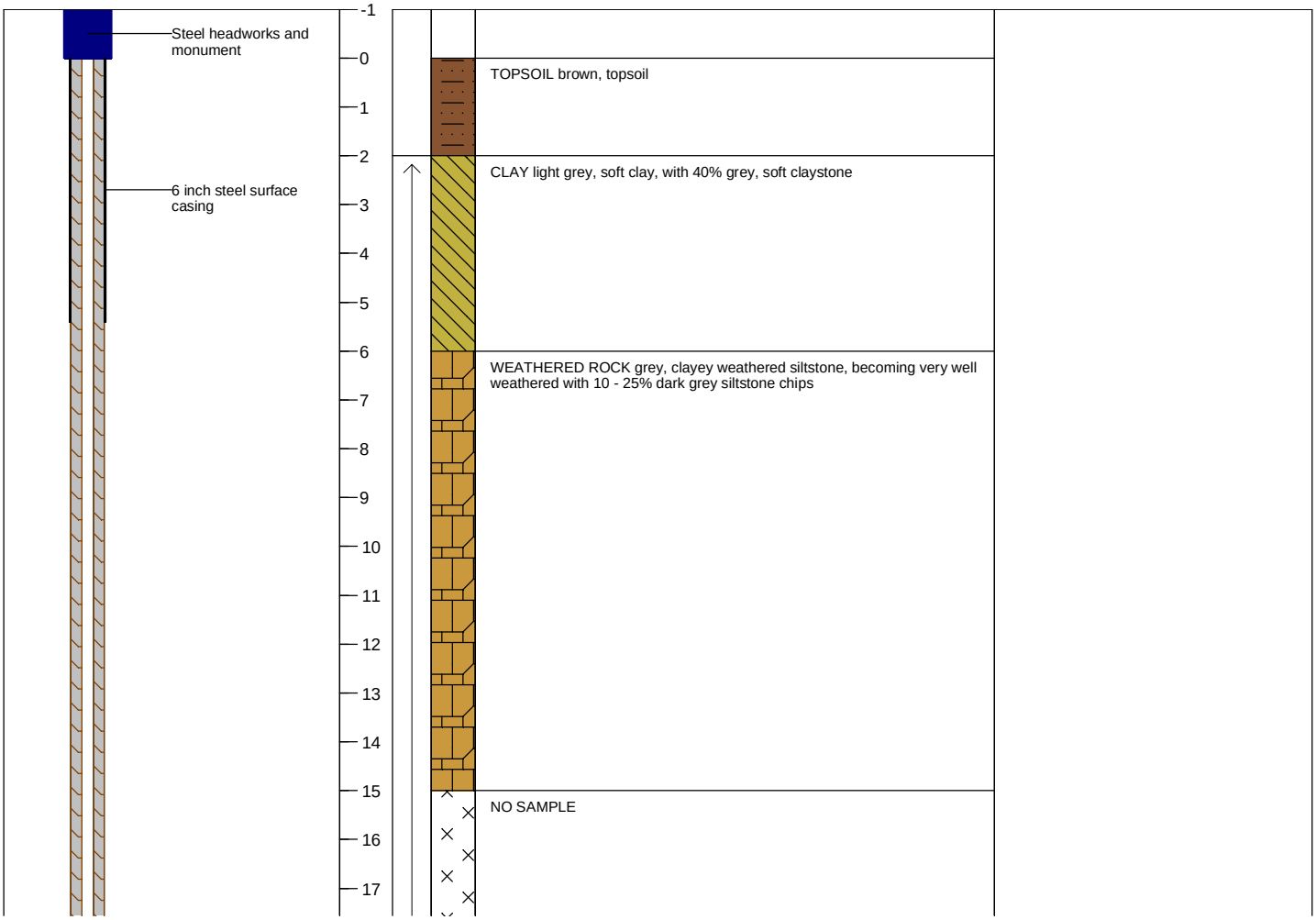
Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 26
Drilling method: Rotary Air **Total drilled depth:** 300.0 m

Borehole diameter:	203 mm	0.0 - 5.4 m	**Bit:** DHH
Borehole diameter:	140 mm	5.4 - 300.0 m	**Bit:** DHH

Purpose of bore: Groundwater monitoring bore
Screened Formation: Hawkesbury Sandstone
Logged by: K. Maher
Start date: 5/10/11
Completion date: 17/10/11

Static WL: 32.29 mAHD 41.25 mbtoc
Water level date: 1/11/11

Plain casing: 0-289.33m: 50mm Galv pipe 50NB
Screen: 289.3-298.9m: 50mm Galv pipe 304SS(1mm slot)
Sump: 298.9-300.0m: 50mm Galv pipe 50NB
Cement grout: 0-124.0m: 1.6m3
Gravel backfill: NA
Bentonite seal: 248.5-286.5m
Gravel pack: 286.5-300.0m: 5mm washed gravel
Bentonite plug: NA



PARSONS BRINCKERHOFF

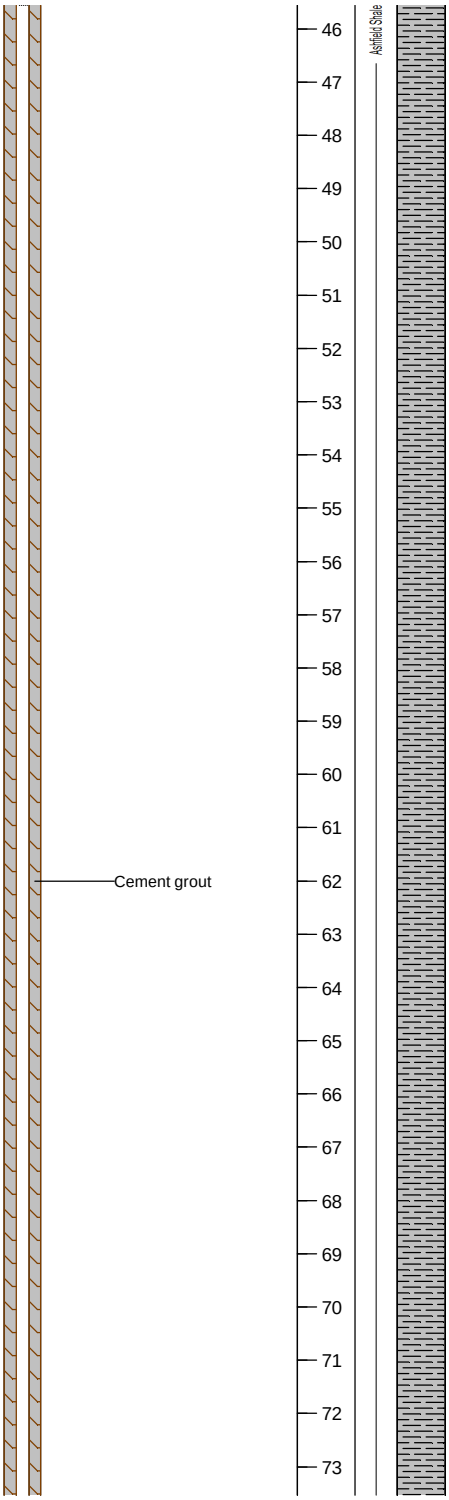
Drawing No.:	RMB03 - Bore Construction		
Revision:	A	Date drawn:	12/2/14
Drawn by:	K. Maher	Checked by:	J. Duggleby
Project No.	2114759B		

AGL

AGL Upstream Investments Pty Ltd
RMB03

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45	Ashfield Shale		SILTSTONE dark grey, siltstone with weathered siltstone and clay (10 - 40%) less clayey weathered rock with depth (10%). some thin bands of dark grey, very fine grained sandstone SANDSTONE grey, fine becoming very fine grained sandstone with some black carbonaceous staining. 20 - 30% weathered siltstone and clay SILTSTONE dark grey, siltstone with weathered siltstone and clay (10 - 40%) less clayey weathered rock with depth (10%). some thin bands of dark grey, very fine grained sandstone	

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY



PARSONS BRINCKERHOFF	Drawing No.: RMB03 - Bore Construction		AGL Upstream Investments Pty Ltd RMB03
	Revision: A	Date drawn: 12/2/14	
	Drawn by: K. Maher	Checked by: J. Duggleby	
	Project No. 2114759B		

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	74–88				
	89–95	Mittagong Formation		SANDSTONE dark grey, very fine grained and light grey, fine grained sandstone, with 10 - 20% weathered sandstone and clay.	
	96–101			SANDSTONE white (some light grey), fine to medium grained, loosly consolidated silica cemented quartz sandstone, with 10 - 40% translucent, sub angular to sub rounded, moderatly sorted coarse quartz	

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	102				Water Cut: 0.10L/s, Temp: 23.79°C pH: 7.79, EC: 5588 µS/cm, TDS: 3.72 g/L, DO: 99.1 %, ORP: -40.7 mV
	103				
	104				
	105				
	106				
	107				
	108				
	109				
	110				
	111				
	112				
	113				
	114				
	115				
	116				
	117				
	118				
	119				
	120				
	121				
	122				
	123				
	124				
	125			SANDSTONE light brown, fine to medium grained, consolidated quartz sandstone, with 40% fine to medium grained, loosly consolidated white sandstone	Water Cut: 0.20L/s, Temp: 23.18°C pH: 7.85, EC: na µS/cm, TDS: 1.761 g/L, DO: 102.1 %, ORP: -51.4 mV
	126				
	127				
	128				
	129				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	130				
	131				
	132				Water Cut: 0.20L/s, Temp: 23.11°C pH: 7.82, EC: 6635 µS/cm, TDS: 4.317 g/L, DO: 97.4 %, ORP: -48.2 mV
	133				
	134				
	135				
	136			SANDSTONE white / light grey, some black carbonaceous staining on the sandstone	
	137				
	138				Water Cut: 0.20L/s, Temp: 22.65°C pH: 7.96, EC: 6440 µS/cm, TDS: 4.187 g/L, DO: 104.0 %, ORP: -49.6 mV
	139				
	140				
	141				
	142				
	143				
	144			SANDSTONE light brown, fine to medium grained, consolidated quartz sandstone, with 40% fine to medium grained, loosly consolidated white sandstone	
50NB MED Galv pipe	145				
	146				
	147				
	148			SANDSTONE dark grey, very fine grained sandtone, with 10% light grey, fine to medium grained sandstone	
	149				
5 1/2 inch diameter borehole	150				Water Cut: 0.25L/s, Temp: 23.14°C pH: 8.00, EC: 9321 µS/cm, TDS: 6.06 g/L, DO: 93.8 %, ORP: -50.5 mV
	151				
	152				
	153			SANDSTONE light brown, fine to medium grained, consolidated quartz sandstone, with 10% fine to medium grained, loosly consolidated white sandstone	
	154				
	155				
	156				Water Cut: 0.30L/s, Temp: 19.93°C pH: 7.90, EC: 9625 µS/cm, TDS: 6.26 g/L, DO: 120.6 %, ORP: -32.8 mV
	157			SANDSTONE dark grey, very fine to fine grained sandstone	

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	158				
	159				
	160				
	161				
	162				Water Cut: 0.25L/s, Temp: 20.63°C pH: 7.91, EC: 9776 µS/cm, TDS: 6.352 g/L, DO: 127.6 %, ORP: -32.9 mV
	163				
	164				
	165				
	166				
	167				
	168				Water Cut: 0.20L/s, Temp: 21.82°C pH: 7.90, EC: 10970 µS/cm, TDS: 7.126 g/L, DO: 109.2 %, ORP: -25.4 mV
	169				
	170				
	171				
	172				
	173				
	174				Water Cut: 0.20L/s, Temp: 23.04°C pH: 7.96, EC: 10458 µS/cm, TDS: 6.798 g/L, DO: 114.5 %, ORP: -24.8 mV
	175				
	176				
	177				
	178				
	179				
	180				Water Cut: 0.20L/s, Temp: 23.64°C pH: 7.94, EC: 9462 µS/cm, TDS: 6.153 g/L, DO: 105.5 %, ORP: -23.4 mV
	181				
	182				
	183				
	184				
	185				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
Blue metal gravel backfill (5-8mm wash)	186	Hawkesbury Sandstone			Water Cut: 0.20L/s, Temp: 22.25°C pH: 7.89, EC: 7533 µS/cm, TDS: 4.895 g/L, DO: 100.8 %, ORP: -22.7 mV
	187				
	188				
	189				
	190				
	191				
	192				Water Cut: 0.20L/s, Temp: 22.2°C pH: 7.89, EC: 7715 µS/cm, TDS: 5.023 g/L, DO: 117.3 %, ORP: -13.5 mV
	193			SANDSTONE light brown, fine to medium grained, consolidated quartz sandstone, with 30 - 40% fine to medium grained, loosly consolidated white sandstone	
	194				
	195				
	196				
	197				
	198				Water Cut: 0.20L/s, Temp: 24.72°C pH: 7.97, EC: 8562 µS/cm, TDS: 5.569 g/L, DO: 106.3 %, ORP: -16.2 mV
	199				
	200				
	201				
	202				
	203				
	204				Water Cut: 0.20L/s, Temp: 24.28°C pH: 7.87, EC: 8658 µS/cm, TDS: 5.638 g/L, DO: 121.1 %, ORP: -18.5 mV
	205				
	206				
	207				
	208				
	209				
	210				Water Cut: 0.20L/s, Temp: 22.76°C pH: 7.83, EC: 9029 µS/cm, TDS: 5.87 g/L, DO: 109.7 %, ORP: -17.1 mV
	211				
	212				
	213				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241			SANDSTONE dark grey, very fine grained sandtone, with 10 - 30% light grey, fine to medium grained sandstone SANDSTONE light grey , some black carbonaceous staining on the sandstone SHALE dark grey, hard, platy habit shale	Water Cut: L/s, Temp: 21.88°C pH: 7.92, EC: 6375 µS/cm, TDS: 4.145 g/L, DO: 96.5 %, ORP: -25.6 mV Water Cut: 0.27L/s, Temp: 22.18°C pH: 7.81, EC: 9632 µS/cm, TDS: 6.26 g/L, DO: 91.8 %, ORP: -22.5 mV Water Cut: 0.27L/s, Temp: 20.41°C pH: 7.81, EC: 6840 µS/cm, TDS: 4.446 g/L, DO: 82.7 %, ORP: -28 mV Water Cut: 0.30L/s, Temp: 21.12°C pH: 7.87, EC: 6912 µS/cm, TDS: 4.492 g/L, DO: 82.6 %, ORP: -29.7 mV Water Cut: 0.40L/s, Temp: 19.48°C pH: 7.63, EC: 8989 µS/cm, TDS: 5.838 g/L, DO: 7.63 %, ORP: -25.9 mV

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	242				
	243				
	244				
	245				
	246				Water Cut: 0.50L/s, Temp: 21.24°C pH: 7.89, EC: 6673 µS/cm, TDS: 4.337 g/L, DO: 90.4 %, ORP: -22.1 mV
	247				
	248				
	249				
	250				
	251				
	252				Water Cut: 0.50L/s, Temp: 20.25°C pH: 7.90, EC: 7244 µS/cm, TDS: 4.715 g/L, DO: 92.2 %, ORP: 29.69 mV
	253				
	254				
	255				
	256				
	257				
	258				Water Cut: 0.50L/s, Temp: 20.58°C pH: 7.83, EC: 6440 µS/cm, TDS: 4.186 g/L, DO: 81.6 %, ORP: -32.6 mV
	259				
	260			SHALE dark grey, hard, platy habit shale	
	261				
	262				
	263				
	264				Water Cut: 0.50L/s, Temp: 19.2°C pH: 6.72, EC: 12035 µS/cm, TDS: 7.823 g/L, DO: 28.5 %, ORP: -139.7 mV
	265			SHALE dark grey, hard, platy habit shale	
	266				
	267				
Bentonite seal	268			SANDSTONE white / light grey, some black carbonaceous staining on the sandstone	
	269				

PARSONS BRINCKERHOFF

Drawing No.: RMB03 - Bore Construction	
Revision: A	Date drawn: 12/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

AGL

AGL Upstream Investments Pty Ltd
RMB03

BORE COMPLETION REPORT - RMB03

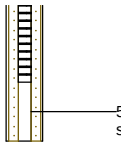
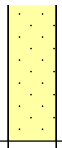
BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	270				Water Cut: 1.25L/s, Temp: 20.06°C pH: 8.02, EC: 7469 µS/cm, TDS: 4.855 g/L, DO: 95.8 %, ORP: -82.3 mV
Bentonite grout seal	271				
	272				
	273				
	274				
	275				
	276				Water Cut: 0.90L/s, Temp: 24.2°C pH: 8.12, EC: 7962 µS/cm, TDS: 5.176 g/L, DO: 89.9 %, ORP: -65.9 mV
	277				
	278				
	279				
	280			SANDSTONE light brown, fine grained, well consolidated quartz sandstone	
	281				
	282				Water Cut: 0.90L/s, Temp: 23.95°C pH: 7.61, EC: 8387 µS/cm, TDS: 5.452 g/L, DO: 102.0 %, ORP: -34.9 mV
	283				
	284				
	285				
	286			SANDSTONE light brown, fine to medium grained, consolidated quartz sandstone, with 10 - 30% fine to medium grained, loosly consolidated white sandstone	
	287				
	288				Water Cut: 0.90L/s, Temp: 25.19°C pH: 7.97, EC: 6852 µS/cm, TDS: 4.454 g/L, DO: 93.4 %, ORP: -32.8 mV
	289				
	290				
	291				
	292			SANDSTONE light brown, fine to medium grained, consolidated quartz sandstone	
Gravel pack (5mm wash)	293				
50mm 304SS (1mm slot)	294				Water Cut: 0.90L/s, Temp: 25.34°C pH: 8.01, EC: 6743 µS/cm, TDS: 4.361 g/L, DO: 103.0 %, ORP: 3.1 mV
	295				
	296				
	297				

PARSONS BRINCKERHOFF

Drawing No.: RMB03 - Bore Construction		
Revision: A	Date drawn: 12/2/14	
Drawn by: K. Maher	Checked by: J. Duggleby	
Project No. 2114759B		

AGL

AGL Upstream Investments Pty Ltd
RMB03

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
 50NB MED Galv pipe sump	298 299 300 301				Water Cut: 0.90L/s, Temp: 25.68°C pH: 7.89, EC: 7850 µS/cm, TDS: 5.107 g/L, DO: 93.0 %, ORP: -40.9 mV

BORE COMPLETION REPORT - RMB04

Project: AGL Camden Gas Project
Location: Denham Court
Easting: 300412.6 **Northing:** 6237189.7
Top of casing elevation: 62.463 mAHD (PVC casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.54 m

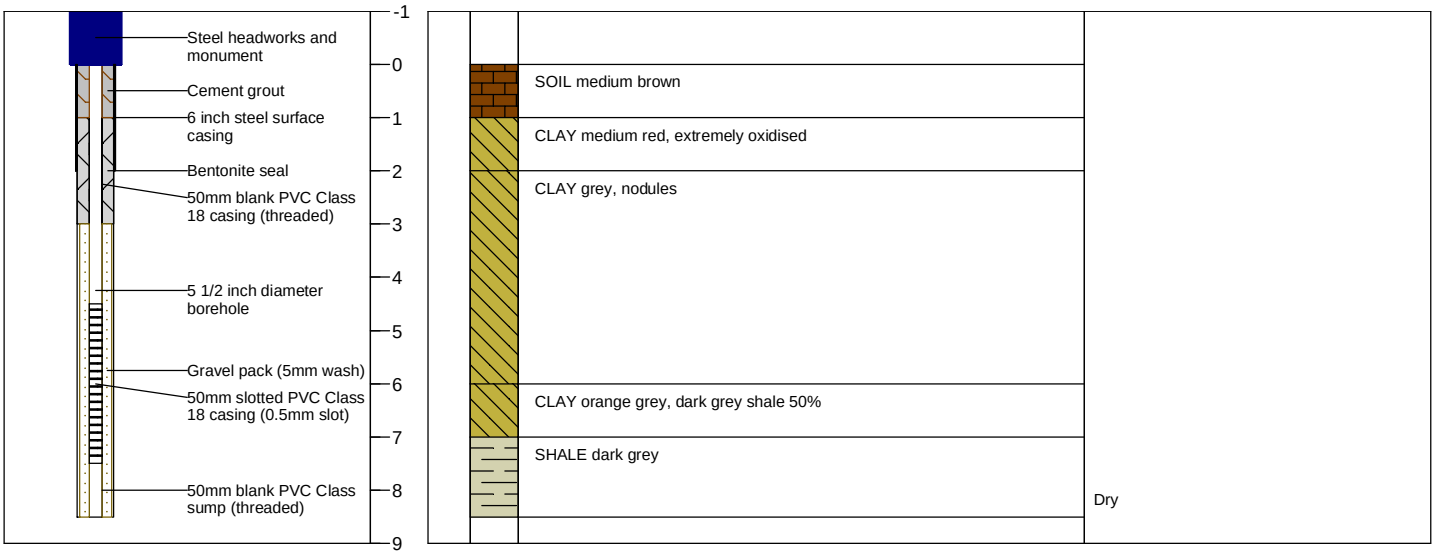
Drilling contractor: Highland Drilling
Driller: NA **Rig:** Rig 26
Drilling method: Auger **Total drilled depth:** 8.5 m

Borehole diameter: 101.6 mm 0.0 - 8.5 m **Bit:** Auger
Borehole diameter: NA **Bit:** NA

Purpose of bore: Groundwater monitoring bore
Screened Formation: Clay and shale
Logged by: K. Maher
Start date: 14/6/13
Completion date: 14/6/13

Static WL: DRY DRY
Water level date: 10/9/13

Plain casing: 0-4.5m: CLASS 18 50mm PVC
Screen: 4.5-7.5m: 50mm PVC Class 18 (0.5mm slot)
Sump: 7.5-8.5: 50mm PVC Class 18
Cement grout: 0-1.0m: 0.012m3
Gravel backfill: NA
Bentonite seal: 1-3m
Gravel pack: 3-8.5m: 5mm washed gravel
Bentonite plug: NA



PARSONS BRINCKERHOFF

Drawing No.: RMB04 - Bore Construction	
Revision: A	Date drawn: 23/10/13
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

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AGL Upstream Investments Pty Ltd
RMB04

BORE COMPLETION REPORT - MPMB01

Project: AGL Camden Gas Project
Location: Menangle Park 25
Easting: 291426.371 **Northing:** 6223648.178
Top of casing elevation: 67.196 m AHD (PVC casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.52 m

Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 25
Drilling method: Rotary Air **Total drilled depth:** 18.5 m

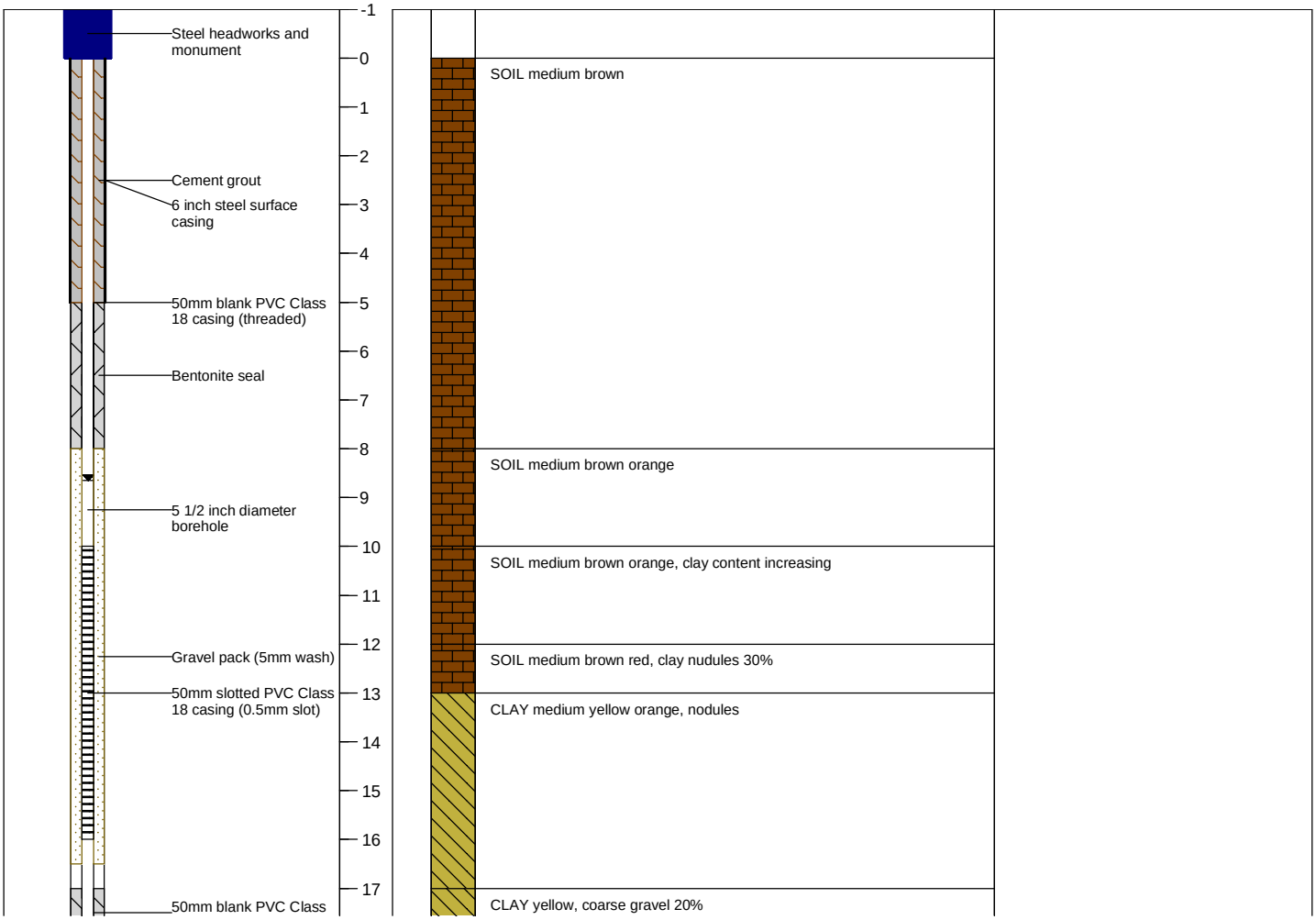
Borehole diameter: 205 mm 0 - 18.5 m **Bit:** Blade
Borehole diameter: NA **Bit:** NA

Purpose of bore: Groundwater monitoring bore
Screened Formation: Shallow Alluvium
Logged by: K. Maher
Start date: 11/6/13
Completion date: 11/6/13

Static WL: 58.03 mAHD 8.65 mbtoc
Water level date: 10/9/13

Plain casing: 0-10.0m: CLASS 18 50mm PVC
Screen: 10-16.0m: 50mm PVC Class 18 (0.5mm slot)
Sump: 16.5-18.5m: 50mm PVC Class 18
Cement grout: 0-5.0m: 0.06m3
Gravel backfill: NA
Bentonite seal: 5.0-8.0m
Gravel pack: 8-16.5m: 5mm washed gravel
Bentonite plug: 17-18.5m

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY / GRAPHIC LOG	LITHOLOGY	WATER QUALITY



PARSONS BRINCKERHOFF

Drawing No.: MPMB01 - Bore Construction	
Revision: A	Date drawn: 23/10/13
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

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MPMB01

Phase 2 Goundwater Investigation

BORE COMPLETION REPORT - MPMB01

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
18 sump (threaded) Bentonite plug	18 19				Dry

PARSONS BRINCKERHOFF	Drawing No.: MPMB01 - Bore Construction		AGL Upstream Investments Pty Ltd MPMB01 Phase 2 Goundwater Investigation
	Revision: A	Date drawn: 23/10/13	
	Drawn by: K. Maher	Checked by: J. Duggleby	
	Project No. 2114759B		

BORE COMPLETION REPORT - MPMB02

Project: AGL Camden Gas Project
Location: Menangle Park 25
Easting: 291426.9 **Northing:** 6223656.1
Top of casing elevation: 67.129 m AHD (PVC casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.50 m

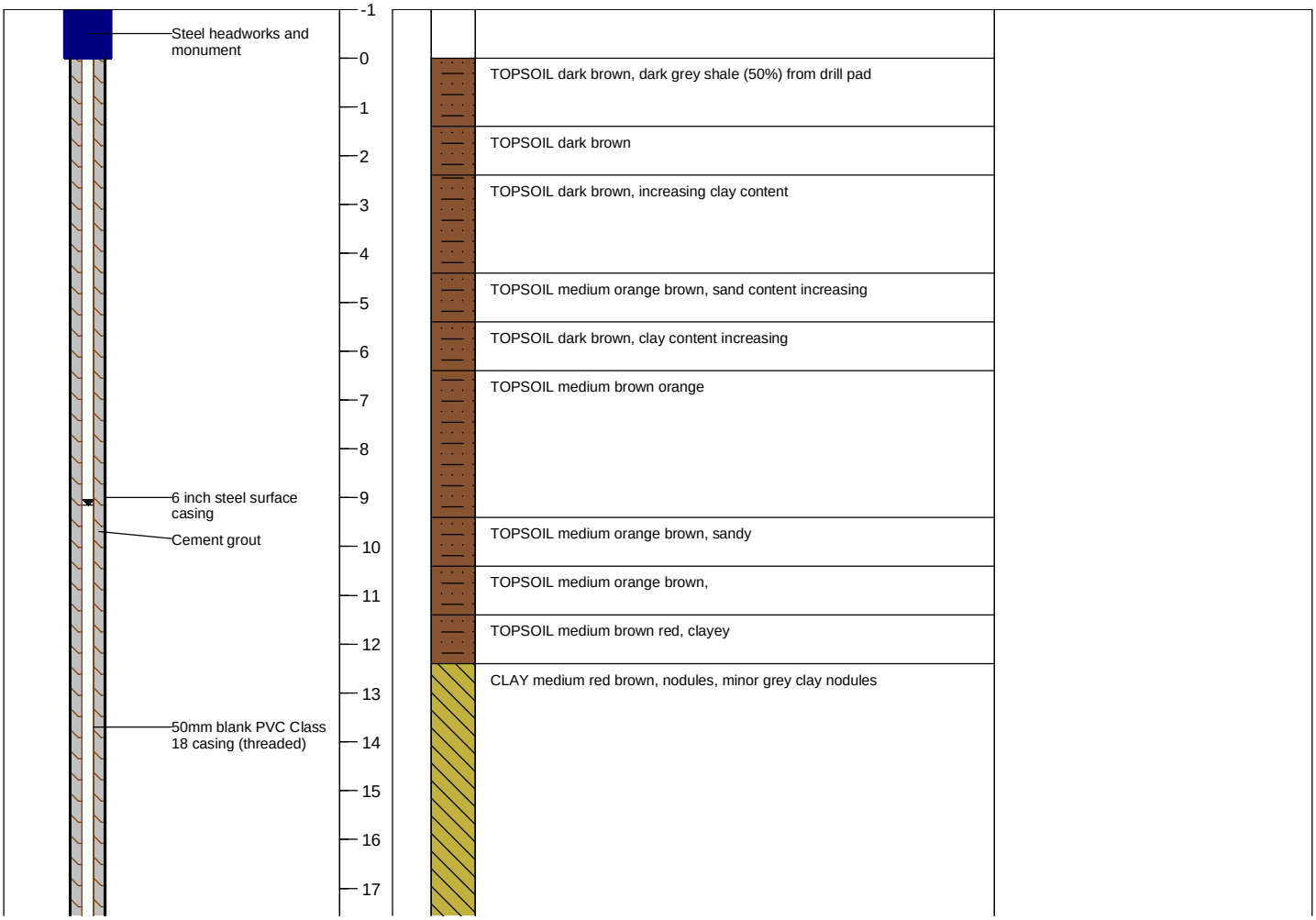
Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 25
Drilling method: RC **Total drilled depth:** 42 m

Borehole diameter:	205 mm	0 - 18.4 m	**Bit:**
Borehole diameter:	139 mm	18.4 - 42.2 m	**Bit:**

Purpose of bore: Groundwater monitoring bore
Screened Formation: Hawkesbury Sandstone
Logged by: K. Maher
Start date: 6/5/13
Completion date: 6/5/13

Static WL: 57.48 mAHD 9.15 mbtoc
Water level date: 10/9/13

Plain casing: 0-27.4m: CLASS 18 50mm PVC
Screen: 27.4-39.4m: 50mm PVC Class 18 (0.5mm slot)
Sump: 39.4-42.4m: 50mm PVC Class 18
Cement grout: 0-19.4m: 0.23m3
Gravel backfill:
Bentonite seal: 19.4-23.4m
Gravel pack: 23.4-39.9m: 5mm washed gravel
Bentonite plug: 39.9-42.4m



PARSONS BRINCKERHOFF

Drawing No.:	MPMB02 - Bore Construction		
Revision:	A	Date drawn:	23/10/13
Drawn by:	K.Maher	Checked by:	
Project No.	2114759B		

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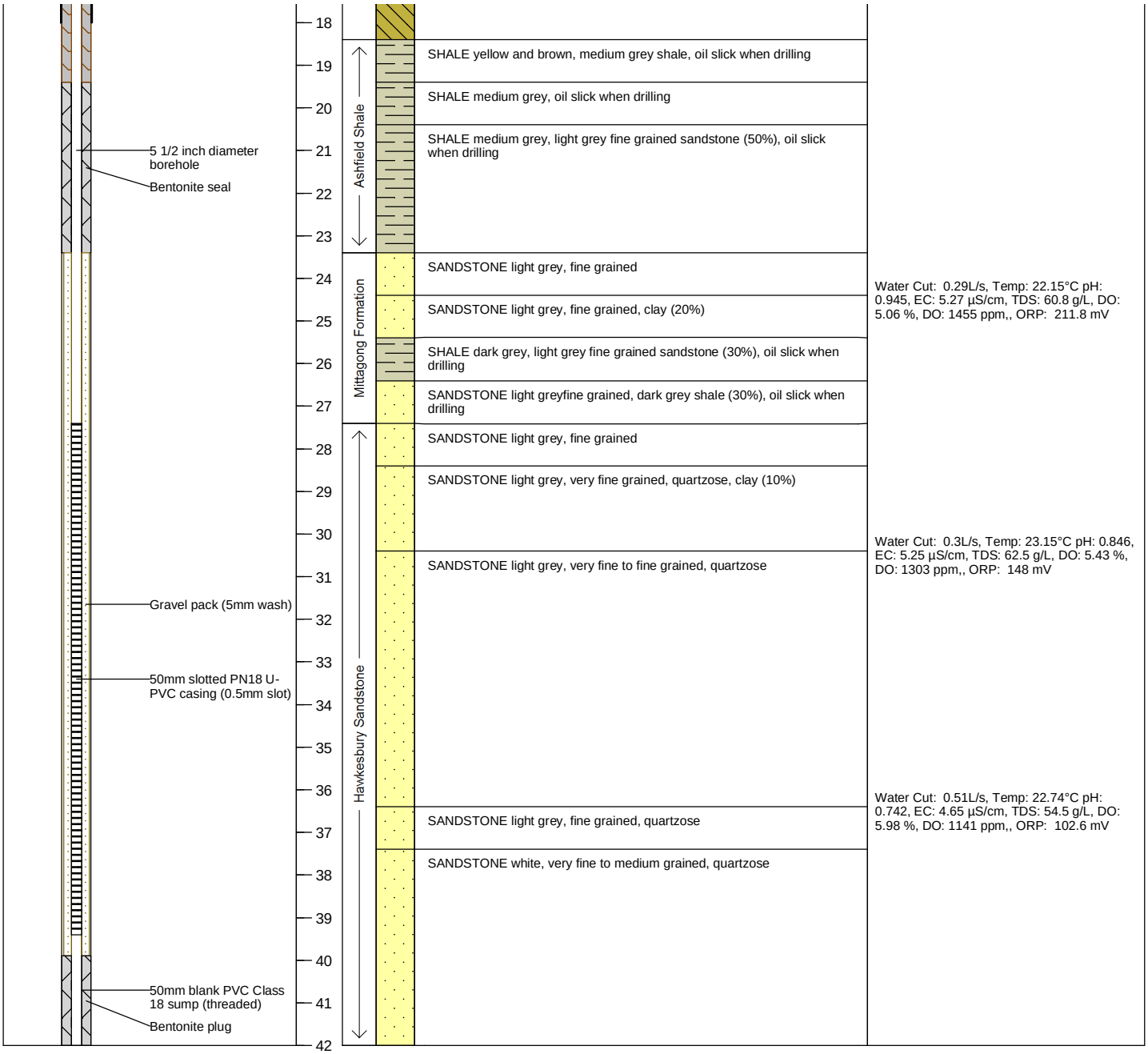
MPMB02

BORE COMPLETION REPORT - MPMB02



PARSONS BRINCKERHOFF

Drawing No.: MPMB02 - Bore Construction	
Revision: A	Date drawn: 23/10/13
Drawn by: K.Maher	Checked by:
Project No. 2114759B	

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MPMB02

BORE COMPLETION REPORT - MPMB03

Project: AGL Camden Gas Project
Location: Menangle Park 25
Easting: 291425.3 **Northing:** 6223662.8
Top of casing elevation: 66.971 mAHD (PCV casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.55 m

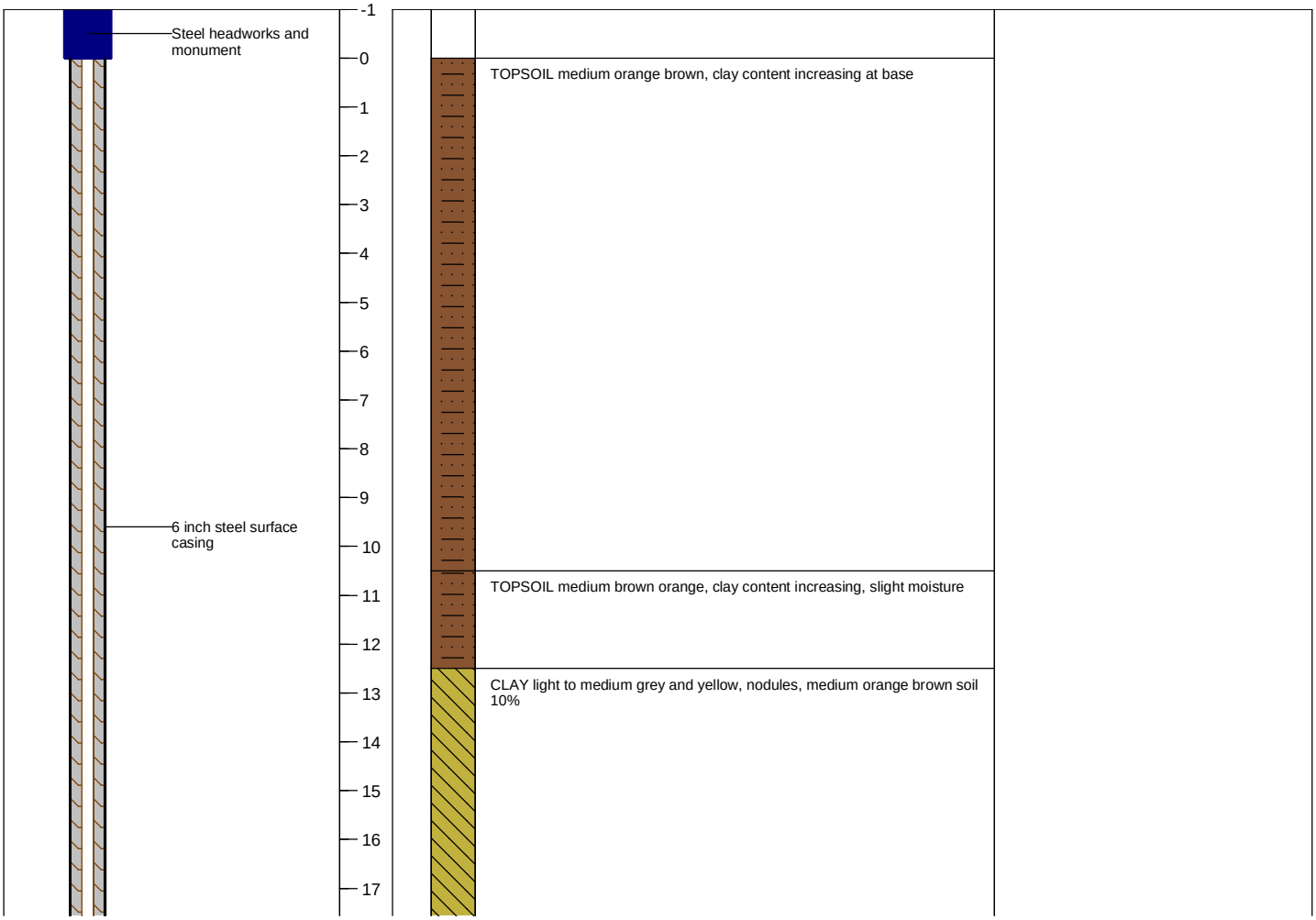
Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 25
Drilling method: Rotarty Air **Total drilled depth:** 108.5 m

Borehole diameter:	205 mm	0 - 19.5 m	**Bit:** Blade
Borehole diameter:	139 mm	19.5 - 108.5 m	**Bit:** DHH

Purpose of bore: Groundwater monitoring bore
Screened Formation: Hawkesbury Sandstone
Logged by: K. Maher
Start date: 29/5/13
Completion date: 3/6/13

Static WL: 58.37 mAHD 8.05 mbtoc
Water level date: 10/9/13

Plain casing: 0-97.0m: CLASS 18 50mm PVC
Screen: 97-106.0m: 50mm PVC Class 18 (0.5mm slot)
Sump: 106-108.0m: 50mm PVC Class 18
Cement grout: 0-48.0m: 2.0m3
Gravel backfill: 50-89.0m: 5-8mm gravel backfill
Bentonite seal: 48-50.0m
Gravel pack: 93-108.0m: 5mm washed gravel
Bentonite plug: NA



PARSONS BRINCKERHOFF

Drawing No.:	MPMB03 - Bore Construction		
Revision:	A	Date drawn:	23/10/13
Drawn by:	K. Maher	Checked by:	J. Duggleby
Project No.	2114759B		

