AGL UPSTREAM INVESTMENTS PTY LTD

GLOUCESTER GAS PROJECT

January 2015 Monitoring Report:
Tiedman Irrigation Program
EPL 20358

Reporting Period: November – 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	Environment Protection Licence 20358
LICENCEE	AGL Upstream Investments Pty Limited (AGL)
LICENCEE'S ADDRESS	Locked Bag 1837, North Sydney, NSW 2060
MONITORING DATE	25, 26 November and 11 December 2014
MONITORING BY	Parsons Brinckerhoff, on behalf of AGL
ANALYSIS BY	ALS Laboratory, Smithfield (Work orders: ES1425982, ES1425982, ES1427511)
DATE AGL OBTAINED DATA	19 December 2014, and 7, 12, 13 January 2015
REPORT DATE	13 January 2015
REPORT PREPARED BY	James Duggleby, Senior Hydrogeologist

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.

This Monitoring Report relates to the water monitoring activities specified in Part 5, Monitoring and Recording Conditions, of the Environment Protection Licence 20358. This report relates specifically to the monitoring surrounding the Tiedman Irrigation Program, and details:

1. Monitoring results from the quarterly water sampling event at the Tiedman Irrigation Program (25, 26 November 2014); and
2. Monitoring results from an overflow event at the Tiedman Irrigation Program catch dams (11 December 2014).

As per the Licence, the 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 Table 2. The monitoring results for this reporting period are shown in Table 3, Table 4, Table 5 and Table 6.

The monitoring points that are the subject of this report are part of the GGP groundwater monitoring network, as described in AGL's Water Management Plan for the Tiedman Irrigation Program (AGL, 2012a) and Soil Quality Monitoring and Management Program (AGL, 2012b)). Water monitoring results for the Irrigation program are presented in a baseline water monitoring report (PB, 2013a) and six-monthly compliance reports (PB, 2013a, 2013b, 2014a, 2014b).

Four sampling methods were used to obtain surface water and groundwater samples:

- Submersible 12V pump at the groundwater monitoring bores screened within relatively permeable geological materials: TMB01, TMB02 and TMB03. A minimum of three well volumes was purged prior to sampling.
- Submersible 12V pump at the seepage monitoring bores TMB04 and TMB05 which are screened within material of very low permeability. The physical parameters of the purged groundwater were initially tested, then the bores were purged dry and if any inflow was observed within 12 hours then physical parameters were tested again and a sample taken for analysis.
- Disposable bailer at the shallow perched soil water piezometers (with piezometers purged dry and if any inflow was observed within 12 hours then physical parameters were tested again and a sample taken for analysis).
- In-situ snap sampler for groundwater monitoring bore S4MB01, screened within material of relatively low permeability.
- Grab sample using a telescopic sampler for surface water and dam water samples

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 calcium, which underwent filtration rather than acid extraction as a preliminary treatment prior to analysis.

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

At the time of publishing this report, finalised data from the November soil monitoring event for monitoring points 53 to 81 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).

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: Water quality monitoring points: Irrigation Program (as per EPL 20358)

