REPORT

LEIGH CREEK MINE: REVIEW OF SURFACE WATER MONITORING DATA

Prepared for Flinders Power

10/02/2017

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Flinders Power

Leigh Creek Mine: Review of Surface Water Monitoring Data

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1 Introduction

The Leigh Creek Lobe B mine site is located in a low rainfall, high evaporation environment and intersects the original pathway of Leigh Creek. The creek systems surrounding Lobe B mine site are ephemeral and overland flow and creek lines have been modified due to the presence of the waste dumps. There is the potential that seepage through and runoff from the waste dumps could impact on the downstream environment through acid and metalliferous drainage (AMD) and saline drainage. However, surface water monitoring has been sporadic and analysis limited over the life of the mine. Access to monitoring sites after significant rainfall events has also hampered data collection and access to monitoring points. Further, there have been historical surface water flows engineered along altered creek lines that have potentially impacted existing edaphic conditions. Whilst these impacts will equilibrate with the surface hydrologic regime their potential impact must also be considered when interpreting monitoring data. MWH were engaged to undertake the following:

1. To provide an initial review of existing surface water monitoring data to assist in defining the risk using a source pathway receptor model, and
2. To provide an independent review of the current water monitoring plan with respect to potential water flow pathways and provide recommendations and appropriate trigger values.

2 Trigger values and trends

Trigger values are used to assess the likelihood or risk that specific water quality conditions will have an impact of the surround ecosystem. These trigger values reflect the natural water quality conditions of the surrounding landscape and are derived from relevant regional datasets, if they exist. The values also provide an indication of the level of ecosystem protect. The initial set of trigger values are based on SA Environmental Protection (Water Quality) Policy 2015 (EPP 2015) and Australian and New Zealand Environmental and Conservation Council guidelines 2000 (ANZECC guidelines) for aquatic ecosystems. It should also be recognised that the ANZECC guidelines are not site specific, hence, the trigger values will need to be adjusted to reflect regional background water quality based on targeted water monitoring points. The initial level of protection is set at 95% in accordance with the EPP 2015. Given the moderate level of disturbance of the site and previous grazing a protection level of 90% should also be considered and, therefore, are also presented. Not all elements are able to have a trigger value set. Initial trigger levels for salinity were set in accordance to SA Museum (2011)[1].

Trigger values for south central Australia for lowland rivers (defined as rivers below 150 mAHD) are used. There are no default values for upland rivers for south central Australia (defined as rivers/streams above 150 mAHD). The Leigh Creek Mine site is located between 150-250 mAHD. The initial set of trigger values are listed in Appendix A.

A complication with data interpretation in ephemeral streams is that the water quality can often be highly variable throughout the flow regime. Hence, measurement of stream flow rates during water quality sampling along with the initiating rainfall event provides additional information to interpret solute fluxes within a flow regime. Constant periodic measurements of stream water quality provides indications of the expected water quality variability, trends and relationships with surrounding ephemeral streams. These factors need to be considered when interpreting the surface water monitoring data.

[1] SA Museum (2011) Environmental impact assessment of discharge water on flora and fauna of the Leigh Creek Waterways, Report prepared for Alinta Energy

3 Review of surface water monitoring data

3.1 1999 to 2004

Surface water monitoring of selected points was undertaken between 1999 and 2004 and are presented in Appendix B. No flow rate data was presented and limited water quality parameters were measured. Nevertheless, the data demonstrates the relative stable nature of salinity in the retention dam ranging between 1200 and 3000 mg/L TDS. Large and rapid salinity fluctuations in the retention dam is not expected due to the buffering capacity of the storage volume. The vast majority of salinity measurements at the 8km crossing (Leigh Creek) are within the range of 20000 to 40000 mg/L TDS which is interspersed with TDS levels below 10000 mg/L. It is unknown what the flow conditions were at the time of sample collection or whether the water had ceased flowing and samples were taken from evaporating ponds. However, the salinity levels at the 11km crossing (Lobe C creek) were more variable fluctuating between 1000 and 20000 mg/L TDS with more dry creek bed periods. These results suggest that the 8km crossing may be influenced by an additional saline source that is elevating the salinity readings in creek line. What is not known is whether these salinity levels are typical of the creek systems within the region.

3.2 October 2010

In October 2010, as a result of significant rainfall, approximately 200ML of water was pumped from M14 pit into Leigh Creek north of the north-west waste dumps (no timeframe given). Surface water quality monitoring occurred as part of this pumping activity and are presented in Appendix C. No flow records at the monitoring sites were recorded, hence, determination of dilution impacts of presented TDS values are not possible. Of note is the low TDS values recorded at the retention dam (540 mg/L) and access road (260 mg/L) monitoring sites compared to the creek line adjacent to M14 (3200 mg/L). Whilst the TDS value is below the trigger value the relatively high TDS value in the creek line adjacent M14 indicates a possible interaction with the runoff from the waste dumps or other salt accumulation in the landscape upstream of this point. What is not known is how close this sampling point was to the M14 discharge point and whether there was any contamination of the water sample during sample collection. Hence, it is unclear from this data whether runoff from the waste dumps is causing an increase in TDS levels and whether this levels poses an increase risk to the surrounding vegetation.

3.3 2012 to 2013

In May 2011, as a result of significant rainfall, water was pumped from L5/6/7 pits into Tobacco Bush creek east of the northern dumps which was diverted to flow to Lobe C (no timeframe given). It is asserted that this practice had occurred previously but no records have been located. In March 2012, as a result of significant rainfall, water was pumped from M14 pit into Leigh Creek north of the north-west waste dumps (no timeframe given), and L5/6/7 into Tobacco Bush creek east of the northern dumps which was diverted to flow to Lobe C (no timeframe given). Surface water quality monitoring occurred as part of this pumping activity and are presented in Appendix D.

It is noted that for all sites monitored metals are below the 95% trigger value. However, ammonia and oxidised nitrogen levels are often elevated above the 95% trigger value, particularly for the pits. Whilst the 8km crossing shows elevated levels of ammonia and oxidised nitrogen its occurrence coincides with the pumping from M14 sump. Once the pumping has ceased, taken as the point that monitoring of M14 ceases, the ammonia and oxidised nitrogen at the 8km crossing falls well below the 95% trigger value.

Like the previous measurements the salinity levels at the 8km crossing remain high and are often above the TDS trigger value this is despite the salinity levels of the retention dam and the access road remaining low during this period. However, without flow data from the various sources no meaningful conclusions can be determined. Of note however is the fact that a considerable volume of saline water from the pits has been dispersed into creek lines north of the waste dumps. There is potential for impacts on

subsequent monitoring due to the effects of residual surface and subsurface saline conditions generated during these pumping activities.

3.4 2016

Significant rainfall events occurred in early winter and spring 2016. Surface water quality monitoring occurred as a result of these events and are presented in Appendix E. The presence of a spring located between the northern waste dumps and the 8km crossing was also located and monitored. No meaningful flow records were taken.

All metals for the surface water monitoring points remained below the trigger value. The salinity levels at the 8km crossing were more variable than previous measurements with the most recent measure below the trigger value. In contrast the salinity measurement at Tobacco Bush creek on the north eastern edge of waste dumps was very low at 160 mg/L TDS. The relative proportion of cations and anions were similar between the 8km crossing, the retention dam and the spring data suggesting no neutralisation is occurring. Changes in the proportions of cations and anions in the water samples over a time series would be an indicator of the presence of AMD. Water quality data from the spring site, however, showed that sulphate, oxidized nitrogen and salinity levels well above the trigger values and are reflected in the elevated values at 8km crossing, which is downstream, compared to other surface water monitoring points. The high level of oxidised nitrogen and sulphate suggest that the source may be associated with the waste dump due to the similar or higher levels found in the mine pits. However, without adequate regional surface and subsurface water quality data it is not possible to attribute these levels directly to the seepage through the waste dumps. High saline readings have been reported in the Telford gravels upstream of the northern waste dumps.