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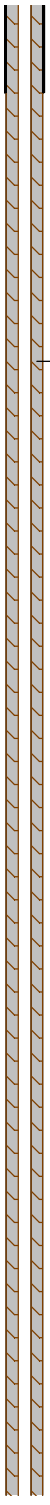
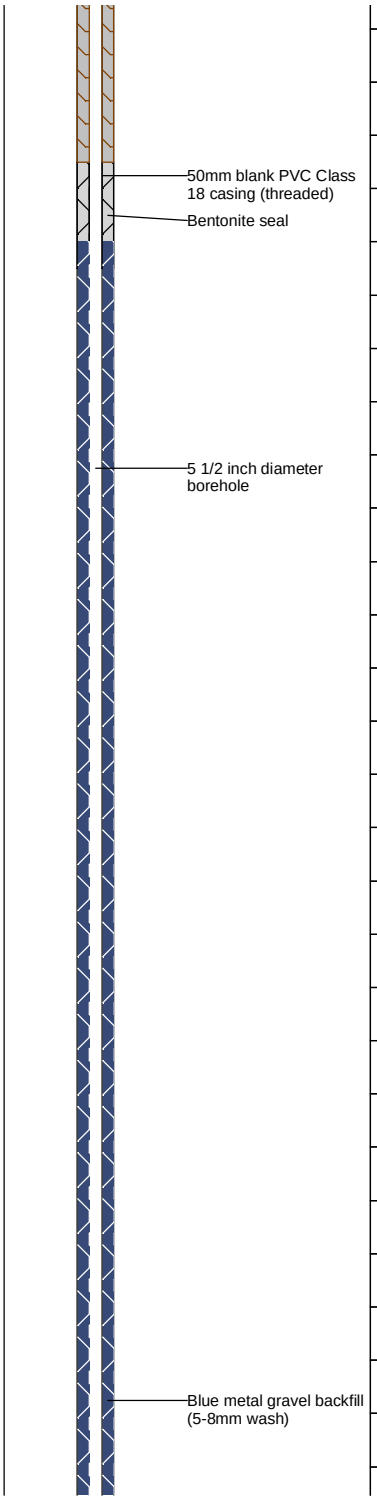
MPMB03

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	18				
	19	Mittagong Formation		SANDSTONE medium orange brown, very fine to fine grained, highly oxidised, white to light grey clay nodules 10%	
	20				
	21				
	22			SANDSTONE light to medium grey, very fine grained	
	23				
	24				
	25			SANDSTONE light grey, fine grained	
	26			SANDSTONE medium grey, very fine to fine grained, dark grey siltstone 10%	
	27			SANDSTONE light grey, fine grained	
	28				
	29			SANDSTONE white, coarse grained, quartzose	
	30				
	31			SANDSTONE white, medium grained, quartzose	Water Cut: 0.22L/s, Temp: 19.95°C pH: 0.928, EC: 6.04 µS/cm, TDS: 60.7 g/L, DO: 6.5 %, DO: 1429 ppm,, ORP: 82.4 mV
	32				
	33				
	34				
	35				
	36			SANDSTONE cream, fine grained, quartzose, dark grey siltstone 10%	
	37			SANDSTONE light grey to white, fine to medium grained, quartzose	
	38			SANDSTONE white, medium grained, quartzose	
	39				
	40				
	41			SANDSTONE white, fine grained, quartzose, dark grey shale 2%	
	42			SANDSTONE white, medium to coarse grained, quartzose, dark grey shale 5%	
	43			SANDSTONE light to medium grey, fien grained	Water Cut: 1.71L/s, Temp: 20.86°C pH: 0.796, EC: 4.93 µS/cm, TDS: 55.2 g/L, DO: 6.65 %, DO: 1220 ppm,, ORP: 16.2 mV
	44			SANDSTONE white medium grained, quartzose	
	45			SANDSTONE light grey, fine grained, quartzose	

BORE COMPLETION REPORT - MPMB03



DEPTH (m)	STRATIGRAPHY	LITHOLOGY	WATER QUALITY
46	Hawkesbury Sandstone	SANDSTONE light grey, fine to medium grained, quartzose	
47			
48		SANDSTONE light grey, medium grained, quartzose	
49		SANDSTONE white, coarse grained, quartzose	Water Cut: 1.92L/s, Temp: 19.55°C pH: 0.56, EC: 5.22 µS/cm, TDS: 57 g/L, DO: 6.98 %, DO: 862 ppm,, ORP: 26.8 mV
50		SANDSTONE white, fine grained, quartzose	
51			
52		SANDSTONE light grey, very fine to fine grained, dark grey shale 5%	
53		SANDSTONE white, fine grained, quartzose	
54			
55		SANDSTONE whtie, coarse grianed, quartzose	
56			
57			
58		SANDSTONE white, fine grained, quartzose	
59			
60		SANDSTONE light grey brown, fine grained, quartzose	
61		SANDSTONE light grey, fine grained, quartzose	Water Cut: 2.38L/s, Temp: 19.71°C pH: 0.996, EC: 6.04 µS/cm, TDS: 80.9 g/L, DO: 7.26 %, DO: 1502 ppm,, ORP: 20.6 mV
62			
63			
64			
65			
66			
67		SANDSTONE light grey, fine grained, quartzose, pyrite 20%	Water Cut: 3.125L/s, Temp: 19.37°C pH: 1.047, EC: 6.22 µS/cm, TDS: 68.1 g/L, DO: 7.39 %, DO: 1611 ppm,, ORP: 19.3 mV
68			
69			
70		SANDSTONE light grey, fine grained, medium grey ahsle 20%	
71			
72		SANDSTONE light grey, coarse grained, quartzose, pyrtite 10%, medium grey shale 2%	
73		SANDSTONE light grey, fine grained, pyrite 5%, rare coal fragments	Water Cut: 6L/s, Temp: 19.07°C pH: 1.077, EC: 6.41 µS/cm, TDS: 70.05 g/L, DO: 7.67 %, DO: 1657 ppm,, ORP: 17.8 mV

PARSONS BRINCKERHOFF

Drawing No.: MPMB03 - Bore Construction	
Revision: A	Date drawn: 23/10/13
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

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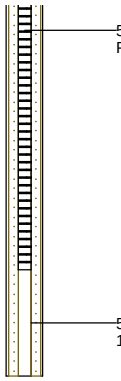
MPMB03

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	74			SANDSTONE light grey, fine grained, quartzose	
	75				
	76				
	77				
	78				
	79			SHALE medium grey, slight oil slick when drilling	Water Cut: 8.18L/s, Temp: 19.78°C pH: 1.264, EC: 5.89 µS/cm, TDS: 65.5 g/L, DO: 7.91 %, DO: 1946 ppm,, ORP: 18.6 mV
	80				
	81				
	82				
	83				
	84				
	85				Water Cut: 9.52L/s, Temp: 17.2°C pH: 0.974, EC: 9.83 µS/cm, TDS: 91.9 g/L, DO: 6.84 %, DO: 1501 ppm,, ORP: 72.1 mV
	86				
	87				
	88				
	89				
	90				
	91			SANDSTONE light grey, fine grained, medium grey shale 30%	Water Cut: 9.52L/s, Temp: 15.24°C pH: 1.68, EC: 6.08 µS/cm, TDS: 61.5 g/L, DO: 6.44 %, DO: 2558 ppm,, ORP: 136.7 mV
	92			SANDSTONE light grey, fine grained, medium grey shale 10%	
	93			SANDSTONE light grey, fine grained	
	94			SHALE dark grey	
	95			SANDSTONE light grey, fine grained, dark grey shale 10%	
	96				
	97			SANDSTONE light grey, fine grained, dark grey shale 5%	Water Cut: 10L/s, Temp: 17.29°C pH: 1.52, EC: 5.81 µS/cm, TDS: 60.9 g/L, DO: 7.19 %, DO: 2339 ppm,, ORP: 89.3 mV
	98			SANDSTONE light to medium grey, fine grained, quartzose	
	99				
	100				
Gravel pack (5mm wash)	101				

BORE COMPLETION REPORT - MPMB03

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
 50mm slotted PN18 U-PVC casing (0.5mm slot) 50mm blank PVC class 18 sump (threaded)	102 103 104 105 106 107 108 109			SANDSTONE light grey, coarse grained, quartzose SANDSTONE light grey, fine grained, quartzose	Water Cut: 10.53L/s, Temp: 17.23°C pH: 1.484, EC: 6.53 µS/cm, TDS: 68.7 g/L, DO: 7.63 %, DO: 2284 ppm,, ORP: 62.1 mV Water Cut: 14.29L/s, Temp: 18.2°C pH: 1.473, EC: 5.87 µS/cm, TDS: 62.9 g/L, DO:

PARSONS BRINCKERHOFF

Drawing No.: MPMB03 - Bore Construction	
Revision: A	Date drawn: 23/10/13
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

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AGL Upstream Investments Pty Ltd
MPMB03

BORE COMPLETION REPORT - MPMB04

Project: AGL Camden Gas Project
Location: Menangle Park 25
Easting: 291418.472 **Northing:** 6223664.149
Top of casing elevation: 66.912 mAHD (Gal casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.70 m

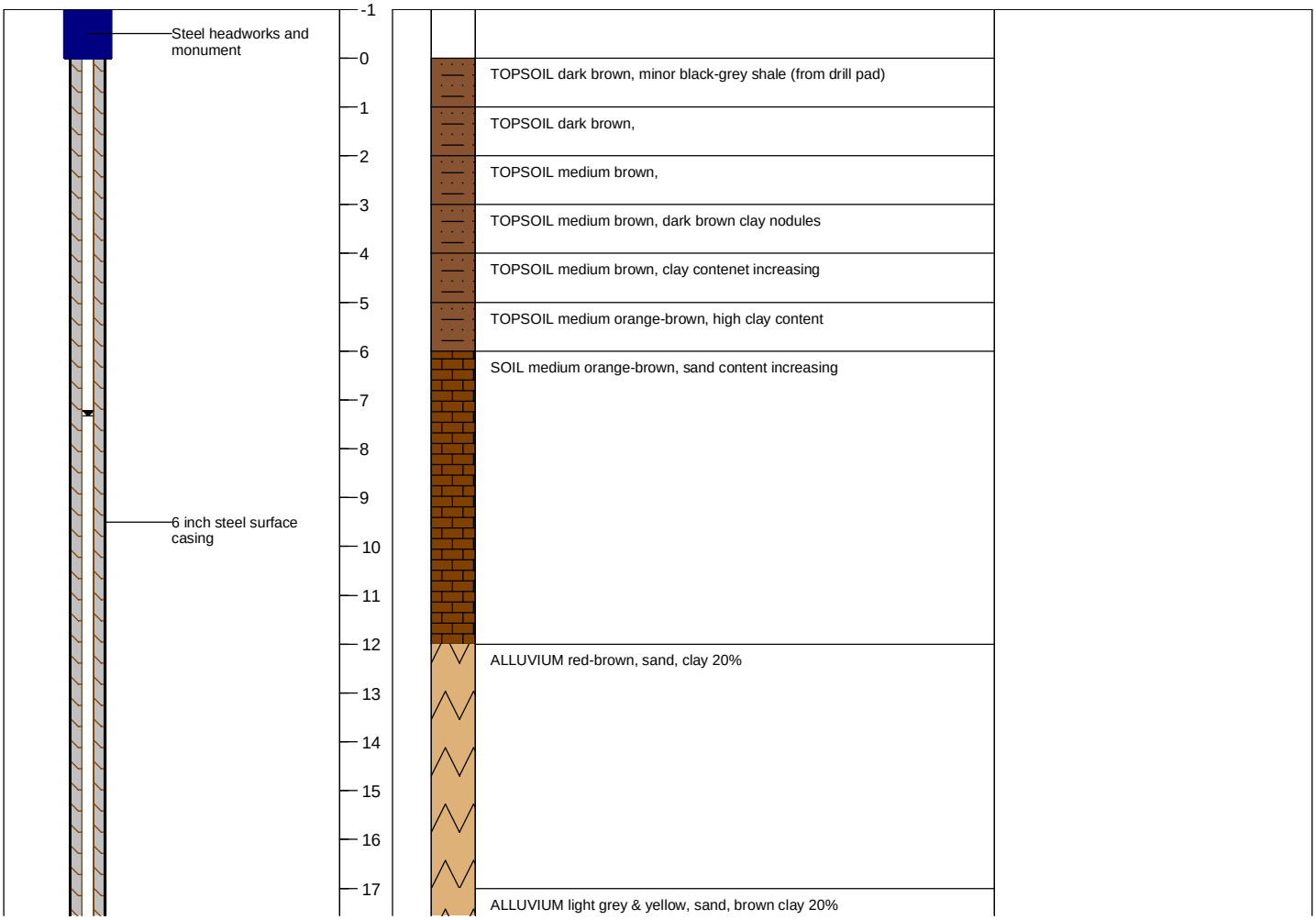
Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 25
Drilling method: Rotary Air **Total drilled depth:** 192.6 m

Borehole diameter:	205 mm	0 - 19 m	**Bit:** Blade
Borehole diameter:	139 mm	19 - 192.6 m	**Bit:** DHH

Purpose of bore: Groundwater monitoring bore
Screened Formation: Hawkesbury Sandstone
Logged by: K. Maher
Start date: 22/5/13
Completion date: 16/10/13

Static WL: 58.89 mAHD 7.32 mbtoc
Water level date: 10/9/13

Plain casing: 0-182.0m: 50mm Galv pipe 50NB
Screen: 182-191.0m: 50mm Galv pipe 304SS(1mm slot)
Sump: 191-192.0m: 50mm Galv pipe 50NB
Cement grout: 0-50.0m: 0.6m3
Gravel backfill: 50.6-72.6m 5-8mm gravel
Bentonite seal: 172.6-177.6m
Gravel pack: 177.6-192.6m: 5mm washed gravel
Bentonite plug: NA



PARSONS BRINCKERHOFF

Drawing No.: MPMB04 - Bore Construction	
Revision: A	Date drawn: 23/10/2013
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

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AGL Upstream Investments Pty Ltd
MPMB04

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
Cement grout	18			ALLUVIUM orange-brown, sand, clay 20%	
	19	Mittagong Formation		SANDSTONE light grey, fine grained, yellow-brown weathered fragments 40%	
	20				
	21			SANDSTONE light grey, fine grained, clay 20%, base of weathering	
	22				
	23				
	24				
	25			SANDSTONE light grey, fine grained, cream coloured clay 20%	
	26			SILTSTONE medium-dark grey, light grey fine grained sandstone 20%, clay 15%	
	27			SANDSTONE light grey, fine grained, clay 10%, siltstone 2%	
	28			SANDSTONE light grey, fine grained, clay 10%, coarse quartz 10%, siltstone 2%	
	29			SANDSTONE light greyfine grained, clay 10%, coarse quartz 10%	
	30				
	31			SANDSTONE light grey, fine grained, quartzose	
	32				
	33				
	34				
	35				
	36				
	37			SANDSTONE light grey, fine-medium grained, quartzose, clay 15%	
	38				
	39			SANDSTONE medium grey, fine-medium grained, quartzose, dark grey siltstone 30%	
	40			SANDSTONE light grey, medium grained, coarse quartz, dark grey silt, 40%	
	41				
	42			SILTSTONE dark grey, light grey medium-coarse sandstone 30%, quartzose	
	43			SANDSTONE light greyfine-medium grained, quartzose	
	44				
	45			SANDSTONE light greyfine to medium grained, quartzose, clay 20%	

PARSONS BRINCKERHOFF

Drawing No.: MPMB04 - Bore Construction	
Revision: A	Date drawn: 23/10/2013
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Project No. 2114759B	

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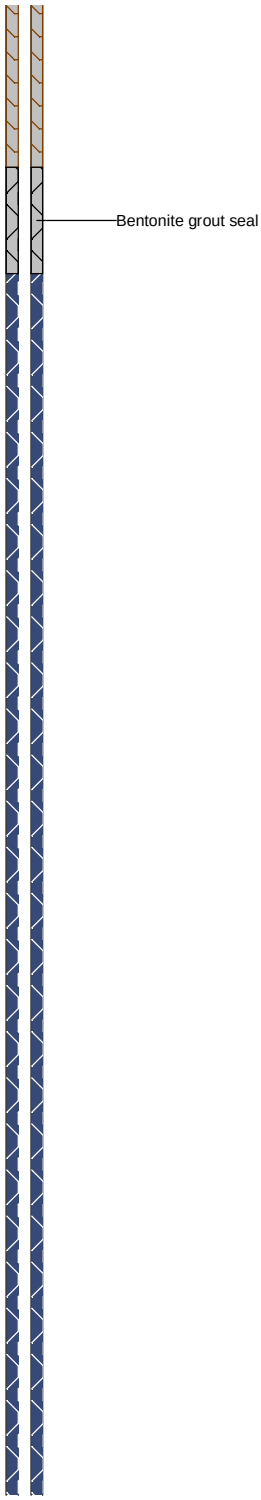
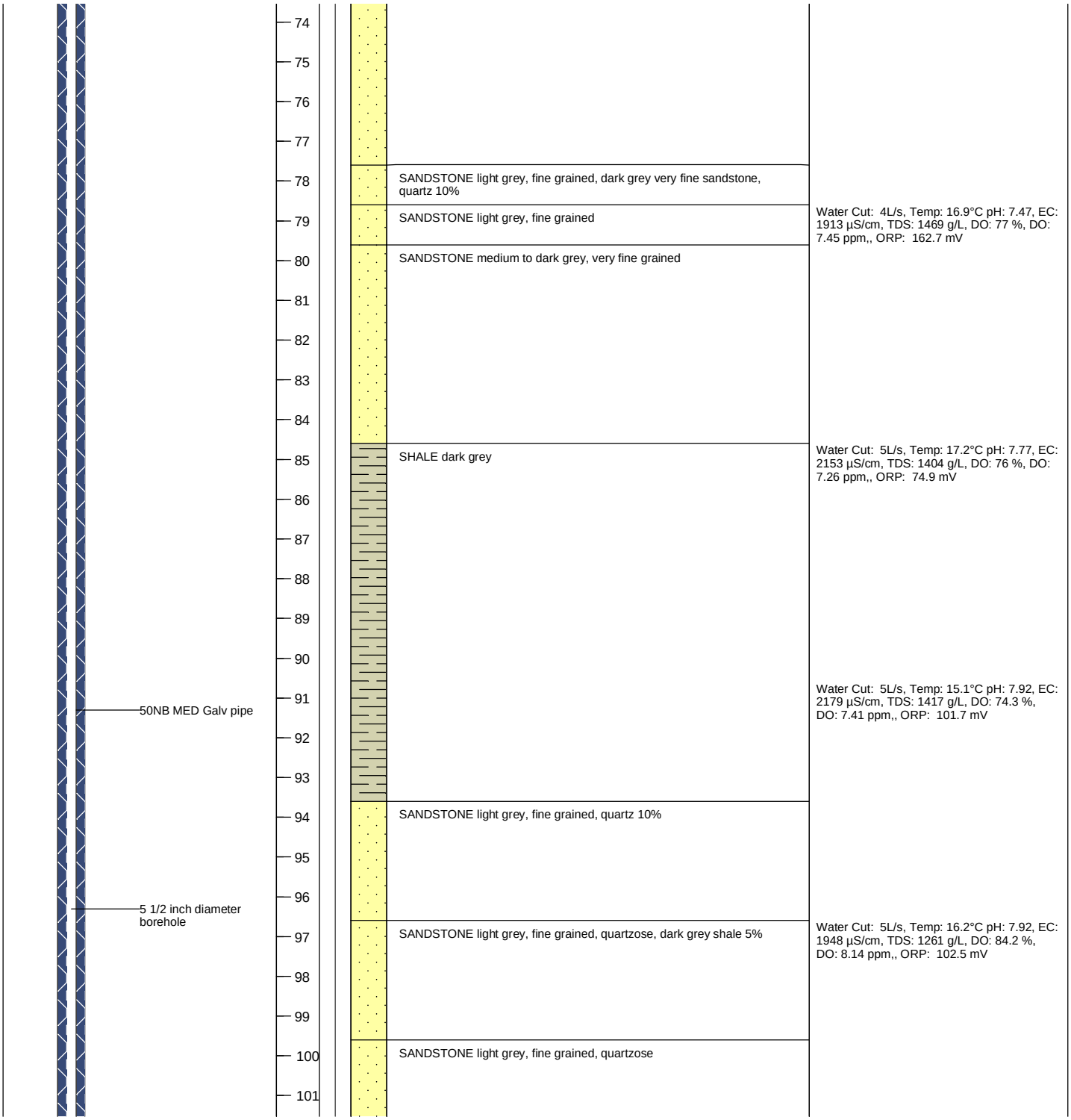
AGL Upstream Investments Pty Ltd
MPMB04

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	46			SANDSTONE light grey, coarse grained, quartzose, dark grey shale 10%	
	47				
	48			SANDSTONE light grey, fine to medium grained, quartzose, clay 20%	
	49			SANDSTONE light grey, coarse grained, quartzose	
	50				
	51			SANDSTONE light greyfine to medium grained, quartzose	
	52				
	53			SANDSTONE light grey, fine grained, quartzose, dark grey shale 30%	
	54			SANDSTONE light greyfine to medium grained, clay 10%	
	55			SANDSTONE light grey, medium to coarse grained, quartzose	
	56				
	57				
	58			SANDSTONE cream fine grained, quartzose	
	59				
	60			SANDSTONE medium brown, fine to medium grained, quartzose, dark grey shale 10%	
	61			SANDSTONE light grey and orange brownfien grained sandstone, moderatley oxidised	Water Cut: 1L/s, Temp: 20.6°C pH: 7.18, EC: µS/cm, TDS: 1319.5 g/L, DO: 113.1 %, DO: 10.34 ppm,, ORP: 142.5 mV
	62			SANDSTONE light grey, fine grained	
	63				
	64				
	65			SANDSTONE light grey to white, coarse grained, quartzose, dark grey siltstone 2%	
	66			SHALE dark grey, siltstone, white coarse grained sandstone 10%	
	67				Water Cut: 1.5L/s, Temp: 19.6°C pH: 7.75, EC: µS/cm, TDS: 1267.5 g/L, DO: 101.4 %, DO: 9.32 ppm,, ORP: 100.2 mV
	68			SANDSTONE light grey, fine grained, quartz 5%	
	69				
	70				
	71				
	72				
	73				Water Cut: 3L/s, Temp: 14.9°C pH: 7.32, EC: 1303 µS/cm, TDS: 1046.5 g/L, DO: 69.9 %, DO: 6.99 ppm,, ORP: 179.4 mV



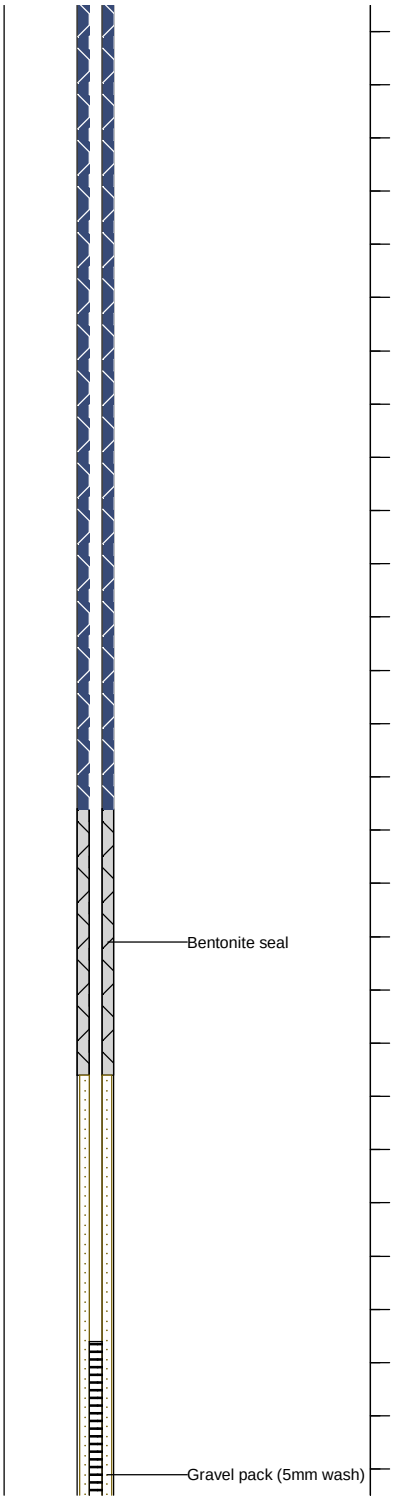
PARSONS BRINCKERHOFF

Drawing No.: MPMB04 - Bore Construction	
Revision: A	Date drawn: 23/10/2013
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

AGL Upstream Investments Pty Ltd
MPMB04

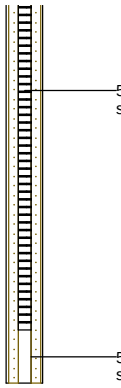
BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	102				
	103			SANDSTONE light grey to white, fine grained, quartzose	Water Cut: 14.3L/s, Temp: 17.4°C pH: 7.86, EC: 2220 µS/cm, TDS: 1443 g/L, DO: 81.4 %, DO: 7.62 ppm,, ORP: 58.3 mV
	104				
	105				
	106				
	107				
	108				
	109				Water Cut: 15L/s, Temp: 17.6°C pH: 7.94, EC: 2129 µS/cm, TDS: 1384.5 g/L, DO: 92.7 %, DO: 8.85 ppm,, ORP: 90.4 mV
	110				
	111				
Blue metal gravel backfill (5-8mm wash)	112	Hawkesbury Sandstone		SANDSTONE light grey, medium grained, quartzose	
	113				
	114				
	115			SANDSTONE light grey, fine to medium grained, quartzose,medium grey siltstone 5%	Water Cut: 9.3L/s, Temp: 16.1°C pH: 8.11, EC: 2406 µS/cm, TDS: 1560 g/L, DO: 63.6 %, DO: 6.24 ppm,, ORP: 93.9 mV
	116				
	117				
	118				
	119				
	120				
	121			SANDSTONE light grey to white, fine grained, quartzose	Water Cut: 8.7L/s, Temp: 19.8°C pH: 8.26, EC: 2375 µS/cm, TDS: 1547 g/L, DO: 84.5 %, DO: 7.63 ppm,, ORP: 86.5 mV
	122				
	123				
	124				
	125				
	126				
	127				Water Cut: 7.3L/s, Temp: 19°C pH: 8.27, EC: 2308 µS/cm, TDS: 1501.5 g/L, DO: 80.8 %, DO: 7.43 ppm,, ORP: 89 mV
	128				
	129				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	130				
	131				
	132				
	133				Water Cut: 7.4L/s, Temp: 18.9°C pH: 8.32, EC: 2335 µS/cm, TDS: 1521 g/L, DO: 82.7 %, DO: 762 ppm,, ORP: 88.9 mV
	134				
	135				
	136				
	137				
	138				
	139			SANDSTONE light grey to white, fine to coarse grained, quartzose	Water Cut: 7.7L/s, Temp: 18.6°C pH: 8.31, EC: 2034 µS/cm, TDS: 1319.5 g/L, DO: 82.3 %, DO: 7.49 ppm,, ORP: 101.3 mV
	140				
	141				
	142			SANDSTONE light grey to white, fine to coarse grained, quartzose, medium grey siltstone 2%	
	143			SANDSTONE light grey to white, fine to coarse grained, quartzose	
	144			SANDSTONE light grey to white, fine to coarse grained, quartzose, minor pebbles	
	145			SANDSTONE light grey to white, medium grained, quartzose	Water Cut: 7.7L/s, Temp: 19°C pH: 8.28, EC: 2308 µS/cm, TDS: 1501.5 g/L, DO: 84.1 %, DO: 7.7 ppm,, ORP: 110.4 mV
	146				
	147				
	148				
	149				
	150			SANDSTONE light grey, medium grained, quartzose, orange sand 5%	
	151			SANDSTONE light grey to white, medium grain, quartzose	Water Cut: 8L/s, Temp: 18.5°C pH: 8.26, EC: 2306 µS/cm, TDS: 1501.5 g/L, DO: 91.7 %, DO: 7.52 ppm,, ORP: 103 mV
	152				
	153				
	154			SANDSTONE light grey to white, coarse grained, quartzose	
	155				
	156				
	157			SANDSTONE light grey to white, medium to coarse grained, quartzose	Water Cut: 8L/s, Temp: 18.3°C pH: 8.27, EC: 2305 µS/cm, TDS: 1495 g/L, DO: 69.6 %, DO: 6.5 ppm,, ORP: 80.8 mV



DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
158				
159				
160				
161			SANDSTONE light grey and tan, medium grained, quartzose	
162				
163				Water Cut: 8L/s, Temp: 18.7°C pH: 8.28, EC: 2298 µS/cm, TDS: 1495 g/L, DO: 73.1 %, DO: 6.76 ppm,, ORP: 83.5 mV
164				
165				
166				
167				
168			SANDSTONE light gret to white, coarse grained, quartzose	
169			SANDSTONE light grey, fine to medium grained, quartzose	Water Cut: 7.7L/s, Temp: 18.4°C pH: 8.28, EC: 2308 µS/cm, TDS: 1501.5 g/L, DO: 66.8 %, DO: 6.23 ppm,, ORP: 68.5 mV
170				
171				
172			SANDSTONE light grey, fine to medium grained, quartzose, minor siltstone, possible contamination fromabove	
173			SANDSTONE light grey, fine to medium grained, quartzose	
174				
175			SANDSTONE light brown, fine to medium grained, quartzose	Water Cut: 8L/s, Temp: 15.7°C pH: 147, EC: 2570 µS/cm, TDS: 6.67 g/L, DO: 82.2 %, DO: 8.06 ppm,, ORP: 65.5 mV
176				
177				
178				
179				
180				
181			SANDSTONE cream to tan, fine grained, quartzose	Water Cut: 8L/s, Temp: 17.2°C pH: 7.65, EC: 2506 µS/cm, TDS: 1631.5 g/L, DO: 82.8 %, DO: 7.9 ppm,, ORP: 142.2 mV
182			SANDSTONE light to medium grey, fine grained, dark grey siltstone 10%	
183				
184				
185				

BORE COMPLETION REPORT - MPMB04

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
 50mm 304SS (0.1mm slot)	186				
	187			SANDSTONE light grey to brown, fine grained, quartzose	Water Cut: 8L/s, Temp: 16.5°C pH: 7.69, EC: 2544 µS/cm, TDS: 1657.5 g/L, DO: 77.3 %, DO: 7.49 ppm,, ORP: 98.6 mV
	188				
	189				
	190				
	191				
50NB MED Galv pipe sump	192				Water Cut: 8L/s, Temp: 18°C pH: 7.78, EC:
	193				

PARSONS BRINCKERHOFF

Drawing No.: MPMB04 - Bore Construction	
Revision: A	Date drawn: 23/10/2013
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

AGL Upstream Investments Pty Ltd

MPMB04

BORE COMPLETION REPORT - GLMB01

Project: AGL Camden Gas Project
Location: Glenlee
Easting: 293339.7 **Northing:** 6226185.5
Top of casing elevation: 86.6 m AHD (PVC casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.49 m

Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 20
Drilling method: Air Rotary **Total drilled depth:** 102 m

Borehole diameter:	205 mm	0 - 10 m	**Bit:** Blade
Borehole diameter:	127 mm	10 - 102 m	**Bit:** PCD

Purpose of bore: Groundwater monitoring bore
Screened Formation: Hawkesbury Sandstone
Logged by: K. Maher
Start date: 30/1/14
Completion date: 31/1/14

Static WL: 74.2 mAHD 11.9 mbtoc
Water level date: 3/2/14

Plain casing: 0-87.0m: Class 18 50mm PVC
Screen: 87.0-99.0m: 50mm PVC Class 18 (0.5mm slot)
Sump: 99.0-102.0m: 50mm PVC Class 18
Cement grout: 0-79.0m: 0.8m3
Gravel backfill: NA
Bentonite seal: 79.0-84.0m
Gravel pack: 84-100.5m: 5mm washed gravel
Bentonite plug: 100.5-102.0m

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY GRAPHIC LOG	LITHOLOGY	WATER QUALITY
Steel headworks and monument 6 inch steel surface casing	-1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17		FILL/SPOIL dark grey, CLAY medium orangey brown, CLAY medium reddish orange, CLAY light yellowish orange, SHALE dark grey, SHALE medium orangey brown, highly weathered, SHALE dark grey, slightly weathered, SHALE medium to dark grey, SHALE dark brownish grey, carbonaceous, SILTSTONE light to medium grey,	

PARSONS BRINCKERHOFF

Drawing No.:	GLMB01 - Bore Construction		
Revision:	A	Date drawn:	5/2/14
Drawn by:	K. Maher	Checked by:	J. Duggleby
Project No.	2114759B		

AGL

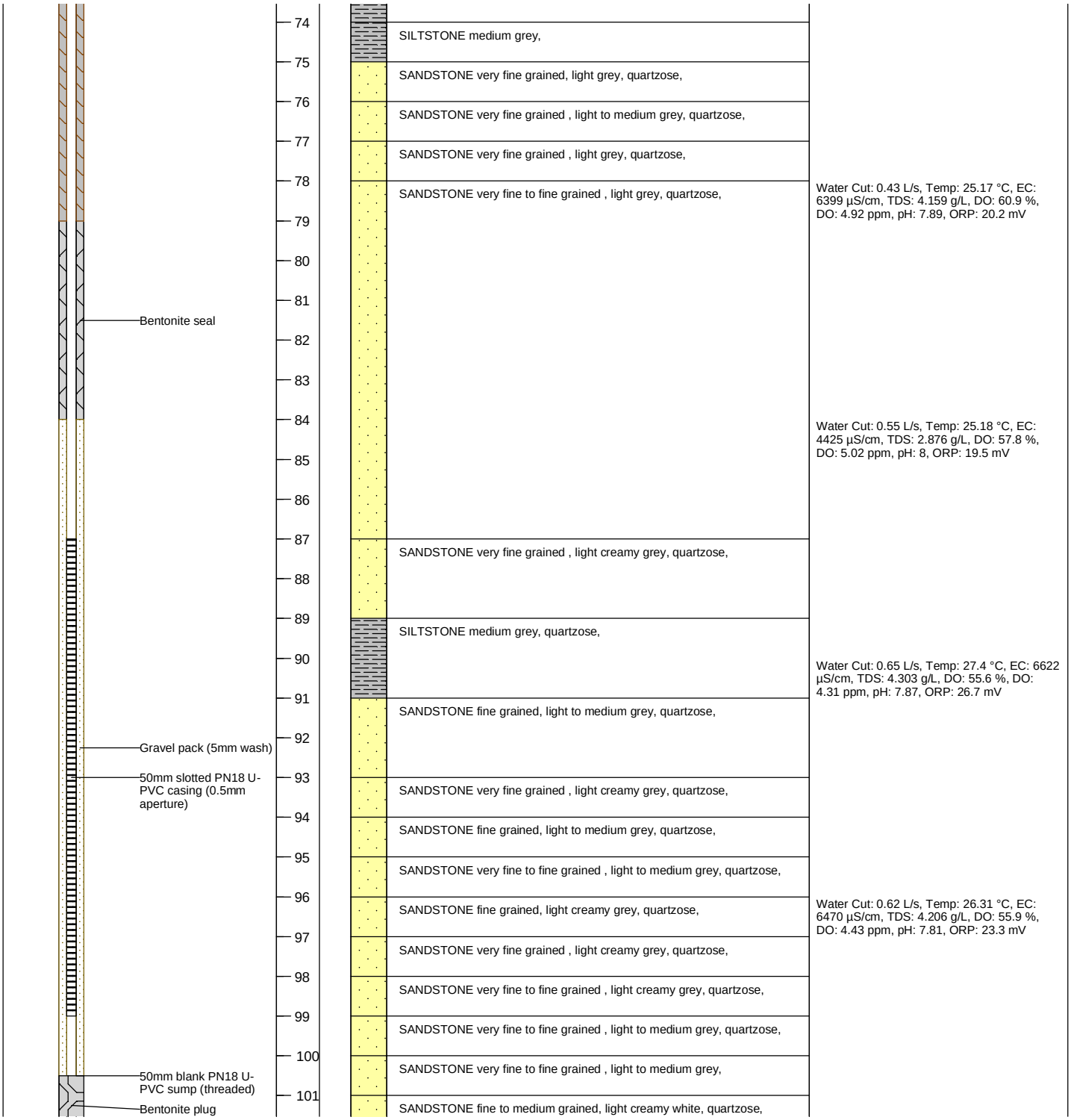
AGL Upstream Investments Pty Ltd
GLMB01

Phase 2 Groundwater Investigation

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	18			SHALE medium to dark grey,	
	19			SHALE dark brownish grey,	
	20			SILTSTONE light to medium grey,	
	21				
	22				
	23				
	24			SHALE medium to dark grey,	
	25				
	26				
	27				
	28				
	29				
	30			SHALE medium to dark grey,	Water Cut: <0.1 L/s, Temp: 25.7 °C, EC: 5751 µS/cm, TDS: 3.738 g/L, DO: 69.5 %, DO: 5.58 ppm, pH: 8.06, ORP: 88.4 mV
	31				
	32				
	33				
	34				
	35				
	36			SHALE medium to dark grey,	Water Cut: 0.1 L/s, Temp: 27.11 °C, EC: 5345 µS/cm, TDS: 3.474 g/L, DO: 58.1 %, DO: 4.55 ppm, pH: 8.11, ORP: 70.5 mV
	37				
	38				
	39				
Cement grout	40				
	41				
	42				Water Cut: 0.35 L/s, Temp: 25.45 °C, EC: 6218 µS/cm, TDS: 4.042 g/L, DO: 75.4 %, DO: 6.2 ppm, pH: 8.07, ORP: 48.9 mV
	43				
	44				
	45				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
50mm blank PN18 U-PVC casing (threaded) 5 inch diameter borehole	46–73			SILTSTONE medium grey,	Water Cut: 0.2 L/s, Temp: 24.44 °C, EC: 6318 µS/cm, TDS: 4.107 g/L, DO: 59.9 %, DO: 4.9 ppm, pH: 8, ORP: 26.6 mV Water Cut: 0.2 L/s, Temp: 24.86 °C, EC: 5975 µS/cm, TDS: 3.884 g/L, DO: 52.6 %, DO: 4.28 ppm, pH: 7.99, ORP: 31.5 mV Water Cut: 0.42 L/s, Temp: 25.25 °C, EC: 5126 µS/cm, TDS: 3.332 g/L, DO: 68.6 %, DO: 4.76 ppm, pH: 8.01, ORP: 33.4 mV Water Cut: 0.53 L/s, Temp: 24.9 °C, EC: 6463 µS/cm, TDS: 4.201 g/L, DO: 58.4 %, DO: 4.74 ppm, pH: 7.94, ORP: 15.2 mV Water Cut: 0.5 L/s, Temp: 24.8 °C, EC: 5319 µS/cm, TDS: 3.457 g/L, DO: 61.6 %, DO: 5 ppm, pH: 7.97, ORP: 27.7 mV

BORE COMPLETION REPORT - GLMB01



PARSONS BRINCKERHOFF

Drawing No.: GLMB01 - Bore Construction	
Revision: A	Date drawn: 5/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

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AGL Upstream Investments Pty Ltd

GLMB01

Phase 2 Groundwater Investigation

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	102				Water Cut: 0.55 L/s, Temp: 27.33 °C, EC: 6812 µS/cm, TDS: 4.428 g/L, DO: 61.4 %, DO: 4.57 ppm, pH: 7.84, ORP: 12 mV
	103				

BORE COMPLETION REPORT - GLMB02

Project: AGL Camden Gas Project
Location: Glenlee
Easting: 293339.6 **Northing:** 6226177.3
Top of casing elevation: 86.6 m AHD (PVC casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.49 m

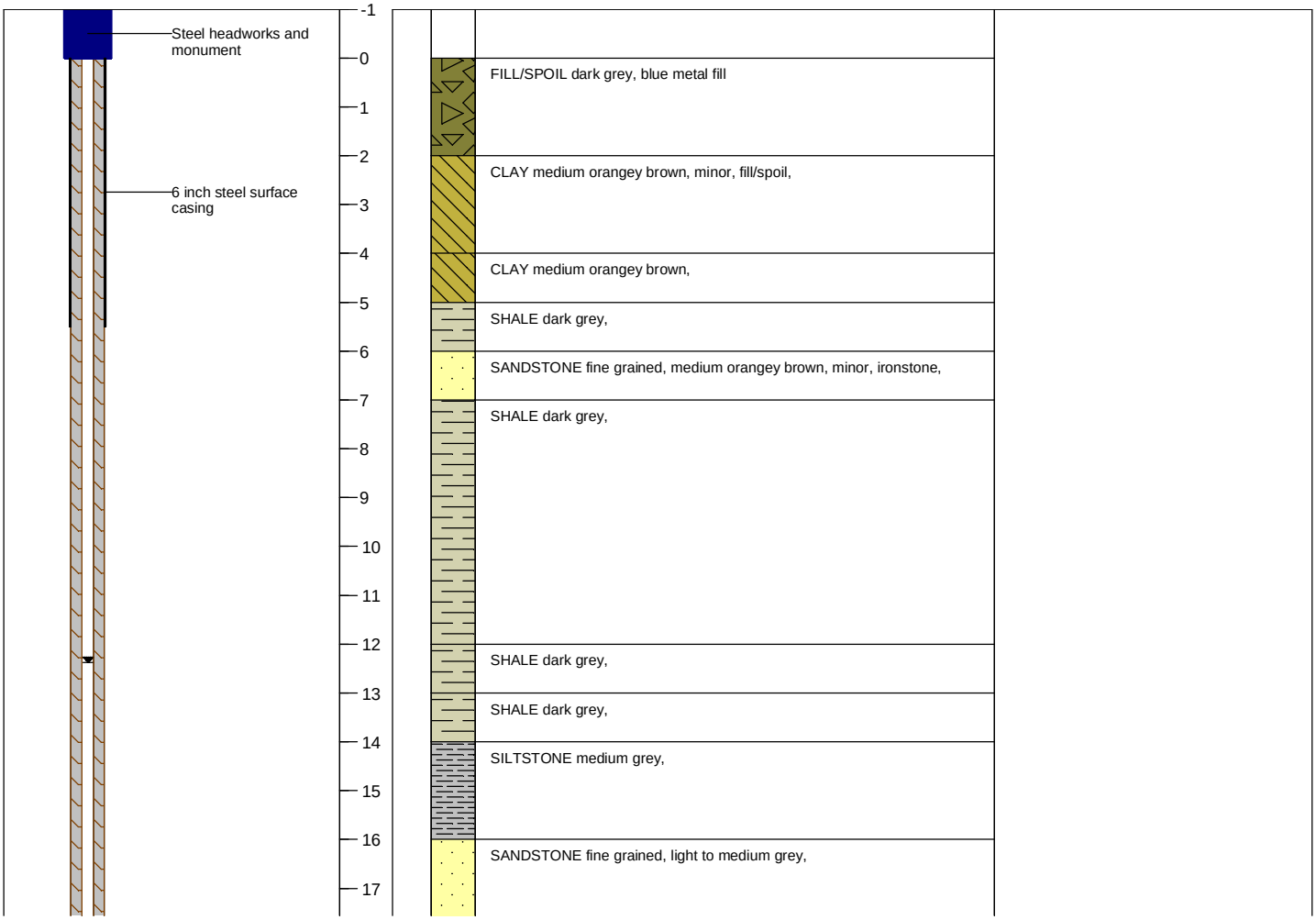
Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 12
Drilling method: Air Rotary **Total drilled depth:** 190.3 m

Borehole diameter:	205 mm	0 - 5.5 m	**Bit:** Blade
Borehole diameter:	139 mm	5.0 - 190.3 m	**Bit:** DHH

Purpose of bore: Groundwater monitoring bore
Screened Formation: Hawkesbury Sandstone
Logged by: K. Maher
Start date: 21/1/14
Completion date: 22/1/14