EPA ID no.	Monitoring Point	Type of monitoring point	Easting (m)	Northing (m)
27	TND	Produced water storage dam	Tiedman property	
28	TSD	Produced water storage dam	Tiedman property	
29	TED	Produced water storage dam	Tiedman property	
30	TMB04	Groundwater quality monitoring	402558.1	6448921.7
31	TMB05	Groundwater quality monitoring	402650.1	6448725.3
33	CDE	Surface water quality monitoring – catch dam east	Tiedman property	
34	CDW	Surface water quality monitoring – catch dam west	Tiedman property	
35	FSW01	Surface water quality monitoring	402001	6449646
36	ASW01	Surface water quality monitoring	401711.09	6449092.2
37	TSW01	Surface water quality monitoring	401993.98	6449416.7
38	TSW02	Surface water quality monitoring	401922.1	6448740.9
39	TMB01	Groundwater quality monitoring	401996.98	6449419.7
40	TMB02	Groundwater quality monitoring	401905.11	6449100.6
41	TMB03	Groundwater quality monitoring	401969.53	6448755
42	S4MB01	Groundwater quality monitoring	402581.88	6449409.7
43	TCMB01	Groundwater quality monitoring	402501.7	6448899
44	TTMB02	Groundwater quality monitoring	402699	6449358
45	SP1B	Soil water quality monitoring	402570.3	6449381.3
46	SP2B	Soil water quality monitoring	402444.2	6449100.1
47	SP4B	Soil water quality monitoring	402252	6449131.3
48	SP6B	Soil water quality monitoring	402103.5	6449178.6
49	SP7B	Soil water quality monitoring	402144.8	6449292.1
50	SP8B	Soil water quality monitoring	402159.1	6449454.8
51	SP9B	Soil water quality monitoring	402387.5	6449016.9
52	SP10B	Soil water quality monitoring	402344.2	6448840.6

