

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 rounded rectangles of varying sizes and positions, creating a stepped effect.

AGL UPSTREAM INVESTMENTS PTY LTD

GLOUCESTER GAS PROJECT

**June 2015 Monitoring Report:  
Tiedman Irrigation Program  
EPL 20358**

Reporting Period: April - May 2015

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## Foreword

<b>PREMISES</b>	Gloucester Coal Seam Gas Project Bucketts Way Gloucester NSW 2422
<b>LICENCE DETAILS</b>	<a href="#"><u>Environment Protection Licence 20358</u></a>
<b>LICENCEE</b>	AGL Upstream Investments Pty Limited (AGL)
<b>LICENCEE'S ADDRESS</b>	Locked Bag 1837, North Sydney, NSW 2060
<b>MONITORING DATE</b>	21 April, and 1, 12, 13, and 14 May 2015
<b>MONITORING BY</b>	Parsons Brinckerhoff, on behalf of AGL
<b>ANALYSIS BY</b>	ALS Laboratory, Smithfield (Work orders: ES1520090, ES1521139, ES1521821, ES1521929, ES1522044)
<b>DATE AGL OBTAINED DATA</b>	19 and 29 May, and 5 June 2015
<b>REPORT DATE</b>	9 June 2015
<b>REPORT PREPARED BY</b>	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.

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 an overflow event at one (CDW) Tiedman Irrigation Program catch dam (21 April);
2. Monitoring results from the quarterly water sampling event at the Tiedman Irrigation Program (12, 13, and 14 May 2015); and
3. Monitoring results from an overflow event at both (CDW and CDE) Tiedman Irrigation Program catch dams (1 May 2015).

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, 2015).

The following 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 May 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](http://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)