Static WL: 73.7 mAHD 12.4 mbtoc
Water level date: 3/2/14

Plain casing: 0-168.0m: Class 18 50mm PVC
Screen: 168.0-180.0: 50mm PVC Class 18 (0.5mm slot)
Sump: 180.0-182.0m: 50mm PVC Class 18
Cement grout: 0-100.0m: 1.26m3
Gravel backfill: 100.0-160.0m: 5-8mm washed blue metal gravel
Bentonite seal: 160-165m
Gravel pack: 165.0-182.0m: 5mm washed gravel
Bentonite plug: 182-185m



PARSONS BRINCKERHOFF

Drawing No.: GLMB02 - Bore Construction	
Revision: A	Date drawn: 5/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

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GLMB02

Phase 2 Groundwater Investigation

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	18			SANDSTONE fine grained, medium grey,	
	19				
	20				
	21			SANDSTONE fine grained, light to medium brownish grey,	
	22			SANDSTONE medium grained , light grey, altered,	
	23			SANDSTONE fine grained, medium grey,	
	24			SHALE medium to dark grey,	
	25				
	26				
	27			SANDSTONE fine grained, medium grey,	
	28				
	29			SHALE dark grey,	
	30			SHALE medium to dark grey,	
	31				
	32				
	33				
	34				
	35				
	36			SHALE medium to dark grey,	
	37			SHALE dark grey,	
	38				
	39				
	40				
	41				
	42			SHALE medium to dark grey,	
	43				
	44				
	45				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
Cement grout	46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73			SHALE medium to dark grey, SHALE medium to dark grey, SANDSTONE fine grained, medium grey,	

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	74				
	75			SANDSTONE fine grained, medium grey,	
	76			SANDSTONE fine grained, light to medium grey,	
	77				
	78				
	79			SANDSTONE medium grained , light grey,	Water Cut: <0.1 L/s, Temp: 26.99 °C, EC: 4095 µS/cm, TDS: 2.662 g/L, DO: 60.5 %, DO: 4.76 ppm, pH: 7.98, ORP: 62.8 mV
	80				
	81				
	82				
	83				
50mm blank PN18 U-PVC casing (threaded)	84			SANDSTONE coarse grained , light grey,	Water Cut: <0.1 L/s, Temp: 31.02 °C, EC: 3685 µS/cm, TDS: 2.396 g/L, DO: 54.8 %, DO: 4.04 ppm, pH: 8.33, ORP: 73.1 mV
	85				
	86			SANDSTONE fine grained, light cream, quartzose,	
	87				
	88				
	89			SHALE dark grey,	
	90			SANDSTONE fine grained, light grey,	Water Cut: 0.036 L/s, Temp: 29.3 °C, EC: 8.617 µS/cm, TDS: 5.601 g/L, DO: 51.9 %, DO: 3.87 ppm, pH: 8.07, ORP: 59.6 mV
	91				
	92			SANDSTONE coarse grained , light cream, quartzose,	
	93				
	94			SANDSTONE fine grained, light cream, quartzose,	
5 1/2 inch diameter borehole	95				
	96			SANDSTONE medium grained , light creamy brown, quartzose,	Water Cut: 0.37 L/s, Temp: 27.87 °C, EC: 6698 µS/cm, TDS: 4.353 g/L, DO: 51 %, DO: 3.92 ppm, pH: 7.97, ORP: 45.4 mV
	97			SANDSTONE medium grained , light cream, quartzose,	
	98				
	99			SANDSTONE fine to medium grained, light creamy grey, quartzose,	
	100			SANDSTONE fine grained, light grey,	
	101			SANDSTONE fine to medium grained, light creamy white, quartzose,	

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	102			SANDSTONE fine to medium grained, light creamy white, quartzose,	Water Cut: 0.07 L/s, Temp: 29.32 °C, EC: 8623 µS/cm, TDS: 5.604 g/L, DO: 50.8 %, DO: 3.78 ppm, pH: 8.01, ORP: 59.1 mV
	103				
	104			SANDSTONE medium to coarse grained , light creamy white, quartzose,	
	105				
	106				
	107				
	108			SANDSTONE coarse to very coarse grained , light creamy white, quartzose,	Water Cut: 0.08 L/s, Temp: 27.09 °C, EC: 8412 µS/cm, TDS: 5.468 g/L, DO: 50.5 %, DO: 3.91 ppm, pH: 7.94, ORP: 46.2 mV
	109			SANDSTONE medium to coarse grained , light creamy white, quartzose,	
	110			SANDSTONE coarse to very coarse grained , white, quartzose,	
	111				
	112			SANDSTONE medium to coarse grained , white, quartzose,	
	113			SANDSTONE medium to coarse grained , light whitish grey, quartzose,	
	114			SANDSTONE fine grained, light grey, quartzose,	Water Cut: 0.94 L/s, Temp: 24.05 °C, EC: 8555 µS/cm, TDS: 5.561 g/L, DO: 61 %, DO: 4.99 ppm, pH: 7.9, ORP: 31.7 mV
	115			SANDSTONE fine grained, white, quartzose,	
	116			SANDSTONE fine grained, light grey,	
	117				
	118			SANDSTONE medium grained , light greyish white, quartzose,	
	119				
	120			SANDSTONE medium to coarse grained , light creamy white, quartzose,	Water Cut: 0.5 L/s, Temp: 22.9 °C, EC: 8494 µS/cm, TDS: 5.521 g/L, DO: 61.6 %, DO: 5.15 ppm, pH: 7.92, ORP: 12.2 mV
	121				
	122			SANDSTONE medium to coarse grained , light creamy red, quartzose,	
	123			SANDSTONE fine grained, light to medium grey,	
	124			SANDSTONE fine to medium grained, light creamy white,	
	125				
	126			SANDSTONE fine grained, medium brownish grey,	Water Cut: 0.6 L/s, Temp: 26.97 °C, EC: 8689 µS/cm, TDS: 5.649 g/L, DO: 72.5 %, DO: 5.55 ppm, pH: 7.97, ORP: 15.6 mV
	127			SANDSTONE fine grained, light creamy white,	
	128			SANDSTONE coarse to very coarse grained , light creamy white, quartzose,	
	129			SANDSTONE medium to coarse grained , light creamy white, quartzose,	

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
Blue metal gravel backfill (5-8mm wash)	130				
	131			SANDSTONE fine to medium grained, light creamy white, quartzose,	
	132			SANDSTONE medium grained , light creamy tonstein, quartzose,	Water Cut: 0.86 L/s, Temp: 25.54 °C, EC: 8598 µS/cm, TDS: 5.589 g/L, DO: 81.3 %, DO: 6.28 ppm, pH: 7.89, ORP: 39.7 mV
	133			SANDSTONE medium grained , light greyish white, quartzose,	
	134			SANDSTONE medium grained , light creamy brown,	
	135			SANDSTONE fine grained, light grey	
	136			SANDSTONE medium grained , light creamy white, quartzose,	
	137				
	138			SANDSTONE medium grained , light creamy brown, quartzose,	Water Cut: 1.39 L/s, Temp: 22.2 °C, EC: 7088 µS/cm, TDS: 4.607 g/L, DO: 71.2 %, DO: 6.06 ppm, pH: 7.91, ORP: 90.8 mV
	139				
	140				
	141				
	142				
	143			SANDSTONE coarse to very coarse grained , light creamy white, quartzose,	
	144			SANDSTONE medium to coarse grained , light creamy white, quartzose,	
	145				
	146			SANDSTONE fine grained, light to medium grey,	
	147			SANDSTONE medium grained , light creamy brown, quartzose,	
	148				
	149			SANDSTONE medium to coarse grained , white, quartzose,	
	150			SANDSTONE medium grained , light orangey grey, quartzose,	Water Cut: 1 L/s, Temp: 22.52 °C, EC: 7148 µS/cm, TDS: 4.645 g/L, DO: 209.3 %, DO: 17.83 ppm, pH: 7.98, ORP: 71.3 mV
	151				
	152			SANDSTONE medium grained , light to medium grey, quartzose,	
	153				
	154			SANDSTONE fine to medium grained, light creamy brown,	
	155			SANDSTONE medium to coarse grained , light creamy brown,	
	156			SANDSTONE fine grained, light to medium grey,	Water Cut: 1.29 L/s, Temp: 23.71 °C, EC: 6948 µS/cm, TDS: 4.512 g/L, DO: 96.6 %, DO: 7.94 ppm, pH: 7.96, ORP: 57.7 mV
	157			SILTSTONE dark grey,	

BORE COMPLETION REPORT - GLMB02

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	158			SANDSTONE coarse to very coarse grained , white, quartzose,	
	159			SANDSTONE fine to medium grained, light creamy brown, quartzose,	
	160			SANDSTONE fine to medium grained, light creamy brown, quartzose,	
	161				
Bentonite seal	162			SANDSTONE fine to medium grained, white, quartzose,	Water Cut: 1.16 L/s, Temp: 22.39 °C, EC: 7405 µS/cm, TDS: 4.813 g/L, DO: 58.6 %, DO: 4.97 ppm, pH: 8, ORP: 57.8 mV
	163			SANDSTONE fine to medium grained, white, quartzose,	
	164				
	165				
	166			SANDSTONE fine grained, light grey, quartzose,	
	167				
	168			SANDSTONE fine to medium grained, light to medium grey,	Water Cut: 1.21 L/s, Temp: 23.02 °C, EC: 6989 µS/cm, TDS: 4.542 g/L, DO: 143.7 %, DO: 1.68 ppm, pH: 8.02, ORP: 26.9 mV
	169				
	170				
	171				
	172				
	173			SILTSTONE dark grey,	
Gravel pack (5mm wash)					
50mm slotted PN18 U-PVC casing (0.5mm aperture)	174			SANDSTONE fine grained, light to medium grey,	Water Cut: 1.15 L/s, Temp: 22.11 °C, EC: 6707 µS/cm, TDS: 4.36 g/L, DO: 56 %, DO: 4.79 ppm, pH: 7.94, ORP: 42.7 mV
	175				
	176			SANDSTONE fine grained, light greyish white,	
	177				
	178			SANDSTONE coarse to very coarse grained , light grey,	
	179				
	180			SANDSTONE fine grained, light grey,	Water Cut: 1.19 L/s, Temp: 22.35 °C, EC: 6903 µS/cm, TDS: 4.487 g/L, DO: 55.1 %, DO: 4.69 ppm, pH: 7.91, ORP: 37.8 mV
50mm blank PN18 U-PVC sump (threaded)	181			SANDSTONE fine grained, light grey,	
	182				
	183				
Bentonite plug	184			SANDSTONE fine to medium grained, light creamy white,	
	185				

PARSONS BRINCKERHOFF

Drawing No.: GLMB02 - Bore Construction	
Revision: A	Date drawn: 5/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

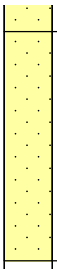
AGL

AGL Upstream Investments Pty Ltd

GLMB02

Phase 2 Groundwater Investigation

BORE COMPLETION REPORT - GLMB02

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
 Blue metal gravel backfill	186 187 188 189 190 191			SANDSTONE medium to coarse grained , white, quartzose,	Water Cut: 1.31 L/s, Temp: 23.33 °C, EC: 6837 µS/cm, TDS: 4.443 g/L, DO: 61.2 %, DO: 5.1 ppm, pH: 8.01, ORP: 12.2 mV

BORE COMPLETION REPORT - GLMB03

Project: AGL Camden Gas Project
Location: Glenlee
Easting: 293339.4 **Northing:** 6226169.3
Top of casing elevation: 86.4 mAHD (Gal casing)
Grid system: MGA 94 Zone 56 **Stick-up height:** 0.55 m

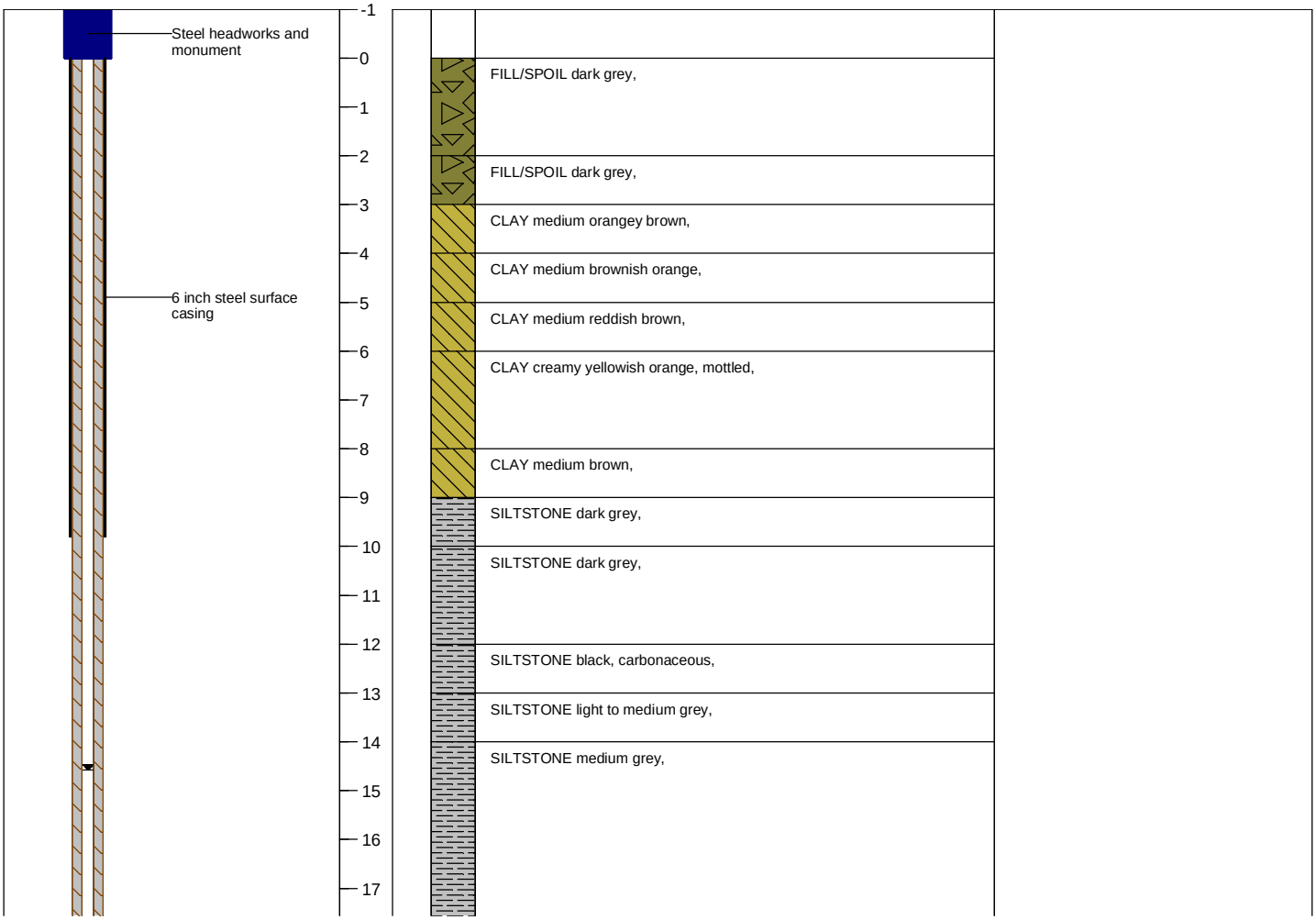
Drilling contractor: Highland Drilling
Driller: I. Palk **Rig:** Rig 20
Drilling method: Air Rotarty **Total drilled depth:** 228.3 m

Borehole diameter:	205 mm	0 - 10.5 m	**Bit:** Blade
Borehole diameter:	127 mm	10.5 - 228.3 m	**Bit:** PCD

Purpose of bore: Groundwater monitoring bore
Screened Formation: Hawkesbury Sandstone
Logged by: K. Maher
Start date: 24/1/14
Completion date: 29/1/14

Static WL: 71.3 mAHD 14.6 mbtoc
Water level date: 3/2/14

Plain casing: 0-212m: 50NB MED Gal pipe
Screen: 212.0-224.0m: 50mm 304SS (1mm slot)
Sump: 224.0-228.0: 50NB MED Gal pipe sump
Cement grout: 0-162.6m: 1.60m3
Gravel backfill: 162.0-200.0m: 5-8mm washed blue metal gravel
Bentonite seal: 200-209m
Gravel pack: 209.0-228.3m: 5mm washed gravel
Bentonite plug: NA



PARSONS BRINCKERHOFF

Drawing No.: GLMB03 - Bore Construction	
Revision: A	Date drawn: 5/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

AGL

AGL Upstream Investments Pty Ltd
GLMB03

Phase 2 Goundwater Investigation

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	18			SILTSTONE dark blackish grey,	Water Cut: <0.1 L/s, Temp: 20.62 °C, EC: 4683 µS/cm, TDS: 3.044 g/L, DO: 103.5 %, DO: 9.38 ppm, pH: 7.79, ORP: 97.1 mV
	19				
	20			SILTSTONE medium grey,	
	21				
	22				
	23				
	24			SILTSTONE medium to dark grey,	Water Cut: <0.1 L/s, Temp: 25.87 °C, EC: 5536 µS/cm, TDS: 3.598 g/L, DO: 62.8 %, DO: 5.02 ppm, pH: 8.09, ORP: 81.4 mV
	25				
	26			SILTSTONE medium to dark grey,	
	27				
	28				
	29				
	30			SHALE medium grey,	Water Cut: 0.67 L/s, Temp: 22.07 °C, EC: 5619 µS/cm, TDS: 3.653 g/L, DO: 65.3 %, DO: 5.6 ppm, pH: 8.04, ORP: 66 mV
	31				
	32				
	33				
	34				
	35				
	36				Water Cut: 0.67 L/s, Temp: 23.04 °C, EC: 5706 µS/cm, TDS: 3.709 g/L, DO: 59.2 %, DO: 4.99 ppm, pH: 8.05, ORP: 63.2 mV
	37				
	38				
	39				
	40				
	41				
	42				Water Cut: 0.69 L/s, Temp: 22.79 °C, EC: 5539 µS/cm, TDS: 3.601 g/L, DO: 59.9 %, DO: 5.07 ppm, pH: 8.03, ORP: 70.3 mV
	43				
	44				
	45				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	46				
	47				
	48				Water Cut: 0.72 L/s, Temp: 23.88 °C, EC: 5765 µS/cm, TDS: 3.747 g/L, DO: 63 %, DO: 5.22 ppm, pH: 8.07, ORP: 54.6 mV
	49				
	50				
	51				
	52				
	53				
	54			SHALE medium to dark grey,	Water Cut: 0.74 L/s, Temp: 22.68 °C, EC: 5617 µS/cm, TDS: 3.651 g/L, DO: 63.1 %, DO: 5.33 ppm, pH: 8.02, ORP: 46.05 mV
	55				
	56				
	57				
	58				
	59				
	60			SHALE medium grey,	Water Cut: 1.09 L/s, Temp: 22.69 °C, EC: 5736 µS/cm, TDS: 3.729 g/L, DO: 55.5 %, DO: 4.72 ppm, pH: 8, ORP: 39.5 mV
	61				
	62			SHALE medium to dark grey,	
	63				
	64				
	65				
	66				Water Cut: 0.93 L/s, Temp: 27.28 °C, EC: 5681 µS/cm, TDS: 3.684 g/L, DO: 84.2 %, DO: 6.5 ppm, pH: 8.05, ORP: 44.5 mV
	67				
	68				
	69				
	70				
	71				
	72				Water Cut: 0.95 L/s, Temp: 23.95 °C, EC: 5739 µS/cm, TDS: 3.73 g/L, DO: 84.8 %, DO: 7.01 ppm, pH: 8.16, ORP: 40.5 mV
	73			SANDSTONE medium grained , light to medium grey,	

PARSONS BRINCKERHOFF

Drawing No.: GLMB03 - Bore Construction	
Revision: A	Date drawn: 5/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

AGL

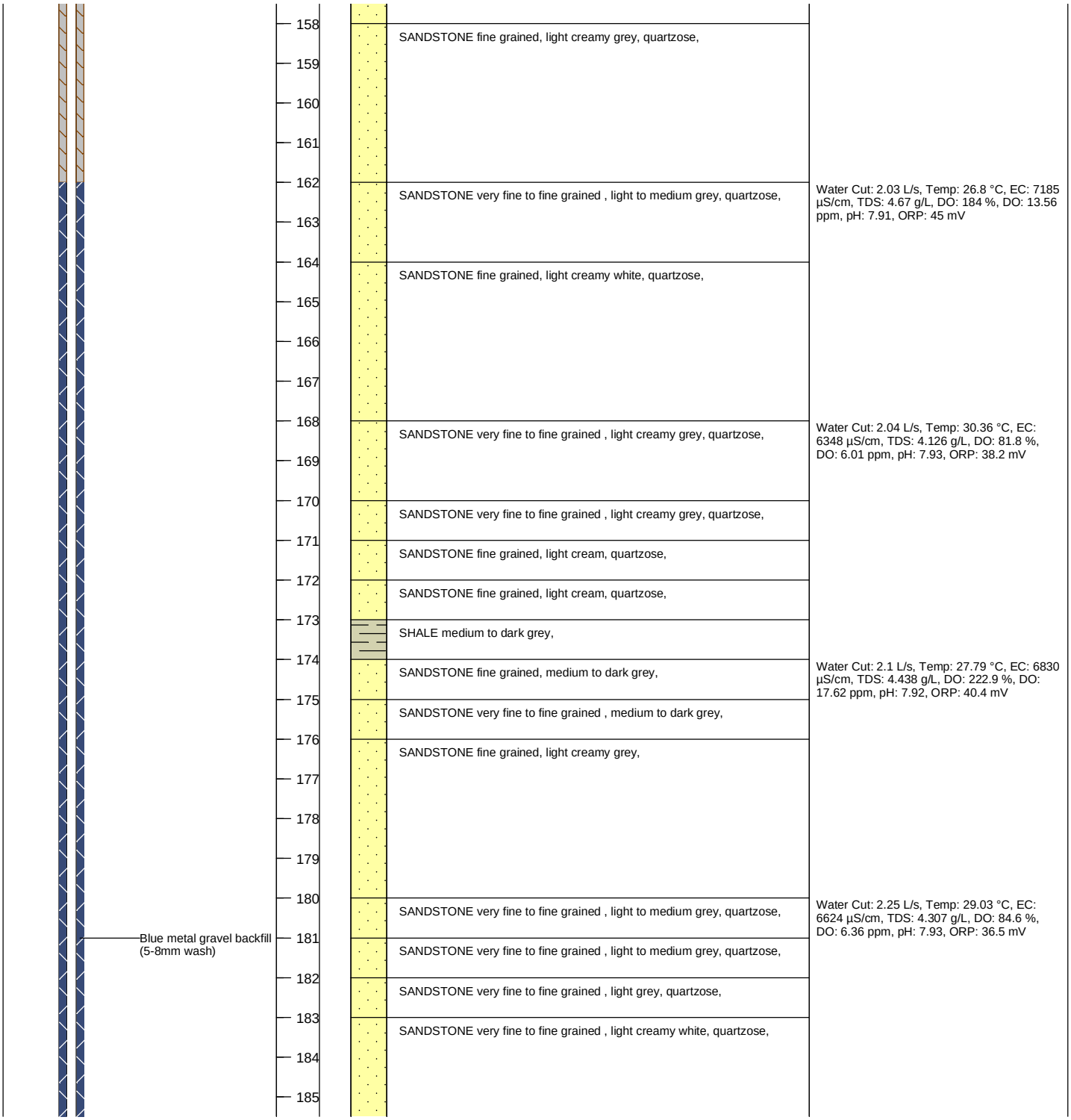
AGL Upstream Investments Pty Ltd
GLMB03

Phase 2 Goundwater Investigation

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	74				
	75				
	76			SANDSTONE medium grained , light to medium grey,	
	77			SANDSTONE medium grained , light grey,	
	78				Water Cut: 1.57 L/s, Temp: 25.19 °C, EC: 6611 µS/cm, TDS: 4.297 g/L, DO: 74.3 %, DO: 5.99 ppm, pH: 8.04, ORP: 41.2 mV
	79				
	80				
Cement grout	81				
	82			SANDSTONE medium grained , light grey,	
	83			SANDSTONE medium grained , light grey,	
	84			SANDSTONE fine grained, light grey,	Water Cut: 1.6 L/s, Temp: 28.43 °C, EC: 6283 µS/cm, TDS: 4.084 g/L, DO: 87.7 %, DO: 6.68 ppm, pH: 8.02, ORP: 49.7 mV
	85				
	86				
	87			SANDSTONE very fine to fine grained , light grey, quartzose,	
	88				
	89				
	90				Water Cut: 1.63 L/s, Temp: 26.36 °C, EC: 6519 µS/cm, TDS: 4.238 g/L, DO: 67.4 %, DO: 5.32 ppm, pH: 8.03, ORP: 47.5 mV
	91				
	92				
	93				
	94				
	95				
	96			SANDSTONE medium grained , light greyish white, quartzose,	Water Cut: 1.52 L/s, Temp: 28.51 °C, EC: 6414 µS/cm, TDS: 4.169 g/L, DO: 184.1 %, DO: 13.78 ppm, pH: 8.01, ORP: 40.6 mV
	97				
	98				
	99			SANDSTONE fine grained, light greyish white, quartzose,	
	100				
	101				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	102			SANDSTONE medium grained , dark grey, quartzose,	Water Cut: 1.24 L/s, Temp: 29.74 °C, EC: 6611 µS/cm, TDS: 4.297 g/L, DO: 77.7 %, DO: 5.77 ppm, pH: 8, ORP: 50.4 mV
	103			SANDSTONE medium grained , light whitish grey, quartzose,	
	104			SANDSTONE fine grained, light whitish grey, quartzose,	
	105				
50NB MED Galv pipe	106			SANDSTONE medium grained , light whitish grey, quartzose,	
	107				
	108			SANDSTONE medium grained , light grey, quartzose,	Water Cut: 1.6 L/s, Temp: 27.8 °C, EC: 6054 µS/cm, TDS: 3.936 g/L, DO: 64.8 %, DO: 4.99 ppm, pH: 8, ORP: 35.8 mV
	109				
	110			SANDSTONE fine grained, light grey, quartzose,	
	111				
	112			SANDSTONE fine grained, light creamy white, quartzose,	
	113				
5 inch diameter borehole	114			SANDSTONE medium grained , light grey, quartzose,	Water Cut: 2.03 L/s, Temp: 31.26 °C, EC: 6746 µS/cm, TDS: 4.385 g/L, DO: 212.6 %, DO: 15.2 ppm, pH: 7.97, ORP: 53.7 mV
	115			SANDSTONE fine grained, light creamy white, quartzose,	
	116				
	117				
	118				
	119			SANDSTONE medium grained , light creamy white, quartzose,	
	120				Water Cut: 1.57 L/s, Temp: 25.85 °C, EC: 5743 µS/cm, TDS: 3.733 g/L, DO: 217.6 %, DO: 17.36 ppm, pH: 8, ORP: 26.5 mV
	121				
	122				
	123				
	124				
	125			SANDSTONE fine grained, light creamy white, quartzose,	
	126			SANDSTONE fine to medium grained, light greyish cream, quartzose,	Water Cut: 1.29 L/s, Temp: 25.24 °C, EC: 7094 µS/cm, TDS: 4.611 g/L, DO: 65.3 %, DO: 5.25 ppm, pH: 7.97, ORP: 21.9 mV
	127				
	128				
	129				

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	130			SANDSTONE fine grained, light creamy white, quartzose,	
	131				
	132			SANDSTONE fine grained, light creamy grey, quartzose,	Water Cut: 1.44 L/s, Temp: 25.47 °C, EC: 6814 µS/cm, TDS: 4.429 g/L, DO: 230.7 %, DO: 18.32 ppm, pH: 7.96, ORP: 20.6 mV
	133				
	134				
	135				
	136				
	137				
	138			SANDSTONE fine grained, creamy brownish grey, quartzose,	Water Cut: 1.7 L/s, Temp: 26.82 °C, EC: 7101 µS/cm, TDS: 4.616 g/L, DO: 62.7 %, DO: 4.89 ppm, pH: 7.97, ORP: 11.5 mV
	139			SANDSTONE fine grained, light creamy grey, quartzose,	
	140				
	141				
	142				
	143				
	144			SANDSTONE fine grained, light creamy white, quartzose,	Water Cut: 1.7 L/s, Temp: 26.46 °C, EC: 6582 µS/cm, TDS: 4.247 g/L, DO: 60.3 %, DO: 4.74 ppm, pH: 7.96, ORP: 14.6 mV
	145				
	146				
	147				
	148				
	149				
	150				Water Cut: 1.71 L/s, Temp: 26.03 °C, EC: 7026 µS/cm, TDS: 4.567 g/L, DO: 210.4 %, DO: 20.79 ppm, pH: 7.96, ORP: 18.8 mV
	151				
	152				
	153				
	154				
	155				
	156			SANDSTONE fine grained, medium to dark grey, quartzose,	Water Cut: 1.94 L/s, Temp: 25.51 °C, EC: 5906 µS/cm, TDS: 3.839 g/L, DO: 65.8 %, DO: 5.26 ppm, pH: 7.97, ORP: 18.9 mV
	157			SANDSTONE fine grained, light creamy grey,	



PARSONS BRINCKERHOFF

Drawing No.: GLMB03 - Bore Construction	
Revision: A	Date drawn: 5/2/14
Drawn by: K. Maher	Checked by: J. Duggleby
Project No. 2114759B	

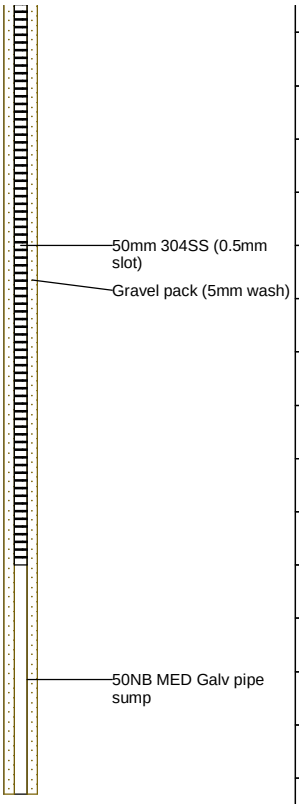
AGL

AGL Upstream Investments Pty Ltd
GLMB03

Phase 2 Goundwater Investigation

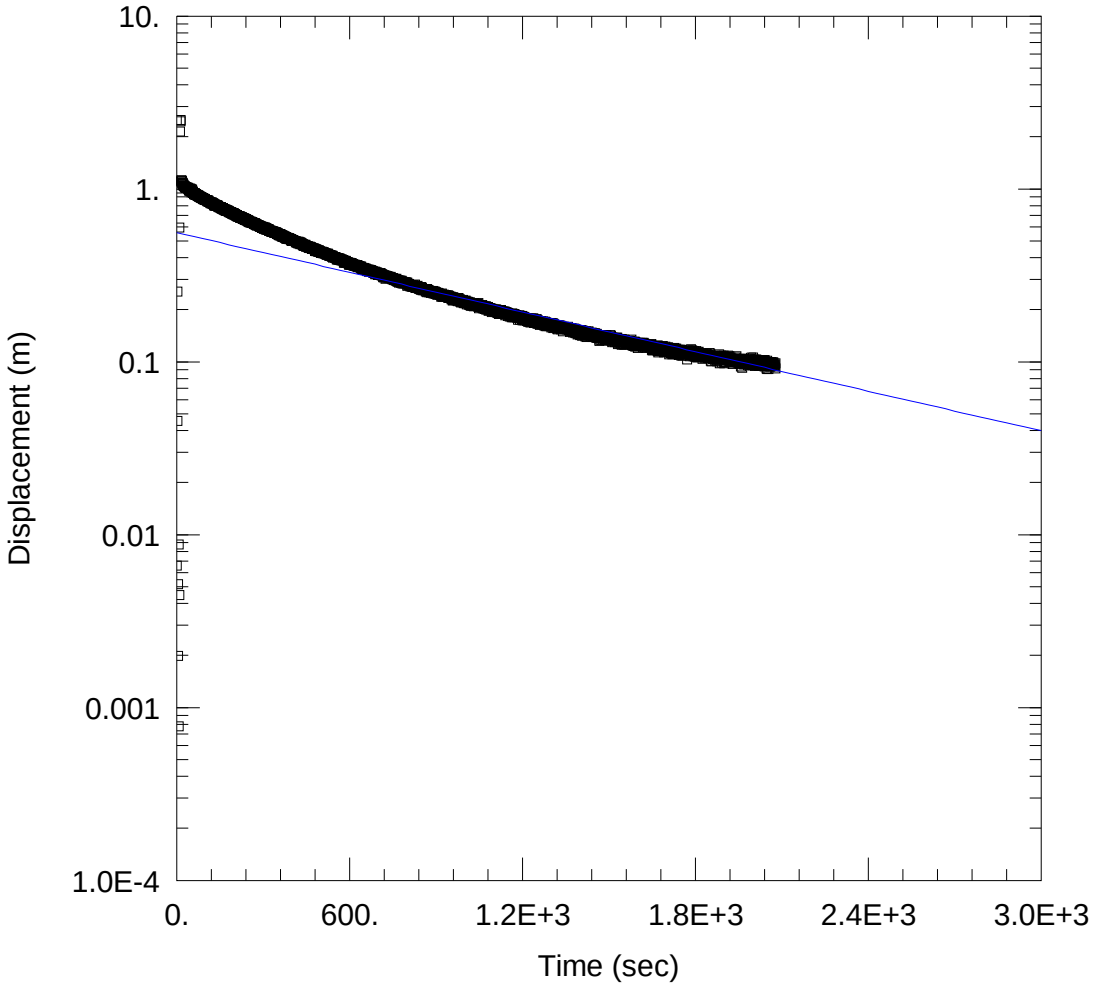
BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	186			SANDSTONE medium grained , light creamy white, quartzose,	Water Cut: 2.3 L/s, Temp: 31.98 °C, EC: 5977 µS/cm, TDS: 3.887 g/L, DO: 165.4 %, DO: 12.07 ppm, pH: 7.91, ORP: 38.3 mV
	187			SANDSTONE fine grained, light creamy white, quartzose,	
	188			SANDSTONE medium grained , light creamy white, quartzose,	
	189			SANDSTONE fine grained, light creamy white, quartzose,	
	190			SANDSTONE medium to coarse grained , light creamy white, quartzose,	
	191			SANDSTONE fine grained, light creamy white, quartzose,	
	192			SANDSTONE fine grained, creamy greyish white,	Water Cut: 2.4 L/s, Temp: 26.01 °C, EC: 6259 µS/cm, TDS: 4.068 g/L, DO: 60 %, DO: 4.77 ppm, pH: 7.94, ORP: 52.5 mV
	193				
	194				
	195				
	196				
	197				
	198				Water Cut: 1.94 L/s, Temp: 33.54 °C, EC: 6699 µS/cm, TDS: 4.356 g/L, DO: 252.4 %, DO: 17.48 ppm, pH: 7.87, ORP: 40.7 mV
	199				
	200				
	201				
	202				
	203				
	204				Water Cut: 2.1 L/s, Temp: 28.68 °C, EC: 6493 µS/cm, TDS: 1.221 g/L, DO: 151.5 %, DO: 11.45 ppm, pH: 7.93, ORP: 46.6 mV
	205				
	206				
	207				
	208				
	209				
	210				Water Cut: 2.89 L/s, Temp: 22.82 °C, EC: 6337 µS/cm, TDS: 4.12 g/L, DO: 78.5 %, DO: 6.6 ppm, pH: 7.95, ORP: 23.6 mV
	211				
	212				
	213				

BORE COMPLETION REPORT - GLMB03

BORE CONSTRUCTION	DEPTH (m)	STRATIGRAPHY	GRAPHIC LOG	LITHOLOGY	WATER QUALITY
	214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229			SANDSTONE fine grained, light tannish grey, SANDSTONE very fine to fine grained , light tannish white, quartzose,	Water Cut: 2.44 L/s, Temp: 24.97 °C, EC: 5843 µS/cm, TDS: 3.798 g/L, DO: 70.4 %, DO: 5.71 ppm, pH: 7.98, ORP: 8.42 mV Water Cut: 2.8 L/s, Temp: 23.94 °C, EC: 5834 µS/cm, TDS: 3.793 g/L, DO: 63 %, DO: 5.13 ppm, pH: 7.99, ORP: 9.32 mV Water Cut: 2.23 L/s, Temp: 24.09 °C, EC: 6513 µS/cm, TDS: 3.782 g/L, DO: 67.4 %,

Appendix B

Slug test results



WELL TEST ANALYSIS

Data Set: \...\RMB02b.aqt
Date: 11/29/11 Time: 13:29:50

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL Energy Ltd
Project: 2114759B
Location: Denham Court Road
Test Well: RMB02_Rising
Test Date: 1 November 2011

AQUIFER DATA

Saturated Thickness: 15. m Anisotropy Ratio (Kz/Kr): 1.

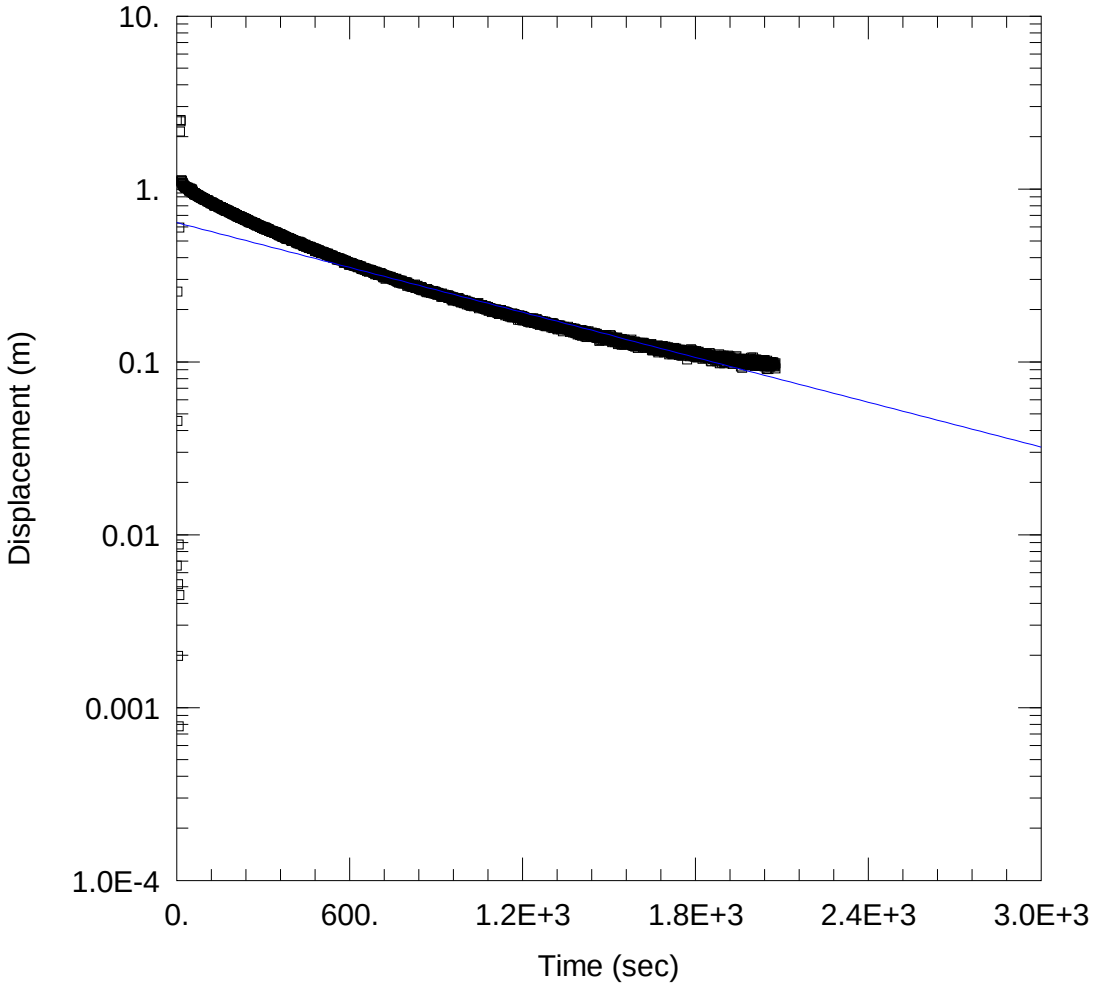
WELL DATA (RMB02)

Initial Displacement: 2.505 m
Total Well Penetration Depth: 105.7 m
Casing Radius: 0.025 m
Static Water Column Height: 108.7 m
Screen Length: 12. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.000906 m/day y0 = 0.5578 m



WELL TEST ANALYSIS

Data Set: \...\RMB02b.aqt
Date: 11/29/11 Time: 13:30:09

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL Energy Ltd
Project: 2114759B
Location: Denham Court Road
Test Well: RMB02_Rising
Test Date: 1 November 2011

AQUIFER DATA

Saturated Thickness: 15. m Anisotropy Ratio (Kz/Kr): 1.

