Centennial Coal

Annual Environmental Management Report

1st January 2012 to 31st December 2012

Clarence Colliery

CCL705, ML1353, ML1354 & ML1583

Centennial Coal
Environment Matters

Name of mine	**Clarence Colliery**		
Titles/Mining Leases	**CCL705, ML1353, ML1354 & ML1583**		
MOP Commencement Date	**01/01/2007**	**MOP Completion Date**	**31/12/2013**
AEMR Commencement Date	**01/01/2012**	**AEMR End Date**	**31/12/2012**
Name of Leaseholder	**Coalex Pty Ltd & Clarence Coal Investments Pty Ltd**		
Name of mine operator (if different)	**Clarence Colliery Pty Ltd**		
Reporting Officer	**Gregory Shields**		
Title	**Mine Manager**		
Signature			
Date			

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1 Introduction

Clarence Colliery Pty Ltd (Clarence) operates an underground coal mine, a coal handling and preparation plant (CHPP), and water treatment plant in the Western Region of New South Wales (NSW). The operation is located approximately 10 kilometres east-north-east of Lithgow. A plan of the regional location and site layout of the mine and the mining leases is included in **Appendix 1**.

Environmental aspects of the Clarence Operation are managed in accordance with legislation, lease, licence and approval conditions with reference to the Clarence Colliery Environmental Management System (EMS). In accordance with Clarence EMS, Clarence has adopted the Centennial Coal Environment and Community Policy, included in **Appendix 2**.

This Annual Environmental Management Report (AEMR) has been prepared to meet the reporting requirements of the NSW Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS), NSW Department of Planning and Infrastructure (DP&I), NSW Office of Water (NoW) and other such regulatory bodies. This AEMR has been prepared in accordance with the Guidelines to Mining, Rehabilitation and Environmental Management Process (2006) published by DTIRIS.

1.1 Consents, Leases and Licences

Mining at Clarence is undertaken within Consolidated Coal Lease 705 (CCL705), Mining Lease 1353 (ML1353), Mining Lease 1354 (ML1354) and Mining Lease 1583 (ML1583) issued by the DTIRIS. Mining during 2012 occurred within CCL705 and ML1583. The location of Clarence leases is shown on Plan CL315 (**Appendix 1**).

Clarence operates under four Development Consents. Approval to commence mining was originally granted in 1976 by the Blaxland Shire Council, now known as Lithgow City Council (LCC). The approval area partially encompassed CCL705. A variation to this approval was granted by the Greater Lithgow County Council (GLCC), now known as LCC in 1993. The approval amended the reject emplacement facilities and expanded the mining area to include all of CCL705. In 1994, another variation to this approval was granted by the GLCC to extend mining activities to the north encompassing ML1353 and ML1354.

In 2005 Clarence received approval from the Department of Infrastructure, Planning and Natural Resources now known as the Department of Planning and Infrastructure (DP&I) for Development Consent DA 504-00. ML1583 is wholly within the DA 504-00 area. A copy of Clarence Development Consents is attached in **Appendix 3**.

Clarence operates in accordance with Environmental Protection Licence (EPL) 726 issued by the Office of Environment and Heritage (OEH). A copy of EPL 726 is attached in **Appendix 3**.

Clarence's current Mining Operations Plan (MOP) 2007-2013 was approved in February 2007. Clarence requested an amendment in November 2010 for the development of Reject Emplacement Area IV, update of mine contact details of relevant personnel, and review of currently used mining equipment.

Additional approvals that relate to Clarence are detailed in **Table 1**. Additional approvals include water licences and reject emplacement area approvals.

Table 1 Clarence Colliery Licences, Consents and Approvals

Authority	Licence/Approval/Consent	Approval/ Licence No.	Valid/Key Date
Lithgow City Council	Development Consent	IRM.GE.76	Development Consent
	Development Consent	None	Development Consent
	Development Consent	None	Development Consent
Department of Planning & Infrastructure	Development Consent	DA 504-00	19/12/2005
Environmental Protection Authority	Environmental Protection Licence	000726	Varied 19/12/2011
Office of Water	Surface Licence Main Dam	10SL039344	26/01/2008-25/01/2013
	Bore licence 79 cut through mine dewatering	10BL165054	22/09/2006-21/09/2011 (application in progress)
	Bore licence 82 cut through mine dewatering		
	Bore licence CC114	10BL165053	22/09/2006-21/09/2011 (application in progress)
	Bore licence CC115		09/03/2009-Perpetuity
	Bore licence CLRP1	10BL602819	09/03/2009-Perpetuity
	Bore licence CLRP2	10BL602820	13/08/2003-Perpetuity
	Bore licence CLRP3	10BL161964	13/08/2003-Perpetuity
	Bore licence CLRP4	10BL161965	10/12/2007-Perpetuity
	Bore licence CLRP5, CLRP7 & CLRP10	10BL602213	13/08/2003-Perpetuity
	Bore licence CLRP6	10BL161962	10/12/2007-Perpetuity
	Bore licence HV1, HV2, HVU1, HVU2	10BL602211	
	Radiation Licence		10/12/2007-Perpetuity
		10BL602212	07/09/2009-Perpetuity
		10BL603337	Renewed Annually
	Bore Licence CLRP 12	739, 740, 1120, 1121, 1122	
	Bore Licence CLRP 11, 13 & 14		
	Bore Licence CLRP 15 & 16	10BL604063	07/06/2010-Perpetuity
	Bore Licence CLRP 17 & 19	10BL604099	05/07/2010-Perpetuity
		10BL604098	05/07/2010-Perpetuity
		10BL605316	30/01/2013-Perpetuity
Trade and Investment, Regional Infrastructure and Services	Consolidated Coal Lease	705	20/12/2006-20/12/2027
	Mining Lease	1353	21/07/1994-21/07/2015
	Mining Lease	1354	21/07/1994-21/07/2015
	Mining Lease	1583	09/07/2006-09/07/2027
	Mining Operations Plan (MOP)	-	01/01/2007-31/12/2013
	Subsidence Management Plan	Eastern Area	10/2005-01/06/2013
	Subsidence Management Plan	Outbye Area (402)	27/03/2009-01/01/2010
	Subsidence Management Plan	Outbye Area (602)	30/01/2009-01/01/2010
	Subsidence Management Plan	Outbye Area (302, 305, 306, 307, 400,	08/05/2009-01/05/2014

