

The logo consists of the text "Energy in action.™" in a blue sans-serif font, positioned within a large, light brown rounded rectangle. Below this rectangle are three smaller, light brown rounded rectangles of varying sizes, arranged in a descending staircase pattern from left to right.

Energy in
action.™

The AGL logo features a blue square containing a white stylized sunburst icon to the left of the letters "AGL" in white, bold, sans-serif font.

AGL

AGL UPSTREAM INVESTMENTS PTY LTD
CAMDEN GAS PROJECT

Quarterly Produced Water Quality Monitoring Report

Reporting Period: FY15, 1st Quarter – July / September 2014

AGL Upstream Investments Pty Ltd

ABN 58 115 063 744

Locked Bag 1837, St Leonards NSW 2065

Level 22, 101 Miller Street, North Sydney NSW 2060

Telephone: 02 9921 2999 Facsimile: 02 9921 2474

Complaints Line (24 hours): 02 9963 1318

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 – July / September 2014 (13-14 th August 2014)
MONITORING BY	AGL
ANALYSIS BY	ALS Laboratory, Smithfield (Work order number: ES1418047)
DATE DATA OBTAINED	22 August 2014
REPORT DATE	9 September 2014
REPORT PREPARED BY	Nicola Fry, Hydrogeologist
REPORT REVIEWED BY	Aaron Clifton, Environment Manager Jenny MacMahon, Head of Environment, Upstream Gas

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 megalitres (ML) per year for the existing CGP and associated dewatering activities from the coal seams. In the 2013-14 financial year, approximately 3.6 ML of water was produced from the coal seams for the entire Camden Gas Project operating wellfield.

This Monitoring Report relates to the groundwater monitoring activities specified in Part 5, Monitoring and Recording Conditions, of the Environment Protection Licence 12003. 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*" (EPA, 2004), with the exception of dissolved methane, phenols and PAHs, which were analysed with an alternate method following verbal approval from the EPA on 06 August 2014, and written approval from the EPA (EPA, 2014).

Many of the operating wells within the Camden Gas Project produce very low volumes of water; frequently, there is not enough water present to allow for sampling at these monitoring points. For

the monitoring round in this reporting period (FY15 Q1) only samples from one monitoring point were able to be taken as there was not enough water present to sample at the remaining monitoring points.

This report is prepared in accordance with the *Requirements for Publishing Pollution Monitoring Data* (EPA, 2013) (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 noted that the result obtained from this monitoring round (FY15 Q1) is a typical value of electrical conductivity for produced water in the Camden Gas Project. 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	Easting (m)	Northing (m)
8	EM40	290847.38	6226891.16
9	SF08	291443.09	6228310.08
10	RB10	288211.17	6219746.92
11	MT05	290356.75	6221081.15
12	MP12	293574.90	6224380.09
13	MP30	291760.40	6225066.50
14	RP12	293397.37	6222719.00
15	SL03	294583.77	6224486.19

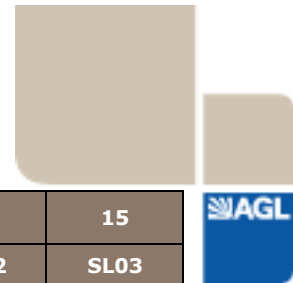
Coordinate reference system: Map Grid of Australia 1994 Zone 56

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 centimetre	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 – July/September 2014



				Monitoring point	8	9	10	11	12	13	14	15
				Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
				Sampled Date	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	13/08/2014	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (14/8/2014)
				Data obtained	na	na	22/08/2014	na	na	na	na	na
Analyte	Units	Limit of reporting	8	9	10	11	12	13	14	15		
Physical	Electrical Conductivity @ 25°C	µS/cm	1	-	-	11700	-	-	-	-		
	Total Dissolved Solids @180°C	mg/L	10	-	-	7580	-	-	-	-		
Major Cations	Calcium	mg/L	1	-	-	7	-	-	-	-		
	Magnesium	mg/L	1	-	-	9	-	-	-	-		
	Potassium	mg/L	1	-	-	29	-	-	-	-		
	Sodium	mg/L	1	-	-	2940	-	-	-	-		
	Total Cations	meq/L	0.01	-	-	130	-	-	-	-		
Major Anions	Bicarbonate Alkalinity as CaCO3	mg/L	1	-	-	6550	-	-	-	-		
	Carbonate Alkalinity as CaCO3	mg/L	1	-	-	300	-	-	-	-		
	Hydroxide Alkalinity as CaCO3	mg/L	1	-	-	<1	-	-	-	-		
	Total Alkalinity as CaCO3	mg/L	1	-	-	6850	-	-	-	-		
	Chloride	mg/L	0.1	-	-	128	-	-	-	-		
	Total Anions	meq/L	0.01	-	-	140	-	-	-	-		
	Ionic Balance	%	0.01	-	-	4.05	-	-	-	-		
Metals (dissolved)	Aluminium	mg/L	0.01	-	-	0.03	-	-	-	-		
	Arsenic	mg/L	0.001	-	-	0.004	-	-	-	-		
	Barium	mg/L	0.001	-	-	9.96	-	-	-	-		
	Beryllium	mg/L	0.001	-	-	<0.001	-	-	-	-		
	Boron	mg/L	0.05	-	-	0.08	-	-	-	-		
	Cadmium	mg/L	0.0001	-	-	<0.0001	-	-	-	-		



