

The logo consists of the text "Energy in action.™" in a blue, sans-serif font, positioned within a large, light brown, rounded rectangular shape. Below this main shape are three smaller, light brown rectangular shapes of varying sizes, arranged in a descending staircase pattern from left to right. At the bottom right of these shapes is the AGL logo, which features a blue square with a white sunburst icon and the letters "AGL" in white.The AGL logo is a blue square containing a white sunburst icon to the left of the letters "AGL" in white, sans-serif font.

# AGL UPSTREAM INVESTMENTS PTY LTD

## CAMDEN GAS PROJECT

### **Quarterly Produced Water Quality Monitoring Report**

Reporting Period: FY15, 4<sup>th</sup> Quarter – April / June 2015

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## Foreword

<b>PREMISES</b>	Rosalind Park Gas Plant Lot 35 Medhurst Road GILEAD NSW 2560
<b>LICENCE DETAILS</b>	<a href="#"><u>Environment Protection Licence 12003</u></a>
<b>LICENCEE</b>	AGL Upstream Investments Pty Limited (AGL)
<b>LICENCEE'S ADDRESS</b>	Locked Bag 1837, North Sydney, NSW 2060
<b>MONITORING DATE</b>	4 <sup>th</sup> Quarter – April/June 2015 (4 May 2015)
<b>MONITORING BY</b>	AGL
<b>ANALYSIS BY</b>	ALS Laboratory, Smithfield (Work order number: ES1521163)
<b>DATE DATA OBTAINED</b>	12 May 2015
<b>REPORT DATE</b>	26 May 2015
<b>REPORT PREPARED BY</b>	N. Fry, Hydrogeologist
<b>REPORT REVIEWED BY</b>	A. Clifton, NSW Environment Manager J. 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 written approval from the EPA (EPA, 2014) (refer to Table 2 for analytical methodology).

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 event in this reporting period (FY15 Q4) 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 the 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 event (FY15 Q4) is a typical value of electrical conductivity for produced water in the CGP.

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](http://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, frequency (as per EPL 12003) and methodology**

Analyte	Units of measure	Frequency	Sampling Method	Analytical method
<b>Aluminium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Ammonia</b>	milligrams per litre	Yearly	Grab sample	APHA (1998) section 4500-NH3
<b>Arsenic</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Barium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Benzene</b>	milligrams per litre	Yearly	Grab sample	USEPA (1996b) method 8260B
<b>Beryllium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Bicarbonate</b>	milligrams per litre	Quarterly	Grab sample	APHA (1998) 2320
<b>Boron</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Bromide</b>	milligrams per litre	Quarterly	Grab sample	APHA (1998) section 4110
<b>Cadmium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Calcium</b>	milligrams per litre	Quarterly	Grab sample	APHA (1998) section 3030B then APHA (1998) section 3120
<b>Carbonate</b>	milligrams per litre	Quarterly	Grab sample	APHA (2012) 2320B
<b>Chloride</b>	milligrams per litre	Quarterly	Grab sample	APHA (1998) section 4110
<b>Chromium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Cobalt</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Copper</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Electrical conductivity</b>	microsiemens per centimetre	Quarterly	Grab sample	APHA (1998) section 2510 B
<b>Ethyl benzene</b>	milligrams per litre	Yearly	Grab sample	USEPA (1996b) method 8260B
<b>Fluoride</b>	milligrams per litre	Quarterly	Grab sample	APHA (1998) section 4500-F- C
<b>Iron</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Lead</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Magnesium</b>	milligrams per litre	Quarterly	Grab sample	APHA (1998) section 3030B then APHA (1998) section 3120
<b>Manganese</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Mercury</b>	milligrams per litre	Quarterly	Grab sample	Preliminary treatment APHA (1998) section 3030B; Then APHA (1998) section 3112
<b>Methane</b>	milligrams per litre	Yearly	Grab sample	In house static headspace GC/FID technique
<b>Molybdenum</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Nickel</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Nitrate</b>	milligrams per litre	Yearly	Grab sample	APHA (1998) section 4500-NO3-F
<b>Nitrite</b>	milligrams per litre	Yearly	Grab sample	APHA (1998) section 4500-NO3-F (with cadmium column removed)
<b>Phenols</b>	milligrams per litre	Yearly	Grab sample	USEPA (1996a) method 8270 D
<b>Polycyclic aromatic hydrocarbons</b>	milligrams per litre	Yearly	Grab sample	USEPA (1996a) method 8270 D
<b>Potassium</b>	milligrams per litre	Quarterly	Grab sample	Preliminary treatment APHA (1998) section 3030B then APHA (1998) section 3120