		403 & 406)	
		700 Area	
	Subsidence Management Plan	700 West Area	08/05/2009-01/05/2014
	Subsidence Management Plan	Reject Emplacement Area II	18/06/2012
	Section 100		24/05/1976
			(Approval 19/06/1992)
		Reject Emplacement Area III	
	Section 100		21/02/1990
		Reject Emplacement Area IV	(Approval 07/10/1993)
	Section 100		Approved 28/03/2011
	Mine within Lithgow No.2 Dam Notification Area (under the NSW Dam Safety Act 1978) (1st Workings only)	Clarence-1	14/07/2010
	Mine within Lithgow No,2 Dam Notification Area (under the NSW Dam Safety Act 1978) (Partial extraction 714 panel only)	Clarence-1	06/12/2011
	Mine within Lithgow No.2 Dam Notification Area (under the NSW Dam Safety Act 1978) (Partial extraction of panel 716)	Clarence-2	28/03/12
	Mine within Lithgow No.2 Dam Notification Area (under the NSW Dam Safety Act 1978) (Partial extraction of panel 707)	Clarence-3	29/05/12
Work Cover NSW	Dangerous Goods Licence	35/020999	15/03/2013
Rail Corp	Occupation Permit	Q648-100	10/07/1981-Life of Loop
Forests NSW	Occupation Permit		Renewed Annually

1.2 Mine Contacts

The contact details for key mine personnel are provided in **Table 2** below.

Table 2 Contact Details for Key Mine Personnel

Name	Title	Phone
Gregory Shields	Mine Manager	02 6353 8033
Jesse Percival	Environment and Community Coordinator	02 6353 8039
Enquiries and Complaints Line	Daytime Contact	02 6353 8039
	Afterhours Contact	02 6353 8010

1.3 Actions Required at Previous AEMR Review

A summary of actions identified at the 2011 AEMR review meeting held at Clarence Colliery on the 9th May 2012, and feedback from the DTIRIS and DOPI on 5th July 2012 is provided in **Table 3** below. Actions

Table 3 Actions required at previous AEMR review

Issue	Action	Where dealt with in this document	Complete/Incomplete/In progress
A Title Block as required by the Department's AEMR Guidelines was not included in the Clarence Colliery AEMR	Ensure that a Title Block is included as per Departmental Guideline EDG03 in subsequent AEMR's.	Title Page	Complete
Section 3.18 (Methane Drainage / Ventilation) of the AEMR did not discuss Ventilation infrastructure at the mine.	Please include a brief outline of the Ventilation systems at the mine and any issues/changes encountered during the AEMR period.	Section 3.18	Complete
The clean water diversion drain installed above REA IV was observed to be poorly formed and actively eroding.	Re-profile or otherwise provide adequate protection to the clean water diversion to ensure it adequately conveys clean water away from disturbed catchments without contributing sediment to the clean water system.	Section 3.4	Complete
A small area near the Truck Wash was again observed to be actively eroding.	Stabilise or rehabilitate this area to avoid unnecessary erosion and sedimentation.	Section 5	In progress Erosion control measures have been installed at the truck wash area. The site will be used as an access to the proposed new Reject Emplacement Area and the site will not be fully rehabilitated until the proposed project is completed.
Several individuals of the noxious weed Pampas Grass were observed near the Main Dam.	Ensure all noxious weeds are controlled in accordance with local council guidelines.	Section 3.8	Incomplete Weeds are sprayed monthly on site by experienced contractors. A risk assessment was completed to spray weeds on the northern shore of the Main Dam however safe access could not be guaranteed.

Clarence Air Quality Monitoring	Review methodology for undertaking air quality monitoring	Section 3.3.3.5	In progress The E-sampler used for TSP/PM10 measurements was analysed, serviced and calibrated during the reporting period. An Air Quality Assessment is scheduled to be completed in Quarter 1 2013 to update the air model for the site. The Dust BMP Site Specific Particulate determination was completed during the reporting period. One of the outcomes will be the dust propensity testing of Clarence Coal.
Clarence water Management Plan	Review the Clarence Water Management Plan	Section 3.4	Complete
Pollution Reduction Program	Conduct a site specific Best Management Practice particulate determination to identify the most practicable means to reduce particle emissions from the premises.	Section 3.3.4	Complete
Water Treatment Plant Communications	Review of the telephone communication system hardware at the Water Treatment Plant to identify any opportunities to improve the design of the system.	Section 2.8.4	Complete
Exploration	Further planning and exploration in the 800 area;	Section 2.1	In progress Approval for the exploration program from DTIRIS was received during the reporting period. Drilling is scheduled for 2013.
Water Treatment Plant Operation	Review of the management system of the Water Treatment Plant in collaboration with the Water Treatment Plant operator.	Section 2.8.4	Complete
Mining Operations Plan	Review of the Mining Operations Plan;	Section 6	In progress New MOP will be completed during the 2013 reporting period.

Rehabilitation	Continued planning for progressive decommissioning and rehabilitation of Reject Emplacement Area III;	Section 5	In progress Significant rehabilitation completed on REA IV during the reporting period. Rehabilitation monitoring (Ecosystem Function Analysis) completed during the reporting period.
Reject Emplacement	Commencement of planning for life of mine reject emplacement	Section 6	In progress The approval process for proposed REA VI project will continue during the reporting period.

