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AGL UPSTREAM INVESTMENTS PTY LTD

CAMDEN GAS PROJECT

Quarterly Produced Water Quality Monitoring Report

Reporting Period: 1st Quarter – August / September 2013

AGL Upstream Investments Pty Ltd

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Foreword

PREMISES	Rosalind Park Gas Plant Lot 35 Medhurst Road GILEAD NSW 2560
LICENCE DETAILS	Environment Protection Licence 12003
LICENCEE	AGL Upstream Investments Pty Limited (AGL)
LICENCEE'S ADDRESS	Locked Bag 1837, North Sydney, NSW 2060
MONITORING DATE	1 st Quarter – August / September 2013
MONITORING BY	AGL
ANALYSIS BY	ALS Laboratory, Smithfield (Work order number: ES1319191)
REPORT DATE	13 September 2013
REPORT PREPARED BY	Nicola Fry, Hydrogeologist

Introduction

The Camden Gas Project (CGP) is owned and operated by AGL and is located in the Macarthur region 65 km southwest of Sydney, in the Wollondilly, Camden and Campbelltown Local Government Areas (Figure 1). The CGP has been producing gas for the Sydney region since 2001 and currently consists of 144 gas wells, low-pressure underground gas gathering pipes and a gas plant facility. Not all production wells are currently operational. The production wells are licensed with Water Access Licences, Works Approvals and Use Approvals under the *Water Management Act 2000* (NSW), including an allocation of 30 ML per year for the existing CGP and associated dewatering activities from the coal seams.

This Monitoring Report relates to the groundwater monitoring activities specified in Part 5, Monitoring and Recording Conditions, of the Environment Protection Licence. The Licence conditions stipulate groundwater monitoring is required to be carried out at the locations as shown in Table 1 and Figure 1. The specific analytes and frequency tested are shown in Table 2.

The monitoring points that are the subject of this report are part of the CGP groundwater monitoring network, as described in AGL's CGP Groundwater Management Plan (2012). Water samples are taken from each gas well at the separator. The deep groundwater (when brought to the surface) is known as produced water. The water quality samples are analysed by an external NATA certified laboratory (ALS Environmental, Smithfield), in accordance with the EPA Approved Methods Publication "*Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales*".

This report is prepared in accordance with the *Requirements for Publishing Pollution Monitoring Data* (EPA, March 2012) (Publication Requirements).

Table 3 displays the results of this quarter's monitoring.

Produced water from the coal seams at CGP ranges in quality, as a result of localised natural variations within the coal. Electrical conductivity (which is a measure of salinity) typically varies between about 7,000 and 15,000 $\mu\text{S}/\text{cm}$. However, it is not unusual to see values outside of this range. Low volume water producing wells frequently show very low electrical conductivity values as a result of evaporation and condensation processes occurring in the well bore (PB, 2013). These very low values are not representative of formation water samples. It is also not uncommon to observe elevated levels of TPH (total petroleum hydrocarbons) after specific wells have undergone maintenance activities. These values are not representative of formation water samples.

More information on the hydrogeology and groundwater of the CGP is available in the Hydrogeological Summary (AGL, 2013) which can be viewed at the CGP website:

agl.com.au/Camden

Table 1- Groundwater quality monitoring points (as per EPL 12003)

EPA Identification no.	Location
8	EM40
9	SF08
10	RB10
11	MT05
12	MP12
13	MP30
14	RP12
15	SL03

Table 2 – Analytes monitored and frequency (as per EPL 12003)

Analyte	Units of measure	Frequency	Sampling Method
Aluminium	milligrams per litre	Quarterly	Grab sample
Ammonia	milligrams per litre	Yearly	Grab sample
Arsenic	milligrams per litre	Quarterly	Grab sample
Barium	milligrams per litre	Quarterly	Grab sample
Benzene	milligrams per litre	Yearly	Grab sample
Beryllium	milligrams per litre	Quarterly	Grab sample
Bicarbonate	milligrams per litre	Quarterly	Grab sample
Boron	milligrams per litre	Quarterly	Grab sample
Bromide	milligrams per litre	Quarterly	Grab sample
Cadmium	milligrams per litre	Quarterly	Grab sample
Calcium	milligrams per litre	Quarterly	Grab sample
Carbonate	milligrams per litre	Quarterly	Grab sample
Chloride	milligrams per litre	Quarterly	Grab sample
Chromium	milligrams per litre	Quarterly	Grab sample
Cobalt	milligrams per litre	Quarterly	Grab sample
Copper	milligrams per litre	Quarterly	Grab sample
Electrical conductivity	microsiemens per centimeter	Quarterly	Grab sample
Ethyl benzene	milligrams per litre	Yearly	Grab sample
Fluoride	milligrams per litre	Quarterly	Grab sample
Iron	milligrams per litre	Quarterly	Grab sample
Lead	milligrams per litre	Quarterly	Grab sample
Magnesium	milligrams per litre	Quarterly	Grab sample
Manganese	milligrams per litre	Quarterly	Grab sample
Mercury	milligrams per litre	Quarterly	Grab sample
Methane	milligrams per litre	Yearly	Grab sample
Molybdenum	milligrams per litre	Quarterly	Grab sample
Nickel	milligrams per litre	Quarterly	Grab sample
Nitrate	milligrams per litre	Yearly	Grab sample
Nitrite	milligrams per litre	Yearly	Grab sample
Phenols	milligrams per litre	Yearly	Grab sample
Polycyclic aromatic	milligrams per litre	Yearly	Grab sample