Analyte	Units of measure	Frequency	Sampling Method	Analytical method
<b>Reactive Phosphorus</b>	milligrams per litre	Yearly	Grab sample	APHA (1998) section 4500-P B; followed by APHA (1998) section 4500-P E
<b>Selenium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Silica</b>	milligrams per litre	Quarterly	Grab sample	APHA 21st ed., 3120
<b>Sodium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Strontium (dissolved)</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3030(E-K) then USEPA (1994f) method 6020
<b>Sulfate</b>	milligrams per litre	Quarterly	Grab sample	APHA(1998) section 4500 SO42--E
<b>Toluene</b>	milligrams per litre	Yearly	Grab sample	USEPA (1996b) method 8260B
<b>Total dissolved solids</b>	milligrams per litre	Quarterly	Grab sample	APHA (1998) section 2540C
<b>Total petroleum hydrocarbons</b>	milligrams per litre	Yearly	Grab sample	USEPA (1996h) method 8015B
<b>Uranium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Vanadium</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
<b>Xylene</b>	milligrams per litre	Yearly	Grab sample	USEPA (1996b) method 8260B
<b>Zinc</b>	milligrams per litre	Quarterly	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020

# Groundwater Monitoring Results

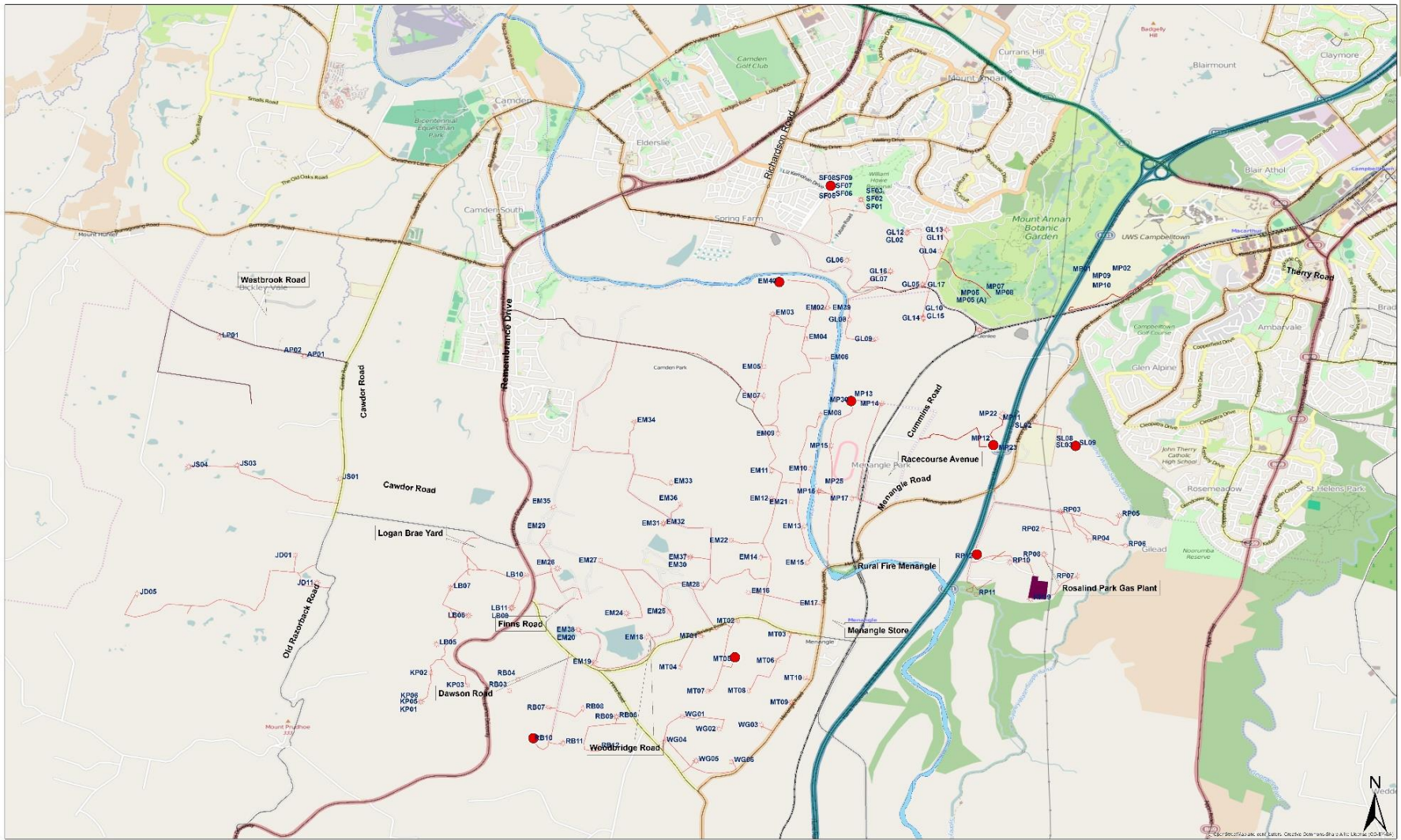
Table 3 - Produced water monitoring results for 4<sup>th</sup> Quarter – April/June 2015