From the monitoring data presented no meaningful conclusions can be drawn in relation to the impact on the downstream environment through acid and metalliferous drainage (AMD) and saline drainage. This is partly due to the intermittent nature of stream flow and limited and disconnected sampling regime that is not based on a site wide water and load balance.

4 Review of surface water monitoring plan

Observations from the recent seepage survey showed that surface water flow at the Leigh Creek mine site is dominated by surface runoff during rainfall events with a small contribution from subsurface lateral flow. For this reason the surface water flow is ephemeral with long periods of no flow interspersed with infrequent highly variable flows. It is recognised that there are several pathways that contribute to surface water flow associated with the Leigh Creek Coal mine. The dominance of these pathways varies depending on location and upstream and downstream edaphic factors. These pathways include:

- Direct runoff from surrounding natural landscape reporting to an established creek line,
- Natural subsurface flow (perched water tables) through prior creek beds that report to established creek lines,
- Direct runoff from the waste dumps that report to a surrounding landscape or direct to an established creek line,
- Short term preferential flow through the waste dumps that report to a surrounding landscape or direct to an established creek line, and
- Longer term seepage through the waste dumps that reports to the surrounding landscape or direct to an established creek line either through surface or subsurface flow.

A schematic of the major flow pathways around the Leigh Creek Coal mine is represented in Figure 1.

The surface water monitoring data reviewed in this short report do not adequately encapsulate the landscape flow regime represented in Figure 1. Consideration must be given to both upstream and downstream monitoring points as well as the measurement of flow rates so that step-wise load estimations along the flow path can be determined. With additional surface water monitoring points,

along with groundwater monitoring, potential impacts from the waste dumps on the downstream environment can be better estimated.

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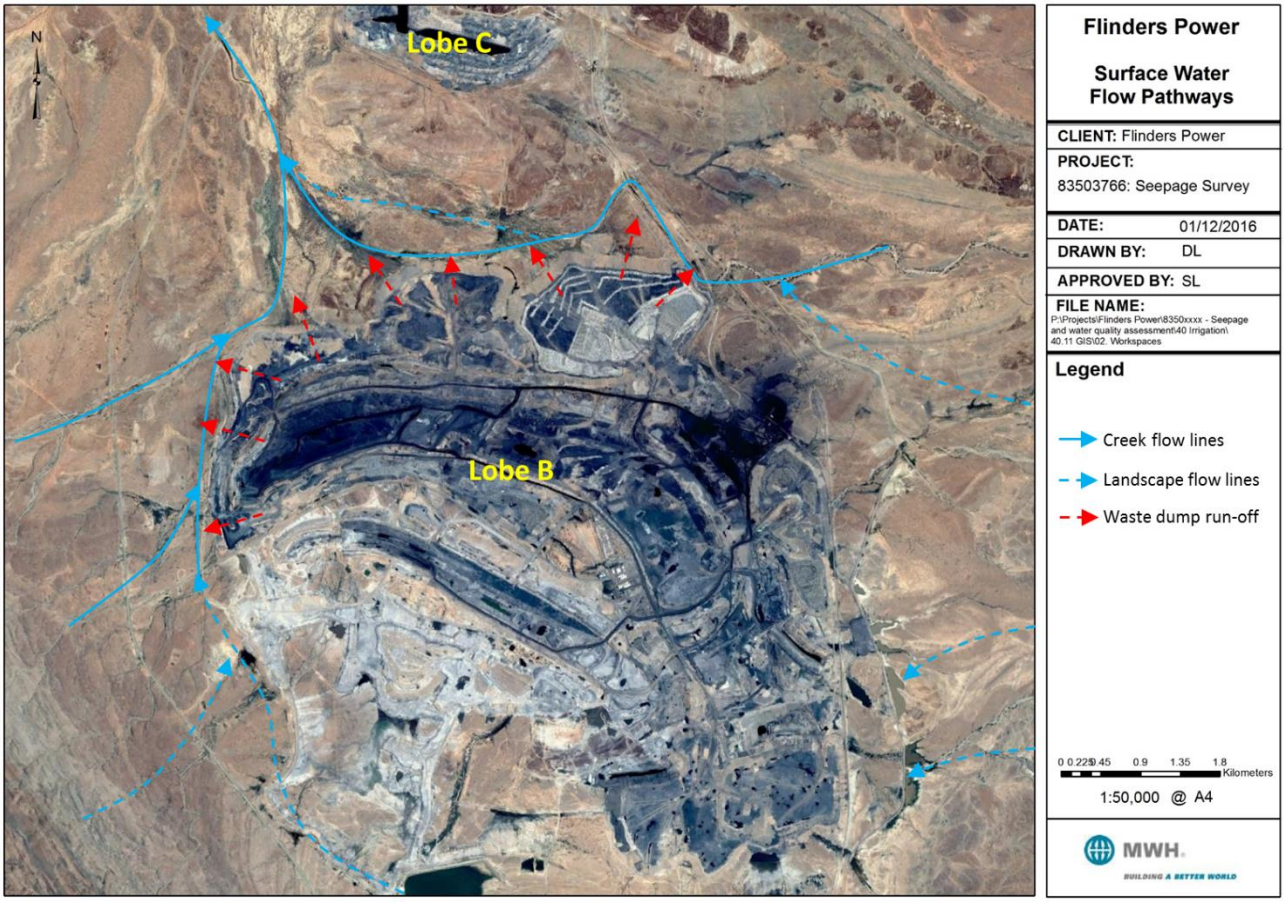

Figure 1: Seepage assessment locations along the Western bund

4.1 Recommendations

The following surface water monitoring points are proposed in order to establish a framework that will monitor various flow pathways at selected locations along with water quality indicator attributes (Appendix F). The monitoring points are located to quantify both the upstream (undisturbed) and downstream (disturbed) surface water conditions. The quantification of the surface water conditions attempt to include both water quality and flow rate so that load rates can be determined and cumulative impacts estimated. It is also recognised that there is also potential interaction with the groundwater monitoring plan. A total of 13 surface water monitoring points are put forward in this plan that suggest varying degrees of monitoring when conditions permit. The location and naming convention of these monitoring points are shown in Figure 2 and are as follows.

Table 1: Surface water monitoring points and rationale

Site	Rationale
Leigh Creek South	Represents regional surface water flow and water quality into the Retention Dam and is unaffected by mining activity
Retention dam*	Represents the upstream water quality condition of the overland flow pathway along the western waste dump

Site	Rationale
Mine Access Road Crossing*	Represents a mid-point of surface water flow along the western waste dump receiving water from the western ridge and the retention dam
West Creek Entrance	Represents regional surface water flow and water quality into the mining lease area from the western ridge and is unaffected by mining activity
Tobacco Bush Creek #1	Represents regional surface water flow and water quality into the mining lease area from the eastern ranges and is unaffected by mining activity
Tobacco Bush Creek #2*	Represents continuation of a current monitoring point where Tobacco Bush Creek enters the mine lease from the east
Tobacco Bush Creek #3	Represents a mid-point along Tobacco Bush Creek as is impacted by runoff from the waste dumps previous mining water management
Northern Waste Dump Creek	Represents a partial continuation of flow from Tobacco Bush Creek and runoff from the waste dumps
Spring*	Represents an unknown source of surface water flow and water quality into the mining lease area and connects with Leigh Creek
Leigh Creek North*	Represents water quality exiting the mining lease area and the sum of Tobacco Bush Creek, waste dump runoff, discharge from the spring and surface waters from the western edge of Lobe B
Lobe C Creek*	Represents water quality exiting the mining lease area associated with Lobe C in the Northfield
Northfield Creek*	Represents water quality exiting the mining lease area associated with Lobe D in the Northfield
Runoff to Tobacco Bush Creek	Represents a major runoff location along the northern waste dumps that report directly into the Tobacco Bush Creek

