Appendix C

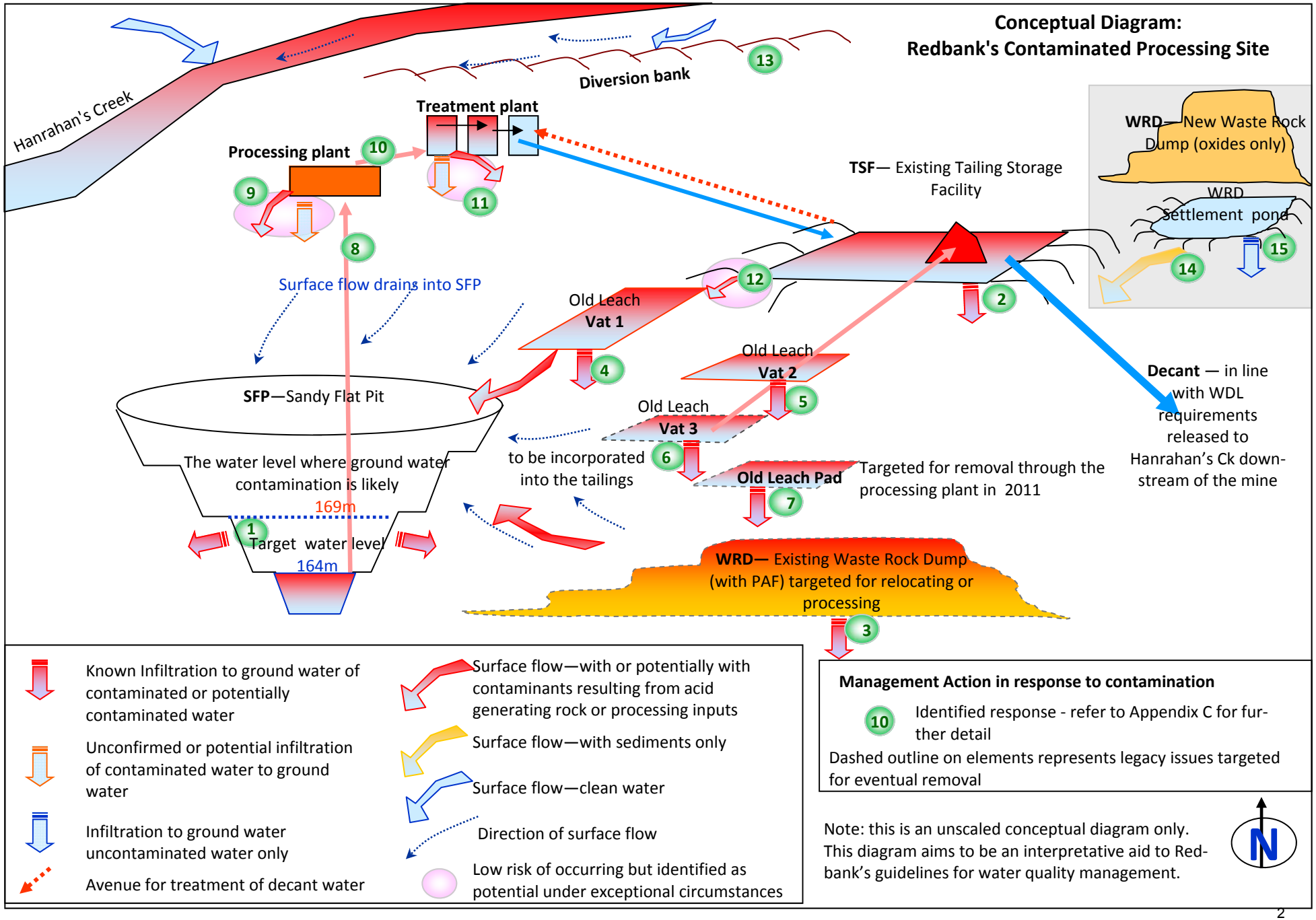
Conceptual Risk Diagram and Table of Remedial Actions

The following highlights the known and potential sources of surface and ground water contamination.

A **conceptual risk diagram** follows, which highlights the main areas of contamination (numbered green circles) remaining from the legacy of previous mining as well as the areas proposed to be used or continue to be used in future processing. The conceptual map is not to scale, it is an interpretative tool to display both surface and ground water contamination pathways, and to facilitate interpretation of the accompanying table.

A **table of proposed remedial actions** follows the conceptual diagram. This table expands upon each source of contamination by detailing the preventative measures, the degree of impact and likelihood of impact occurring, the monitoring proposed for early detection and the proposed mitigation response if monitoring suggests that an unacceptable impact is occurring (e.g. measures of key parameters exceed trigger values).

The information presented will contribute to the revised Water Management Plan for Redbank, which will be submitted at the end of February 2010.


Conceptual Diagram:
Redbank's Contaminated Processing Site
Hanrahan's Creek
Diversion bank
13
Treatment plant
Processing plant
10
9
11
8
Surface flow drains into SFP
TSF— Existing Tailing Storage Facility
WRD— New Waste Rock Dump (oxides only)
WRD Settlement pond
14
15
12
2
Old Leach Vat 1
4
Old Leach Vat 2
5
Old Leach Vat 3
6
Old Leach Pad
7
SFP—Sandy Flat Pit
The water level where ground water contamination is likely
169m
1
Target water level
164m
to be incorporated into the tailings
Targeted for removal through the processing plant in 2011
Decant — in line with WDL requirements released to Hanrahan's Ck down-stream of the mine
WRD— Existing Waste Rock Dump (with PAF) targeted for relocating or processing
3
Known Infiltration to ground water of contaminated or potentially contaminated water
Unconfirmed or potential infiltration of contaminated water to ground water
Infiltration to ground water uncontaminated water only
Avenue for treatment of decant water
Surface flow—with or potentially with contaminants resulting from acid generating rock or processing inputs
Surface flow—with sediments only
Surface flow—clean water
Direction of surface flow
Low risk of occurring but identified as potential under exceptional circumstances
Management Action in response to contamination
10
Identified response - refer to Appendix C for further detail
Dashed outline on elements represents legacy issues targeted for eventual removal
Note: this is an unscaled conceptual diagram only. This diagram aims to be an interpretative aid to Redbank's guidelines for water quality management.
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Area	Conceptual Risk Diagram #	Potential source	Preventative Measures	Nature of Contamination	Likelihood of breach	Monitoring Measures	Response
Sandy Flat Pit Legacy							
	1	SFP waters leaching to groundwater	Maintaining pit water level below identified groundwater interactive layer nominated at 164m depth.	Highly acidic (pH around 2) water with high metal loads	Unlikely if pit levels maintained	Monthly groundwater monitoring, testing for acidity and metal loadings. Groundwater flow models and monitoring results used to understand rate of infiltration from SFP correlated with pit water levels.	Pre production - all efforts focussed toward pumping SFP waters through the processing plant, secondary treatment with lime at treatment ponds before pumping to TSF for settling. During extreme rainfall events, site water extraction will increase to ensure the pit water level does not raise to above 164m. Review pit water level requirements if trigger levels in nearby EMBs are continually exceeded.
	8	SFP Dewatering Hose / Pipe leak	Design according to standards, regular scheduled infrastructure inspections	Highly acidic (pH around 2) water with high metal loads	Unlikely with regular inspections and maintenance	Operations inspections, monthly groundwater monitoring	In the first instance, dewatering will cease and all efforts will be targeted towards fixing leak or replacing hose / pipe. If incident re-occurs, dewatering infrastructure options will be reviewed and upgraded. All pipework is within the contained catchment of the SFP.
	unlikely	Overflow of SFP	Maintaining pit water level at low levels capable of accommodating more than a 50 year rainfall event, and divert clean surface water away from the pit.	Highly acidic (pH around 2) water with high metal loads	Highly unlikely - extreme rainfall event	Visual - daily inspection of the depth of water in SFP	Pre production - All efforts focussed toward pumping SFP waters through the processing plant and secondary treatment with lime in the treatment ponds before going to TSF for settling. During extreme rainfall events site water extraction will increase to ensure the pit water level is under control.

