

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, overlapping light brown rectangles of varying sizes and orientations, creating a stepped effect. 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.

AGL UPSTREAM INVESTMENTS PTY LTD

GLOUCESTER GAS PROJECT

20 January 2015 Water Monitoring Report including:

- **Addendum to November 2014 Water Monitoring Report Rev B, 10 December 2014; and**
- **Addendum to January 2015 Water Monitoring Report, 13 January 2015**

Waukivory Pilot Project: Fracture Stimulation and Flow Test EPL 20358

Reporting Period: October to December 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): 1300 799 716



Foreword

PREMISES	Gloucester Coal Seam Gas Project Bucketts Way Gloucester NSW 2422
LICENCE DETAILS	<u>Environment Protection Licence 20358</u>
LICENCEE	AGL Upstream Investments Pty Limited (AGL)
LICENCEE'S ADDRESS	Locked Bag 1837, North Sydney, NSW 2060
MONITORING DATE(s)	3, 9, 10, 16, 22, 23, 29 December 2014 In addition, report includes THPS analyses from: 21 October 2014 – 27 November 2014
MONITORING BY	Parsons Brinckerhoff, on behalf of AGL
ANALYSIS BY	ALS Laboratory, Smithfield (Work orders: ES1426783, ES1427399, ES1428670, ES1428185 and ES1428806) Envirolab Services, Chatswood (Work orders: 120523, 120776, 121501, 121374, 121536, 121385, 119760 and 120027)
DATE AGL OBTAINED DATA	15 January 2015
REPORT DATE	Revision 1 20 January 2015
REPORT PREPARED BY	James Duggleby, Senior Hydrogeologist

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Introduction

AGL is proposing to build the Gloucester Gas Project (GGP) which comprises several stages of development facilitating the extraction of coal seam gas (CSG) from the Gloucester Basin. Concept plan and project approval (Part 3A Approval) for the Stage 1 Gas Field Development Area (GFDA) was granted on 22 February 2011 under Part 3A of the Environmental Planning and Assessment Act (1979) (EP&A Act). In addition the project received approval under the Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act) (EPBC Approval) on 11 February 2013.

The GGP will involve depressurising of deep groundwater and the extraction of gas from multiple coal seams within the Gloucester coal measures. Target coal seam depths will vary from site to site but are expected to range between 200 and 1,000 m below ground level (mbgl). The current GGP includes the construction, operation, and decommissioning of not more than 110 coal seam gas wells and associated infrastructure, including gas and water gathering lines within the Stage 1 GFDA. A comprehensive groundwater investigation (Phase 2 Groundwater Investigations) was completed in early 2012 to confirm the hydrogeological conceptual model across the Stage 1 GFDA (PB, 2012). Surface water and groundwater investigations are ongoing.

The GGP has Environment Protection Licence (EPL 20358) for coal seam gas activities. This Monitoring Report relates to the water monitoring activities specified in Part 5, Monitoring and Recording Conditions, of EPL 20358. This report relates specifically to the monitoring surrounding the Waukivory Pilot Project, and details:

- a) Monitoring results from a sampling event one week after the completion of the fracture stimulation of AGL gas well WK11 – 3 December 2014;
- b) Monitoring results from sampling events at two weeks after the completion of the Waukivory Pilot Project fracture stimulation – 9 and 10 December 2014
- c) Monitoring results from sampling events at the commencement of the Waukivory Pilot Project flow testing at AGL gas well WK13 – 16 December 2014;
- d) Monitoring results from sampling events at four weeks after the completion of the Waukivory Pilot Project fracture stimulation – 22 December 2014
- e) Monitoring results from sampling events at the commencement of the Waukivory Pilot Project flow testing at AGL gas well WK12 and two weeks after the commencement of flow testing at AGL gas well WK13 – 29 December 2014;
- f) Analytical results of Tetrakis (Hydroxymethyl) Phosphonium Sulphate (THPS) from 20 October 2014 to 31 December 2014 of samples that were collected and stored on ice prior to the EPA's approval of analytical methodology on 19 December 2014 (including Addendum to November 2014 Water Monitoring Report Rev B, 10 December 2014 (AGL 2014a); and Addendum to January 2015 Water Monitoring Report, 13 January 2015 (AGL 2015)).