* Continuance of existing monitoring point

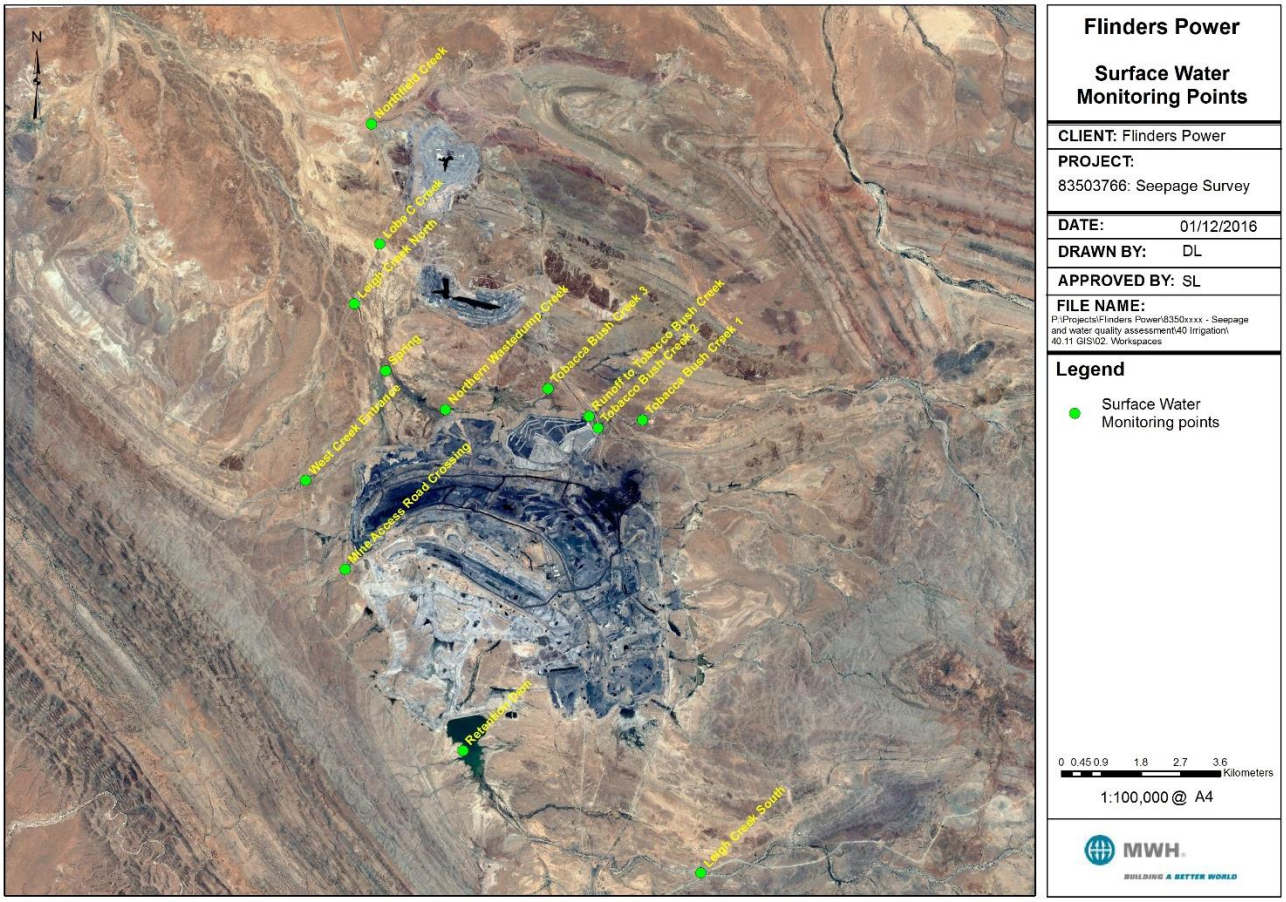

Figure 2: Suggested surface water monitoring points

Appendices

Appendix A Trigger values used to assess water quality

Element	Units	Creeks		Reservoirs	
Level of Protection		**95%**	**90%**	**95%**	**90%**
Nitrogen – total	mg/L	1.0		1.0	
Phosphorus – total	mg/L	0.1		0.025	
Ammonia	mg/L	0.9	1.43	0.9	1.43
Oxidized Nitrogen (NOx)[A]	mg/L	0.7	3.4	0.7	3.4
Organic Carbon - total	mg/L	ND		ND	
Alkalinity as CaCO3	mg/L	ND		ND	
Acidity as CaCO3	mg/L	ND		ND	
Bicarbonate	mg/L	ND		ND	
Carbonate	mg/L	ND		ND	
Hydroxide	mg/L	ND		ND	
Conductivity, EC	µS/cm	15000		15000	
Total dissolved solids (TDS)	mg/L	10000		10000	
pH	mg/L	<6.5, >9.0		<6.5, >9.0	
Turbidity	NTU	50		100	
Suspended sediment	mg/L	ND		ND	
Cations					
Calcium - total	mg/L	1000		1000	
Magnesium - total	mg/L	ND		ND	
Sodium - total	mg/L	ND		ND	
Potassium - total	mg/L	ND		ND	
Anions					
Sulphate - total (SO4)	mg/L	1000		1000	
Fluoride	mg/L	2		2	
Chloride	mg/L	ND		ND	
Metals (level of protection)					
Aluminium – soluble (pH>6.5)	µg/L	55	80	55	80
Antimony - total	µg/L	ND		ND	
Arsenic - total	µg/L	24	94	24	94
Barium – total	µg/L	ND		ND	
Boron - soluble	µg/L	370	680	370	680
*Cadmium – total (Alk. < 30 mg/L)	µg/L	0.2	0.4	0.2	0.4
Chromium - total	µg/L	ND		ND	
Chromium VI –Soluble	µg/L	1	6	1	6
Cobalt – total	µg/L	ND		ND	
*Copper – total (Alk. < 30 mg/L)	µg/L	1.4	1.8	1.4	1.8
Iron – total	µg/L	ND		ND	
*Lead – total (Alk. < 30 mg/L)	µg/L	3.4	5.6	3.4	5.6
Manganese - total	µg/L	1900	2500	1900	2500
Mercury - total	µg/L	0.6	1.9	0.6	1.9
Molybdenum – total[#]	µg/L	150		150	
*Nickel – total (Alk. < 30 mg/L)	µg/L	11	13	11	13
Selenium - total	µg/L	11	18	11	18

Element	Units	Creeks		Reservoirs	
Silica – total	µg/L	ND		ND	
Silver - total	µg/L	0.05	0.1	0.05	0.1
Strontium - total	µg/L	ND		ND	
Thallium - total	µg/L	ND		ND	
Tin – total	µg/L	ND		ND	
Titanium – total	µg/L	ND		ND	
Uranium – total#	µg/L	200		200	
Vanadium – total	µg/L	ND		ND	
*Zinc – total (Alk. < 30 mg/L)	µg/L	8	15	8	15

A – derived from nitrate trigger levels
- derived from livestock drinking water trigger values
*Trigger value correction for hardness where TV – trigger value (µg/L), HMTV – hardenss modified trigger value (µg/L), H is hardness (mg/L as $CaCO_3$)

Cadmium $HMTV = TV (H/30)^{0.89}$
Copper $HMTV = TV (H/30)^{0.85}$
Lead $HMTV = TV (H/30)^{1.27}$
Nickel $HMTV = TV (H/30)^{0.85}$
Zinc $HMTV = TV (H/30)^{0.85}$