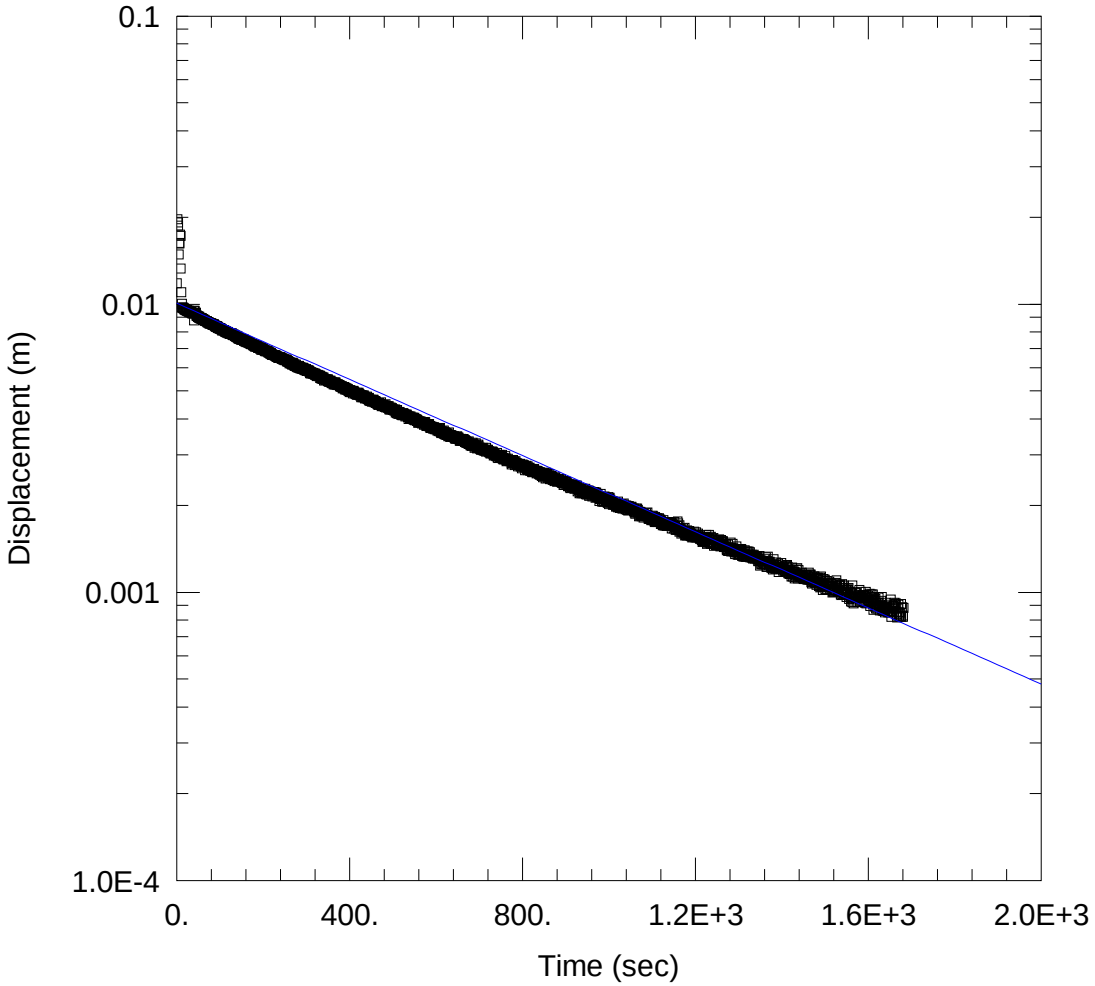
WELL DATA (RMB02)

Initial Displacement: 2.505 m
Total Well Penetration Depth: 105.7 m
Casing Radius: 0.025 m
Static Water Column Height: 108.7 m
Screen Length: 12. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.0009415 m/day y0 = 0.6388 m



WELL TEST ANALYSIS

Data Set: \...\RMB02a.aqt
Date: 11/29/11 Time: 13:29:19

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL Energy Ltd
Project: 2114759B
Location: Denham Court Road
Test Well: RMB02_Falling_A
Test Date: 1 November 2011

AQUIFER DATA

Saturated Thickness: 15. m Anisotropy Ratio (Kz/Kr): 1.

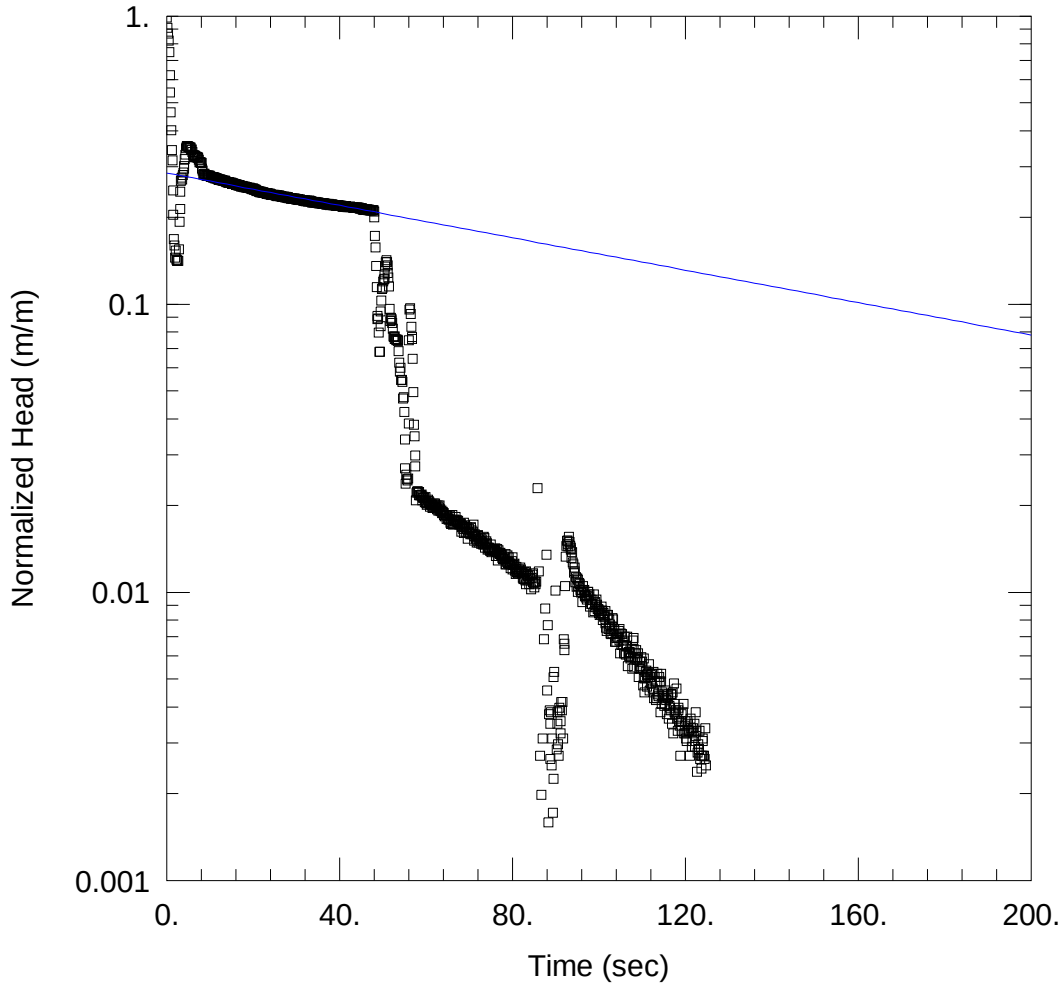
WELL DATA (RMB02)

Initial Displacement: 1.965 m
Total Well Penetration Depth: 105.7 m
Casing Radius: 0.025 m
Static Water Column Height: 108.7 m
Screen Length: 12. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.001566 m/day y0 = 0.01006 m



WELL TEST ANALYSIS

Data Set: \...\MPMB01-slug1-rising1.aqt
Date: 07/08/13 Time: 09:38:29

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL Energy
Project: 2114759B
Location: Menangle Park
Test Well: MPMB01
Test Date: 24/6/13

AQUIFER DATA

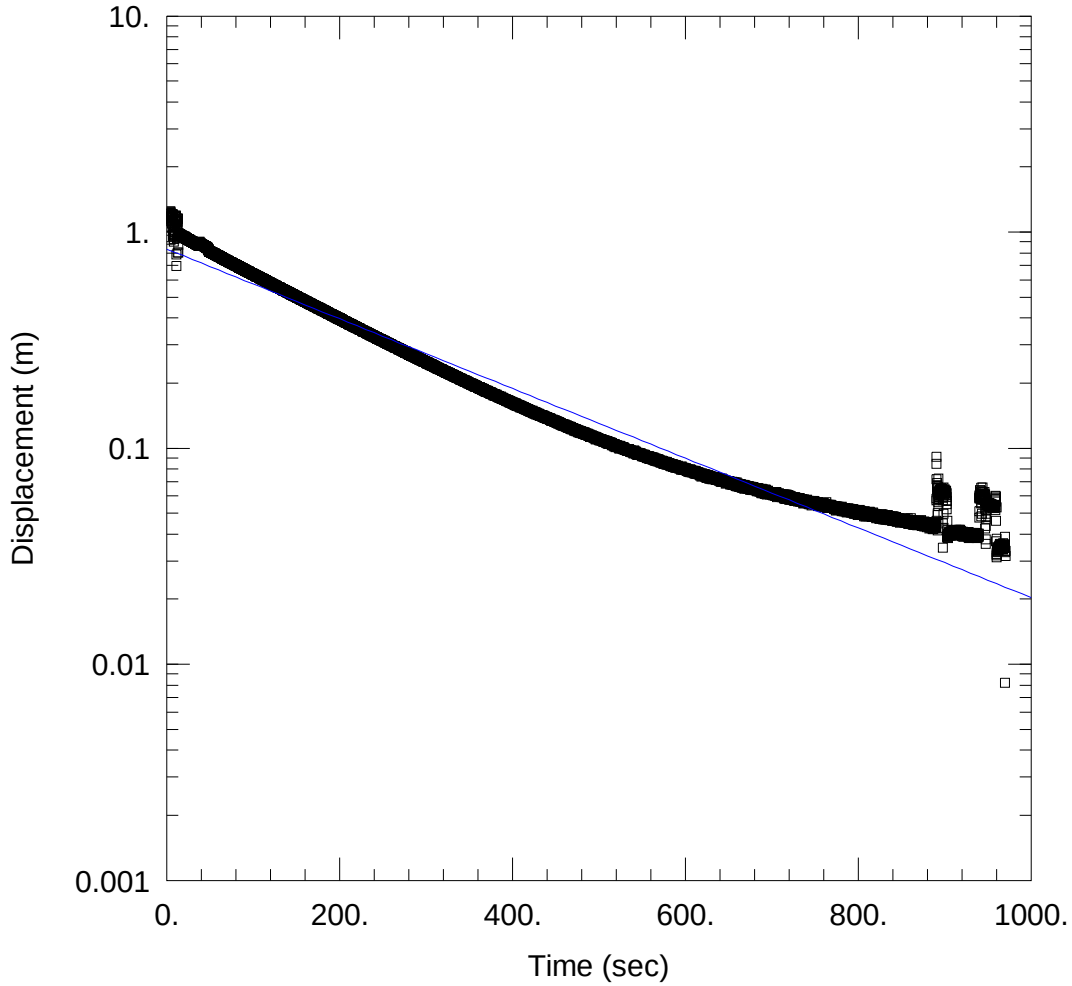
Saturated Thickness: 9.57 m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MPMB01)

Initial Displacement: -1.513 m
Total Well Penetration Depth: 7.07 m
Casing Radius: 0.025 m
Static Water Column Height: 9.57 m
Screen Length: 6. m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.1509 m/day
y0 = -0.4314 m



WELL TEST ANALYSIS

Data Set: \...\MPMB02-slug-falling1.aqt
Date: 07/08/13 Time: 10:28:41

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL Energy
Project: 2114759B
Location: Menangle Park
Test Well: MPMB02
Test Date: 24/6/13

AQUIFER DATA

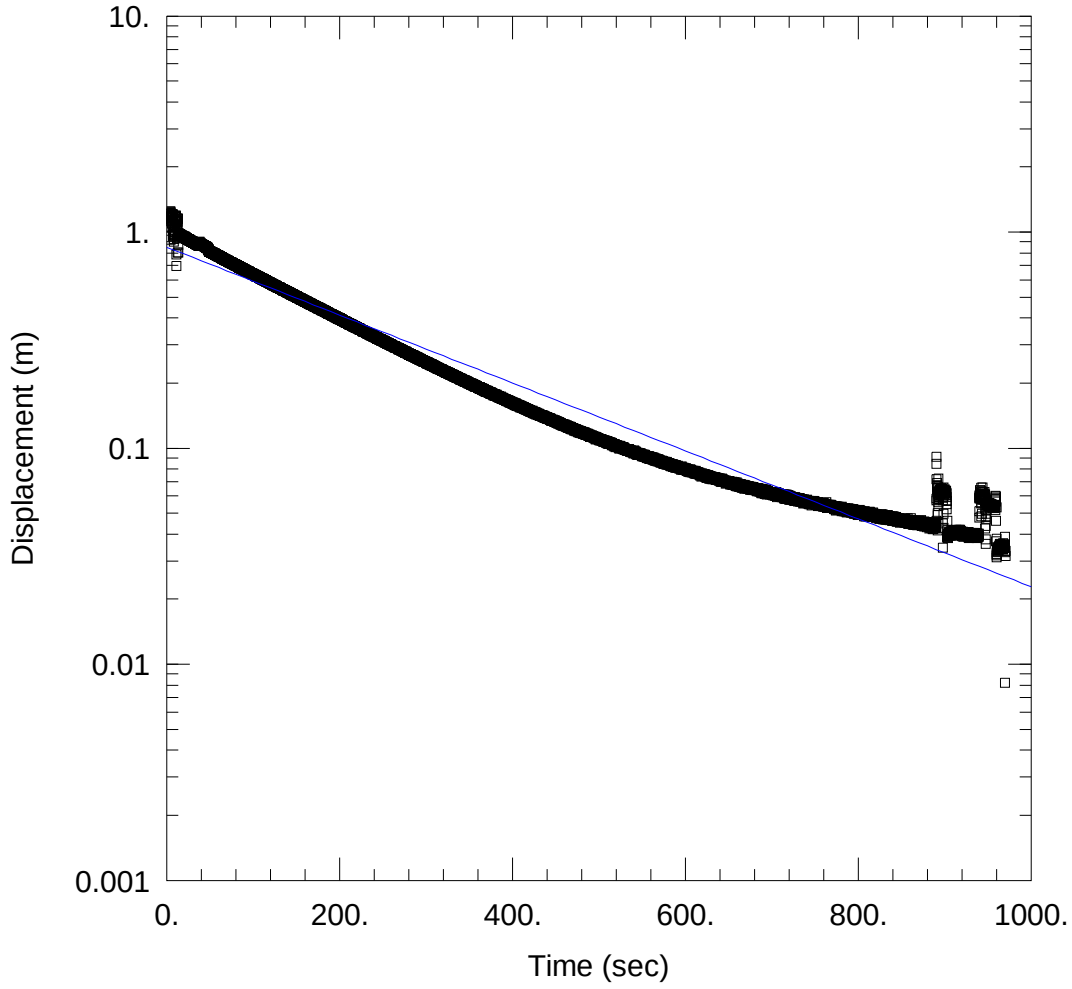
Saturated Thickness: 16. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MPMB02)

Initial Displacement: 33.08 m
Total Well Penetration Depth: 13. m
Casing Radius: 0.025 m
Static Water Column Height: 33.13 m
Screen Length: 12. m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.04999 m/day
y0 = 0.8341 m



WELL TEST ANALYSIS

Data Set: \...\MPMB02-slug-falling1.aqt
Date: 07/08/13 Time: 10:29:19

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL Energy
Project: 2114759B
Location: Menangle Park
Test Well: MPMB02
Test Date: 24/6/13

AQUIFER DATA

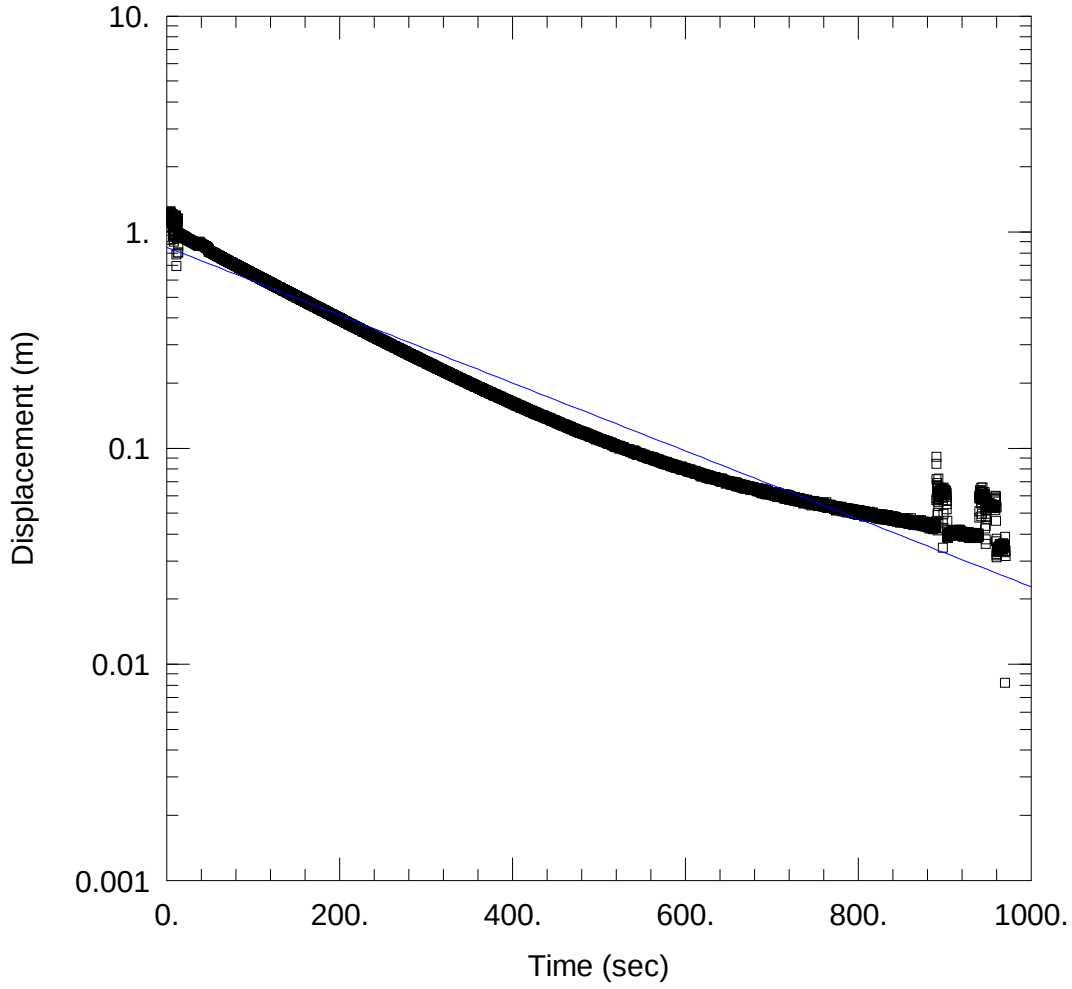
Saturated Thickness: 16. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MPMB02)

Initial Displacement: 33.08 m
Total Well Penetration Depth: 13. m
Casing Radius: 0.025 m
Static Water Column Height: 33.13 m
Screen Length: 12. m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.05965 m/day
y0 = 0.8518 m



WELL TEST ANALYSIS

Data Set: \...\MPMB02-slug-falling1.aqt
Date: 07/08/13 Time: 10:29:19

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL Energy
Project: 2114759B
Location: Menangle Park
Test Well: MPMB02
Test Date: 24/6/13

AQUIFER DATA

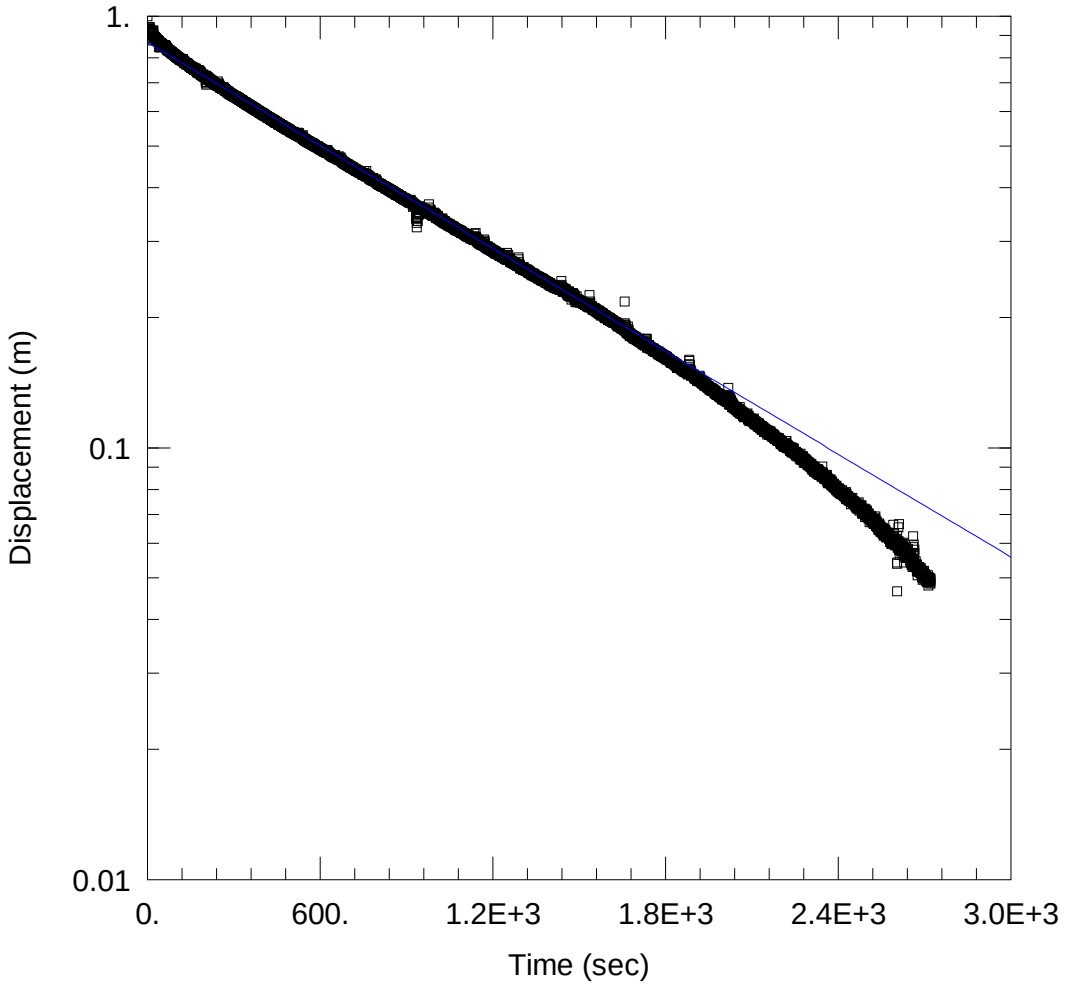
Saturated Thickness: 16. m
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MPMB02)

Initial Displacement: 33.08 m
Total Well Penetration Depth: 13. m
Casing Radius: 0.025 m
Static Water Column Height: 33.13 m
Screen Length: 12. m
Well Radius: 0.025 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.05965 m/day
y0 = 0.8518 m



WELL TEST ANALYSIS

Data Set: \...\GLMB01_RH2.aqt
Date: 03/12/14 Time: 10:00:25

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB01
Test Date: 19/02/2014

AQUIFER DATA

Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

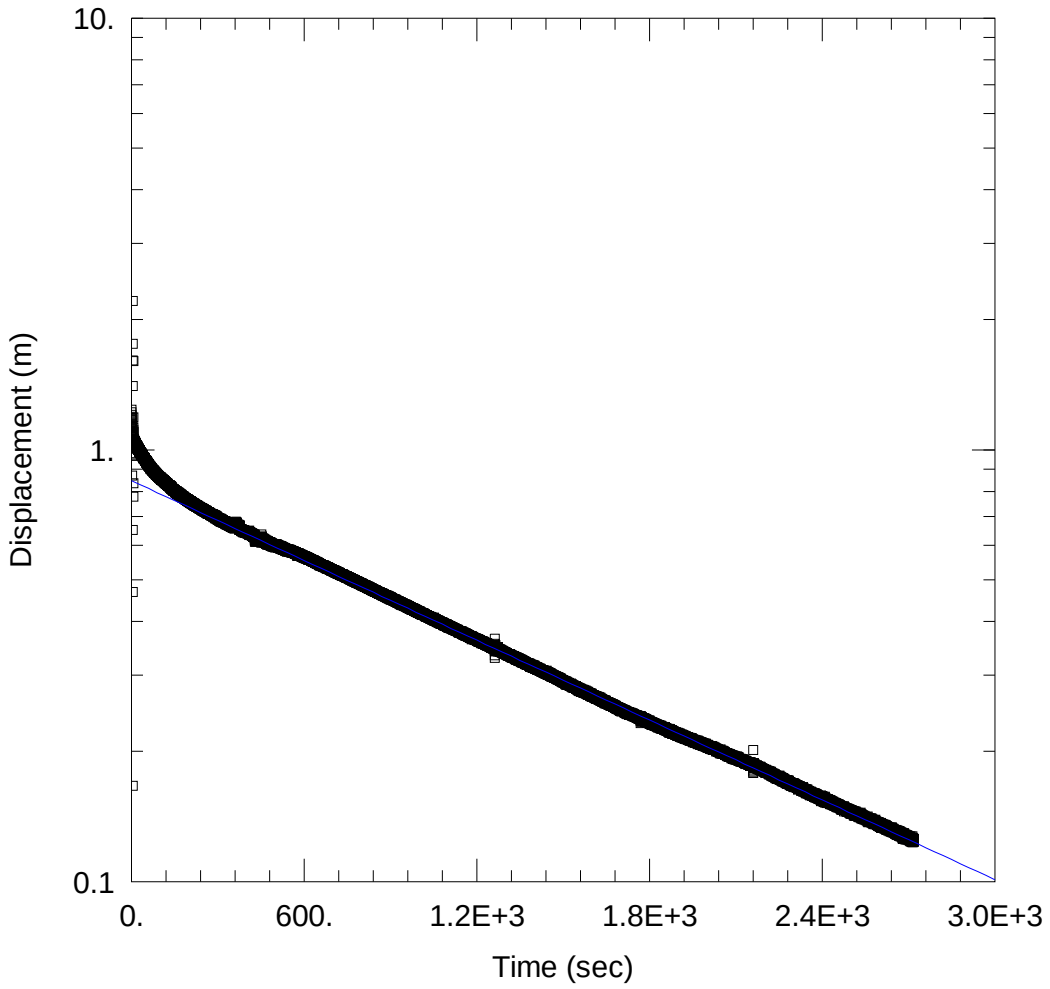
WELL DATA (GLMB01)

Initial Displacement: 1. m
Total Well Penetration Depth: 15. m
Casing Radius: 0.025 m
Static Water Column Height: 88.12 m
Screen Length: 12. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.01271 m/day y0 = 0.8686 m



WELL TEST ANALYSIS

Data Set: \...\GLMB01_FH1.aqt
Date: 03/12/14 Time: 09:58:49

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB01
Test Date: 19/02/2014

AQUIFER DATA

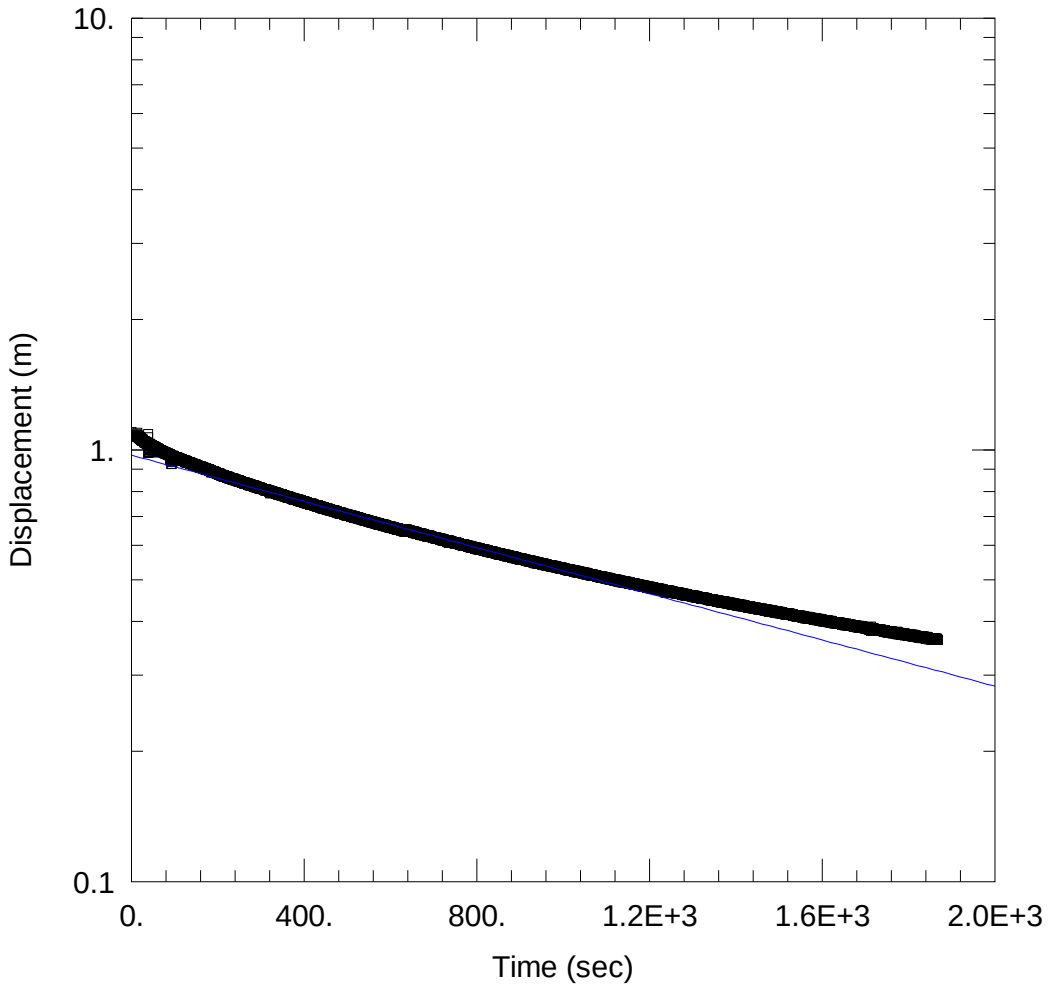
Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GLMB01)

Initial Displacement: 1.15 m
Static Water Column Height: 88.12 m
Total Well Penetration Depth: 15. m
Screen Length: 12. m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.009853 m/day
y0 = 0.8481 m



WELL TEST ANALYSIS

Data Set: \...\GLMB01_RH1.aqt
Date: 03/12/14 Time: 09:59:59

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB01
Test Date: 19/02/2014

AQUIFER DATA

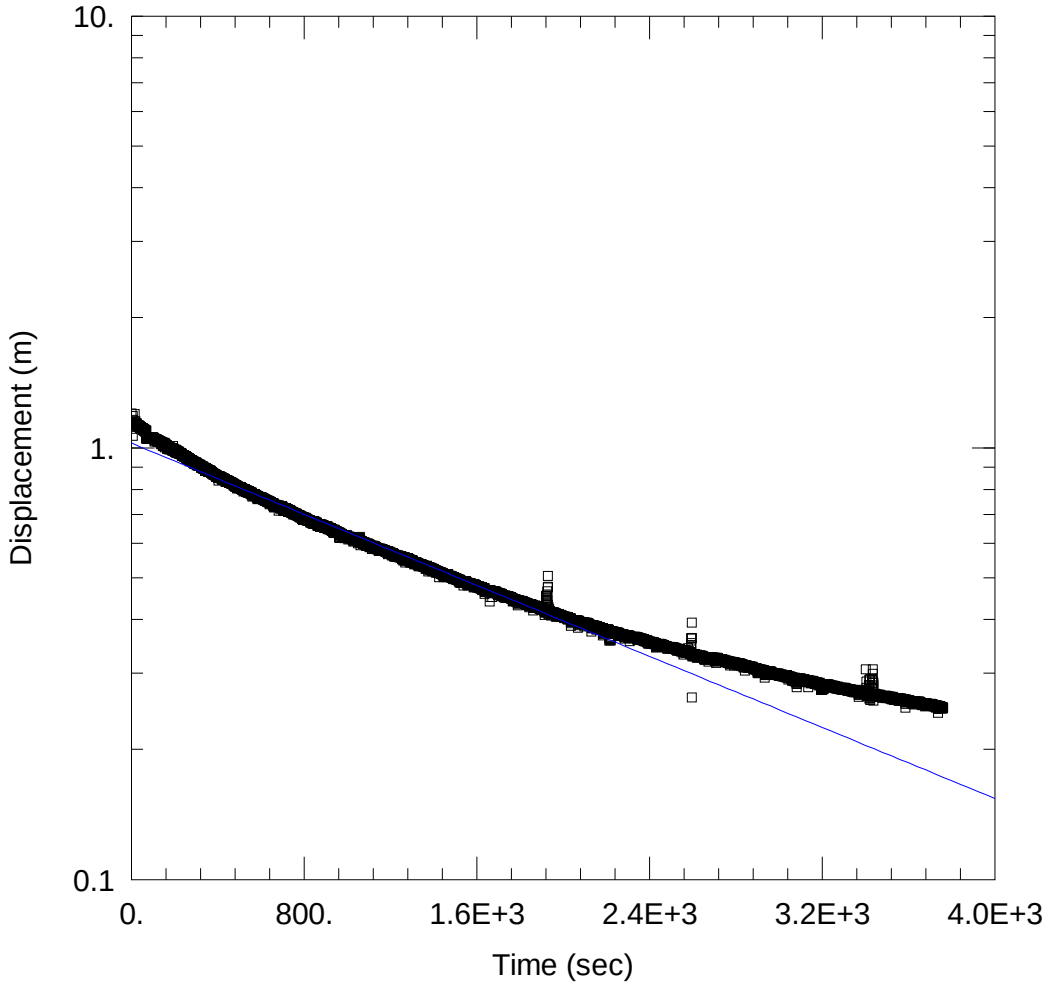
Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GLMB01)

Initial Displacement: 1.1 m
Static Water Column Height: 88.12 m
Total Well Penetration Depth: 15. m
Screen Length: 12. m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.008553 m/day
y0 = 0.971 m



WELL TEST ANALYSIS

Data Set: \...\GLMB01_FH2.aqt
Date: 03/12/14 Time: 09:59:36

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB01
Test Date: 19/02/2014

AQUIFER DATA

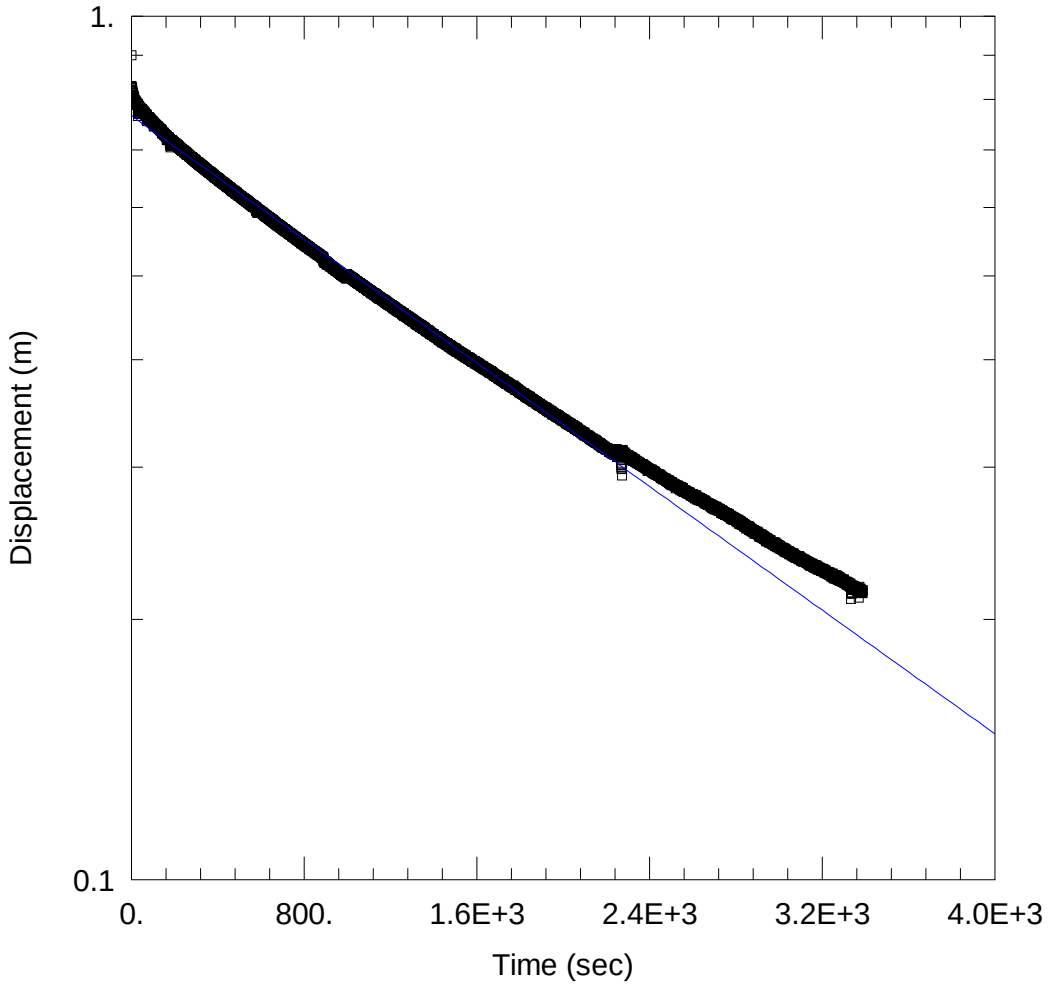
Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GLMB01)

Initial Displacement: 1.2 m
Static Water Column Height: 88.12 m
Total Well Penetration Depth: 15. m
Screen Length: 12. m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.00658 m/day
y0 = 1.024 m



WELL TEST ANALYSIS

Data Set: \...\GLMB03_RH1.aqt
Date: 03/12/14 Time: 10:03:56

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB03
Test Date: 19/02/2014

AQUIFER DATA

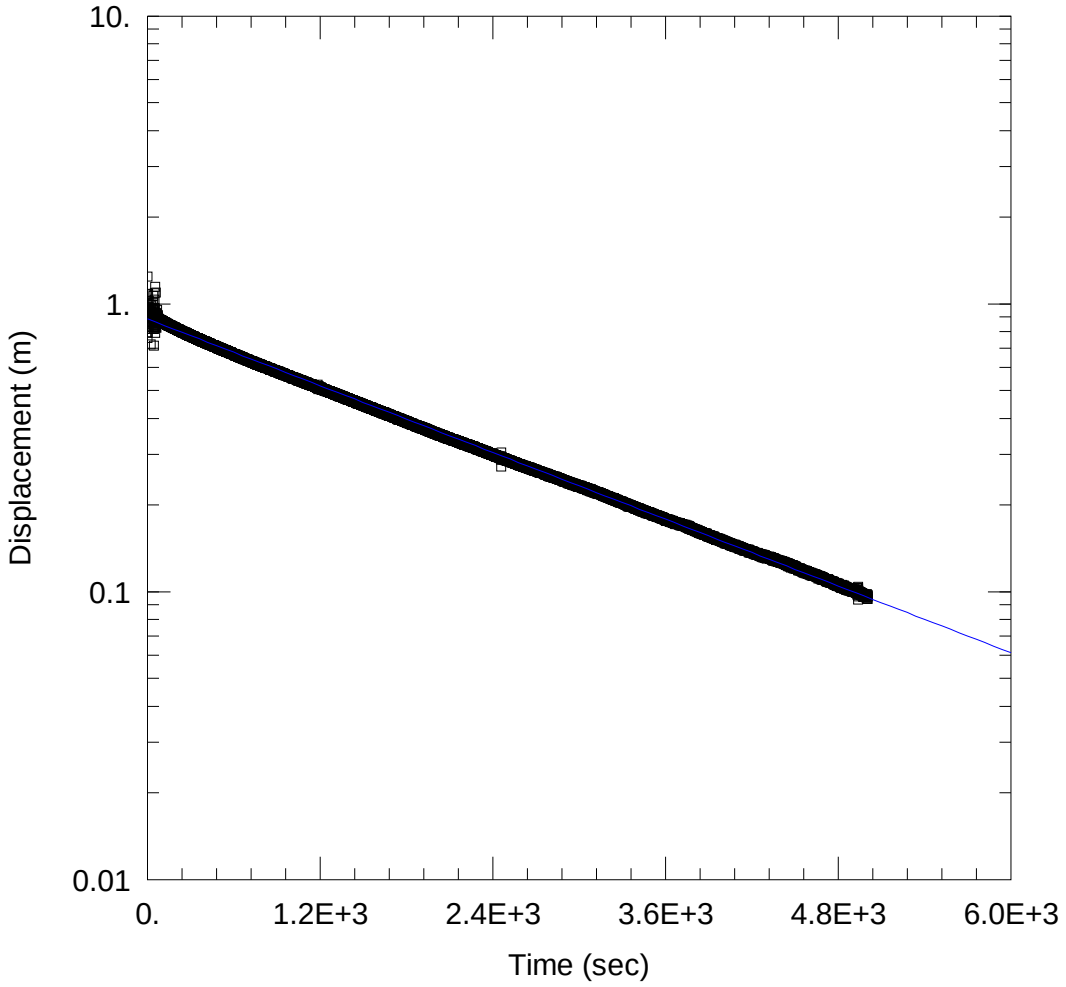
Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GLMB03)

Initial Displacement: 0.9 m
Static Water Column Height: 209.7 m
Total Well Penetration Depth: 15. m
Screen Length: 12. m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.005723 m/day
y0 = 0.7666 m



WELL TEST ANALYSIS

Data Set: \...\GLMB03_FH2.aqt
Date: 03/12/14 Time: 10:03:26

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB03
Test Date: 20/02/2014

AQUIFER DATA

Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

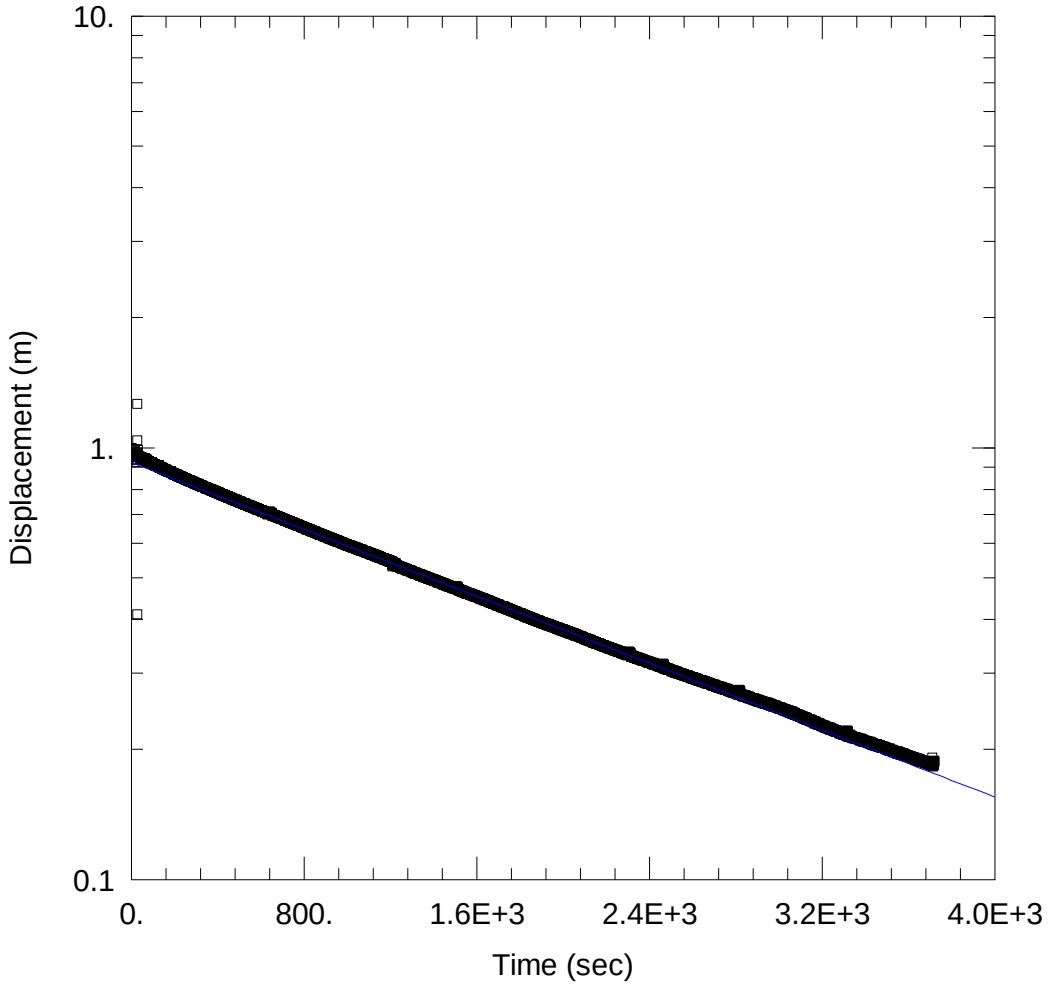
WELL DATA (GLMB03)