Area	Conceptual Risk Diagram #	Potential source	Preventative Measures	Nature of Contamination	Likelihood of breach	Monitoring Measures	Response
TSF Legacy and Reuse	2	TSF leach to groundwater	TSF attempted to be sealed with a precipitation of lime from the ARD treatment. Future oxide tails may be slightly acidic, however all water will be pumped back to the processing plant for reuse and all water inputs will be neutralised.	New oxide tails are relatively benign, however legacy issues have resulted in acidic waters being placed into the TSF.	Possible	Monthly groundwater monitoring to detect acidity and metal loadings, which will trigger response if exceeding target levels. Groundwater flow models will enable water from an EMB that has triggered to be traced back to an approximate point source - such as the TSF	Neutralise waters collected within the TSF (pump back to settlement ponds for addition of lime and return) as contamination potential is dramatically reduced without acid. If groundwater in EMBs downgradient of TSF continues to exceed set trigger levels despite management of TSF waters, legacy remediation measures such as further sealing the TSF will be enacted.
	12	TSF overflow	Discharge treated water regularly such that TSF water levels remain low. Divert clean surface water away from the TSF.	Aim to maintain neutral TSF waters, however, treatment process may not keep up with extreme rainfall, and thus waters may be slightly acidic with some metal loadings	Unlikely - cyclone or severe monsoon trough resulting in significant rainfall over short timeframe	Visual inspection of TSF water levels, at least monthly testing of TSF surface water	TSF has not experienced overflow during its 16 plus years of existence. Treat TSF overflow point with lime - pump to treatment ponds and discharge when pH of 7, in extreme cases, pump straight to SFP. Immediate management review to identify management strategy to ensure TSF levels do not breach again.
	11	Discharge of treated water (from treatment Plant) to the TSF	Water will be tested prior to discharge to ensure decant quality meets WDL requirements.	pH of 7 required prior to discharge, thus any metal loadings will have precipitated to base of TSF / treatment ponds.	likelihood of release high during 2010 and reducing from then on.	Testing of treated water against WDL requirements prior to discharge	If water not of suitable quality, it will be pumped to treatment ponds for treatment and tested again prior to discharge.
	16	Discharge of treated water from TSF to Harahan's Creek	Treat TSF water to WDL standards	pH of 7 required prior to discharge, thus any metal loadings will have precipitated and removed	likelihood possible	Testing of treated water against WDL requirements prior to discharge	If water not of suitable quality, it will be pumped to treatment ponds for treatment and tested again prior to discharge.

Area	Conceptual Risk Diagram #	Potential source	Preventative Measures	Nature of Contamination	Likelihood of breach	Monitoring Measures	Response
Processing Plant	9	Failure of hydrocarbon, acid, & chemicals storage at processing plant	Design standards, and regular scheduled maintenance should minimise potential breaches. Hazardous substances will not be stored in large quantities, but separated into smaller containment facilities, bunded and stored according to Australian Standards.	Potential for major acid, hydrocarbon or chemical spill	Unlikely - in an extreme event such as earthquake or cyclone	Test for additional potential contaminants (hydrocarbons etc) at nearby EMB and closest down gradient surface water site	Cease operations, enable spill cleanup procedures, deploy maintenance personnel to fix failure and/or consider flying in contractors, ensure improved preventative measures for future
Old WRD and Leach Pad Legacy	managed through SFP Refer to #1	Surface water runoff to watercourses from old PAF material	Diversion banks directing surface water runoff from old WRD to SFP, and processing of old ARD sources until eliminated	Potentially acidic with high metal loadings	Possible until ARD sources are eliminated	Visual inspection of diversion banks early, during and post wet season. Testing of sediment trap soils and soils in the vicinity of the old WRD for pH and metals to determine the potential for contaminated surface runoff. Ground water monitoring in the vicinity of the legacy WRD	If trigger levels for acidity and metal loadings are exceeded for sediment and soil monitoring or ground water indicates an increase in contamiation speed up prioritise processing of remnant sources of PAF material over new oxide material or alternatively relocate the remannt sources where contaimination can be restricted.
	3	Leaching to groundwater from WRD old ARD sources.	The legacy WRD is targeted for either processing or relocating to an alternative site	Potentially acidic with high metal loadings	Possible until ARD sources are eliminated	Monthly groundwater monitoring, testing for acidity and metal loadings	If sediment samples indicate contamination and trigger values for ground water are exceeded or speed up prioritise processing of remnant sources of PAF material over new oxide material or alternatively relocate the remannt sources where contaimination can be restricted.
	managed through SFP Refer to #1	VAT 1 Surface water runoff to watercourses from old PAF material	The legacy WRD is targeted for reuse	Potentially acidic with high metal loadings	Possible	Monthly soil and groundwater monitoring, testing for acidity and metal loadings	Refer to point 4
	4	VAT 1 Ground water contamination	This site is targeted to relocated to the TSF to remove the source of contamination in year 2 of operations	Potentially acidic with high metal loadings	Possible	Refer to point 3	Refer to point 3
	managed through SFP Refer to #1	VAT 2 Surface water runoff to watercourses from old PAF material	Refer to point 4	Potentially acidic with high metal loadings	Possible	Refer to point 3	Refer to point 1 and 5