Appendix B 1999-2004 water monitoring data

RESULTS FROM MONITORING MINE WATER BODIES - Monthly Testing Locations

	Site 1 - Retention Dam				Site 3 - 8 Km Crossing - Monthly				Site 4 - 11 Km Crossing - Monthly				Site 15 - Aroona Seepage			
Date	pH	Salinity (ppm)	Turbidity (NTU)	Comments	pH	Salinity (ppm)	Turbidity (NTU)	Comments	pH	Salinity (ppm)	Turbidity (NTU)	Comments	pH	Salinity (ppm)	Turbidity (NTU)	Comments
29/07/99	9.1	2820	13		9	25500	3.6	FISH				DRY	8.4	1720	1.2	
25/08/99	9	2920	12.5		9.3	26200	5.3					DRY	8.5	1760	1	
28/09/99	9.1	2810	13		9	27800	3.8					DRY	8.4	1780	1.2	
12/10/99	9	2790	20		9.8	29300	4.3		8.6	884	11		8.7	1800	0.6	
11/11/99	8.4	2680	10		9	31900	6.2					DRY	8	1650	0.8	
15/12/99	8.7	2720	27.5		9.1	37800	11					DRY	8.1	1750	0.8	
31/01/00	8.7	2870	14		9.3	37300	6.5					DRY	8.2	1650	1	
29/02/00	8.2	1470	15		8.7	5080	52		8.7	591	48		7.9	1640	1.2	
03/05/00	8.4	1910	36		9.5	22700	15		9.2	3350	10		8.1	2010	0.7	
29/06/00	8.8	2010	35		9.2	25100	12		8.7	12300	6.5		8.1	1800	0.5	
31/07/00	8.3	2070	40		8.6	27500	10.2		8.4	22300	3.9		8.1	1700	0.3	
04/09/00	8.4	1980	47		8.3	27800	62		8.5	9390	4.1		8.1	1660	0.6	
12/10/00	8.5	2100	40		8.4	28200	17		8.5	10450	5		8.1	1710	0.8	
14/11/00	8.3	1990	43		8.4	33400	25		8.5	10730	8.3		8.1	1740	0.7	
12/12/00	8.3	1940	22.4		8.7	29800	15		8.6	11200	8.8		8	1580	1	
10/01/01	8.4	2000	21		8.9	36300	12		8.7	12570	19		8	1690	1.2	
20/02/01	8.3	1220	19		9.1	22800	11		8.8	8050	12		7.8	1550	1	
12/03/01	8.4	1298	19.7		9.3	31800	43		8.7	11850	35.7		7.7	1580	1.1	
19/04/01	9	1402	19		9.4	33500	12		8.8	12010	12		7.8	1600	0.8	
22/05/01	8.6	1460	41		9.5	38700	9		8.8	9750	4.5		8.3	1490	0.7	
28/06/01	8.5	1149	16.7		8.7	7400	51		8.8	5850	36		8.2	1580	1.3	
26/07/01	9.1	1580	27.4		9	17400	16		9.1	6830	5		8.5	1410	0.9	
22/08/01	8.5	1212	26.6		9.2	21800	6.7		9.2	7450	4.1		8.7	1399	0.8	
20/11/01	9.4	1315	30		9.6	28500	40		9.6	5630	14		9	1220	0.9	
07/02/02	9.4	1208	21		9.9	98300	8		10.1	17100	27		9	1470	1.2	
30/04/02	8.4	1407	11		9.4	34600	24		8.5	5290	29		8	1550	1	
22/07/02	8.2	1510	14.2		8.3	42300	11					DRY	8.2	1680	0.9	
22/10/02	8.4	1730	27					DRY				DRY	8	1720	1.6	
14/01/03	7.7	2120	28					DRY				DRY	8.1	1830	1.2	
11/03/03	8.6	1900	15.6		8.4	43300	42					DRY	7.9	1870	0.8	
24/06/03	8.6	2160	17					DRY				DRY	7.8	1940	0.4	
01/07/03	8.7	2170	13.8		7.5	7050	6.3					DRY	7.9	1950	0.3	
11/05/04	8.1	3660	23		7.5	2290	11		7.5	3070	5.1		7.6	290	0.4	

RESULTS FROM MONITORING MINE WATER BODIES - 6-Monthly Testing Locations

	Mar-99				Aug-99				Mar-00			
Date	pH	Salinity (ppm)	Turbidity (NTU)	Comments	pH	Salinity (ppm)	Turbidity (NTU)	Comments	pH	Salinity (ppm)	Turbidity (NTU)	Comments
Retention Dam	7.8	1198	2.8		9.2	3000	11.5		8.5	1930	17	
Quarry Pits - East	8	8250	2.5		9.3	8770	2.6		8.6	10880	2.7	
Quarry Pits - West	8.2	8250	2.5		9.3	8480	1		9	10710	4.2	
8km Crossing	8.3	3146	4.3		9.3	26300	5.4		8.9	25900	29.5	
11km Crossing	7.9	3146	3.1					DRY	8.6	8390	2.8	
L5 cut	8.9	920	1.8		8.9	11300	10		8.6	7750	11.7	
Southern Dumps (Lobe C)	8.4	326	8.4					DRY	8.3	8230	15.2	
Northern Dumps (Lobe D)	8.7	611	5.2		9.7	8920	35		7.2	11960	10.5	
Wetlands	8.4	1250	4.5		8.5	114700	3.1		8.5	2400	14.5	
Dragline Holes	7.3	4530	3.7		8.8	33000	17		8.9	485	25.4	
Aroona Dam	7.5	242	6.2		8.2	280	4.9		8.1	274	4.8	
Aroona Seepage	7.9	1322	3.3		8.5	1770	1.1		8.1	2010	0.7	

Appendix C October 2010 water monitoring data

Alinta Energy

Summary of Results

EPP Water Quality Policy Pollutants & Criteria (mg/L)

Metals:	LOR's #	*	EPP Criteria	M14 #	M14-adjacent *	L2/3(L5) #	L6/7 #	Retention Dam *	Access Road *
Aluminium (soluble)	0.01	0.001	0.1	0.167	0.002	<0.01	0.297	0.006	0.018
Antimony (total)	0.005	0.0005	0.03	<0.005	<0.0005	0.011	0.006	<0.0005	0.018
Arsenic (total)	0.003	0.0003	0.05	<0.003	0.0013	0.005	0.005	0.0015	0.0008
Beryllium (total)	0.003	0.0003	0.004	<0.003	<0.0003	<0.003	<0.003	<0.0003	<0.0003
Cadmium (total)	0.001	0.0001	0.002	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001
Chromium VI	0.001	0.0001	0.001	0.001	0.0002	0.002	0.002	0.0003	0.0005
Copper (total)	0.001	0.0001	0.01	0.001	0.0016	0.003	0.003	0.0022	0.0019
Iron (total)	0.005	0.0005	1	0.102	0.0804	0.123	0.086	0.1905	0.168
Lead (total)	0.001	0.0001	0.005	<0.001	<0.0001	<0.001	<0.001	0.0001	0.0002
Mercury (total)	0.00003	0.00003	0.0001	0.00003	0.00009	0.00099	0.00008	0.00102	0.00012
Nickel (total)	0.001	0.0001	0.15	0.002	0.0013	0.004	0.014	0.0006	0.0011
Selenium (total)	0.001	0.0001	0.005	0.009	0.0006	0.003	0.004	0.0003	0.0004
Silver (total)	0.0003	0.00003	0.0001	<0.0003	<0.00003	<0.0003	<0.0003	<0.00003	<0.00003
Thallium (total)	0.001	0.0001	0.004	<0.001	<0.0001	<0.001	<0.001	<0.0001	<0.0001
Zinc (total)	0.003	0.0003	0.05	<0.003	0.001	0.004	0.007	0.0007	0.0007
NOTE : difference in LOR for metals relates to high TDS samples being analysed on another machine LOR1 = # LOR2 = *									
Inorganic pollutants:									
Ammonia (total as Nitrogen)			0.5	<0.5	<0.5	<0.5	2.34	<0.5	<0.5
Biochemical Oxygen Demand (5-day test)			10	<2	<2	<2	<2	<2	<2
colour (Hazen units)			30	22	27	68	94	24	64
oxidised Nitrogen (as Nitrogen)			0.5	0.952	0.012	0.004	2.64	0.26	<0.003
Phosphorus (total as Phosphorus)			0.5	0.017	0.024	0.029	0.026	0.014	0.023
Phosphorus (soluble as Phosphorus)			0.1	0.006	<0.003	0.005	0.004	<0.003	<0.003
conductivity µScm				10,900	3,280	10,200	29,300	478	975
total dissolved solids (TDS) mg/L				6,200	1,800	5,800	18,000	260	540
Sulfide (LOR 0.1 mg/L)			0.002	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
suspended sediment			20	4	3	22	9	4	5
total Nitrogen (as nitrogen)			5	1.25	0.42	0.66	4.47	0.26	0.31
total organic Carbon			15	2.5	4.2	5.1	4.6	3.5	3.1
turbidity (Nephelometric Turbidity units (NTU))			20	4.6	1.8	12	6.9	4.8	5.4
Organic pollutants:									
Monochlorophenol (tested for 2 and 4-chlorophenol) (LOR 0.0001 mg/L)			0.007	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Dichlorophenol (tested for 2,4 & 2,5 & 3,5 with LOR 0.0001 mg/L)			0.0002	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Trichlorophenol (total) (tested 2,4 and 2,5; LOR 0.0001 mg/L)			0.018	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
oil and grease			10	2	<1	<1	1	<1	2
Pentachlorophenol (LOR 0.0001 mg/L)			0.00005	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Hexachlorobenzene (LOR 0.00005 mg/L)			0.000007	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Other organic pollutants									
Benzene (LOR 0.001 mg/L)			0.3	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
pesticides (LORs 0.00001 or 0.00005 mg/L)			0	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Polyaromatic hydrocarbons (PAHs) (LOR 0.0005 except Benzofluoranthene LOR 0.001 mg/L)			0.003	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Phenols (LOR 0.01 mg/L)			0.05	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Polychlorinated biphenyls (PCBs) LOR 0.01mg/L)			0.000001	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Toluene (LOR 0.001 mg/L)			0.3	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
CHARACTERISTICS (Clause 13(1)(b))									
pH (pH units)			between 6.5-9	8.2	8.1	8.6	8.1	8.6	8.3

