Sustainable Minerals Institute
Sir James Foots Building
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Director
Professor Neville Plint
CRICOS PROVIDER NUMBER 00025B

28 January 2020

Mr. Stephen Love
Environment & Community Superintendent
Metropolitan Coal
Peabody Energy Australia
PO Box 402
Helensburgh NSW 2508

Dear Stephen,

Subject: Pools P and U Gas Releases – Assessment against Subsidence Impact Performance Measure

Background and Purpose

In the July to September 2019 period, gas releases have been observed in Pools P and U on the Waratah Rivulet downstream of the Longwall 23 maingate.

The Longwall 304 Water Management Plan subsidence impact performance indicator for gas releases on the Waratah Rivulet, *Gas releases in Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir have not increased beyond those observed up to the commencement of Longwall 301 extraction,* has been exceeded at Pools P and U as a result of free carbon dioxide concentrations being above 13 mg/L (Pool P – 32 mg/L on 6 August 2019 and 20 mg/L on 3 September 2019, and Pool U – 34 mg/L on 31 July 2019 and 38 mg/L on 3 September 2019).

Following the exceedance of the performance indicator in July 2019, an assessment against the performance measure for the Waratah Rivulet was undertaken. The assessment concluded that the performance measure, *Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases)*, had not been exceeded as a result of the gas releases observed at Pool U. Accordingly, this assessment only considers the results for September 2019 at Pool U.

An assessment is provided for the Pools P and U gas releases against the performance measure for the Waratah Rivulet, between the full supply level of the Woronora Reservoir and the maingate of Longwall 23:

> *Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) …*

Figure 1 shows the location of Pools P and U on Waratah Rivulet in relation to the mining of Longwalls 20-27 and Longwalls 301-304. The gas releases in Pools P and U are a continuation of previously recorded gas releases during the mining of Longwalls 20-27. Longwall 27 was completed in March 2017. Longwall 301 commenced in June 2017 and was completed in February 2018. Longwall 302 commenced in March 2018 and was completed in October 2018. Longwall 303 commenced in November 2018 and was completed in May 2019. Longwall 304 commenced in July 2019.

Supporting Information

Information considered in the assessment has included:

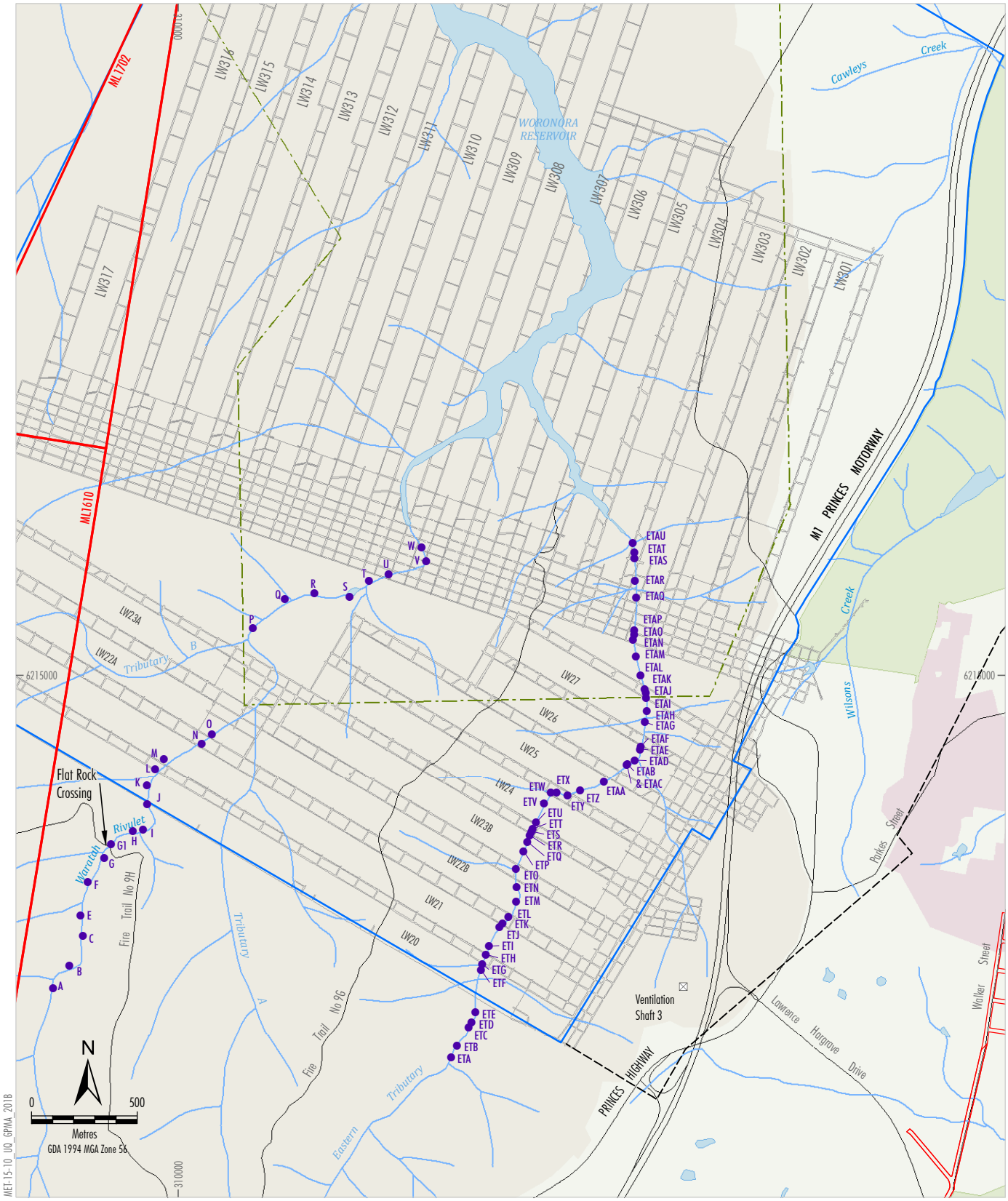
- Water quality sampling (gas concentration) results for Waratah Rivulet gas releases in Pools A, J, K, L, O, P, S, U and W and for Eastern Tributary gas releases in Pools ETAG, ETAH, ETAI, ETAL and ETAM.
- Metropolitan Coal routine water quality monitoring data for Pools J, K, L, M, N, O, P, R, S, T, U, V and W on the Waratah Rivulet.

Gas Release Water Quality Sample Results

Gas releases observed by Metropolitan Coal are monitored weekly (i.e. a description of the gas release is recorded [isolated bubbles or continuous stream], and a water sample is taken to determine the type of gas [i.e. methane or carbon dioxide]).

Samples of water have been collected from pools following observations of gas releases by Metropolitan Coal and forwarded to the laboratory for measurement of pH, free carbon dioxide, total carbon dioxide and methane (Table 1).

The direct measurement of dissolved methane is the most reliable method to measure methane in water. Column 6 in Table 1 converts the dissolved methane concentrations to carbon. Multiplying the dissolved methane (mg/L) concentration by 0.75 (the fraction of carbon in methane) gives the amount of carbon (mg/L) in water. The dissolved methane concentrations expressed as –C (carbon) mg/L in Table 1 can be compared against the measurements of total organic carbon (TOC) (mg/L) in water (Attachment 1). The dissolved methane concentrations expressed as –C (carbon) mg/L in Pools P and U (Table 1) are all very low. That is, the dissolved methane concentrations in Pools P and U are contributing an insignificant amount of carbon to each respective pool, as evidenced by the dissolved methane concentrations recorded in Table 1 and comparison with TOC (Attachment 1).



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)
- Pool

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2018); MSEC (2018)

Notes: 1. The streams are based on mapping by the Lands Department (2006). More detailed and accurate mapping of the streams is provided in WMP Appendices 1 to 4.

Peabody
METROPOLITAN COAL

Waratah Rivulet and Eastern Tributary Pools

Figure 1

Table 1 **Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary**

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Waratah Rivulet					
Pool A					
2 February 2017	6.90	5	54	0.031	0.0233
6 February 2017	7.34	5	54	0.092	0.0690
15 February 2017	6.70	4	40	0.026	0.0195
21 February 2017	6.60	4	47	0.027	0.0203
9 March 2017	6.40	3	10	<0.010	<0.0075
29 March 2017	6.30	3	16	0.014	0.0105
11 April 2017	6.91	3	14	0.025	0.0188
19 April 2017	6.50	4	22	0.018	0.0135
27 April 2017	6.70	2	22	0.017	0.0128
2 May 2017	6.60	7	34	0.023	0.0173
10 May 2017	6.80	9	39	0.031	0.0233
18 May 2017	6.70	14	43	0.017	0.0128
22 May 2017	6.70	13	42	0.019	0.0143
14 June 2017	6.40	6	13	<0.010	<0.0075
22 June 2017	6.80	2	16	<0.010	<0.0075
3 July 2017	6.70	10	31	0.028	0.0210
17 July 2017	6.46	23	52	0.015	0.0113
12 September 2017	6.90	4	48	0.014	0.0105
24 October 2017	7.10	2	55	<0.010	<0.0075
6 April 2018	6.30	6	38	0.029	0.0218
10 April 2018	6.60	9	48	<0.010	<0.0075
19 April 2018	6.70	11	55	<0.010	<0.0075
23 April 2018	6.80	6	53	0.010	0.0075
30 April 2018	6.70	9	54	0.014	0.0105
8 May 2018	7.10	5	51	<0.010	<0.0075
15 May 2018	6.80	4	53	0.012	0.0090
22 May 2018	6.80	5	54	0.036	0.0270
30 May 2018	6.70	5	53	<0.010	<0.0075
4 June 2018	6.70	5	57	<0.010	<0.0075
22 June 2018	6.70	6	48	<0.010	<0.0075
28 June 2018	6.80	4	50	<0.010	<0.0075
3 July 2018	6.70	5	49	<0.010	<0.0075
12 July 2018	7.10	2	48	<0.010	<0.0075
25 July 2018	6.83	16	65	<0.010	<0.0075
15 August 2018	7.65	2	49	<0.010	<0.0075
5 September 2018	7.38	5	48	<0.010	<0.0075

Table 1 Cont. **Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary**

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool A (Continued)					
11 September 2018	7.02	9	49	<0.010	<0.0075
27 September 2018	7.51	3	42	<0.010	<0.0075
3 October 2018	7.20	6	48	<0.010	<0.0075
23 October 2018	6.60	5	22	0.011	0.0083
30 October 2018	7.06	6	34	0.036	0.0270
7 November 2018	6.80	4	45	<0.010	<0.0075
22 November 2018	7.54	3	56	<0.010	<0.0075
27 November 2018	7.00	3	55	<0.010	<0.0075
5 December 2018	7.19	4	33	<0.010	<0.0075
11 December 2018	6.90	11	50	<0.010	<0.0075
15 January 2019	7.53	3	49	0.015	0.0113
23 January 2019	7.39	4	52	<0.010	<0.0075
5 February 2019	7.17	8	57	<0.010	<0.0075
19 February 2019	7.12	8	56	0.080	0.0600
28 March 2019	7.33	2	22	<0.010	<0.0075
2 April 2019	7.33	2	23	<0.010	<0.0075
9 April 2019	7.23	2	21	0.014	0.0105
18 April 2019	8.20	<1	36	<0.010	<0.0075
24 April 2019	7.51	2	36	<0.010	<0.0075
30 April 2019	7.46	3	36	<0.010	<0.0075
15 May 2019	7.34	4	45	<0.010	<0.0075
21 May 2019	7.53	3	48	0.011	0.0083
13 June 2019	6.96	10	50	0.110	0.0825
18 June 2019	7.08	6	36	<0.010	<0.0075
27 June 2019	7.48	3	39	<0.010	<0.0075
10 July 2019	6.69	8	27	0.011	0.0083
16 July 2019	6.55	19	48	0.013	0.0098
6 August 2019	6.49	32	75	<0.01	<0.0075
20 August 2019	6.34	47	92	<0.01	<0.0075
5 September 2019	7.23	4	34	<0.01	<0.0075
25 September 2019	6.20	23	38	<0.01	<0.0075

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Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool J[1]					
29 February 2016	7.59	2	31	0.091	0.0683
07 March 2016	7.40	2	36	0.155	0.1163
14 March 2016	7.40	2	42	0.121	0.0908
21 March 2016	7.40	2	38	0.142	0.1065
29 March 2016	7.40	4	39	0.056	0.0420
04 April 2016	7.50	2	35	0.068	0.0510
11 April 2016	7.60	2	41	0.051	0.0383
Pool K					
14 February 2014	7.40	1	40	1.180	0.8850
25 July 2014	7.50	2	40	0.014	0.0105
5 August 2014	7.50	2	44	0.359	0.2693
13 August 2014	7.60	3	51	0.556	0.4170
3 September 2014	7.10	3	13	<0.010	<0.0075
30 December 2014	-	-	-	0.358	0.2685
4 June 2015	7.43	2	23	<0.010	<0.0075
16 October 2015	7.30	2	32	0.413	0.3098
23 October 2015	7.50	1	32	0.374	0.2805
30 October 2015	7.40	4	40	0.510	0.3825
25 November 2015	7.40	2	28	0.036	0.0270
9 December 2015	7.50	2	38	0.076	0.0570
17 February 2016	7.50	3	31	<0.010	<0.0075
Pool L					
14 February 2014	6.50	4	53	10.500	7.8750
5 May 2014	6.80	<1	27	2.100	1.5750
12 May 2014	7.48	2	32	1.090	0.8175
19 May 2014	6.80	4	36	1.520	1.1400
27 May 2014	7.43	3	36	1.230	0.9225
3 June 2014	7.33	4	38	1.850	1.3875
25 June 2014	7.40	2	38	1.380	1.0350
1 July 2014	7.20	2	40	1.990	1.4925
10 July 2014	7.30	2	40	1.970	1.4775
14 July 2014	7.30	4	42	2.460	1.8450
25 July 2014	7.20	2	42	3.150	2.3625
5 August 2014	7.10	3	46	4.200	3.1500
13 August 2014	7.20	5	48	2.850	2.1375
3 September 2014	6.90	4	13	1.880	1.4100
11 September 2014	6.97	3	18	2.740	2.0550