As per the EPL, monitoring encompasses the monitoring points at the locations as shown in

Table 1 and Figure 1. The specific analytes and frequency tested are shown in Appendix A. The monitoring results for this reporting period are shown in Appendix B.

The monitoring points that are the subject of this report are part of the GGP groundwater and surface water monitoring network, as described in AGL's Surface and Groundwater Management Plan (SGMP) for the Waukivory Pilot Project (AGL, 2014b).

Three methods were used to obtain groundwater and surface water samples:

- A submersible pump at groundwater monitoring bores screened within relatively permeable geological materials i.e. monitoring point 90 (12V pump) and monitoring point 91 (240V pump).
- A micro-purge™ low flow sampling pump at groundwater monitoring points 10, 11 and 12. The micro-purge™ system allows groundwater to be drawn into the pump intake directly from the screened portion of the aquifer, eliminating the need for excessive groundwater purging.
- A telescopic sampler to collect grab samples from the surface water monitoring points 7, 8 and 9.
- Water samples were collected directly from the separator valve located at the surface headworks of each gas well.

EC and pH were monitored during purging to ensure that they had stabilised prior to sample collection. 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:

- Methane, which was analysed with a laboratory developed in-house technique which offers high resolution based on the "*Technical Guidance for Natural Attenuation Indicators: Methane, Ethane and Ethene*" (USEPA, 2002). The EPA have acknowledged that this method is a suitable technique for detecting dissolved methane in water (EPA, 2014a).
- Nitrogen, which was analysed using an updated persulphate digestion method based on the "*Standard Methods for the Examination of Water and Wastewater: 22nd Edition*" (APHA, 2012). The EPA have acknowledged that this method is a suitable technique for detecting total nitrogen in water (EPA, 2014a).
- Monoethanolamine borate, which was analysed as monoethanolamine using the Liquid Chromatography Triple Quadruple Mass Spectrometry (LC/MSMS) method. The EPA have acknowledged that this method is a suitable technique for representing detections of monoethanolamine borate in water (EPA, 2014b).
- Sodium hypochlorite, where detections of free and total residual chlorine were used as a proxy. The EPA have acknowledged that this method is a suitable technique for representing detections of sodium hypochlorite in water (EPA, 2014a).
- Tetrakis (Hydroxymethyl) Phosphonium Sulphate (THPS), which was analysed using ultra-High Performance Liquid Chromatography methodology with UV detection (uHPLC-UV), based on NIOSH 5046. The EPA have acknowledged, on 19 December 2014, that this method is a suitable technique for representing detections of THPS in water (EPA, 2014c). Samples collected prior to this date were stored on ice and underwent analysis post 19 December 2014. These results are also presented in this report.

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

The remaining water and land monitoring points in EPL 20358 will be reported in subsequent reports when the requirement for monitoring is triggered.

More information on the groundwater monitoring of the GGP is available on the project website: agl.com.au/Gloucester

Table 1: Waukivory Pilot Project water monitoring points (as per EPL 20358)

EPA Identification no.	Monitoring Point	Type of monitoring point	Easting (m)	Northing (m)
7	WKSW03	Stream gauge (surface water)	402486.36	6453090.65
8	WKSW02	Stream gauge (surface water)	402748.00	6452139.00
9	WKSW01	Stream gauge (surface water)	402069.00	6452241.00
10	WKMB01	Groundwater monitoring bore	402153.63	6452566.28
11	WKMB02	Groundwater monitoring bore	402575.54	6452572.49
12	WKMB03	Groundwater monitoring bore	402589.87	6452584.93
14	PL03	Vibrating wire piezometer (groundwater)	402633.90	6449898.67
85	WKMB05 ^a	Packer and piezometer completion (groundwater)	402576.59	6452128.62
86	WK11 ^b	Gas well	402419.02	6452589.82
87	WK12 ^b	Gas well	402748.92	6452883.77
88	WK13 ^b	Gas well	402416.74	6452164.46
89	WK14 ^b	Gas well	402906.10	6452384.08
90	GR-P3	Private groundwater bore	402905.50	6452518.71
91	GW080487	Private groundwater bore	401226.00	6454020.00