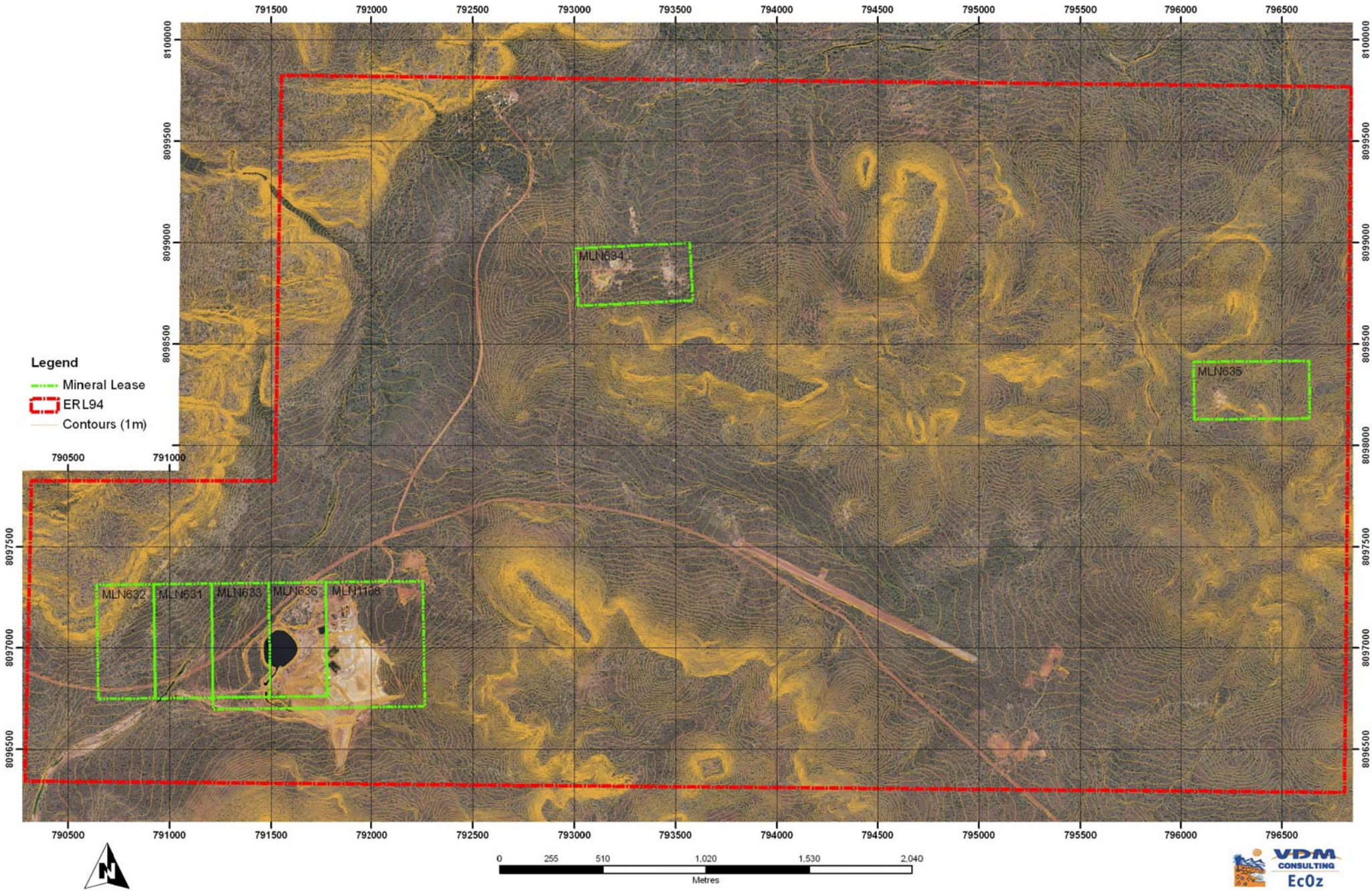
Area	Conceptual Risk Diagram #	Potential source	Preventative Measures	Nature of Contamination	Likelihood of breach	Monitoring Measures	Response
Old WRD and Leach Pad Legacy	5	VAT 2 Ground water contamination	Refer to point 4	Potentially acidic with high metal loadings	Possible	Refer to point 3	Refer to point 3
	managed through SFP Refer to #1	VAT 3 Surface water runoff to watercourses from old PAF material	Refer to point 4	Potentially acidic with high metal loadings	Possible	Refer to point 3	Refer to point 1 and 6
	6	VAT 3 Ground water contamination	Refer to point 4	Potentially acidic with high metal loadings	Possible	Refer to point 3	Refer to point 3
	managed through SFP Refer to #1	Heap Leach Pad Surface water runoff to watercourses from old PAF material	This site is targeted for reprocessing to remove the source of contamination in year 2 of operations	Potentially acidic with high metal loadings	Possible	Refer to point 3	Refer to point 1 and 7
	7	Heap Leach Pad Ground water contamination	This site is targeted for reprocessing to remove the source of contamination in year 2 of operations	Potentially acidic with high metal loadings	Possible	Refer to point 3	If sediment samples indicate contamination and trigger values for ground water are exceeded or speed up prioritise processing of remnant sources of PAF material over new oxide material or alternatively relocate the remannt sources where contaimination can be restricted.

Area	Conceptual Risk Diagram #	Potential source	Preventative Measures	Nature of Contamination	Likelihood of breach	Monitoring Measures	Response
General	13	Diversion bank breach	Design to cope with high rainfall events, regular inspection of bank integrity	Chance that volumes of contained contaminated water increase with influx, or potentially contaminated runoff escapes to watercourses	Unlikely - in an extreme wet season	Visual weekly inspection of site erosion, pit and TSF levels, and diversion bank integrity. Regular surface water monitoring checking that acidity and metal loadings are below trigger levels	Repair diversion banks immediately, revise diversion bank design to avoid future breeches.
Proposed Waste Rock Dumps	14	Waste rock dump surface water runoff entering watercourses	WRDs sited to minimise uncontrolled surface water runoff. Diversion banks channel runoff to settlement pond. Only benign material will be stored in the new WRD,	Water with sediment load	Likely in the wet season only	Turbidity measures in surfacewater, and close observation of changes in acidity in surface water, visual inspection and on site testing (weekly) of settlement pond	Repair or restructure diversion banks, or alter management plan such that settlement ponds are emptied of sediment more often throughout the wet season than annually.
	15	Waste rock dump leach to groundwater	Only oxide material considered benign will be stored in WRD. Regular in pit geological sampling of ore and water so as to determine its potential.	Water with sediment load only	Likely - Seepage to groundwater expected	Groundwater monitoring in EMBs will enable detection of small changes in metal loadings and acidity, groundwater flow models will enable contaminants to be traced to an approximate source	Frequency of waste rock testing may be increased. Should less benign material require storage, mine and WRD management will undergo review (and approvals process) to ensure that the WRD is capable
New Pits		Unexpected sulfide material	Pit depth will not exceed the end of the oxide layer or start of the transition layer (between oxides and sulphides) as determined by geologist	PAF material, resulting in flow on effects to all aspects of mine management	Unlikely -site XRF and lab testing indicate low potential.	The nature of ore material removed from the pits will be tested regularly to determine acid potential	If sulphide material is uncovered in one of the pits, excavation at this site will **cease immediately**

	unlikely but considered
	legacy issue will occur regardless of mining
	resolved through SFP water reuse

Appendix D
Digital Terrain Model Image of ERL 94

DIGITAL TERRAIN MODEL OF THE REDBANK PROJECT AREA (ERL94)



Appendix E
Surface and Groundwater Monitoring Dashboards

Redbank Mine Surface Water Sampling Dashboard

The Parameters listed on the Dashboard are results that have triggered the ANZECC Guidelines for Aquatic ecosystems freshwater 80% species level. All metals are Total unless specified **Dissolved**

Sampling undertaken by ALS and NTEL is to N.A.T.A standards.