Coordinate reference system: Map Grid of Australia 1994

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

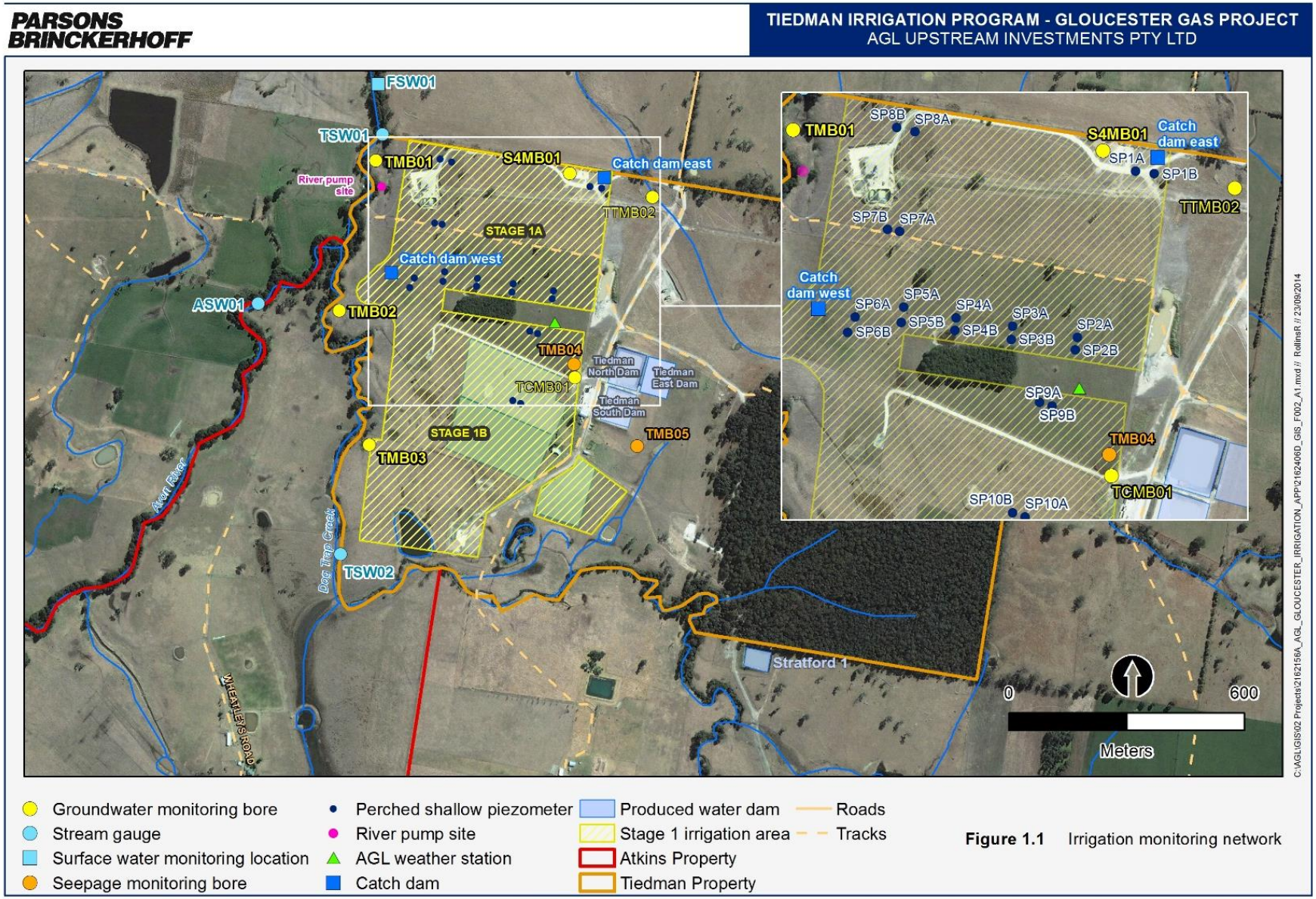

Figure 1.1 Irrigation monitoring network

Table 2: Analytes monitored and frequency (as per EPL 20358) - monitoring points 27 – 52 (water monitoring points)

Analyte	Units of measure	Monitoring points																	
		27,29		28		30,31		33,34		35		36,37,38		39,40,41,42		43,44		45,46,47,48,49,50,51, 52	
		Frequency	sampling method	Frequency	sampling method	Frequency	sampling method	Frequency	sampling method	Frequency	sampling method	Frequency	sampling method	Frequency	sampling method	Frequency	sampling method	Frequency	sampling method
Aluminium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Ammonia	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Arsenic	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Barium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Beryllium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Bicarbonate	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample												
Boron	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Cadmium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Calcium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Chloride	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample												
Chromium	milligrams per litre							Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Cobalt	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Copper	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Dissolved oxygen	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Electrical conductivity	microsiemens per centimetre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Special Frequency 8	Special method 5	Quarterly	Grab sample	Special frequency 8	Special method 5	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Iron	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Lead	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Magnesium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Manganese	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Mercury	milligrams per litre							Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Molybdenum	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Nickel	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Nitrate	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Nitrite	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample												
pH	pH	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Phosphorus (total)	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Potassium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Reactive Phosphorus	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample												
Redox potential	millivolts	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Selenium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Silica	milligrams per litre							Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Sodium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Sodium Adsorption Ratio	sodium adsorption ratio			Quarterly	Special Method 4														
Standing water level	meters (Australian Height Datum)					Special frequency 8	Special method 5							Special frequency 8	Special method 5	Special frequency 8	Special method 5	Quarterly	Special method 1
Strontium (dissolved)	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Sulfate	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Total alkalinity	milligrams per litre							Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Total dissolved solids	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Total organic carbon	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample												
Total suspended solids	milligrams per litre							Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample						
Uranium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Vanadium	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample
Zinc	milligrams per litre	Quarterly	Grab sample	Quarterly	Grab sample	Special Frequency 1	Grab sample	Each overflow event	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample

Notes:

Special Frequency 1 – Quarterly if inflow within 12 hours of purging dry.