Potassium	milligrams per litre	Quarterly	Grab sample
Reactive Phosphorus	milligrams per litre	Yearly	Grab sample
Selenium	milligrams per litre	Quarterly	Grab sample
Silica	milligrams per litre	Quarterly	Grab sample
Sodium	milligrams per litre	Quarterly	Grab sample
Strontium (dissolved)	milligrams per litre	Quarterly	Grab sample
Sulfate	milligrams per litre	Quarterly	Grab sample
Toluene	milligrams per litre	Yearly	Grab sample
Total dissolved solids	milligrams per litre	Quarterly	Grab sample
Total petroleum hydrocarbons	milligrams per litre	Yearly	Grab sample
Uranium	milligrams per litre	Quarterly	Grab sample
Vanadium	milligrams per litre	Quarterly	Grab sample
Xylene	milligrams per litre	Yearly	Grab sample
Zinc	milligrams per litre	Quarterly	Grab sample



Groundwater Monitoring Results

Table 3 - Produced water monitoring results for 1st Quarter - August/September 2013

Monitoring point	8	9	10	11	12	13	14	15
Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
Sampled date/ comment	Not enough water to sample	Not enough water to sample	29/08/2013	Not enough water to sample	Not enough water to sample	05/09/2013	Not enough water to sample	Not enough water to sample

	Analyte	Units	Limit of reporting							
Physical	Electrical conductivity *(lab)	µS/cm	1			10,500			10,800	
	TDS	mg/L	10			6450			7940	
	TSS	mg/L	5			20			<5	
Major Cations	Calcium (Filtered)	mg/L	1			5			4	
	Magnesium (Filtered)	mg/L	1			5			3	
	Potassium (Filtered)	mg/L	1			30			65	
	Sodium (Filtered)	mg/L	1			3730			3610	
	Cations Total	meq/L	0.01			164			159	
Major Anions	Alkalinity (Bicarbonate as CaCO ₃)	mg/L	1			7020			6660	
	Alkalinity (Carbonate as CaCO ₃)	mg/L	1			200			175	
	Alkalinity (Hydroxide) as CaCO ₃	mg/L	1			<1			<1	
	Alkalinity (total) as CaCO ₃	mg/L	1			7220			6840	
	Chloride	mg/L	1			134			258	
	Anions Total	meq/L	0.01			148			144	



			Monitoring point	8	9	10	11	12	13	14	15
			Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
Ionic Balance	Ionic Balance	%	0.01			4.95			4.94		
Metals	Aluminium (Filtered)	mg/L	0.01			<0.1			<0.01		
	Arsenic (Filtered)	mg/L	0.001			<0.010			0.003		
	Barium (Filtered)	mg/L	0.001			10.4			11.6		
	Beryllium (Filtered)	mg/L	0.001			<0.010			<0.001		
	Boron (Filtered)	mg/L	0.05			<0.50			0.16		
	Cadmium (Filtered)	mg/L	0.0001			<0.0010			<0.0001		
	Chromium (III+VI) (Filtered)	mg/L	0.001			<0.010			<0.001		
	Cobalt (Filtered)	mg/L	0.001			<0.010			0.009		
	Copper (Filtered)	mg/L	0.001			<0.010			<0.001		
	Iron (Filtered)	mg/L	0.05			2.72			0.44		
	Lead (Filtered)	mg/L	0.001			<0.010			0.008		
	Manganese (Filtered)	mg/L	0.001			0.018			0.032		
	Mercury (Filtered)	mg/L	0.0001			<0.0001			<0.0001		
	Molybdenum (Filtered)	mg/L	0.001			0.016			0.051		
	Nickel (Filtered)	mg/L	0.001			<0.010			0.02		
	Selenium (Filtered)	mg/L	0.01			<0.10			<0.01		
Strontium (Filtered)	mg/L	0.001			3.13			2.81			
Uranium (Filtered)	mg/L	0.001			<0.010			0.005			