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Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool L (Continued)					
16 September 2014	6.93	5	26	2.620	1.9650
23 September 2014	7.07	4	27	3.270	2.4525
30 September 2014	7.60	2	29	1.740	1.3050
9 October 2014	-	<1	32	2.100	1.5750
13 October 2014	-	<1	40	2.310	1.7325
21 October 2014	7.40	2	20	1.480	1.1100
28 October 2014	7.44	-	-	1.540	1.1550
4 November 2014	7.41	3	41	2.020	1.5150
11 November 2014	6.52 (field)	2	34	2.490	1.8675
18 November 2014	7.47	3	44	2.800	2.1000
26 November 2014	7.06	8	46	3.720	2.7900
3 December 2014	7.59	2	34	1.760	1.3200
17 December 2014	7.39	2	22	1.880	1.4100
30 December 2014	-	-	-	1.510	1.1325
8 January 2015	7.18	5	40	1.890	1.4175
20 January 2015	6.88 (field)	2	13	0.339	0.2543
30 January 2015	-	2	13	0.339	0.2543
4 February 2015	-	3	23	0.834	0.6255
11 February 2015	6.44 (field)	2	27	1.890	1.4175
17 February 2015	-	1	12	1.350	1.0125
23 February 2015	7.21	3	24	1.200	0.9000
2 March 2015	7.29	2	15	1.290	0.9675
16 March 2015	7.46	2	28	1.490	1.1175
23 March 2015	7.36	3	37	1.100	0.8250
21 May 2015	7.04	2	24	0.606	0.4545
4 June 2015	7.06	4	27	0.649	0.4868
23 June 2015	6.98	2	13	0.247	0.1853
17 September 2015	7.12	2	25	0.951	0.7133
23 September 2015	7.20	5	26	0.916	0.6870
1 October 2015	7.00	3	27	1.060	0.7950
7 October 2015	6.90	4	29	1.640	1.2300
16 October 2015	6.90	4	35	1.440	1.0800
23 October 2015	7.40	2	32	0.518	0.3885
30 October 2015	7.40	4	40	0.798	0.5985
12 November 2015	7.60	1	25	0.058	0.0435
25 November 2015	7.40	2	30	0.831	0.6233
3 December 2015	7.30	2	36	1.120	0.8400

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Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool L (Continued)					
9 December 2015	7.20	2	40	0.828	0.6210
18 December 2015	5.43	<1	<1	2.100	1.5750
13 January 2016	6.80	1	16	1.090	0.8175
21 January 2016	6.60	3	19	1.840	1.3800
28 January 2016	7.30	1	19	0.982	0.7365
2 February 2016	7.32	1	14	0.799	0.5993
11 February 2016	7.40	3	26	1.270	0.9525
17 February 2016	7.30	2	34	0.777	0.5828
24 February 2016	7.40	8	33	0.429	0.3218
29 February 2016	7.11	5	34	1.680	1.2600
7 March 2016	7.90	2	38	1.940	1.4550
14 March 2016	7.00	3	42	1.710	1.2825
21 March 2016	6.80	4	41	2.300	1.7250
29 March 2016	7.10	4	40	2.920	2.1900
4 April 2016	7.00	4	39	1.590	1.1925
11 April 2016	6.90	6	46	4.310	3.2325
18 April 2016	6.80	4	44	4.240	3.1800
26 April 2016	6.80	5	45	2.920	2.1900
3 May 2016	6.90	5	42	2.780	2.0850
10 May 2016	7.70	3	38	0.079	0.0593
16 May 2016	7.00	6	47	2.830	2.1225
24 May 2016	7.20	4	43	1.040	0.7800
30 May 2016	7.00	4	44	2.220	1.6650
16 June 2016	7.21	2	18	0.530	0.3975
24 June 2016	7.00	7	27	0.456	0.3420
30 June 2016	6.60	6	32	2.820	2.1150
6 July 2016	7.02	6	33	2.190	1.6425
14 July 2016	7.20	3	16	0.314	0.2355
19 July 2016	7.10	6	21	0.156	0.1170
26 July 2016	6.80	1	21	1.840	1.3800
2 August 2016	7.00	6	75	1.870	1.4025
10 August 2016	7.00	7	19	0.277	0.2078
17 August 2016	6.80	1	20	0.354	0.2655
23 August 2016	7.30	6	24	<0.010	<0.0075
31 August 2016	6.80	6	23	0.909	0.6818
7 September 2016	6.90	4	19	0.314	0.2355
15 September 2016	7.00	2	24	0.469	0.3518

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Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool L (Continued)					
20 September 2016	6.80	5	29	1.830	1.3725
27 September 2016	6.70	4	30	1.790	1.3425
7 October 2016	7.50	8	36	0.992	0.7440
13 October 2016	5.74 (field)	6	41	1.450	1.0875
17 October 2016	6.80 (field)	7	43	1.760	1.3200
26 October 2016	7.00	3	36	1.310	0.9825
1 November 2016	7.13	6	39	1.510	1.1325
8 November 2016	7.39	3	38	1.380	1.0350
17 November 2016	7.60	5	40	0.939	0.7043
30 November 2016	7.50	4	41	1.070	0.8025
20 December 2016	7.44	3	46	1.070	0.8025
28 December 2016	7.36	4	46	1.220	0.9150
24 January 2017	6.60	2	51	4.300	3.2250
2 February 2017	6.90	4	51	0.850	0.6375
6 February 2017	7.50	3	50	1.110	0.8325
29 March 2017	6.60	2	12	0.392	0.2940
11 April 2017	6.89	2	11	0.213	0.1598
19 April 2017	7.20	2	18	0.209	0.1568
27 April 2017	7.10	1	21	0.238	0.1785
2 May 2017	6.80	4	29	0.397	0.2978
10 May 2017	6.90	7	42	0.921	0.6908
18 May 2017	6.80	13	42	0.863	0.6473
30 May 2017	7.20	4	34	0.651	0.4883
3 July 2017	6.80	8	30	0.548	0.4110
12 September 2017	6.90	2	40	0.015	0.0113
19 September 2017	7.20	6	46	0.514	0.3855
25 September 2017	6.90	5	43	1.780	1.3350
11 October 2017	7.20	2	44	0.739	0.5543
17 October 2017	7.10	4	49	0.874	0.6555
24 October 2017	7.3	3	48	1.450	1.0875
31 October 2017	6.6	5	50	2.440	1.8300
14 November 2017	7.1	4	49	0.844	0.6330
22 November 2017	7.0	5	45	0.631	0.4732
8 December 2017	7.4	4	51	2.040	1.5300
19 December 2017	6.8	5	53	1.760	1.3200
4 January 2018	7.01	13	70	2.280	1.7100
5 February 2018	6.80	5	63	1.420	1.0650

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Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool L (Continued)					
12 February 2018	6.80	22	84	2.300	1.7250
2 March 2018	6.80	16	64	1.820	1.3650
6 March 2018	7.40	9	54	0.812	0.6090
20 March 2018	6.80	4	43	1.110	0.8325
6 April 2018	7.00	2	30	0.416	0.3120
10 April 2018	6.80	3	36	0.387	0.2903
30 October 2018	7.24	4	32	0.556	0.4170
7 November 2018	7.00	3	39	0.604	0.4530
16 November 2018	7.00	2	51	1.190	0.8925
22 November 2018	7.40	4	47	0.679	0.5093
27 November 2018	7.10	2	48	0.803	0.6023
5 December 2018	7.37	2	29	0.379	0.2843
11 December 2018	7.07	11	70	0.700	0.5250
15 January 2019	7.61	2	39	0.652	0.4890
31 January 2019	6.80	7	49	0.690	0.5175
5 February 2019	7.09	8	51	0.830	0.6225
5 March 2019	7.24	6	51	2.330	1.7475
14 March 2019	7.18	8	62	2.440	1.8300
2 April 2019	7.51	2	25	0.544	0.4080
24 April 2019	7.41	3	34	0.388	0.2910
30 April 2019	7.26	6	54	0.652	0.4890
15 May 2019	7.40	3	38	1.340	1.0050
21 May 2019	7.47	3	42	0.376	0.2820
29 May 2019	7.28	5	47	1.510	1.1325
13 June 2019	6.98	9	48	1.130	0.8475
27 June 2019	7.66	2	37	0.564	0.4230
10 July 2019	6.86	7	31	1.250	0.9375
16 July 2019	6.73	12	40	0.943	0.7073
25 July 2019	8.00	<1	36	0.510	0.3825
31 July 2019	6.47	27	62	0.893	0.6698
6 August 2019	6.41	35	75	0.776	0.5820
5 September 2019	7.33	3	33	1.160	0.8700
10 September 2019	7.50	3	40	0.822	0.6165

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Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool O					
5 May 2014	7.40	2	28	0.036	0.0270
12 May 2014	7.46	2	32	0.203	0.1523
19 May 2014	6.90	2	34	0.127	0.0953
27 May 2014	7.29	3	36	0.026	0.0195
3 June 2014	7.10	6	38	0.017	0.0128
5 August 2014	7.00	4	46	0.214	0.1605
3 September 2014	7.20	<1	13	0.309	0.2318
11 September 2014	7.14	2	17	0.721	0.5408
16 September 2014	7.26	3	25	0.508	0.3810
23 September 2014	7.12	4	28	1.610	1.2075
30 September 2014	7.59	2	28	0.518	0.3885
9 October 2014	-	<1	30	0.447	0.3353
13 October 2014	-	<1	39	0.311	0.2333
21 October 2014	7.50	2	23	0.465	0.3488
28 October 2014	7.43	-	-	0.368	0.2760
4 November 2014	7.26	4	40	0.382	0.2865
11 November 2014	7.09 (field)	3	18	0.060	0.0450
18 November 2014	7.70	2	42	0.072	0.0540
26 November 2014	7.22	5	43	0.262	0.1965
3 December 2014	7.69	2	36	0.050	0.0375
18 December 2014	7.47	1	20	0.026	0.0195
30 December 2014	-	-	-	0.044	0.0330
8 January 2015	7.29	4	40	0.207	0.1553
20 January 2015	7.42 (field)	3	28	0.060	0.0450
30 January 2015	-	1	13	0.056	0.0420
4 February 2015	-	2	23	0.091	0.0683
11 February 2015	6.67 (field)	2	28	0.102	0.0765
17 February 2015	-	1	17	0.033	0.0248
23 February 2015	7.24	3	24	0.045	0.0338
2 March 2015	7.38	2	25	0.104	0.0780
16 March 2015	7.62	1	29	0.088	0.0660
23 March 2015	7.54	2	36	0.096	0.0720
21 May 2015	7.32	1	20	0.129	0.0968
4 June 2015	7.26	3	26	0.072	0.0540
23 June 2015	7.08	2	14	0.045	0.0338

Table 1 Cont. Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool P					
14 February 2014	7.10	2	55	0.146	0.1095
3 September 2014	7.10	3	15	0.320	0.2400
11 September 2014	7.22	3	22	0.170	0.1275
16 September 2014	7.33	3	27	0.059	0.0443
23 September 2014	7.26	3	30	0.129	0.0968
30 September 2014	7.63	2	32	0.051	0.0383
9 October 2014	-	<1	39	0.058	0.0435
13 October 2014	-	<1	51	0.129	0.0968
21 October 2014	7.50	2	24	0.061	0.0458
28 October 2014	7.56	-	-	0.043	0.0323
21 May 2015	7.23	2	26	0.081	0.0608
23 June 2015	7.10	2	17	0.064	0.0480
11 February 2016	7.40	4	35	0.175	0.1313
14 March 2016	7.00	3	65	0.517	0.3878
22 March 2016	7.20	3	52	0.298	0.2235
30 March 2016	7.20	3	50	0.159	0.1193
11 April 2016	7.20	3	60	0.732	0.5490
19 April 2016	7.30	2	51	0.154	0.1155
26 April 2016	7.20	3	52	0.228	0.1710
3 May 2016	7.30	3	56	0.207	0.1553
10 May 2016	7.20	5	59	0.214	0.1605
17 May 2016	7.30	3	59	0.370	0.2775
23 May 2016	7.40	3	61	0.350	0.2625
16 June 2016	7.54	2	27	0.111	0.0833
1 July 2016	7.10	4	31	0.200	0.1500
6 July 2016	7.27	3	32	0.116	0.0870
19 July 2016	7.00	5	27	0.072	0.0540
27 July 2016	6.90	19	39	0.118	0.0885
2 August 2016	7.10	5	28	0.138	0.1035
11 August 2016	6.90	4	23	0.084	0.0630
17 August 2016	6.90	2	26	0.080	0.0600
22 August 2016	7.70	5	30	0.162	0.1215
31 August 2016	6.90	5	26	0.130	0.0975
14 September 2016	6.80	12	37	0.081	0.0608
21 September 2016	7.00	3	32	0.098	0.0735
26 September 2016	7.00	3	32	0.136	0.1020

Table 1 Cont. Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool P (Continued)					
5 October 2016	8.00	10	45	0.192	0.1440
17 October 2016	6.46 (field)	6	51	0.225	0.1688
24 October 2016	7.10	3	51	0.399	0.2993
31 October 2016	7.41	4	48	0.162	0.1215
8 November 2016	7.56	3	48	0.178	0.1335
15 November 2016	7.40	2	50	0.297	0.2228
24 November 2016	6.89 (field)	6	62	0.396	0.2970
30 November 2016	6.90	10	58	0.420	0.3150
6 December 2016	7.75	2	49	0.111	0.0833
19 December 2016	7.67	2	55	0.232	0.1740
28 December 2016	7.55	4	66	0.228	0.1710
6 January 2017	7.20	5	55	0.237	0.1778
12 January 2017	7.10	4	53	0.138	0.1035
19 January 2017	7.40	3	72	0.178	0.1335
25 January 2017	7.30	2	65	0.132	0.0990
2 February 2017	7.20	4	73	0.204	0.1530
6 February 2017	7.64	3	61	0.080	0.0600
15 February 2017	7.00	3	59	0.149	0.1118
22 February 2017	7.10	3	63	0.128	0.0960
9 March 2017	6.80	2	12	0.039	0.0293
29 March 2017	6.80	2	14	0.051	0.0383
12 April 2017	7.03	3	17	0.039	0.0293
21 April 2017	7.00	3	21	0.128	0.0960
28 April 2017	7.10	1	27	0.137	0.1028
2 May 2017	6.60	5	32	0.082	0.0615
9 May 2017	6.80	6	40	0.146	0.1095
18 May 2017	7.10	6	42	0.163	0.1223
25 May 2017	7.00	8	45	0.123	0.0923
30 May 2017	6.80	13	48	0.160	0.1200
8 June 2017	7.00	8	42	0.128	0.0960
21 June 2017	6.90	2	21	0.057	0.0428
27 June 2017	6.60	2	26	0.083	0.0623
3 July 2017	6.90	9	40	0.106	0.0795
12 July 2017	7.10	16	48	0.110	0.0825
17 July 2017	7.73	2	39	0.121	0.0908
24 July 2017	6.90	1	36	0.128	0.0960
31 July 2017	7.20	5	39	0.128	0.0960