2 Operations During the Reporting Period

2.1 Exploration

No boreholes were drilled for exploration or groundwater monitoring during 2012.

The location of existing boreholes are shown on Plan CL315 in **Appendix 1.**

In 2012 Clarence undertook the approval process for a four hole exploration program within the '800 Area' on the Newnes Plateau. The exploration drilling program includes four partly-cored drill holes to explore and further define coal resources of the exploration area. The proposed boreholes are located along existing and overgrown fire trails and vehicle access tracks on the Newnes Plateau. A Review of Environmental Factors (REF) was prepared which considered the environmental impacts of the exploration program and mitigation measures which would be employed.

Approval from the DTIRIS was received on the 17th of December 2012. The issuing of monitoring bore licences from the NSW Office of Water (NoW) was pending a signed occupation permit with the Landholder Forests NSW expected in early 2013. Clarence plans to begin drilling in Quarter 2 2013.

At the completion of each borehole drilling, the borehole will be geo-physically logged by a specialist contractor. The logging operation will take approximately one day, and the drill rig will remain on site during this process. Upon completion of the exploration activities, two of the boreholes (CLRP17 and CLRP19) will be converted to monitoring boreholes, with a locked monument fitted to hold data equipment. The remaining two boreholes will be sealed in accordance with the DTIRIS guideline '*EDG01 Environmental Management Guideline for Industry - Borehole Sealing Requirements on Land: Coal Exploration'* (Department of Mineral Resources, 1997).

The remainder of the drill pad area will be rehabilitated.

A copy of the REF is available on Resources & Energy Website at the following address:

http://www.resources.nsw.gov.au/environment/ref/2012

A summary of rehabilitation progress for previous Clarence drilling activities is included in **Table 4** below.

Table 4 Drilling activities rehabilitation progress

Borehole Number	License Number	Drilling Date	Drilling Site Rehabilitation Progress	Borehole Sealing Rehabilitation Progress
CLRP1	10BL161964	Aug-04	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP2	10BL161965	Aug-04	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP3	10BL602213	Dec-06	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP4/MBN01	10BL161962	Aug-03	Complete	Standpipe Single Data Logger
CLRP5	10BL602211	May-08	Complete	Standpipe Single Data Logger
CLRP6	10BL602212	May-08	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP7	10BL602211	Apr-08	Complete	Standpipe Single Data Logger
CLRP9	N/A	May-08	Complete	Sealed
CLRP10	10BL602211	May-08	Complete	Standpipe Single Data Logger
CLRP11	10BL604099	Sep-10	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP12	10BL604063	Aug-10	Complete	Sealed
CLRP13	10BL604099	Sep-10	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP14	10BL604099	Sep-10	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP15a	10BL604098	Oct-10	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP15	10BL604098	Oct-10	Complete	Multi Level Vibrating Wire Piezometer Grouted
CLRP16	10BL604098	Oct-10	Complete	Multi Level Vibrating Wire Piezometer Grouted
CC111	N/A	Aug-08	Complete	Sealed
CC112	N/A	Aug-08	Complete	Sealed
CC113	N/A	Oct-07	Complete	Standpipe Single Data Logger
CC114	10BL602819	Apr-09	Complete,	Multi Level Vibrating Wire Piezometer Grouted
CC115	10BL602820	Apr-09	Complete	Multi Level Vibrating Wire Piezometer Grouted
Happy Valley Upper Swamp 1	10BL603337	Dec-10	Complete- Minimal disturbance	Standpipe Single Data Logger
Happy Valley Upper Swamp 2	10BL603337	Dec-10	Complete- Minimal disturbance	Standpipe Single Data Logger
Happy Valley Swamp 1	10BL603337	Dec-10	Complete- Minimal disturbance	Standpipe Single Data Logger
Happy Valley Swamp 2	10BL603337	Dec-10	Complete- Minimal disturbance	Standpipe Single Data Logger

2.2 Land Preparation

Land preparation for Reject Emplacement Area (REA) IV final stage 3 and 4 wall lift was completed during the reporting period. The total area cleared was 1.2 hectares. Cleared vegetation and stripped topsoil and subsoil were applied directly to the lower batters of REA IV according to progressive rehabilitation best management practice.

Rehabilitation activities are discussed in **Section 5.**

2.3 Construction

Three emergency fire tanks were constructed during the reporting period on previous disturbed site behind the water treatment plant. The tanks are noted in **Appendix 1**. The construction met the requirements of *emergency equipment (replacement of fire systems)* the Mining SEPP and no development application was required.

2.4 Mining

During 2012, the following mining activities took place:

- Extraction within 707 panel commenced on 14 August 2012 and finished on 20th November 2012.
- Extraction within 714 panel commenced on 5th September 2012 and finished 18th December 2012.
- Development commenced in 706 panel on 22nd August 2011 and continued until the end of the reporting period.
- Development commenced in 801 panel in July 2012 and continued until the end of the reporting period.
- Development commenced in 901 panel in November 2012 and continued until the end of the reporting period.

The current mine plan with progress of development and extraction is included in **Appendix 1**. Also included in Appendix 1 is the proposed mine plan for 2013.

The coal production (run of mine) tonnes are presented in **Table 5** below. The production and waste summary for 2012 is presented in **Table 6** below.