Initial Displacement: 1. m
Total Well Penetration Depth: 15. m
Casing Radius: 0.025 m
Static Water Column Height: 209.7 m
Screen Length: 12. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.006182 m/day y0 = 0.886 m



WELL TEST ANALYSIS

Data Set: \...\GLMB03_FH1.aqt
Date: 03/12/14 Time: 10:02:56

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB03
Test Date: 19/02/2014

AQUIFER DATA

Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

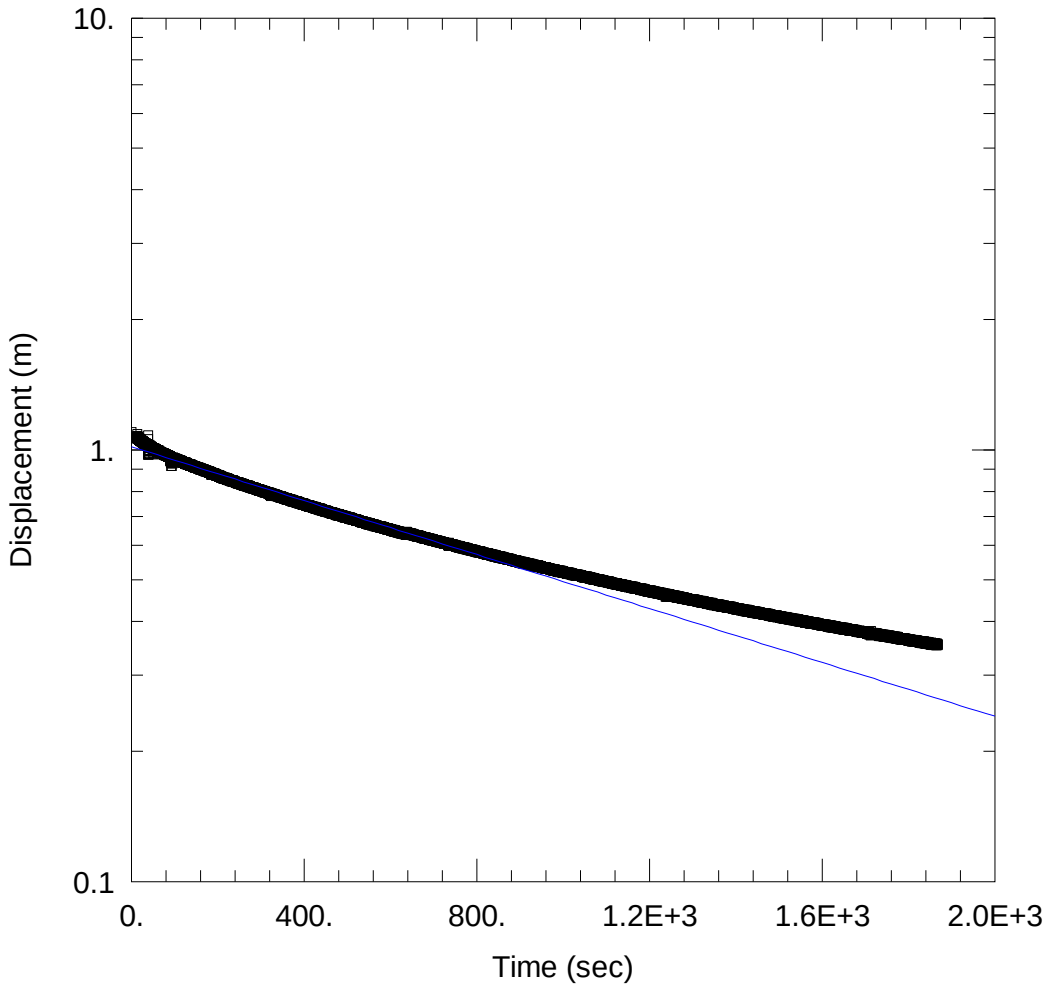
WELL DATA (GLMB03)

Initial Displacement: 1. m
Total Well Penetration Depth: 15. m
Casing Radius: 0.025 m
Static Water Column Height: 209.7 m
Screen Length: 12. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 0.006198 m/day y0 = 0.9246 m



WELL TEST ANALYSIS

Data Set: \...\GLMB02_RH2.aqt
Date: 03/12/14 Time: 10:02:24

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB02
Test Date: 19/02/2014

AQUIFER DATA

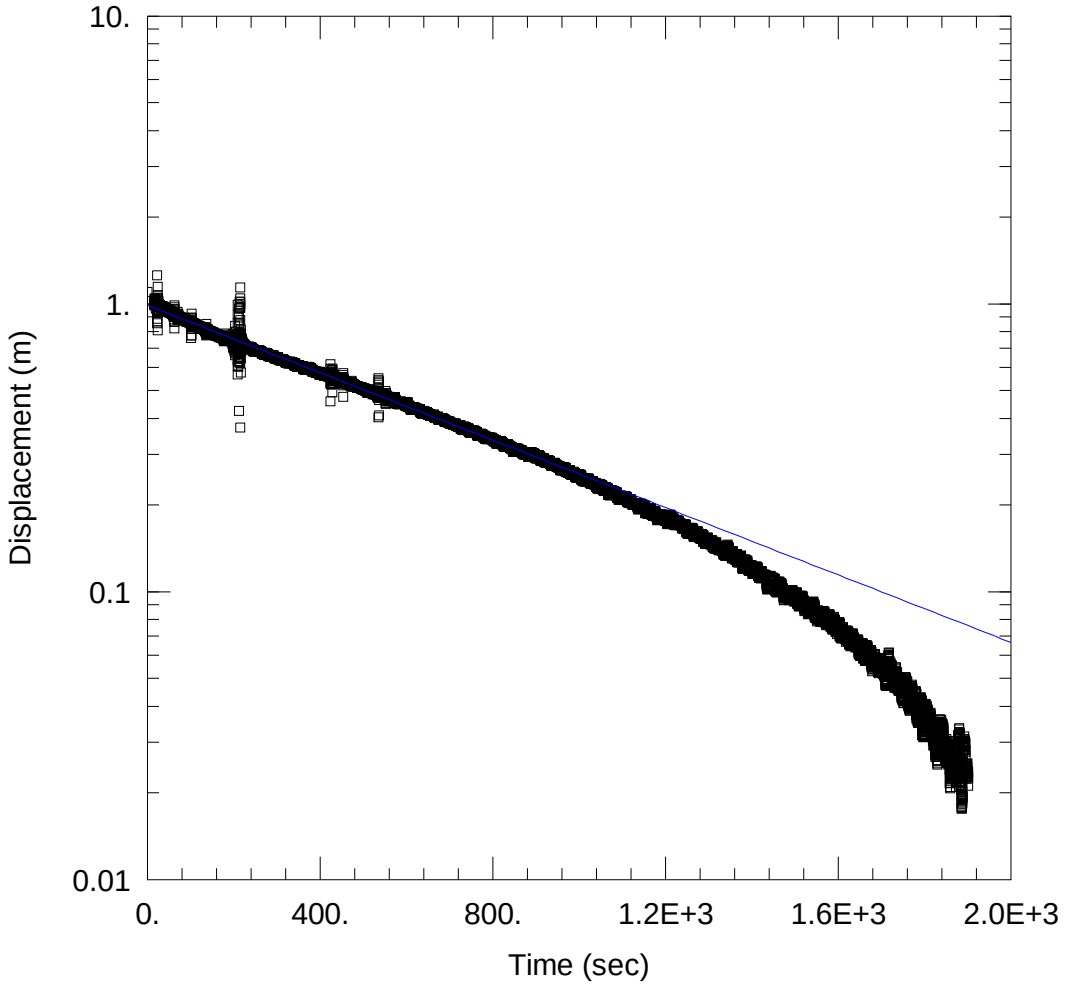
Saturated Thickness: 15. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GLMB02)

Initial Displacement: 1.1 m
Total Well Penetration Depth: 15. m
Casing Radius: 0.025 m
Static Water Column Height: 171.3 m
Screen Length: 12. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.01111 m/day
y0 = 1.016 m



WELL TEST ANALYSIS

Data Set: \...\GLMB02_FH1.aqt
Date: 03/12/14 Time: 10:00:48

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB02
Test Date: 19/02/2014

AQUIFER DATA

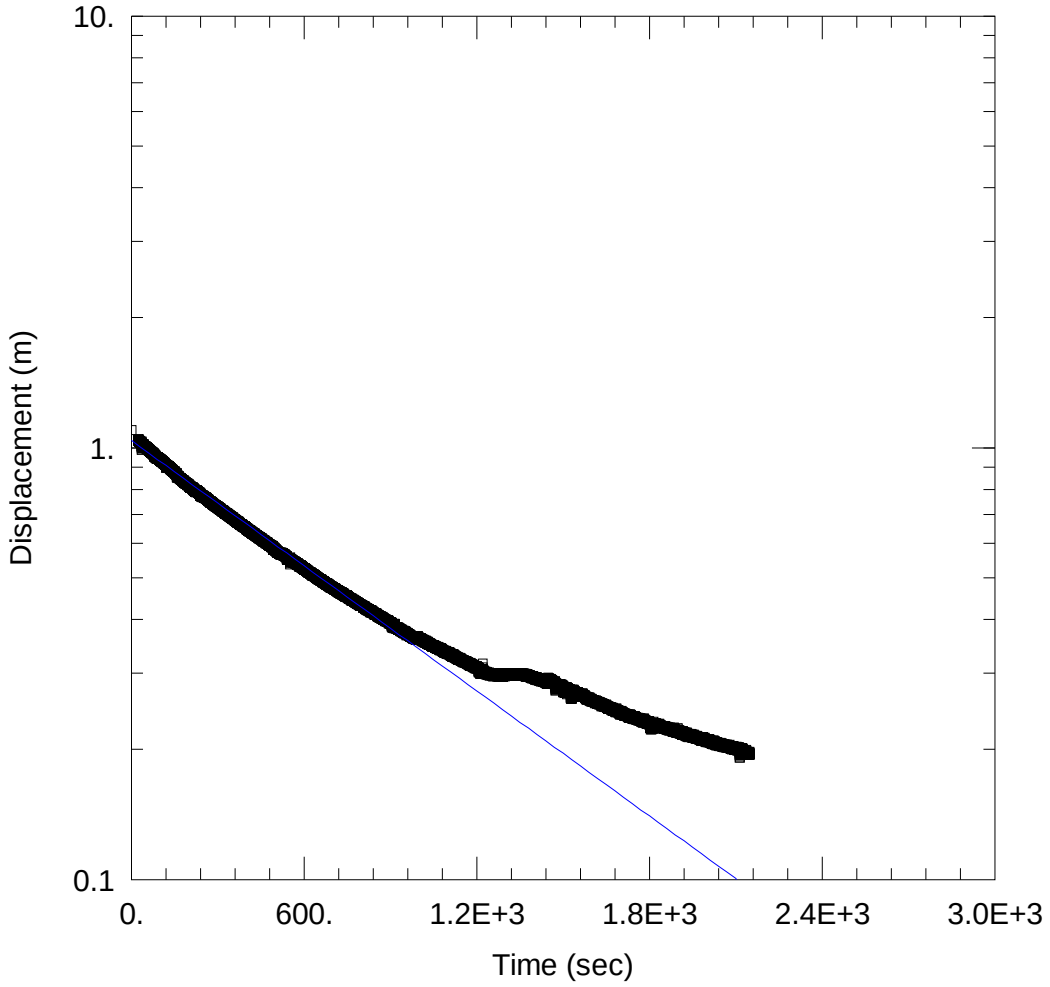
Saturated Thickness: 15. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GLMB02)

Initial Displacement: 1.1 m
Static Water Column Height: 169.3 m
Total Well Penetration Depth: 15. m
Screen Length: 12. m
Casing Radius: 0.025 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.02083 m/day
y0 = 0.9881 m



WELL TEST ANALYSIS

Data Set: \...\GLMB02_RH1.aqt
Date: 03/12/14 Time: 10:01:46

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB02
Test Date: 19/02/2014

AQUIFER DATA

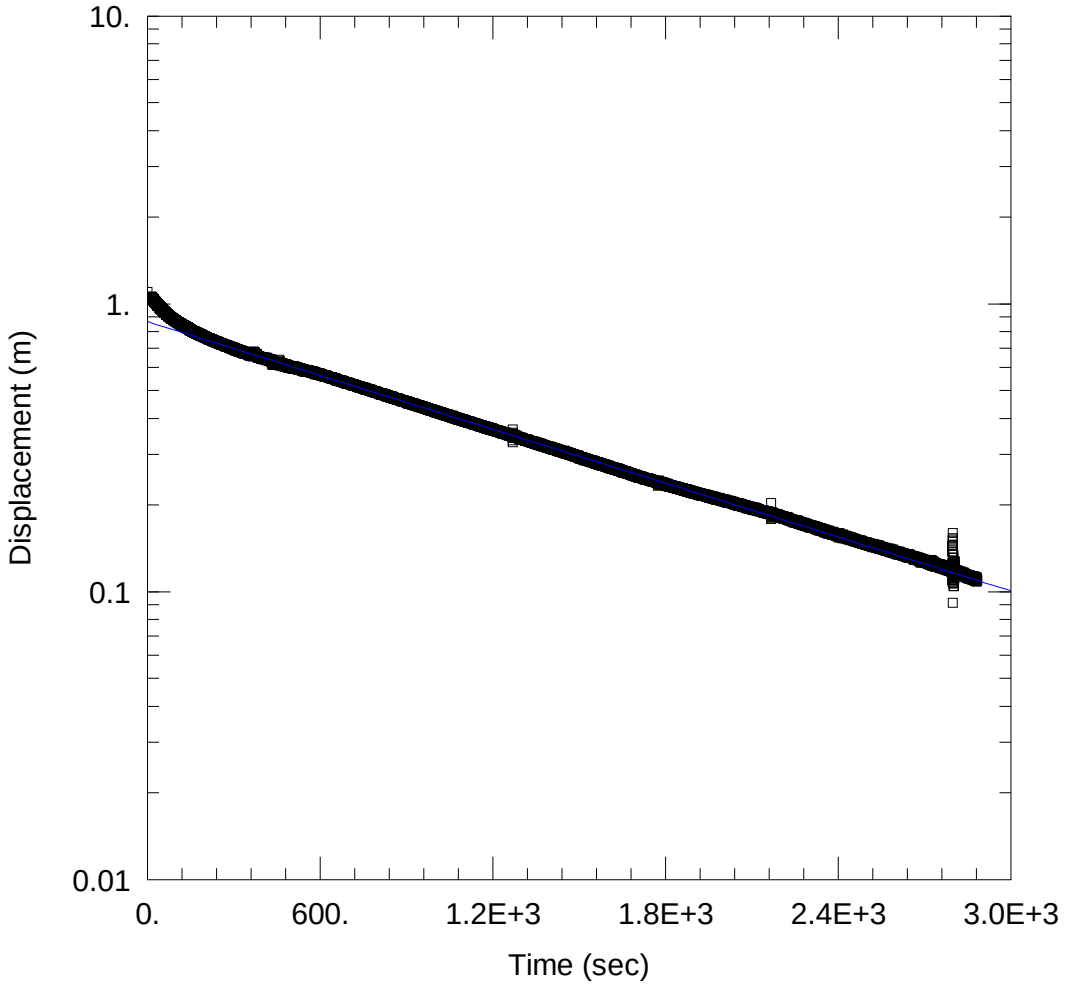
Saturated Thickness: 15. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GLMB02)

Initial Displacement: 1.1 m
Total Well Penetration Depth: 15. m
Casing Radius: 0.025 m
Static Water Column Height: 169.3 m
Screen Length: 12. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.01719 m/day
y0 = 1.039 m



WELL TEST ANALYSIS

Data Set: \...\GLMB02_FH2.aqt
Date: 03/12/14 Time: 10:01:18

PROJECT INFORMATION

Company: Parsons Brinckerhoff
Client: AGL
Project: 2193361A
Location: Gloucester
Test Well: GLMB02
Test Date: 19/02/2014

AQUIFER DATA

Saturated Thickness: 15. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GLMB02)

Initial Displacement: 1.1 m
Total Well Penetration Depth: 15. m
Casing Radius: 0.025 m
Static Water Column Height: 169.3 m
Screen Length: 12. m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 0.01109 m/day
y0 = 0.8674 m