Appendix D 2011 to 2012 water monitoring data

Leigh Creek Water Testing Results

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2012 Results for L5

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

Metals:	WQP	5/03/2012	13/03/2012	19/03/2012	26/03/2012	4/04/2012	16/04/2012	7/05/2012	14/05/2012	21/05/2012	28/05/2012	4/06/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.019	<0.010	<0.010
Chromium VI -Soluble 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
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0005	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0012
Selenium (total) mg/L	0.005	0.003	0.022	0.002	0.002	0.003	<0.001	<0.001	0.002	0.004	0.003	<0.001
Inorganic pollutants:												
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	11	<0.5	0.8	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.576	0.529	0.539	0.681	0.583	0.472	0.206	0.249	0.212	0.212	0.216
conductivity µS/cm	ND	5530	12500	12300	12200	12100	12200	8490	8500	8600	8600	8520
total dissolved solids (TDS) mg/L	ND	3100	7200	7100	7000	6000	7000	4800	4900	4900	4900	4800
suspended sediment mg/L	20	27	6	18	18	12	20	<0.5	16	3	20	21
turbidity (Nephelometric Turbidity units (NTU))	20	23	3.5	14	20	5.5	4.4	5.5	21	6.8	6.8	5.4
		*										

Metals:	WQP	25/06/2012	2/07/2012	16/07/2012	6/08/2012	13/08/2012	20/08/2012	27/08/2012	3/09/2012	10/09/2012	17/09/2012	2/10/2012
Aluminium (soluble) mg/L	0.1	<0.010	0.057	<0.010	0.014	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	<0.001	<0.001	<0.001	0.003	0.001	0.002	0.001	0.001	<0.001	<0.001	0.003
Inorganic pollutants:												
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.074	0.061	0.035	<0.003	0.036	0.007	0.018	0.034	0.065	0.043	0.15
conductivity µS/cm	ND	8660	8720	8470	8610	8610	8740	8750	8810	9500	9400	9590
total dissolved solids (TDS) mg/L	ND	4900	4900	4800	4900	4900	5000	5000	5000	5400	5300	5500
suspended sediment mg/L	20	12	8	11	21	8	7	8	4	10	15	37
turbidity (Nephelometric Turbidity units (NTU))	20	6.2	3.7	6.8	20	3.4	4.4	5.8	3.9	4.9	3.5	19

Metals:	WQP	8/10/2012	15/10/2012	22/10/2012	29/10/2012	5/11/2012	12/11/2012	19/11/2012	26/11/2012	3/12/2012	10/12/2012	17/12/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble 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
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.002	0.002	0.002	0.003	0.002	0.001	0.002	0.002	0.002	0.003	0.003
Inorganic pollutants:												
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	75.5	0.66	<0.5	<0.5	<0.5	<0.5	1.67	0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.183	0.242	0.339	0.527	0.402	0.418	0.392	0.229	0.009	0.053	0.237
conductivity µS/cm	ND	9730	9960	10200	9900	10500	10600	10600	10700	10700	10900	10600
total dissolved solids (TDS) mg/L	ND	5500	5700	5800	5600	6000	6100	6100	6100	6100	6200	6200
suspended sediment mg/L	20	14	9	7	2	5	4	11	8	10	18	8
turbidity (Nephelometric Turbidity units (NTU))	20	10	10	5.3	1.9	1.4	3.7	2.2	4.6	5.9	8	1.5

Leigh Creek Water Testing Results

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2012 Results for L7

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

Metals:	WQP	13/03/2012	19/03/2012	26/03/2012	4/04/2012	16/04/2012	7/05/2012	14/05/2012	21/05/2012	28/05/2012	16/07/2012	13/08/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.015	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.002	<0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.014	0.006	0.005	0.002	<0.001	0.002	0.002	<0.001	0.004	<0.001	<0.001
Inorganic pollutants:												
Ammonia (total as Nitrogen) mg/L	0.5	1.37	<0.5	<0.55	9.78	8.9	3.85	4.39	3.56	3.35	0.72	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	5.09	9.83	9	0.958	1.17	4.48	3.31	3.02	4.31	0.519	0.024
conductivity µS/cm	ND	10200	13600	14400	9100	10200	11600	10100	10000	11600	8310	1070
total dissolved solids (TDS) mg/L	ND	5800	7900	8300	5200	5800	6600	5800	5700	6600	4700	590
suspended sediment mg/L	20	6	5	55	192	91	8	10	2	3	14	9
turbidity (Nephelometric Turbidity units (NTU))	20	1.2	4.9	30	59	76	4.4	13	6	4.7	10	15

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Leigh Creek Water Testing Results

2012 Results for L6/7

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

		L6/L7	L6/L7	L6/L7	L6/L7	L6/L7	L6/L7	L6/L7	L6/L7	L6/L7
Metals:	**WQP**	**12/11/2012**	**19/11/2012**	**26/11/2012**	**3/12/2012**	**10/12/2012**	**17/12/2012**	**7/01/2013**	**14/01/2013**	**21/01/2013**
Aluminium (soluble) mg/L	0.1	<0.010	0.028	<0.010	0.011	0.011	0.011	<0.010	0.08	0.08
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.02	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.002	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.006
Inorganic pollutants:										
Ammonia (total as Nitrogen) mg/L	0.5	0.87	0.89	0.92	0.83	1.36	0.98	0.86	0.98	0.86
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	2.27	2.19	2.02	1.9	1.97	2.01	1.85	2.09	1.92
conductivity µScm	ND	16400	16500	16600	16400	16600	16100	16500	16500	16500
total dissolved solids (TDS) mg/L	ND	9600	9600	9700	9600	9700	9400	9600	9600	9600
suspended sediment mg/L	20	2	8	36	13	6	11	4	2	3
turbidity (Nephelometric Turbidity units (NTU))	20	3.4	3.3	20	6.3	2.1	2	3.5	2.3	2.9