Monitoring point	8	9	10	11	12	13	14	15
Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
Sampled Date	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	13/08/2014	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (14/8/2014)
Data obtained	na	na	22/08/2014	na	na	na	na	na

	Analyte	Units	Limit of reporting							
	Chromium	mg/L	0.001	-	-	0.014	-	-	-	-
	Cobalt	mg/L	0.001	-	-	<0.001	-	-	-	-
	Copper	mg/L	0.001	-	-	<0.001	-	-	-	-
	Iron	mg/L	0.05	-	-	1.10	-	-	-	-
	Lead	mg/L	0.001	-	-	<0.001	-	-	-	-
	Manganese	mg/L	0.001	-	-	0.005	-	-	-	-
	Mercury	mg/L	0.0001	-	-	<0.0001	-	-	-	-
	Molybdenum	mg/L	0.001	-	-	0.005	-	-	-	-
	Nickel	mg/L	0.001	-	-	0.002	-	-	-	-
	Selenium	mg/L	0.01	-	-	<0.01	-	-	-	-
	Strontium	mg/L	0.001	-	-	3.37	-	-	-	-
	Uranium	mg/L	0.001	-	-	<0.001	-	-	-	-
	Vanadium	mg/L	0.01	-	-	<0.01	-	-	-	-
	Zinc	mg/L	0.005	-	-	0.018	-	-	-	-
Other	Bromide	mg/L	0.01	-	-	0.714	-	-	-	-
	Fluoride	mg/L	0.01	-	-	0.176	-	-	-	-
	Sulfate	mg/L	0.1	-	-	0.111	-	-	-	-
	Silicon as SiO2	mg/L	0.1	-	-	14.7	-	-	-	-
	Methane	mg/L	0.01	-	-	2.10	-	-	-	-
Nutrients	Ammonia as N	mg/L	0.01	-	-	4.57	-	-	-	-
	Nitrate as N	mg/L	0.01	-	-	0.02	-	-	-	-
	Nitrite as N	mg/L	0.01	-	-	<0.01	-	-	-	-
	Reactive Phosphorus as P	mg/L	0.01	-	-	0.15	-	-	-	-
Phenols	Phenol	mg/L	0.001	-	-	<0.001	-	-	-	-



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Data obtained	na	na	22/08/2014	na	na	na	na	na

	Analyte	Units	Limit of reporting							
	2-Chlorophenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	2-Methylphenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	3- & 4-Methylphenol	mg/L	0.002	-	-	<0.002	-	-	-	-
	2-Nitrophenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	2.4-Dimethylphenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	2.4-Dichlorophenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	2.6-Dichlorophenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	4-Chloro-3-methylphenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	2.4.6-Trichlorophenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	2.4.5-Trichlorophenol	mg/L	0.001	-	-	<0.001	-	-	-	-
	Pentachlorophenol	mg/L	0.002	-	-	<0.002	-	-	-	-
PAH	Naphthalene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Acenaphthylene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Acenaphthene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Fluorene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Phenanthrene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Anthracene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Fluoranthene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Pyrene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Benz(a)anthracene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Chrysene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Benzo(b+j)fluoranthene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Benzo(k)fluoranthene	mg/L	0.001	-	-	<0.001	-	-	-	-
Benzo(a)pyrene	mg/L	0.0005	-	-	<0.0005	-	-	-	-	



Monitoring point	8	9	10	11	12	13	14	15
Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
Sampled Date	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	13/08/2014	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (13/8/2014)	Not enough water to sample (14/8/2014)
Data obtained	na	na	22/08/2014	na	na	na	na	na