Appendix C

Hydrographs

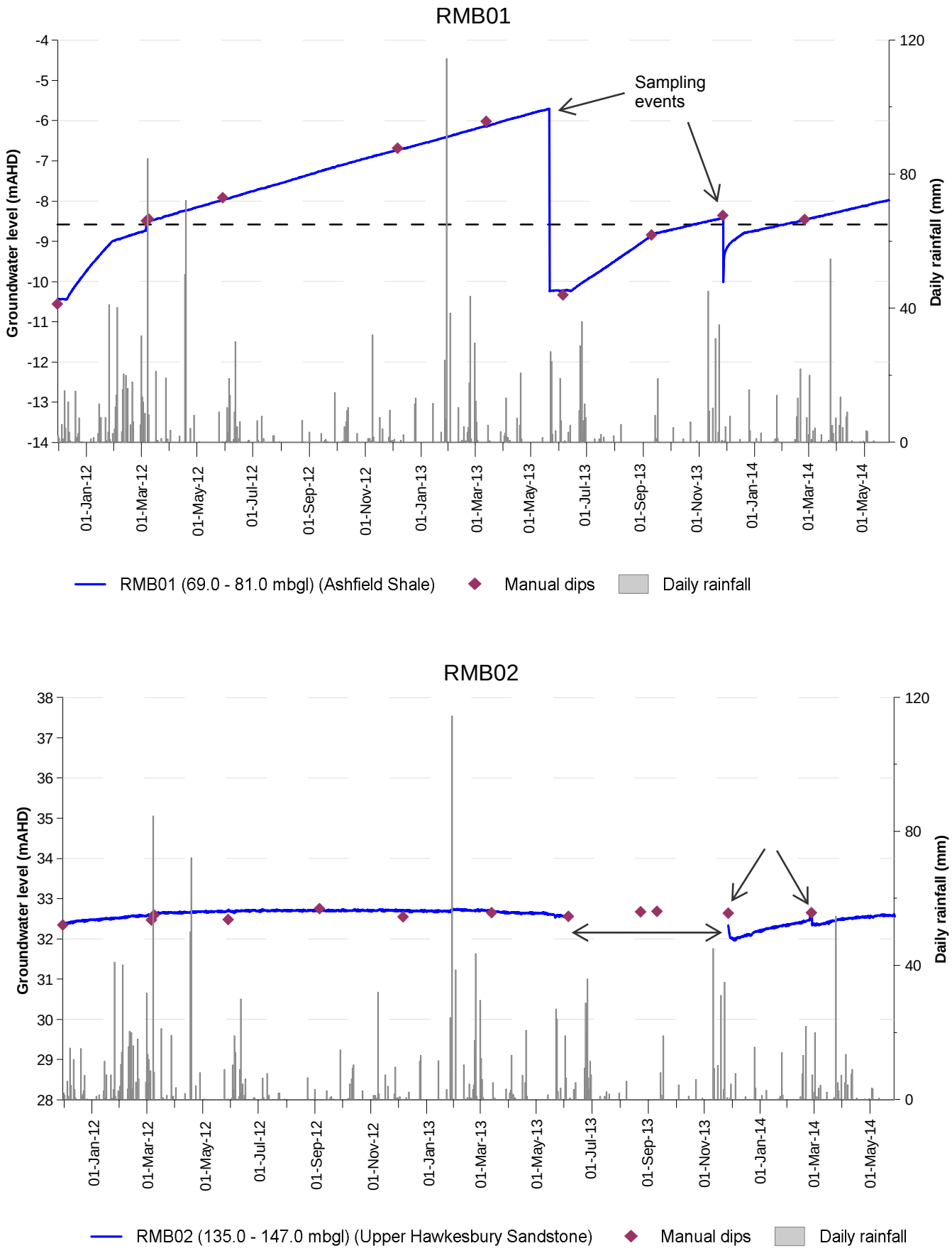


Figure A.1: RMB01 and RMB02 monitoring bores

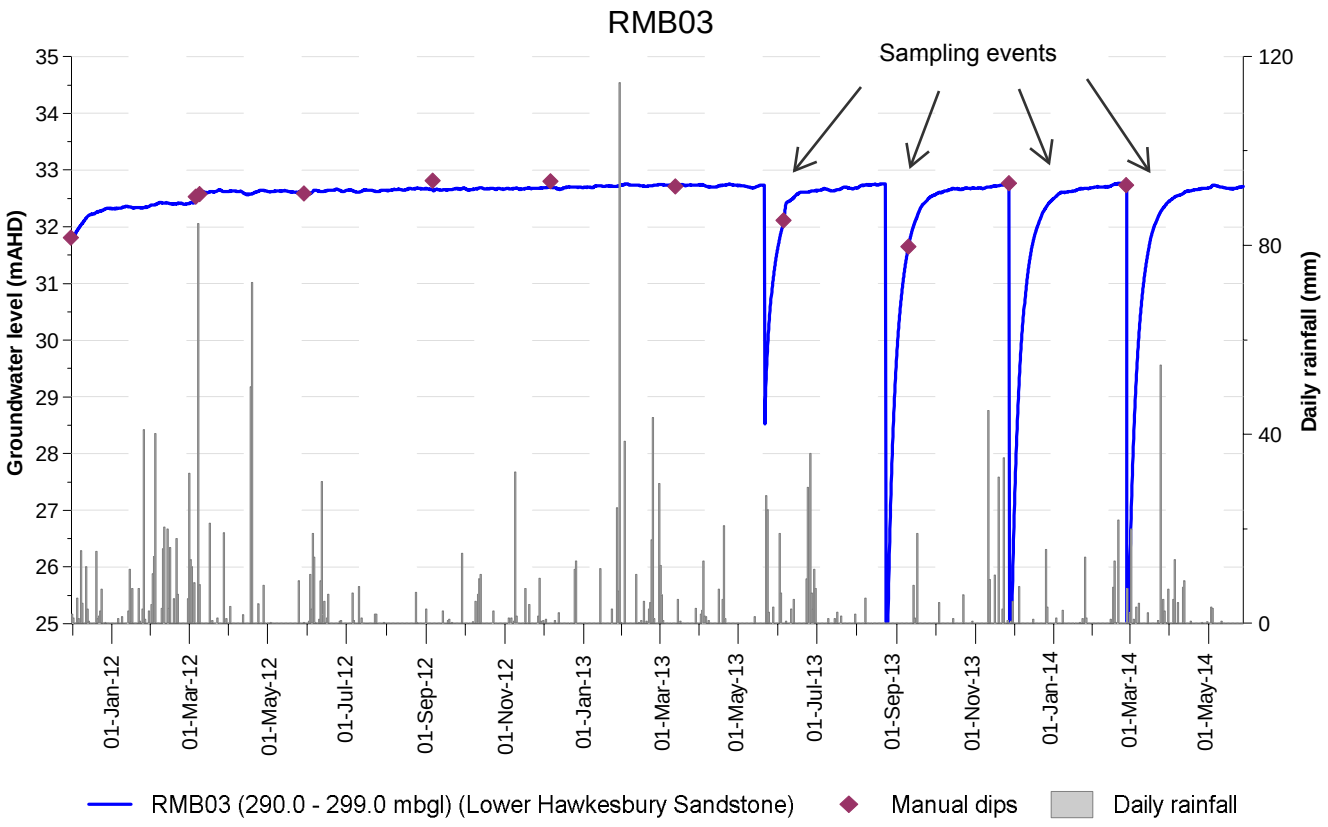


Figure A.2: RMB03 monitoring bore

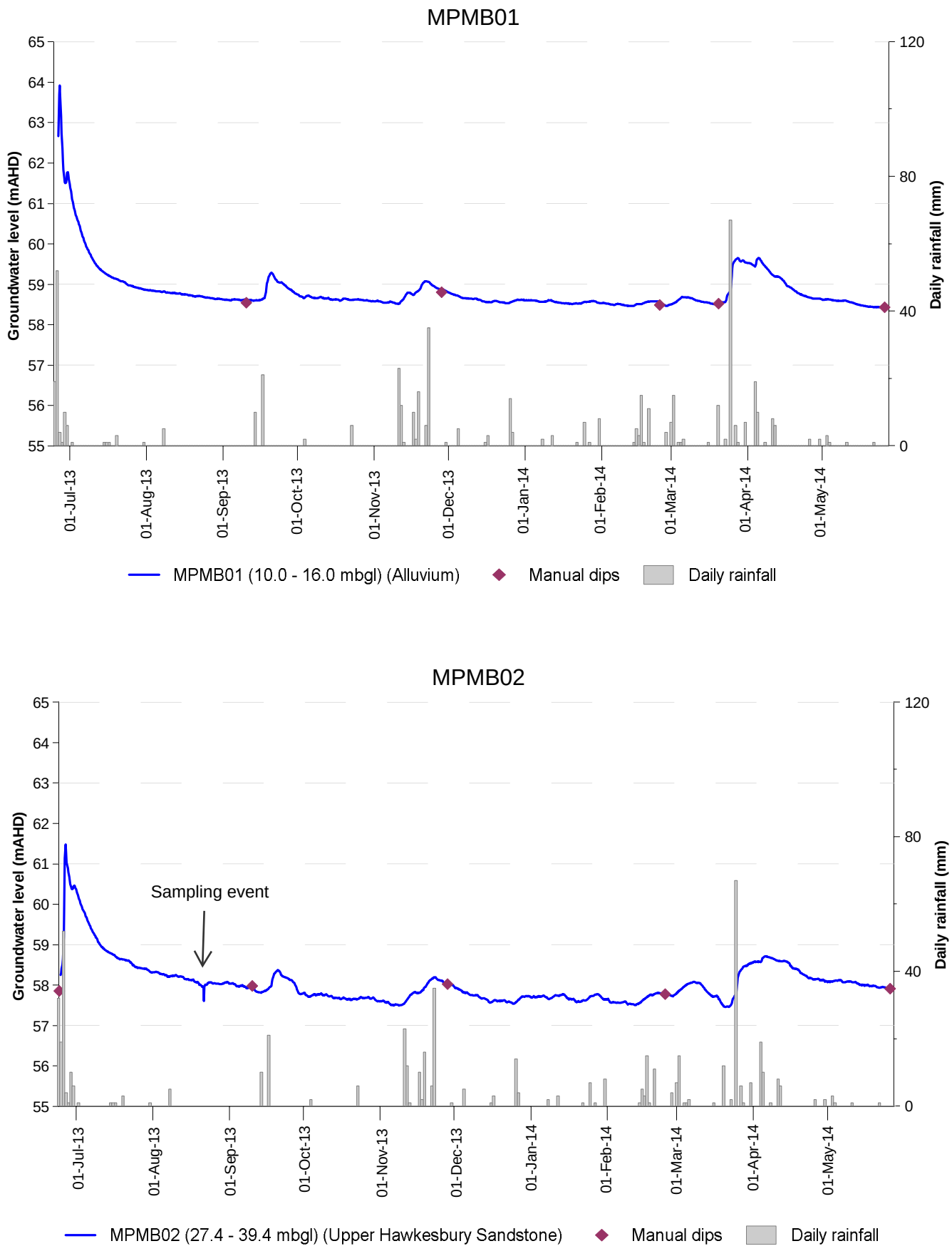


Figure A.3: MPMB01 and MPMB02 monitoring bores

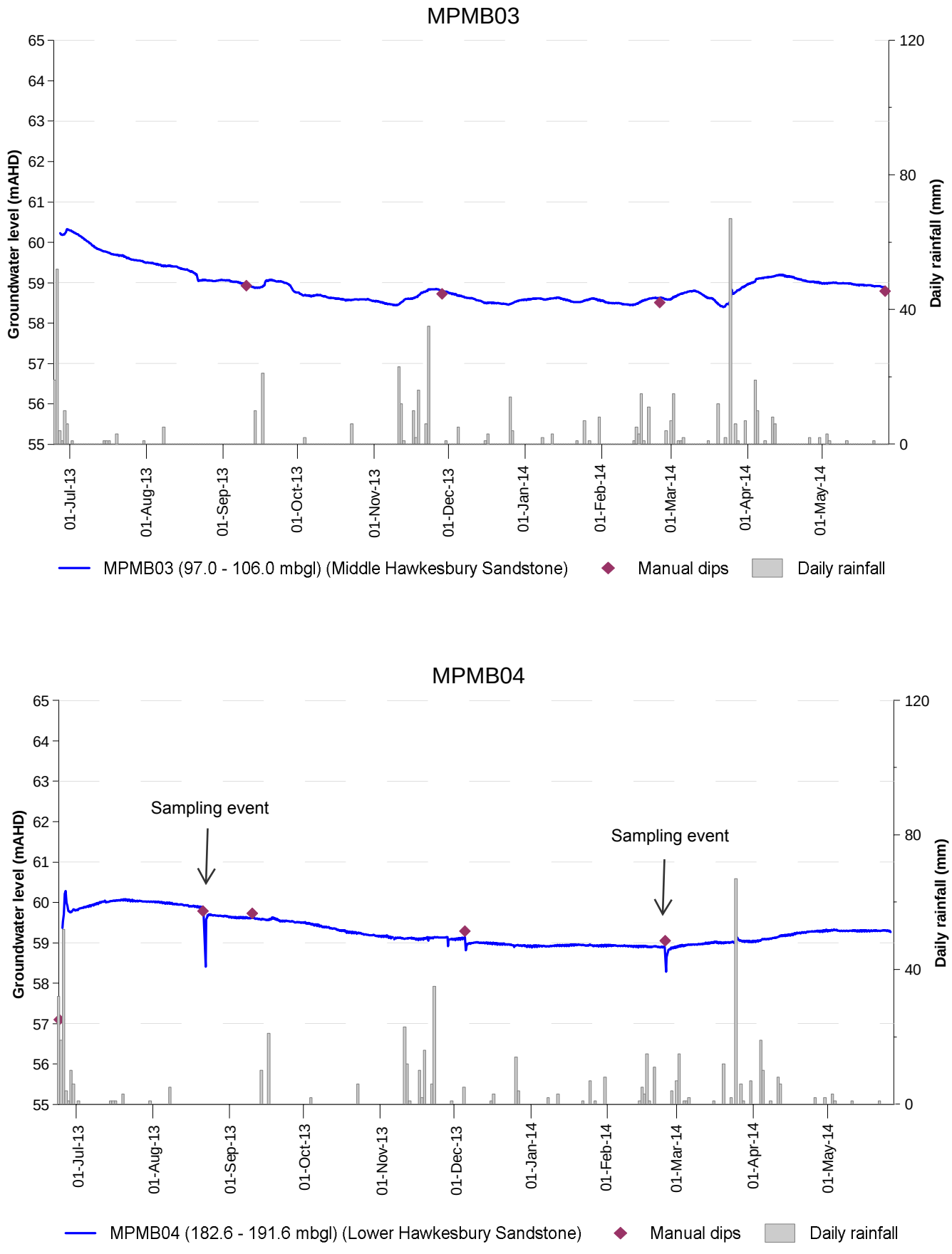


Figure A.4: MPMB03 and MPMB04 monitoring bores

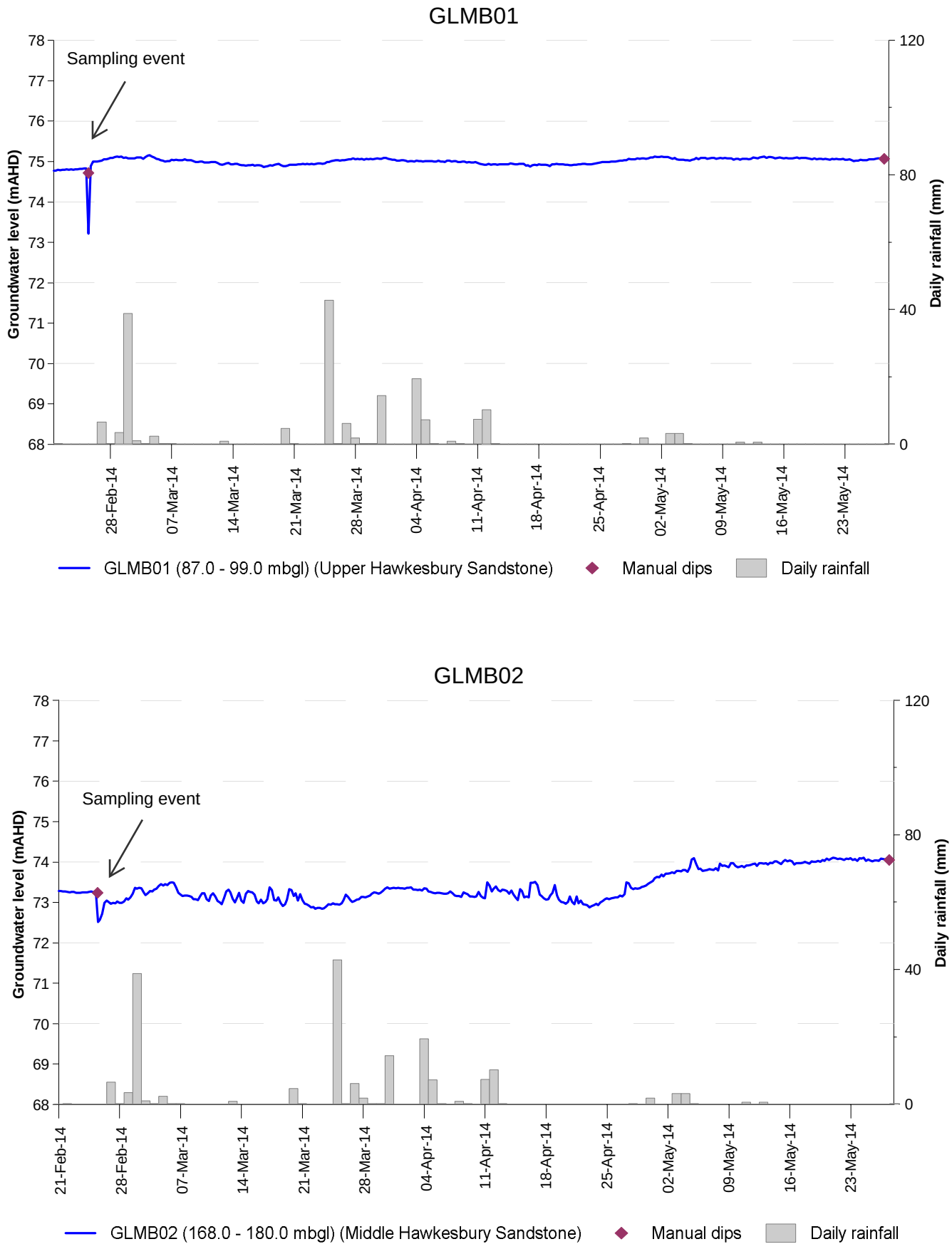


Figure A.5: GLMB01 and GLM02 monitoring bores

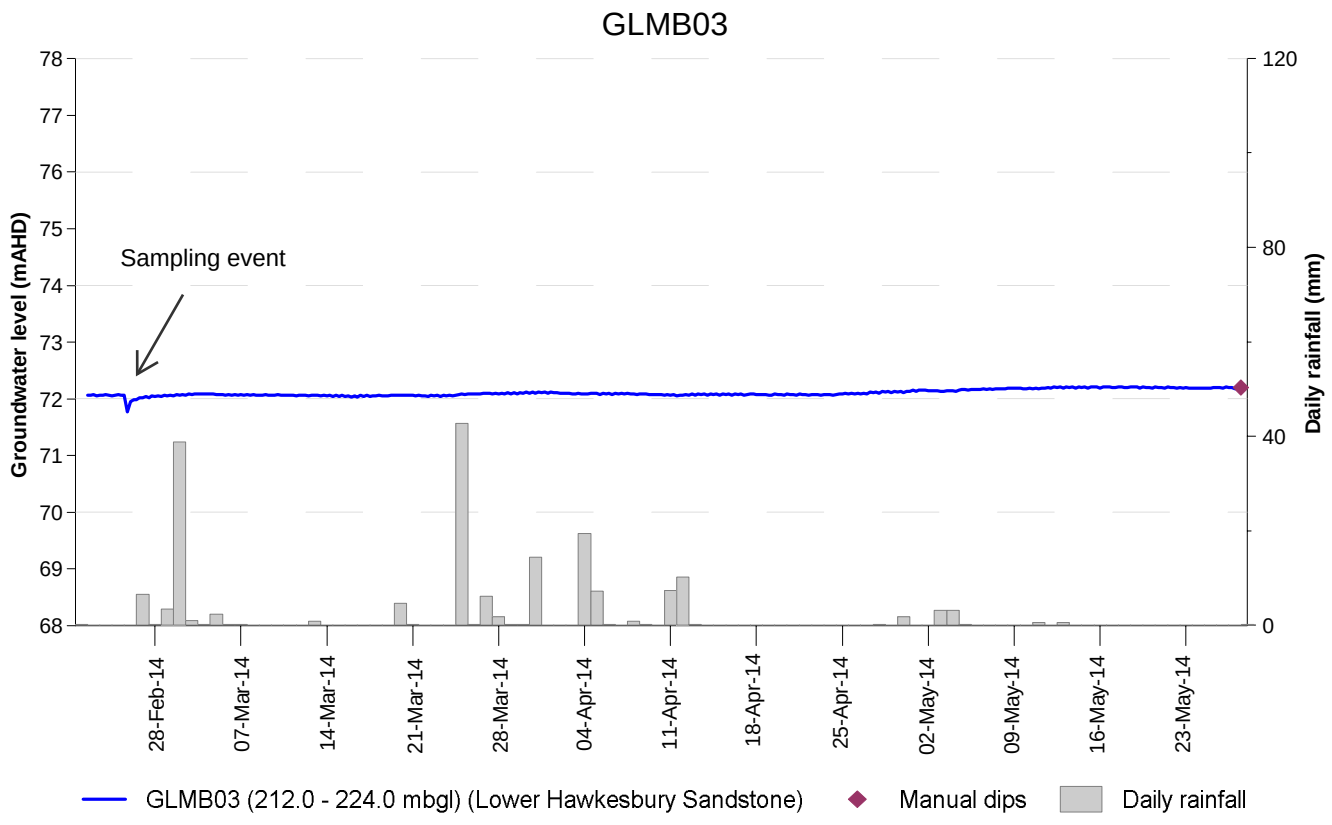


Figure A.6: GLM03 monitoring bore

Appendix D

Water quality summary tables

WATER QUALITY RESULTS - CAMDEN

Analyte	Units	LOR	Denham Court Groundwater Monitoring Bores													
			RMB01	RMB02						RMB03						
Sample date			27/11/2013	3/11/2011	21/05/2013	23/08/2013	27/11/2013	26/02/2014	28/05/2014	8/11/2011	21/05/2013	23/08/2013	27/11/2013	26/02/2014	28/05/2014	
Formation			Ashfield Shale	Hawkesbury Sandstone (upper)						Hawkesbury Sandstone (lower)						
General parameters																
pH (field)	pH units	0.01	6.97	6.52	6.35	6.67	6.58	6.51	6.78	7.42	9.50	9.61	9.47	9.43	9.70	
pH (lab)			7.18	na	7.24	7.41	7.06	7.55	7.21	na	9.43	9.34	9.38	9.37	9.52	
Electrical conductivity (field)	µS/cm	1	12,788	9,517	10,003	10,106	10,182	10,333	10,636	5,713	7,794	8,173	8,145	8,055	7,746	
Electrical conductivity (lab)			13,000	na	10,700	10,500	10,400	10,700	10,400	na	8,320	8,520	8,360	8,300	7,970	
Temperature	ºC	0.01	24.41	27.55	21.72	18.22	19.7	22.53	19.53	na	18.86	18.48	20.06	23.83	20.51	
Dissolved oxygen	% sat	0.01	31.9	5.8	10.6	3.2	1.9	2.9	8.3	5.6	5.6	4.1	1.8	3.3	10.2	
Total dissolved solids (field)	mg/L	1	8,312	6,188	6,515	6,569	6,617	6,716	6,917	3,759	5,070	5,316	5,292	5,232	5,034	
Total dissolved solids (lab)			7,880	na	5,550	5,720	6,280	6,220	6,560	na	4,200	3,720	4,710	4,650	4,470	
Suspended solids	mg/L	-	74	na	18	6	<5	<5	<5	na	80	<5	<5	<5	<5	
Redox	mV	-	-100.1	-10	-175	-122.4	-419.0	-156.7	-98.4	-136	-127	-119	-245.2	-215.6	-253.0	
Water type #	-	-	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	Na-Cl	
Laboratory analytes																
Hydroxide alkalinity as $CaCO_3$	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Carbonate alkalinity as $CaCO_3$	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	260	268	295	225	240	
Bicarbonate alkalinity as $CaCO_3$	mg/L	1	937	743	836	886	882	856	829	606	228	255	239	265	234	
Total alkalinity as $CaCO_3$	mg/L	1	937	743	836	886	882	856	829	606	488	523	534	490	474	
Sulfate as SO_4^{2-}	mg/L	1	<1	86	<10	2	<10	<10	<1	39	10	<1	<1	<1	<1	
Chloride	mg/L	1	3,990	3,980	2,800	3,080	3,130	3,050	3,020	2,350	2,280	2,490	2,460	2,400	2,340	
Calcium	mg/L	1	284	385	307	293	313	319	192	121	7	7	8	7	2	
Magnesium	mg/L	1	88	93	83	84	81	79	79	50	18	25	26	21	12	
Sodium	mg/L	1	2,250	2,090	1,820	1,760	1,670	2,170	1,690	1,580	1,810	1,740	1,680	2,090	1,560	
Potassium	mg/L	1	43	35	35	42	38	33	39	25	21	26	23	20	20	
Silica	mg/L	0.1	14.70	15.6	10.6	10.3	11.10	10.90	10.80	10.0	6.85	6.01	5.93	5.90	6.49	
Total cyanide	mg/L	0.004	<0.004	na	<0.004	<0.004	<0.004	<0.004	<0.004	na	<0.004	<0.004	<0.004	<0.004	<0.004	
Fluoride	mg/L	0.1	0.3	na	0.2	0.2	0.1	0.2	0.2	na	0.3	0.3	0.3	0.4	0.4	
Ions																
Total Anions	meq/L	0.01	131.0	129	95.7	105	106	103	102	79.2	74.3	80.7	80.1	77.5	75.5	
Total Cations	meq/L	0.01	120.0	119	102	99.2	95.9	118	91.2	79.5	81.1	78.8	76.2	93.5	69.4	
Ionic Balance	%	0.01	4.34	4.14	3.29	2.69	4.97	6.56	5.49	0.18	4.36	1.24	2.5	9.34	4.18	
Dissolved metals																
Aluminium	mg/L	0.01	0.04	<0.01	<0.01	<0.01	0.02	0.01	<0.01	<0.01	<0.01	0.02	0.02	0.02	<0.01	
Antimony	mg/L	0.001	<0.001	na	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001	0.001	0.001	<0.001	<0.001	
Arsenic	mg/L	0.001	0.002	0.009	<0.001	0.002	<0.001	<0.001	<0.001	0.006	0.002	<0.001	<0.001	<0.001	<0.001	
Barium	mg/L	0.001	37.2	1.18	35.1	39.8	37.0	35.0	48.0	5.44	6.35	7.42	6.63	5.76	5.41	
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Chromium	mg/L	0.001	<0.001	na	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001	<0.001	0.001	<0.001	<0.001	
Cobalt	mg/L	0.001	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	
Copper	mg/L	0.001	0.054	0	<0.001	<0.001	0.074	<0.001	<0.001	0.005	<0.001	<0.001	0.107	<0.001	<0.001	
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001	<0.001	
Manganese	mg/L	0.001	0.082	0.116	0.051	0.040	0.034	0.032	0.027	0.085	0.002	0.004	0.002	0.002	<0.001	
Mercury	mg/L	0.0001	<0.0001	na	na	<0.0001	<0.0001	<0.0001	<0.0001	na	na	<0.0001	<0.0001	<0.0001	<0.0001	
Molybdenum	mg/L	0.001	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.014	0.006	0.007	0.005	0.004	0.004	
Nickel	mg/L	0.001	0.004	0.009	0.004	0.001	0.002	<0.001	<0.001	0.018	<0.001	0.002	0.001	<0.001	<0.001	
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Strontium	mg/L	0.001	13.400	10.80	8.00	9.66	9.22	8.12	10.10	5.78	1.82	2.51	2.46	2.00	2.28	
Uranium	mg/L	0.001	0.002	0.016	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Zinc	mg/L	0.005	0.062	0.624	0.020	0.043	0.031	0.026	0.015	12.00	0.602	0.035	0.014	0.013	<0.005	
Boron	mg/L	0.05	0.12	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	0.16	0.16	0.17	0.17	0.17	
Iron	mg/L	0.05	5.23	0.29	5.89	5.59	5.64	6.11	5.22	0.62	<0.05	0.08	0.20	<0.05	<0.05	
Bromine	mg/L	0.1	9.8	7.9	7.3	6.4	7.8	7.0	6.6	4.9	5.9	4.9	6.6	5.8	5.1	
Nutrients																
Ammonia as N	mg/L	0.01	5.24	4.51	4.50	3.97	4.12	4.57	4.36	2.77	3.82	3.36	3.43	3.88	3.42	
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Nitrate as N	mg/L	0.01	0.06	<0.01	<0.01	<0.01	<0.01	0.01	0.02	0.02	<0.01	<0.01	<0.01	0.01	<0.01	
Total Phosphorous	mg/L	0.01	<0.10	<0.01	0.13	0.04	<0.10	<0.01	<0.05	<0.01	0.02	0.03	0.02	0.02	0.01	
Reactive Phosphorous	mg/L	0.01	0.10	<0.01	0.10	0.04	0.10	0.05	0.08	<0.01	0.02	0.02	0.01	0.02	<0.01	
Total Organic Carbon	mg/L	1	124	9	3	na	3	<1	<1	17	18	25	27	22	28	
Dissolved gases																
Methane	µg/L	10	3,200	10,100	7,650	17,700	8,240	13,600	37,600	18,200	13,100	18,600	17,500	37,000	42,000	
Ethene	µg/L	10	<10	na	<10	<10	<10	<10	<10	na	<10	<10	<10	<10	<10	
Ethane	µg/L	10	136	na	<10	<10	<10	21	14	na	<10	<10	<10	19	10	
Propene	µg/L	10	<10	na	<10	<10	<10	<10	<10	na	<10	<10	<10	<10	<10	
Propane	µg/L	10	196	na	<10	<10	<10	<10	<10	na	<10	<10	<10	<10	<10	
Butene	µg/L	10	<10	na	<10	<10	<10	<10	<10	na	<10	<10	<10	<10	<10	
Butane	µg/L	10	<10	na	<10	<10	<10	<10	<10	na	<10	<10	<10	<10	<10	
Phenolic compounds																
Phenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.1	<1.0	1.2	<1.0	<1.0	<1.0	
2-Chlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2-Methylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
3-&4-Methylphenol	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.9	<2.0	3.8	<2.0	<2.0	
2-Nitrophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4-Dimethylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4-Dichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.6-Dichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
4-Chloro-3-Methylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4.6-Trichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
2.4.5-Trichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Pentachlorophenol	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
Polycyclic aromatic																
Naphthalene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthylene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Acenaphthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluorene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Phenanthrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Pyrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benz(a)anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Chrysene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(b)fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(k)fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(a)pyrene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Indeno(1.2.3.cd)pyrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Dibenz(a.h)anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Benzo(g.h.i)perylene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	
Sum of PAHs	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Total petroleum hydrocarbons																
C_6-C_9 fraction	µg/L	20	40	<20	<20	50	<20	<20	<20	<20	<20	140	90	70	60	
C_{10}-C_{14} fraction	µg/L	50	<50	<50	<50	<50	<50	<50	<50	<50	100	120	<50	80	50	
C_{15}-C_{28} fraction	µg/L	100	190	460	<100	<100	<100	<100	<100	210	410	190	<100	<100	120	
C_{29}-C_{36} fraction	µg/L	50	<50	<50	<50	<50	<50	<50	<50	<50	150	<50	<50	<50	<50	
C_{10}-C_{36} fraction (sum)	µg/L	50	190	460	<50	<50	<50	<50	<50	210	660	310	<50	80	170	
Total recoverable hydrocarbons																
C_6-C_{10} fraction	µg/L	20	40	<20	<20	50	<20	<20	<20	<20	<20	140	90	80	70	
C_6-C_{10} fraction minus BTEX	µg/L	20	30	<20	<20	30	<20	<20	<20	<20	<20	70	40	40	40	
>C_{10}-C_{16} fraction	µg/L	100	<100	<100	<100	<100	<100	<100	<100	<100	120	140	<100	<100	<100	
>C_{16}-C_{34} fraction	µg/L	100	190	420	<100	<100	<100	<100	<100	220	520	160	<100	<100	140	
>C_{34}-C_{40} fraction	µg/L	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	
>C_{10}-C_{40} fraction (sum)	µg/L	100	190	420	<100	<100	<100	<100	<100	220	640	300	<100	<100	140	
Aromatic hydrocarbons																
Benzene	µg/L	1	11	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	
Toluene	µg/L	2	<2	<5	<2	23	6	<2	<2	<5	8	74	48	37	35	
Ethylbenzene	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	
m&p-Xylenes	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	
o-Xylenes	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	
Total xlyenes	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	
Sum of BTEX	µg/L	1	11	<1	<1	23	6	<1	<1	<1	8	74	48	37	35	
Naphthalene	µg/L	5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	

Calculated using Aquachem

PARSONS BRINCKERHOFF

WATER QUALITY RESULTS - CAMDEN

Analyte	Units	LOR	Menangle Park Groundwater Monitoring Bores														
			MPMB01				MBMP02				MPMB03				MBMP04		
Sample date			22/08/2013	28/11/2013	24/02/2014	26/05/2014	22/08/2013	28/11/2013	24/02/2014	25/05/2014	22/08/2013	28/11/2013	24/02/2014	25/05/2014	5/12/2013	24/02/2014	25/05/2014
Formation			Alluvium				Hawkesbury Sandstone (upper)				Hawkesbury Sandstone (middle)				Hawkesbury Sandstone (lower)		
General parameters																	
pH (field)	pH units	0.01	4.78	5.21	5.09	5.54	5.72	6.37	6.37	6.44	6.30	6.97	7.09	7.04	9.61	9.80	9.84
pH (lab)			6.14	5.60	5.86	5.45	7.16	6.64	7.00	6.81	7.69	7.35	7.71	7.44	8.72	9.18	9.45
Electrical conductivity (field)	µS/cm	1	980	923	920	902	874	937	898	885	1,092	1,054	1,144	1,020	929	1,216	1,031
Electrical conductivity (lab)			1,000	940	936	924	881	938	897	890	1,100	1,060	1,070	1,070	992	1,090	1,050
Temperature	ºC	0.01	18.16	20.95	20.14	21.46	18.88	22.64	21.98	25.70	17.3	20.26	19.44	18.95	19.8	21.39	19.39
Dissolved oxygen	% sat	0.01	19.8	16.9	11.0	7.45	20	5.6	6.1	12.3	2.3	1.4	35.3	1.6	0.8	22.5	0.8
Total dissolved solids (field)	mg/L	1	637	601	598	586	568	609	584	575	716	685	747	663	605	790	670
Total dissolved solids (lab)			619	548	464	518	442	465	392	413	596	619	551	550	718	548	541
Suspended solids	mg/L	-	49	104	114	114	56	18	<5	80	8	<5	6	<5	26,600	70	86
Redox	mV	-	81	59.2	140.9	153.7	-88.9	-380.2	-86.5	-124.5	-144.3	-413.6	-192.3	-215.4	-34.1	-121.6	-215.5
Water type #	-	-	Na-Mg-Cl	Na-Mg-Cl	Na-Mg-Cl	Na-Mg-Cl	Na-Mg-Cl-HCO_3	Na-Mg-Cl-HCO_3	Na-Mg-Cl-HCO_3	Na-Mg-Cl-HCO_3	Na-Ca-HCO_3-Cl	Na-Ca-HCO_3-Cl	Ca-Na-HCO_3	Na-Ca-HCO_3	Na-HCO_3	Na-Cl-CO_3-HCO_3	Na-Cl-CO_3-HCO_3
Laboratory analytes																	
Hydroxide alkalinity as $CaCO_3$	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as $CaCO_3$	mg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	100	76	126
Bicarbonate alkalinity as $CaCO_3$	mg/L	1	18	17	14	16	182	166	165	200	416	434	455	493	1,960	206	167
Total alkalinity as $CaCO_3$	mg/L	1	18	17	14	16	182	166	165	200	416	434	455	493	2,060	282	293
Sulfate as SO_4^{2-}	mg/L	1	6	3	3	3	10	27	7	7	<1	<1	<1	<1	2	1	<1
Chloride	mg/L	1	294	273	262	283	174	182	172	177	109	80	74	78	163	166	172
Calcium	mg/L	1	15	16	14	14	32	30	33	28	80	75	94	85	5	14	6
Magnesium	mg/L	1	25	23	25	25	31	28	33	27	23	20	23	22	4	9	5
Sodium	mg/L	1	129	116	115	119	93	100	92	101	116	111	104	107	208	196	181
Potassium	mg/L	1	2	2	1	1	4	4	3	4	15	17	14	14	16	19	18
Silica	mg/L	0.1	16.3	18.10	18.40	19.70	13	12.90	13.10	13.30	9.87	9.02	8.79	9.25	2.60	3.98	3.97
Total cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.6	0.4	0.5
Ions																	
Total Anions	meq/L	0.01	8.78	8.10	7.73	8.37	8.75	9.02	8.29	9.13	11.40	10.90	11.20	12.00	45.80	10.30	10.70
Total Cations	meq/L	0.01	8.47	7.86	7.78	7.99	8.48	8.67	8.44	8.33	11.30	10.60	11.50	11.10	10.00	10.40	9.12
Ionic Balance	%	0.01	1.8	1.99	0.32	2.28	1.63	1.93	0.87	4.63	0.32	1.32	1.26	4.27	64.10	0.51	8.05
Dissolved metals																	
Aluminium	mg/L	0.01	0.05	0.04	0.02	0.01	0.03	0.03	0.03	0.03	0.08	0.01	0.15	<0.01	0.02	0.02	0.02
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.008	0.003	0.002	0.004	0.022	0.012	0.035	0.035	0.016	0.003	0.003
Barium	mg/L	0.001	0.751	0.711	0.70	0.716	0.436	0.431	0.475	0.510	4.04	3.44	3.04	3.35	0.761	0.949	0.891
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.044	0.042	0.042	0.042	0.010	0.004	0.002	0.002	0.009	0.003	0.004	0.004	<0.001	<0.001	<0.001
Copper	mg/L	0.001	<0.001	0.016	0.003	0.015	0.003	0.001	0.001	0.001	<0.001	0.010	<0.001	<0.001	0.002	<0.001	0.002
Lead	mg/L	0.001	0.002	0.004	0.003	0.009	0.013	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.486	0.479	0.485	0.504	0.278	0.195	0.182	0.148	0.329	0.058	0.063	0.047	0.005	0.016	0.020
Mercury	mg/L	0.0001	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	<0.001	0.01	0.006	0.007
Nickel	mg/L	0.001	0.016	0.017	0.018	0.016	0.01	0.006	0.002	0.001	0.013	0.002	0.004	0.004	0.003	<0.001	<0.001
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	mg/L	0.001	0.169	0.152	0.165	0.154	0.361	0.368	0.342	0.361	1.15	0.977	0.843	1.080	0.248	0.304	0.265
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	0.057	0.103	0.077	0.070	0.059	0.024	0.019	0.009	0.031	0.02	<0.005	0.006	0.055	0.041	0.039
Boron	mg/L	0.05	<0.05	<0.05	0.16	<0.05	<0.05	<0.05	0.10	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	0.07	<0.05
Iron	mg/L	0.05	0.08	<0.05	<0.05	<0.05	3.36	3.80	3.11	3.96	2.63	1.39	0.93	0.83	<0.05	<0.05	<0.05
Bromine	mg/L	0.1	0.6	0.6	0.7	0.8	0.3	0.5	0.7	0.4	0.2	0.3	0.3	0.2	0.6	0.4	0.4
Nutrients																	
Ammonia as N	mg/L	0.01	<0.01	0.02	0.04	0.01	0.08	0.10	0.09	0.09	0.76	0.95	0.92	0.93	0.80	1.00	0.99
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	0.09	0.1	0.16	0.15	<0.01	<0.01	<0.01	0.02	<0.01	0.02	<0.01	0.02	<0.01	<0.01	0.02
Total Phosphorous	mg/L	0.01	0.02	0.06	0.06	0.10	0.02	0.08	0.53	0.04	0.02	0.03	0.01	0.02	2.18	0.02	0.03
Reactive Phosphorous	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01
Total Organic Carbon	mg/L	1	<1	2	<1	5	<1	7	2	3	<1	<1	<1	<1	25	15	15
Dissolved gases																	
Methane	µg/L	10	<10	<10	<10	<10	83	34	20	53	14,700	32,200	34,400	35,900	8,560	24,000	27,300
Ethene	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Ethane	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Propene	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Propane	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Butene	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Butane	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Phenolic compounds																	
Phenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	11.6	9.3	10.2
2-Chlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
3-&4-Methylphenol	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Polycyclic aromatic hydrocarbons																	
Naphthalene	µg/L	1	<1.0	18.5	<1.0	11	<1.0	14.1	<1.0	5.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	µg/L	1	<1.0	14.9	<1.0	12.3	<1.0	13.7	<1.0	7.8	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	µg/L	1	<1.0	11.1	<1.0	9.7	<1.0	10.6	<1.0	6.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	µg/L	1	<1.0	14.1	<1.0	15.3	<1.0	14.2	<1.0	10.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	µg/L	1	<1.0	2.2	<1.0	1.3	<1.0	1.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	µg/L	1	<1.0	1.5	<1.0	1.6	<1.0	1.7	<1.0	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sum of PAHs	µg/L	0.5	<0.5	62.3	<0.5	51.2	<0.5	56.0	<0.5	31.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total petroleum hydrocarbons																	
C_6-C_9 Fraction	µg/L	20	<20	<20	<20	<20	<20	<20	<20	<20	40	<20	<20	<20	<20	90	130
C_{10}-C_{14} Fraction	µg/L	50	<50	800	<50	520	<50	460	<50	250	<50	<50	<50	<50	60	<50	60
C_{15}-C_{28} Fraction	µg/L	100	<100	160	<100	190	<100	290	<100	<100	<100	<100	<100	<100	1,760	<100	190
C_{29}-C_{36} Fraction	µg/L	50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	1,060	<50	60
C_{10}-C_{36} Fraction (sum)	µg/L	50	<50	960	<50	710	<50	750	<50	250	<50	<50	<50	<50	2,880	<50	310
Total recoverable hydrocarbons																	
C_6-C_{10} Fraction	µg/L	20	<20	<20	<20	<20	<20	<20	<20	<20	40	<20	<20	<20	<20	150	130
C_6-C_{10} Fraction minus BTEX	µg/L	20	<20	<20	<20	<20	<20	<20	<20	<20	30	<20	<20	<20	<20	120	50
C_{10}-C_{16} Fraction	µg/L	100	<100	820	<100	540	<100	470	<100	230	<100	<100	<100	<100	<100	<100	<100
C_{16}-C_{34} Fraction	µg/L	100	<100	110	<100	160	<100	260	<100	<100	<100	<100	<100	<100	2,570	<100	220
C_{34}-C_{40} Fraction	µg/L	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	450	<100	<100
C_{10}-C_{40} Fraction (sum)	µg/L	100	<100	930	<100	700	<100	730	<100	230	<100	<100	<100	<100	3,020	<100	220
Aromatic hydrocarbons																	
Benzene	µg/L	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	2	<1
Toluene	µg/L	2	<2	8	<2	<2	<2	6	<2	<2	14	2	<2	<2	10	<2	84
Ethylbenzene	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	17	<2
m&p-Xylenes	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	16	<2
o-Xylenes	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Total xlyenes	µg/L	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	16	<2
Sum of BTEX	µg/L	1	<1	8	<1	<1	<1	6	<1	<1	14	2	<1	<1	10	35	84
Naphthalene	µg/L	5	<5	15	<5	17	<5	13	<5	<5	<5	<5	<5	<5	<5	<5	<5

Calculated using Aquachem

PARSONS BRINCKERHOFF

WATER QUALITY RESULTS - CAMDEN

Analyte	Units	LOR	Glenlee Monitoring Bores					
			GLMB01		GLMB02		GLMB03	
Sample date			25/02/2014	27/05/2014	25/02/2014	27/05/2014	25/02/2014	27/05/2014
Formation			Hawkesbury Sandstone		Hawkesbury Sandstone		Hawkesbury Sandstone	
General parameters								
pH (field)	pH units	0.01	6.71	6.77	6.86	7.03	7.62	8.17
pH (lab)			7.89	7.32	7.83	7.46	8.33	8.29
Electrical conductivity (field)	µS/cm	1	8,950	9,075	6,768	6,655	6,233	5,453
Electrical conductivity (lab)			9,360	9,330	7,000	6,840	6,550	5,570
Temperature	ºC	0.01	20.99	19.90	21.58	20.98	21.43	20.13
Dissolved oxygen	% sat	0.01	7.8	2.1	1.6	10.3	4.9	4.1
Total dissolved solids (field)	mg/L	1	5,775	5,904	4,409	4,326	4,119	3,544
Total dissolved solids (lab)			4,010	5,650	3,400	4,000	3,700	2,820
Suspended solids	mg/L	-	<5	5	25	25	8	<5
Redox	mV	-	-137.2	-218.3	-211.7	-213.3	-235.2	-232.0
Water type #	-	-	Na-Cl	Na-Cl	Na-Cl	$Na\text{-}Cl\text{-}HCO_3$	$Na\text{-}Cl\text{-}HCO_3$	$Na\text{-}Cl\text{-}HCO_3$
Laboratory analytes								
Hydroxide alkalinity as $CaCO_3$	mg/L	1	<1	<1	<1	<1	<1	<1
Carbonate alkalinity as $CaCO_3$	mg/L	1	<1	<1	<1	<1	16	<1
Bicarbonate alkalinity as $CaCO_3$	mg/L	1	529	574	646	829	756	816
Total alkalinity as $CaCO_3$	mg/L	1	529	574	646	829	772	816
Sulfate as SO_4^{2-}	mg/L	1	134	138	98	<1	40	<1
Chloride	mg/L	1	2,630	2,880	1,590	1,600	1,410	1,240
Calcium	mg/L	1	224	197	249	210	210	49
Magnesium	mg/L	1	230	223	106	92	99	78
Sodium	mg/L	1	1,670	1,390	1,230	979	1,160	910
Potassium	mg/L	1	30	28	30	26	33	30
Silica	mg/L	0.1	11.70	11.70	20.00	22.90	12.90	12.10
Total cyanide	mg/L	0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	mg/L	0.1	0.2	0.2	0.3	0.2	0.3	0.2
Ions								
Total Anions	meq/L	0.01	87.6	95.6	59.8	61.7	56.0	51.3
Total Cations	meq/L	0.01	104.0	89.4	75.4	61.3	69.9	49.2
Ionic Balance	%	0.01	8.35	3.37	11.50	0.33	11.00	2.08
Dissolved metals								
Aluminium	mg/L	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	mg/L	0.001	0.009	0.004	0.006	0.012	0.011	0.037
Barium	mg/L	0.001	1.81	0.351	1.03	8.540	2.260	5.670
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	0.006	0.002	<0.001	<0.001	0.008	0.002
Copper	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.558	0.442	1.160	0.897	0.350	0.024
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.017	0.004
Nickel	mg/L	0.001	0.002	0.002	<0.001	<0.001	0.01	0.003
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Strontium	mg/L	0.001	5.15	5.34	4.42	4.43	4.27	3.32
Uranium	mg/L	0.001	0.003	0.001	0.003	<0.001	<0.001	<0.001
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	0.024	0.018	<0.005	0.006	2.530	0.075
Boron	mg/L	0.05	<0.05	<0.05	0.06	<0.05	0.05	0.05
Iron	mg/L	0.05	3.56	2.20	3.10	1.45	1.60	0.44
Bromine	mg/L	0.1	7.1	7.5	4.4	4.6	4.3	3.6
Nutrients								
Ammonia as N	mg/L	0.01	2.50	2.39	1.90	1.74	2.36	2.24
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	<0.01	0.01	0.02	0.01	<0.01	0.02
Total Phosphorous	mg/L	0.01	0.04	0.05	0.10	0.15	0.04	0.03
Reactive Phosphorous	mg/L	0.01	<0.01	<0.01	<0.01	0.06	<0.01	0.01
Total Organic Carbon	mg/L	1	<1	<1	25	<1	18	<1
Dissolved gases								
Methane	µg/L	10	21,000	35,600	13,500	16,200	19,800	33,500
Ethene	µg/L	10	<10	<10	<10	<10	<10	<10
Ethane	µg/L	10	3,410	1,950	2,480	816	2,360	371
Propene	µg/L	10	<10	<10	<10	<10	<10	<10
Propane	µg/L	10	804	544	336	190	293	69
Butene	µg/L	10	<10	<10	<10	<10	<10	<10
Butane	µg/L	10	89	115	14	36	15	<10
Phenolic compounds								
Phenol	µg/L	1	<1.0	<1.0	10.9	<1.0	10.9	1.8
2-Chlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
3-&4-Methylphenol	µg/L	2	<2.0	<2.0	<2.0	2.2	<2.0	<2.0
2-Nitrophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	µg/L	2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Polycyclic aromatic hydrocarbons								
Naphthalene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b)fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	µg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sum of PAHs	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total petroleum hydrocarbons								
C_6-C_9 Fraction	µg/L	20	120	110	150	100	50	160
C_{10}-C_{14} Fraction	µg/L	50	<50	<50	60	<50	<50	<50
C_{15}-C_{28} Fraction	µg/L	100	<100	<100	<100	<100	<100	<100
C_{29}-C_{36} Fraction	µg/L	50	<50	<50	<50	<50	<50	<50
C_{10}-C_{36} Fraction (sum)	µg/L	50	<50	<50	60	<50	<50	<50
Total recoverable hydrocarbons								
C_6-C_{10} Fraction	µg/L	20	120	110	160	100	60	160
C_6-C_{10} Fraction minus BTEX	µg/L	20	50	110	90	80	30	50
C_{10}-C_{16} Fraction	µg/L	100	<100	<100	<100	<100	<100	<100
C_{16}-C_{34} Fraction	µg/L	100	<100	<100	<100	<100	<100	<100
C_{34}-C_{40} Fraction	µg/L	100	<100	<100	<100	<100	<100	<100
C_{10}-C_{40} Fraction (sum)	µg/L	100	<100	<100	<100	<100	<100	<100
Aromatic hydrocarbons								
Benzene	µg/L	1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	2	68	<2	71	19	23	109
Ethylbenzene	µg/L	2	<2	<2	<2	<2	<2	<2
m&p-Xylenes	µg/L	2	<2	<2	3	2	3	2
o-Xylenes	µg/L	2	<2	<2	<2	<2	<2	<2
Total xlyenes	µg/L	2	<2	<2	3	2	3	2
Sum of BTEX	µg/L	1	68	<1	74	21	26	111
Naphthalene	µg/L	5	<5	<5	<5	<5	<5	<5

na - not analysed

Calculated using Aquachem

PARSONS BRINCKERHOFF

Appendix E

ALS results

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1124333**	Page	: 1 of 7
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Loren Schiavon
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: loren.schiavon@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61 2 8784 8503
Facsimile	: +61 02 9272 5101	Facsimile	: +61 2 8784 8500
Project	: 2114759B	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 08-NOV-2011
Sampler	: SM	Issue Date	: 16-NOV-2011
Site	: ----		
		No. of samples received	: 4
Quote number	: SY/394/09	No. of samples analysed	: 4

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

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

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*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics

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 insuffient 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

- **EG020-: LCS recovery for some elements falls outside ALS Dynamic Control Limit. However, they are within the acceptance criteria based on ALS DQO. No further action is required.**
- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID	RMB03	RMB02 03/11/11	TS	TB	----
				Client sampling date / time	08-NOV-2011 15:00	03-NOV-2011 00:30	03-NOV-2011 00:30	03-NOV-2011 00:30	----
					ES1124333-001	ES1124333-002	ES1124333-003	ES1124333-004	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**606**	**743**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**606**	**743**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**39**	**86**	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**2350**	**3980**	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**121**	**385**	----	----	----
Magnesium	7439-95-4	1	mg/L		**50**	**93**	----	----	----
Sodium	7440-23-5	1	mg/L		**1580**	**2090**	----	----	----
Potassium	7440-09-7	1	mg/L		**25**	**35**	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		<0.01	<0.01	----	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.006**	**0.009**	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L		**5.44**	**1.18**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	----	----	----
Cobalt	7440-48-4	0.001	mg/L		**0.006**	**0.004**	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.005**	**0.003**	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.085**	**0.116**	----	----	----
Molybdenum	7439-98-7	0.001	mg/L		**0.014**	**0.001**	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.018**	**0.009**	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	----	----	----
Strontium	7440-24-6	0.001	mg/L		**5.78**	**10.8**	----	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	**0.016**	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L		**12.0**	**0.624**	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.08**	**0.06**	----	----	----
Iron	7439-89-6	0.05	mg/L		**0.62**	**0.29**	----	----	----
Bromine	7726-95-6	0.1	mg/L		**4.9**	**7.9**	----	----	----
EG052F: Dissolved Silica by ICPAES									
Silica	7631-86-9	0.1	mg/L		**10.0**	**15.6**	----	----	----
EK055G: Ammonia as N by Discrete Analyser									

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID	RMB03	RMB02 03/11/11	TS	TB	----
				Client sampling date / time	08-NOV-2011 15:00	03-NOV-2011 00:30	03-NOV-2011 00:30	03-NOV-2011 00:30	----
					ES1124333-001	ES1124333-002	ES1124333-003	ES1124333-004	----
EK055G: Ammonia as N by Discrete Analyser - Continued									
Ammonia as N	7664-41-7	0.01	mg/L		**2.77**	**4.51**	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.02**	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.02**	<0.01	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.01	<0.01	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	----	0.01	mg/L		<0.01	<0.01	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**79.2**	**129**	----	----	----
Total Cations	----	0.01	meq/L		**79.5**	**119**	----	----	----
Ionic Balance	----	0.01	%		**0.18**	**4.14**	----	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		**17**	**9**	----	----	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		**18200**	**10100**	----	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		**1.1**	<1.0	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	----	----	----
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	----	----	----

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID	RMB03	RMB02 03/11/11	TS	TB	----
				Client sampling date / time	08-NOV-2011 15:00	03-NOV-2011 00:30	03-NOV-2011 00:30	03-NOV-2011 00:30	----
					ES1124333-001	ES1124333-002	ES1124333-003	ES1124333-004	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	----	----	----
Phenanthrene	85-01-8	1.0	µg/L		<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L		<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L		<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L		<1.0	<1.0	----	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L		<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	<1.0	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	<1.0	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	<1.0	----	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L		<0.5	<0.5	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	----	<20	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	----	----	----
C15 - C28 Fraction	----	100	µg/L		**210**	**460**	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	<50	----	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		**210**	**460**	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft									
C6 - C10 Fraction	----	20	µg/L		<20	<20	----	<20	----
^ **C6 - C10 Fraction minus BTEX (F1)**	----	20	µg/L		<20	<20	----	<20	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	----	----	----
>C16 - C34 Fraction	----	100	µg/L		**220**	**420**	----	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	----	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		**220**	**420**	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	**15**	<1	----
Toluene	108-88-3	2	µg/L		<5	<5	**16**	<5	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	**16**	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	**15**	<2	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	**16**	<2	----
^ **Total Xylenes**	1330-20-7	2	µg/L		<2	<2	**31**	<2	----
^ **Sum of BTEX**	----	1	µg/L		<1	<1	**78**	<1	----
Naphthalene	91-20-3	5	µg/L		<5	<5	**18**	<5	----
EP075(SIM)S: Phenolic Compound Surrogates									

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID	RMB03	RMB02 03/11/11	TS	TB	----
				Client sampling date / time	08-NOV-2011 15:00	03-NOV-2011 00:30	03-NOV-2011 00:30	03-NOV-2011 00:30	----
					ES1124333-001	ES1124333-002	ES1124333-003	ES1124333-004	----
EP075(SIM)S: Phenolic Compound Surrogates - Continued									
Phenol-d6	13127-88-3	0.1	%		**25.4**	**26.1**	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%		**62.6**	**60.8**	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%		**81.1**	**80.6**	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**84.5**	**78.6**	----	----	----
Anthracene-d10	1719-06-8	0.1	%		**77.0**	**77.2**	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		**62.7**	**64.2**	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**111**	**104**	**99.2**	**109**	----
Toluene-D8	2037-26-5	0.1	%		**98.2**	**95.4**	**98.9**	**96.9**	----
4-Bromofluorobenzene	460-00-4	0.1	%		**96.8**	**97.8**	**97.6**	**98.3**	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	64.1
2-Chlorophenol-D4	93951-73-6	11.3	122.9
2.4.6-Tribromophenol	118-79-6	11.7	144.0
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	19.9	122.8
Anthracene-d10	1719-06-8	23.3	125.8
4-Terphenyl-d14	1718-51-0	20.3	134.5
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

CERTIFICATE OF ANALYSIS

Work Order	: **ES1311719**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Loren Schiavon
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: loren.schiavon@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61 2 8784 8503
Facsimile	: +61 02 9272 5101	Facsimile	: +61 2 8784 8500
Project	: 214759B	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 23-MAY-2013
Sampler	: SM	Issue Date	: 29-MAY-2013
Site	: ----		
		No. of samples received	: 2
Quote number	: EN/008/12	No. of samples analysed	: 2

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

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

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*
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Phalak Inthaksone	Laboratory Manager - Organics	Sydney Organics
Phalak Inthaksone	Laboratory Manager - Organics	Sydney Organics
Raymond Commodor	Instrument Chemist	Sydney Inorganics

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

- **ED041G:LOR raised for Sulfate analysis on sample ID(RMB02) due to sample matrix.**
- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**
- **EK026SF: Spike failed for Total Cyanide analysis due to matrix interferences (confirmed via re-analysis).**
- **EK026SF: Unpreserved natural samples used for Total Cyanide analysis.**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RMB02	RMB03	----	----	----
			Client sampling date / time	21-MAY-2013 12:30	21-MAY-2013 16:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1311719-001	ES1311719-002	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.24	9.43	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	10700	8320	----	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	5550	4200	----	----	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	18	80	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	260	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	836	228	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	836	488	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	10	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	2800	2280	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	307	7	----	----	----
Magnesium	7439-95-4	1	mg/L	83	18	----	----	----
Sodium	7440-23-5	1	mg/L	1820	1810	----	----	----
Potassium	7440-09-7	1	mg/L	35	21	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.002	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	35.1	6.35	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	0.051	0.002	----	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	RMB02	RMB03	----	----	----
				Client sampling date / time	21-MAY-2013 12:30	21-MAY-2013 16:00	----	----	----
					ES1311719-001	ES1311719-002	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Molybdenum	7439-98-7	0.001	mg/L		<0.001	**0.006**	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.004**	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	----	----	----
Strontium	7440-24-6	0.001	mg/L		**8.00**	**1.82**	----	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.020**	**0.602**	----	----	----
Boron	7440-42-8	0.05	mg/L		<0.05	**0.16**	----	----	----
Iron	7439-89-6	0.05	mg/L		**5.89**	<0.05	----	----	----
Bromine	7726-95-6	0.1	mg/L		**7.3**	**5.9**	----	----	----
EG052G: Silica by Discrete Analyser									
Reactive Silica	----	0.10	mg/L		**10.6**	**6.85**	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	<0.004	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	**0.3**	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**4.50**	**3.82**	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		<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	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.13**	**0.02**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.10**	**0.02**	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**95.7**	**74.3**	----	----	----
Total Cations	----	0.01	meq/L		**102**	**81.1**	----	----	----
Ionic Balance	----	0.01	%		**3.29**	**4.36**	----	----	----
EP005: Total Organic Carbon (TOC)									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RMB02	RMB03	----	----	----
			Client sampling date / time	21-MAY-2013 12:30	21-MAY-2013 16:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1311719-001	ES1311719-002	----	----	----
EP005: Total Organic Carbon (TOC) - Continued								
Total Organic Carbon	----	1	mg/L	**3**	**18**	----	----	----
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**7650**	**13100**	----	----	----
Ethene	74-85-1	10	µg/L	<10	<10	----	----	----
Ethane	74-84-0	10	µg/L	<10	<10	----	----	----
Propene	115-07-1	10	µg/L	<10	<10	----	----	----
Propane	74-98-6	10	µg/L	<10	<10	----	----	----
Butene	25167-67-3	10	µg/L	<10	<10	----	----	----
Butane	106-97-8	10	µg/L	<10	<10	----	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	**2.9**	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	----	----	----
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RMB02	RMB03	----	----	----
			Client sampling date / time	21-MAY-2013 12:30	21-MAY-2013 16:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1311719-001	ES1311719-002	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (WHO)	----	0.5	µg/L	<0.5	<0.5	----	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	----	----	----
C10 - C14 Fraction	----	50	µg/L	<50	**100**	----	----	----
C15 - C28 Fraction	----	100	µg/L	<100	**410**	----	----	----
C29 - C36 Fraction	----	50	µg/L	<50	**150**	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	**660**	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft								
C6 - C10 Fraction	----	20	µg/L	<20	<20	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	----	20	µg/L	<20	<20	----	----	----
>C10 - C16 Fraction	----	100	µg/L	<100	**120**	----	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	**520**	----	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	**640**	----	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	----	----	----
Toluene	108-88-3	2	µg/L	<2	**8**	----	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	----	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	----	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	----	----	----
^ Sum of BTEX	----	1	µg/L	<1	**8**	----	----	----
Naphthalene	91-20-3	5	µg/L	<5	<5	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**41.2**	**41.1**	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	**92.7**	**94.3**	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RMB02	RMB03	----	----	----
			Client sampling date / time	21-MAY-2013 12:30	21-MAY-2013 16:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1311719-001	ES1311719-002	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates - Continued								
2.4.6-Tribromophenol	118-79-6	0.1	%	106	116	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	75.7	84.6	----	----	----
Anthracene-d10	1719-06-8	0.1	%	105	107	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	106	104	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	84.2	77.9	----	----	----
Toluene-D8	2037-26-5	0.1	%	111	104	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	98.8	96.6	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
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

CERTIFICATE OF ANALYSIS

Work Order	: **ES1318824**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2193361A	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 23-AUG-2013
Sampler	: JAMES DUGGLEBY	Issue Date	: 02-SEP-2013
Site	: ----		
		No. of samples received	: 5
Quote number	: EN/008/13	No. of samples analysed	: 5

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

- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**
- **EG035:Positive mercury results have been confirmed by re-analysis.**
- **EP005 : NPOC analysis was carried out for sample ID (RMB02) due to high inorganic carbon content.**

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
		Sydney Organics
Sanjeshni Jyoti Mala	Senior Chemist Volatile	Sydney Organics

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB03	MPMB02	MPMB01	RMB02	RMB03
				Client sampling date / time	22-AUG-2013 14:30	22-AUG-2013 11:30	22-AUG-2013 13:00	22-AUG-2013 13:30	22-AUG-2013 10:30
					ES1318824-001	ES1318824-002	ES1318824-003	ES1318824-004	ES1318824-005
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.69**	**7.16**	**6.14**	**7.41**	**9.34**
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**1100**	**881**	**1000**	**10500**	**8520**
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**596**	**442**	**619**	**5720**	**3720**
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		**8**	**56**	**49**	**6**	<5
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	**268**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**416**	**182**	**18**	**886**	**255**
Total Alkalinity as CaCO3	----	1	mg/L		**416**	**182**	**18**	**886**	**523**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<1	**10**	**6**	**2**	<1
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**109**	**174**	**294**	**3080**	**2490**
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**80**	**32**	**15**	**293**	**7**
Magnesium	7439-95-4	1	mg/L		**23**	**31**	**25**	**84**	**25**
Sodium	7440-23-5	1	mg/L		**116**	**93**	**129**	**1760**	**1740**
Potassium	7440-09-7	1	mg/L		**15**	**4**	**2**	**42**	**26**
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.08**	**0.03**	**0.05**	<0.01	**0.02**
Antimony	7440-36-0	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	**0.001**
Arsenic	7440-38-2	0.001	mg/L		**0.022**	**0.008**	<0.001	**0.002**	<0.001
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L		**4.04**	**0.436**	**0.751**	**39.8**	**7.42**
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<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	**0.003**	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L		**0.009**	**0.010**	**0.044**	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L		**0.013**	**0.010**	**0.016**	**0.001**	**0.002**
Lead	7439-92-1	0.001	mg/L		**0.002**	**0.013**	**0.002**	<0.001	**0.002**

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: MPMB03	MPMB02	MPMB01	RMB02	RMB03
				Client sampling date / time: 22-AUG-2013 14:30	22-AUG-2013 11:30	22-AUG-2013 13:00	22-AUG-2013 13:30	22-AUG-2013 10:30
				ES1318824-001	ES1318824-002	ES1318824-003	ES1318824-004	ES1318824-005
EG020F: Dissolved Metals by ICP-MS - Continued								
Zinc	7440-66-6	0.005	mg/L	**0.031**	**0.059**	**0.057**	**0.043**	**0.035**
Manganese	7439-96-5	0.001	mg/L	**0.329**	**0.278**	**0.486**	**0.040**	**0.004**
Molybdenum	7439-98-7	0.001	mg/L	**0.004**	**0.007**	<0.001	<0.001	**0.007**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	**1.15**	**0.361**	**0.169**	**9.66**	**2.51**
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	**0.16**
Iron	7439-89-6	0.05	mg/L	**2.63**	**3.36**	**0.08**	**5.59**	**0.08**
Bromine	7726-95-6	0.1	mg/L	**0.2**	**0.3**	**0.6**	**6.4**	**4.9**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	**0.0002**	<0.0001	<0.0001
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**9.87**	**13.0**	**16.3**	**10.3**	**6.01**
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.2**	<0.1	**0.2**	**0.3**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.76**	**0.08**	<0.01	**3.97**	**3.36**
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	**0.09**	<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	**0.09**	<0.01	<0.01
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.02**	**0.02**	**0.02**	**0.04**	**0.03**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	**0.04**	**0.02**
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**11.4**	----	**8.78**	**105**	**80.7**
Total Anions	----	0.01	meq/L	----	**8.75**	----	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB03	MPMB02	MPMB01	RMB02	RMB03
				Client sampling date / time	22-AUG-2013 14:30	22-AUG-2013 11:30	22-AUG-2013 13:00	22-AUG-2013 13:30	22-AUG-2013 10:30
					ES1318824-001	ES1318824-002	ES1318824-003	ES1318824-004	ES1318824-005
EN055: Ionic Balance - Continued									
Total Cations	----	0.01	meq/L		**11.3**	----	**8.47**	**99.2**	**78.8**
Total Cations	----	0.01	meq/L		----	**8.48**	----	----	----
Ionic Balance	----	0.01	%		**0.32**	----	**1.80**	**2.69**	**1.24**
Ionic Balance	----	0.01	%		----	**1.63**	----	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		<1	<1	<1	----	**25**
Nonpurgeable Organic Carbon	----	1	mg/L		----	----	----	**1**	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		**14700**	**83**	<10	**17700**	**18600**
Ethene	74-85-1	10	µg/L		<10	<10	<10	<10	<10
Ethane	74-84-0	10	µg/L		<10	<10	<10	<10	<10
Propene	115-07-1	10	µg/L		<10	<10	<10	<10	<10
Propane	74-98-6	10	µg/L		<10	<10	<10	<10	<10
Butene	25167-67-3	10	µg/L		<10	<10	<10	<10	<10
Butane	106-97-8	10	µg/L		<10	<10	<10	<10	<10
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	**1.2**
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<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**)

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB03	MPMB02	MPMB01	RMB02	RMB03
				Client sampling date / time	22-AUG-2013 14:30	22-AUG-2013 11:30	22-AUG-2013 13:00	22-AUG-2013 13:30	22-AUG-2013 10:30
					ES1318824-001	ES1318824-002	ES1318824-003	ES1318824-004	ES1318824-005
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		<0.5	<0.5	<0.5	<0.5	<0.5
^ **Benzo(a)pyrene TEQ (zero)**	----	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		**40**	<20	<20	**50**	**140**
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	**120**
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	**190**
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	<50	<50	<50	**310**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2010 Draft									
C6 - C10 Fraction	C6_C10	20	µg/L		**40**	<20	<20	**50**	**140**
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		**30**	<20	<20	**30**	**70**
>C10 - C16 Fraction	>C10_C16	100	µg/L		<100	<100	<100	<100	**140**
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	**160**
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	<100	<100	<100	**300**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013									
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	<100	<100	<100	**140**
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		**14**	<2	<2	**23**	**74**