Table 1 Cont. Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool P (Continued)					
8 August 2017	6.70	4	42	0.108	0.0810
15 August 2017	7.00	4	46	0.146	0.1095
22 August 2017	6.50	3	59	0.199	0.1493
29 August 2017	8.60	3	46	0.133	0.0998
6 September 2017	6.80	30	74	0.169	0.1268
11 September 2017	6.70	3	51	0.217	0.1628
19 September 2017	7.10	8	60	0.162	0.1215
25 September 2017	7.20	4	64	0.331	0.2483
6 October 2017	7.30	1	61	0.086	0.0645
11 October 2017	7.00	4	60	0.025	0.0188
16 October 2017	7.30	4	69	0.249	0.1868
23 October 2017	7.30	5	82	0.311	0.2333
14 November 2017	7.30	4	67	0.180	0.1350
23 November 2017	7.30	4	64	0.238	0.1785
8 December 2017	7.30	2	60	0.173	0.1298
18 December 2017	7.20	4	70	0.108	0.0810
4 January 2018	7.57	4	74	0.156	0.1170
15 January 2018	7.20	5	75	0.288	0.2160
31 January 2018	7.40	4	82	0.173	0.1298
5 February 2018	7.40	2	80	0.241	0.1808
12 February 2018	7.30	9	87	0.153	0.1148
1 March 2018	7.20	6	66	0.104	0.0780
5 March 2018	8.40	12	71	0.081	0.0608
20 March 2018	7.20	3	74	0.309	0.2318
27 March 2018	6.50	2	24	0.029	0.0218
3 April 2018	6.90	2	33	0.022	0.0165
11 April 2018	7.00	3	49	0.091	0.0683
7 May 2018	7.20	3	55	0.133	0.0998
14 May 2018	7.00	2	56	0.104	0.0780
22 May 2018	6.90	2	54	0.117	0.0878
30 May 2018	7.10	3	52	0.082	0.0615
4 June 2018	7.00	2	63	0.165	0.1238
22 June 2018	7.30	4	56	0.105	0.0788
28 June 2018	7.20	3	54	0.069	0.0518
3 July 2018	7.10	4	56	0.117	0.0878
12 July 2018	6.70	2	59	0.127	0.0953
25 July 2018	7.06	11	68	0.120	0.0900

Table 1 Cont. Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool P (Continued)					
31 July 2018	6.82	19	74	0.170	0.1275
15 August 2018	7.61	3	61	0.186	0.1395
29 August 2018	7.67	3	67	0.214	0.1605
11 September 2018	7.61	3	49	0.061	0.0458
3 October 2018	7.60	2	62	0.125	0.0938
23 October 2018	7.20	5	26	0.017	0.0128
30 October 2018	7.12	5	33	0.028	0.0210
7 November 2018	7.20	3	47	0.038	0.0285
16 November 2018	7.40	1	59	0.047	0.0353
22 November 2018	7.58	4	68	0.034	0.0255
27 November 2018	7.40	2	59	0.060	0.0450
5 December 2018	7.37	3	33	0.042	0.0315
11 December 2018	7.24	6	48	0.011	0.0083
16 January 2019	7.78	2	49	0.042	0.0315
23 January 2019	7.80	2	57	0.054	0.0405
30 January 2019	7.20	6	67	0.068	0.0510
5 February 2019	7.44	5	63	0.032	0.0240
26 February 2019	7.92	2	60	0.218	0.1635
5 March 2019	7.74	2	63	0.070	0.0525
14 March 2019	7.29	7	71	0.038	0.0285
21 March 2019	6.99	4	23	0.058	0.0435
28 March 2019	7.47	2	31	0.024	0.0180
9 April 2019	7.55	2	29	0.031	0.0233
24 April 2019	7.58	2	43	0.052	0.0390
30 April 2019	7.78	2	49	0.112	0.0840
15 May 2019	7.66	2	52	0.104	0.0780
21 May 2019	7.77	2	55	0.100	0.0750
13 June 2019	7.96	1	54	0.055	0.0413
27 June 2019	7.71	2	46	0.060	0.0450
6 August 2019	6.54	32	82	0.123	0.0923
20 August 2019	6.93	16	74	0.132	0.0990
29 August 2019	7.28	7	64	0.142	0.1065
3 September 2019	6.68	20	62	0.011	0.0083
30 September 2019	7.52	3	41	0.192	0.1440

Table 1 Cont. Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool S					
19 December 2017	7.90	2	62	<0.010	<0.0075
4 January 2018	8.06	1	70	<0.010	<0.0075
15 January 2018	7.90	2	67	0.045	0.0338
31 January 2018	8.10	2	70	<0.010	<0.0075
1 March 2018	8.10	4	62	<0.010	<0.0075
16 April 2018	7.60	2	46	<0.010	<0.0075
30 October 2018	7.35	3	31	<0.010	<0.0075
7 November 2018	7.80	1	41	<0.010	<0.0075
27 November 2018	8.10	1	57	<0.010	<0.0075
30 January 2019	7.90	3	56	<0.010	<0.0075
26 February 2019	8.03	1	54	0.029	0.0218
5 March 2019	8.01	1	59	<0.010	<0.0075
14 March 2019	7.47	5	66	<0.010	<0.0075
Pool U					
31 August 2016	7.50	3	24	<0.010	<0.0075
7 September 2016	7.60	6	24	<0.010	<0.0075
14 September 2016	7.50	9	33	0.015	0.0113
21 September 2016	7.80	4	30	<0.010	<0.0075
26 September 2016	7.70	2	29	<0.010	<0.0075
5 October 2016	7.10	4	37	<0.010	<0.0075
11 October 2016	7.69 (field)	13	51	<0.010	<0.0075
24 October 2016	8.00	1	45	<0.010	<0.0075
31 October 2016	7.90	1	42	<0.010	<0.0075
8 November 2016	7.82	2	48	0.017	0.0128
15 November 2016	7.80	2	46	0.016	0.0120
24 November 2016	8.18 (field)	3	51	0.058	0.0435
30 November 2016	8.00	3	53	0.016	0.0120
6 December 2016	7.69	2	49	0.029	0.0218
19 December 2016	7.80	2	47	<0.010	<0.0075
28 December 2016	7.91	2	55	<0.010	<0.0075
6 January 2017	8.00	2	49	<0.010	<0.0075
12 January 2017	8.10	2	48	0.024	0.0180
19 January 2017	8.10	2	70	0.022	0.0165
25 January 2017	8.10	1	65	<0.010	<0.0075
2 February 2017	8.00	2	66	0.017	0.0128
6 February 2017	8.02	1	66	0.018	0.0135
15 February 2017	7.60	2	53	0.013	0.0098

Table 1 Cont. Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool U (Continued)					
22 February 2017	8.00	1	60	0.014	0.0105
9 March 2017	7.20	2	12	<0.010	<0.0075
12 April 2017	7.10	2	16	<0.010	<0.0075
2 May 2017	6.80	3	32	<0.010	<0.0075
18 May 2017	7.40	3	36	<0.010	<0.0075
25 May 2017	7.60	2	38	<0.010	<0.0075
30 May 2017	7.20	5	42	<0.010	<0.0075
8 June 2017	7.20	5	40	<0.010	<0.0075
15 June 2017	7.00	2	13	<0.010	<0.0075
21 June 2017	7.10	2	19	<0.010	<0.0075
27 June 2017	6.70	1	22	<0.010	<0.0075
3 July 2017	6.80	9	35	<0.010	<0.0075
17 July 2017	6.63	18	53	<0.010	<0.0075
31 July 2017	7.20	2	39	<0.010	<0.0075
15 August 2017	6.90	3	44	<0.010	<0.0075
22 August 2017	6.80	1	43	<0.010	<0.0075
29 August 2017	8.60	2	42	<0.010	<0.0075
6 September 2017	7.00	8	52	<0.010	<0.0075
11 September 2017	6.90	1	49	<0.010	<0.0075
19 September 2017	7.60	3	54	<0.010	<0.0075
6 October 2017	8.30	1	62	0.018	0.0135
11 October 2017	8.30	<1	57	<0.010	<0.0075
16 October 2017	8.60	1	61	<0.010	<0.0075
23 October 2017	8.10	1	61	<0.010	<0.0075
14 November 2017	8.40	<1	60	0.017	0.0128
23 November 2017	8.20	1	66	<0.010	<0.0075
8 December 2017	8.20	1	52	<0.010	<0.0075
18 December 2017	8.20	2	63	<0.010	<0.0075
4 January 2018	8.23	<1	70	<0.010	<0.0075
15 January 2018	8.20	2	67	0.073	0.0548
31 January 2018	8.30	2	76	0.052	0.0390
5 February 2018	8.30	1	73	0.026	0.0195
12 February 2018	8.30	<1	76	0.024	0.0180
1 March 2018	7.90	6	64	<0.010	<0.0075
5 March 2018	7.80	<1	59	0.029	0.0218
20 March 2018	8.20	1	61	0.011	0.0083
27 March 2018	7.10	2	17	<0.010	<0.0075

Table 1 Cont. **Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary**

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool U (Continued)					
3 April 2018	7.80	1	31	<0.010	<0.0075
11 April 2018	7.60	2	43	<0.010	<0.0075
16 April 2018	7.80	2	47	<0.01	<0.0075
7 May 2018	7.60	2	49	0.047	0.0353
31 July 2018	7.06	11	67	<0.010	<0.0075
29 August 2018	7.77	2	58	<0.010	<0.0075
11 September 2018	7.90	1	50	<0.010	<0.0075
3 October 2018	8.50	<1	58	<0.010	<0.0075
30 October 2018	7.26	3	31	<0.010	<0.0075
7 November 2018	7.80	1	40	<0.010	<0.0075
22 November 2018	7.73	2	53	<0.010	<0.0075
11 December 2018	7.50	3	44	<0.010	<0.0075
16 January 2019	7.99	1	46	0.022	0.0165
23 January 2019	7.91	1	53	0.020	0.0150
30 January 2019	7.90	3	55	0.032	0.0240
5 February 2019	7.72	2	62	0.017	0.0128
19 February 2019	7.99	1	62	0.032	0.0240
26 February 2019	8.07	1	56	0.021	0.0158
5 March 2019	8.21	<1	56	0.022	0.0165
14 March 2019	7.51	4	67	0.018	0.0135
24 April 2019	7.65	2	39	<0.010	<0.0075
30 April 2019	7.83	1	43	0.036	0.0270
15 May 2019	7.83	2	46	0.018	0.0135
21 May 2019	7.88	2	53	0.047	0.0353
13 June 2019	7.36	5	53	<0.010	<0.0075
31 July 2019	6.46	34	77	<0.010	<0.0075
3 September 2019	6.48	38	88	0.096	0.0720

Table 1 Cont. **Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary**

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool W					
28 January 2016	7.50	2	25	0.019	0.0143
3 February 2016	7.50	2	24	0.014	0.0105
11 February 2016	7.90	2	31	0.018	0.0135
3 March 2016	7.70	2	46	0.014	0.0105
8 March 2016	7.70	2	47	0.018	0.0135
14 March 2016	7.00	2	57	0.017	0.0128
22 March 2016	7.80	2	48	<0.010	<0.0075
30 March 2016	7.70	3	48	0.014	0.0105
4 April 2016	7.80	1	48	<0.010	<0.0075
11 April 2016	7.80	2	52	0.013	0.0098
19 April 2016	7.60	2	50	<0.010	<0.0075
26 April 2016	7.70	2	47	<0.010	<0.0075
3 May 2016	7.80	2	50	0.011	0.0083
10 May 2016	7.70	2	51	<0.010	<0.0075
17 May 2016	8.00	2	55	<0.010	<0.0075
23 May 2016	7.90	1	54	<0.010	<0.0075
31 October 2016	7.77	2	42	<0.010	<0.0075
11 December 2018	7.32	4	45	<0.010	<0.0075
Eastern Tributary					
Pool ETAG					
15 February 2017	7.20	2	18	<0.010	<0.0075
4 April 2018	6.54	3	7	<0.010	<0.0075
Pool ETAH					
8 October 2018	6.70	6	19	<0.010	<0.0075
Pool ETAI					
1 March 2017	6.7	3	8	<0.010	<0.0075
Pool ETAL					
28 January 2016	7.4	1	23	0.012	0.0090
29 February 2016	7.71	2	41	<0.010	<0.0075
14 March 2016	7.5	2	56	<0.010	<0.0075
29 March 2016	7.6	2	56	<0.010	<0.0075
Pool ETAM					
28 January 2016	7.3	1	23	0.034	0.0255
2 February 2016	7.32	2	16	0.016	0.0120
11 February 2016	7.5	2	32	0.040	0.0300
17 February 2016	7.6	2	39	0.014	0.0105
24 February 2016	7.5	4	45	<0.010	<0.0075

Table 1 Cont. Gas concentrations in water samples from Pools A, J, K, L, O, P, S, U and W on the Waratah Rivulet, and Pools ETAG, ETAH, ETAI, ETAL and ETAM on the Eastern Tributary

Date	pH (lab)	Free Carbon Dioxide as CO_2 (mg/L)	Total Carbon Dioxide as CO_2 (mg/L)	Methane (mg/L)	Conversion of Dissolved Methane (mg/L) to Carbon (mg/L)
Pool ETAM (Continued)					
29 February 2016	7.63	2	42	0.021	0.0158
7 March 2016	7.4	2	48	0.024	0.0180
14 March 2016	7.4	2	55	0.029	0.0218
21 March 2016	7.5	2	41	<0.010	<0.0075
29 March 2016	7.3	2	57	0.011	0.0083
19 April 2016	7.2	3	44	<0.010	<0.0075
27 April 2016	7.2	2	40	0.147	0.1103
9 May 2016	7.5	2	57	0.044	0.0330
16 May 2016	7.7	2	66	0.025	0.01875
24 May 2016	7.7	2	68	<0.010	<0.0075
30 June 2016	7.3	3	28	<0.010	<0.0075

[1] In the November 2014 report *Gas Release Assessment against the Subsidence Impact Performance Measure for Pool P* (The University of Queensland, 2014), results were provided for Pool J from 14 February 2014 to 28 October 2014; however these results were taken at Pool J to indicate the levels in a pool not subject to gas releases. Gas releases in Pool J were first observed on 29 February 2016.

Metropolitan Coal Waratah Rivulet Water Quality Data

Routine water quality sampling has been conducted by Metropolitan Coal at a number of sites on the Waratah Rivulet including WRWQJ (Pool J), WRWQK (Pool K), WRWQL (Pool L), WRWQM (Pool M), WRWQN (Pool N), WRWQO (Pool O), WRWQP (Pool P), WRWQR (Pool R), WRWQS (Pool S), WRWQT (Pool T), WRWQU (Pool U), WRWQV (Pool V) and WRWQW (Pool W) on the Waratah Rivulet (Figure 1). This includes data before and after the commencement of Longwall 20 (in May 2010).

