



AGL UPSTREAM INVESTMENTS PTY LTD

CAMDEN GAS PROJECT

**Six-Monthly Produced Water Quality Monitoring
Report**

Reporting Period: August 2016

AGL Upstream Investments Pty Ltd

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Foreword

PREMISES	Rosalind Park Gas Plant Lot 35 Medhurst Road GILEAD NSW 2560
LICENCE DETAILS	<u>Environment Protection Licence 12003</u>
LICENCEE	AGL Upstream Investments Pty Limited (AGL)
LICENCEE'S ADDRESS	Locked Bag 1837, North Sydney, NSW 2060
MONITORING DATE	16 August 2016
MONITORING BY	AGL
ANALYSIS BY	ALS Laboratory, Smithfield (Work order number: ES1618068)
DATE DATA OBTAINED	22 August 2016
REPORT DATE	1 September 2016
REPORT PREPARED BY	James Duggleby, Senior Hydrogeologist
REPORT REVIEWED BY	A. Clifton, NSW Environment Manager

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 consists of 144 gas wells, low-pressure underground gas gathering pipes and a gas plant facility. Not all production wells are currently operational and some have been plugged and abandoned. 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 2015-16 financial year, approximately 2.5 ML of water was produced from the coal seams for the entire CGP 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. Analytes with a 'yearly' monitoring frequency are reported in this August 2016 report.

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 (2015). 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 CGP 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 samples from only four monitoring points were able to be taken as there was not enough water present to sample at the remaining monitoring points. Samples were tested for all six monthly and yearly analytes shown in Table 2.

This report (including amendments) is prepared in accordance with the *Requirements for Publishing Pollution Monitoring Data* (EPA, 2013) (Publication Requirements).

Table 3 displays the results of this monitoring round.

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 results obtained from this monitoring event (FY17: August 2016) at monitoring points 10, 11, 12 and 13 (RB10, SL02, MP22, MP07) are typical values of electrical conductivity for produced water within 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

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

EPA monitoring point	Location	Easting (m)	Northing (m)
8	SF07	291438.99	6228305.89
9	SF08	291443.09	6228310.08
10	RB10	287810.84	6219786.79
11	SL02	294099.72	6224788.05
12	MP22	293687.20	6224899.40
13	MP07	293375.45	6226186.09
14	MP02	294535.49	6226548.66
15	MP09	294530.71	6226543.64

Coordinate reference system: Map Grid of Australia 1994 Zone 56

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

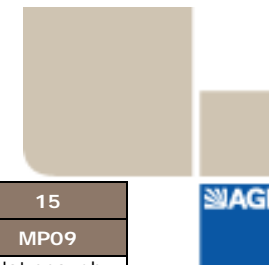
Analyte	Units of measure	Frequency	Sampling Method	Analytical method
Aluminium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Ammonia	milligrams per litre	Yearly	Grab sample	APHA (1998) section 4500-NH3
Arsenic	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Barium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Benzene	milligrams per litre	Yearly	Grab sample	USEPA (1996b) method 8260B
Beryllium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Bicarbonate	milligrams per litre	Every 6 months	Grab sample	APHA (1998) 2320
Boron	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Bromide	milligrams per litre	Every 6 months	Grab sample	APHA (1998) section 4110
Cadmium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Calcium	milligrams per litre	Every 6 months	Grab sample	APHA (1998) section 3030B then APHA (1998) section 3120
Carbonate	milligrams per litre	Every 6 months	Grab sample	APHA (2012) 2320B
Chloride	milligrams per litre	Every 6 months	Grab sample	APHA (1998) section 4110
Chromium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Cobalt	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Copper	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Electrical conductivity	microsiemens per centimetre	Every 6 months	Grab sample	APHA (1998) section 2510 B
Ethyl benzene	milligrams per litre	Yearly	Grab sample	USEPA (1996b) method 8260B
Fluoride	milligrams per litre	Every 6 months	Grab sample	APHA (1998) section 4500-F- C
Iron	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Lead	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Magnesium	milligrams per litre	Every 6 months	Grab sample	APHA (1998) section 3030B then APHA (1998) section 3120
Manganese	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Mercury	milligrams per litre	Every 6 months	Grab sample	Preliminary treatment APHA (1998) section 3030B; Then APHA (1998) section 3112
Methane	milligrams per litre	Yearly	Grab sample	In house static headspace GC/FID technique
Molybdenum	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Nickel	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Nitrate	milligrams per litre	Yearly	Grab sample	APHA (1998) section 4500-NO3-F
Nitrite	milligrams per litre	Yearly	Grab sample	APHA (1998) section 4500-NO3-F (with cadmium column removed)
Phenols	milligrams per litre	Yearly	Grab sample	USEPA (1996a) method 8270 D
Polycyclic aromatic hydrocarbons	milligrams per litre	Yearly	Grab sample	USEPA (1996a) method 8270 D
Potassium	milligrams per litre	Every 6 months	Grab sample	Preliminary treatment APHA (1998) section 3030B then APHA (1998) section 3120
Reactive Phosphorus	milligrams per litre	Yearly	Grab sample	APHA (1998) section 4500-P B; followed by APHA (1998) section 4500-P E
Selenium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Silica	milligrams per litre	Every 6 months	Grab sample	APHA 21st ed., 3120
Sodium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Strontium (dissolved)	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3030(E-K) then USEPA (1994f) method 6020