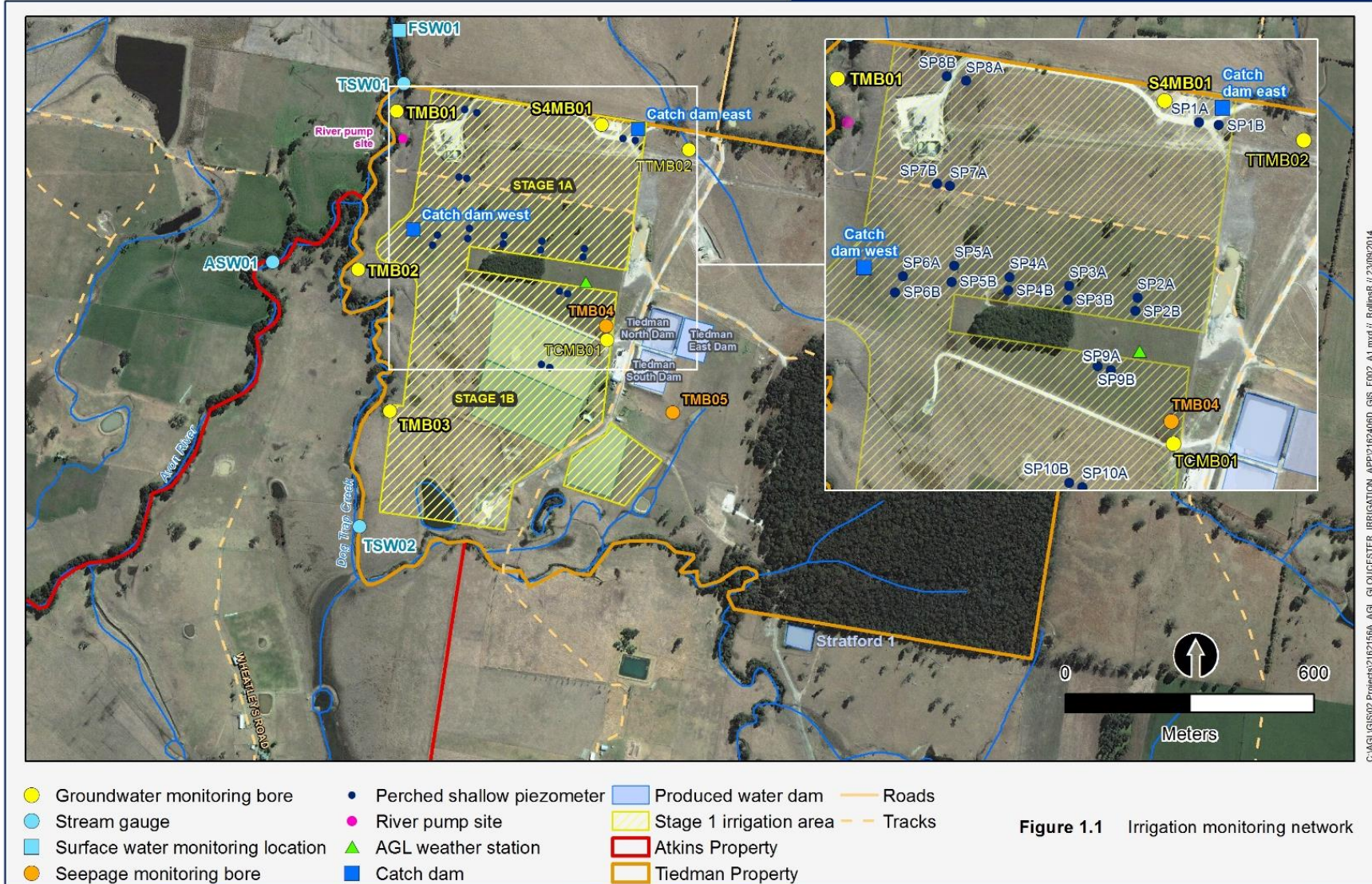


Figure 1.1 Irrigation monitoring network

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**Groundwater and surface water monitoring results**

**Table 3: April-May 2015 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 <sup>a</sup>	TMB01	
		Sampled date	12/05/2015	12/05/2015	12/05/2015	13/05/2015	14/05/2015	1/05/2015 <sup>b</sup>	21/04/2015 <sup>b</sup>	1/05/2015 <sup>b</sup>	13/05/2015	14/05/2015	13/05/2015	13/05/2015	
		Date AGL obtained data	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	19/05/2015	19/05/2015	19/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015	
Analyte	Units of measure	Limit of reporting													
Aluminium	mg/L	0.01	0.01	<0.01	0.02	0.05	0.15	1.16	0.01	0.04	0.03	0.01	0.02	0.14	<0.01
Ammonia	mg/L	0.01	0.01	<0.01	<0.01	0.04	3.06	0.08	0.09	0.07	0.03	0.02	0.03	<0.01	0.13
Arsenic	mg/L	0.001	0.003	0.003	<0.001	<0.001	0.001	0.002	0.002	0.003	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.001	0.115	0.149	0.076	0.054	0.282	0.085	0.119	0.045	0.034	0.037	0.032	0.031	0.185
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bicarbonate	mg/L	1	61	156	72	159	91								
Boron	mg/L	0.05	0.08	0.14	<0.05	<0.05	<0.05	0.07	0.1	0.06	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	0.0008	0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L	1	55	11	11	73	75	22	171	75	11	13	10	8	223
Chloride	mg/L	0.1	80.5	167	36.1	2060	2320								
Chromium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	0.089	0.162	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	0.002	0.002	<0.001	0.005	0.001	0.001	0.003	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved oxygen <sup>c</sup>	mg/L	0.01	15.15	11.60	10.07	4.81	9.18	12.83	1.86	16.15	6.75	8.40	6.78	6.20	2.03
Electrical conductivity	µS/cm	1	919	1120	312	7140	7570	298	1520	754	269	295	275	437	7500
Iron	mg/L	0.05	<0.05	<0.05	<0.05	1.53	32.8	0.6	<0.05	0.09	0.26	0.2	0.26	0.45	2.31
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L	1	14	5	2	200	231	5	33	15	8	7	7	9	199
Manganese	mg/L	0.001	0.004	0.004	0.004	9.64	17.2	0.004	0.046	0.001	0.054	0.051	0.048	0.036	0.891
Mercury	mg/L	0.0001						<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	0.005	0.004	<0.001	<0.001	0.002	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	<0.001	<0.001	<0.001	0.038	0.075	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Nitrate	mg/L	0.01	<0.01	<0.01	<0.01	0.06	0.01	0.27	1.68	0.65	0.03	0.04	0.03	0.01	<0.01
Nitrite	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01								
pH <sup>d</sup>	pH	0.01	9	9.13	7.15	5.75	5.83	7.51	7.47	8.17	6.7	6.99	7.1	7	6.34
Phosphorus (Total)	mg/L	0.01	1.03	0.85	0.2	0.08	2.04	0.89	1.44	1.33	0.05	0.03	0.04	0.07	0.04
Potassium	mg/L	1	34	56	10	19	16	11	29	18	2	2	2	3	2
Reactive Phosphorus	mg/L	0.01	0.33	0.01	<0.01	<0.01	<0.01								
Redox potential <sup>d</sup>	mV	0.1	60.7	72.8	-36.3	28.7	-5.6	184.0	214.8	153.7	-22.9	-29.2	-35.2	-20.3	-16.0
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	<0.01	<0.01	<0.01
Silica	mg/L	0.1						7.9	14.3	6.5	22.1	22.2	22	14.6	38.6
Sodium	mg/L	1	104	200	51	1020	938	30	106	60	32	30	30	34	1060
Sodium Adsorption Ratio	ratio	0.01		12.6											
Standing water level	m AHD	0.01				Refer to table 5	Refer to table 5								Refer to table 6
Strontium (dissolved)	mg/L	0.001	0.345	0.201	0.12	0.724	1.36	0.118	0.792	0.389	0.124	0.146	0.119	0.101	5.42
Sulfate	mg/L	1	206	12	3	605	207	70	612	276	10	9	10	15	81
Total alkalinity	mg/L	1						43	100	56	43	54	48	48	562
Total dissolved solids	mg/L	10	560	586	186	4660	4580	388	1130	558	181	181	184	193	4780
Total organic carbon	mg/L	1	20	25	14	8	59								
Total suspended solids	mg/L							230 <sup>e</sup>	36	635 <sup>e</sup>	<5	26	<5	<5	
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	<0.001	<0.001	0.001
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	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	<0.005	0.009	<0.005	0.269	0.272	0.058	0.012	<0.005	0.047	0.005	<0.005	0.007	0.021