Table 5 Coal Production (Run of Mine) 1999-2012

Year	Coal Production (Run of Mine) Tonnes
2012	2 017 674
2011	2 006 738
2010	1 829 454
2009	1 978 214
2008	1 829 551
2007	1 474 944
2006	1 604 397
2005	1 626 414
2004	1 729 167
2003	1 529 667
2002	1 129 550
2001	1 384 162
2000	1 092 525
1999	920 680

Table 6 Production and Waste Summary 2012

Aspect	Volume (Tonnes)
Topsoil Stripped	1 200
Topsoil Used/Spread	900
Waste Rock	0
ROM	2 017 674
Processing Waste	192 324
Product Domestic	103 596
Product International	1 825 264

2.5 Mineral Processing

The CHPP is designed to operate at 650 tonnes per hour (tph). Product less than 50mm sizing is pushed into underground reclaim tunnels via a dozer. A medium is added to the water which aids the separation of the heavier material from the coal. Coal is screened to separate less than 0.05mm coal fines which report to the thickener, and product coal is sent to the product stockpile. The fine material is pumped from the thickener to belt filter presses which were installed in 2009. The filter press compresses slurry into a cake, and water is returned to the plant. The filter cake is transported to the product stockpile.

The washed coal is added to an export stockpile, or sized in a screening plant into 50mm minus to plus 25mm, 25mm minus to plus 15mm or 15mm minus. Screened material is stockpiled and loaded for domestic sale via road haulage.

Coarse reject from the plant is transported via a belt from the CHPP to a reject bin and trucked to the reject emplacement area.

2.6 Waste Management

Waste is managed in accordance with Clarence Waste Management Plan. Waste management practices are based on the Waste Management Hierarchy whereby waste is minimised in the first instance, reused/recycled in the second instance and disposed of as a last resort.

Clarence reviewed its Waste Management Plan in 2012 and updated the plan to include waste performance targets. Clarence has set the following targets to ensure continual improvement in site waste minimisation and management:

- 5% reduction in total waste volumes on a comparative year basis. Total waste volumes will be calculated on a kg of waste per ROM tonne produced.
- 10% improvement in recycling rates on a comparative year basis. Recycling rates will be calculated as a percentage of total waste material.

Waste targets will be reviewed and modified as required to assist in improving waste minimisation and management procedures. Total waste and percentage of material recycled during the reporting period in presented below in **Figure 1.**

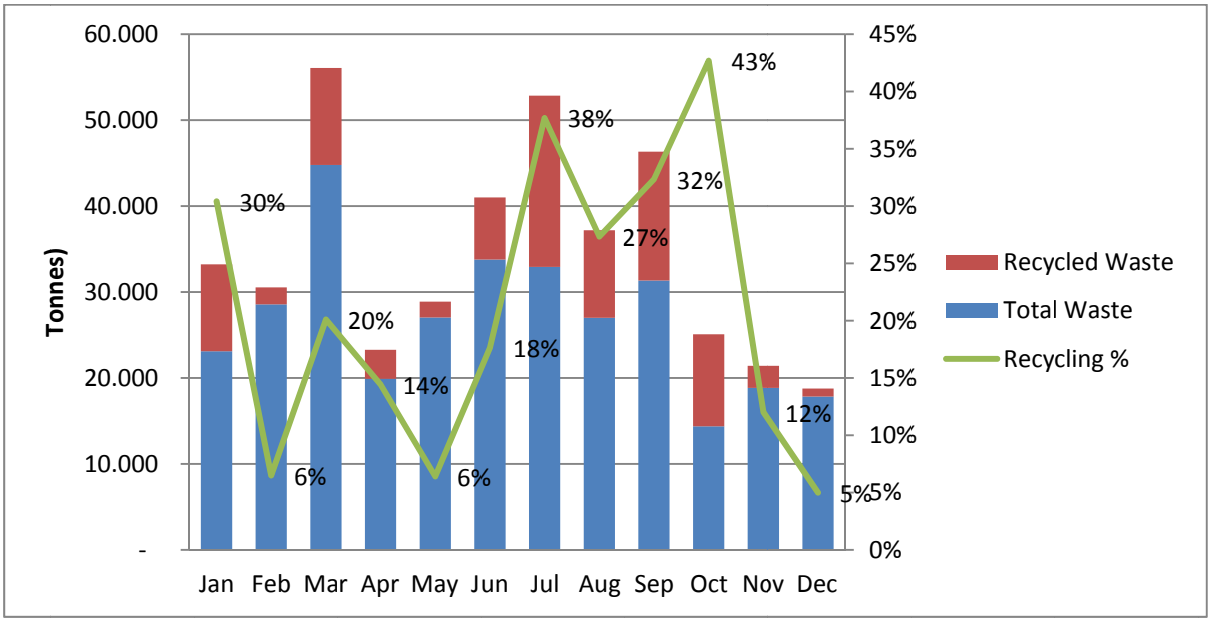

Figure 1 Total Waste and Recycling 2012

2.6.1 Reject Management

Reject material from the CHPP is produced when 'washing' coal to reduce ash content. Washing coal removes impurities in the coal (e.g. sedimentary rock, clay, high-ash coal) to meet desired ash content in the final product. Washing is undertaken as required to meet market specifications.

During the reporting period all reject material was placed on Reject Emplacement Area (REA) IV. Prior to the installation of the belt press filters in 2008 Clarence placed fines within REA III. Clarence excavates fines which are mixed with coal product on the stockpile.

2.6.2 Sewage Treatment

A package sewage treatment plant is connected to a holding tank that receives raw sewage from the administration and CHPP buildings. Treated effluent is discharged to a twin pond system for maturation, from where it is then pumped to a spray irrigation area between the coal stockpiles and the rail-loading loop. Approximately 9 ML is applied to the irrigation area each year. There were no changes to current sewerage treatment methods during the reporting period.

Irrigation of treated effluent currently occurs on the proposed new Reject Emplacement Site VI site. Clarence Colliery commissioned consultants in 2012 to determine alternate areas which treated effluent could be applied. These potential areas include previously disturbed areas on the Clarence pit top and rehabilitation sites. The investigation will be completed during the 2013 reporting period.