Notes:

^a = At the time of writing of this report, finalised data from monitoring point 85 was not yet obtained and will be reported in a subsequent report in accordance with the *Requirements for Publishing Pollution Monitoring Data* (EPA, 2012) (Publication Requirements)

^b = will be sampled/monitored and reported as finalised data and results are obtained from the commencement of the flow testing program for each individual well (in accordance with the *Requirements for Publishing Pollution Monitoring Data* (EPA, 2012) (Publication Requirements)

Coordinate reference system: Map Grid of Australia 1994

Figure 1: Location of groundwater and surface water quality monitoring points: Waukivory Pilot Program (as per EPL 20358)



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Appendix A - Table 2: Analytes monitored and frequency required for monitoring points in Table 1 (as per EPL 20358)

Pollutant	Units of measure	Monitoring points											
		7,8,9		10,11,12		14,85		86,87,88,89		90		91	
		Frequency	Sampling method	Frequency	Sampling method	Frequency	Sampling method	Frequency	Sampling method	Frequency	Sampling method	Frequency	Sampling method
Aluminium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Ammonia	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Arsenic	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Barium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Beryllium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Bicarbonate	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Boron	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Cadmium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Calcium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Carbonate	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Chloride	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Chromium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Cobalt	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Copper	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Electrical conductivity	microsiemens per centimetre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Fluoride	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Iron	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Lead	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Magnesium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Manganese	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Mercury	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Methane	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Molybdenum	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Monoethanolamine Borate	micrograms per litre	Special Frequency 5	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority			Special Frequency 4	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority
Nickel	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Nitrate	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Nitrite	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
pH	pH	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Phosphorus (total)	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Potassium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Reactive Phosphorus	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Selenium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Silica	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Sodium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Sodium Hypochlorite	milligrams per litre	Special Frequency 5	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority			Special Frequency 4	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority
Standing water level	meters (Australian Height Datum)			Special Frequency 8	Special Method 5	Special Frequency 8	Special Method 5	Special Frequency 9	Special Method 3	Special Frequency 8	Special Method 5	Special Frequency 6	Special Method 1
Strontium (dissolved)	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Sulfate	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
THPS (Phosphonium, Tetrakis (Hydroxymethyl-sulfate))	micrograms per litre	Special Frequency 5	Method approved in writing by the Authority (after the data was received for this report)	Special Frequency 3	Method approved in writing by the Authority (after the data was received for this report)			Special Frequency 4	Method approved in writing by the Authority (after the data was received for this report)	Special Frequency 3	Method approved in writing by the Authority (after the data was received for this report)	Special Frequency 3	Method approved in writing by the Authority (after the data was received for this report)
Total dissolved solids	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Total organic carbon	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Total suspended solids	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Uranium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Vanadium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Zinc	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample

Notes:

Special Frequency 3 – One sampling event before the Waukivory Pilot Project fracture stimulation commences, one sampling event within 24 hours of the completion of the fracture stimulation of each well, and one sample at week 2 and week 4 after the completion of the Waukivory Pilot Project fracture stimulation.

Special Frequency 4 – Every fortnight for 8 weeks from the commencement of the Waukivory pilot flow testing, then every 2 months thereafter until the cessation of the Waukivory pilot flow testing.

Special Frequency 5 – One sampling event within 24 hours of the completion of the fracture stimulation of each well, and one sampling event one week after the completion of the fracture stimulation of each well, and one sampling event every 6 months thereafter until the cessation of the Waukivory pilot flow testing.