Shaded grey = not required to be analysed

<sup>a</sup> No water present at this location at the time of sampling

<sup>b</sup> Overflow event

<sup>c</sup> Exceedence of 100 percentile concentration limit for total suspended solids (50 mg/L). Exceedence reported to the EPA on 20 May 2015.

<sup>d</sup> measured with calibrated field meter

na - not analysed as no sample collected





**Groundwater and surface water monitoring results**

**Table 4: May 2015 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 <sup>a</sup>	SP2B <sup>a</sup>	SP4B <sup>a</sup>	SP6B <sup>a</sup>	SP7B <sup>a</sup>	SP8B <sup>a</sup>	SP9B <sup>a</sup>	SP10B <sup>a</sup>
		Sampled date	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015	13/05/2015
		Date AGL obtained data	29/05/2015	29/05/2015	29/05/2015	29/05/2015	29/05/2015						29/05/2015		
Analyte	Units of measure	Limit of reporting													
Aluminium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	na	na	na	na	1.6	na	na
Ammonia	mg/L	0.01	0.3	0.09	1.74	1.2	0.53	na	na	na	na	na	0.04	na	na
Arsenic	mg/L	0.001	0.003	0.003	<0.001	<0.001	<0.001	na	na	na	na	na	0.004	na	na
Barium	mg/L	0.001	0.796	0.186	8.27	8.23	0.716	na	na	na	na	na	0.191	na	na
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na	na	na	<0.001	na	na
Bicarbonate	mg/L	1													
Boron	mg/L	0.05	<0.05	<0.05	0.15	<0.05	<0.05	na	na	na	na	na	<0.05	na	na
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	na	na	na	na	na	<0.0001	na	na
Calcium	mg/L	1	164	211	455	309	190	na	na	na	na	na	2	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	0.001	na	na
Cobalt	mg/L	0.001	0.001	0.005	<0.001	<0.001	<0.001	na	na	na	na	na	0.002	na	na
Copper	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na	na	na	0.005	na	na
Dissolved oxygen <sup>b</sup>	mg/L	0.01	1.72	4.07	0.73	0.65	0.88	na	na	na	na	na	5.46	na	na
Electrical conductivity	µS/cm	1	3720	5780	4790	3000	2490	na	na	na	na	na	405	na	na
Iron	mg/L	0.05	6.7	1.28	1.73	1.55	2.52	na	na	na	na	na	2.98	na	na
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na	na	na	0.004	na	na
Magnesium	mg/L	1	91	134	62	73	52	na	na	na	na	na	3	na	na
Manganese	mg/L	0.001	1.08	1.74	0.164	0.03	0.092	na	na	na	na	na	0.042	na	na
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	na	na	na	na	na	<0.0001	na	na
Molybdenum	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	na	na	na	na	na	<0.001	na	na
Nickel	mg/L	0.001	<0.001	<0.001	0.003	<0.001	<0.001	na	na	na	na	na	0.004	na	na
Nitrate	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	na	na	na	na	0.53	na	na
Nitrite	mg/L	0.01													
pH <sup>c</sup>	pH	0.01	6.21	6.46	6.96	6.87	6.61	na	na	na	na	na	6.81	na	na
Phosphorus (total)	mg/L	0.01	0.06	0.02	0.08	<0.01	0.27	na	na	na	na	na	0.68	na	na
Potassium	mg/L	1	3	2	6	4	3	na	na	na	na	na	<1	na	na
Reactive Phosphorus	mg/L	0.01													
Redox potential <sup>b</sup>	mV	0.1	-15.2	-17.9	-122.9	-102.2	-129.5	na	na	na	na	na	14.4	na	na
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	na	na	na	na	<0.01	na	na
Silica	mg/L	0.1	35.2	32.6	29.7	20.5	34.8	na	na	na	na	na	67.1	na	na
Sodium	mg/L	1	443	796	631	276	233	na	na	na	na	na	80	na	na
Sodium Adsorption Ratio	ratio	0.01													
Standing water level	m AHD	0.01	Refer to table 6	Refer to table 6	Refer to table 6	Refer to table 6	Refer to table 6	na	na	na	na	na	Refer to table 6	na	na
Strontium (dissolved)	mg/L	0.001	3.43	4.89	23.9	14.2	3.01	na	na	na	na	na	0.013	na	na
Sulfate	mg/L	1	20	214	14	2	52	na	na	na	na	na	55	na	na
Total alkalinity	mg/L	1	174	575	575	324	378	na	na	na	na	na	10	na	na
Total dissolved solids	mg/L	10	2450	3190	3050	2110	1480	na	na	na	na	na	3110	na	na
Total organic carbon	mg/L	1													
Total suspended solids	mg/L	5													
Uranium	mg/L	0.001	<0.001	0.008	<0.001	<0.001	<0.001	na	na	na	na	na	<0.001	na	na
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	na	na	na	na	na	<0.01	na	na
Zinc	mg/L	0.005	0.007	0.014	0.011	0.014	0.011	na	na	na	na	na	0.027	na	na