2.6.3 Oil and Grease Containment and Disposal

Clarence Colliery utilises oil and grease handling and recovery systems for oil evacuation at workshops to waste oil tanks which are emptied by a licensed contractor. The handling and recovery systems prevent the entry of waste oil into the water system. There were no changes to oil and grease handling during the reporting period.

Clarence collects liquid waste oil, oily rags and oil filters from the workshop and CHPP for recycling and disposal. Total quantities of packaged and liquid oily waste recycling in 2012 are presented in **Figure 2** and **Figure 3** below.

All oily waste was tracked in accordance with *Protection of the Environment Operation (Waste) Regulation.*

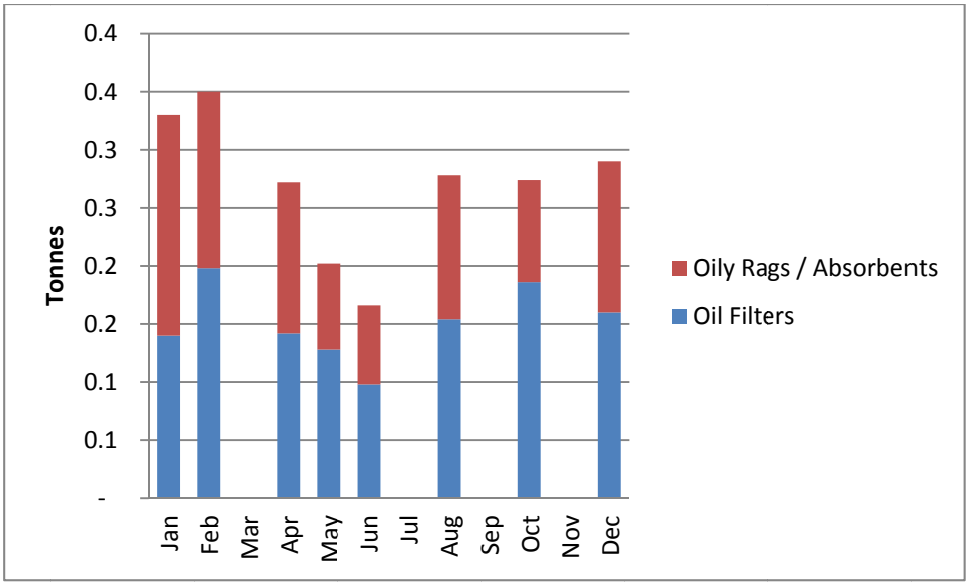

Figure 2 Packaged Oily Waste Recycling 2012

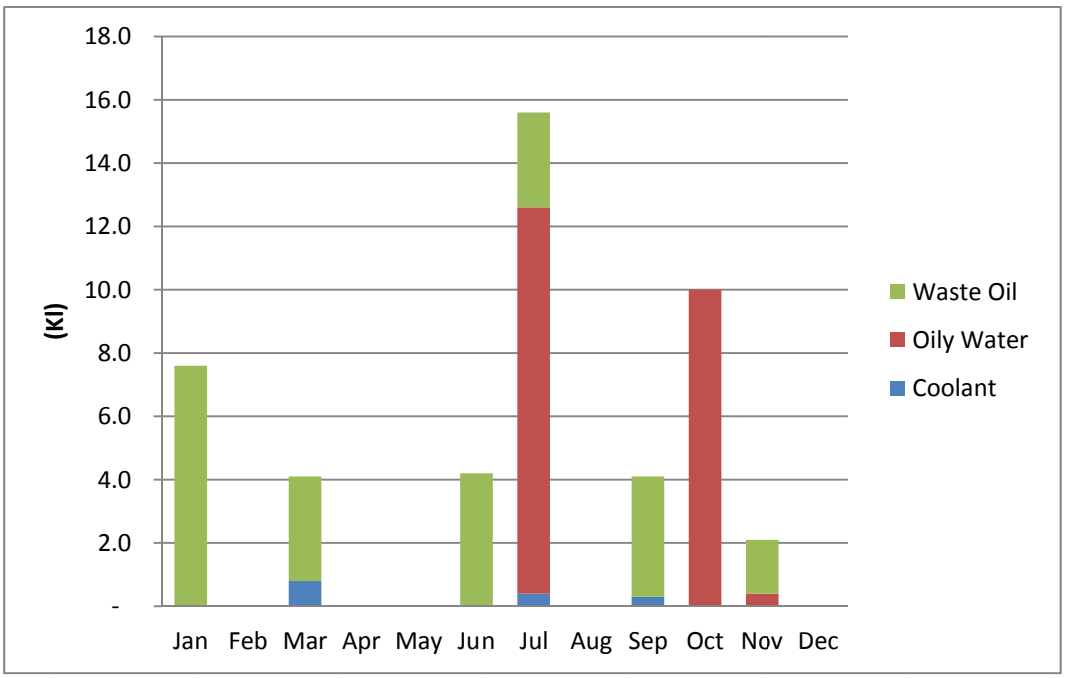

Figure 3 Liquid Oily Waste Recycling 2012

2.7 Ore and Product Stockpiles

Raw coal production from the underground mine is transported by conveyor to the 1000 tonne underground storage bin using covered and enclosed conveyor belts.

Coal is delivered from the underground storage bin to the surface by conveyor. Run of mine (ROM) coal is initially passed over a 100 mm vibrating scalping screen. Oversize from the scalping screen passes to the rotating Bradford Breaker where the coal is reduced in size to a nominal <100 mm size range and rock and timber are removed.

The ROM stockpile area has a capacity of 300,000 tonnes. The eastern half of the ROM stockpile area contains an automatic understack coal reclaim system that can extract ROM coal from the stockpile and direct it to the train-loading bin. The western half of the ROM stockpile has an understack coal reclaim system which supplies coal to the CHPP as required.