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB03	MPMB02	MPMB01	RMB02	RMB03
				Client sampling date / time	22-AUG-2013 14:30	22-AUG-2013 11:30	22-AUG-2013 13:00	22-AUG-2013 13:30	22-AUG-2013 10:30
					ES1318824-001	ES1318824-002	ES1318824-003	ES1318824-004	ES1318824-005
EP080: BTEXN - Continued									
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ **Total Xylenes**	1330-20-7	2	µg/L		<2	<2	<2	<2	<2
^ **Sum of BTEX**	----	1	µg/L		**14**	<1	<1	**23**	**74**
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		**27.0**	**28.0**	**26.4**	**28.9**	**28.6**
2-Chlorophenol-D4	93951-73-6	0.1	%		**63.6**	**61.6**	**61.9**	**67.8**	**61.0**
2.4.6-Tribromophenol	118-79-6	0.1	%		**92.7**	**93.9**	**96.6**	**96.3**	**83.5**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**80.4**	**80.6**	**81.6**	**81.1**	**79.2**
Anthracene-d10	1719-06-8	0.1	%		**80.8**	**79.1**	**81.1**	**79.7**	**78.0**
4-Terphenyl-d14	1718-51-0	0.1	%		**84.5**	**81.8**	**83.5**	**81.8**	**78.5**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**111**	**128**	**136**	**108**	**111**
Toluene-D8	2037-26-5	0.1	%		**126**	**93.6**	**88.3**	**125**	**125**
4-Bromofluorobenzene	460-00-4	0.1	%		**119**	**83.4**	**81.3**	**118**	**118**

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1318971**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Loren Schiavon
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: loren.schiavon@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61 2 8784 8503
Facsimile	: +61 02 9272 5101	Facsimile	: +61 2 8784 8500
Project	: 2193361A	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 27-AUG-2013
Sampler	: CR	Issue Date	: 02-SEP-2013
Site	: ----		
		No. of samples received	: 1
Quote number	: SY/394/09	No. of samples analysed	: 1

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

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Hoa Nguyen	Senior Inorganic Chemist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Pabi Subba	Senior Organic Chemist	Sydney Organics

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

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	NR	----	----	----	----
			Client sampling date / time	26-AUG-2013 11:30	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1318971-001	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.53**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**192**	----	----	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	**108**	----	----	----	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	<5	----	----	----	----
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	**35**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**35**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**5**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**33**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**3**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**28**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**2**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.05**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.053**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.028**	----	----	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: NR	----	----	----	----
				Client sampling date / time: 26-AUG-2013 11:30	----	----	----	----
				ES1318971-001	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.052**	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.015**	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.22**	----	----	----	----
Bromine	7726-95-6	0.1	mg/L	**0.1**	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**2.63**	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.03**	----	----	----	----
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	**0.21**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.21**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.36**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**1.73**	----	----	----	----
Total Cations	----	0.01	meq/L	**1.67**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	NR	----	----	----	----
				Client sampling date / time	26-AUG-2013 11:30	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1318971-001	----	----	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		**4**	----	----	----	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		<10	----	----	----	----
Ethene	74-85-1	10	µg/L		<10	----	----	----	----
Ethane	74-84-0	10	µg/L		<10	----	----	----	----
Propene	115-07-1	10	µg/L		<10	----	----	----	----
Propane	74-98-6	10	µg/L		<10	----	----	----	----
Butene	25167-67-3	10	µg/L		<10	----	----	----	----
Butane	106-97-8	10	µg/L		<10	----	----	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	----	----	----	----
4-Chloro-3-Methylphenol	59-50-7	1.0	µg/L		<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	----	----	----	----
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	----	----	----	----
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	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	NR	----	----	----	----
				Client sampling date / time	26-AUG-2013 11:30	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1318971-001	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
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 (zero)	----	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 2013									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	----	----	----	----
>C10 - C16 Fraction	>C10_C16	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	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	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	----	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L		<1	----	----	----	----
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	NR	----	----	----	----
				Client sampling date / time	26-AUG-2013 11:30	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1318971-001	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates - Continued									
Phenol-d6	13127-88-3	0.1	%		**28.8**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%		**64.8**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%		**98.7**	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**84.2**	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%		**82.1**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		**82.1**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**90.3**	----	----	----	----
Toluene-D8	2037-26-5	0.1	%		**108**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		**101**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

CERTIFICATE OF ANALYSIS

Work Order	: **ES1326058**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2193361A	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 29-NOV-2013
Sampler	: CR, DW	Issue Date	: 06-DEC-2013
Site	: ----		
		No. of samples received	: 3
Quote number	: EN/008/13	No. of samples analysed	: 3

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

- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	----	----
				Client sampling date / time	28-NOV-2013 10:00	28-NOV-2013 12:30	28-NOV-2013 12:15	----	----
					ES1326058-001	ES1326058-002	ES1326058-003	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**5.60**	**6.64**	**7.35**	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**940**	**938**	**1060**	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**548**	**465**	**619**	----	----
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		**104**	**18**	----	----	----
Suspended Solids (SS)	----	5	mg/L		----	----	<5	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**17**	**166**	**434**	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**17**	**166**	**434**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**3**	**27**	<1	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**273**	**182**	**80**	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**16**	**30**	**75**	----	----
Magnesium	7439-95-4	1	mg/L		**23**	**28**	**20**	----	----
Sodium	7440-23-5	1	mg/L		**116**	**100**	**111**	----	----
Potassium	7440-09-7	1	mg/L		**2**	**4**	**17**	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.04**	**0.03**	**0.01**	----	----
Antimony	7440-36-0	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L		<0.001	**0.003**	**0.012**	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L		**0.711**	**0.431**	**3.44**	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L		**0.042**	**0.004**	**0.003**	----	----
Copper	7440-50-8	0.001	mg/L		**0.016**	**0.001**	**0.010**	----	----
Lead	7439-92-1	0.001	mg/L		**0.004**	<0.001	<0.001	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: MPMB01	MPMB02	MPMB03	----	----
				Client sampling date / time: 28-NOV-2013 10:00	28-NOV-2013 12:30	28-NOV-2013 12:15	----	----
				ES1326058-001	ES1326058-002	ES1326058-003	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Manganese	7439-96-5	0.001	mg/L	**0.479**	**0.195**	**0.058**	----	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Nickel	7440-02-0	0.001	mg/L	**0.017**	**0.006**	**0.002**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Strontium	7440-24-6	0.001	mg/L	**0.152**	**0.368**	**0.977**	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	**0.002**	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	**0.103**	**0.024**	**0.020**	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	**3.80**	**1.39**	----	----
Bromine	7726-95-6	0.1	mg/L	**0.6**	**0.5**	**0.3**	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**18.1**	**12.9**	**9.02**	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	**0.2**	**0.2**	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	**0.10**	**0.95**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.10**	<0.01	**0.02**	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.10**	<0.01	**0.02**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.06**	**0.08**	**0.03**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**8.10**	----	----	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	----	----
				Client sampling date / time	28-NOV-2013 10:00	28-NOV-2013 12:30	28-NOV-2013 12:15	----	----
					ES1326058-001	ES1326058-002	ES1326058-003	----	----
EN055: Ionic Balance - Continued									
Total Anions	----	0.01	meq/L		----	**9.02**	**10.9**	----	----
Total Cations	----	0.01	meq/L		**7.86**	**8.67**	**10.6**	----	----
Ionic Balance	----	0.01	%		**1.99**	----	----	----	----
Ionic Balance	----	0.01	%		----	**1.93**	**1.32**	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		**2**	**7**	<1	----	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		<10	**34**	**32200**	----	----
Ethene	74-85-1	10	µg/L		<10	<10	<10	----	----
Ethane	74-84-0	10	µg/L		<10	<10	<10	----	----
Propene	115-07-1	10	µg/L		<10	<10	<10	----	----
Propane	74-98-6	10	µg/L		<10	<10	<10	----	----
Butene	25167-67-3	10	µg/L		<10	<10	<10	----	----
Butane	106-97-8	10	µg/L		<10	<10	<10	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	<2.0	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	<2.0	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		**18.5**	**14.1**	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L		**14.9**	**13.7**	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L		**11.1**	**10.6**	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L		**14.1**	**14.2**	<1.0	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	----	----
				Client sampling date / time	28-NOV-2013 10:00	28-NOV-2013 12:30	28-NOV-2013 12:15	----	----
					ES1326058-001	ES1326058-002	ES1326058-003	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Anthracene	120-12-7	1.0	µg/L		**2.2**	**1.7**	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L		**1.5**	**1.7**	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L		**62.3**	**56.0**	<0.5	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L		<0.5	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	----	----
C10 - C14 Fraction	----	50	µg/L		**800**	**460**	<50	----	----
C15 - C28 Fraction	----	100	µg/L		**160**	**290**	<100	----	----
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		**960**	**750**	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	<20	<20	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L		**820**	**470**	<100	----	----
>C16 - C34 Fraction	----	100	µg/L		**110**	**260**	<100	----	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		**930**	**730**	<100	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		**800**	**460**	<100	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L		**8**	**6**	**2**	----	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	----	----
				Client sampling date / time	28-NOV-2013 10:00	28-NOV-2013 12:30	28-NOV-2013 12:15	----	----
					ES1326058-001	ES1326058-002	ES1326058-003	----	----
EP080: BTEXN - Continued									
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L		<2	<2	<2	----	----
^ **Sum of BTEX**	----	1	µg/L		**8**	**6**	**2**	----	----
Naphthalene	91-20-3	5	µg/L		**15**	**13**	<5	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		**28.6**	**28.7**	**30.3**	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%		**78.0**	**76.2**	**75.2**	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%		**83.9**	**87.1**	**93.1**	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**41.5**	**53.9**	**65.1**	----	----
Anthracene-d10	1719-06-8	0.1	%		**72.8**	**69.9**	**73.3**	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		**65.2**	**62.1**	**65.9**	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**102**	**92.7**	**97.2**	----	----
Toluene-D8	2037-26-5	0.1	%		**122**	**112**	**117**	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		**108**	**97.4**	**107**	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1325894**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2193361A	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 27-NOV-2013
Sampler	: CR	Issue Date	: 04-DEC-2013
Site	: ----		
		No. of samples received	: 3
Quote number	: EN/008/13	No. of samples analysed	: 3

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

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

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.

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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

- **ED041G:LOR raised for Sulfate analysis on sample ID(RMB02) due to sample matrix.**
- **EK067G: LOR raised for Total P on sample ID(RMB01) and (RMB02)due to sample marix.**
- **EP080: All the positive results has been confirmed by re-analysis.**

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	RMB01	RMB02	RMB03	----	----
				Client sampling date / time	[27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
					ES1325894-001	ES1325894-002	ES1325894-003	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.18**	**7.06**	**9.38**	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**13000**	**10400**	**8360**	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**7880**	**6280**	**4710**	----	----
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		**74**	<5	<5	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	**295**	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**937**	**882**	**239**	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**937**	**882**	**534**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<1	<10	<1	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**3990**	**3130**	**2460**	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**284**	**313**	**8**	----	----
Magnesium	7439-95-4	1	mg/L		**88**	**81**	**26**	----	----
Sodium	7440-23-5	1	mg/L		**2250**	**1670**	**1680**	----	----
Potassium	7440-09-7	1	mg/L		**43**	**38**	**23**	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.04**	**0.02**	**0.02**	----	----
Antimony	7440-36-0	0.001	mg/L		<0.001	<0.001	**0.001**	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.002**	<0.001	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L		**37.2**	**37.0**	**6.63**	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	**0.001**	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L		**0.054**	**0.074**	**0.107**	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L		**0.082**	**0.034**	**0.002**	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: RMB01	RMB02	RMB03	----	----
				Client sampling date / time: [27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
				ES1325894-001	ES1325894-002	ES1325894-003	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	<0.001	**0.005**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.004**	**0.002**	**0.001**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Strontium	7440-24-6	0.001	mg/L	**13.4**	**9.22**	**2.46**	----	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	**0.062**	**0.031**	**0.014**	----	----
Boron	7440-42-8	0.05	mg/L	**0.12**	<0.05	**0.17**	----	----
Iron	7439-89-6	0.05	mg/L	**5.23**	**5.64**	**0.20**	----	----
Bromine	7726-95-6	0.1	mg/L	**9.8**	**7.8**	**6.6**	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**14.7**	**11.1**	**5.93**	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**	**0.1**	**0.3**	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**5.24**	**4.12**	**3.43**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.06**	<0.01	<0.01	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.06**	<0.01	<0.01	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.10	<0.10	**0.02**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.10**	**0.10**	**0.01**	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**131**	**106**	**80.1**	----	----
Total Cations	----	0.01	meq/L	**120**	**95.9**	**76.2**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	RMB01	RMB02	RMB03	----	----
				Client sampling date / time	[27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
Compound	CAS Number	LOR	Unit		ES1325894-001	ES1325894-002	ES1325894-003	----	----
EN055: Ionic Balance - Continued									
Ionic Balance	----	0.01	%		4.34	4.97	2.50	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		124	3	27	----	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		3200	8240	17500	----	----
Ethene	74-85-1	10	µg/L		<10	<10	<10	----	----
Ethane	74-84-0	10	µg/L		136	<10	<10	----	----
Propene	115-07-1	10	µg/L		<10	<10	<10	----	----
Propane	74-98-6	10	µg/L		196	<10	<10	----	----
Butene	25167-67-3	10	µg/L		<10	<10	<10	----	----
Butane	106-97-8	10	µg/L		<10	<10	<10	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	3.8	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	<2.0	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: RMB01	RMB02	RMB03	-----	-----
				Client sampling date / time: [27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
				ES1325894-001	**ES1325894-002**	**ES1325894-003**	**----**	**----**
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**40**	<20	**90**	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	**190**	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**190**	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013								
C6 - C10 Fraction	C6_C10	20	µg/L	**40**	<20	**90**	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	**30**	<20	**40**	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	**190**	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**190**	<100	<100	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	**11**	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	**6**	**48**	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	<2	<2	<2	----	----
^ **Sum of BTEX**	----	1	µg/L	**11**	**6**	**48**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RMB01	RMB02	RMB03	----	----
			Client sampling date / time	[27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
Compound	CAS Number	LOR	Unit	ES1325894-001	ES1325894-002	ES1325894-003	----	----
EP080: BTEXN - Continued								
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	25.5	25.9	25.2	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	60.2	63.2	63.1	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%	83.8	81.4	60.2	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	41.9	31.7	32.5	----	----
Anthracene-d10	1719-06-8	0.1	%	63.0	64.1	66.8	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	56.9	58.7	61.8	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	94.9	118	117	----	----
Toluene-D8	2037-26-5	0.1	%	114	106	109	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	108	115	98.7	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
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4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1325894**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
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Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2193361A	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 27-NOV-2013
Sampler	: CR	Issue Date	: 04-DEC-2013
Site	: ----		
		No. of samples received	: 3
Quote number	: EN/008/13	No. of samples analysed	: 3

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This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

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^ = This result is computed from individual analyte detections at or above the level of reporting

- **ED041G:LOR raised for Sulfate analysis on sample ID(RMB02) due to sample matrix.**
- **EK067G: LOR raised for Total P on sample ID(RMB01) and (RMB02)due to sample marix.**
- **EP080: All the positive results has been confirmed by re-analysis.**

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	RMB01	RMB02	RMB03	----	----
				Client sampling date / time	[27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
					ES1325894-001	ES1325894-002	ES1325894-003	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.18**	**7.06**	**9.38**	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**13000**	**10400**	**8360**	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**7880**	**6280**	**4710**	----	----
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		**74**	<5	<5	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	**295**	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**937**	**882**	**239**	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**937**	**882**	**534**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<1	<10	<1	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**3990**	**3130**	**2460**	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**284**	**313**	**8**	----	----
Magnesium	7439-95-4	1	mg/L		**88**	**81**	**26**	----	----
Sodium	7440-23-5	1	mg/L		**2250**	**1670**	**1680**	----	----
Potassium	7440-09-7	1	mg/L		**43**	**38**	**23**	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.04**	**0.02**	**0.02**	----	----
Antimony	7440-36-0	0.001	mg/L		<0.001	<0.001	**0.001**	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.002**	<0.001	<0.001	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L		**37.2**	**37.0**	**6.63**	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	**0.001**	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Copper	7440-50-8	0.001	mg/L		**0.054**	**0.074**	**0.107**	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L		**0.082**	**0.034**	**0.002**	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: RMB01	RMB02	RMB03	----	----
				Client sampling date / time: [27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
				ES1325894-001	ES1325894-002	ES1325894-003	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Molybdenum	7439-98-7	0.001	mg/L	**0.002**	<0.001	**0.005**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.004**	**0.002**	**0.001**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Strontium	7440-24-6	0.001	mg/L	**13.4**	**9.22**	**2.46**	----	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	**0.062**	**0.031**	**0.014**	----	----
Boron	7440-42-8	0.05	mg/L	**0.12**	<0.05	**0.17**	----	----
Iron	7439-89-6	0.05	mg/L	**5.23**	**5.64**	**0.20**	----	----
Bromine	7726-95-6	0.1	mg/L	**9.8**	**7.8**	**6.6**	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**14.7**	**11.1**	**5.93**	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**	**0.1**	**0.3**	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**5.24**	**4.12**	**3.43**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.06**	<0.01	<0.01	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.06**	<0.01	<0.01	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.10	<0.10	**0.02**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.10**	**0.10**	**0.01**	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**131**	**106**	**80.1**	----	----
Total Cations	----	0.01	meq/L	**120**	**95.9**	**76.2**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	RMB01	RMB02	RMB03	----	----
				Client sampling date / time	[27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
Compound	CAS Number	LOR	Unit		ES1325894-001	ES1325894-002	ES1325894-003	----	----
EN055: Ionic Balance - Continued									
Ionic Balance	----	0.01	%		4.34	4.97	2.50	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		124	3	27	----	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		3200	8240	17500	----	----
Ethene	74-85-1	10	µg/L		<10	<10	<10	----	----
Ethane	74-84-0	10	µg/L		136	<10	<10	----	----
Propene	115-07-1	10	µg/L		<10	<10	<10	----	----
Propane	74-98-6	10	µg/L		196	<10	<10	----	----
Butene	25167-67-3	10	µg/L		<10	<10	<10	----	----
Butane	106-97-8	10	µg/L		<10	<10	<10	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	3.8	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	<1.0	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	<2.0	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	<1.0	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: RMB01	RMB02	RMB03	-----	-----
				Client sampling date / time: [27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
				ES1325894-001	**ES1325894-002**	**ES1325894-003**	**----**	**----**
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(b)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**40**	<20	**90**	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	**190**	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	**190**	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013								
C6 - C10 Fraction	C6_C10	20	µg/L	**40**	<20	**90**	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	**30**	<20	**40**	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	**190**	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	**190**	<100	<100	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	**11**	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	**6**	**48**	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	<2	<2	<2	----	----
^ **Sum of BTEX**	----	1	µg/L	**11**	**6**	**48**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	RMB01	RMB02	RMB03	----	----
			Client sampling date / time	[27-NOV-2013]	[27-NOV-2013]	[27-NOV-2013]	----	----
Compound	CAS Number	LOR	Unit	ES1325894-001	ES1325894-002	ES1325894-003	----	----
EP080: BTEXN - Continued								
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	25.5	25.9	25.2	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	60.2	63.2	63.1	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%	83.8	81.4	60.2	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	41.9	31.7	32.5	----	----
Anthracene-d10	1719-06-8	0.1	%	63.0	64.1	66.8	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	56.9	58.7	61.8	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	94.9	118	117	----	----
Toluene-D8	2037-26-5	0.1	%	114	106	109	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	108	115	98.7	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1326772**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2193361A	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 06-DEC-2013
Sampler	: CR/CS	Issue Date	: 17-DEC-2013
Site	: ----		
		No. of samples received	: 1
Quote number	: EN/008/13	No. of samples analysed	: 1

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

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

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

- **EG035: Poor matrix spike recovery was obtained for Mercury on sample ES1326701-#2 due to sample heterogeneity. Results have been confirmed by re-extraction and reanalysis.**
- **Ionic Balance out of acceptable limits due to analytes not quantified in this report.**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	MPMB04	----	----	----	----
			Client sampling date / time	05-DEC-2013 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1326772-001	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.72**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**992**	----	----	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	**718**	----	----	----	----
EA025: Suspended Solids								
Suspended Solids (SS)	----	5	mg/L	**26600**	----	----	----	----
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	**100**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**1960**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**2060**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**2**	----	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	**163**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**5**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**4**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**208**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**16**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.02**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.016**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.761**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.005**	----	----	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB04	----	----	----	----
				Client sampling date / time	05-DEC-2013 15:00	----	----	----	----
					ES1326772-001	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Molybdenum	7439-98-7	0.001	mg/L		**0.010**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.003**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Strontium	7440-24-6	0.001	mg/L		**0.248**	----	----	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.055**	----	----	----	----
Boron	7440-42-8	0.05	mg/L		<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	----	----	----	----
Bromine	7726-95-6	0.1	mg/L		**0.6**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG052G: Silica by Discrete Analyser									
Reactive Silica	----	0.10	mg/L		**2.60**	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.6**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.80**	----	----	----	----
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	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**2.18**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.02**	----	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**45.8**	----	----	----	----
Total Cations	----	0.01	meq/L		**10.0**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MPMB04	----	----	----	----
				Client sampling date / time	05-DEC-2013 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1326772-001	----	----	----	----
EN055: Ionic Balance - Continued									
Ionic Balance	----	0.01	%		**64.1**	----	----	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		**25**	----	----	----	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		**8560**	----	----	----	----
Ethene	74-85-1	10	µg/L		<10	----	----	----	----
Ethane	74-84-0	10	µg/L		<10	----	----	----	----
Propene	115-07-1	10	µg/L		<10	----	----	----	----
Propane	74-98-6	10	µg/L		<10	----	----	----	----
Butene	25167-67-3	10	µg/L		<10	----	----	----	----
Butane	106-97-8	10	µg/L		<10	----	----	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		**11.6**	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	----	----	----	----
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	----	----	----	----
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	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MPMB04	----	----	----	----
				Client sampling date / time	05-DEC-2013 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1326772-001	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
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 (zero)	----	0.5	µg/L		<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		**60**	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		**1760**	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		**1060**	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		**2880**	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	----	----	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L		<100	----	----	----	----
>C16 - C34 Fraction	----	100	µg/L		**2570**	----	----	----	----
>C34 - C40 Fraction	----	100	µg/L		**450**	----	----	----	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		**3020**	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		**10**	----	----	----	----
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	----	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L		**10**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	MPMB04	----	----	----	----
			Client sampling date / time	05-DEC-2013 15:00	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1326772-001	----	----	----	----
EP080: BTEXN - Continued								
Naphthalene	91-20-3	5	µg/L	<5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**36.5**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	**68.2**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%	**75.2**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**74.1**	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%	**65.9**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	**65.2**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**84.4**	----	----	----	----
Toluene-D8	2037-26-5	0.1	%	**79.8**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	**78.4**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

CERTIFICATE OF ANALYSIS

Work Order	: **ES1403919**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2114759B	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 25-FEB-2014
Sampler	: CR	Issue Date	: 04-MAR-2014
Site	: ----		
		No. of samples received	: 4
Quote number	: EN/008/13	No. of samples analysed	: 4

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.

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	MPMB04	----
				Client sampling date / time	24-FEB-2014 13:45	24-FEB-2014 12:00	24-FEB-2014 11:45	24-FEB-2014 14:00	----
					ES1403919-001	ES1403919-002	ES1403919-003	ES1403919-004	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**5.86**	**7.00**	**7.71**	**9.18**	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**936**	**897**	**1070**	**1090**	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**464**	**392**	**551**	**548**	----
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		**114**	<5	**6**	**70**	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	**76**	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**14**	**165**	**455**	**206**	----
Total Alkalinity as CaCO3	----	1	mg/L		**14**	**165**	**455**	**282**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**3**	**7**	<1	**1**	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**262**	**172**	**74**	**166**	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**14**	**33**	**94**	**14**	----
Magnesium	7439-95-4	1	mg/L		**25**	**33**	**23**	**9**	----
Sodium	7440-23-5	1	mg/L		**115**	**92**	**104**	**196**	----
Potassium	7440-09-7	1	mg/L		**1**	**3**	**14**	**19**	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.02**	**0.03**	**0.15**	**0.02**	----
Antimony	7440-36-0	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L		<0.001	**0.002**	**0.035**	**0.003**	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Barium	7440-39-3	0.001	mg/L		**0.700**	**0.475**	**3.04**	**0.949**	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0001**	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L		**0.042**	**0.002**	**0.004**	<0.001	----
Copper	7440-50-8	0.001	mg/L		**0.003**	**0.001**	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L		**0.003**	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L		**0.485**	**0.182**	**0.063**	**0.016**	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	MPMB04	----
				Client sampling date / time	24-FEB-2014 13:45	24-FEB-2014 12:00	24-FEB-2014 11:45	24-FEB-2014 14:00	----
					ES1403919-001	ES1403919-002	ES1403919-003	ES1403919-004	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Molybdenum	7439-98-7	0.001	mg/L		<0.001	<0.001	<0.001	**0.006**	----
Nickel	7440-02-0	0.001	mg/L		**0.018**	**0.002**	**0.004**	<0.001	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Strontium	7440-24-6	0.001	mg/L		**0.165**	**0.342**	**0.843**	**0.304**	----
Uranium	7440-61-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L		**0.077**	**0.019**	<0.005	**0.041**	----
Boron	7440-42-8	0.05	mg/L		**0.16**	**0.10**	**0.05**	**0.07**	----
Iron	7439-89-6	0.05	mg/L		<0.05	**3.11**	**0.93**	<0.05	----
Bromine	7726-95-6	0.1	mg/L		**0.7**	**0.7**	**0.3**	**0.4**	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	----
EG052G: Silica by Discrete Analyser									
Reactive Silica	----	0.10	mg/L		**18.4**	**13.1**	**8.79**	**3.98**	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L		<0.004	<0.004	<0.004	<0.004	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		<0.1	**0.2**	**0.2**	**0.4**	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.04**	**0.09**	**0.92**	**1.00**	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		<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		**0.16**	<0.01	<0.01	<0.01	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.16**	<0.01	<0.01	<0.01	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.06**	**0.53**	**0.01**	**0.02**	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**7.73**	**8.29**	**11.2**	**10.3**	----
Total Cations	----	0.01	meq/L		**7.78**	**8.44**	**11.5**	**10.4**	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	MPMB04	----
				Client sampling date / time	24-FEB-2014 13:45	24-FEB-2014 12:00	24-FEB-2014 11:45	24-FEB-2014 14:00	----
					ES1403919-001	ES1403919-002	ES1403919-003	ES1403919-004	----
EN055: Ionic Balance - Continued									
Ionic Balance	----	0.01	%		**0.32**	**0.87**	**1.26**	**0.51**	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		<1	**2**	<1	**15**	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		<10	**20**	**34400**	**24000**	----
Ethene	74-85-1	10	µg/L		<10	<10	<10	<10	----
Ethane	74-84-0	10	µg/L		<10	<10	<10	<10	----
Propene	115-07-1	10	µg/L		<10	<10	<10	<10	----
Propane	74-98-6	10	µg/L		<10	<10	<10	<10	----
Butene	25167-67-3	10	µg/L		<10	<10	<10	<10	----
Butane	106-97-8	10	µg/L		<10	<10	<10	<10	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	<1.0	<1.0	**9.3**	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Acenaphthylene	208-96-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Acenaphthene	83-32-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Fluorene	86-73-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Phenanthrene	85-01-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Anthracene	120-12-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Fluoranthene	206-44-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Pyrene	129-00-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	MPMB04	----
				Client sampling date / time	24-FEB-2014 13:45	24-FEB-2014 12:00	24-FEB-2014 11:45	24-FEB-2014 14:00	----
					ES1403919-001	ES1403919-002	ES1403919-003	ES1403919-004	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Benz(a)anthracene	56-55-3	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
Chrysene	218-01-9	1.0	µg/L		<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	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L		<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	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L		<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	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		<20	<20	<20	**90**	----
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	----
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	**150**	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	<20	<20	**120**	----
>C10 - C16 Fraction	>C10_C16	100	µg/L		<100	<100	<100	<100	----
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		<100	<100	<100	<100	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		<100	<100	<100	<100	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	**2**	----
Toluene	108-88-3	2	µg/L		<2	<2	<2	<2	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	**17**	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	**16**	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	----
^ **Total Xylenes**	1330-20-7	2	µg/L		<2	<2	<2	**16**	----
^ **Sum of BTEX**	----	1	µg/L		<1	<1	<1	**35**	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	MPMB01	MPMB02	MPMB03	MPMB04	----
			Client sampling date / time	24-FEB-2014 13:45	24-FEB-2014 12:00	24-FEB-2014 11:45	24-FEB-2014 14:00	----
Compound	CAS Number	LOR	Unit	ES1403919-001	ES1403919-002	ES1403919-003	ES1403919-004	----
EP080: BTEXN - Continued								
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	**25.0**	**28.4**	**25.6**	**24.2**	----
2-Chlorophenol-D4	93951-73-6	0.1	%	**43.8**	**47.4**	**45.8**	**36.7**	----
2.4.6-Tribromophenol	118-79-6	0.1	%	**48.0**	**49.4**	**37.8**	**78.2**	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	**50.8**	**53.9**	**51.2**	**48.7**	----
Anthracene-d10	1719-06-8	0.1	%	**58.3**	**61.2**	**53.3**	**59.0**	----
4-Terphenyl-d14	1718-51-0	0.1	%	**59.4**	**65.2**	**55.0**	**66.2**	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	**87.4**	**84.4**	**93.0**	**94.3**	----
Toluene-D8	2037-26-5	0.1	%	**93.1**	**91.6**	**84.4**	**93.7**	----
4-Bromofluorobenzene	460-00-4	0.1	%	**82.0**	**82.6**	**83.0**	**86.1**	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

CERTIFICATE OF ANALYSIS

Work Order	: **ES1404061**	Page	: 1 of 13
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2114759B	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 26-FEB-2014
Sampler	: CR	Issue Date	: 05-MAR-2014
Site	: ----		
		No. of samples received	: 6
Quote number	: EN/008/13	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

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics

General Comments

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

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

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

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

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **ED041G:LOR raised for sulfate analysis on sample ID(RMB02 & QA) due to sample matrix.**
- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**
- **EK071G: It has been noted that Reactive P is greater than Total P for sample ID(RMB02) and(QA), however this results have been confimed by reanalysis.**
- **Ionic Balance out of acceptable limits for various samples due to analytes not quantified in this report.**

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	RMB02	RMB03	GLMB01	GLMB02	GLMB03
				Client sampling date / time	26-FEB-2014 10:30	26-FEB-2014 13:00	25-FEB-2014 12:30	25-FEB-2014 13:15	25-FEB-2014 15:00
					ES1404061-001	ES1404061-002	ES1404061-003	ES1404061-004	ES1404061-005
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.55**	**9.37**	**7.89**	**7.83**	**8.33**
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**10700**	**8300**	**9360**	**7000**	**6550**
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**6220**	**4650**	**4010**	**3400**	**3700**
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		<5	<5	<5	**25**	**8**
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	**225**	<1	<1	**16**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**856**	**265**	**529**	**646**	**756**
Total Alkalinity as CaCO3	----	1	mg/L		**856**	**490**	**529**	**646**	**772**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<10	<1	**134**	**98**	**40**
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**3050**	**2400**	**2630**	**1590**	**1410**
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**319**	**7**	**224**	**249**	**210**
Magnesium	7439-95-4	1	mg/L		**79**	**21**	**230**	**106**	**99**
Sodium	7440-23-5	1	mg/L		**2170**	**2090**	**1670**	**1230**	**1160**
Potassium	7440-09-7	1	mg/L		**33**	**20**	**30**	**30**	**33**
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.01**	**0.02**	**0.02**	<0.01	<0.01
Antimony	7440-36-0	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L		<0.001	<0.001	**0.009**	**0.006**	**0.011**
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L		**35.0**	**5.76**	**1.81**	**1.03**	**2.26**
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<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
Cobalt	7440-48-4	0.001	mg/L		<0.001	<0.001	**0.006**	<0.001	**0.008**
Copper	7440-50-8	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L		**0.032**	**0.002**	**0.558**	**1.16**	**0.350**

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: RMB02	RMB03	GLMB01	GLMB02	GLMB03
				Client sampling date / time: 26-FEB-2014 10:30	26-FEB-2014 13:00	25-FEB-2014 12:30	25-FEB-2014 13:15	25-FEB-2014 15:00
				ES1404061-001	ES1404061-002	ES1404061-003	ES1404061-004	ES1404061-005
EG020F: Dissolved Metals by ICP-MS - Continued								
Molybdenum	7439-98-7	0.001	mg/L	<0.001	**0.004**	<0.001	<0.001	**0.017**
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	**0.002**	<0.001	**0.010**
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.01**
Strontium	7440-24-6	0.001	mg/L	**8.12**	**2.00**	**5.15**	**4.42**	**4.27**
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	**0.003**	**0.003**	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	**0.026**	**0.013**	**0.024**	<0.005	**2.53**
Boron	7440-42-8	0.05	mg/L	<0.05	**0.17**	<0.05	**0.06**	**0.05**
Iron	7439-89-6	0.05	mg/L	**6.11**	<0.05	**3.56**	**3.10**	**1.60**
Bromine	7726-95-6	0.1	mg/L	**7.0**	**5.8**	**7.1**	**4.4**	**4.3**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.10	mg/L	**10.9**	**5.90**	**11.7**	**20.0**	**12.9**
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.4**	**0.2**	**0.3**	**0.3**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**4.57**	**3.88**	**2.50**	**1.90**	**2.36**
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	**0.02**	<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	**0.02**	<0.01
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	<0.01	**0.02**	**0.04**	**0.10**	**0.04**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	**0.05**	**0.02**	<0.01	<0.01	<0.01
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**103**	**77.5**	**87.6**	**59.8**	**56.0**
Total Cations	----	0.01	meq/L	**118**	**93.5**	**104**	**75.4**	**69.9**

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	RMB02	RMB03	GLMB01	GLMB02	GLMB03
				Client sampling date / time	26-FEB-2014 10:30	26-FEB-2014 13:00	25-FEB-2014 12:30	25-FEB-2014 13:15	25-FEB-2014 15:00
					ES1404061-001	ES1404061-002	ES1404061-003	ES1404061-004	ES1404061-005
EN055: Ionic Balance - Continued									
Ionic Balance	----	0.01	%		**6.56**	**9.34**	**8.35**	**11.5**	**11.0**
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		<1	**22**	<1	**25**	**18**
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		**13600**	**37000**	**21000**	**13500**	**19800**
Ethene	74-85-1	10	µg/L		<10	<10	<10	<10	<10
Ethane	74-84-0	10	µg/L		**21**	**19**	**3410**	**2480**	**2360**
Propene	115-07-1	10	µg/L		<10	<10	<10	<10	<10
Propane	74-98-6	10	µg/L		<10	<10	**804**	**336**	**293**
Butene	25167-67-3	10	µg/L		<10	<10	<10	<10	<10
Butane	106-97-8	10	µg/L		<10	<10	**89**	**14**	**15**
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	<1.0	<1.0	**10.9**	**10.9**
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		<1.0	<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
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

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Compound	CAS Number	LOR	Unit	Client sample ID	RMB02	RMB03	GLMB01	GLMB02	GLMB03
				Client sampling date / time	26-FEB-2014 10:30	26-FEB-2014 13:00	25-FEB-2014 12:30	25-FEB-2014 13:15	25-FEB-2014 15:00
					ES1404061-001	ES1404061-002	ES1404061-003	ES1404061-004	ES1404061-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
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		<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	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	**70**	**120**	**150**	**50**
C10 - C14 Fraction	----	50	µg/L		<50	**80**	<50	**60**	<50
C15 - C28 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L		<50	**80**	<50	**60**	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	**80**	**120**	**160**	**60**
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		<20	**40**	**50**	**90**	**30**
>C10 - C16 Fraction	>C10_C16	100	µg/L		<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L		<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	<100
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	**37**	**68**	**71**	**23**
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	**3**	**3**
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	<2
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	<2	**3**	**3**
^ Sum of BTEX	----	1	µg/L		<1	**37**	**68**	**74**	**26**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	RMB02	RMB03	GLMB01	GLMB02	GLMB03
				Client sampling date / time	26-FEB-2014 10:30	26-FEB-2014 13:00	25-FEB-2014 12:30	25-FEB-2014 13:15	25-FEB-2014 15:00
Compound	CAS Number	LOR	Unit		ES1404061-001	ES1404061-002	ES1404061-003	ES1404061-004	ES1404061-005
EP080: BTEXN - Continued									
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	<5
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		**21.2**	**30.2**	**23.9**	**25.2**	**24.2**
2-Chlorophenol-D4	93951-73-6	0.1	%		**50.4**	**66.6**	**57.5**	**60.2**	**72.2**
2.4.6-Tribromophenol	118-79-6	0.1	%		**43.4**	**85.1**	**49.0**	**72.5**	**57.1**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**70.0**	**90.2**	**81.3**	**63.8**	**87.1**
Anthracene-d10	1719-06-8	0.1	%		**99.4**	**88.5**	**95.7**	**81.0**	**92.6**
4-Terphenyl-d14	1718-51-0	0.1	%		**97.6**	**96.2**	**99.4**	**91.2**	**96.8**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**88.7**	**101**	**100**	**89.0**	**83.0**
Toluene-D8	2037-26-5	0.1	%		**86.0**	**88.6**	**89.2**	**93.1**	**90.5**
4-Bromofluorobenzene	460-00-4	0.1	%		**81.7**	**81.4**	**79.2**	**76.6**	**76.8**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	QA	----	----	----	----
				Client sampling date / time	[26-FEB-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1404061-006	----	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.62**	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**10700**	----	----	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**6390**	----	----	----	----
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		<5	----	----	----	----
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		**846**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**846**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<10	----	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**3100**	----	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**322**	----	----	----	----
Magnesium	7439-95-4	1	mg/L		**80**	----	----	----	----
Sodium	7440-23-5	1	mg/L		**2250**	----	----	----	----
Potassium	7440-09-7	1	mg/L		**34**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		<0.01	----	----	----	----
Antimony	7440-36-0	0.001	mg/L		<0.001	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		<0.001	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L		**34.7**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.033**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	QA	----	----	----	----
				Client sampling date / time	[26-FEB-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit	ES1404061-006	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Molybdenum	7439-98-7	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.01**	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**7.93**	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.040**	----	----	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**6.06**	----	----	----	----
Bromine	7726-95-6	0.1	mg/L	**6.8**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EG052G: Silica by Discrete Analyser									
Reactive Silica	----	0.10	mg/L	**11.2**	----	----	----	----
EK026SF: Total CN by Segmented Flow Analyser									
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	**0.2**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	**4.47**	----	----	----	----
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	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	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	**0.03**	----	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L	**104**	----	----	----	----
Total Cations	----	0.01	meq/L	**121**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	QA	----	----	----	----
				Client sampling date / time	[26-FEB-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1404061-006	----	----	----	----
EN055: Ionic Balance - Continued									
Ionic Balance	----	0.01	%		7.54	----	----	----	----
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		<1	----	----	----	----
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		36100	----	----	----	----
Ethene	74-85-1	10	µg/L		<10	----	----	----	----
Ethane	74-84-0	10	µg/L		18	----	----	----	----
Propene	115-07-1	10	µg/L		<10	----	----	----	----
Propane	74-98-6	10	µg/L		<10	----	----	----	----
Butene	25167-67-3	10	µg/L		<10	----	----	----	----
Butane	106-97-8	10	µg/L		<10	----	----	----	----
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	----	----	----	----
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	----	----	----	----
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	----	----	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	----	----	----	----
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	----	----	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	----	----	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	----	----	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	----	----	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	----	----	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	----	----	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	----	----	----	----
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	----	----	----	----
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	----	----	----	----
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	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	QA	----	----	----	----
				Client sampling date / time	[26-FEB-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1404061-006	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
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 (zero)	----	0.5	µg/L		<0.5	----	----	----	----
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		**90**	----	----	----	----
C10 - C14 Fraction	----	50	µg/L		**100**	----	----	----	----
C15 - C28 Fraction	----	100	µg/L		<100	----	----	----	----
C29 - C36 Fraction	----	50	µg/L		<50	----	----	----	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		**100**	----	----	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013									
C6 - C10 Fraction	C6_C10	20	µg/L		**90**	----	----	----	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		**40**	----	----	----	----
>C10 - C16 Fraction	>C10_C16	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	----	----	----	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	----	----	----	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	----	----	----	----
Toluene	108-88-3	2	µg/L		**45**	----	----	----	----
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	----	----	----	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	----	----	----	----
^ Sum of BTEX	----	1	µg/L		**45**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	QA	----	----	----	----
				Client sampling date / time	[26-FEB-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1404061-006	----	----	----	----
EP080: BTEXN - Continued									
Naphthalene	91-20-3	5	µg/L		<5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		**25.4**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%		**81.8**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%		**80.6**	----	----	----	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**95.1**	----	----	----	----
Anthracene-d10	1719-06-8	0.1	%		**97.2**	----	----	----	----
4-Terphenyl-d14	1718-51-0	0.1	%		**97.9**	----	----	----	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**107**	----	----	----	----
Toluene-D8	2037-26-5	0.1	%		**94.8**	----	----	----	----
4-Bromofluorobenzene	460-00-4	0.1	%		**88.6**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

CERTIFICATE OF ANALYSIS

Work Order	: **ES1411715**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2193361A	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 27-MAY-2014
Sampler	: CR & CS	Issue Date	: 02-JUN-2014
Site	: ----		
		No. of samples received	: 5
Quote number	: EN/008/13	No. of samples analysed	: 5

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.