Of particular relevance is the monitoring data for pH and TOC. Monitoring data for pH (field) and TOC (mg/L) from routine water quality sampling is provided for each pool in Attachment 1.

It is noted that gas releases on Waratah Rivulet have been identified in Pools A, J, K, L, O, P, S, U and W and on Eastern Tributary in Pools ETAG, ETAH, ETAI, ETAL and ETAM over certain periods[1]. The results for these periods have been considered in the assessment of water quality data.

Pools P and U Gas Releases - Assessment of Performance Measure of Minimal Gas Releases

An assessment of potential impacts of the gas releases in Pools P and U on water quality has been conducted by reviewing and analysing the gas concentration data, i.e. would the potential impacts on water quality associated with the observed gas release be considered to be negligible.

Primarily, the two minor natural gas components that could occur in gas releases in the Waratah Rivulet from mine subsidence are carbon dioxide and methane.

Carbon Dioxide Concentrations

Carbon dioxide has the potential to alter the alkalinity of water and reduce pH levels, if concentrations are high enough.

Comparison of the measured free carbon dioxide and total carbon dioxide concentrations in the Pool U water samples (Table 1) and the solubility of carbon dioxide in water (1,450 mg/L @ 25°C 100 kPa; CRC 2005) shows that carbon dioxide is not saturated in water. That is, the carbon dioxide levels shown in Table 1 are anticipated to come from the contact of creek water with carbonate minerals from geological strata giving bicarbonate/carbonate in solution, rather than from the gas releases as the levels of carbon dioxide are not high enough to have become dissolved in water to the point of saturation.

Laboratory analysis of water collected at the Pool P and Pool U gas releases indicate the gas releases are not contributing carbon dioxide to Waratah Rivulet (Table 1). Notwithstanding the above, comparison of pH levels in pools on the Waratah Rivulet, including pools subject to gas releases, shows that pH levels have not reduced in pools as a result of the gas releases (Attachment 1).

[1] Metropolitan Coal has provided the following information regarding the occurrence of gas releases (to 30 September 2018):
Pool A – gas releases observed in February to July 2017; September to October 2017; April 2018 to September 2019.
Pool J – gas releases observed in February to April 2016.
Pool K – gas releases initially observed in July 2013; December 2013 to February 2014; July and August 2014; November and December 2014; October to December 2015; February 2016.
Pool L – gas releases observed in March 2012; July 2013 to March 2015; May and June 2015; September 2015 to May 2017; July 2017; September 2017 to April 2018; October 2018 to September 2019.
Pool O – gas releases observed in April 2012 to February 2014; mid April to mid May 2014; September 2014 to June 2015.
Pool P – gas releases observed in February 2014; May 2014 to February 2015; May and June 2015; September 2015 to June 2019; August 2019 to September 2019.
Pool S – gas releases observed in December 2017 and January 2018; March 2018 and April 2018; October and November 2018; January 2019 to March 2019.
Pool U – gas releases observed in August 2016 to May 2018; July 2018 to July 2019; September 2019.
Pool W – gas releases observed in January to May 2016; October 2016; December 2018.
Pool ETAG – gas releases observed in February 2017; April 2018.
Pool ETAH – gas releases observed in October 2018.
Pool ETAI – gas releases observed in March 2017.
Pool ETAL – gas releases observed in January to March 2016.
Pool ETAM – gas releases observed in January to June 2016.

Methane Concentrations

Laboratory analysis of water collected from Pools P and U indicates the gas releases are contributing very low concentrations of methane to the Waratah Rivulet. Gas releases comprised of methane have the potential to increase the concentration of TOC in a stream.

The TOC concentrations recorded for Pools P and U prior to the commencement of Longwall 20 (May 2010) ranged from 2 - 6 mg/L. The TOC concentrations recorded for Pool P from January 2018 to September 2019 ranged from <1 – 6 mg/L (TOC concentration recorded in August and September 2019 was 2 mg/L) on all sampling occasions (Attachment 1). The TOC concentrations recorded for Pool U from January 2018 to September 2019 ranged from <1 – 5 mg/L (TOC concentration recorded in September 2019 was 2 mg/L) on all sampling occasions (Attachment 1).

When compared to other gas release sites on the Waratah Rivulet, dissolved methane in water has been highest in Pool L. Although Pool L has the highest methane concentration in water (Table 1), comparison with the solubility of methane in water (22.7g/L @ 25°C; CRC 2005) shows that only a very small amount of methane has dissolved in water. That is, even at the highest concentrations recorded in Pool L, the methane has not contributed to the TOC concentrations of Waratah Rivulet (Table 1 and Attachment 1).

Methane (in low or higher quantities that are below the saturated level in water) does not have the potential to influence other water quality parameters such as pH levels, dissolved oxygen, electrical conductivity, cation or anion concentrations, which are of greater relevance to aquatic biota in Waratah Rivulet.

Conclusion

It is concluded that the potential impacts on water quality associated with the observed gas releases in Pools P and U on the Waratah Rivulet are negligible.

The performance measure relating to the gas releases observed at Pools P and U on the Waratah Rivulet, *Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases),* has not been exceeded.

References

CRC (2005) CRC Handbook of Chemistry and Physics. 86th Edition. CRC Press, Taylor and Francis, Boca Raten, USA.

Metropolitan Coal (2019) Longwall 304 Water Management Plan.

Yours Sincerely,

Barry N Noller
Principal Research Fellow
Centre For Mined Land Rehabilitation

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Attachment 1

Waratah Rivulet Pools - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Attachment 1
Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool J				Pool K				Pool L				Pool M				Pool N			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
								11/12/2008	7.50	7.61	3	11/12/2008	7.60	7.59	2	11/12/2008	7.80	7.40	2
								13/01/2009	7.50	7.63	1	13/01/2009	7.40	7.77	1	13/01/2009	7.30	7.76	2
								12/02/2009	7.60	7.04	3	10/02/2009	7.60	7.31	2	10/02/2009	7.50	7.27	2
								10/03/2009	7.00	7.22	2	10/03/2009	7.10	7.26	2	10/03/2009	7.00	6.99	3
								15/04/2009	6.10	6.97	5	15/04/2009	5.70	7.09	5	15/04/2009	6.00	7.03	5
								5/05/2009	6.50	7.28	4	5/05/2009	6.60	7.35	4	5/05/2009	6.50	7.28	3
								12/06/2009	6.00	7.10	3	12/06/2009	6.10	7.16	3	12/06/2009	5.90	6.84	3
								7/07/2009	5.90	6.85	2	9/07/2009	5.80	6.28	3	9/07/2009	5.60	5.51	3
								20/08/2009	6.20	8.02	2	20/08/2009	6.10	7.38	6	20/08/2009	6.00	7.31	2
								9/09/2009	6.50	7.28	3	9/09/2009	6.50	7.34	3	9/09/2009	6.50	7.28	2
								14/10/2009	6.40	7.61	3	13/10/2009	6.30	7.64	2	13/10/2009	6.40	7.57	2
								11/11/2009	6.70	7.21	3	11/11/2009	6.70	7.34	3	11/11/2009	6.70	7.32	3
								2/12/2009	6.90	7.84	2	2/12/2009	7.00	7.84	2	2/12/2009	6.90	7.70	2
27/01/2010	7.00	6.97	2	27/01/2010	6.70	7.24	2	12/01/2010	7.00	7.00	1	12/01/2010	6.80	6.67	2	12/01/2010	6.80	6.99	2
10/02/2010	6.50	6.43	6	10/02/2010	6.50	6.42	6	10/02/2010	6.40	6.62	5	10/02/2010	6.40	6.71	5	10/02/2010	6.50	6.60	5
16/03/2010	6.90	7.10	3	16/03/2010	7.50	7.03	3	16/03/2010	7.50	7.01	2	16/03/2010	7.50	6.76	2	11/03/2010	7.30	7.00	3
8/04/2010	7.10	6.37	2	8/04/2010	7.30	6.31	3	8/04/2010	7.20	6.30	3	8/04/2010	7.40	6.57	3	8/04/2010	7.40	6.82	3
13/05/2010	7.00	7.62	2	13/05/2010	7.20	7.48	2	13/05/2010	7.20	7.48	2	13/05/2010	7.20	7.40	3	13/05/2010	7.20	7.14	3
9/06/2010	6.80	6.83	4	9/06/2010	6.80	6.70	4	9/06/2010	6.90	6.79	3	9/06/2010	6.80	6.81	4	9/06/2010	6.70	6.90	4
7/07/2010	6.80	6.79	2	7/07/2010	6.80	6.59	2	7/07/2010	6.90	6.65	2	7/07/2010	6.80	6.90	2	7/07/2010	6.90	6.61	2
11/08/2010	6.70	7.00	3	11/08/2010	6.70	7.04	3	11/08/2010	6.80	6.81	2	11/08/2010	6.80	6.72	2	11/08/2010	6.70	6.53	3
2/09/2010	6.70	6.95	3	2/09/2010	6.90	6.84	3	2/09/2010	6.80	6.91	3	2/09/2010	6.90	6.90	3	2/09/2010	6.90	6.69	3
11/10/2010	6.60	7.03	3	11/10/2010	6.60	7.03	3	11/10/2010	6.60	7.02	3	11/10/2010	6.60	6.89	3	11/10/2010	6.70	6.77	3
4/11/2010	6.70	6.81	3	4/11/2010	6.70	6.42	4	4/11/2010	6.50	6.66	3	4/11/2010	6.50	6.60	3	4/11/2010	6.60	6.59	3
7/12/2010	6.60	7.51	4	7/12/2010	6.60	7.27	4	7/12/2010		7.58	3	7/12/2010	6.60	7.46	3	7/12/2010	6.60	7.35	4
18/01/2011	6.90	7.39	4	18/01/2011	6.80	7.42	3	18/01/2011	6.80	7.35	3	18/01/2011	6.90	7.54	3	18/01/2011	6.90	7.20	3
16/02/2011	7.10	7.18	2	16/02/2011	7.20	7.13	2	16/02/2011	7.50	7.11	2	16/02/2011	7.50	7.02	2	16/02/2011	7.60	6.93	1
3/03/2011	6.90	7.01	3	3/03/2011	7.00	7.37	3	3/03/2011	7.00	7.36	3	3/03/2011	7.10	7.57	3	3/03/2011	7.10	7.41	3
13/04/2011	7.00	7.25	4	13/04/2011	7.00	7.45	4	13/04/2011	6.90	7.54	3	13/04/2011	7.10	8.77	3	13/04/2011	7.10	7.43	4
26/05/2011	7.00	6.37	3	24/05/2011	7.00	7.06	3	24/05/2011	7.10	7.05	3	24/05/2011	7.20	7.34	3	24/05/2011	7.30	6.94	3
23/06/2011	7.10	7.09	4	23/06/2011	7.00	6.86	3	23/06/2011	7.00	7.00	4	23/06/2011	7.00	6.92	4	23/06/2011	7.30	6.71	3
13/07/2011	7.00	6.50	5	13/07/2011	7.10	6.49	5	13/07/2011	7.10	5.66 (pH unable to stabilise)	3	13/07/2011	7.00	5.66 (pH unable to stabilise)	3	13/07/2011	7.30	6.67	3
17/08/2011	7.20	6.60	3	17/08/2011	7.10	6.49	3	17/08/2011	7.30	6.45	3	17/08/2011	7.20	6.44	3	17/08/2011	7.20	6.40	3
13/09/2011	7.10	7.26	2	13/09/2011	7.10	7.40	2	13/09/2011	7.30	7.24	3	13/09/2011	7.20	7.36	3	13/09/2011	7.20	7.30	3
12/10/2011	6.90	6.91	3	12/10/2011	6.80	7.03	3	12/10/2011	6.80	6.80	3	12/10/2011	6.90	6.95	3	12/10/2011	6.90	6.68	3
16/11/2011	6.90	7.41	2	16/11/2011	6.80	7.36	2	16/11/2011	6.90	7.36	2	16/11/2011	7.00	7.87	2	16/11/2011	7.00	7.61	2
20/12/2011	6.90	6.36	3	20/12/2011	6.80	6.81	3	20/12/2011	6.90	6.98	3	20/12/2011	6.90	6.79	3	20/12/2011	6.80	7.47	3
12/01/2012	6.90	6.89	2	12/01/2012	6.80	7.16	2	12/01/2012	6.900	7.20	2	12/01/2012	6.90	7.26	2	12/01/2012	7.00	7.21	2
7/02/2012	6.90	6.31	3	7/02/2012	6.80	6.98	3	7/02/2012	6.90	7.12	2	7/02/2012	6.80	7.17	3	9/02/2012	6.90	6.90	3
22/03/2012	6.80	7.28	5	22/03/2012	6.90	7.41	5	22/03/2012	6.80	7.04	6	22/03/2012	6.80	7.03	5	22/03/2012	6.90	7.02	5
3/04/2012	7.00	6.88	4	3/04/2012	7.00	7.11	4	3/04/2012	7.10	6.74	4	3/04/2012	7.00	6.97	4	3/04/2012	7.00	6.68	4
2/05/2012	6.90	6.83	4	2/05/2012	7.00	6.89	3	2/05/2012	7.00	6.73	4	2/05/2012	7.00	6.84	4	2/05/2012	7.00	6.64	4
20/06/2012	6.60	6.77	4	20/06/2012	6.60	6.70	4	20/06/2012	6.70	6.70	4	20/06/2012	6.70	6.64	4	20/06/2012	6.80	6.65	4
4/07/2012	6.80	6.84	3	4/07/2012	6.80	6.69	3	4/07/2012	6.80	6.77	3	4/07/2012	6.80	6.62	3	4/07/2012	6.90	6.52	3
1/08/2012	6.80	6.92	3	1/08/2012	6.90	6.83	3	1/08/2012	6.90	6.64	3	1/08/2012	6.80	6.87	3	1/08/2012	6.80	6.65	3
11/09/2012	7.00	6.91	2	11/09/2012	7.00	7.04	2	11/09/2012	6.90	6.81	2	11/09/2012	7.00	7.05	2	11/09/2012	7.00	7.01	2
3/10/2012	7.00	6.82	3	3/10/2012	7.10	6.77	3	3/10/2012	6.90	6.65	3	3/10/2012	7.20	6.61	3	3/10/2012	7.00	6.46	3
7/11/2012	6.90	6.78	3	7/11/2012	7.00	6.57	3	7/11/2012	6.90	6.26	3	7/11/2012	7.00	6.42	3	7/11/2012	7.10	6.37	3
11/12/2012	7.00	6.52	3	11/12/2012	7.00	6.41	3	11/12/2012	6.90	6.07	3	11/12/2012	7.00	6.38	3	11/12/2012	7.00	6.22	4
16/01/2013	7.00	6.51	4	16/01/2013	7.00	6.72	4	16/01/2013	6.90	5.65	4	16/01/2013	7.00	6.06	4	16/01/2013			
7/02/2013	6.80	7.16	4	7/02/2013	6.80	6.95	3	7/02/2013	6.70	6.60	4	7/02/2013	6.70	6.91	3	7/02/2013	6.70	6.70	3
12/03/2013	6.80	7.21	4	12/03/2013	6.80	7.05	4	12/03/2013	6.90	6.79	4	12/03/2013	6.80	7.04	4	12/03/2013	6.80	6.86	4
24/04/2013	6.90	7.03	4	24/04/2013	6.90	7.05	5	24/04/2013	6.70	6.98	4	24/04/2013	6.70	7.09	4	24/04/2013	6.80	7.61	5
9/05/2013	6.90	7.25	4	9/05/2013	6.90	7.23	3	9/05/2013	6.90	6.84	3	9/05/2013	7.00	7.01	4	9/05/2013	7.00	6.68	4