NTEL **ALS** **Govt** **ERISS**

Regional summary

Limitations for setting Ambient Triggers for Reference Sites:

* limited records
* single data entries
* total metals analyses only

Redbank Creek

	pH		6.3 - 8.3
	Aluminium	µg/L	200 - 217
Total	Copper	µg/L	2.9 - 14.2
	Cadmium	µg/L	1.7

Reference Sites:		Branch Creek (14)	7 Mile (15)
	pH	7.2 - 8.7	7.7 - 8.5
	Aluminium	µg/L	101 - 126	6
Total	Copper	µg/L	0.9 - 2.2	0.6 - 2.0
	Cadmium	µg/L	<0.2	<0.1 - 0.2

Other Reference Sites:

Echo Creek (5)

pH		5.8 - 6.1
Aluminium	µg/L	31 - 50
Copper	µg/L	1.9 - 2.0
Cadmium	µg/L	<0.2 - 0.3

12 Mile Creek (8)

pH		6.1 - 8.3
Aluminium	µg/L	4 - 20
Copper	µg/L	0.2 - 6.0
Cadmium	µg/L	<0.2 - 0.2

Settlement Creek (11)

pH		7.4 - 8.7
Aluminium	µg/L	11 -170
Copper	µg/L	0.9 - 33.0
Cadmium	µg/L	<0.2 - 0.2

Redbank Creek

Site 1	Unit	Limit	Minimum	Maximum	Average	StdDev	16/06/2009	19/09/2009	20/10/2009	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	6.3	7.0	6.6	0.3	6.3	7.0	*	6.47	6.47
Aluminium	µg/L	150	217.0	860.0	479.0	337.6	217	*	*	860	360
Copper	µg/L	2.5	7.0	56.0	20.0	20.3	14.2	7.0	56.0	12	11

Site 2	Unit	Limit	Minimum	Maximum	Average	StdDev	16/06/2009	1/12/2009	1/12/2009
pH	pH Unit	6.5-8.5	6.9	8.3	7.9	0.8	6.9	8.3	8.3
Aluminium	µg/L	150	160.0	160.0	160.0	#DIV/0!	*	160.0	*
Copper	µg/L	2.5	3.1	42.0	25.0	19.9	3.1	30.0	42.0

Site 3	Unit	Limit	Minimum	Maximum	Average	StdDev	25/03/2009	16/06/2009	19/09/2009
pH	pH Unit	6.5-8.5	6.6	8.3	7.4	0.7	7.3	8.3	6.6
Aluminium	µg/L	150	200	200	200	-	*	200	*
Cadmium	µg/L	0.8	2	2	2	-	1.7	*	*
Copper	µg/L	2.5	8	8	-	-	*	*	8.0

Site 4	Unit	Limit	Minimum	Maximum	Average	StdDev	15/03/2008	25/03/2009
pH	pH Unit	6.5-8.5	7.1	7.1	7.1	0.0	7.1	7.1
Copper	µg/L	2.5	3	3	3	0	3.2	3.0

Echo Creek

Site 5	Unit	Limit	Minimum	Maximum	Average	StdDev	3/02/2008	24/02/2008	31/03/2008	29/01/2009	Feb-09	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	5.8	6.1	6.0	0.2	*	*	*	6.1	6.1	5.84	5.84
Alumium			150.0	160.0	155.0	7.1	*	*	*	*	*	160	150
Copper	µg/L	2.5	11.4	30,800.0	4,453.1	11,618.1	30800	30	50	185	11.4	60	35
Nickel			30.0	30.0	30.0	0.0	*	*	*	*	*	30	30

Site 6	Unit	Limit	Minimum	Maximum	Average	StdDev	25/05/2002	16/11/2006	3/02/2008	24/02/2008	16/03/2008	31/03/2008	29/01/2009	1/02/2009	25/03/2009	May-09	16/06/2009	13/07/2009	12/08/2009	20/10/2009	20/10/2009	1/12/2009	1/12/2009	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	3.5	6.8	4.9	1.0	6.8	3.9	*	*	4.7	*	5.6	4.6	4.3	4.6	5.2			5.8	5.8	5.3	5.3	3.45	3.45
Aluminium	µg/L	150	617.0	28,000.0	8,021.4	9,485.6	*	4130	*	*	617	*	*	*	5420	*	10200	6300	6320	2550	2200	2410	1110	27000	28000
Cadmium	µg/L	0.8	1.2	2.0	1.6	0.3	*	*	*	*	*	*	*	*	*	*	2.0	*	1.2	1.7	1.4	1.6	1.6	*	*
Copper	µg/L	2.5	493.9	87,800.0	43,173.4	32,698.9	494	43200	29500	8250	1400	4280	1800	2270	19200	77200	75700	48800	87800	77600	74700	66900	59300	73800	68100
Manganese	µg/L	3600	3,670.0	13,400.0	8,501.0	4,054.7	*	3670	*	*	*	*	*	*	*	*	7760	5060	8780	13400	12300	13000	12600	4340	4100
Nickel	µg/L	17	23.0	1,770.0	952.9	601.4	23	659	*	*	70	*	*	*	259	*	1220	721	1250	1770	1670	1560	1530	844	812
Zinc	µg/L	31	116.0	2,290.0	1,314.4	727.9	*	292	*	*	116	*	*	*	441	*	1530	994	1740	2290	2160	1900	1800	1270	1240

Site 7	Unit	Limit	Minimum	Maximum	Average	StdDev	18/03/2008	25/03/2009	16/06/2009
pH	pH Unit	6.5-8.5	5.1	9.1	6.7	2.2	5.1	5.8	9.1
Copper	µg/L	2.5	197	5,180	2,136	2,669	5180	1030	197
Nickel	µg/L	17	75	5,290	2,682	3,688	75	*	5290
Zinc	µg/L	31	109	109	109		109		

12 Mile Creek

Site 8	Unit	Limit	Minimum	Maximum	Average	StdDev	27/05/2003	10/05/2006	25/03/2009	20/09/2009
pH	pH Unit	6.5-8.5	6.1	8.3	6.8	1.0	6.6	6.1	6.3	8.3
Copper	µg/L	2.5	3	6	4	2	3.2	5.3	3.0	6.0

Site 9	Unit	Limit	Minimum	Maximum	Average	StdDev	15/11/2004	15/11/2004	15/11/2004	6/05/2005	20/04/2006	4/05/2006	18/03/2009	25/03/2009	16/06/2009	20/09/2009
pH	pH Unit	6.5-8.5	4.1	8.4	6.0	1.9	4.1	4.2	4.2	7.7	-	-	5.9	5.3	8.4	8.3
Aluminium	µg/L	150	190	326,000	95,498	154,223	326000	28400	27400	*	*	*	*	*	*	190
Copper	µg/L	2.5	182	180,000	53,030	80,070	180000	162000	164000	242	16300	2590	1400	2660	921	182
Manganese	µg/L	3600	27,100	29,600	27,967	1,415	29600	27100	27200	*	*	*	*	*	*	*
Nickel	µg/L	17	21	3,270	1,552	1,674	3270	3000	2960	*	*	*	21	37	24	*
Zinc	µg/L	31	31	1,070	542	522	1070	993	990	*	94	*	31	76	*	*

Site 10	Unit	Limit	Minimum	Maximum	Average	StdDev	13/07/2006	17/03/2006	16/06/2009
pH	pH Unit	6.5-8.5	6.4	8.9	7.7	1.3	6.4	7.7	8.9
Copper	µg/L	2.5	87	414	218	173	414	152	87