Analyte	Units of measure	Frequency	Sampling Method	Analytical method
Sulfate	milligrams per litre	Every 6 months	Grab sample	APHA(1998) section 4500 SO42--E
Toluene	milligrams per litre	Yearly	Grab sample	USEPA (1996b) method 8260B
Total dissolved solids	milligrams per litre	Every 6 months	Grab sample	APHA (1998) section 2540C
Total petroleum hydrocarbons	milligrams per litre	Yearly	Grab sample	USEPA (1996h) method 8015B
Uranium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Vanadium	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020
Xylene	milligrams per litre	Yearly	Grab sample	USEPA (1996b) method 8260B
Zinc	milligrams per litre	Every 6 months	Grab sample	USEPA (1992a) method 3005A then USEPA (1994f) method 6020

Groundwater Monitoring Results

Table 3 - Produced water monitoring results: August 2016

		Monitoring point	8	9	10	11	12	13	14	15
		Location	SF07	SF08	RB10	SLO2	MP22	MP07	MP02	MP09
		Sampled Date	Not enough water to sample (16/8/2016)	Not enough water to sample (16/8/2016)	16/8/2016	16/8/2016	16/8/2016	16/8/2016	Not enough water to sample (16/8/2016)	Not enough water to sample (16/8/2016)
		Data obtained	na	na	22/8/2016	22/8/2016	22/8/2016	22/8/2016	na	na
Analyte	Units	Limit of reporting								
Aluminium	mg/L	0.01	-	-	<0.10	0.01	<0.10	<0.10	-	-
Ammonia	mg/L	0.01	-	-	4.80	6.73	6.79	6.86	-	-
Arsenic	mg/L	0.001	-	-	<0.010	<0.001	<0.010	<0.010	-	-
Barium	mg/L	0.001	-	-	4.910	5.620	11.600	22.000	-	-
Benzene	mg/L	0.001	-	-	<0.001	<0.001	<0.001	<0.001	-	-
Beryllium	mg/L	0.001	-	-	<0.010	<0.001	<0.010	<0.010	-	-
Bicarbonate	mg/L	1	-	-	8080	4660	8580	9310	-	-
Boron	mg/L	0.05	-	-	<0.10	0.16	<0.10	0.16	-	-
Bromide	mg/L	0.01	-	-	<0.50	<0.50	0.85	0.77	-	-
Cadmium	mg/L	0.0001	-	-	<0.0010	<0.0001	<0.0010	<0.0010	-	-
Calcium	mg/L	1	-	-	10	16	30	30	-	-
Carbonate	mg/L	1	-	-	<1	<1	<1	<1	-	-
Chloride	mg/L	0.1	-	-	111	433	485	490	-	-
Chromium	mg/L	0.001	-	-	<0.010	<0.001	<0.010	<0.010	-	-
Cobalt	mg/L	0.001	-	-	<0.010	<0.001	<0.010	<0.010	-	-
Copper	mg/L	0.001	-	-	<0.010	<0.001	<0.010	<0.010	-	-
Electrical conductivity	µS/cm	1	-	-	11900	8120	13900	14600	-	-
Ethyl benzene	mg/L	0.002	-	-	<0.002	<0.002	<0.002	<0.002	-	-
Fluoride	mg/L	0.1	-	-	1.5	0.9	0.9	1.5	-	-
Iron	mg/L	0.05	-	-	1.50	0.10	2.77	0.36	-	-
Lead	mg/L	0.001	-	-	<0.010	<0.001	<0.010	<0.010	-	-
Magnesium	mg/L	1	-	-	5	4	12	6	-	-
Manganese	mg/L	0.001	-	-	<0.010	0.005	<0.010	<0.010	-	-
Mercury	mg/L	0.0001	-	-	<0.0001	<0.0001	<0.0001	<0.0001	-	-