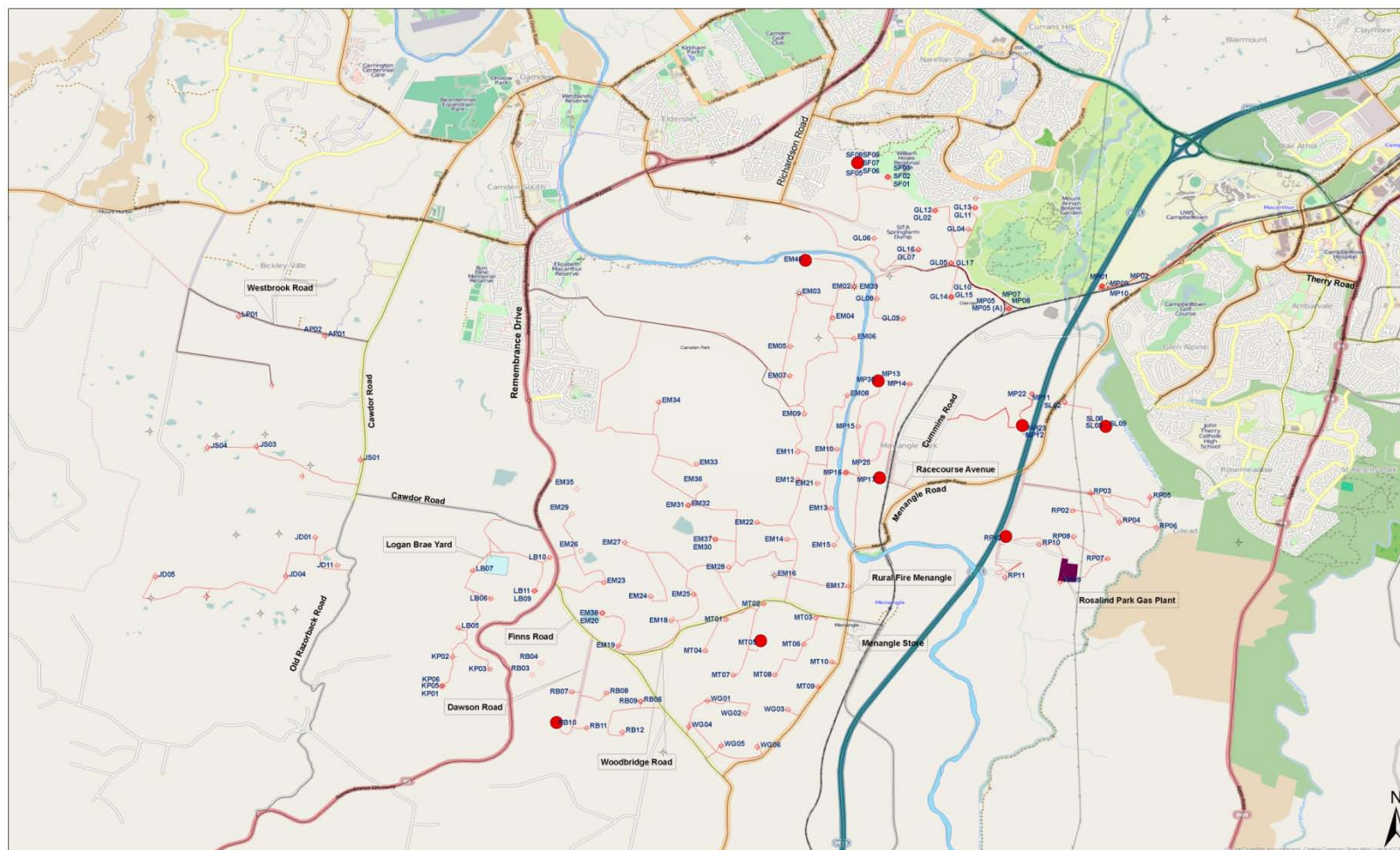
			Monitoring point	8	9	10	11	12	13	14	15
			Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
Metals	Vanadium (Filtered)	mg/L	0.01			<0.10			<0.01		
	Zinc (Filtered)	mg/L	0.005			<0.050			0.009		
Other	Bromine (Filtered)	mg/L	0.1			<1.0			1.2		
	Fluoride	mg/L	0.1			1.2			1.8		
	Iodine (Filtered)	mg/L	0.1			<1.0			<0.1		
	Sulphate (Filtered)	mg/L	1			<10			<1		
Inorganics	Ammonia as N	mg/L	0.01			4.74			12.7		
	Nitrate (as N)	mg/L	0.01			<0.01			0.04		
	Nitrite (as N)	mg/L	0.01			<0.01			<0.01		
	Nitrogen (Total Oxidised)	mg/L	0.01			<0.01			0.04		
	Reactive Phosphorus as P	mg/L	0.01			0.10			0.08		
	Silica as SiO2 (Filtered)	mg/L	0.1			16.4			12.2		
	Hardness as CaCO3 (Filtered)	mg/L	1			33			22		
	Methane	mg/L	0.01			0.331			0.253		
PAH/Phenols	2,4-dimethylphenol	mg/L	0.001			<0.001			<0.001		
	2-methylphenol	mg/L	0.001			<0.001			<0.001		
	2-nitrophenol	mg/L	0.001			<0.001			<0.001		
	3-&4-methylphenol	mg/L	0.002			<0.002			<0.002		
	4-chloro-3-methylphenol	mg/L	0.001			<0.001			<0.001		