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Leigh Creek Water Testing Results

2012 Results for L6

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

Metals:	**WQP**	**5/03/2012**	**13/03/2012**	**19/03/2012**	**26/03/2012**	**4/04/2012**	**16/04/2012**	**7/05/2012**	**14/05/2012**	**21/05/2012**	**28/05/2012**
Aluminium (soluble) mg/L	0.1	0.036	0.019	0.021	0.028	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.006	<0.001	<0.001	<0.001	<0.001	0.002
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0003	0.0005	<0.0003
Selenium (total) mg/L	0.005	0.008	0.02	0.003	0.003	0.005	0.002	0.002	0.003	0.001	0.003
Inorganic pollutants:											
Ammonia (total as Nitrogen) mg/L	0.5	2.71	2.26	2.01	1.73	1.55	2.26	3.75	3.84	3.77	3.65
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	5.24	5.3	5.26	5.5	5.5	5.26	4.77	4.66	4.35	4.26
conductivity µScm	ND	5530	7810	8600	9424	10200	11800	11600	11700	11600	11500
total dissolved solids (TDS) mg/L	ND	3100	4400	4900	5400	5800	6800	6600	6700	6600	6600
suspended sediment mg/L	20	10	12	4	6	38	19	8	2	4	5
turbidity (Nephelometric Turbidity units (NTU))	20	23	8.5	5.6	6.5	34	3.4	4.4	6.7	5.3	4.7

Metals:	**WQP**	**4/06/2012**	**25/06/2012**	**2/07/2012**	**16/07/2012**	**6/08/2012**	**13/08/2012**	**20/08/2012**	**27/08/2012**	**3/09/2012**	**10/09/2012**
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.01	<0.010	<0.010	<0.010	<0.010	0.012	0.011	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	<0.001	<0.002	0.003	0.001	0.002	<0.001	0.002	<0.001	0.002	<0.001
Inorganic pollutants:											
Ammonia (total as Nitrogen) mg/L	0.5	2.17	2.33	2.23	1.77	1.26	1.07	1.11	0.93	0.95	0.93
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	3.32	4.43	4.37	4.11	4.11	3.73	3.4	3.65	3.24	3.24
conductivity µScm	ND	10900	11300	12100	12300	12900	13000	13100	13200	13200	14000
total dissolved solids (TDS) mg/L	ND	6200	6300	6900	7100	7400	7500	7600	7600	7600	8100
suspended sediment mg/L	20	6	1	2	7	10	14	8	5	3	3
turbidity (Nephelometric Turbidity units (NTU))	20	5.8	2.2	1.9	2	5.4	6.9	6	4.7	3.6	3.2

Metals:	**WQP**	**17/09/2012**	**24/09/2012**	**2/10/2012**	**8/10/2012**	**15/10/2012**	**22/10/2012**	**29/10/2012**	**5/11/2012**
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.016
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0004	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.001	0.002	0.004	0.003	0.004	0.0003	0.004	0.004
Inorganic pollutants:									
Ammonia (total as Nitrogen) mg/L	0.5	0.88	0.87	1.01	0.92	0.93	0.85	<0.5	0.81
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	3.13	3.11	2.99	3.06	2.59	2.68	2.24	1.76
conductivity µScm	ND	14100	14000	14100	14000	14000	14600	15000	15700
total dissolved solids (TDS) mg/L	ND	8200	8100	8200	8100	8100	8500	8700	9100
suspended sediment mg/L	20	12	6	8	9	24	4	<1	2
turbidity (Nephelometric Turbidity units (NTU))	20	3.2	3.3	3.4	5	18	2.9	1.9	3.8

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Leigh Creek Water Testing Results

2012 Results for Access Road

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

Metals:	WQP	16/04/2012	28/05/2012	4/06/2012	25/06/2012	2/07/2012	16/07/2012	13/08/2012	20/08/2012	27/08/2012
Aluminium (soluble) mg/L	0.1	0.018	0.019	<0.010	<0.010	0.014	0.016	0.012	0.012	0.019
Chromium VI -Soluble mg/L	0.001	<0.001	<0.002	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Inorganic pollutants:										
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.042	0.024	0.038	0.063	0.065	0.082	0.05	0.038	0.035
conductivity µScm	ND	772	1050	1170	1410	1430	1390	1380	1330	1390
total dissolved solids (TDS) mg/L	ND	420	580	640	780	790	770	760	730	770
suspended sediment mg/L	20	58	46	5	6	4	3	4	5	4
turbidity (Nephelometric Turbidity units (NTU))	20	21	49	6.2	5.5	2.4	2.1	4.2	3.9	4.2

Metals:	WQP	3/09/2012	10/09/2012	17/09/2012	24/09/2012	2/10/2012	8/10/2012	15/10/2012	22/10/2012
Aluminium (soluble) mg/L	0.1	0.029	<0.010	<0.010	<0.010	<0.010	<0.010	0.018	0.018
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.0007
Mercury (total) mg/L	0.0001	<0.0003	0.0004	<0.0003	<0.0003	0.0004	0.0005	<0.0003	0.0007
Selenium (total) mg/L	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0003
Inorganic pollutants:									
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.032	0.137	0.035	0.036	0.009	0.031	0.015	0.019
conductivity µScm	ND	1310	2420	1890	5810	6750	1900	1910	1950
total dissolved solids (TDS) mg/L	ND	720	1300	1000	3300	3800	1000	1100	1100
suspended sediment mg/L	20	8	1	2	9	9	4	2	2
turbidity (Nephelometric Turbidity units (NTU))	20	4	3.6	2.1	4.5	2.2	2.4	2.8	1.4

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Leigh Creek Water Testing Results

2012 Results for 8K Crossing (alias AK Crossing)

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

Metals:	WQP	16/04/2012	7/05/2012	14/05/2012	21/05/2012	28/05/2012	4/06/2012	25/06/2012	2/07/2012	16/07/2012	6/08/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	0.0008	0.0006	0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	<0.001	0.002	0.002	0.001	0.003	<0.001	<0.002	<0.001	0.002	0.004
Inorganic pollutants:											
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.162	0.222	0.193	0.298	0.392	0.656	0.792	0.754	0.858	0.767
conductivity µScm	ND	1710	20700	32500	34500	34000	20000	26200	30700	23600	20500
total dissolved solids (TDS) mg/L	ND	940	17000	20000	21000	22000	12000	16000	19000	14000	17000
suspended sediment mg/L	20	67	31	1	<1	<1	3	<1	1	10	13
turbidity (Nephelometric Turbidity units (NTU))	20	28	12	1.8	0.55	0.42	0.52	0.31	0.53	0.81	1.3

Metals:	WQP	13/08/2012	20/08/2012	27/08/2012	3/09/2012	10/09/2012	17/09/2012	2/10/2012	8/10/2012	15/10/2012	22/10/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	0.017	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.004	0.004	0.002	0.004	0.003	0.002	0.003	0.003	0.003	0.003
Inorganic pollutants:											
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.718	0.641	0.611	0.017	0.426	0.497	0.522	0.298	0.222	0.065
conductivity µScm	ND	30000	30700	26700	32100	26200	26800	20200	22900	31500	35600
total dissolved solids (TDS) mg/L	ND	18000	19000	16000	20000	16000	16000	12000	14000	19000	22000
suspended sediment mg/L	20	16	1	<1	2	1	6	2	3	2	2
turbidity (Nephelometric Turbidity units (NTU))	20	1.3	0.58	0.66	0.7	1.1	0.9	1.1	0.84	2.3	1.5