The eastern stockpile has a capacity of approximately 300,000 tonnes. This area is used for washed product and is also used for screened coal stockpiles. There were no changes to the management of ore and product stockpiles during the reporting period.

2.8 Water Management

Water Management at Clarence is managed in accordance with a Water Management Plan approved by DP&I. A schematic showing water flows around the Clarence site is attached in **Appendix 1**.

Clarence reviewed the Water Management Plan during the previous reporting periods. The review included updating the Plan in accordance with applications and approval conditions of the Outbye and 700 Area SMP's. Following consultation with regulatory bodies, DP&I approved the Water Management Plan on 25th June 2012.

Clarence undertook specific changes to the water management system during the reporting period supporting continuous improvement. Changes made to the water management in 2012 are described throughout **Section 2.8** below.

Clarence supplies water to the LCC through the water transfer scheme outlined in **Section 2.8.6**. Clarence continued to work with LCC during the reporting period.

2.8.1 Water Management Strategy Team

During the reporting period Clarence established a Water Strategy Team to improve the Clarence Water Management System through a whole of mine approach. The team included representatives from all departments and met on a monthly basis to identity, assess and schedule improvement projects. Significant improvements to the water management system were completed including:

- Increased monitoring of the quality and quantity of underground water and improved water accounting;
- Increased monitoring of the quality and quantity of surface water and improved water accounting;
- Improved use of surface water management infrastructure including the B thickener, primary arrestor and grit traps for primary water treatment;
- Optimisation and upgrades to the Clarence Mine Water Treatment Plant;
- Improved monitoring systems at the Clarence Mine Water Treatment Plant to prevent licence exceedences;
- Improved leachate management including the enlargement of leachate capture dams and the separation of surface and leachate water sources; and
- Sediment basin review completed;

Water Strategy Team Meetings will continue during the 2013 reporting period with focus on the following:

- Improving redundancy in the water management system;
- Ongoing monitoring of surface and underground water quality and quantity;
- Continued improvements and optimisation of the Mine Water Treatment Plant; and
- Improvements to underground water delivery

2.8.2 Water Supply and Use

Clarence is not connected to the Lithgow township potable water system. Water on site is captured in rain water tanks or treated mine water. Primary contact water is sourced from a number of treated water tanks located on the site. The approximate consumption of bathhouse water was 9ML.

The installation of additional metering on the surface, underground and CHPP have resulted in significant improvements in the site water balance. Site water usage and transferred is measured on a daily basis and the site water balance calibrated monthly.

The consumption of process water (inclusive of water used in the mine, CHPP, WTP process water and for dust suppression) was 837ML in 2012. A breakdown of the total process water used in 2012 is outlined below in **Table 7.**

Table 7 Process Water Supply 2012

Area	Supply 2012 (ML)
Underground	126
CHPP	511
Other Surface (Pit Top, administration)	200
TOTAL	837

2.8.3 Groundwater Management

Clarence is licensed to dewater the mine for safety reasons under dewatering licences issued by the NSW Office of Water (NoW). The underground workings are dewatered via two boreholes on the northern extent of the surface infrastructure. Water is transported from the dewatering boreholes by an overland pipeline for each borehole to the water treatment plant for treatment and release off site through Licensed Discharge Point 2. During 2012 the overland pipes were replaced with new larger diameter pipes that improved the energy efficiency of mine dewatering.

With the completion of extraction in the north-eastern portion of CCL705, dewatering is no longer required in this area and water has been allowed to remain within the Katoomba seam in this area of the mine. In March 2012, water reached a pre-determined level within the mine and dewatering resumed so as to prevent ingress to the eastern areas of ML1583 (800 area).

The recommencement of pumping from the north-eastern portion of the mine increased mine dewatering volumes for 2012 by approximately 80% compared with 2011. As a result of the increase in volumes pumped to the surface, the water treatment plant initially could not adequately treat the water and four EPA licence exceedances for manganese were recorded from 26th March to 3rd July 2012. The exceedances and remedial actions are discussed in **Section 2.8.5**.

2.8.4 Surface Water Management

Clarence surface water is managed in accordance with the site Water Management Plan. Run-off is collected within various dirty water and clean water management structures. A schematic of surface water infrastructure is provided in **Appendix 1**. A flow diagram water schematic is also included in **Appendix 1**. A detailed description of water management structures is provided in **Sections 2.8.4.1** through to **2.8.4.3** below. A summary of the system is subsequently provided.

All surface water runoff (excluding reject emplacement areas) is collected in the Polishing Lagoon prior to release off site through Licensed Discharge Point 2. Dirty water is settled in a series of structures including the Grit Trap, Primary Arrestor and “B” Thickener prior to release to the Polishing Lagoon.

Runoff and leachate water from reject emplacement areas is collected in either Leachate No.1 Dam or Leachate No.2 Dam. Leachate water is transferred to the underground water storage for mixing with underground mine water.

All water in the underground water storage (collected from mine water make and leachate water) is pumped through the 79 c/t and 82 c/t dewatering pumps to the

Water Treatment Plant where the water is treated before being discharged through Licensed Discharge Point 2. The Water Treatment Plant was designed specifically to remove manganese and iron from raw water. Details on the Water Treatment Plant are provided in **Section 2.8.5**.

2.8.4.1 Leachate

Leachate water originates from REA's I, II III and IV. The leachate water is collected in open drainage lines at the toe of REA I, II, III and IV. Water is transferred from the open drainage lines to Leachate Dam No. 1 and Leachate Dam No. 2. Water from each leachate dam is transferred via a pipeline to the Leachate Borehole.

The Leachate Borehole is gravity fed receiving water from Leachate Dam No. 1 and Leachate Dam No. 2. The water mixes underground in the 79 c/t and 82 c/t water storage area. The water is mixed to provide consistent water chemistry for treatment at the water treatment plant on the surface. The leachate water and underground water have different chemical properties for which the water treatment plant cannot respond to adequately without prior mixing and dilution.