Attachment 1
Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool J				Pool K				Pool L				Pool M				Pool N			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
11/06/2013	6.40	6.78	4	11/06/2013	6.50	6.73	4	11/06/2013	6.60	6.54	4	11/06/2013	6.60	6.59	4	11/06/2013	6.70	6.51	4
16/07/2013	6.80	6.58	3	16/07/2013	6.70	6.93	3	16/07/2013	6.70	6.55	3	16/07/2013	6.80	6.18	3	16/07/2013	6.70	6.08	4
14/08/2013	6.80	7.01	3	14/08/2013	6.90	7.37	3	14/08/2013	6.90	6.19	3	14/08/2013	7.00	7.06	3	14/08/2013	7.00	5.17	3
04/09/2013	7.00	7.50	3	04/09/2013	7.10	7.30	4	04/09/2013	7.00	6.80	3	04/09/2013	7.00	6.60	3	04/09/2013	7.10	6.50	3
2/10/2013	7.00	6.94	4	2/10/2013	7.00	7.20	3	2/10/2013	6.90	7.10	3	2/10/2013	7.00	5.68	4	2/10/2013	7.00	6.02	3
6/11/2013	7.10	6.24	3	6/11/2013	7.20	6.39	3	6/11/2013	7.00	5.44	3	6/11/2013	6.90	4.85	4	6/11/2013	7.00	5.90	3
2/12/2013	6.80	6.71	3	2/12/2013	6.90	6.70	3	2/12/2013	6.80	6.70	3	2/12/2013	6.90	6.29	4	2/12/2013	7.00	6.09	3
21/01/2014	7.00	6.91	3	21/01/2014	7.10	6.70	3	21/01/2014	7.10	6.11	3	21/01/2014	7.00	6.67	4	21/01/2014			
4/02/2014	7.20	6.93	3	4/02/2014	7.30	7.75	3	4/02/2014	7.20	9.71	3	4/02/2014	7.00	7.31	3	4/02/2014			
18/03/2014	7.00	7.39	4	18/03/2014	7.20	7.17	3	18/03/2014	7.00	6.82	3	18/03/2014	7.10	7.12	3	18/03/2014	7.10	7.13	3
10/04/2014	6.80	6.83	4	10/04/2014	6.90	6.75	3	10/04/2014	6.80	6.48	3	10/04/2014	6.80	6.60	3	10/04/2014	6.70	6.68	4
7/05/2014	7.00	7.43	3	7/05/2014	7.10	7.18	4	7/05/2014	6.90	7.15	4	7/05/2014	6.90	7.15	3	7/05/2014	6.90	7.65	4
5/06/2014	6.90	7.42	3	5/06/2014	7.00	6.90	3	5/06/2014	6.90	7.06	3	5/06/2014	6.80	6.91	3	5/06/2014	6.90	7.08	4
1/07/2014	7.00	7.23	3	1/07/2014	7.00	7.17	3	1/07/2014	6.90	6.95	3	1/07/2014	6.80	7.14	3	1/07/2014	6.80	7.25	3
7/08/2014	7.10	7.64	3	7/08/2014	7.10	6.95	3	7/08/2014	7.00	6.70	3	7/08/2014	6.90	6.67	3	7/08/2014	7.00	6.98	3
10/09/2014	6.80	6.86	3	10/09/2014	6.80	6.64	3	10/09/2014	6.70	6.51	3	10/09/2014	6.80	6.30	3	10/09/2014	6.80	6.20	3
21/10/2014	6.90	7.06	3	21/10/2014	6.90	7.38	3	21/10/2014	6.90	7.06	3	21/10/2014	6.90	7.21	3	21/10/2014	6.80	7.01	3
12/11/2014	7.20	7.12	2	12/11/2014	7.20	6.89	3	12/11/2014	7.00	6.52	3	12/11/2014	7.00	7.20	3	12/11/2014	7.40	7.40	2
2/12/2014	6.90	7.34	3	2/12/2014	7.10	8.13	3	2/12/2014	7.00	7.08	3	2/12/2014	7.00	6.82	3	2/12/2014	6.50	6.50	3
21/01/2015	7.00	7.22	3	21/01/2015	7.10	7.10	3	21/01/2015	7.00	6.88	3	21/01/2015	7.00	6.92	3	21/01/2015	6.85	6.85	4
10/02/2015	7.20	7.55	3	10/02/2015	7.10	7.46	3	10/02/2015	7.00	6.44	3	10/02/2015	7.00	7.00	3	10/02/2015	6.74	6.74	3
11/03/2015	7.10	6.72	3	11/03/2015	7.20	7.13	4	11/03/2015	7.10	6.08	3	11/03/2015	7.00	6.37	3	11/03/2015	6.66	6.66	3
16/04/2015	6.90	6.94	3	16/04/2015	7.10	7.11	3	16/04/2015	7.00	6.79	3	16/04/2015	6.90	6.84	3	16/04/2015	6.26	6.26	3
14/05/2015	6.90	7.04	3	14/05/2015	6.90	6.99	3	14/05/2015	6.90	6.97	3	14/05/2015	7.00	6.89	3	14/05/2015	6.62	6.62	3
2/06/2015	7.09	7.06	2	2/06/2015	7.15	7.26	2	2/06/2015	7.17	7.13	2	1/06/2015	7.20	7.25	2	1/06/2015	7.10	7.10	2
3/07/2015	6.53	6.86	2	3/07/2015	6.52	7.41	-	3/07/2015	6.58	7.18	2	6/07/2015	6.61	7.21	2	6/07/2015	7.26	7.26	2
3/08/2015	7.13	7.43	3	3/08/2015	7.24	7.51	2	3/08/2015	7.01	7.19	2	3/08/2015	7.15	7.16	2	3/08/2015	7.25	7.25	1
15/09/2015	7.28	7.54	2	15/09/2015	7.01	7.70	2	15/09/2015	6.91	7.16	2	15/09/2015	6.97	7.27	2	15/09/2015	7.25	7.25	2
7/10/2015	7.83	7.65	2	7/10/2015	7.65	7.52	2	7/10/2015	7.69	7.14	2	7/10/2015	7.62	7.15	2	7/10/2015	7.23	7.23	2
3/11/2015	7.24	7.45	3	3/11/2015	7.45	7.57	8	3/11/2015	7.29	7.19	10	3/11/2015	7.31	7.22	11	3/11/2015	7.14	7.14	8
2/12/2015	7.59	7.39	2	2/12/2015	7.68	7.69	2	2/12/2015	7.70	6.80	4	2/12/2015	7.72	7.07	2	2/12/2015	7.13	7.13	2
11/01/2016	7.15	7.31	3	11/01/2016	7.43	7.40	3	11/01/2016	7.32	7.00	3	11/01/2016	7.34	7.03	3	11/01/2016	7.11	7.13	3
1/02/2016	7.14	6.96	4	1/02/2016	7.13	7.20	4	1/02/2016	7.25	6.78	4	1/02/2016	7.31	7.14	4	1/02/2016	7.29	6.93	4
1/03/2016	7.58	7.54	2	1/03/2016	7.61	7.65	2	1/03/2016	7.49	6.57	2	2/03/2016	7.58	7.21	2	2/03/2016	7.54	6.91	2
3/05/2016	7.68	7.51	2	3/05/2016	7.64	7.65	1	3/05/2016	7.06	7.00	1	3/05/2016	7.47	7.29	1	3/05/2016	7.50	7.27	1
15/06/2016	7.10	7.17	6	15/06/2016	7.21	7.38	4	15/06/2016	7.11	7.19	4	15/06/2016	7.19	7.29	2	15/06/2016	7.02	7.25	3
4/07/2016	6.40	7.33	2	4/07/2016	6.42	7.43	2	4/07/2016	6.42	7.17	2	4/07/2016	6.42	7.25	2	4/07/2016	6.42	7.25	2
1/08/2016	7.20	7.27	2	1/08/2016	7.40	7.32	2	1/08/2016	7.29	7.10	2	1/08/2016	7.31	7.12	2	1/08/2016	7.31	7.13	2
1/09/2016	6.86	7.15	2	1/09/2016	7.00	7.55	2	1/09/2016	6.94	7.28	2	1/09/2016	6.95	7.36	2	1/09/2016	6.96	7.35	2
6/10/2016	7.01	7.60	2	6/10/2016	7.27	7.72	2	6/10/2016	7.23	6.98	1	6/10/2016	7.30	7.23	2	6/10/2016	7.35	7.23	2
8/11/2016	7.51	6.84	2	8/11/2016	7.49	7.72	<1	8/11/2016	7.20	6.29	<1	8/11/2016	7.22	6.96	<1	8/11/2016	7.39	7.02	<1
1/12/2016	6.99	7.59	2	1/12/2016	7.30	7.95	2	1/12/2016	7.18	6.51	2	1/12/2016	7.16	7.14	2	1/12/2016	7.19	7.12	2
9/01/2017	7.35	7.69	2	9/01/2017	7.59	7.90	2	9/01/2017	7.18	6.70	2	9/01/2017	7.21	6.97	2	9/01/2017	7.37	7.12	2
1/02/2017	7.64	7.25	<1	1/02/2017	7.81	7.68	2	1/02/2017	7.35	6.67	2	1/02/2017	7.44	6.80	<1	1/02/2017	7.63	7.08	2
8/03/2017	7.00	6.98	4	8/03/2017	7.09	7.01	4	8/03/2017	7.05	6.90	4	8/03/2017	7.06	6.98	4	8/03/2017	7.06	6.96	4
18/04/2017	7.31	7.62	3	18/04/2017	7.42	7.81	3	18/04/2017	7.28	6.88	3	18/04/2017	7.29	7.35	3	18/04/2017	7.26	7.37	2
4/05/2017	7.30	7.56	2	4/05/2017	7.39	7.84	2	4/05/2017	7.29	7.16	2	4/05/2017	7.52	7.21	2	4/05/2017	7.32	7.37	2
1/06/2017	7.28	7.39	2	1/06/2017	7.12	7.54	2	1/06/2017	7.15	6.82	2	1/06/2017	7.30	7.06	2	1/06/2017	7.34		2
5/07/2017	6.50	7.37	2	5/07/2017	6.65	7.48	2	5/07/2017	6.62	7.00	2	5/07/2017	6.54	7.18	2	5/07/2017	6.55	7.22	2
2/08/2017	7.60	7.59	2	2/08/2017	7.42	7.52	1	2/08/2017	7.29	6.81	1	2/08/2017	7.48	7.52	1	2/08/2017	7.52	7.08	2
4/09/2017	7.56	7.77	2	4/09/2017	7.71	8.00	1	4/09/2017	7.48	7.09	1	4/09/2017	7.60	7.35	1	4/09/2017	7.56	7.31	1
3/10/2017	7.45	7.66	1	3/10/2017	7.40	7.79	1	3/10/2017	7.16	6.81	1	3/10/2017	7.38	7.02	2	3/10/2017	7.44	7.10	2
2/11/2017	7.78	7.58	1	2/11/2017	7.85	7.87	2	2/11/2017	7.34	6.58	2	2/11/2017	7.45	7.14	2	2/11/2017	7.63	7.08	2
5/12/2017	7.55	7.70	1	5/12/2017	7.66	7.94	3	5/12/2017	7.17	6.35	1	5/12/2017	7.31	6.97	2	5/12/2017	7.43	7.09	2