Shaded grey = not required to be analysed

<sup>a</sup> No water present at this location at the time of sampling

<sup>b</sup> 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 01 December 2014 – 13 May 2015**

Monitoring point	33	34	36	37	38
Location	CDE	CDW	ASW01*	TSW01	TSW02
Data type	Electrical conductivity				
Units	µS/cm				
Data date range	01/12/14 – 31/03/15 (points 36, 37) 01/12/14 – 13/05/15 (points 33, 34 and 38)				
Date data downloaded	13/05/15	13/05/15	31/03/15	31/03/15	13/05/15
Date data supplied to AGL	05/06/15	05/06/15	05/06/15	05/06/15	05/06/15
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	3920	3920	10176	11552	15690
Min. value	15.3	155.0	93.0	86.0	75.0
Mean value	566.2	788.0	258.9	273.0	384.1
Median value	427.4	705.0	267.0	284.0	359.0
Max. value	2998.4	2800.0	429.0	453.0	870.0

\* Logger failure between 04/12/15 and 18/12/15.

**Table 6: Continuous water level monitoring results for monitoring points 39 - 44 for the period 24 February 2015 - 13 May 2015**

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	24/02/15 - 13/05/15							
Date data downloaded	12/05/15	12/05/15	13/05/15	13/05/15	13/05/15	12/05/15	30/03/15	13/05/15
Date data supplied to AGL	05/06/15	05/06/15	05/06/15	05/06/15	05/06/15	05/06/15	05/06/15	05/06/15
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	308	308	309	309	307	308	136	24
Min. value	111.6	116.4	102.7	102.4	103.2	112.8	113.7	113.9
Mean value	113.2	119.1	103.0	102.7	103.4	112.9	113.8	114.0
Median value	113.2	119.2	102.9	102.7	103.4	112.9	113.8	114.0
Max. value	113.3	119.2	104.1	103.2	104.0	113.0	113.8	114.0

\* No data from 30/03/15 to 13/05/15 due to logger communication failure. Logger will be replaced at the next monitoring round, and data retrieval will be attempted by logger supplier.

\*\* No data from 24/02/15 to 07/05/15. Data is currently being retrieved by logger supplier.

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