Special Frequency 6 – One monitoring event to determine water level prior to the Waukivory Pilot Project fracture stimulation.

Special Frequency 8 – Every 6 hours

Special Frequency 9 – Every 6 hours when using an automated datalogger, or, once every fortnight using a Sonolog in the event of failure of an automated datalogger.

Special method 1 - manual dip

Special method 3 - Use of an automated datalogger. As a back up contingency, by use of Sonolog in the event of an automated datalogger.

Special method 5 - Automated datalogger

Shaded grey = not required to be analysed



Appendix B – Table 3: Water quality monitoring data for points 7, 8, 9

Analysis by: ALS Laboratory, Smithfield (Work order: ES1426783) and Envirolab Services, Chatswood (Ref: 120523)

		Monitoring points	7	8	9	
		Location	WКСW03	WКСW02	WКСW01	
		Sampled date	3/12/2014	3/12/2014	3/12/2014	
		Date AGL obtained data	15/01/2015	15/01/2015	15/01/2015	
		Monitoring event (see key below)	a	a	a	

Analyte	Units of measure	Limit of reporting				Analyte
Aluminium	mg/L	0.01	0.02	0.01	<0.01	Aluminium
Ammonia	mg/L	0.01				Ammonia
Arsenic	mg/L	0.001	0.002	0.002	0.001	Arsenic
Barium	mg/L	0.001	0.037	0.069	0.059	Barium
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	Beryllium
Bicarbonate	mg/L	1	79	120	108	Bicarbonate
Boron	mg/L	0.05	<0.05	<0.05	<0.05	Boron
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	Cadmium
Calcium	mg/L	1	14	36	28	Calcium
Carbonate	mg/L	1	<1	<1	<1	Carbonate
Chloride	mg/L	0.1	95.9	114	114	Chloride
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	Chromium
Cobalt	mg/L	0.001	<0.001	0.001	<0.001	Cobalt
Copper	mg/L	0.001	0.001	0.013	<0.001	Copper
Electrical conductivity	µS/cm	1	527	682	638	Electrical conductivity
Fluoride	mg/L	0.1	0.1	0.1	0.1	Fluoride
Iron	mg/L	0.05	0.67	0.17	0.46	Iron
Lead	mg/L	0.001	<0.001	<0.001	<0.001	Lead
Magnesium	mg/L	1	13	18	17	Magnesium
Manganese	mg/L	0.001	0.248	0.797	0.545	Manganese
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	Mercury
Methane	mg/L	0.010				Methane
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	Molybdenum
Monoethanolamine Borate (reported as (mono) ethanolamine))	µg/L	1	<1	<1	<1	Monoethanolamine Borate (reported as (mono) ethanolamine))
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	Nickel
Nitrate	mg/L	0.01				Nitrate
Nitrite	mg/L	0.01				Nitrite
pH	pH Unit	0.01	7.22	6.63	6.93	pH
Phosphorus (total)	mg/L	0.01				Phosphorus (total)
Potassium	mg/L	1	6	3	5	Potassium
Reactive Phosphorus	mg/L	0.01				Reactive Phosphorus
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	Selenium
Silica	mg/L	0.05	2.44	23.2	10.6	Silica
Sodium	mg/L	1	63	64	62	Sodium
Sodium Hypochlorite (reported as free chlorine)	mg/L	0.2	<0.2	<0.2	<0.2	Sodium Hypochlorite (reported as free chlorine)
Sodium Hypochlorite (reported as total residual chlorine)	mg/L	0.2	<0.2	<0.2	<0.2	Sodium Hypochlorite (reported as total residual chlorine)
Standing water level	mAHD					Standing water level
Strontium (dissolved)	mg/L	0.001	0.226	0.411	0.348	Strontium (dissolved)
Sulfate	mg/L	1	<1	5	4	Sulfate
THPS (Phosphonium, Tetrakis (Hydroxymethyl-sulfate))	µg/L	50	<50	<50	<50	THPS (Phosphonium, Tetrakis (Hydroxymethyl-sulfate))
Total dissolved solids	mg/L	10	253	342	301	Total dissolved solids
Total organic carbon	mg/L	1	19	16	13	Total organic carbon
Total suspended solids	mg/L	5				Total suspended solids
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	Uranium
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	Vanadium
Zinc	mg/L	0.005	0.008	0.020	0.071	Zinc