Attachment 1

Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool J				Pool K				Pool L				Pool M				Pool N			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
8/01/2018	7.11	7.70	2	8/01/2018	7.84	7.84	2	8/01/2018	7.67	6.39	2	8/01/2018	7.45	6.73	1	8/01/2018	7.63	7.23	3
1/02/2018	7.88	7.73	2	1/02/2018	7.93	8.39	2	1/02/2018	7.67	6.57	1	1/02/2018	7.83	6.97	1	1/02/2018	7.87	7.15	1
8/03/2018	7.35	7.62	2	8/03/2018	7.49	8.23	2	8/03/2018	7.06	6.39	2	8/03/2018	7.12	6.90	2	8/03/2018	7.26	6.96	2
11/04/2018	7.69	7.80	1	11/04/2018	7.70	7.92	1	11/04/2018	7.30	6.74	2	11/04/2018	7.39	6.96	2	11/04/2018	7.37	7.00	2
1/05/2018	7.71	7.62	2	1/05/2018	7.72	7.82	2	1/05/2018	7.32	6.87	1	1/05/2018	7.42	7.07	2	1/05/2018	7.41	7.02	2
4/06/2018	7.56	7.73	1	4/06/2018	7.74	8.02	1	4/06/2018	7.14	6.87	2	4/06/2018	7.35	6.95	2	4/06/2018	7.42	7.01	2
4/07/2018	7.25	7.64	2	4/07/2018	7.33	7.64	2	4/07/2018	6.85	6.89	1	4/07/2018	7.00	7.05	2	4/07/2018	7.08	7.13	2
1/08/2018	6.61	7.46	1	1/08/2018	6.88	7.79	1	1/08/2018	6.58	6.65	1	1/08/2018	6.44	6.80	1	1/08/2018	6.63	6.75	1
6/09/2018	7.23	7.57	1	6/09/2018	7.43	7.75	1	6/09/2018	6.92	6.58	1	6/09/2018	7.08	6.81	1	6/09/2018	7.17	6.94	1
23/10/2018	7.21	7.38	3	23/10/2018	6.83	7.54	4	23/10/2018	6.89	6.85	3	23/10/2018	6.92	7.08	3	23/10/2018	6.93	7.11	3
13/11/2018	7.29	7.82	2	13/11/2018	7.4	7.97	2	13/11/2018	7.27	6.77	2	13/11/2018	7.31	7.11	2	13/11/2018	7.37	7.73	2
03/12/2018	7.69	7.32	3	03/12/2018	7.46	7.54	3	03/12/2018	7.27	6.11	3	03/12/2018	7.29	6.92	3	03/12/2018	7.29	6.99	3
15/01/2019	7.78	7.75	2	15/01/2019	7.89	7.93	2	15/01/2019	7.41	6.33	2	15/01/2019	7.43	7.02	2	15/01/2019	7.56	7.26	2
07/02/2019	7.39	7.96	2	07/02/2019	7.37	8.02	2	07/02/2019	7.28	6.5	2	07/02/2019	7.32	7.14	2	07/02/2019	7.4	7.29	3
27/03/2019	7.33	7.22	3	27/03/2019	7.41	7.49	3	27/03/2019	7.38	6.77	3	27/03/2019	7.34	6.88	3	27/03/2019	7.42	6.8	3
11/04/2019	7.25	7.65	2	11/04/2019	7.2	7.66	2	11/04/2019	7.19	6.8	2	11/04/2019	7.22	7.16	2	11/04/2019	7.14	7.07	2
07/05/2019	7.73	7.64		07/05/2019	7.5	7.65		07/05/2019	7.21	6.87		07/05/2019	7.34	6.92		07/05/2019	7.34	6.96	
20/06/2019	7.17	7.16	2	20/06/2019	7.17	7.52	2	20/06/2019	7.2	7.17	2	20/06/2019	7.31	7.16	2	20/06/2019	7.28	7.22	1
18/07/2019	7.56	7.61	2	18/07/2019	7.45	7.34	2	18/07/2019	7.19	6.75	2	18/07/2019	7.36	7.02	2	18/07/2019	7.35	6.93	2
07/08/2019	6.38	7.72	1	07/08/2019	6.52	7.86	1	07/08/2019	6.46	6.92	1	07/08/2019	6.47		1	07/08/2019	6.48	7.11	1
04/09/2019	7.61	7.61	2	04/09/2019	7.63	7.85	2	04/09/2019	7.38	6.84	2	04/09/2019	7.5	7.34	1	04/09/2019	7.36	7.33	2

Attachment 1

Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool O				Pool P				Pool R				Pool S				Pool T			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
11/12/2008	7.60	6.26	3	11/12/2008	6.80	7.21	2	11/12/2008	6.90	7.04	4	11/12/2008	7.20	7.60	3				
13/01/2009	7.40	7.78	2	15/01/2009	7.20	6.76	2	15/01/2009	7.50	6.83	2	15/01/2009	7.00	6.66	2				
10/02/2009	7.60	6.81	2	12/02/2009	7.30	7.00	2	12/02/2009	7.70	7.75	2	12/02/2009	7.20	7.64	2				
10/03/2009	7.70	6.57	3	12/03/2009	7.00	7.35	3	12/03/2009	7.20	7.42	3	12/03/2009	7.10	7.44	3				
15/04/2009	5.70	7.25	6	15/04/2009	5.70	7.50	5	15/04/2009	5.40	7.44	6	15/04/2009	5.70	7.35	6				
5/05/2009	6.90	7.20	4	7/05/2009	6.60	7.27	3	7/05/2009	6.40	7.35	3	7/05/2009	6.50	7.47	3				
12/06/2009	5.80	6.63	4	18/06/2009	5.70	6.27	3	18/06/2009	5.70	6.87	3	18/06/2009	5.80	6.80	3				
9/07/2009	5.70	5.83	4	16/07/2009	5.70	6.02	3	16/07/2009	5.80	6.32	3	16/07/2009	5.80	6.17	3				
20/08/2009	5.90	6.81	2	20/08/2009	6.00	6.85	3	20/08/2009	4.60	7.25	2	20/08/2009	6.10	7.13	2				
9/09/2009	6.60	7.04	2	15/09/2009	6.40	6.85	2	15/09/2009	6.50	7.47	2	15/09/2009	6.40	7.51	2				
13/10/2009	6.40	7.52	3	13/10/2009	6.40	7.40	2	13/10/2009	6.40	7.66	3	13/10/2009	6.40	7.67	3				
11/11/2009	6.70	7.11	2	12/11/2009	6.70	7.29	3	12/11/2009	6.80	7.26	3	12/11/2009	6.80	7.11	3				
2/12/2009	6.90	7.21	3	2/12/2009	6.90	7.38	2	2/12/2009	7.00	7.74	3	2/12/2009	6.90	7.64	2				
12/01/2010	6.90	6.55	2	20/01/2010	6.80	6.74	3	20/01/2010	6.90	7.46	2	20/01/2010	6.80	7.59	2	20/01/2010	7.00	7.67	3
10/02/2010	6.40	6.35	6	10/02/2010	6.80	6.06	6	10/02/2010	6.50	6.27	6	10/02/2010	6.50	6.30	6	10/02/2010	6.40	6.75	6
11/03/2010	7.50	7.70	3	11/03/2010	7.20	6.67	3	11/03/2010	7.40	7.63	3	11/03/2010	7.10	7.74	3	11/03/2010	7.50	7.87	4
8/04/2010	7.50	6.88	3	8/04/2010	7.40	6.47	3	8/04/2010	7.40	6.81	3	8/04/2010	7.50	7.18	3	8/04/2010	7.60	7.29	3
13/05/2010	7.30	6.13	2	21/05/2010	7.20	6.11	2	21/05/2010	7.30	6.80	3	21/05/2010	7.20	6.80	2	21/05/2010	7.40	6.77	2
9/06/2010	6.80	7.05	4	9/06/2010	6.70		4	9/06/2010	6.70	6.88	4	9/06/2010	6.70	6.78	4	9/06/2010	6.80	7.01	4
7/07/2010	6.70	6.69	2	20/07/2010	6.90	5.87	2	20/07/2010	6.80	7.50	2	20/07/2010	6.80	7.36	2	20/07/2010	6.70	7.59	2
11/08/2010	6.90	6.09	3	30/08/2010	6.80	7.66	3	30/08/2010	6.80	8.05	3	30/08/2010	6.70	8.04	3	30/08/2010	6.80	7.92	3
2/09/2010	6.90	6.54	3	23/09/2010	6.50	7.17	4	23/09/2010	6.50	6.99	4	23/09/2010	6.60	6.84	5	23/09/2010	6.60	6.94	4
11/10/2010	6.60	6.71	3	14/10/2010	6.50	7.31	4	14/10/2010	6.50	7.23	3	14/10/2010	6.50	7.27	3	14/10/2010	6.60	7.19	3
4/11/2010	6.60	6.41	4	23/11/2010	6.60	6.78	3	23/11/2010	6.60	6.21	3	23/11/2010	6.60	6.49	3	23/11/2010	6.70	6.75	3
7/12/2010	6.50	7.38	4	14/12/2010	6.70	7.15	3	14/12/2010	6.70	6.62	3	14/12/2010	6.60	7.37	3	14/12/2010	6.70	7.32	3
18/01/2011	7.00	7.68	3	18/01/2011	6.90	7.57	4	18/01/2011	6.90	7.84	3	18/01/2011	7.00	8.04	3	18/01/2011	7.00	8.29	3
16/02/2011	7.50	6.65	1	17/02/2011	7.50	7.57	2	17/02/2011	7.60	6.58	2	17/02/2011	7.60	7.91	2	17/02/2011	7.70	7.83	2
3/03/2011	7.20	7.72	3	17/03/2011	7.20	7.20	3	17/03/2011	7.30	7.32	3	17/03/2011	7.20	7.93	3	17/03/2011	7.20	8.04	3
13/04/2011	7.10	7.50	3	6/04/2011	7.00	7.62	4	6/04/2011	7.00	7.99	4	6/04/2011	7.00	7.72	4	6/04/2011	7.20	7.88	4
24/05/2011	7.20	7.10	3	4/05/2011	7.10	6.25	3	4/05/2011	6.90	7.10	4	4/05/2011	7.00	7.86	3	4/05/2011	7.00	7.02	4
23/06/2011	7.30	6.13	3	22/06/2011	7.20	5.84	4	22/06/2011	7.00	7.88	4	22/06/2011	7.10	7.12	4	22/06/2011	7.00	6.98	4
13/07/2011	7.30	6.64	4	14/07/2011	7.20	6.70	4	14/07/2011	7.20	7.64	3	14/07/2011	7.20	7.61	3	14/07/2011	7.20	7.89	3
17/08/2011	7.10	6.73	3	10/08/2011	7.20	6.71	3	10/08/2011	7.10	7.51	3	10/08/2011	7.00	8.03	3	10/08/2011	7.10	7.23	3
13/09/2011	7.20	7.30	3	13/09/2011	7.20	6.60	2	14/09/2011	7.20	8.39	2	14/09/2011	7.10	8.04	2	14/09/2011	7.10	7.72	2
12/10/2011	6.80	6.53	3	19/10/2011	6.90	7.07	4	19/10/2011	6.90	8.53	4	19/10/2011	7.00	7.47	3	19/10/2011	7.00	7.51	3
16/11/2011	6.90	7.39	2	17/11/2011	7.00	8.79	2	17/11/2011	7.00	7.75	2	17/11/2011	7.00	7.75	2	17/11/2011	7.10	7.89	2
20/12/2011	6.80	7.52	3	19/12/2011	6.70	7.16	3	19/12/2011	6.80	7.24	3	19/12/2011	6.90	7.46	3	19/12/2011	6.80	7.54	3
12/01/2012	6.90	7.41	2	19/01/2012	6.80	6.77	2	19/01/2012	6.80	7.40	2	19/01/2012	6.70	7.45	3	19/01/2012	6.80	8.35	2
9/02/2012	6.80	7.68	3	9/02/2012	6.80	6.43	3	9/02/2012	6.70	6.81	3	9/02/2012	6.70	7.07	3	9/02/2012	6.70	7.07	3
22/03/2012	6.80	7.39	5	23/03/2012	6.90	7.08	6	23/03/2012	6.80	7.80	6	23/03/2012	6.90	7.56	6	23/03/2012	6.90	7.54	6
3/04/2012	7.10	6.73	4	12/04/2012	7.10	6.50	4	12/04/2012	7.30	7.00	4	12/04/2012	7.20	7.05	4	12/04/2012	7.20	7.45	3
2/05/2012	6.90	6.77	3	3/05/2012	6.90	6.88	3	3/05/2012	7.00	7.54	3	3/05/2012	7.00	7.17	4	3/05/2012	7.00	7.05	4
20/06/2012	6.80	6.57	4	19/06/2012	6.80	5.77	4	19/06/2012	6.80	6.24	4	19/06/2012	6.80	7.16	4	19/06/2012	6.80	7.30	4
4/07/2012	6.80	5.95	3	10/07/2012	6.80	6.06	3	10/07/2012	6.80	7.89	3	10/07/2012	6.90	7.12	3	10/07/2012	7.00	7.12	3
1/08/2012	6.90	6.66	3	2/08/2012	6.90	6.82	3	2/08/2012	7.00	7.65	3	2/08/2012	6.90	7.13	3	2/08/2012	7.00	7.06	3
11/09/2012	7.00	6.80	2	12/09/2012	6.80	6.70	2	12/09/2012	7.00	7.45	2	12/09/2012	7.10	7.34	2	12/09/2012	7.10	7.80	2
3/10/2012	6.90	6.32	3	10/10/2012	7.00	5.85	2	10/10/2012	7.30	7.27	3	10/10/2012	7.30	7.23	2	10/10/2012	7.30	7.22	2
7/11/2012	7.00	6.18	3	15/11/2012	7.00	6.11	3	15/11/2012	7.10	7.22	3	15/11/2012	7.20	7.22	3	15/11/2012	7.20	7.12	3
11/12/2012	6.80	5.83	3	12/12/2012	7.10	5.88	3	12/12/2012	7.10	7.04	3	12/12/2012	7.20	7.32	3	12/12/2012	7.20	7.27	3
16/01/2013	7.00	6.36	3	15/01/2013	7.10	7.19	3	15/01/2013	7.10	7.60	4	15/01/2013	7.10	8.08	3	15/01/2013	7.00	8.47	3
7/02/2013	6.70	6.33	3	5/02/2013	6.70	6.33	3	5/02/2013	6.80	7.76	3	5/02/2013	6.70	7.38	4	5/02/2013	6.70	6.84	3
12/03/2013	6.80	6.60	4	7/03/2013	6.80	5.88	4	7/03/2013	6.90	7.96	4	7/03/2013	6.80	7.09	4	7/03/2013	6.80	7.09	4
24/04/2013	6.80	6.49	4	9/04/2013	6.80	6.60	4	9/04/2013	6.90	8.37	5	9/04/2013	6.90	7.49	5	9/04/2013	6.80	7.50	4
9/05/2013	7.00	6.42	4	8/05/2013	7.10	6.89	4	8/05/2013	7.20	7.79	3	8/05/2013	7.20	7.79	3	8/05/2013	7.20	7.77	4
11/06/2013	6.70	6.03	4	14/06/2013	6.70	6.94	4	14/06/2013	6.70	7.15	4	14/06/2013	6.80	7.46	4	14/06/2013	6.70	7.24	4
16/07/2013	6.70	5.97	4	8/07/2013	6.70	7.16	3	8/07/2013	6.70	7.20	3	8/07/2013	6.60	7.10	3	8/07/2013	6.70	7.16	3
14/08/2013	7.00	6.89	3	13/08/2013	7.00	6.71	3	13/08/2013	7.10	7.87	3	13/08/2013	7.10	7.79	3	13/08/2013	7.00	6.87	3
4/09/2013	6.90	6.20	3	03/09/2013	7.00	5.80	3	03/09/2013	7.10	7.60	3	03/09/2013	7.20	7.80	4	3/09/2013	7.20	7.60	3