Settlement Ceek

Site 11	Unit	Limit	Minimum	Maximum	Average	StdDev	13/07/2006	15/06/2009	19/09/2009
pH	pH Unit	6.5-8.5	8.3	8.7	8.6	0.2	8.3	8.7	8.7
Aluminium	µg/L	150	170	170	170	-	*	*	170
Copper	µg/L	2.5	4	33	18	14	4.4	32.5	16.0
Manganese	µg/L	3600	4,450	4,450	4,450	-	4450	*	*

Site 12	Unit	Limit	Minimum	Maximum	Average	StdDev	13/06/2006	17/03/2008
pH	pH Unit	6.5-8.5	7.4	7.9	7.7	0.3	7.9	7.4
Copper	µg/L	2.5	23	208	116	131	208	23
Zinc	µg/L	31	47	47	47		47	*

Site 13	Unit	Limit	Minimum	Maximum	Average	StdDev	27/05/2002	7/05/2005	7/05/2005	13/11/2006	16/03/2008	25/03/2009	15/06/2009	20/09/2009	20/10/2009	1/12/2009	1/12/2009	10/01/2010
pH	pH Unit	6.5-8.5	7.3	8.6	7.9	0.4	7.9	7.9	7.9	8.6	7.5	7.8	8.4	7.9	*	8.0	8.0	7.33
Aluminium	µg/L	150	164.0	1,140.0	398.0	417.1	*	164	173	*	*	*	253	260	*	*	*	1140
Copper	µg/L	2.5	7.3	718.0	84.9	210.7	7	9	10	*	10	68	16	39	20	19	17	718
Copper	µg/L	2.5	5.9	351.0	69.1	138.4	6	6	6	31	*	*	*	*	14	*	*	351

Site 25	Unit	Limit	Minimum	Maximum	Average	StdDev	1/12/2009	1/12/2009
pH	pH Unit	6.5-8.5	8.3	8.3	8.3	0.0	8.3	8.3
Aluminium	µg/L	150	160.0	160.0	160.0	#DIV/0!	160	*
Copper	µg/L	2.5	42.0	54.0	48.0	8.5	54	42

Branch Creek/7 Mile Creek

Site 14	Unit	Limit	Minimum	Maximum	Average	StdDev	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	7.5	7.5	7.5	0.0	7.52	7.52
Copper	µg/L	2.5	5.0	36.0	20.5	21.9	5	36

Site 15	Unit	Limit	Minimum	Maximum	Average	StdDev	10/01/2010
pH	pH Unit	6.5-8.5	8.1	8.1	8.1	#DIV/0!	8.12
Copper	µg/L	2.5	3.0	3.0	3.0	#DIV/0!	3

Hanrahans Creek

Road Crossing

Site 23	Unit	Limit	Minimum	Maximum	Average	StdDev	5/05/2004	3/02/2008	24/02/2008	31/03/2008	29/01/2009	1/02/2009	May-09	16-Jun-09	13/07/2009	12/08/2009	19/09/2009	20/10/2009	20/10/2009	1/12/2009	1/12/2009	10/01/2010	10/01/2010
pH Value	pH Unit	6.5-8.5	3.3	5.7	4.1	0.9	4.2	*	*	*	5.7	5.6	3.4	3.7	*	*	3.3	*	*	3.6	3.6	4.02	4.02
Aluminium	µg/L	150	3,350.0	391,000.0	134,559.1	138,212.7	3350	*	*	*	*	*	*	274000	391000	314000	217000	71100	70000	59300	51500	14900	14000
Cadmium	µg/L	0.8	1.1	20.0	4.5	6.4	*	*	*	*	*	*	*	20	4	4	3	2	1	1	1	*	*
Copper	µg/L	2.5	2,270.0	743,000.0	205,231.8	251,110.4	20100	29100	41500	24700	2270	2270	699000	463000	743000	537000	317000	147000	143000	132000	127000	31600	29400
Lead	µg/L	9.4	10.0	10.0	10.0	#DIV/0!	*	*	*	*	*	*	*	10	*	*	*	*	*	*	*	*	*
Manganese	µg/L	3600	649.0	30,700.0	22,394.3	9,144.4	649	*	*	*	*	*	*	28200	30000	30700	25900	20100	19200	25100	21700	*	*
Nickel	µg/L	17	246.0	5,840.0	2,426.9	1,981.4	246	*	*	*	*	*	*	5120	5840	4270	3680	1760	1730	1810	1500	387	353
Zinc	µg/L	31	118.0	11,600.0	4,080.7	3,784.1	118	*	*	*	*	*	*	11600	9140	7050	5800	2760	2620	2320	1980	762	738

Hanrahans Pool

Site 24	Unit	Limit	Minimum	Maximum	Average	StdDev	3/02/2008	24/02/2008	31/03/2008	29/01/2009	1/02/2009	May-09	16-Jun-09	13/07/2009	12/08/2009	19/09/2009	20/10/2009	20/10/2009	1/12/2009	1/12/2009	10/01/2010	10/01/2010
pH Value	pH Unit	6.5-8.5	3	5	4	0	*	*	*	4.6	4.4	3.5	3.7	*	*	3.3	*	*	3.6	3.6	4.05	4.05
Aluminium	µg/L	150	12,100	350,000	149,120	135,988	*	*	*	*	*	*	296000	318000	350000	225000	135000	12100	67500	60300	14100	13200
Cadmium	µg/L	0.8	1	20	5	6	*	*	*	*	*	*	20	3	4	4	2	2	1	1	*	*
Copper	µg/L	2.5	8,520	704,000	237,745	236,182	80100	42100	47200	8520	10800	704000	528000	563000	583000	335000	263000	248000	164000	166000	32100	29100
Lead	µg/L	9.4	10	10	10	#DIV/0!	*	*	*	*	*	*	10	*	*	*	*	*	*	*	*	*
Manganese	µg/L	3600	17,800	34,300	24,538	5,144	*	*	*	*	*	*	26400	24700	34300	27900	23500	21700	20000	17800	*	*
Nickel	µg/L	17	352	5,820	2,912	1,864	*	*	*	*	*	*	5820	4940	4430	3900	2930	2740	1920	1700	384	352
Zinc	µg/L	31	712	8,240	4,512	2,799	*	*	*	*	*	*	8240	7860	7140	6000	4810	4460	2730	2420	747	712

Redbank Mine

Site 16	Unit	Limit	Minimum	Maximum	Average	StdDev	24/02/2008	29/01/2009	1/02/2009	20/10/2009	20/10/2009	1/12/2009	1/12/2009	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	4.0	5.7	5.0	0.7	*	4	*	5.22	5.22	5.69	5.69	4.42	4.42
Aluminium	µg/L	150	360.0	8,400.0	4,681.7	3,281.5	*	*	*	6290	5640	880.00	360.00	8400	6520
Cadmium	µg/L	0.8	0.9	4.6	2.0	1.7	*	*	*	4.6	3.8	0.90	0.90	1	1
Copper	µg/L	2.5	9,870.0	174,000.0	105,752.2	58,648.8	127000	123000	98400	174000	161000	10500	9870	130000	118000
Manganese	µg/L	3600	4,400.0	15,200.0	9,550.0	5,906.2	*	*	*	15200	14100	4500	4400	*	*
Nickel	µg/L	17	599.0	3,630.0	1,619.7	1,442.4	*	*	*	3630	3320	621	599	789	759
Zinc	µg/L	31	873.0	7,730.0	3,369.5	3,141.9	*	*	*	7730	7020	874	873	1880	1840