Metals:	WQP	29/10/2012	5/11/2012	12/11/2012	19/11/2012	26/11/2012	3/12/2012	10/12/2012	17/12/2012	7/01/2013	14/01/2013	21/01/2013
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.08	0.014
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.02	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.004	0.003	0.002	0.002	0.003	0.003	0.003	0.005	0.002	0.005	0.004
Inorganic pollutants:												
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.24	<0.5	<0.5	0.6	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.24	0.005	0.005	0.005	0.004	0.004	<0.003	0.006	0.004	0.004	<0.0003
conductivity µScm	ND	35400	35200	39200	39900	40700	39700	41600	41400	44800	44500	44900
total dissolved solids (TDS) mg/L	ND	22000	22000	25000	25000	26000	25000	26000	26000	29000	29000	29000
suspended sediment mg/L	20	<1	2	<1	1	3	4	2	3	2	2	3
turbidity (Nephelometric Turbidity units (NTU))	20	0.5	1	2.6	0.71	1.5	0.98	1.4	1.3	1.5	2	1.6

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Leigh Creek Water Testing Results

2012 Results for Retention Dam

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

Metals:	WQP	25/06/2012	2/07/2012	6/08/2012	20/08/2012
Aluminium (soluble) mg/L	0.1	0.017	0.321	0.019	0.014
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	0.0003
Selenium (total) mg/L	0.005	<0.001	<0.001	<0.001	<0.001
Inorganic pollutants:					
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.015	0.007	0.003	0.011
conductivity µScm	ND	936	970	1060	1100
total dissolved solids (TDS) mg/L	ND	510	530	580	610
suspended sediment mg/L	20	84	15	15	7
turbidity (Nephelometric Turbidity units (NTU))	20	14	7.7	5.2	2.9

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Leigh Creek Water Testing Results

2012 Results for M14

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

Metals:	WQP	20/02/2012	13/03/2012	19/03/2012	26/03/2012	4/04/2012	16/04/2012	7/05/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.001	<0.001	0.0004	<0.0003
Selenium (total) mg/L	0.005	0.002	0.005	0.001	0.001	0.003	0.001	0.005
Inorganic pollutants:								
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.52
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.755	0.623	0.678	0.81	0.72	1.2	1.35
conductivity µScm	ND	11900	2860	3220	3710	5000	6910	21100
total dissolved solids (TDS) mg/L	ND	6800	1600	1800	2100	2800	3900	13000
suspended sediment mg/L	20	37	18	8	2	55	29	8
turbidity (Nephelometric Turbidity units (NTU))	20	11	4.9	8.6	1.5	10	26	6.1

Metals:	WQP	14/05/2012	21/05/2012	28/05/2012	13/08/2012	5/11/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.007	0.004	0.001	<0.001	0.002
Inorganic pollutants:						
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	10.7	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	3.01	2.09	0.437	0.2	0.966
conductivity µScm	ND	17800	20400	3960	8980	11300
total dissolved solids (TDS) mg/L	ND	10000	12000	2200	5100	6500
suspended sediment mg/L	20	35	<1	8	18	15
turbidity (Nephelometric Turbidity units (NTU))	20	24	0.54	8	14	22

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Leigh Creek Water Testing Results

2012 Results for M14 Super Sump

EPP Water Quality Policy Pollutants & Criteria (mg/L except conductivity & turbidity)

Metals:	WQP	16/01/2012	23/01/2012	30/01/2012	13/02/2012	5/03/2012	13/03/2012	19/03/2012	26/03/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002
Mercury (total) mg/L	0.0001	<0.0004	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	<0.001	0.004	<0.001	0.002	0.007	0.013	0.006	0.004
Inorganic pollutants:									
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	0.67	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.79	0.712	0.505	0.82	3.75	3.55	2.78	1.99
conductivity µScm	ND	11800	11700	11600	11600	5690	5930	6770	6720
total dissolved solids (TDS) mg/L	ND	6800	6700	6600	6600	3200	3300	3800	3800
suspended sediment mg/L	20	33	29	22	22	19	14	24	44
turbidity (Nephelometric Turbidity units (NTU))	20	25	21	15	34	18	7.5	20	31

Metals:	WQP	4/04/2012	16/04/2012	7/05/2012	14/05/2012	21/05/2012	28/05/2012	4/06/2012	25/06/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.002	<0.002	0.002	<0.001	<0.002	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.006	0.002	0.003	0.005	0.003	0.001	<0.001	<0.002
Inorganic pollutants:									
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	1.79	0.511	1.39	1.88	2.96	0.437	0.125	0.246
conductivity µScm	ND	7330	8930	8570	10800	13200	3960	1960	12600
total dissolved solids (TDS) mg/L	ND	4100	5100	4900	6200	7600	2200	1100	7200
suspended sediment mg/L	20	145	140	57	23	15	8	3	34
turbidity (Nephelometric Turbidity units (NTU))	20	75	40	57	26	11	8	2.1	23

Metals:	WQP	2/07/2012	16/07/2012	6/08/2012	13/08/2012	20/08/2012	27/08/2012	3/09/2012	10/09/2012
Aluminium (soluble) mg/L	0.1	0.608	0.012	0.011	<0.01	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.003	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.011
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	0.0004	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.003	<0.001	0.002	0.002	0.003	0.002	0.003	<0.001
Inorganic pollutants:									
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	1.44	0.038	0.942	1.53	1.53	1.48	1.08	0.986
conductivity µScm	ND	9320	970	7750	11100	11700	11000	8770	9100
total dissolved solids (TDS) mg/L	ND	5300	530	4400	6400	6700	6300	5000	5200
suspended sediment mg/L	20	23	3	41	41	9	8	5	13
turbidity (Nephelometric Turbidity units (NTU))	20	7.8	0.82	17	38	5.3	4.8	8.4	11

Metals:	WQP	17/09/2012	24/09/2012	2/10/2012	8/10/2012	15/10/2012	22/10/2012	29/10/2012
Aluminium (soluble) mg/L	0.1	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chromium VI -Soluble mg/L	0.001	<0.001	<0.001	<0.001	<0.007	<0.001	<0.001	<0.001
Mercury (total) mg/L	0.0001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Selenium (total) mg/L	0.005	0.002	<0.001	0.003	<0.001	0.003	0.002	0.004
Inorganic pollutants:								
Ammonia (total as Nitrogen) mg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
oxidised Nitrogen (sum of Nitrate + Nitrite as N) mg/L	0.3	0.96	1.02	1.24	0.009	1.26	0.946	1.09
conductivity µScm	ND	8910	10000	11000	9270	11300	10500	11700
total dissolved solids (TDS) mg/L	ND	5100	5700	6300	5300	6500	6000	6700
suspended sediment mg/L	20	18	14	124	48	18	16	3
turbidity (Nephelometric Turbidity units (NTU))	20	10	10	21	26	16	9.9	3.5