Attachment 1
Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool O				Pool P				Pool R				Pool S				Pool T			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
2/10/2013	7.10	6.42	3	2/10/2013	7.20	7.06	3	2/10/2013	7.20	7.60	3	2/10/2013	7.30	7.76	3	2/10/2013	7.30	8.10	3
6/11/2013	7.00	6.12	3	21/11/2013	6.50	6.37	3	21/11/2013	6.30	3.18	4	21/11/2013	6.30	6.44	3	21/11/2013	6.30	6.96	3
2/12/2013	7.00	6.04	3	5/12/2013	7.00	6.13	3	5/12/2013	7.20	7.51	3	5/12/2013	7.10	7.56	3	5/12/2013	7.20	7.71	3
21/01/2014	6.90	6.28	3	8/01/2014	6.80	6.61	3	8/01/2014	7.00	7.91	3	8/01/2014	7.10	8.17	3	8/01/2014	7.20	7.82	4
4/02/2014	7.00	10.54	4	12/02/2014	7.10	7.00	3	12/02/2014	7.30	7.47	3	12/02/2014	7.30	8.45	3	12/02/2014	7.40	8.46	3
18/03/2014	6.90	6.75	4	11/03/2014	7.10	6.88	4	11/03/2014	7.20	7.53	3	11/03/2014	7.20	7.35	3	11/03/2014	7.20	7.45	3
10/04/2014	6.80	6.65	4	15/04/2014	6.90	7.15	3	15/04/2014	6.90	7.98	3	15/04/2014	6.90	7.37	3	15/04/2014	6.90	7.63	4
7/05/2014	6.80	7.19	4	9/05/2014	6.90	6.71	3	9/05/2014	6.90	6.71	3	9/05/2014	7.10	7.42	3	9/05/2014	7.10	7.24	3
5/06/2014	6.90	6.92	4	12/06/2014	7.00	7.21	3	12/06/2014	7.00	7.48	3	12/06/2014	7.10	7.33	3	12/06/2014	7.20	7.10	3
1/07/2014	6.80	6.79	3	8/07/2014	7.00	7.12	3	8/07/2014	7.00	7.66	3	8/07/2014	7.00	7.46	3	8/07/2014	7.10	7.28	3
7/08/2014	7.00	6.76	3	5/08/2014	7.10	6.40	3	5/08/2014	7.00	6.96	3	5/08/2014	7.10	7.86	3	5/08/2014	7.10	7.95	3
10/09/2014	6.90	5.99	3	4/09/2014	6.90	6.65	3	4/09/2014	6.80	7.58	3	4/09/2014	6.90	6.97	3	4/09/2014	6.90	7.02	3
21/10/2014	6.80	6.81	3	23/10/2014	7.00	7.19	3	23/10/2014	7.00	7.20	3	23/10/2014	7.10	7.39	3	23/10/2014	7.10	7.20	3
12/11/2014	6.90	7.40	2	11/11/2014	7.00	7.31	2	11/11/2014	7.20	7.96	2	11/11/2014	7.10	7.64	3	11/11/2014	7.10	7.42	3
2/12/2014	6.90	6.50	3	3/12/2014	7.00	6.70	4	3/12/2014	7.10	7.54	3	3/12/2014	7.20	7.99	3	3/12/2014	7.20	7.67	4
21/01/2015	6.90	6.85	4	7/01/2015	7.10	7.10	3	7/01/2015	7.10	7.57	3	7/01/2015	7.20	8.04	4	7/01/2015	7.20	8.35	3
10/02/2015	7.10	6.74	3	3/02/2015	7.00	5.91	3	3/02/2015	6.90	7.46	4	3/02/2015	7.10	7.49	3	3/02/2015	7.10	7.32	4
11/03/2015	6.90	6.66	3	4/03/2015	7.00	6.51	3	4/03/2015	7.00	7.59	4	4/03/2015	7.00	7.60	3	4/03/2015	7.10	7.56	3
16/04/2015	7.00	6.26	3	7/05/2015	6.80	6.74	3	7/05/2015	6.90	7.32	3	7/05/2015	6.90	7.31	3	7/05/2015	6.90	7.09	3
14/05/2015	7.10	6.62	3	13/05/2015	6.90	5.56	3	13/05/2015	6.90	7.84	3	13/05/2015	6.90	7.27	3	13/05/2015	6.90	7.23	4
1/06/2015	7.18	7.10	2	11/06/2015	7.28	7.03	2	11/06/2015	7.37	7.32	2	11/06/2015	7.34	7.92	2	11/06/2015	7.50	8.00	2
6/07/2015	6.61	7.26	2	1/07/2015	7.15	7.18	3	1/07/2015	7.20	7.43	3	1/07/2015	7.14	7.68	2	1/07/2015	7.23	7.75	2
3/08/2015	7.16	7.25	1	4/08/2015	7.24	7.21	1	4/08/2015	7.25	7.44	1	4/08/2015	7.40	7.85	1	4/08/2015	7.39	7.86	2
15/09/2015	6.95	7.25	2	8/09/2015	7.12	7.22	1	8/09/2015	7.33	7.39	2	8/09/2015	7.38	7.91	2	8/09/2015	7.40	7.87	11
7/10/2015	7.54	7.23	2	1/10/2015	7.38	7.17	2	1/10/2015	7.53	7.32	2	1/10/2015	7.60	7.96	2	1/10/2015	7.66	7.93	2
3/11/2015	7.39	7.14	8	10/11/2015	7.48	7.13	4	10/11/2015	7.46	7.41	4	10/11/2015	7.53	7.79	4	10/11/2015	7.53	7.45	4
2/12/2015	7.69	7.13	2	10/12/2015	7.74	7.23	2	10/12/2015	7.73	7.47	2	10/12/2015	7.75	7.96	3	10/12/2015	7.75	8.16	2
11/01/2016	7.11	7.13	3	12/01/2016	7.42	7.19	3	12/01/2016	7.42	7.42	3	12/01/2015	7.50	7.69	3	12/01/2016	7.54	7.85	3
1/02/2016	7.29	6.93	4	3/02/2016	7.54	6.95	3	3/02/2016	7.43	7.20	2	3/02/2016	7.53	7.57	3	3/02/2016	7.53	7.68	3
2/03/2016	7.54	6.91	2	3/03/2016	7.77		3	3/03/2016	7.69	7.10	3	3/03/2016	7.87	8.02	2	3/03/2016	8.01	8.34	2
				4/04/2016	7.57		3	4/04/2016	7.73	7.33	2	4/04/2016	7.75	7.95	2	4/04/2016	7.87	8.26	2
3/05/2016	7.50	7.27	1	3/05/2016	7.70		2	3/05/2016	7.84	7.41	2	3/05/2016	7.97	7.99	2	3/05/2016	7.94	8.15	2
15/06/2016	7.21	7.45	3	16/06/2016	7.47		3	16/06/2016	7.37	7.16	2	16/06/2016	7.53	7.55	3	16/06/2016	7.52	7.62	2
4/07/2016	6.43	7.52	2	6/07/2016	6.58	7.08	2	6/07/2016	6.68	7.37	2	6/07/2016	6.73	7.73	2	6/07/2016	6.56	7.76	2
1/08/2016	7.34	7.43	2	2/08/2016	7.31	6.77	2	2/08/2016	7.30	7.29	2	2/08/2016	7.43	7.79	2	2/08/2016	7.45	7.82	2
1/09/2016	7.04	7.64	2	7/09/2016	6.59	7.09	2	7/09/2016	6.74	7.28	2	7/09/2016	6.82	7.79	2	7/09/2016	6.84	7.68	2
6/10/2016	6.98	7.60	1	5/10/2016	7.74	6.91	2	5/10/2016	7.51	7.41	2	5/10/2016	7.51	7.86	2	5/10/2016	7.51	8.05	2
8/11/2016	7.58	7.61	<1	8/11/2016	7.50	7.31	1	8/11/2016	7.66	7.80	<1	8/11/2016	7.68	8.29	<1	8/11/2016	7.89	8.42	1
1/12/2016	7.34	7.91	2	19/12/2016	7.57	7.57	7	19/12/2016	7.60	7.68	6	19/12/2016	7.71	8.12	5	19/12/2016	7.78	8.31	4
9/01/2017	7.59	7.91	2	12/01/2017	7.65	6.98	2	12/01/2017	7.71	7.49	2	12/01/2017	7.84	7.93	2	12/01/2017	7.91	8.20	2
1/02/2017	7.54	6.88	2	2/02/2017	7.61	7.39	2	2/02/2017	7.74	7.71	2	2/02/2017	7.86	7.94	2	2/02/2017	7.79	8.14	2
8/03/2017	7.12	7.12	4	9/03/2017	7.09	6.88	5	9/03/2017	7.10	7.14	4	9/03/2017	7.22	7.34	3	3/09/2017	7.19	7.38	4
18/04/2017	7.33	7.56	3	12/04/2017	7.18	7.02	4	12/04/2017	7.23	7.19	4	12/04/2017	7.27	7.47	4	12/04/2017	7.23	7.54	4
4/05/2017	7.42	7.66	2	2/05/2017	7.48	7.25	2	2/05/2017	7.45	7.56	2	2/05/2017	7.53	7.82	2	2/05/2017	7.44	7.92	2
1/06/2017	7.52	7.46	2	5/06/2017	7.58	7.21	2	5/06/2017	7.51	7.74	2	5/06/2017	7.78	7.85	2	5/06/2017	7.78	7.88	2
5/07/2017	6.57	7.49	2	3/07/2017	6.93	7.17	2	3/07/2017	6.94	7.56	2	3/07/2017	7.00	7.43	2	3/07/2017	7.00	7.45	2
4/08/2017	7.71	7.90	1	4/08/2017	7.51	7.46	2	4/08/2017	7.63	8.11	2	4/08/2017	7.70	7.88	2	4/08/2017	7.72	8.02	2
4/09/2017	7.71	7.90	1	19/09/2017	7.22	7.59	1	19/09/2017	7.49	7.69	2	19/09/2017	7.63	8.52	2	19/09/2017	7.76	8.41	2
3/10/2017	7.55	7.75	1	16/10/2017	7.56	6.98	2	16/10/2017	7.73	7.74	2	16/10/2017	7.91	8.22	2	16/10/2017	8.00	8.32	2
2/11/2017	7.71	7.57	2	23/11/2017	7.85	7.22	2	23/11/2017	7.91	7.72	2	23/11/2017	7.96	8.10	2	23/11/2017	8.03	8.22	2
5/12/2017	7.61	7.69	2	18/12/2017	7.62	7.33	2	18/12/2017	7.70	7.61	2	18/12/2017	7.86	8.15	2	18/12/2017	7.77	8.41	2

Attachment 1
Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool O				Pool P				Pool R				Pool S				Pool T			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
8/01/2018	7.60	7.08	2	31/01/2018	7.79	7.44	2	31/01/2018	7.97	7.79	2	31/01/2018	8.08	8.26	2	31/01/2018	8.23	8.49	2
1/02/2018	7.90	7.20	2	12/02/2018	7.79	7.23	2	12/02/2018	8.05	7.51	2	12/02/2018	8.08	8.15	2	12/02/2018	8.17	8.46	2
8/03/2018	7.32	7.16	2	20/03/2018	7.69	7.28	2	20/03/2018	7.80	7.77	2	20/03/2018	7.87	8.19	2	20/03/2018	7.96	8.66	3
11/04/2018	7.60	7.56	2	16/04/2018	7.67	7.10	6	16/04/2018	7.71	7.86	6	16/04/2018	7.80	8.01	8	16/04/2018	7.86	8.34	6
1/05/2018	7.59	7.65	2	14/05/2018	7.72	7.23	2	14/05/2018	7.83	7.60	2	14/05/2018	7.92	8.08	2	14/05/2018	7.97	8.14	2
4/06/2018	7.72	7.75	1	21/06/2018	7.65	7.28	1	21/06/2018	7.79	7.94	<1	21/06/2018	7.88	7.83	2	21/06/2018	7.94	7.83	<1
4/07/2018	7.32	7.67	1	18/07/2018	6.72	6.80	2	18/07/2018	7.01	7.55	2	18/07/2018	7.25	7.92	2	18/07/2018	7.26	8.01	2
1/08/2018	6.79	7.42	1	15/08/2018	7.69	7.41	1	15/08/2018	7.76	7.76	2	15/08/2018	7.83	7.95	1	15/08/2018	7.91	8.09	1
6/09/2018	7.26	7.13	1	11/09/2018	7.48	7.20	1	11/09/2018	7.34	7.53	1	11/09/2018	7.57	8.04	2	11/09/2018	7.70	8.28	2
23/10/2018	7	7.34	3	02/10/2018	7.9	7.71	2	02/10/2018	8.01	7.77	2	02/10/2018	8.12	8.25	2	02/10/2018	8.12	8.44	2
13/11/2018	7.4	7.8	2	06/11/2018	7.62	7.16	2	06/11/2018	7.57	7.41	2	06/11/2018	7.46	7.48	2	06/11/2018	7.54	7.98	2
03/12/2018	7.4	7.34	3	11/12/2018	7.14	7.14	2	11/12/2018	7.32	7.37	2	11/12/2018	7.44	7.87	2	11/12/2018	7.49	8.06	3
15/01/2019	7.67	7.51	2	23/01/2019	7.78	7.36	<1	23/01/2019	7.85	7.62	<1	23/01/2019	7.63	8.08	<1	23/01/2019	7.81	8.29	<1
07/02/2019	7.47	7.4	2	19/02/2019	7.79	7.17	2	19/02/2019	7.61	7.39	2	19/02/2019	7.78	7.94	3	19/02/2019	7.92	8.21	3
27/03/2019	7.42	7.21	3	21/03/2019	6.84	6.89	5	21/03/2019	6.9	7.27	5	21/03/2019	6.95	7.65	5	21/03/2019	6.93	7.71	5
11/04/2019	7.1	7.33	2	18/04/2019	8.18	7.35	2	18/04/2019	7.82	7.14	2	18/04/2019	7.78	7.84	2	18/04/2019	7.73	7.75	2
07/05/2019	7.46	7.05		21/05/2019	7.6	7.2	1	21/05/2019	7.09	7.49	1	21/05/2019	7.6	7.85	2	21/05/2019	7.61	8.01	2
20/06/2019	7.36	7.36	2	13/06/2019	7.7	6.93	2	13/06/2019	7.79	7.4	1	13/06/2019	7.84	8.24	1	13/06/2019	7.8	8.08	1
18/07/2019	7.42	7.17	2	16/07/2019	6.96	7.1	2	16/07/2019	7.02	7.35	2	16/07/2019	7.05	7.79	2	16/07/2019	7.02	7.85	2
07/08/2019	6.55	7.82	1	06/08/2019	6.86	7.31	2	06/08/2019	6.83	7.62	1	06/08/2019	6.81	8.05	2	06/08/2019	6.75	8.26	2
04/09/2019	7.54	7.74	2	10/09/2019	7.4	7.48	1	10/09/2019	7.42	7.47	2	10/09/2019	7.53	8.25	2	10/09/2019	7.54	8.83	2