Water is pumped to the surface via the 79 c/t and 82 c/t dewatering boreholes. The water is treated at the water treatment plant described in Section 2.8.5. After the water is treated it is released through LD2.

Whilst Leachate Dam No.1 and Leachate Dam No.2 are operated to be zero discharge under normal conditions, during high rainfall events these dams may discharge through Licensed Discharge Point 3 and 4 respectively. During the reporting period Licensed Discharge Point 4 did not discharge and Licensed Discharge Point 3 discharged on one occasion following rainfall events.

Following heavy rainfall during March 2012, de-silting of Leachate Dam No.2 occurred during the year to maximise freeboard and settling times.

2.8.4.2 Main Dam

The Main Dam is a storage dam located on the Wollangambe River and has a maximum holding capacity of approximately 70ML. Licensed Discharge Point 2 flows into the Main Dam. The dam is used as a source of water for underground operations, fire water, process water for the CHPP and water treatment plant and it supplements Lithgow's water supply (described in Section 2.8.6 below).

2.8.4.3 Stored Water

The stored water at the beginning and end of the reporting period are presented in **Table 8**. It should be noted that these values are estimates only.

Table 8 Water Storage 2012 Reporting Period

Area	Beginning of Reporting Period (ML)	End of Reporting Period (ML)	Capacity (ML)
Clean Water			
Polishing Lagoon	16.7	16.7	16.7
Main Dam	70.0	70.0	70.0
Processed Water Tank (1)	3.5	1.5	4.5
Dirty Water			
Grit Trap	1.0	0.5	1.0
Settling Pond	3.2	3.2	3.2
Leachate Dam 1	3.0	1.0	3.0
Leachate Dam 2	1.0	<0.5	3.0
Primary Arrestor	1.5	<0.5	3.0
A Thickener	1.8	1.8	1.8
B Thickener	1.8	1.8	1.8

2.8.5 Clarence Colliery Water Treatment Plant

The Clarence Colliery Water Treatment Plant was upgraded in 2004. The water treatment plant treats the mine water through aeration, chemical dosing and dissolved air flotation (DAF).

The treatment plant operates primarily to reduce filterable manganese and iron levels in the water. Levels of manganese and iron are not process additives but are found naturally occurring in local groundwater and streams.

After recovery from the underground mine workings, raw mine water (along with leachate water) is directed into an aeration tank where lime and potassium permanganate are added immediately prior to aeration to raise the pH of the water and oxidise dissolved metals. This has the effect of precipitating iron and manganese. A surfactant and polymer are added for the coagulation/flocculation process on the way to the flocculation tank.

Water leaves the flocculation tank and enters the DAF tank. As the water enters the DAF tank, the flocculants are carried to the surface by small bubbles of air and forms a sludge blanket. The sludge blanket is automatically swept into a sludge tank/hopper that is located internally within the DAF. Sludge is then pumped to a drying pond within the Reject Emplacement Area. The treated water is then adjusted for pH with sulphuric acid and released off site through LD2.

In March 2012, the recommencement of pumping from the north-eastern portion of the mine combined with the increased water make led to a significant increase in mine dewatering volumes as discussed in **Section 2.8.3**. The water treatment plant initially could not adequately treat the water and four EPA licence exceedances for manganese were recorded from 26th March to 3rd July 2012. Changes to the water treatment plant were made to handle the increased volumes and altered water chemistry. The changes included an upgrade to the lime dosing system, alteration of dosing rates and an increase in sludge removal rates. These changes were successful and the water treatment plant was able to meet EPA licence limits from 3rd July onwards.

2.8.6 Clarence Water Transfer Scheme

Clarence has an agreement with Lithgow City Council (**LCC**) to provide water from the Main Dam to supplement Lithgow's water supply. LCC pump water from the Main Dam at Clarence to a designated LCC tank, following provision of water for the Colliery. LCC manage the pumping of water from the tank to settlement ponds on the Newnes Plateau, which transfer water into the Lithgow No. 2 Dam (Farmers Creek Dam) under a Surface Authority held by LCC.

LCC had not taken water for a number of years due to the higher rainfall during this time. In November 2012, LCC re-commenced transferring water and approximately 56 ML during November and December 2012.

LCC is working to upgrade the water transfer scheme in accordance with terms of an agreement with the Federal Government. LCC has approval to upgrade the existing water transfer scheme and Clarence will assist with the upgrade where required throughout 2013.

2.9 Hazardous Material Management

The Dangerous Goods Licence 35/020999 was renewed on 15th March 2012. The licence covered two above ground self-bunded diesel tanks and an above ground sulfuric acid tank.

The Clarence Dangerous Goods and Hazardous Substances Management Plan provide guidance for the purchase, storage, use, handling and disposal of Hazardous Substances at Clarence Colliery. A dangerous goods audit of the dangerous goods stored on site in accordance with the current Australian Standards was also completed during the reporting period.

2.10 Other Infrastructure Management

2.10.1 Facility Alterations

Three new fire tanks were installed during the reporting period. These tanks will take water directly from the Clarence water treatment plant resulting in significant energy savings as discussed in **Section 3.20.1**.

The current surface layout and facilities are shown in **Appendix 1**.

2.10.2 Transport Alterations

There have been no changes to the product transport system from Clarence in 2012.

2.10.3 Changes in Mining Equipment or Method

Clarence implemented the fourth generation Flexible Conveyor Train (FCT) in 2010. The FCT replaced shuttle cars in one of the mining panels at Clarence. The FCT is a 110m conveyor belt that can move on track and bend to go around corners while conveying coal. An operator steers the FCT up or down the panel roadways with a radio remote control. The receiving hopper of the FCT follows the continuous miner as it cuts the coal and takes the coal through a crusher before loading it onto the flexible conveyor. The coal travels to the panel conveyor where it commences its journey to leave the mine on a series of conveyor belts.