Special Frequency 2 – Every 24 hours

Special Frequency 8 – Every 6 hours

Special Method 1 – manual dip

Special Method 4 – by calculation

Special Method 5 - automated datalogger

Shaded grey - not required to be analysed

Groundwater and surface water monitoring results

Table 3: November 2014 water monitoring results for monitoring points 27 – 39

		Monitoring points	27	28	29	30	31	33	34	35	36	37	38	39
		Location	TND	TSD	TED	TMB04	TMB05	CDE	CDW	FSW01	ASW01	TSW01	TSW02[a]	TMB01
		Sampled date	25/11/2014	25/11/2014	25/11/2014	25/11/2014	26/11/2014	11/12/14[b]	11/1214[b]	26/11/2014	25/11/2014	25/11/2014	25/11/2014	25/11/2014
		Date AGL obtained data	12/01/2014	12/01/2014	12/01/2014	12/01/2014	12/01/2014	19/12/2914	19/12/2914	12/01/2014	12/01/2014	12/01/2014	7/01/2014	12/01/2014
Analyte	**Units of measure**	**Limit of reporting**												
Aluminium	mg/L	0.01	2.94	0.17	0.32	0.09	0.57	1.77	0.03	0.02	<0.01	0.08	na	0.13
Ammonia	mg/L	0.01	0.21	<0.01	0.02	0.29	0.28	0.05	0.04	<0.01	<0.01	0.05	na	0.13
Arsenic	mg/L	0.001	0.013	0.003	0.004	0.001	0.001	0.001	0.001	0.003	0.002	0.004	na	0.001
Barium	mg/L	0.001	0.331	0.128	0.151	0.082	0.202	0.019	0.018	0.055	0.062	0.079	na	0.260
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001
Bicarbonate	mg/L	1	492	135	189	307	5							
Boron	mg/L	0.05	0.72	0.20	0.22	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	na	<0.05
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0025	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	na	<0.0001
Calcium	mg/L	1	8	12	10	164	58	5	5	13	17	20	na	320
Chloride	mg/L	0.1	936.0	250.0	163.0	2000.0	2400.0							
Chromium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001
Cobalt	mg/L	0.001	0.001	<0.001	<0.001	0.017	0.359	<0.001	<0.001	<0.001	<0.001	0.001	na	<0.001
Copper	mg/L	0.001	0.020	0.001	<0.001	0.005	0.202	0.002	0.003	0.001	<0.001	<0.001	na	<0.001
Dissolved oxygen[d]	mg/L	0.01	3.44	5.95	5.98	8.21	6.69	11.51	9.67	1.33	2.40	1.07	na	1.74
Electrical conductivity	µS/cm	1	5870	1610	1220	7520	7490	Refer to table 4	Refer to table 4	440	Refer to table 4	Refer to table 4	Refer to table 4	9010
Iron	mg/L	0.05	1.22	0.09	0.13	12.60	11.40	0.82	0.12	1.14	1.07	2.93	na	2.29
Lead	mg/L	0.001	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001
Magnesium	mg/L	1	3	7	6	194	236	1	2	11	9	12	na	239
Manganese	mg/L	0.001	0.024	0.020	0.014	8.560	18.900	0.005	0.002	0.459	0.267	0.892	na	0.875
Mercury	mg/L	0.0001						<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	na	<0.0001
Molybdenum	mg/L	0.001	0.031	0.007	0.003	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	na	<0.001
Nickel	mg/L	0.001	0.005	0.001	<0.001	0.010	0.175	<0.001	<0.001	<0.001	<0.001	<0.001	na	<0.001
Nitrate	mg/L	0.01	0.03	0.02	0.04	0.03	0.02	0.26	0.20	<0.01	0.03	0.03	na	0.04
Nitrite	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01							
pH[d]	pH	0.01	10.24	10.30	9.67	6.35	6.50	7.10	7.14	5.54	7.85	8.05	na	6.70
Phosphorus (total)	mg/L	0.01	1.75	0.48	0.57	0.52	0.15	1.10	1.72	0.22	0.14	0.29	na	0.08
Potassium	mg/L	1	303	73	39	17	15	6	9	6	5	6	na	2
Reactive Phosphorus	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01							
Redox potential[d]	mV	0.1	-54.3	-40.7	-38.7	-21.5	-5.3	-30.3	-36.2	146.9	-80.7	-58.4	na	-29.9
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	na	<0.01
Silica	mg/L	0.1						11.9	33.1	14.0	8.3	16.8	na	35.4
Sodium	mg/L	1	1150	300	222	1080	1010	14	33	49	36	60	na	1200
Sodium Adsorption Ratio	ratio	0.01		16.96										
Standing water level	m AHD	0.01				Refer to table 5	Refer to table 5							Refer to table 5
Strontium (dissolved)	mg/L	0.001	0.396	0.215	0.252	1.920	1.030	0.019	0.028	0.209	0.197	0.251	na	6.830
Sulfate	mg/L	1	15	32	12	657	219	14	29	13	<10	9	na	92
Total alkalinity	mg/L	1						34	58	55	72	83	na	656
Total dissolved solids	mg/L	10	3000	954	751	4720	4260	249	287	271	229	324	na	5980
Total organic carbon	mg/L	1	124	31	36	6	10							
Total suspended solids	mg/L	5						151[c]	105[c]	12	10	12	na	
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	0.005
Vanadium	mg/L	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	<0.01
Zinc	mg/L	0.005	0.034	0.007	0.012	0.066	1.200	<0.005	0.007	<0.005	0.006	0.012	na	0.020