Appendix E 2016 water monitoring data

Element	Units	Trigger value		Retention dam		Leigh Creek north	
		95%	90%	27/06/16	12/09/16	27/06/16	12/09/16
pH	-	<6.5, >9.0		8.4	8.3	8.2	8.1
Alkalinity as Calcium Carbonate	mg/L	ND			117	116	116
Bicarbonate	mg/L	ND			140	142	142
Carbonate	mg/L	ND			1		0
Hydroxide	mg/L	ND			0		0
Total Carbon	mg/L	ND			34.2		31.3
Aluminium - Soluble	mg/L	0.055	0.080	0.004	0.006	0.002	0.002
Chromium (VI) - Soluble	mg/L	0.001	0.006	<0.0002	<0.0002	<0.0004	<0.0003
Mercury - Total	mg/L	0.0006	0.0019	0.00004	<0.00003	0.00003	0.00007
Selenium - Total	mg/L	0.011	0.018	<.0001	0.0001	0.0034	0.0009
Fluoride	mg/L	2			0.21		0.58
Calcium	mg/L	1000			63.7		317
Sulphate	mg/L	1000			213		1000
Sodium	mg/L	ND			236		1520
Ammonia as N	mg/L	0.9	1.43	0.052	<0.005	0.015	0.01
Nitrate + Nitrite as N	mg/L	0.7	3.4	0.042	0.023	0.005	0.187
Conductivity	µS/cm	15000	15000	1730	1760	28300	9690
Total Dissolved Solids (by EC)	mg/L	10000	10000	950	970	17000	5500
Suspended Solids	mg/L	ND		4	14	42	37
Turbidity	NTU	100/50			15	2.8	40
Chromium - Total	mg/L	ND			0.0002		0.0003
Acidity as Calcium Carbonate	mg/L	ND			7		20
Potassium	mg/L	ND			12.3		10.9
Magnesium	mg/L	ND			28.7		222
Silver - Total	mg/L	0.00005	0.0001		<0.00003		<0.00003
Arsenic - Total	mg/L	0.024	0.094		0.001		0.001
Boron - Soluble	mg/L	0.37	0.68		0.292		1.2
Barium - Total	mg/L	ND			0.1049		0.0951
*Cadmium - Total	mg/L	0.0007	0.0013		<0.0001		<0.0001
Cobalt - Total	mg/L	ND			0.0004		0.0011
*Copper - Total	mg/L	0.0045	0.0057		0.0022		0.0014
Iron - Total	mg/L	ND			0.2434		0.2245
Manganese - Total	mg/L	1.9	2.5		0.0288		0.1364
Molybdenum - Total	mg/L	ND			0.0007		0.0018
*Nickel - Total	mg/L	0.035	0.041		0.0007		0.0012
*Lead - Total	mg/L	0.019	0.032		0.0002		0.0002
Antimony - Total	mg/L	ND			<0.0005		<0.0005
Silica - Total	mg/L	ND			3.7		11.1
Tin - Total	mg/L	ND			<0.0005		<0.0005
Titanium - Total	mg/L	ND			0.0086		0.0095
Uranium - Total	mg/L	ND			0.0012		0.011
Vanadium - Total	mg/L	ND			0.002		0.0052
*Zinc - Total	mg/L	0.025	0.048		0.0013		0.0015
Strontium - Total	mg/L	ND			0.7083		6.034
Thallium - Total	mg/L	ND			<0.0001		<0.0001

* trigger value corrected for carbonate level

Element	Units	Trigger value		North field creek		Tobacco Bush Creek	Spring
		95%	90%	27/06/16	12/09/16	12/09/16	18/10/16
pH	-	<6.5, >9.0		7.3	7.5	8	7.5
Alkalinity as Calcium Carbonate	mg/L	ND			74	71	271
Bicarbonate	mg/L	ND			91	86	330
Carbonate	mg/L	ND			0	0	0
Hydroxide	mg/L	ND			0	0	0
Total Carbon	mg/L	ND			24.8	21.9	67.6
Aluminium - Soluble	mg/L	0.055	0.080	0.071	0.013	0.008	<0.001
Chromium (VI) - Soluble	mg/L	0.001	0.006	<0.0013	<0.0002	<0.0017	<0.0001
Mercury - Total	mg/L	0.0006	0.0019	<0.00003	<0.00003	<0.00003	0.0002
Selenium - Total	mg/L	0.011	0.018	0.0002	0.0002	0.0001	0.0046
Fluoride	mg/L	2			0.17	<0.1	1.8
Calcium	mg/L	1000			101	25	1050
Sulphate	mg/L	1000			241	37.5	3150
Sodium	mg/L	ND			136	22.5	4830
Ammonia as N	mg/L	0.9	1.43	0.402	<0.005	<0.005	<0.005
Nitrate + Nitrite as N	mg/L	0.7	3.4	0.427	0.018	0.106	1.15
Conductivity	µS/cm	15000	15000	1500	1310	286	28500
Total Dissolved Solids (by EC)	mg/L	10000	10000	830	720	160	17000
Suspended Solids	mg/L	ND		12	6	58	3
Turbidity	NTU	50		28	8.1	13	0.57
Chromium - Total	mg/L	ND			0.0002	0.0017	0.0001
Acidity as Calcium Carbonate	mg/L	ND			7	4	69
Potassium	mg/L	ND			6.93	4.74	7.42
Magnesium	mg/L	ND			11.8	3.8	926
Silver - Total	mg/L	0.00005	0.0001		<0.00003	<0.00003	0.00015
Arsenic - Total	mg/L	0.024	0.094		0.0008	0.0019	0.001
Boron - Soluble	mg/L	0.37	0.68		0.147	0.067	4.47
Barium - Total	mg/L	ND			0.0459	0.0564	0.0181
*Cadmium - Total	mg/L	0.0007	0.0013		<0.0001	<0.0001	0.0001
Cobalt - Total	mg/L	ND			0.0009	0.0017	0.0002
*Copper - Total	mg/L	0.0045	0.0057		0.003	0.0047	0.0045
Iron - Total	mg/L	ND			0.1368	3.224	0.0058
Manganese - Total	mg/L	1.9	2.5		0.0316	0.0948	0.0394
Molybdenum - Total	mg/L	ND			0.0004	0.0001	0.0056
*Nickel - Total	mg/L	0.035	0.041		0.001	0.0028	0.0007
*Lead - Total	mg/L	0.019	0.032		0.0001	0.0018	0.0002
Antimony - Total	mg/L	ND			<0.0005	<0.0005	<0.0005
Silica - Total	mg/L	ND			7.2	42.4	25.3
Tin - Total	mg/L	ND			<0.0005	<0.0005	<0.0005
Titanium - Total	mg/L	ND			0.0082	0.2244	<0.0003
Uranium - Total	mg/L	ND			0.0017	0.0005	0.0405
Vanadium - Total	mg/L	ND			0.0056	0.0159	0.0032
*Zinc - Total	mg/L	0.025	0.048		0.0024	0.0069	0.0044
Strontium - Total	mg/L	ND			0.5672	0.1511	20.54
Thallium - Total	mg/L	ND			<0.0001	<0.0001	<0.0001

* trigger value corrected for carbonate level

Appendix F Water quality analytes

Element	Units
Chemical and Physical Stressors	
Ammonia (NH_4^+)	mg/L
Oxidized Nitrogen (NO_x)	mg/L
Organic Carbon - total	mg/L
Alkalinity as CaCO3	mg/L
Acidity as CaCO3	mg/L
Bicarbonate	mg/L
Carbonate	mg/L
Hydroxide	mg/L
Conductivity, EC	µS/cm
Total dissolved solids (TDS)	mg/L
pH	mg/L
Turbidity	NTU
Suspended sediment	mg/L
Cations	
Calcium - total	mg/L
Magnesium - total	mg/L
Sodium - total	mg/L
Potassium - total	mg/L
Anions	
Sulphate - total (SO4)	mg/L
Fluoride	mg/L
Chloride	mg/L
Optional	
Nitrogen – total	mg/L
Phosphorus – total	mg/L

Element	Units
Metals	
Aluminium – soluble (pH>6.5)	µg/L
Antimony - total	µg/L
Arsenic - total	µg/L
Barium – total	µg/L
Boron - soluble	µg/L
Cadmium – total	µg/L
Chromium - total	µg/L
Chromium VI –Soluble	µg/L
Cobalt – total	µg/L
Copper – total	µg/L
Iron – total	µg/L
Lead – total	µg/L
Manganese - total	µg/L
Mercury - total	µg/L
Molybdenum - total	µg/L
Nickel –	µg/L
Selenium - total	µg/L
Silica – total	µg/L
Silver - total	µg/L
Strontium - total	µg/L
Thallium - total	µg/L
Tin – total	µg/L
Titanium – total	µg/L
Uranium – total	µg/L
Vanadium – total	µg/L
Zinc – total	µg/L

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