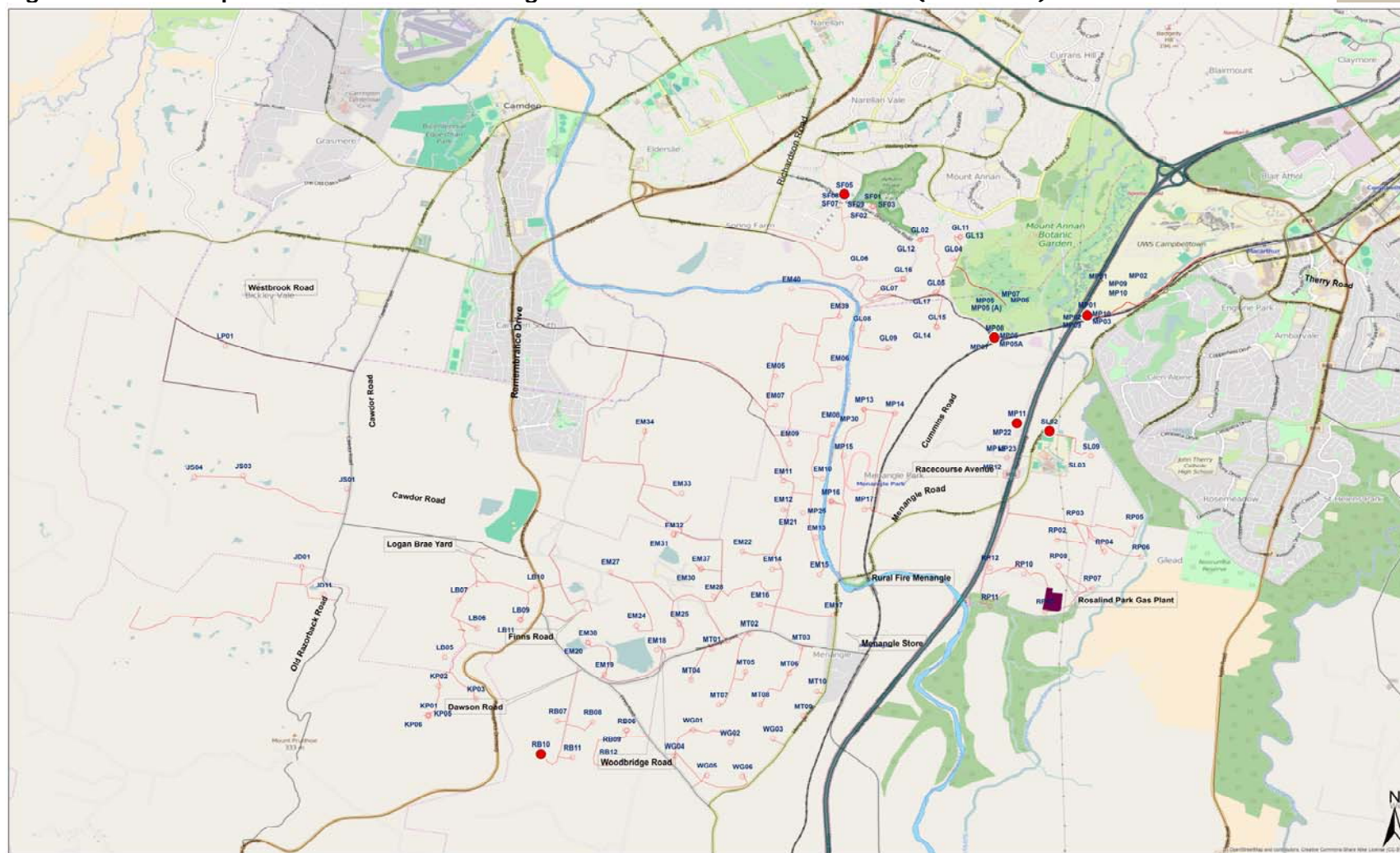


Monitoring point	8	9	10	11	12	13	14	15
Location	SF07	SF08	RB10	SL02	MP22	MP07	MP02	MP09
Sampled Date	Not enough water to sample (16/8/2016)	Not enough water to sample (16/8/2016)	16/8/2016	16/8/2016	16/8/2016	16/8/2016	Not enough water to sample (16/8/2016)	Not enough water to sample (16/8/2016)
Data obtained	na	na	22/8/2016	22/8/2016	22/8/2016	22/8/2016	na	na

Analyte	Units	Limit of reporting								
Methane	mg/L	0.01	-	-	7.78	2.45	2.27	1.06	-	-
Molybdenum	mg/L	0.001	-	-	0.013	0.002	<0.010	<0.010	-	-
Nickel	mg/L	0.001	-	-	<0.010	<0.001	<0.010	<0.010	-	-
Nitrate	mg/L	0.01	-	-	0.05	<0.10	0.12	0.50	-	-
Nitrite	mg/L	0.01	-	-	0.04	<0.10	0.05	0.30	-	-
Phenols	mg/L	0.001	-	-	<0.001	<0.001	<0.001	<0.001	-	-
Polycyclic aromatic hydrocarbons	mg/L	0.0005	-	-	<0.0005	<0.0005	0.0059	<0.0005	-	-
Potassium	mg/L	1	-	-	27	8	20	13	-	-
Reactive Phosphorus	mg/L	0.01	-	-	0.11	0.10	0.69	0.85	-	-
Selenium	mg/L	0.01	-	-	<0.10	<0.01	<0.10	<0.10	-	-
Silica	mg/L	0.1	-	-	13.6	17.4	17.6	15.9	-	-