Key:

Shaded grey = not required to be reported

Monitoring event:

a one week after the completion of the Waukivory Pilot Program fracture stimulation



Appendix B – Table 4: Water quality monitoring data for points 10, 11, 12, 90, 91

Analysis by: ALS Laboratory, Smithfield (Work orders: ES1427399, ES1428670) and Envirolab Services, Chatswood (Refs: 120776, 121501)

Monitoring points		10		11		12		90		91		Analyte	
Location		WKMB01	WKMB01	WKMB02	WKMB02	WKMB03	WKMB03	GR-P3	GR-P3	GW080487	GW080487		
Sampled date		10/12/2014	22/12/2014	9/12/2014	22/12/2014	9/12/2014	22/12/2014	10/12/2014	23/12/2014	9/12/2014	22/12/2014		
Date AGL obtained data		15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015		
Monitoring event (see key below)		a	b	a	b	a	b	a	b	a	b		
Analyte	Units of measure	Limit of reporting										Analyte	
Aluminium	mg/L	0.01	0.02	0.03	0.09	0.13	0.03	0.03	0.02	0.51	<0.01	0.12	Aluminium
Ammonia	mg/L	0.01	0.57	0.46	0.24	0.23	17	14.8	0.02	0.02	0.51	0.38	Ammonia
Arsenic	mg/L	0.001	0.002	0.001	0.002	0.001	0.002	0.002	0.002	0.001	<0.001	<0.001	Arsenic
Barium	mg/L	0.001	0.211	0.230	0.074	0.076	0.926	0.944	0.488	0.553	0.203	0.191	Barium
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Beryllium
Bicarbonate	mg/L	1	838	954	252	296	16	3	349	401	990	1160	Bicarbonate
Boron	mg/L	0.05	0.10	0.13	<0.05	<0.05	0.08	0.09	<0.05	<0.05	0.05	0.06	Boron
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	Cadmium
Calcium	mg/L	1	11	12	2	3	5	7	128	103	76	92	Calcium
Carbonate	mg/L	1	11	<1	62	67	1040	1230	<1	<1	<1	<1	Carbonate
Chloride	mg/L	0.1	1000	899	60.3	56.8	380	371	1050	1040	626	620	Chloride
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Chromium
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	Cobalt
Copper	mg/L	0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	0.004	<0.001	<0.001	0.002	Copper
Electrical conductivity	µS/cm	1	4780	4570	864	860	3380	3310	4100	4090	3920	3870	Electrical conductivity
Fluoride	mg/L	0.1	1.5	1.6	0.3	0.3	2.1	2.3	0.2	0.2	0.2	0.2	Fluoride
Iron	mg/L	0.05	0.09	0.10	<0.05	0.05	<0.05	<0.05	0.30	0.54	0.40	0.43	Iron
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.010	0.010	<0.001	<0.001	<0.001	<0.001	Lead
Magnesium	mg/L	1	2	2	<1	<1	<1	<1	75	62	42	46	Magnesium
Manganese	mg/L	0.001	0.010	0.010	0.008	0.007	0.001	<0.001	0.600	0.669	0.049	0.056	Manganese