Sandy Flat Pit

Site 17	Unit	Limit	Minimum	Maximum	Average	StdDev	27/05/2002	28/11/2002	26/05/2003	22/11/2003	5/05/2004	15/11/2004	18/11/2004	5/05/2005	9/05/2006	16/11/2006	3/02/2008	24/02/2008	31/03/2008	29/01/2009	Feb-09	1/05/2009	16-Jun-09	13/07/2009	12/08/2009	20/10/2009	20/10/2009	19/09/2009	1/12/2009	1/12/2009	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	2.1	3.2	2.6	0.3	3.1	3.1	2.9	2.9	2.1	2.8	*	2.1	3.2	2.2	*	*	*	2.8	2.5	2.6	2.7	*	*	*	*	2.2	2.4	2.4	2.68	2.68
Aluminium	µg/L	150	191,000.0	660,000.0	367,650.1	119,094.8	242352	273000	260000	289000	248000	316000	*	299000	191000	380000	*	*	*	*	*	*	393000	523000	660000	457000	433000	482000	468000	453000	307000	311000
Cadmium	µg/L	0.8	4.2	20.0	7.4	4.0	6	*	*	6	*	7	*	*	*	*	*	*	*	*	*	*	20	6	8	9	6	7	6	8	4.2	4.2
Copper	µg/L	2.5	621.0	1,170,000.0	703,363.4	259,246.4	643827	741000	466000	516000	543000	662000	621	586000	561000	833000	782000	732000	962000	1020000	683000	1070000	794000	1170000	127000	850000	815000	644000	924000	910000	669000	583000
Lead	µg/L	9.4	10.0	25.6	15.2	9.0	*	*	*	10	*	*	*	26	*	*	*	*	*	*	*	*	10	*	*	<1	<1	*	*	*	*	*
Manganese	µg/L	3600	11,100.0	76,000.0	32,554.9	14,030.2	27044	29600	21900	27200	22700	29700	*	23700	11100	24400	*	*	*	*	*	*	33500	47400	76000	40000	37200	40500	44600	38100	21000	22900
Nickel	µg/L	17	4,860.0	11,400.0	8,444.3	1,625.4	8022	9050	7600	8890	7980	9310	*	7910	4860	9380	*	*	*	*	*	*	9930	8420	8600	11400	8600	9440	9180	10400	5950	5520
Zinc	µg/L	31	1,960.0	24,700.0	9,985.2	7,071.2	2178	1960	3720	3610	3590	4160	*	6840	3240	5690	*	*	*	*	*	*	15100	12600	24700	18800	17200	16800	18400	16100	7480	7550

Site 18	Unit	Limit	Minimum	Maximum	Average	StdDev	29/01/2009	Feb-09	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	5.5	6.6	6.0	0.6	6.6	6.5	5.52	5.52
Aluminium	µg/L	150	330.0	410.0	370.0	56.6	*	*	330	410
Copper	µg/L	2.5	26.2	3,800.0	1,925.3	2,119.4	155	26	3800	3720
Manganese	µg/L	3600	32.0	35.0	33.5	2.1	*	*	32	35

Site 19	Unit	Limit	Minimum	Maximum	Average	StdDev	31/03/2008	24/02/2008	29/01/2009	Feb-09	1/12/2009	1/12/2009	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	2.8	4.8	3.5	0.9	*	*	4.8	4.6	2.77	2.77	3.03	3.03
Aluminium	µg/L	150	214,000.0	496,000.0	346,000.0	147,392.9	*	*	*	*	449000	496000	214000	225000
Cadmium	µg/L	0.8	3.0	8.3	5.4	2.7	*	*	*	*	8.3	7	3	3.3
Copper	µg/L	2.5	6,680.0	953,000.0	419,241.3	376,809.8	131000	364000	6680	7250	953000	945000	491000	456000
Manganese	µg/L	3600	12,000.0	32,000.0	21,125.0	10,088.1	*	*	*	*	27400	32000	12000	13100
Nickel	µg/L	17	4,210.0	12,500.0	7,757.5	4,155.6	*	*	*	*	12500	9990	4330	4210
Zinc	µg/L	31	3,540.0	10,300.0	6,630.0	3,563.3	*	*	*	*	10300	9070	3540	3610

Site 20	Unit	Limit	Minimum	Maximum	Average	StdDev	22/11/2003	22/11/2003	15/11/2004	9/05/2006	16/11/2006	24/02/2008	31/03/2008	29/01/2009	Feb-09	1/05/2009	16-Jun-09	13/07/2009	12/08/2009	20/10/2009	20/10/2009	1/12/2009	1/12/2009	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	2.2	3.2	2.7	0.3	2.9	2.9	2.9	3.2	2.2	*	*	3.2	2.5	2.5	2.8	*	*	2.48	2.48	2.6	2.6	2.95	2.95
Aluminium	µg/L	150	84,400.0	705,000.0	451,242.9	162,765.2	507000	401000	472000	84400	470000	*	*	*	*	*	455000	469000	455000	621000	705000	561000	602000	260000	255000
Cadmium	µg/L	0.8	3.4	20.0	8.2	5.1	*	*	*	*	*	*	*	*	*	*	20	5	6	10.5	7	10	8	3.6	3.4
Copper	µg/L	2.5	266,000.0	1,220,000.0	834,736.8	290,332.9	1100000	822000	1040000	266000	1000000	560000	278000	700000	680000	867000	948000	993000	936000	1100000	1220000	1110000	1160000	579000	501000
Lead	µg/L	9.4	10.0	10.0	10.0	#DIV/0!	*	*	*	*	*	*	*	*	*	*	10	*	*	*	*	*	*	*	*
Manganese	µg/L	3600	7,710.0	85,100.0	44,422.1	21,446.5	52500	41400	54400	7710	36300	*	*	*	*	*	51700	43500	52100	74400	85100	50200	41800	16000	14800
Nickel	µg/L	17	2,560.0	16,100.0	10,212.9	4,352.2	16100	12100	15300	2560	12100	*	*	*	*	*	10400	7460	6660	12300	10600	15900	12000	4900	4600
Zinc	µg/L	31	925.0	27,900.0	10,084.6	7,954.2	4190	3460	5380	925	5550	*	*	*	*	*	14400	11800	10300	23900	27900	13800	11400	4160	4020

Site 21	Unit	Limit	Minimum	Maximum	Average	StdDev	29/01/2009	Feb-09
pH	pH Unit	6.5-8.5	5.6	6.0	5.8	0.3	6	5.6
Copper	µg/L	2.5	505.0	790.0	647.5	201.5	505	790

