AGL UPSTREAM INVESTMENTS PTY LTD

CAMDEN GAS PROJECT

Six-Monthly Produced Water Quality Monitoring Report

Reporting Period: August 2017

AGL Upstream Investments Pty Ltd
ABN 58 115 063 744
Locked Bag 1837, St Leonards NSW 2065
200 George Street, Sydney NSW 2000
Telephone: 02 9921 2999 Facsimile: 02 9921 2474
Complaints Line (24 hours): 1300 799 716

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	25 August 2017
MONITORING BY	AGL
ANALYSIS BY	ALS Laboratory, Smithfield (Work order number: ES1721262)
DATE DATA OBTAINED	31 August 2017
REPORT DATE	04 September 2017
REPORT PREPARED BY	A. Clifton, NSW Environment Business Partner

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 2016-17 financial year, approximately 1.7 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 2017 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 three 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 μS/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 (FY18: August 2017) at monitoring points 10 and 15 (RB10 and MP09) are typical values of electrical conductivity for produced water within the CGP however monitoring point 11 (SL02) has a very low electrical conductivity value.

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

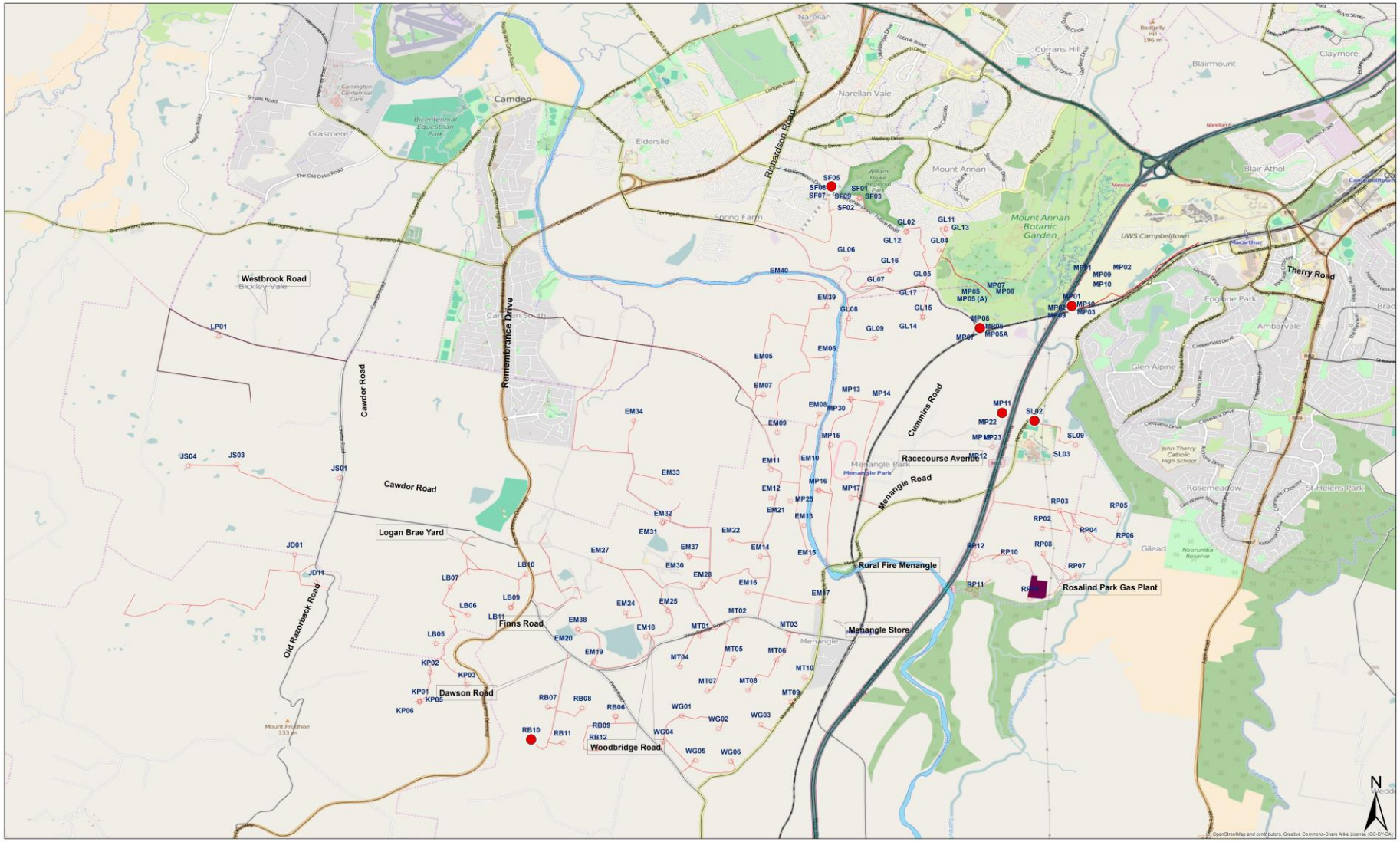
Table 3 - Produced water monitoring results: August 2017