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.**
- **EG020: 'Bromine' quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**
- **Ionic Balance out of acceptable limits due to analytes not quantified in this report.**

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
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Sanjeshni Jyoti Mala	Senior Chemist Volatile	Sydney Organics

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	MPMB04	QA
				Client sampling date / time	26-MAY-2014 12:00	26-MAY-2014 13:30	26-MAY-2014 14:15	26-MAY-2014 15:00	26-MAY-2014 15:00
					ES1411715-001	ES1411715-002	ES1411715-003	ES1411715-004	ES1411715-005
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		5.45	6.81	7.44	9.45	6.75
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		924	890	1070	1050	899
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		518	413	550	541	416
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		114	80	<5	86	66
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	126	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		16	200	493	167	205
Total Alkalinity as CaCO3	----	1	mg/L		16	200	493	293	205
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		3	7	<1	<1	7
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		283	177	78	172	175
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		14	28	85	6	29
Magnesium	7439-95-4	1	mg/L		25	27	22	5	28
Sodium	7440-23-5	1	mg/L		119	101	107	181	100
Potassium	7440-09-7	1	mg/L		1	4	14	18	4
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		0.01	0.03	<0.01	0.02	0.02
Antimony	7440-36-0	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L		<0.001	0.004	0.035	0.003	0.002
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L		0.716	0.510	3.35	0.891	0.506
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<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
Cobalt	7440-48-4	0.001	mg/L		0.042	0.002	0.004	<0.001	0.002
Copper	7440-50-8	0.001	mg/L		0.015	0.001	<0.001	0.002	<0.001
Lead	7439-92-1	0.001	mg/L		0.009	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L		0.504	0.148	0.047	0.020	0.169

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: MPMB01	MPMB02	MPMB03	MPMB04	QA
				Client sampling date / time: 26-MAY-2014 12:00	26-MAY-2014 13:30	26-MAY-2014 14:15	26-MAY-2014 15:00	26-MAY-2014 15:00
				ES1411715-001	ES1411715-002	ES1411715-003	ES1411715-004	ES1411715-005
EG020F: Dissolved Metals by ICP-MS - Continued								
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	<0.001	**0.007**	<0.001
Nickel	7440-02-0	0.001	mg/L	**0.016**	**0.001**	**0.004**	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium	7440-24-6	0.001	mg/L	**0.154**	**0.361**	**1.08**	**0.265**	**0.349**
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	**0.070**	**0.009**	**0.006**	**0.039**	**0.011**
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
Iron	7439-89-6	0.05	mg/L	<0.05	**3.96**	**0.83**	<0.05	**3.94**
Bromine	7726-95-6	0.1	mg/L	**0.8**	**0.4**	**0.2**	**0.4**	**0.4**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.05	mg/L	**19.7**	**13.3**	**9.25**	**3.97**	**12.7**
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	**0.2**	**0.2**	**0.5**	**0.2**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.01**	**0.09**	**0.93**	**0.99**	**0.11**
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	**0.15**	**0.02**	**0.02**	**0.02**	**0.02**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.15**	**0.02**	**0.02**	**0.02**	**0.02**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.10**	**0.04**	**0.02**	**0.03**	**0.04**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**8.37**	**9.13**	**12.0**	**10.7**	**9.18**
Total Cations	----	0.01	meq/L	----	----	**11.1**	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	MPMB04	QA
				Client sampling date / time	26-MAY-2014 12:00	26-MAY-2014 13:30	26-MAY-2014 14:15	26-MAY-2014 15:00	26-MAY-2014 15:00
					ES1411715-001	ES1411715-002	ES1411715-003	ES1411715-004	ES1411715-005
EN055: Ionic Balance - Continued									
Total Cations	----	0.01	meq/L		**7.99**	**8.33**	----	**9.12**	**8.42**
Ionic Balance	----	0.01	%		----	----	**4.27**	----	----
Ionic Balance	----	0.01	%		**2.28**	**4.63**	----	**8.05**	**4.34**
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L		**5**	**3**	<1	**15**	**4**
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	10	µg/L		<10	**53**	**35900**	**27300**	**64**
Ethene	74-85-1	10	µg/L		<10	<10	<10	<10	<10
Ethane	74-84-0	10	µg/L		<10	<10	<10	<10	<10
Propene	115-07-1	10	µg/L		<10	<10	<10	<10	<10
Propane	74-98-6	10	µg/L		<10	<10	<10	<10	<10
Butene	25167-67-3	10	µg/L		<10	<10	<10	<10	<10
Butane	106-97-8	10	µg/L		<10	<10	<10	<10	<10
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1.0	µg/L		<1.0	<1.0	<1.0	**10.2**	<1.0
2-Chlorophenol	95-57-8	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2-Methylphenol	95-48-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
3- & 4-Methylphenol	1319-77-3	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
2-Nitrophenol	88-75-5	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dimethylphenol	105-67-9	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4-Dichlorophenol	120-83-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.6-Dichlorophenol	87-65-0	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L		<1.0	<1.0	<1.0	<1.0	<1.0
Pentachlorophenol	87-86-5	2.0	µg/L		<2.0	<2.0	<2.0	<2.0	<2.0
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1.0	µg/L		**11.0**	**5.7**	<1.0	<1.0	**5.7**
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		**12.3**	**7.8**	<1.0	<1.0	**7.8**
Fluorene	86-73-7	1.0	µg/L		**9.7**	**6.4**	<1.0	<1.0	**6.4**
Phenanthrene	85-01-8	1.0	µg/L		**15.3**	**10.2**	<1.0	<1.0	**10.0**
Anthracene	120-12-7	1.0	µg/L		**1.3**	<1.0	<1.0	<1.0	<1.0

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	MPMB01	MPMB02	MPMB03	MPMB04	QA
				Client sampling date / time	26-MAY-2014 12:00	26-MAY-2014 13:30	26-MAY-2014 14:15	26-MAY-2014 15:00	26-MAY-2014 15:00
					ES1411715-001	ES1411715-002	ES1411715-003	ES1411715-004	ES1411715-005
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued									
Fluoranthene	206-44-0	1.0	µg/L		**1.6**	**1.1**	<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+j)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		**51.2**	**31.2**	<0.5	<0.5	**30.9**
^ **Benzo(a)pyrene TEQ (zero)**	----	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	**130**	<20
C10 - C14 Fraction	----	50	µg/L		**520**	**250**	<50	**60**	**230**
C15 - C28 Fraction	----	100	µg/L		**190**	<100	<100	**190**	<100
C29 - C36 Fraction	----	50	µg/L		<50	<50	<50	**60**	<50
^ **C10 - C36 Fraction (sum)**	----	50	µg/L		**710**	**250**	<50	**310**	**230**
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013									
C6 - C10 Fraction	C6_C10	20	µg/L		<20	<20	<20	**130**	<20
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L		<20	<20	<20	**50**	<20
>C10 - C16 Fraction	>C10_C16	100	µg/L		**540**	**230**	<100	<100	**240**
>C16 - C34 Fraction	----	100	µg/L		**160**	<100	<100	**220**	<100
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	<100
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L		**700**	**230**	<100	**220**	**240**
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L		**520**	**230**	<100	<100	**240**
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L		<2	<2	<2	**84**	<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		<2	<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	MPMB01	MPMB02	MPMB03	MPMB04	QA
				Client sampling date / time	26-MAY-2014 12:00	26-MAY-2014 13:30	26-MAY-2014 14:15	26-MAY-2014 15:00	26-MAY-2014 15:00
Compound	CAS Number	LOR	Unit		ES1411715-001	ES1411715-002	ES1411715-003	ES1411715-004	ES1411715-005
EP080: BTEXN - Continued									
^ **Total Xylenes**	1330-20-7	2	µg/L		<2	<2	<2	<2	<2
^ **Sum of BTEX**	----	1	µg/L		<1	<1	<1	**84**	<1
Naphthalene	91-20-3	5	µg/L		**17**	<5	<5	<5	<5
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	0.1	%		**32.8**	**35.1**	**31.7**	**29.7**	**35.1**
2-Chlorophenol-D4	93951-73-6	0.1	%		**87.4**	**84.0**	**81.3**	**71.2**	**85.8**
2.4.6-Tribromophenol	118-79-6	0.1	%		**89.1**	**83.5**	**78.9**	**76.8**	**79.9**
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	0.1	%		**80.2**	**84.8**	**83.5**	**87.0**	**84.6**
Anthracene-d10	1719-06-8	0.1	%		**103**	**98.7**	**98.5**	**99.8**	**96.9**
4-Terphenyl-d14	1718-51-0	0.1	%		**96.0**	**93.7**	**92.0**	**94.1**	**92.7**
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	0.1	%		**77.1**	**78.7**	**83.2**	**78.3**	**82.7**
Toluene-D8	2037-26-5	0.1	%		**104**	**103**	**101**	**102**	**108**
4-Bromofluorobenzene	460-00-4	0.1	%		**107**	**106**	**107**	**104**	**109**

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

CERTIFICATE OF ANALYSIS

Work Order	: **ES1411829**	Page	: 1 of 8
Client	: **PARSONS BRINCKERHOFF AUST P/L**	Laboratory	: Environmental Division Sydney
Contact	: MR JAMES DUGGLEBY	Contact	: Client Services
Address	: GPO BOX 5394 SYDNEY NSW, AUSTRALIA 2001	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: jduggleby@pb.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 02 9272 5100	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 9272 5101	Facsimile	: +61-2-8784 8500
Project	: 2193361A	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 28-MAY-2014
Sampler	: CR ,CS	Issue Date	: 04-JUN-2014
Site	: ----		
		No. of samples received	: 3
Quote number	: EN/008/13	No. of samples analysed	: 3

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

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

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
Pabi Subba	Senior Organic Chemist	Sydney Organics
Shobhna Chandra	Metals Coordinator	Sydney Inorganics

General Comments

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

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

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

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

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero, for 'TEQ 1/2LOR' are treated as half the reported LOR, and for 'TEQ LOR' are treated as being equal to the reported LOR. Note: TEQ 1/2LOR and TEQ LOR will calculate as 0.6mg/Kg and 1.2mg/Kg respectively for samples with non-detects for all of the eight TEQ PAHs.**
- **EG020: Bromine quantification may be unreliable due to its low solubility in acid, leading to variable volatility during measurement by ICPMS.**
- **EG052G: Silica spk failed due to sample matrix. Result confirmed by reanalysis.**
- **EK026SF:Spike failed for Total Cyanide analysis due to matrix interference(confirmed by re analysis)**

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID	GLMB01	GLMB02	GLMB03	----	----
				Client sampling date / time	27-MAY-2014 14:00	27-MAY-2014 12:30	27-MAY-2014 12:00	----	----
					ES1411829-001	ES1411829-002	ES1411829-003	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**7.32**	**7.46**	**8.29**	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**9330**	**6840**	**5570**	----	----
EA015: Total Dissolved Solids									
Total Dissolved Solids @180°C	----	10	mg/L		**5650**	**4000**	**2820**	----	----
EA025: Suspended Solids									
Suspended Solids (SS)	----	5	mg/L		**5**	**25**	<5	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**574**	**829**	**816**	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**574**	**829**	**816**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**138**	<1	<1	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**2880**	**1600**	**1240**	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**197**	**210**	**49**	----	----
Magnesium	7439-95-4	1	mg/L		**223**	**92**	**78**	----	----
Sodium	7440-23-5	1	mg/L		**1390**	**979**	**910**	----	----
Potassium	7440-09-7	1	mg/L		**28**	**26**	**30**	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Antimony	7440-36-0	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.004**	**0.012**	**0.037**	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Barium	7440-39-3	0.001	mg/L		**0.351**	**8.54**	**5.67**	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Cobalt	7440-48-4	0.001	mg/L		**0.002**	<0.001	**0.002**	----	----
Copper	7440-50-8	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Manganese	7439-96-5	0.001	mg/L		**0.442**	**0.897**	**0.024**	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: GLMB01	GLMB02	GLMB03	----	----
				Client sampling date / time: 27-MAY-2014 14:00	27-MAY-2014 12:30	27-MAY-2014 12:00	----	----
				ES1411829-001	ES1411829-002	ES1411829-003	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	**0.004**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	<0.001	**0.003**	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Strontium	7440-24-6	0.001	mg/L	**5.34**	**4.43**	**3.32**	----	----
Uranium	7440-61-1	0.001	mg/L	**0.001**	<0.001	<0.001	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L	**0.018**	**0.006**	**0.075**	----	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	**0.05**	----	----
Iron	7439-89-6	0.05	mg/L	**2.20**	**1.45**	**0.44**	----	----
Bromine	7726-95-6	0.1	mg/L	**7.5**	**4.6**	**3.6**	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
EG052G: Silica by Discrete Analyser								
Reactive Silica	----	0.05	mg/L	**11.7**	**22.9**	**12.1**	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	**0.2**	**0.2**	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**2.39**	**1.74**	**2.24**	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<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**	**0.02**	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.01**	**0.01**	**0.02**	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.05**	**0.15**	**0.03**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**0.06**	**0.01**	----	----
EN055: Ionic Balance								
Total Anions	----	0.01	meq/L	**95.6**	**61.7**	**51.3**	----	----
Total Cations	----	0.01	meq/L	**89.4**	**61.3**	**49.2**	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: GLMB01	GLMB02	GLMB03	----	----
				Client sampling date / time: 27-MAY-2014 14:00	27-MAY-2014 12:30	27-MAY-2014 12:00	----	----
				ES1411829-001	ES1411829-002	ES1411829-003	----	----
EN055: Ionic Balance - Continued								
Ionic Balance	----	0.01	%	**3.37**	**0.33**	**2.08**	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	<1	<1	<1	----	----
EP033: C1 - C4 Hydrocarbon Gases								
Methane	74-82-8	10	µg/L	**35600**	**16200**	**33500**	----	----
Ethene	74-85-1	10	µg/L	<10	<10	<10	----	----
Ethane	74-84-0	10	µg/L	**1950**	**816**	**371**	----	----
Propene	115-07-1	10	µg/L	<10	<10	<10	----	----
Propane	74-98-6	10	µg/L	**544**	**190**	**69**	----	----
Butene	25167-67-3	10	µg/L	<10	<10	<10	----	----
Butane	106-97-8	10	µg/L	**115**	**36**	<10	----	----
EP075(SIM)A: Phenolic Compounds								
Phenol	108-95-2	1.0	µg/L	<1.0	<1.0	**1.8**	----	----
2-Chlorophenol	95-57-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2-Methylphenol	95-48-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
3- & 4-Methylphenol	1319-77-3	2.0	µg/L	<2.0	**2.2**	<2.0	----	----
2-Nitrophenol	88-75-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.4-Dimethylphenol	105-67-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.4-Dichlorophenol	120-83-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.6-Dichlorophenol	87-65-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
4-Chloro-3-methylphenol	59-50-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.4.6-Trichlorophenol	88-06-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
2.4.5-Trichlorophenol	95-95-4	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Pentachlorophenol	87-86-5	2.0	µg/L	<2.0	<2.0	<2.0	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	----	----

Analytical Results

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

Compound	CAS Number	LOR	Unit	Client sample ID: GLMB01	GLMB02	GLMB03	----	----
				Client sampling date / time: 27-MAY-2014 14:00	27-MAY-2014 12:30	27-MAY-2014 12:00	----	----
				ES1411829-001	ES1411829-002	ES1411829-003	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons - Continued								
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(b+j)fluoranthene	205-99-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	----	----
^ **Sum of polycyclic aromatic hydrocarbons**	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	**110**	**100**	**160**	----	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	----	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	----	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----
^ **C10 - C36 Fraction (sum)**	----	50	µg/L	<50	<50	<50	----	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013								
C6 - C10 Fraction	C6_C10	20	µg/L	**110**	**100**	**160**	----	----
^ **C6 - C10 Fraction minus BTEX (F1)**	C6_C10-BTEX	20	µg/L	**110**	**80**	**50**	----	----
>C10 - C16 Fraction	>C10_C16	100	µg/L	<100	<100	<100	----	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	----	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C40 Fraction (sum)**	----	100	µg/L	<100	<100	<100	----	----
^ **>C10 - C16 Fraction minus Naphthalene (F2)**	----	100	µg/L	<100	<100	<100	----	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----
Toluene	108-88-3	2	µg/L	<2	**19**	**109**	----	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	**2**	**2**	----	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----
^ **Total Xylenes**	1330-20-7	2	µg/L	<2	**2**	**2**	----	----
^ **Sum of BTEX**	----	1	µg/L	<1	**21**	**111**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	GLMB01	GLMB02	GLMB03	----	----
			Client sampling date / time	27-MAY-2014 14:00	27-MAY-2014 12:30	27-MAY-2014 12:00	----	----
Compound	CAS Number	LOR	Unit	ES1411829-001	ES1411829-002	ES1411829-003	----	----
EP080: BTEXN - Continued								
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	0.1	%	40.1	39.7	36.8	----	----
2-Chlorophenol-D4	93951-73-6	0.1	%	94.9	89.6	87.1	----	----
2.4.6-Tribromophenol	118-79-6	0.1	%	111	111	109	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	0.1	%	72.7	67.5	76.8	----	----
Anthracene-d10	1719-06-8	0.1	%	113	107	106	----	----
4-Terphenyl-d14	1718-51-0	0.1	%	120	114	111	----	----
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	0.1	%	88.0	86.5	76.3	----	----
Toluene-D8	2037-26-5	0.1	%	108	109	102	----	----
4-Bromofluorobenzene	460-00-4	0.1	%	114	113	104	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10.0	44
2-Chlorophenol-D4	93951-73-6	14	94
2.4.6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27.4	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128

Appendix F

GNS Stable Isotope Laboratory results

STABLE ISOTOPE RESULTS

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30 Gracefield Road
Lower Hutt 5010
PO Box 31 312
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New Zealand
T +64-4-570 1444
F +64-4-570 4657
www.gns.cri.nz

Parsons Brinckerhoff
Level 27, 680 George St
World Square, Sydney
NSW 2001
Australia

Project Title	2193361A	**Invoice**	**Parsons Brinckerhoff**
SIL Order No.:		**Attn:**	**Ellen Kwantes**
Client Ref.:			**Level 27, 680 George St**
Date Received:	3/09/2013		**World Square, Sydney**
Date Measured:			**NSW 2001**
Approved By:			**Australia**
Date Reported:	4/10/2013		

Sample Type: **water (H & O)**

SIL ID	External ID	δD Value	δ18O Value	Analysis Type	Overseas or NZ	State or Province	Country Code	Collection Date/Time (Start)	Meters or Feet	Other Info
W-1302060	MBMP02	-31.7	-6.11	D, O18	OS	New South Wales	AS	22/08/2013 11:30		groundwater
W-1302061	MBMP03	-33.3	-6.38	D, O18	OS	New South Wales	AS	22/08/2013 14:30		groundwater
W-1302062	RMB02	-36.3	-5.91	D, O19	OS	New South Wales	AS	23/08/2013 13:30		groundwater
W-1302063	RMB03	-34.8	-6.07	D, O20	OS	New South Wales	AS	23/08/2013 10:30		groundwater

STABLE ISOTOPE RESULTS

National Isotope Centre
30 Gracefield Road
Lower Hutt 5010
PO Box 31 312
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T +64-4-570 1444
F +64-4-570 4657
www.gns.cri.nz

Parsons Brinckerhoff
Level 27, 680 George St
World Square, Sydney
NSW 2001
Australia

Project Title	2193361A	**Invoice**	**Parsons Brinckerhoff**
SIL Order No.:	W-1303036	**Attn:**	**Carolina Sardella**
Client Ref.:			**Level 27, 680 George St**
Date Received:	9/12/2013		**World Square, Sydney**
Date Measured:			**NSW 2001**
Approved By:			**Australia**
Date Reported:	13/01/2014		

Sample Type: **water (H & O)**

SIL ID	External ID	δD Value	δ18O Value	Analysis Type	Overseas or NZ	State or Province	Country Code	Collection Date/Time (Start)	Meters or Feet	Other Info
W-1303036	RMB01	-31.7	-5.66	D, O18	OS	New South Wales	AS	27/11/2013 12:30	m	groundwater
W-1303037	RMB02	-34.0	-6.01	D, O18	OS	New South Wales	AS	27/11/2013 14:15	m	groundwater
W-1303038	RMB03	-33.9	-5.86	D, O19	OS	New South Wales	AS	27/11/2013 15:35	m	groundwater
W-1303039	MPMB04	-35.4	-6.13	D, O20	OS	New South Wales	AS	5/12/2013 15:00	m	groundwater

STABLE ISOTOPE RESULTS

National Isotope Centre
30 Gracefield Road
Lower Hutt 5010
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Parsons Brinckerhoff
Level 27, 680 George St
World Square, Sydney
NSW 2001
Australia

Project Title	2114759B	**Invoice**	**Parsons Brinckerhoff**
SIL Order No.:		**Attn:**	**Carolina Sardella**
Client Ref.:			**Level 27, 680 George St**
Date Received:	24/03/2014		**World Square, Sydney**
Date Measured:			**NSW 2001**
Approved By:			**Australia**
Date Reported:	16/04/2014		

Sample Type: **water (H & O)**

SIL ID	External ID	δD Value	δ18O Value	Analysis Type	Overseas or NZ	State or Province	Country Code	Collection Date/Time (Start)	Other Info
W-1400441	GLMB01	-30.7	-5.60	D, O18	OS	New South Wales	AS	25/02/2014 12:35	Groundwater
W-1400442	GLMB02	-30.4	-5.39	D, O18	OS	New South Wales	AS	25/02/2014 13:15	Groundwater
W-1400443	GLMB03	-32.2	-5.61	D, O18	OS	New South Wales	AS	25/02/2014 14:50	Groundwater

Appendix G

Rafter Radiocarbon Laboratory results

Rafter Radiocarbon

Accelerator Mass Spectrometry Result

NZA 55661

R 40421/1

Job No: 198128

Report issued: 4 Mar 2014

Sample ID	RMB01
Description	Groundwater
Fraction dated	Water
Submitter	Carolina Sardella Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**11218**	±	**35**	
$\delta^{13}C$ and Source of measurement	-0.3	±	0.2	IRMS
Fraction modern	0.2475	±	0.0011	
$\Delta^{14}C$ (‰) and collection date	-754.4	±	1.1	27 Nov 2012

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a 500 mL white plastic bottle, not completely filled, with water level only to rim. Orangey coloured precipitate observed. Sample was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 230.3 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 19.2 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach (*Radiocarbon 19*:355-363, 1977). $\Delta^{14}C$ is reported only if collection date was supplied and is decay corrected to that date. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25‰, defined by Donahue et al. (*Radiocarbon*, *32*(2):135-142, 1990). $\delta^{13}C$ normalization is always performed using $\delta^{13}C$ measured by AMS, thus accounting for AMS fractionation. Although not used in the ^{14}C age calculations, the environmental $\delta^{13}C$ measured offline by IRMS is reported if sufficient sample material was available. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

National Isotope Centre, GNS Science
PO Box 31-312 Lower Hutt, New Zealand Phone +64 4 570 4644
Email radiocarbon@gns.cri.nz Website www.RafterRadiocarbon.co.nz

RAFTER
GNS SCIENCE

Accelerator Mass Spectrometry Result

This result for the sample submitted is for the exclusive use of the submitter.
All liability whatsoever to any third party is excluded.

NZA	**39024**
R	32930/1
Job No	109639
Measured	14-Feb-12
TW No	2709
Issued	16-Feb-12

Sample ID RMB02 3/11
Description Groundwater
Fraction Dated dissolved inorganic caobon
Submitter Wendy McLean Parsons Brinckerhoff

*** Radiocarbon Age**		**35620 ± 370 BP**		**$\delta^{13}C$ =**	5.4 ‰
**** Per cent modern =**	1.18 ± 0.05	**$\delta^{14}C$ =**	-987.5 ± 0.6 ‰	**$\Delta^{14}C$ =**	-988.2 ± 0.5 ‰

* Reported age is the conventional radiocarbon age before present (BP)
** Per cent modern means absolute per cent modern relative to the NBS oxalic acid standard (HOxI) corrected for decay since 1950.
Age, $\Delta^{14}C$, $\delta^{14}C$ and absolute per cent modern are as defined by Stuiver Polach, Radiocarbon 19:355-363 (1977)

Sample Treatment Details
Sample submitted in white Nalgene plastic bottle. Water odourless, clear and colourless with very small amount of orangey coloured precipitate. Phosphoric acid evolution, carbonate content = 222.9mg/kg and TDIC=18.6mmol/kg CO2.

Stored the remainder of water

Comments

The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error component based on the analysis of an ongoing series of measurements on an oxalic acid standard.
For the present result the system error component is conservatively estimated as 0% (= ± 0 radiocarbon years).

National Isotope Centre, Institute of Geological and Nuclear Sciences Ltd (GNS Science)
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www.RafterRadiocarbon.co.nz

Rafter Radiocarbon

Accelerator Mass Spectrometry Result

This result for the sample submitted is for the exclusive use of the submitter. All liability whatsoever to any third party is excluded.

NZA 54636
R 40362/3
Job No: 196641
Measured: 24/09/2013
TW No: 2889
Date issued: 30 Sep 2013

Sample ID	RMB02
Description	Groundwater
Fraction dated	Water
Submitter	Ellen Kwantes Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**41369**	±	**928**	
$\delta^{13}C$ and Source of measurement	5.3	±	0.2	C13
Fraction modern	0.0058	±	0.0007	
$\Delta^{14}C$ (‰) and collection date	-994.2	±	0.7	23 Aug 2013

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a fully capped plastic bottle with very tiny amount of orangey precipitate and no head space. Sample was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 269.8 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 22.5 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach, Radiocarbon 19:355-363 (1977) and $\Delta^{14}C$ is decay corrected to the collection date given, and not reported if no collection date was supplied. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25 permil, defined by Donahue, D. J., T. Linick, and A. T. Jull, *Radiocarbon*, *32* (2):135-142 (1990). $\delta^{13}C$ was obtained from the source indicated. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error component based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Rafter Radiocarbon

Accelerator Mass Spectrometry Result

This result for the sample submitted is for the exclusive use of the submitter. All liability whatsoever to any third party is excluded.

NZA 55662

R 40421/2

Job No: 198127

Report issued: 4 Mar 2014

Sample ID	RMB02
Description	Groundwater
Fraction dated	Water
Submitter	Carolina Sardella Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**45612**	±	**2372**	
$\delta^{13}C$ and Source of measurement	6.1	±	0.2	IRMS
Fraction modern	0.0034	±	0.0010	
$\Delta^{14}C$ (‰) and collection date	-996.6	±	1.0	27 Nov 2012

Measurement Comment: This result was very close to carbonate blank for this wheel. Finite age calculated, but since this age was fairly close to background we suggest some degree of caution with the interpretation of this result.

Sample Treatment Details

Sample was submitted in: a 500 mL white plastic bottle with orangey coloured precipitate and no head space. Sample was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 240.5 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 20 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach (*Radiocarbon 19*:355-363, 1977). $\Delta^{14}C$ is reported only if collection date was supplied and is decay corrected to that date. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25‰, defined by Donahue et al. (*Radiocarbon*, *32*(2):135-142, 1990). $\delta^{13}C$ normalization is always performed using $\delta^{13}C$ measured by AMS, thus accounting for AMS fractionation. Although not used in the ^{14}C age calculations, the environmental $\delta^{13}C$ measured offline by IRMS is reported if sufficient sample material was available. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Accelerator Mass Spectrometry Result

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All liability whatsoever to any third party is excluded.

NZA	**39025**
R	32930/2
Job No	109640
Measured	14-Feb-12
TW No	2709
Issued	16-Feb-12

Sample ID RMB03 7/11
Description Groundwater
Fraction Dated dissolved inorganic caobon
Submitter Wendy McLean Parsons Brinckerhoff

*** Radiocarbon Age**		**31900 ± 240 BP**		**$\delta^{13}C$ =**	8.4 ‰
**** Per cent modern =**	1.87 ± 0.06	**$\delta^{14}C$ =**	-980 ± 0.6 ‰	**$\Delta^{14}C$ =**	-981.3 ± 0.6 ‰

* Reported age is the conventional radiocarbon age before present (BP)
** Per cent modern means absolute per cent modern relative to the NBS oxalic acid standard (HOxI) corrected for decay since 1950.
Age, $\Delta^{14}C$, $\delta^{14}C$ and absolute per cent modern are as defined by Stuiver Polach, Radiocarbon 19:355-363 (1977)

Sample Treatment Details
Sample submitted in white Nalgene plastic bottle. Water odourless, clear and colourless with small amount of orangey coloured precipitate. Phosphoric acid evolution, carbonate content = 177.6mg/kg and TDIC=14.8mmol/kg CO2.

Stored the remainder of water

Comments

The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error component based on the analysis of an ongoing series of measurements on an oxalic acid standard.
For the present result the system error component is conservatively estimated as 0% (= ± 0 radiocarbon years).

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Accelerator Mass Spectrometry Result

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NZA 54637
R 40362/4
Job No: 196642
Measured: 24/09/2013
TW No: 2889
Date issued: 30 Sep 2013

Sample ID	RMB03
Description	Groundwater
Fraction dated	Water
Submitter	Ellen Kwantes Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**17992**	±	**66**	
$\delta^{13}C$ and Source of measurement	14.1	±	0.2	C13
Fraction modern	0.1065	±	0.0009	
$\Delta^{14}C$ (‰) and collection date	-894.3	±	0.9	23 Aug 2013

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a fully capped plastic bottle with no head space. Water was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 100.8 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 8.4 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach, Radiocarbon 19:355-363 (1977) and $\Delta^{14}C$ is decay corrected to the collection date given, and not reported if no collection date was supplied. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25 permil, defined by Donahue, D. J., T. Linick, and A. T. Jull, *Radiocarbon*, *32* (2):135-142 (1990). $\delta^{13}C$ was obtained from the source indicated. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error component based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Rafter Radiocarbon

Accelerator Mass Spectrometry Result

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NZA 55663

R 40421/3

Job No: 197706

Report issued: 4 Mar 2014

Sample ID	RMB03
Description	Groundwater
Fraction dated	Water
Submitter	Carolina Sardella Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**17484**	±	**69**	
$\delta^{13}C$ and Source of measurement	11.1	±	0.2	IRMS
Fraction modern	0.1134	±	0.0010	
$\Delta^{14}C$ (‰) and collection date	-887.4	±	1.0	27 Nov 2012

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a 500 mL white plastic bottle with orangey coloured precipitate and no head space. Sample was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 112.5 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 9.4 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach (*Radiocarbon 19*:355-363, 1977). $\Delta^{14}C$ is reported only if collection date was supplied and is decay corrected to that date. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25‰, defined by Donahue et al. (*Radiocarbon*, *32*(2):135-142, 1990). $\delta^{13}C$ normalization is always performed using $\delta^{13}C$ measured by AMS, thus accounting for AMS fractionation. Although not used in the ^{14}C age calculations, the environmental $\delta^{13}C$ measured offline by IRMS is reported if sufficient sample material was available. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Rafter Radiocarbon

Accelerator Mass Spectrometry Result

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NZA 54612
R 40362/1
Job No: 196639
Measured: 23/09/2013
TW No: 2888
Date issued: 30 Sep 2013

Sample ID	MPMB02
Description	Groundwater
Fraction dated	Water
Submitter	Ellen Kwantes Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**5403**	±	**26**	
$\delta^{13}C$ and Source of measurement	-16.4	±	0.2	C13
Fraction modern	0.5104	±	0.0017	
$\Delta^{14}C$ (‰) and collection date	-493.6	±	1.7	22 Aug 2013

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a fully capped plastic bottle with small amount of orangish precipitate but no head space. Water was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 69 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 5.7 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach, Radiocarbon 19:355-363 (1977) and $\Delta^{14}C$ is decay corrected to the collection date given, and not reported if no collection date was supplied. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25 permil, defined by Donahue, D. J., T. Linick, and A. T. Jull, *Radiocarbon*, *32* (2):135-142 (1990). $\delta^{13}C$ was obtained from the source indicated. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error component based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Rafter Radiocarbon

Accelerator Mass Spectrometry Result

NZA 54613
R 40362/2
Job No: 196640
Measured: 23/09/2013
TW No: 2888
Date issued: 30 Sep 2013

Sample ID	MPMB03
Description	Groundwater
Fraction dated	Water
Submitter	Ellen Kwantes Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**25964**	±	**155**	
$\delta^{13}C$ and Source of measurement	-1.7	±	0.2	C13
Fraction modern	0.0395	±	0.0008	
$\Delta^{14}C$ (‰) and collection date	-960.8	±	0.8	22 Aug 2013

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a fully capped plastic bottle with very tiny amount of orangey precipitate but no head space. Water was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 118.7 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 9.9 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach, Radiocarbon 19:355-363 (1977) and $\Delta^{14}C$ is decay corrected to the collection date given, and not reported if no collection date was supplied. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25 permil, defined by Donahue, D. J., T. Linick, and A. T. Jull, *Radiocarbon*, *32* (2):135-142 (1990). $\delta^{13}C$ was obtained from the source indicated. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error component based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Rafter Radiocarbon

Accelerator Mass Spectrometry Result

NZA 55664

R 40421/4

Job No: 197707

Report issued: 4 Mar 2014

Sample ID	MPMB04
Description	Groundwater
Fraction dated	Water
Submitter	Carolina Sardella Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**20024**	±	**98**	
$\delta^{13}C$ and Source of measurement	0.0	±	0.2	IRMS
Fraction modern	0.0827	±	0.0010	
$\Delta^{14}C$ (‰) and collection date	-918.0	±	1.0	5 Dec 2013

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a 500 mL white plastic bottle with grey coloured precipitate 1cm thick but with no head space. Sample was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 54.5 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 4.5 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach (*Radiocarbon 19*:355-363, 1977). $\Delta^{14}C$ is reported only if collection date was supplied and is decay corrected to that date. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25‰, defined by Donahue et al. (*Radiocarbon*, *32*(2):135-142, 1990). $\delta^{13}C$ normalization is always performed using $\delta^{13}C$ measured by AMS, thus accounting for AMS fractionation. Although not used in the ^{14}C age calculations, the environmental $\delta^{13}C$ measured offline by IRMS is reported if sufficient sample material was available. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Rafter Radiocarbon

Accelerator Mass Spectrometry Result

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NZA 56144

R 40492/1

Job No: 198578

Report issued: 8 May 2014

Sample ID	GLMB01
Description	Groundwater
Fraction dated	Groundwater
Submitter	Carolina Sardella Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**23940**	±	**89**	
$\delta^{13}C$ and Source of measurement	-9.3	±	0.2	IRMS
Fraction modern	0.0508	±	0.0006	
$\Delta^{14}C$ (‰) and collection date	-949.6	±	0.6	25 Feb 2014

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a clear nalgene bottle with small particulates in the sample but no precipitate. Sample had a small head space at top of bottle. Sample was odourless and colourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 155.39 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 12.95 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach (*Radiocarbon 19*:355-363, 1977). $\Delta^{14}C$ is reported only if collection date was supplied and is decay corrected to that date. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25‰, defined by Donahue et al. (*Radiocarbon*, *32*(2):135-142, 1990). $\delta^{13}C$ normalization is always performed using $\delta^{13}C$ measured by AMS, thus accounting for AMS fractionation. Although not used in the ^{14}C age calculations, the environmental $\delta^{13}C$ measured offline by IRMS is reported if sufficient sample material was available. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Rafter Radiocarbon

Accelerator Mass Spectrometry Result

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NZA 56145

R 40492/2

Job No: 198579

Report issued: 8 May 2014

Sample ID	GLMB02
Description	Groundwater
Fraction dated	Groundwater
Submitter	Carolina Sardella Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**10733**	±	**26**	
$\delta^{13}C$ and Source of measurement	-10.5	±	0.2	IRMS
Fraction modern	0.2629	±	0.0009	
$\Delta^{14}C$ (‰) and collection date	-739.2	±	0.9	25 Feb 2014

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a clear nalgene bottle with small particulates but no precipitate. Bottle had a small head space at the top. Sample was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 187.2 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 15.6 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach (*Radiocarbon 19*:355-363, 1977). $\Delta^{14}C$ is reported only if collection date was supplied and is decay corrected to that date. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25‰, defined by Donahue et al. (*Radiocarbon*, *32*(2):135-142, 1990). $\delta^{13}C$ normalization is always performed using $\delta^{13}C$ measured by AMS, thus accounting for AMS fractionation. Although not used in the ^{14}C age calculations, the environmental $\delta^{13}C$ measured offline by IRMS is reported if sufficient sample material was available. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Rafter Radiocarbon

Accelerator Mass Spectrometry Result

NZA 56366

R 40492/3

Job No: 198580

Report issued: 8 May 2014

Sample ID	GLMB03
Description	Groundwater
Fraction dated	Groundwater
Submitter	Carolina Sardella Parsons Brinckerhoff

Conventional Radiocarbon Age (years BP)	**20572**	±	**102**	
$\delta^{13}C$ and Source of measurement	-4.8	±	0.2	IRMS
Fraction modern	0.0772	±	0.0010	
$\Delta^{14}C$ (‰) and collection date	-923.4	±	1.0	25 Feb 2014

Measurement Comment:

Sample Treatment Details

Sample was submitted in: a clear nalgene bottle with small particulates in sample but with no precipitate. Bottle had a small gap at top for head space. Sample was colourless and odourless. CO2 was generated by phosphoric acid evolution, and carbonate content was 208.1 mgC/kgH2O, total dissolved inorganic carbon (TDIC) 17.3 mmol/kgH2O. Sample carbon dioxide was converted to graphite by reduction with hydrogen over iron catalyst.

Conventional Radiocarbon Age and $\Delta^{14}C$ are reported as defined by Stuiver and Polach (*Radiocarbon 19*:355-363, 1977). $\Delta^{14}C$ is reported only if collection date was supplied and is decay corrected to that date. Fraction modern (F) is the blank corrected fraction modern normalized to $\delta^{13}C$ of -25‰, defined by Donahue et al. (*Radiocarbon*, *32*(2):135-142, 1990). $\delta^{13}C$ normalization is always performed using $\delta^{13}C$ measured by AMS, thus accounting for AMS fractionation. Although not used in the ^{14}C age calculations, the environmental $\delta^{13}C$ measured offline by IRMS is reported if sufficient sample material was available. The reported errors comprise statistical errors in sample and standard determinations, combined in quadrature with a system error based on the analysis of an ongoing series of measurements on an oxalic acid standard. Further details of pretreatment and analysis are available on request.

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Appendix H

ANSTO Laboratory tritium results

Australian Government

Nuclear-based science benefiting all Australians

Institute for Environmental Research Analytical Report

Client:	**Parsons Brinckerhoff** **GPO Box 5394** **Sydney** **NSW 2001**
Contact:	**Ellen Kwantes**
Tel:	**(02) 9272-5078**

Report Number:	**2013/0242**
Batch Description:	**tritium in groundwater**
Samples Received:	**6**
Registration Date:	**2-Sep-2013**
Report Date:	**8-Nov-2013**
Logged By:	**Kellie-Anne Farrawell**
ANSTO Cost Code:	**0205v-1**
Funds Type:	**Project - Commercial**
Supervising Analyst:	**Robert Chisari**

Signature: Robert Chisari Date: 8/11/2013

Robert Chisari

AUSTRALIAN NUCLEAR SCIENCE AND TECHNOLOGY ORGANISATION

New Illawarra Road, Lucas Heights (Locked Bag 2001, Kirrawee DC NSW 2232) T +61 2 9717 3111 F +61 2 9543 5097

www.ansto.gov.au

LIMS ID#	Client Identification	Sample Description
2013/0242-3	MPMB02	Groundwater
2013/0242-4	MPMB03	Groundwater
2013/0242-5	RMB02	Groundwater
2013/0242-6	RMB03	Groundwater

Institute for Environmental Research
Analytical Report

Report Number: 2013/0242

Tritium Concentration at Sampling Date

Client Identification	Sample No.	Date Sample Collected	Tritium Ratio	Uncertainty [1]	Quant Limit [2]	Tritium Activity	Uncertainty [1]	MDA [2]
			TU	TU	TU	Bq/kg	Bq/kg	Bq/kg
MPMB02	3	22/08/2013	0.01^	0.03	0.15	0.001^	0.003	0.018
MPMB03	4	22/08/2013	0.03^	0.02	0.15	0.004^	0.003	0.018
RMB02	5	23/08/2013	0.03^	0.02	0.15	0.003^	0.003	0.018
RMB03	6	23/08/2013	0.06^	0.03	0.15	0.007^	0.003	0.018

Notes:

1. Values reported are combined standard uncertainty, calculated to 1 sigma. A Coverage factor, *k*, of 2 may be used to calculate Expanded Uncertainty to 95% confidence.

2. The MDA (Minimum Detectable Activity) and Quant Limit (Limit of Quantification) are calculated to 95% confidence.

^ This result is below the MDA/Quant Limit and therefore has an unacceptable level of uncertainty. Hence, the data should only be used as an indicator of the true concentration

Signature: Robert Chisari Date: 8/11/2013

Robert Chisari

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Australian Government

Nuclear-based science benefiting all Australians

Institute for Environmental Research Analytical Report

Client:	**Parsons Brinckerhoff** **GPO Box 5394** **Sydney** **NSW 2001**
Contact:	**Carolina Sardella**
Tel:	**(02) 9272-5078**

Report Number:	**2013/0350**
Batch Description:	**Tritium in groundwater**
Samples Received:	**4**
Registration Date:	**11-Dec-2013**
Report Date:	**21-Feb-2014**
Logged By:	**Kellie-Anne Farrawell**
ANSTO Cost Code:	**0205V-1**
Funds Type:	**Project - Commercial**
Supervising Analyst:	**Robert Chisari**

Signature: Robert Chisari Date: 21/02/2014

Robert Chisari

Institute for Environmental Research
Analytical Report

Report Number: 2013/0317

LIMS ID#	Client Identification	Sample Description
2013/0350-1	RMB01	Groundwater
2013/0350-2	RMB02	Groundwater
2013/0350-3	RMB03	Groundwater
2013/0350-4	MPMB04	Groundwater

Tritium Concentration at Sampling Date

Client Identification	Sample No.	Date Sample Collected	Tritium Ratio	Uncertainty [1]	Quant Limit [2]	Tritium Activity	Uncertainty [1]	MDA [2]
			TU	TU	TU	Bq/kg	Bq/kg	Bq/kg
RMB01	1	27/11/2013	0.05^	0.03	0.18	0.006^	0.003	0.021
RMB02	2	27/11/2013	0.01^	0.04	0.16	0.001^	0.005	0.019
RMB03	3	27/11/2013	0.07^	0.03	0.15	0.008^	0.003	0.018
MPMB04	4	5/12/2013	0.05^	0.02	0.15	0.006^	0.003	0.018

Notes:

1. Values reported are combined standard uncertainty, calculated to 1 sigma. A Coverage factor, *k*, of 2 may be used to calculate Expanded Uncertainty to 95% confidence.

2. The MDA (Minimum Detectable Activity) and Quant Limit (Limit of Quantification) are calculated to 95% confidence.

^ This result is below the MDA/Quant Limit and therefore has an unacceptable level of uncertainty. Hence, the data should only be used as an indicator of the true concentration

Signature: Robert Chisari Date: 21/02/2014

Robert Chisari

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Appendix I

GNS Laboratory tritium results

WATER DATING LABORATORY ANALYTICAL RESULTS

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16 May 2014

Parsons Brinckerhoff

FAO: Carolina Sardella

Results of Tritium Analyses Order No: 2114759B

Lab ID	Collection Date	Sample ID	Tritium conc. TR	± TR
TAUS747	25.2.14	GLMBO1	0.006	0.016
TAUS748	25.2.14	GLMBO2	0.049	0.047
TAUS749	25.2.14	GLMBO3	0.080	0.017

Tritium is measured by electrolytic enrichment and liquid scintillation counting using Quantulus low-level counters (Morgenstern & Taylor, 2009).. 1 TR is a $^{3}H/^{1}H$ ratio of 1×10^{-18}. ±TR = one sigma standard measurement error. The detection limit is approximately 0.025 TR.

Regards,

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Reviewed by:
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Morgenstern, U. Taylor, C.B. 2009 Ultra low-level tritium measurement using electrolytic enrichment and LSC. Isotopes in Environmental and Health Studies. 45(2), 96-117