Attachment 1

Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool U				Pool V				Pool W			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
20/01/2010	7.00	7.48	3	20/01/2010	6.90	6.87	3	20/01/2010	6.90	7.09	3
10/02/2010	6.60	6.60	6	10/02/2010	6.50	6.45	6	10/02/2010	6.50	6.34	6
11/03/2010	7.40	7.61	2	11/03/2010	7.20	7.38	3	11/03/2010	7.30	7.42	3
8/04/2010	7.50	7.42	3	8/04/2010	7.40	7.38	3	8/04/2010	7.50	7.20	3
21/05/2010	7.40	6.63	2	21/05/2010	7.30	6.52	2	21/05/2010	7.30	6.25	3
9/06/2010	6.80	6.95	4	9/06/2010	6.90	7.23	4	9/06/2010	6.80	7.22	4
20/07/2010	6.70	7.52	1	20/07/2010	6.80	7.36	1	20/07/2010	6.80	7.19	2
30/08/2010	6.80	7.82	3	30/08/2010	6.90	7.71	3	30/08/2010	6.80	7.63	3
23/09/2010	6.50	6.19	5	23/09/2010	6.50	4.60	5	23/09/2010	6.50	4.34	5
14/10/2010	6.40	6.84	3	14/10/2010	6.50	6.77	3	14/10/2010	6.50	6.21	3
23/11/2010	6.50	6.51	3	23/11/2010	6.50	6.70	3	23/11/2010	6.50	6.80	3
14/12/2010	6.60	7.49	4	14/12/2010	6.60	7.41	3	14/12/2010	6.50	7.46	3
18/01/2011	7.00	7.90	4	18/01/2011	6.90	7.85	3	18/01/2011	6.90	7.93	3
17/02/2011	7.60	7.09	2	17/02/2011	7.60	7.40	2	17/02/2011	7.60	7.37	2
17/03/2011	7.30	7.52	3	17/03/2011	7.30	7.55	3	17/03/2011	7.20	7.67	2
6/04/2011	7.30	7.82	4	6/04/2011	7.30	7.64	4	6/04/2011	7.20	7.76	4
4/05/2011	7.10	7.29	3	4/05/2011	7.00	6.94	3	4/05/2011	7.00	6.99	4
22/06/2011	7.00	6.90	3	22/06/2011	7.00	6.72	3	22/06/2011	7.10	6.47	4
14/07/2011	7.10	7.52	4	14/07/2011	7.20	7.36	3	14/07/2011	7.20	7.32	3
10/08/2011	7.00	7.33	3	10/08/2011	7.10	7.00	3	10/08/2011	7.00	7.10	3
14/09/2011	7.10	7.63	3	14/09/2011	7.20	7.47	2	14/09/2011	7.10	7.36	2
19/10/2011	7.00	7.89	4	19/10/2011	6.90	7.42	4	19/10/2011	6.90	7.03	3
17/11/2011	7.10	7.79	2	17/11/2011	7.10	7.72	2	17/11/2011	7.00	8.09	2
19/12/2011	6.90	7.55	3	19/12/2011	7.00	7.47	3	19/12/2011	6.90	7.52	3
19/01/2012	6.80	7.33	3	19/01/2012	6.80	7.22	3	19/01/2012	6.80	7.22	3
9/02/2012	6.80	7.17	3	9/02/2012	6.80	6.97	3	9/02/2012	6.80	7.08	3
23/03/2012	6.90	7.63	6	23/03/2012	6.80	7.43	6	23/03/2012	6.90	7.46	6
12/04/2012	7.30	7.10	5	12/04/2012	7.20	7.01	4	12/04/2012	7.10	7.15	5
3/05/2012	7.10	7.01	3	3/05/2012	7.00	7.72	3	3/05/2012	7.00	7.13	3
19/06/2012	6.80	7.17	4	19/06/2012	6.80	7.30	4	19/06/2012	6.90	6.69	4
10/07/2012	7.00	6.35	3	10/07/2012	7.00	6.86	3	10/07/2012	6.90	6.64	3
2/08/2012	7.00	6.95	3	2/08/2012	7.00	7.03	3	2/08/2012	7.00	7.06	3
12/09/2012	7.20	7.20	2	12/09/2012	7.20	7.31	2	12/09/2012	7.30	7.36	2
10/10/2012	7.20	6.76	3	10/10/2012	7.10	7.02	3	10/10/2012	7.30	6.94	2
15/11/2012	7.20	6.53	3	15/11/2012	7.10	6.91	3	15/11/2012	7.20	6.74	3
12/12/2012	7.20	6.40	3	12/12/2012	7.10	6.79	3	12/12/2012	7.20	6.52	3
15/01/2013	7.10	8.41	4	15/01/2013	7.20	7.81	4	15/01/2013	7.10	7.96	3
5/02/2013	6.50	7.00	4	5/02/2013	6.50	7.21	4	5/02/2013	6.60	7.24	3
7/03/2013	6.80	6.73	4	7/03/2013	6.80	6.98	4	7/03/2013	6.80	6.89	4
9/04/2013	6.80	6.88	5	9/04/2013	6.90	7.33	5	9/04/2013	6.90	7.25	5
8/05/2013	7.20	7.89	4	16/05/2013	No sample taken			8/05/2013	7.20	7.82	4
14/06/2013	6.80	7.39	4	14/06/2013	6.70	7.52	4	14/06/2013	6.70	7.51	3
8/07/2013	6.80	7.00	4	8/07/2013	6.70	7.06	4	8/07/2013	6.70	7.58	4
13/08/2013	7.00	7.86	4	13/08/2013	7.10	7.69	3	13/08/2013	7.00	7.26	3
3/09/2013	7.20	7.50	3	3/09/2013	7.10	7.40	3	3/09/2013	7.10	7.00	3
2/10/2013	7.30	8.45	3	2/10/2013	7.20	7.96	3	2/10/2013	7.30	7.45	3
21/11/2013	6.20	5.49	4	21/11/2013	6.20	6.42	3	21/11/2013	6.20	7.93	3
5/12/2013	7.10	7.53	3	5/12/2013	7.10	7.36	3	5/12/2013	7.20	7.43	3
8/01/2014	7.20		3	8/01/2014	7.10	8.63	3	8/01/2014	7.10	7.59	3
12/02/2014	7.40	8.60	4	12/02/2014	7.40	8.27	4	12/02/2014	7.40	8.30	3
11/03/2014	7.10	7.19	4	11/03/2014	7.10	7.29	3	11/03/2014	7.10	7.17	3
15/04/2014	6.80	7.41	3	15/04/2014	6.80	7.36	3	15/04/2014	6.80	7.42	3
9/05/2014	7.00	7.18	3	9/05/2014	6.90	7.37	3	9/05/2014	7.00	7.28	3
12/06/2014	7.10	7.51	3	12/06/2014	7.10	7.39	3	12/06/2014	7.10	7.46	3
8/07/2014	7.20	7.70	3	8/07/2014	7.20	7.79	2	8/07/2014	7.10	7.75	3
5/08/2014	7.10	8.01	3	5/08/2014	7.10	7.93	2	5/08/2014	7.10	7.93	3
4/09/2014	7.00	6.98	3	4/09/2014	7.00	7.07	3	4/09/2014	7.00	6.96	3
23/10/2014	7.10	7.28	3	23/10/2014	7.10	7.21	3	23/10/2014	7.10	7.30	3

Attachment 1

Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool U				Pool V				Pool W			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
11/11/2014	7.30	8.15	3	11/11/2014	7.30	8.15	3	11/11/2014	7.30	8.00	3
3/12/2014	7.20	7.94	3	3/12/2014	7.20	8.32	3	3/12/2014	7.10	7.86	3
7/01/2015	7.20	8.28	3	7/01/2015	7.20	7.74	3	7/01/2015	7.20	7.78	3
3/02/2015	7.10	7.41	4	3/02/2015	7.10	7.37	4	3/02/2015	6.90	7.38	3
4/03/2015	7.00	7.69	3	4/03/2015	7.10	7.36	3	4/03/2015	7.10	7.20	3
7/05/2015	6.90	7.18	3	7/05/2015	6.80	7.35	3	7/05/2015	6.80	7.38	3
13/05/2015	7.00	7.16	3	13/05/2015	7.10	7.16	3	13/05/2015	7.00	7.23	3
11/06/2015	7.50	7.90	2	11/06/2015	7.40	7.68	2	11/06/2015	7.50	7.74	2
1/07/2015	7.30	7.73	2	1/07/2015	7.20	7.54	2	1/07/2015	7.30	7.73	2
4/08/2015	7.40	7.87	2	4/08/2015	7.10	7.62	1	4/08/2015	7.30	7.38	2
8/09/2015	7.40	7.88	2	8/09/2015	7.40	7.63	2	8/09/2015	7.40	7.70	2
1/10/2015	7.50	7.83	2	1/10/2015	7.50	7.44	2	1/10/2015	7.60	7.48	2
10/11/2015	7.60	7.87	4	10/11/2015	7.50	7.40	4	10/11/2015	7.30	7.60	4
10/12/2015	7.30	8.13	2	10/12/2015	7.50	7.63	2	10/12/2015	7.70	7.30	2
12/01/2016	7.30	7.76	3	12/01/2016	7.60	7.46	3	12/01/2016	7.52	7.16	3
3/02/2016	7.55	7.71	3	3/02/2016	7.51	7.39	3	3/02/2016	7.57	7.37	3
3/03/2016	7.96	8.35	3	3/03/2016	7.75	7.70	2	3/03/2016	7.72	7.77	2
4/04/2016	7.78	8.12	3	4/04/2016	7.79	7.62	2	4/04/2016	7.75	7.77	2
3/05/2016	7.93	8.13	1	3/05/2016	7.88	7.76	2	3/05/2016	7.90	7.82	2
16/06/2016	7.36	7.75	2	16/06/2014	7.47	7.44	3	16/06/2016	7.40	7.50	3
6/07/2016	6.66	7.80	2	6/07/2016	6.69	7.64	2	6/07/2016	6.72	7.70	2
2/08/2016	7.46	7.81	2	2/08/2016	7.41	7.58	2	2/08/2016	7.20	7.67	2
7/09/2016	6.84	7.82	2	7/09/2016	6.82	7.59	2	7/09/2016	6.84	7.71	1
5/10/2016	7.51	8.05	2	5/10/2016	7.51	7.78	2	5/10/2016	7.50	7.85	2
8/11/2016	7.94	8.48	3	8/11/2016	7.81	7.83	2	8/11/2016	7.80	7.65	3
19/12/2016	7.49	8.29	3	19/12/2016	7.57	7.66	3	19/12/2016	7.65	7.48	3
12/01/2017	7.91	8.31	2	12/01/2017	7.49	7.52	2	12/01/2017	7.74	7.79	2
2/02/2017	7.91	8.04	2	2/02/2017	7.77	7.57	2	2/02/2017	7.83	7.62	2
9/03/2017	7.20	7.35	8	9/03/2017	7.18	7.17	4	9/03/2017	7.17	7.20	4
12/04/2017	7.25	7.63	4	12/04/2017	7.21	7.42	4	12/04/2017	7.21	7.50	4
2/05/2017	7.53	7.83	2	2/05/2017	7.60	7.53	2	2/05/2017	7.44	7.49	2
5/06/2017	7.76	7.78	2	5/06/2017	7.68	7.48	2	5/06/2017	7.58	7.38	<1
3/07/2017	7.03	7.46	2	3/07/2017	7.02	7.21	2	3/07/2017	7.03	6.62	2
4/08/2017	7.73	8.00	2	4/08/2017	7.70	7.82	2	4/08/2017	7.74	7.78	2
19/09/2017	7.73	8.42	2	19/09/2017	7.66	8.05	2	19/09/2017	7.68	8.35	2
16/10/2017	8.08	8.15	2	16/10/2017	7.79	7.89	2	16/10/2017	7.59	8.23	2
23/11/2017	8.01	8.28	2	23/11/2017	7.84	7.91	2	23/11/2017	7.95	7.97	2
18/12/2017	7.97	8.36	2	18/12/2017	7.71	7.65	2	18/12/2017	7.76	7.80	2
31/01/2018	7.96	8.42	2	31/01/2018	7.88	7.62	3	31/01/2018	7.98	7.94	2
12/02/2018	8.15	8.37	3	12/02/2018	7.90	7.52	2	12/02/2018	7.95	7.67	2
20/03/2018	7.98	8.41	2	20/03/2018	7.81	7.63	2	20/03/2018	7.85	7.69	2
16/04/2018	7.85	8.13	5	16/04/2018	7.62	7.64	4	16/04/2018	7.77	7.79	3
14/04/2018	7.97	8.33	2	14/05/2018	7.82	7.85	2	14/05/2018	7.90	8.08	2
21/06/2018	7.99	7.90	2	21/06/2018	7.82	7.55	1	21/06/2018	7.89	7.44	1
18/07/2018	7.30	7.95	2	18/07/2018	7.20	7.79	1	18/07/2018	7.18	7.70	2
15/08/2018	7.92	8.17	2	15/08/2018	7.85	7.87	1	15/08/2018	7.87	7.83	2
11/09/2018	7.71	8.40	2	11/09/2018	7.64	7.84	2	11/09/2018	7.72	7.86	2
02/10/2018	8.13	8.7	2	02/10/2018	8.05	8.11	2	02/10/2018	7.99	7.85	2
06/11/2018	7.57	7.93	2	06/11/2018	7.61	7.53	2	06/11/2018	7.57	7.74	2
11/12/2018	7.52	8.03	2	11/12/2018	7.41	7.38	2	11/12/2018	7.46	7.78	3
23/01/2019	7.93	8.25	<1	23/01/2019	7.84	7.6	<1	23/01/2019	7.73	7.77	<1
19/02/2019	7.98	8.3	2	19/02/2019	7.73	7.68	2	19/02/2019	7.8	7.79	2
21/03/2019	6.93	7.67	5	21/03/2019	6.9	7.28	5	21/03/2019	6.91	7.39	5
18/04/2019	7.75	7.88	2	18/04/2019	7.76	7.38	2	18/04/2019	7.74	7.62	2
21/05/2019	7.49	8.04	1	21/05/2019	7.73	7.73	1	21/05/2019	7.83	7.86	1
13/06/2019	7.84	8.01	2	13/06/2019	7.81	7.72	2	13/06/2019	7.83	7.61	2
16/07/2019	7.05	7.81	2	16/07/2019	7.01	7.54	2	16/07/2019	7.02	7.76	2

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Waratah Rivulet - pH and Total Organic Carbon (TOC) Water Quality Monitoring Results

Pool U				Pool V				Pool W			
Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L	Date	pH Lab	pH Field	TOC mg/L
06/08/2019	6.76	8.19	2	06/08/2019	6.75	7.93	2	06/08/2019	6.97	7.91	2
10/09/2019	7.57	8.33	2	10/09/2019	7.53	8.0	2	10/09/2019	7.54	8.08	2