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	Mercury
Methane	mg/L	0.010	31.5	21	3.47	3.16	23.6	21.8	<0.01	<0.01	0.091	0.044	Methane
Molybdenum	mg/L	0.001	<0.001	<0.001	0.002	0.001	0.005	0.008	<0.001	<0.001	<0.001	<0.001	Molybdenum
Monoethanolamine Borate (reported as (mono) ethanolamine))	µg/L	1	<1	<1	<1	<1	<1	<1	2	<1	2	<1	Monoethanolamine Borate (reported as (mono) ethanolamine))
Nickel	mg/L	0.001	0.003	0.001	<0.001	<0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	Nickel
Nitrate	mg/L	0.01	0.05	<0.01	0.06	<0.01	0.04	<0.01	0.04	<0.01	0.10	0.02	Nitrate
Nitrite	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	Nitrite
pH	pH Unit	0.01	7.87	8.06	9.16	9.49	11.21	11.41	6.34	6.30	6.56	6.88	pH
Phosphorus (total)	mg/L	0.01	0.04	0.04	0.06	0.07	0.06	0.08	0.05	0.06	0.01	0.02	Phosphorus (total)
Potassium	mg/L	1	3	3	4	6	16	18	2	2	7	7	Potassium
Reactive Phosphorus	mg/L	0.01	0.03	0.04	0.06	0.07	0.05	0.06	0.02	0.05	<0.01	<0.01	Reactive Phosphorus
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	Selenium
Silica	mg/L	0.05	16.2	16.2	21.4	21.8	31.8	31.2	35.3	33.2	19.7	19.5	Silica
Sodium	mg/L	1	1130	1100	219	211	799	814	635	562	836	837	Sodium
Sodium Hypochlorite (reported as free chlorine)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	Sodium Hypochlorite (reported as free chlorine)
Sodium Hypochlorite (reported as total residual chlorine)	mg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	Sodium Hypochlorite (reported as total residual chlorine)
Standing water level	mAHD												Standing water level
Strontium (dissolved)	mg/L	0.001	1.73	1.82	0.233	0.253	1.03	1.11	2.05	2.39	5.02	5.84	Strontium (dissolved)
Sulfate	mg/L	1	106	99	14	15	<1	5	75	74	90	87	Sulfate
THPS (Phosphonium, Tetrakis (Hydroxymethyl-sulfate))	µg/L	50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	THPS (Phosphonium, Tetrakis (Hydroxymethyl-sulfate))
Total dissolved solids	mg/L	10	2660	3290	462	660	2010	2390	2210	2180	1930	2120	Total dissolved solids
Total organic carbon	mg/L	1	18	19	3	4	89	<1	<1	<1	<1	<1	Total organic carbon
Total suspended solids	mg/L	5	15	12	6	14	32	44	35	44	9	<5	Total suspended solids
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.003	<0.001	<0.001	Uranium
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	Vanadium
Zinc	mg/L	0.005	0.005	0.006	<0.005	<0.005	6.79	6.99	0.014	0.018	0.010	0.014	Zinc