		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 (25/08/2017)	Not enough water to sample (25/08/2017)	25/08/2017	25/08/2017	Not enough water to sample (25/08/2017)	Not enough water to sample (25/08/2017)	Not enough water to sample (25/08/2017)	25/08/2017
		Data obtained	N/A	N/A	31/08/2017	31/08/2017	N/A	N/A	N/A	31/08/2017
Analyte	**Units**	**Limit of reporting**								
Aluminium	mg/L	0.01	-	-	<0.01	0.04	-	-	-	0.13
Ammonia	mg/L	0.01	-	-	4.85	14.2	-	-	-	6.22
Arsenic	mg/L	0.001	-	-	0.003	<0.001	-	-	-	<0.001
Barium	mg/L	0.001	-	-	8.77	0.365	-	-	-	12.2
Benzene	mg/L	0.001	-	-	<0.001	<0.001	-	-	-	<0.001
Beryllium	mg/L	0.001	-	-	<0.001	<0.001	-	-	-	<0.001
Bicarbonate	mg/L	1	-	-	7100	58	-	-	-	7750
Boron	mg/L	0.05	-	-	0.14	<0.05	-	-	-	0.16
Bromide	mg/L	0.01	-	-	0.277	<0.010	-	-	-	1.06
Cadmium	mg/L	0.0001	-	-	<0.0001	<0.0001	-	-	-	<0.0001
Calcium	mg/L	1	-	-	14	2	-	-	-	17
Carbonate	mg/L	1	-	-	<1	<1	-	-	-	<1
Chloride	mg/L	0.1	-	-	136	6.12	-	-	-	609
Chromium	mg/L	0.001	-	-	<0.001	0.002	-	-	-	<0.001
Cobalt	mg/L	0.001	-	-	<0.001	<0.001	-	-	-	<0.001
Copper	mg/L	0.001	-	-	<0.001	0.002	-	-	-	<0.001
Electrical conductivity	µS/cm	1	-	-	10700	172	-	-	-	13100
Ethyl benzene	mg/L	0.002	-	-	<0.002	<0.002	-	-	-	<0.002
Fluoride	mg/L	0.1	-	-	1.4	<0.1	-	-	-	2.0
Iron	mg/L	0.05	-	-	0.13	30.3	-	-	-	<0.05
Lead	mg/L	0.001	-	-	<0.001	<0.001	-	-	-	<0.001
Magnesium	mg/L	1	-	-	8	<1	-	-	-	4
Manganese	mg/L	0.001	-	-	0.011	0.305	-	-	-	0.018