Shaded grey = not required to be analysed

[a] No water present at this location at the time of sampling

[b] Overflow event

[c] Exceedence of 100 percentile concentration limit for total suspended solids (50 mg/L). Exceedence reported to the EPA on 19th December 2014.

[d] - measured with calibrated field meter

na - not analysed as no sample collected

Groundwater and surface water monitoring results

Table 4: November 2014 water monitoring results for monitoring points 40 - 52

		Monitoring points	40	41	42	43	44	45	46	47	48	49	50	51	52
		Location	TMB02	TMB03	S4MB01	TCMB01	TTMB02	SP1B[a]	SP2B[a]	SP4B[a]	SP6B[a]	SP7B[a]	SP8B[a]	SP9B[a]	SP10B[a]
		Sampled date	25/11/2014	25/11/2014	27/11/2014	25/11/2014	25/11/2014	25/11/2014	25/11/2014	25/11/2014	25/11/2014	25/11/2014	25/11/2014	25/11/2014	25/11/2014
		Date AGL obtained data	12/01/2014	12/01/2014	12/01/2014	12/01/2014	12/01/2014								
Analyte	**Units of measure**	**Limit of reporting**													
Aluminium	mg/L	0.01	<0.01	0.08	<0.01	0.04	0.03	na	na	na	na	na	na	na	na
Ammonia	mg/L	0.01	0.29	0.23	1.82	1.34	0.60	na	na	na	na	na	na	na	na
Arsenic	mg/L	0.001	0.003	0.006	0.002	<0.001	0.001	na	na	na	na	na	na	na	na
Barium	mg/L	0.001	0.770	0.218	6.190	7.400	0.804	na	na	na	na	na	na	na	na
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na	na	na	na	na	na
Bicarbonate	mg/L	1													
Boron	mg/L	0.05	<0.05	<0.05	0.16	<0.05	<0.05	na	na	na	na	na	na	na	na
Cadmium	mg/L	0.0001	<0.0001	0.0001	<0.0001	<0.0001	0.0097	na	na	na	na	na	na	na	na
Calcium	mg/L	1	188	392	341	212	220	na	na	na	na	na	na	na	na
Chloride	mg/L	0.1													
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na	na	na	na	na	na
Cobalt	mg/L	0.001	0.002	0.002	<0.001	<0.001	0.001	na	na	na	na	na	na	na	na
Copper	mg/L	0.001	<0.001	0.007	<0.001	0.002	0.013	na	na	na	na	na	na	na	na
Dissolved oxygen[b]	mg/L	0.01	1.43	1.42	2.74	0.90	0.92	na	na	na	na	na	na	na	na
Electrical conductivity	µS/cm	1	4010	6190	4810	3060	2350	na	na	na	na	na	na	na	na
Iron	mg/L	0.05	5.34	5.22	1.50	1.98	2.05	na	na	na	na	na	na	na	na
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.006	na	na	na	na	na	na	na	na
Magnesium	mg/L	1	85	151	58	70	48	na	na	na	na	na	na	na	na
Manganese	mg/L	0.001	1.230	1.620	0.198	0.064	0.105	na	na	na	na	na	na	na	na
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	na	na	na	na	na	na	na	na
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na	na	na	na	na	na
Nickel	mg/L	0.001	<0.001	0.001	<0.001	0.003	0.003	na	na	na	na	na	na	na	na
Nitrate	mg/L	0.01	0.04	0.03	<0.01	0.03	0.04	na	na	na	na	na	na	na	na