Key:

Shaded grey = not required to be reported

Monitoring event:

- a two weeks after the completion of the Waukivory Pilot Program fracture stimulation
- b four weeks after the completion of the Waukivory Pilot Program fracture stimulation



Appendix B – Table 5: Water quality monitoring data for points 87,88

Analysis by: ALS Laboratory, Smithfield (Work orders: ES1428185, ES1428806) and Envirolab Services, Chatswood (Refs: 121374, 121536)

		Monitoring points	87	88		
		Location	WK12	WK13	WK13	
		Sampled date	29/12/2014	16/12/2014	29/12/2014	
		Date AGL obtained data	15/01/2015	15/01/2015	15/01/2015	
		Monitoring event (see key below)	b	a	b	
Analyte	Units of measure	Limit of reporting				Analyte
Aluminium	mg/L	0.01	<0.01	<0.01	0.03	Aluminium
Ammonia	mg/L	0.01	2.98	3.45	5.12	Ammonia
Arsenic	mg/L	0.001	<0.001	0.003	0.004	Arsenic
Barium	mg/L	0.001	0.227	0.839	5.95	Barium
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	Beryllium
Bicarbonate	mg/L	1	3480	1650	3400	Bicarbonate
Boron	mg/L	0.05	<0.05	10.3	12.7	Boron
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	Cadmium
Calcium	mg/L	1	15	13	30	Calcium
Carbonate	mg/L	1	<1	44	<1	Carbonate
Chloride	mg/L	0.1	721	386	676	Chloride
Chromium	mg/L	0.001	<0.001	<0.001	0.002	Chromium
Cobalt	mg/L	0.001	0.001	<0.001	<0.001	Cobalt
Copper	mg/L	0.001	<0.001	0.001	0.003	Copper
Electrical conductivity	µS/cm	1	7720	4750	8250	Electrical conductivity
Fluoride	mg/L	0.1	0.7	0.9	1.4	Fluoride
Iron	mg/L	0.05	0.08	0.12	2.99	Iron
Lead	mg/L	0.001	<0.001	<0.001	<0.001	Lead
Magnesium	mg/L	1	4	3	4	Magnesium
Manganese	mg/L	0.001	0.256	0.029	0.111	Manganese
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	Mercury
Methane	mg/L	0.010	9.06	2.42	9.17	Methane
Molybdenum	mg/L	0.001	0.006	0.045	0.002	Molybdenum
Monoethanolamine Borate (reported as (mono) ethanolamine))	µg/L	1	305	150	273	Monoethanolamine Borate (reported as (mono) ethanolamine))
Nickel	mg/L	0.001	0.009	0.013	0.003	Nickel
Nitrate	mg/L	0.01	<0.10	<0.01	0.01	Nitrate
Nitrite	mg/L	0.01	<0.10	<0.01	<0.01	Nitrite
pH	pH Unit	0.01	7.15	8.74	7.33	pH
Phosphorus (total)	mg/L	0.01	2.96	2.63	3.64	Phosphorus (total)
Potassium	mg/L	1	27	18	18	Potassium
Reactive Phosphorus	mg/L	0.01	<0.10	0.03	0.11	Reactive Phosphorus
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	Selenium
Silica	mg/L	0.05	31.6	11.2	27.7	Silica
Sodium	mg/L	1	2080	1140	2160	Sodium
Sodium Hypochlorite (reported as free chlorine)	mg/L	0.2	<2.0	<0.2	<0.4	Sodium Hypochlorite (reported as free chlorine)
Sodium Hypochlorite (reported as total residual chlorine)	mg/L	0.2	<2.0	<0.2	<0.4	Sodium Hypochlorite (reported as total residual chlorine)
Standing water level	mAHD		Will be reported in subsequent reports as results are obtained			Standing water level
Strontium (dissolved)	mg/L	0.001	0.966	1.62	5.00	Strontium (dissolved)
Sulfate	mg/L	1	<10	<1	<10	Sulfate
THPS (Phosphonium, Tetrakis (Hydroxymethyl-sulfate))	µg/L	50	440	430	410	THPS (Phosphonium, Tetrakis (Hydroxymethyl-sulfate))
Total dissolved solids	mg/L	10	5280	3730	6520	Total dissolved solids
Total organic carbon	mg/L	1	332	541	1010*	Total organic carbon
Total suspended solids	mg/L	5	208	63	67	Total suspended solids
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	Uranium
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	Vanadium
Zinc	mg/L	0.005	<0.005	0.022	0.010	Zinc

Key:

*analysed as non-purgeable organic carbon (NPOC)

Monitoring event:

- a Commencement of the Waukivory Pilot Project flow testing
- b Two weeks after the commencement of the Waukivory Pilot Project flow testing



Appendix B – Table 6: THPS analysis results for monitoring data for points 7, 8, 9, 10, 11, 12, 90, 91 (21 October 2014 - 27 November 2014)

EnviroLab Services, Chatswood (Refs: 121385, 119760, 120027)