		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 (25/08/2017)	Not enough water to sample (25/08/2017)	25/08/2017	25/08/2017	Not enough water to sample (25/08/2017)	Not enough water to sample (25/08/2017)	Not enough water to sample (25/08/2017)	25/08/2017
		Data obtained	N/A	N/A	31/08/2017	31/08/2017	N/A	N/A	N/A	31/08/2017
Analyte	**Units**	**Limit of reporting**								
Mercury	mg/L	0.0001	-	-	<0.0001	<0.0001	-	-	-	<0.0001
Methane	mg/L	0.01	-	-	3.7	7.87	-	-	-	1.65
Molybdenum	mg/L	0.001	-	-	0.014	<0.001	-	-	-	0.006
Nickel	mg/L	0.001	-	-	0.005	0.003	-	-	-	0.001
Nitrate	mg/L	0.01	-	-	<0.01	<0.01	-	-	-	<0.01
Nitrite	mg/L	0.01	-	-	0.01	<0.01	-	-	-	<0.01
Phenols	mg/L	0.001	-	-	<0.001	<0.001	-	-	-	<0.001
Polycyclic aromatic hydrocarbons	mg/L	0.0005	-	-	<0.0005	<0.0005	-	-	-	0.013
Potassium	mg/L	1	-	-	22	<1	-	-	-	14
Reactive Phosphorus	mg/L	0.01	-	-	0.10	<0.01	-	-	-	0.15
Selenium	mg/L	0.01	-	-	<0.01	<0.01	-	-	-	<0.01
Silica	mg/L	0.1	-	-	12.5	0.9	-	-	-	17.5
Sodium	mg/L	1	-	-	3540	<1	-	-	-	3810
Strontium (dissolved)	mg/L	0.001	-	-	2.67	0.111	-	-	-	3.97
Sulfate	mg/L	1	-	-	<1	<1	-	-	-	<1
Toluene	mg/L	0.002	-	-	<0.002	<0.002	-	-	-	<0.002
Total dissolved solids	mg/L	10	-	-	7510	64	-	-	-	9470
Total petroleum hydrocarbons	mg/L	0.05	-	-	0.41	<0.05	-	-	-	0.34
Uranium	mg/L	0.001	-	-	<0.001	<0.001	-	-	-	<0.001
Vanadium	mg/L	0.01	-	-	<0.01	<0.01	-	-	-	<0.01
Xylene	mg/L	0.002	-	-	<0.002	<0.002	-	-	-	<0.002
Zinc	mg/L	0.005	-	-	0.015	0.025	-	-	-	0.006

Key:
- not analysed na = not applicable

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



References

AGL, 2015. Groundwater Management Plan. AGL document. Dated 30 October 2015. Available online: https://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/Camden%20Document%20Repository/Water%20Plans/20151030_Camden%20Gas%20Project%20%20%20Groundwater%20Management%20Plan.pdf

AGL, 2013. Hydrogeological Summary of the Camden Gas Project area. Dated 31 January 2013. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Camden/Assessments%20and%20Reports/2013/January/Hydrogeological%20Summary%20of%20the%20Camden%20Gas%20Project%20Area.pdf

Environment Protection Authority (EPA), 2014. Letter correspondence to AGL Upstream Investments Pty Ltd., titled: *Environment Protection Licence 12003*, EPA reference: EF13/2522:DOC14/95163-07:CK, dated 28 August 2014, signed: Greg Newman (Acting Manager Illawarra).

Environment Protection Authority (EPA), 2004. Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales, The Department of Environment and Conservation, Sydney, Australia. Available online: http://www.environment.nsw.gov.au/resources/water/approvedmethods-water.pdf

The State of NSW and Environment Protection Authority (EPA), 2013. Requirements for publishing pollution monitoring data. Environment Protection Authority, Sydney, Australia. Available online: http://www.epa.nsw.gov.au/resources/licensing/130742reqpubpmdata.pdf

Parsons Brinckerhoff (PB), 2013. Water Quality Investigation Camden Gas Project. Report for AGL Upstream Investments Pty Ltd, Document number: 2114759C PT_7196, dated 2 July 2013. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Camden/Assessments%20and%20Reports/2013/September/2114759C%20%20PT_7196_RevD_web.pdf