	Analyte	Units	Limit of reporting							
	Indeno(1.2.3.cd)pyrene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Dibenz(a.h)anthracene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Benzo(g.h.i)perylene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Sum of polycyclic aromatic hydrocarbons	mg/L	0.0005	-	-	<0.0005	-	-	-	-
	Benzo(a)pyrene TEQ (zero)	mg/L	0.0005	-	-	<0.0005	-	-	-	-
BTEX	Benzene	mg/L	0.001	-	-	<0.001	-	-	-	-
	Toluene	mg/L	0.002	-	-	<0.002	-	-	-	-
	Ethylbenzene	mg/L	0.002	-	-	<0.002	-	-	-	-
	meta- & para-Xylene	mg/L	0.002	-	-	<0.002	-	-	-	-
	ortho-Xylene	mg/L	0.002	-	-	<0.002	-	-	-	-
	Total Xylenes	mg/L	0.002	-	-	<0.002	-	-	-	-
	Sum of BTEX	mg/L	0.001	-	-	<0.001	-	-	-	-
TPH	C6 - C9 Fraction	mg/L	0.020	-	-	<0.020	-	-	-	-
	C10 - C14 Fraction	mg/L	0.050	-	-	<0.050	-	-	-	-
	C15 - C28 Fraction	mg/L	0.100	-	-	0.660	-	-	-	-
	C29 - C36 Fraction	mg/L	0.050	-	-	0.140	-	-	-	-
	C10 - C36 Fraction (sum)	mg/L	0.050	-	-	0.800	-	-	-	-

- not analysed

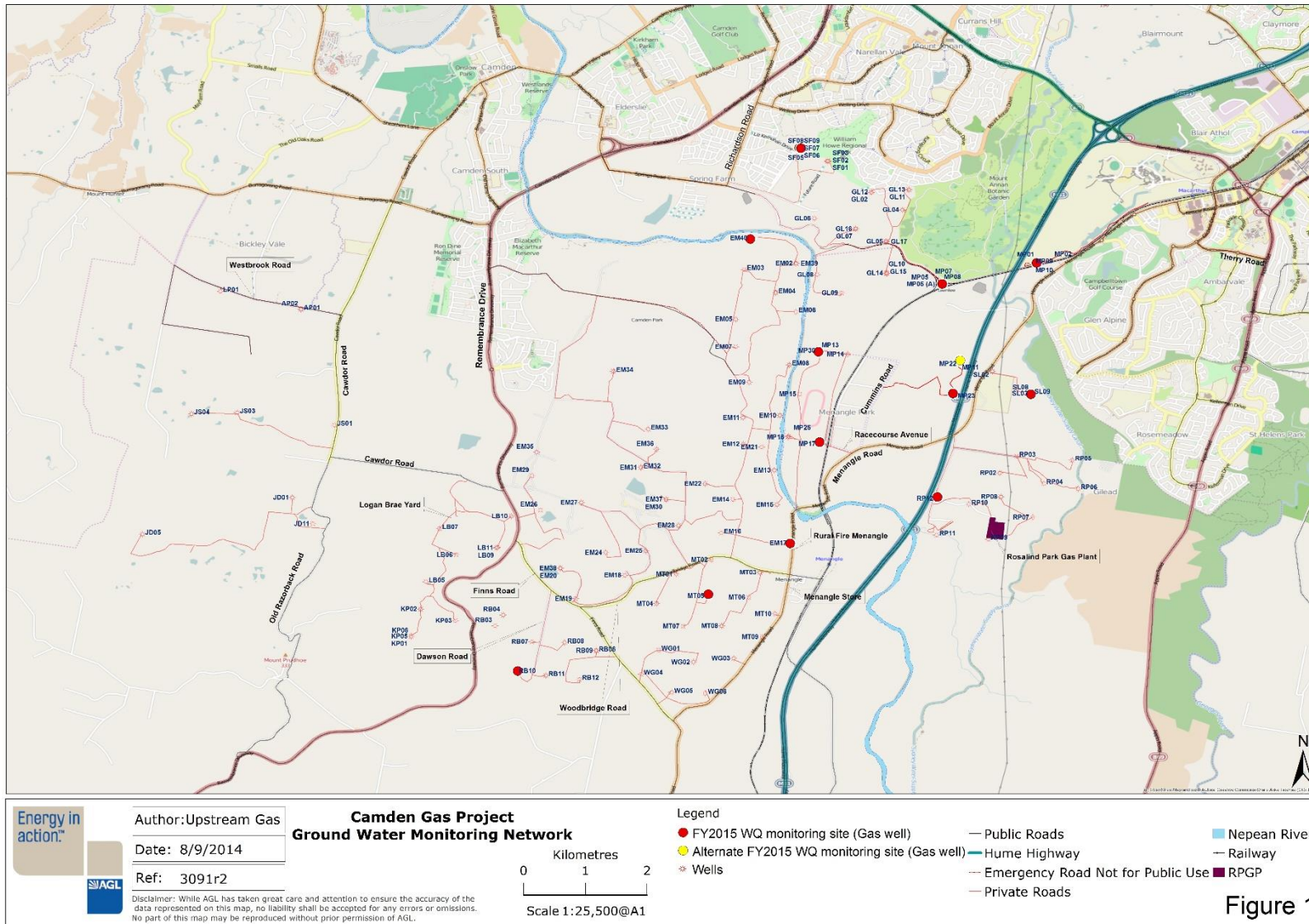


Figure 1- CGP and produced water monitoring locations as listed in EPL12003 (CSG wells)

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