Nitrite	mg/L	0.01													
pH[b]	pH	0.01	6.60	6.49	6.99	6.93	6.50	na	na	na	na	na	na	na	na
Phosphorus (total)	mg/L	0.01	0.07	0.04	0.07	0.01	0.23	na	na	na	na	na	na	na	na
Potassium	mg/L	1	3	3	6	6	4	na	na	na	na	na	na	na	na
Reactive Phosphorus	mg/L	0.01													
Redox potential[b]	mV	0.1	-26.6	-22.3	-130.2	-27.5	-47.9	na	na	na	na	na	na	na	na
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	na	na	na	na	na	na	na
Silica	mg/L	0.1	35.0	32.8	29.3	20.7	33.6	na	na	na	na	na	na	na	na
Sodium	mg/L	1	507	714	638	325	226	na	na	na	na	na	na	na	na
Sodium Adsorption Ratio	ratio	0.01													
Standing water level	m AHD	0.01	Refer to table 5	Refer to table 5	Refer to table 5	Refer to table 5	Refer to table 5	na	na	na	na	na	na	na	na
Strontium (dissolved)	mg/L	0.001	3.320	7.380	24.300	14.900	3.140	na	na	na	na	na	na	na	na
Sulfate	mg/L	1	43	199	17	<1	49	na	na	na	na	na	na	na	na
Total alkalinity	mg/L	1	203	501	473	329	400	na	na	na	na	na	na	na	na
Total dissolved solids	mg/L	10	2540	4440	2880	1920	1450	na	na	na	na	na	na	na	na
Total organic carbon	mg/L	1													
Total suspended solids	mg/L	5													
Uranium	mg/L	0.001	<0.001	0.002	<0.001	<0.001	<0.001	na	na	na	na	na	na	na	na
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	na	na	na	na	na	na	na
Zinc	mg/L	0.005	0.013	0.026	<0.005	0.025	0.327	na	na	na	na	na	na	na	na

Shaded grey = not required to be analysed

[a] No water present at this location at the time of sampling

[b] - measured with calibrated field meter

na - not analysed as no sample collected

Table 5: Continuous electrical conductivity monitoring results for monitoring points 33, 34, 36, 37 and 38 for the period 20 August 2014 – 30 November 2014

Monitoring point	33	34	36	37	38
Location	CDE	CDW	ASW01	TSW01	TSW02
Data type	Electrical conductivity				
Units	µS/cm				
Data date range	20/8/2014 – 30/11/2014				
Date data downloaded	22/12/14	22/12/14	4/12/14	4/12/14	4/12/14
Date data supplied to AGL	07/01/15	07/01/15	07/01/15	07/01/15	07/01/15
Monitoring frequency required by EPL 20358	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours
Actual monitoring frequency	Every 1 hour	Every 1 hour	Every 15 minutes	Every 15 minutes	Every 15 minutes
No. of times measured during monitoring period	2157	2161	2102	dry	2155
Min. value	60.9	100.0	140.3	dry	6.0
Mean value	290.0	328.7	236.3	dry	453.0
Median value	277.5	325.0	235.8	dry	450.0
Max. value	554.3	505.0	1081.9	dry	987.0

Note - Loggers at ASW01, TSW01 and TSW02 were dry for some or all of the monitoring period.