Sodium	mg/L	1	-	-	3890	2360	4480	4320	-	-
Strontium (dissolved)	mg/L	0.001	-	-	1.590	3.010	5.250	6.140	-	-
Sulfate	mg/L	1	-	-	<1	<10	<1	<1	-	-
Toluene	mg/L	0.002	-	-	<0.002	<0.002	<0.002	<0.002	-	-
Total dissolved solids	mg/L	10	-	-	7090	4810	7520	8930	-	-
Total petroleum hydrocarbons	mg/L	0.05	-	-	1.26	<0.05	0.22	<0.05	-	-
Uranium	mg/L	0.001	-	-	<0.010	<0.001	<0.010	<0.010	-	-
Vanadium	mg/L	0.01	-	-	<0.10	<0.01	<0.10	<0.10	-	-
Xylene	mg/L	0.002	-	-	<0.002	<0.002	<0.002	<0.002	-	-
Zinc	mg/L	0.005	-	-	<0.050	<0.005	<0.050	<0.050	-	-

Key:
 - not analysed
 na not applicable

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



Energy in action.



Author: Upstream Gas
 Date: 31/08/2016
 Ref: 3091r5

**Camden Gas Project
 Ground Water Monitoring Network**

Kilometres
 0 1 2
 Scale 1:25,500@A1

Legend

- EPL monitoring point (gas well)
- Wells
- Public Roads
- Hume Highway
- Emergency Road Not for Public Use
- Private Roads
- Nepean River
- RGP

References

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