Site 22	Unit	Limit	Minimum	Maximum	Average	StdDev	31/03/2008	24/02/2008	29/01/2009	Feb-09	10/01/2010	10/01/2010
pH	pH Unit	6.5-8.5	2.4	3.0	2.7	0.4	*	*	2.4	2.4	3.02	3.02
Aluminium	µg/L	150	266,000.0	269,000.0	267,500.0	2,121.3	*	*	*	*	269000	266000
Cadmium	µg/L	0.8	1.8	1.8	1.8	0.0	*	*	*	*	1.8	1.8
Copper	µg/L	2.5	319,000.0	1,170,000.0	568,000.0	314,858.1	1170000	319000	616000	531000	412000	360000
Manganese	µg/L	3600	19,600.0	20,700.0	20,150.0	777.8	*	*	*	*	20700	19600
Nickel	µg/L	17	1,360.0	2,190.0	1,775.0	586.9	*	*	*	*	1360	2190
Zinc	µg/L	31	10,200.0	10,400.0	10,300.0	141.4	*	*	*	*	10400	10200

Redbank Mine Groundwater Sampling Dashboard

The Parameters listed on the Dashboard are results that have triggered the ANZECC Guidelines for Aquatic ecosystems freshwater 80% species level.

Sampling undertaken by ALS and SGS (Splits) to N.A.T.A standards.

Govt
ALS
SGS

EMB 1	Unit	Limit	Minimum	Maximum	Average	StdDev	22/11/2003	24/11/2003	17/11/2004	3/11/2005	15/11/2006	15/11/2006	16-Sep-09
pH	pH Unit	**6.5-8.5**	3.4	7.8	4.2	1.6	3.6	7.8	3.38	3.55	3.54	3.54	3.89
Aluminium	µg/L	150	352.0	297000.0	183193.1	125226.5	248000	352	263000	149000	297000	295000	30000
Cadmium	µg/L	0.8	6.6	10.2	8.4	2.5	6.6	<0.2	-	-	-	-	10.2
Copper	µg/L	2.5	3.4	5070000.0	1016286.2	1800134.6	433000	3.4	5070000	230000	584000	584000	213000
Lead	µg/L	9.4	4.4	12.6	9.8	3.7	11.1	<0.1	11.1	4.4	<2	<2	12.6
Manganese	µg/L	3600	687.0	36500.0	25412.4	11620.8	26500	687	27000	36500	26800	26700	33700
Nickel	µg/L	17	15.5	9170.0	6873.6	3309.3	8530	15.5	8970	6460	9170	9120	5850
Zinc	µg/L	31	5.0	7340.0	4187.9	2325.4	3400	5	3630	3770	5550	5620	7340

EMB 13	Unit	Limit	Minimum	Maximum	Average	StdDev	27/05/2003	17/11/2004	3/11/2005	14/11/2006	16-Sep-09	16/09/2009 (DUP)
pH	pH Unit	**6.5-8.5**	4.4	5.4	4.8	0.4	4.97	4.87	5.37	4.57	4.38	4.38
Aluminium	µg/L	150	254.0	4610.0	2619.7	1866.5	254	2700	434	4610	3850	3870
Cadmium	µg/L	0.8	4.5	4.6	4.6	0.1	-	-	-	-	4.54	4.62
Copper	µg/L	2.5	30900.0	174000.0	117466.7	58613.5	126000	62900	30900	139000	174000	172000
Manganese	µg/L	3600	262.0	12900.0	8502.0	4996.7	262	7400	5850	11800	12900	12800
Nickel	µg/L	17	97.1	4520.0	2827.9	1630.8	97.1	2860	1840	4520	3900	3750
Zinc	µg/L	31	46.8	2030.0	1182.3	775.2	46.8	936	641	1540	1900	2030

EMB 14	Unit	Limit	Minimum	Maximum	Average	StdDev	22/01/2003	3/11/2005	15/11/2006	16-Sep-09
pH	pH Unit	**6.5-8.5**	3.4	3.9	3.6	0.2	3.93	3.37	3.59	3.5
Aluminium	µg/L	150	4650.0	102000.0	51412.5	39806.4	50000	102000	49000	4650
Cadmium	µg/L	0.8	0.8	4.2	2.5	2.4	4.2	-	-	0.8
Copper	µg/L	2.5	23000.0	133000.0	74100.0	52901.5	104000	23000	133000	36400
Lead	µg/L	9.4	8.9	65.6	28.5	32.1	8.9	11	<1	65.6
Manganese	µg/L	3600	1390.0	28500.0	13797.5	14289.3	23600	1700	28500	1390
Nickel	µg/L	17	673.0	4030.0	2738.3	1448.5	2950	4030	3300	673
Zinc	µg/L	31	883.0	2420.0	1780.8	689.9	1610	2420	2210	883

EMB 15	Unit	Limit	Minimum	Maximum	Average	StdDev	23/11/2003	22/11/2003	17/11/2004	17/11/2004	3/11/2005	15/11/2006	17-Sep-09
pH	pH Unit	**6.5-8.5**	3.3	6.7	4.5	1.1	4.57	4.57	4.23	3.33	4.67	3.57	6.65
Aluminium	µg/L	150	2620.0	85000.0	19760.0	32164.1	4400	4440	11400	85000	2620	10700	<5
Cadmium	µg/L	0.8	6.6	8.4	7.3	1.0	6.8	6.6	-	-	-	-	8.43
Copper	µg/L	2.5	973.0	543000.0	105639.0	193656.0	31300	32200	36800	543000	33800	61400	973
Manganese	µg/L	3600	1920.0	41500.0	28788.6	14179.5	38200	38800	41500	18400	28800	33900	1920
Nickel	µg/L	17	257.0	3650.0	2349.6	1131.0	2190	2090	3480	3650	2050	2730	257
Zinc	µg/L	31	796.0	2590.0	1682.6	665.9	1680	1580	2590	796	2060	2190	882

EMB 16	Unit	Limit	Minimum	Maximum	Average	StdDev	24/11/2003	4/11/2005	14/11/2006	17-Sep-09
pH	pH Unit	**6.5-8.5**	2.9	3.4	3.1	0.2	3.05	3.36	3.24	2.93
Aluminium	µg/L	150	6110.0	142000.0	79227.5	61474.1	52800	142000	116000	6110
Cadmium	µg/L	0.8	2.7	3.0	2.9	0.2	3	-	-	2.7
Copper	µg/L	2.5	217000.0	635000.0	453000.0	187453.1	393000	567000	635000	217000
Manganese	µg/L	3600	15800.0	77400.0	51525.0	28526.6	15800	41500	71400	77400
Nickel	µg/L	17	1970.0	3830.0	2920.0	931.4	2280	3600	3830	1970
Zinc	µg/L	31	575.0	9240.0	3853.8	3741.1	575	2750	2850	9240

EMB 17	Unit	Limit	Minimum	Maximum	Average	StdDev	21/01/2003	3/11/2005	14/11/2006	16-Sep-09
pH	pH Unit	**6.5-8.5**	2.8	6.1	3.7	1.6	6.12	2.87	2.89	2.82
Aluminium	µg/L	150	8.0	91800.0	48069.3	46049.0	8	91800	52400	<5
Cadmium	µg/L	0.8	5.7	7.2	6.4	1.1	<0.2	7.2	-	5.69
Copper	µg/L	2.5	32000.0	208000.0	107700.0	90542.1	-	32000	83100	208000
Manganese	µg/L	3600	585.0	168000.0	80546.3	74917.1	585	168000	39600	114000
Nickel	µg/L	17	17.3	3500.0	2111.8	1695.5	17.3	3500	1450	3480
Zinc	µg/L	31	2290.0	19300.0	9940.0	8633.0	<5	19300	8230	2290