			Monitoring point	8	9	10	11	12	13	14	15
			Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
PAH/Phenols	Acenaphthene	mg/L	0.001			<0.001			<0.001		
	Acenaphthylene	mg/L	0.001			<0.001			<0.001		
	Anthracene	mg/L	0.001			<0.001			<0.001		
	Benz(a)anthracene	mg/L	0.001			<0.001			<0.001		
	Benzo(a) pyrene	mg/L	0.0005			<0.0005			<0.0005		
	Benzo(b)fluoranthene	mg/L	0.001			<0.001			<0.001		
	Benzo(g,h,i)perylene	mg/L	0.001			<0.001			<0.001		
	Benzo(k)fluoranthene	mg/L	0.001			<0.001			<0.001		
	Chrysene	mg/L	0.001			<0.001			<0.001		
	Dibenz(a,h)anthracene	mg/L	0.001			<0.001			<0.001		
	Fluoranthene	mg/L	0.001			<0.001			<0.001		
	Fluorene	mg/L	0.001			<0.001			<0.001		
	Indeno(1,2,3-c,d)pyrene	mg/L	0.001			<0.001			<0.001		
	Naphthalene	mg/L	0.001			<0.001			<0.001		
	PAHs (Sum of total)	mg/L	0.0005			<0.0005			<0.0005		
Phenanthrene	mg/L	0.001			<0.001			<0.001			
Phenol	mg/L	0.001			<0.001			<0.001			
Pyrene	mg/L	0.001			<0.001			<0.001			
Halogenated Phenols	2,4,5-trichlorophenol	mg/L	0.001			<0.001			<0.001		



			Monitoring point	8	9	10	11	12	13	14	15
			Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
Halogenated Phenols	2,4,6-trichlorophenol	mg/L	0.001			<0.001			<0.001		
	2,4-dichlorophenol	mg/L	0.001			<0.001			<0.001		
	2,6-dichlorophenol	mg/L	0.001			<0.001			<0.001		
	2-chlorophenol	mg/L	0.001			<0.001			<0.001		
	Pentachlorophenol	mg/L	0.002			<0.002			<0.002		
TPH	C6 - C9	mg/L	0.02			<0.02			<0.1		
	C10 - C14	mg/L	0.05			<0.05			1.97		
	C15 - C28	mg/L	0.1			1.02			7.78		
	C29-C36	mg/L	0.05			0.5			0.28		
	+C10 - C36 (Sum of total)	mg/L	0.05			1.52			10		
BTEX	Benzene	mg/L	0.001			<0.001			<0.005		
	Ethylbenzene	mg/L	0.002			<0.002			<0.005		
	Toluene	mg/L	0.002			<0.002			0.005		
	Total BTEX	mg/L	0.001			<0.001			0.005		
	Xylene (m & p)	mg/L	0.002			<0.002			<0.005		
	Xylene (o)	mg/L	0.002			<0.002			<0.005		
	Xylene Total	mg/L	0.002			<0.002			<0.005		



 	Author: Upstream Gas	Camden Gas Project Produced Water Monitoring Network Kilometres 0 1 2 Scale 1:25,500@A1	Legend ● Produced Water Monitoring Site ○ Wells — Public Roads — Hume Highway — Emergency Road Not for Public Use	— Private Roads — Nepean River — Railway — Logan Brae Yard ■ RGP
	Date: 5/6/2013		Figure 1	
	Ref: 3091			

Disclaimer: While AGL has taken great care and attention to ensure the accuracy of the data represented on this map, no liability shall be accepted for any errors or omissions. No part of this map may be reproduced without prior permission of AGL.

Figure 1- CGP and produced water monitoring locations as listed in EPL12003 (CSG wells)

References

AGL, 2012. Groundwater Management Plan. AGL document. Last revised November 2012. Available online:

<http://www.agl.com.au/~ /media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Camden/Assessments%20and%20Reports/2012/November/Groundwater%20Management%20Plan%20for%20the%20Camden%20Gas%20Project%20%20%20Nov%202012.pdf>

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