			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 (4/5/2015)	Not enough water to sample (4/5/2015)	4/5/2015	Not enough water to sample (4/5/2015)	Not enough water to sample (4/5/2015)	Not enough water to sample (4/5/2015)	Not enough water to sample (4/5/2015)	Not enough water to sample (4/5/2015)
			Data obtained	na	na	12/5/2015	na	na	na	na	na
	Analyte	Units	Limit of reporting								
Physicochemical	Electrical Conductivity @ 25°C	µS/cm	1	-	-	11500	-	-	-	-	-
	Total Dissolved Solids @ 180°C	mg/L	10	-	-	8290	-	-	-	-	-
Major Cations	Calcium	mg/L	1	-	-	23	-	-	-	-	-
	Magnesium	mg/L	1	-	-	8	-	-	-	-	-
	Potassium	mg/L	1	-	-	24	-	-	-	-	-
	Sodium	mg/L	1	-	-	3510	-	-	-	-	-
Major Anions	Bicarbonate Alkalinity as CaCO3	mg/L	1	-	-	6920	-	-	-	-	-
	Carbonate Alkalinity as CaCO3	mg/L	1	-	-	500	-	-	-	-	-
	Hydroxide Alkalinity as CaCO3	mg/L	1	-	-	<1	-	-	-	-	-
	Total Alkalinity as CaCO3	mg/L	1	-	-	7420	-	-	-	-	-
	Chloride	mg/L	0.1	-	-	134	-	-	-	-	-
Metals (dissolved)	Aluminium	mg/L	0.01	-	-	<0.10	-	-	-	-	-
	Arsenic	mg/L	0.001	-	-	<0.010	-	-	-	-	-
	Barium	mg/L	0.001	-	-	9.58	-	-	-	-	-
	Beryllium	mg/L	0.001	-	-	<0.010	-	-	-	-	-

			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 (4/5/2015)	Not enough water to sample (4/5/2015)	4/5/2015	Not enough water to sample (4/5/2015)	Not enough water to sample (4/5/2015)	Not enough water to sample (4/5/2015)	Not enough water to sample (4/5/2015)	Not enough water to sample (4/5/2015)
			Data obtained	na	na	12/5/2015	na	na	na	na	na
Analyte	Units	Limit of reporting									
<b>Boron</b>	mg/L	0.05	-	-	0.34	-	-	-	-	-	-
<b>Cadmium</b>	mg/L	0.0001	-	-	<0.0010	-	-	-	-	-	-
<b>Chromium</b>	mg/L	0.001	-	-	<0.010	-	-	-	-	-	-
<b>Cobalt</b>	mg/L	0.001	-	-	<0.010	-	-	-	-	-	-
<b>Copper</b>	mg/L	0.001	-	-	<0.010	-	-	-	-	-	-
<b>Iron</b>	mg/L	0.05	-	-	0.82	-	-	-	-	-	-
<b>Lead</b>	mg/L	0.001	-	-	<0.010	-	-	-	-	-	-
<b>Manganese</b>	mg/L	0.001	-	-	<0.010	-	-	-	-	-	-
<b>Mercury</b>	mg/L	0.0001	-	-	<0.0001	-	-	-	-	-	-
<b>Molybdenum</b>	mg/L	0.001	-	-	<0.010	-	-	-	-	-	-
<b>Nickel</b>	mg/L	0.001	-	-	<0.010	-	-	-	-	-	-
<b>Selenium</b>	mg/L	0.01	-	-	<0.10	-	-	-	-	-	-
<b>Strontium</b>	mg/L	0.001	-	-	3.00	-	-	-	-	-	-
<b>Uranium</b>	mg/L	0.001	-	-	<0.010	-	-	-	-	-	-
<b>Vanadium</b>	mg/L	0.01	-	-	<0.1	-	-	-	-	-	-
<b>Zinc</b>	mg/L	0.005	-	-	<0.050	-	-	-	-	-	-
<b>Other</b>	<b>Bromide</b>	mg/L	0.010	-	-	0.982	-	-	-	-	-
	<b>Fluoride</b>	mg/L	0.01	-	-	1.5	-	-	-	-	-
	<b>Sulfate</b>	mg/L	0.100	-	-	<0.100	-	-	-	-	-
	<b>Silicon as SiO2</b>	mg/L	0.1	-	-	5.8	-	-	-	-	-

Key:  
- not analysed  
na not applicable





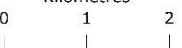


Author: Upstream Gas  
Date: 2/12/2014  
Ref: 3091r3

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.

**Camden Gas Project**  
**Ground Water Monitoring Network**

Kilometres



Scale 1:25,500@A1

**Legend**

- EPL12003 water monitoring point
- \* Wells
- Public Roads
- Emergency Road Not for Public Use
- Private Roads
- Nepean River
- Railway
- RPGP

Figure 1

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



## References

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<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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