Monitoring point		7							8							9						
Location	WКСW01	WКСW01	WКСW01	WКСW01	WКСW01	WКСW01	WКСW01	WКСW02	WКСW02	WКСW02	WКСW02	WКСW02	WКСW02	WКСW02	WКСW03	WКСW03	WКСW03	WКСW03	WКСW03	WКСW03	WКСW03	WКСW03
Date sampled	21/10/2014	6/11/2014	12/11/2014	18/11/2014	20/11/2014	24/11/2014	27/11/2014	21/10/2014	6/11/2014	12/11/2014	17/11/2014	20/11/2014	24/11/2014	27/11/2014	21/10/2014	6/11/2014	12/11/2014	18/11/2014	20/11/2014	24/11/2014	27/11/2014	
Date analysed	22/12/2014	22/12/2014	22/12/2014	24/12/2014	24/12/2014	24/12/2014	24/12/2014	22/12/2014	22/12/2014	22/12/2014	24/12/2014	24/12/2014	24/12/2014	24/12/2014	22/12/2014	22/12/2014	22/12/2014	24/12/2014	24/12/2014	24/12/2014	24/12/2014	
Date AGL obtained data	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	
Monitoring event (see key below)	a	b	c	d	e	f	h	a	b	c	d	e	f	h	a	b	c	d	e	f	h	
Analyte	Unit	PQL (Note 1)																				
THPS	µg/L	50 (Note 2)	<50	57	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	59	<50	<50	<50	<50	

Monitoring point		10					11					12				
Location	WКMB01	WКMB01	WКMB01	WКMB01	WКMB01	WКMB02	WКMB02	WКMB02	WКMB02	WКMB02	WКMB03	WКMB03	WКMB03	WКMB03	WКMB03	
Date sampled	21/10/2014	6/11/2014	17/11/2014	20/11/2014	26/11/2014	21/10/2014	6/11/2014	17/11/2014	20/11/2014	26/11/2014	21/10/2014	6/11/2014	17/11/2014	20/11/2014	26/11/2014	
Date analysed	22/12/2014	22/12/2014	24/12/2014	24/12/2014	24/12/2014	22/12/2014	22/12/2014	24/12/2014	24/12/2014	24/12/2014	22/12/2014	22/12/2014	24/12/2014	24/12/2014	24/12/2014	
Date AGL obtained data	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	
Monitoring event (see key below)	a	b	d	e	g	a	b	d	e	g	a	b	d	e	g	
Analyte	Unit	PQL (Note 1)														
THPS	µg/L	50 (Note 2)	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	

Monitoring point		90					91				
Location	GR-P3	GR-P3	GR-P3	GR-P3	GR-P3	GW080487	GW080487	GW080487	GW080487	GW080487	
Date sampled	21/10/2014	6/11/2014	17/11/2014	20/11/2014	26/11/2014	22/10/2014	6/11/2014	17/11/2014	20/11/2014	26/11/2014	
Date analysed	22/12/2014	22/12/2014	24/12/2014	24/12/2014	24/12/2014	22/12/2014	22/12/2014	24/12/2014	24/12/2014	24/12/2014	
Date AGL obtained data	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	15/01/2015	
Monitoring event (see key below)	a	b	d	e	g	a	b	d	e	g	
Analyte	Unit	PQL (Note 1)									
THPS	µg/L	50 (Note 2)	<50	<50	<50	<50	<50	<50	<50	<50	

Key:

Monitoring event:

- a final baseline round
- b 24 hours after the completion of the fracture stimulation of WK13
- c one week after the completion of the fracture stimulation of WK13
- d 24 hours after the completion of the fracture stimulation of WK14
- e 24 hours after the completion of the fracture stimulation of WK12
- f one week after the completion of the fracture stimulation of WK14
- g 24 hours after the completion of the fracture stimulation of WK11
- h 24 hours after the completion of the fracture stimulation of WK11 and one week after the completion of the fracture stimulation of WK12

Notes:

Note 1: PQL or Practical Quantitation Limit, is the lowest testing level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

Note 2: The lowest level detectable for THPS is 50 parts per billion, with a margin of error at PQL level of +/- 50 parts per billion.