EMB 20	Unit	Limit	Minimum	Maximum	Average	StdDev	15-Sep-09	15-Sep-09	6-Nov-09
pH	pH Unit	**6.5-8.5**	5.9	5.9	5.9	0.0	5.89	5.89	5.89
Dissolved Metals									
Copper	µg/L	2.5	17.0	35.0	28.5	10.0	33.6	35	17
Nickel	µg/L	17	29.0	40.0	33.9	5.6	32.7	40	29
Zinc	µg/L	31	92.0	97.0	94.5	3.5	92	97	-
Total Metals									
Copper	µg/L	2.5	55.0	55.0	55.0	#DIV/0!	-	-	55
Nickel	µg/L	17	26.0	26.0	26.0	#DIV/0!	-	-	26

EMB 21	Unit	Limit	Minimum	Maximum	Average	StdDev	15-Sep-09	6-Nov-09
pH	pH Unit	**6.5-8.5**	6.5	6.5	6.5	0.0	6.52	6.47
Dissolved Metals								
Copper	µg/L	2.5	3.0	186.0	94.5	129.4	186	3
Zinc	µg/L	31	49.0	49.0	49.0	#DIV/0!	49	-
Total Metals								
Copper	µg/L	2.5	101.0	101.0	101.0	#DIV/0!	-	101

EMB 22	Unit	Limit	Minimum	Maximum	Average	StdDev	16-Sep-09	6-Nov-09
pH	pH Unit	**6.5-8.5**	6.0	6.1	6.1	0.1	6.12	6.04
Dissolved Metals								
Manganese	µg/L	3600	4470.0	5900.0	5185.0	1011.2	4470	5900
Nickel	µg/L	17	48.0	96.0	72.0	33.9	48	96
Zinc	µg/L	31	68.0	68.0	68.0	#DIV/0!	68	-
Total Metals								
Manganese	µg/L	3600	5150.0	5150.0	5150.0	#DIV/0!	-	5150
Nickel	µg/L	17	96.0	96.0	96.0	#DIV/0!	-	96

EMB 23	Unit	Limit	Minimum	Maximum	Average	StdDev	15-Sep-09	6-Nov-09
pH	pH Unit	**6.5-8.5**	4.4	4.5	4.4	0.0	4.41	4.48
Dissolved Metals								
Aluminium	µg/L	150	7880.0	28500.0	18190.0	14580.5	7880	28500
Cadmium	µg/L	0.8	24.0	44.6	34.3	14.6	24	44.6
Copper	µg/L	2.5	67000.0	76700.0	71850.0	6858.9	67000	76700
Lead	µg/L	9.4	41.0	41.5	41.3	0.4	41.5	41
Manganese	µg/L	3600	131000.0	172000.0	151500.0	28991.4	131000	172000
Nickel	µg/L	17	7350.0	9110.0	8230.0	1244.5	7350	9110
Zinc	µg/L	31	9290.0	12300.0	10795.0	2128.4	9290	12300
Total Metals								
Aluminium	µg/L	150	30400.0	30400.0	30400.0	#DIV/0!	-	30400
Cadmium	µg/L	0.8	42.0	42.0	42.0	#DIV/0!	-	42
Copper	µg/L	2.5	75400.0	75400.0	75400.0	#DIV/0!	-	75400
Lead	µg/L	9.4	51.0	51.0	51.0	#DIV/0!	-	51
Manganese	µg/L	3600	162000.0	162000.0	162000.0	#DIV/0!	-	162000
Nickel	µg/L	17	9070.0	9070.0	9070.0	#DIV/0!	-	9070
Zinc	µg/L	31	11700.0	11700.0	11700.0	#DIV/0!	-	11700

EMB 24	Unit	Limit	Minimum	Maximum	Average	StdDev	16-Sep-09	6-Nov-09
pH	pH Unit	**6.5-8.5**	5.9	6.0	6.0	0.1	6.03	5.91
Dissolved Metals								
Copper	µg/L	2.5	20.0	20.0	20.0	#DIV/0!	-	20
Manganese	µg/L	3600	19000.0	21700.0	20350.0	1909.2	19000	21700
Nickel	µg/L	17	1010.0	1020.0	1015.0	7.1	1010	1020
Zinc	µg/L	31	543.0	602.0	572.5	41.7	602	543
Total Metals								
Manganese	µg/L	3600	19500.0	19500.0	19500.0	#DIV/0!	-	19500
Nickel	µg/L	17	1010.0	1010.0	1010.0	#DIV/0!	-	1010
Zinc	µg/L	31	585.0	585.0	585.0	#DIV/0!	-	585

EMB 25	Unit	Limit	Minimum	Maximum	Average	StdDev	6-Nov-09
pH	pH Unit	**6.5-8.5**	6.5	6.5	6.5	#DIV/0!	6.45
Dissolved Metals							
Copper	µg/L	2.5	4.0	4.0	4.0	#DIV/0!	4
Total Metals							
Copper	µg/L	2.5	5.0	5.0	5.0	#DIV/0!	5

EMB 26	Unit	Limit	Minimum	Maximum	Average	StdDev	15-Sep-09	6-Nov-09
pH	pH Unit	**6.5-8.5**	6.1	6.1	6.1	0.0	6.06	6.12
Dissolved Metals								
Copper	µg/L	2.5	3.1	3.1	3.1	#DIV/0!	3.1	-
Zinc	µg/L	31	51.0	51.0	51.0	#DIV/0!	51	-
Total Metals								
Copper	µg/L	2.5	4.0	4.0	4.0	#DIV/0!	-	4

EMB 27	Unit	Limit	Minimum	Maximum	Average	StdDev	15-Sep-09	6-Nov-09
pH	pH Unit	**6.5-8.5**	6.6	6.7	6.7	0.1	6.74	6.63
Dissolved Metals								
Copper	µg/L	2.5	23.1	23.1	23.1	#DIV/0!	23.1	-
Total Metals								
Copper	µg/L	2.5	3.0	3.0	3.0	#DIV/0!	-	3

T 01	Unit	Limit	Minimum	Maximum	Average	StdDev	6-Nov-09
pH	pH Unit	**6.5-8.5**	6.4	6.4	6.4	#DIV/0!	6.4
Dissolved Metals							
Copper	µg/L	2.5	58.0	58.0	58.0	#DIV/0!	58
Total Metals							
Copper	µg/L	2.5	166.0	166.0	166.0	#DIV/0!	166

EB 1	Unit	Limit	Minimum	Maximum	Average	StdDev	19-Sep-09
pH	pH Unit	**6.5-8.5**	6.1	6.1	6.1	#DIV/0!	6.11
Dissolved Metals							
Copper	µg/L	2.5	3.5	3.5	3.5	#DIV/0!	3.5