Table 6: Continuous water level monitoring results for monitoring points 39 - 44 for the period 20 August 2014 – 30 November 2014

Monitoring point	30	31	39	40	41	42	43	44
Location	TMB04	TMB05	TMB01	TMB02	TMB03	S4MB01	TCMB01	TTMB02
Data type	Standing water level							
Units	mAHD							
Data date range	20/8/2014 – 30/11/2014							
Date data downloaded	25/11/14	25/11/14	04/12/14	04/12/14	4/12/14	3/12/14	4/12/14	3/12/14
Date data supplied to AGL	13/01/15	13/01/15	07/01/15	07/01/15	07/01/15	07/01/15	07/01/15	07/01/15
Monitoring frequency required by EPL 20358	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours
Actual monitoring frequency	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours
No. of times measured during monitoring period	391	391	412	412	412	157*	217**	411
Min. value	111.8	116.8	101.8	102.1	103.2	112.8	113.7	113.9
Mean value	113.4	119.1	102.3	102.4	103.4	112.9	113.8	114.0
Median value	113.4	119.1	102.4	102.4	103.4	112.9	113.8	114.0
Max. value	113.5	119.2	102.8	102.5	103.5	112.9	113.9	114.1

* S4MB01 logger operational from 22/10/14

**TCMB01 logger failed between 04/09/14 to 22/10/14

References

AGL, 2012a. Water Management Plan for the Tiedman Irrigation Program AGL. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Gloucester/Plans%20and%20Proposals/2013/May/AGL%20WMP%20Tiedman%20Irrigation%20V1%203%20140512%20Final%20Compiled%20LowRes.pdf

AGL, 2012b. Soil Quality Monitoring and Management Program. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Gloucester/Plans%20and%20Proposals/2013/May/Gloucester%20Soil%20Management.pdf

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

Parsons Brinckerhoff (PB) 2012. Phase 2 Groundwater Investigations – Stage 1 Gas Field Development Area, Gloucester Gas Project. Report dated January 2012, PR_5630. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Gloucester/Assessments%20and%20Reports/2012/January/PB%20Gloucester%20Groundwater%20Report%20Phase%202%20Appendices%20E-P.pdf

Parsons Brinckerhoff (PB) 2013a. Gloucester Gas Project – Tiedman Irrigation Trial Baseline Water Monitoring Program. Report dated January 2013, 2162406D PR_6306. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Gloucester/Plans%20and%20Proposals/2013/May/Gloucester%20Irrigation_PR.pdf

Parsons Brinckerhoff (PB) 2013b. Tiedman Irrigation Trial – August 2013 Water Compliance Report, Gloucester Gas Project. Report dated August 2013, 2162406F-WAT-RTP-7408 RevC. http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20Community%20News/Gloucester/Community%20Updates/2013/September/2162406F%20WAT%20RPT%207408%20FINAL_LowRes.pdf

Parsons Brinckerhoff (PB) 2014a. Tiedman Irrigation Program – Water Compliance Report for the Period 1 July to 31 December 2013, Gloucester Gas Project. Report dated January 2014, 2162406F-WAT-RPT-7674 RevB. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Gloucester/Assessments%20and%20Reports/2014/20140131_Teidman%20Irrigation%20Program%20%20%20Water%20Compliance%20Report.pdf

Parsons Brinckerhoff (PB) 2014b. Tiedman Irrigation Program – Water Compliance Report for the Period 1 January to 4 July 2014, Gloucester Gas Project. Report dated August 2014, 2162406F-WAT-RPT-7674 001 RevD. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/Gloucester%20Document%20Repository/Irrigation%20Program/20140828_Tiedman%20Irrigation%20Program%20%20%20Water%20Compliance%20Report.pdf

The State of NSW and Environment Protection Authority (EPA), 2012. Requirements for publishing pollution monitoring data. Environment Protection Authority, Sydney, Australia. Available online: http://www.epa.nsw.gov.au/resources/licensing/130742reqpubpmdata.pdf