Clarence requested an amendment for the inclusion of the FCT as new mining equipment in the 2007-2013 MOP during November 2010.

There were no changes in mining equipment or method during 2012.

3 Environmental Management and Performance

This section summarises environmental management throughout the 2011 reporting period at Clarence Colliery. A plan of environmental monitoring locations is located in **Appendix 1**.

3.1 Environment Protection Licence

Clarence is licenced by the EPA under the *Protection of the Environment Operations Act 1997* with EPL. 726. As outlined in **Section 1.1** the licence was reviewed during the 2011 reporting period and a variation issued on the 19th December 2011. The variation had reduced concentration limits for arsenic, boron, cadmium, chloride, chromium (hexavalent), copper, fluoride, lead, oil and grease, silver and zinc for water discharged from licensed discharge points. In addition the licence stated that Clarence must conduct a site specific Best Management Practice (BMP) particulate determination to identify the most practicable means to reduce particle emissions from the premises. A copy of the latest licence can be found in **Appendix 3**.

Clarence is required to complete an Annual Return detailing compliance against EPL 726 conditions for the reporting period. Clarence has provided a summary report of compliance within **Section 3.4** below and in **Appendix 3**.

3.2 Meteorological Data

Meteorological data is obtained from the Clarence Colliery meteorological station. The station was installed in accordance with *Approved Methods for Sampling of Air Pollutants in New South Wales (DECCW 2007)* during 2010 and was serviced and calibrated in 2012. Clarence notified the OEH and the DP&I in September 2010 of the installation. The meteorological station is calibrated every six months. Climate data is presented below.

3.2.1 Temperature

A summary by month of temperature for 2012 is presented in **Table 9** below.

Table 9 Average Minimum and Maximum Temperature Data

Month	Average Minimum Temperature	Average Maximum Temperature
January	12.1	21.0
February	12.4	20.6
March	10.7	18.9
April	9.0	17.5
May	4.9	13.1
June	3.7	9.3
July	2.7	9.2
August	2.2	11.0
September	4.75	15.6
October	6.9	18.3
November	10.0	21.5
December	11.1	23.02

3.2.2 Rainfall

Total annual rainfall for 2012 was 1019mm compared with 1062 mm in 2011. Rainfall data is presented in **Table 10** below.

Table 10 Rainfall recorded at Clarence

Month	Rainfall (mm) Clarence Meteorological Station
January	96.2
February	244.2
March	175.0
April	75.2
May	39.4
June	99.6
July	50.6
August	26.4
September	55.4
October	33.0
November	48.4
December	75.6
Total	1019

3.2.3 Wind Speed and Direction

The wind direction during 2012 was predominantly southerly. Average wind speed ranged from 6km/h to 8km/h. The maximum wind speed at Clarence was 70km/h in September. Wind speed data is presented in **Table 11** below.

Table 11 Average Wind speed and Direction

Month	Average Wind speed(km/h)	Max Wind speed(km/h)	Average Wind direction (deg))
January	8	49	ESE
February	6	40	SSE
March	7	47	ESE
April	6	46	SSE
May	5	67	SSW
June	7	44	SSW
July	7	42	SSW
August	8	49	WSW
September	7	70	SSW
October	8	47	SSW
November	7	50	SSE
December	7	48	SSE

3.3 Air Quality

Clarence Development Consent (DA 504-00) details the air quality criteria that are to be met by operational activities at Clarence Colliery. Clarence Environmental Air Quality Monitoring Program outlines how this is to be achieved by the operation.

Depositional dust gauges are collected on a monthly basis. Samples are analysed for insoluble solids with results reported in grams per square metre per month (g/m^2/month). The depositional dust limit stated in the Development Consent is $4g/m^2$/month on an annual average basis. This criterion is also outlined in the Environmental Air Quality Monitoring Program.

Monitoring for PM_{10} (Particulate Matter less than 10 micrometres in size) and TSP (Total Suspended Particulates) was also undertaken during the reporting period.

A review of the Air Quality Monitoring plan occurs in the first quarter of each year during the preparation of the Clarence Colliery AEMR and the Annual Return for Environment Protection Licence No.726.

In 2012 Clarence conducted a site specific Best Management Practice (BMP) particulate determination to identify the most practicable means to reduce particle emissions from the premises. A variation was applied to EPL 726 during December 2011 to include a PRP which outlined the requirement to complete a BMP. Results and Recommendations of the Dust BMP are discussed below **in Section 3.3.4.**

3.3.1 Dust performance against Environmental Impact Statement Prediction

The Environmental Impact Statement (2000) concluded that the proposed development would have no additional impact on air quality. No impact has been observed from the operation of Clarence Colliery.

Annual average insoluble solids were below 4g/m^2/month for all depositional dust gauges during 2011. Monitoring for TSP and PM_{10} also showed results well below the Development Consent criteria during 2012.

3.3.2 Review of Dust Monitoring Results

Air Quality is monitored at three locations around the perimeter of the site. The location of the monitoring sites is shown on the Monitoring Plan in **Appendix 1**. The locations of the air quality monitoring sites are:

1. Adjacent to the nearest residence, south of the Pit Top (TSP, PM10 and depositional Dust Gauge (DG) 1);
2. To the north of the Pit Top (DG2); and
3. On the entrance road to the south-west of the Pit Top (DG3).

DG3 is actually located further south-west along the entrance road, closer to Clarence village. Clarence Colliery has also commenced negotiations to relocate DG3 to private property within Clarence village itself to measure any dust impacts on nearby residences. Once the final location is agreed, the Environmental Air Quality Monitoring Program will be revised accordingly.

3.3.2.1 Dust Depositional Gauges 1, 2 and 3

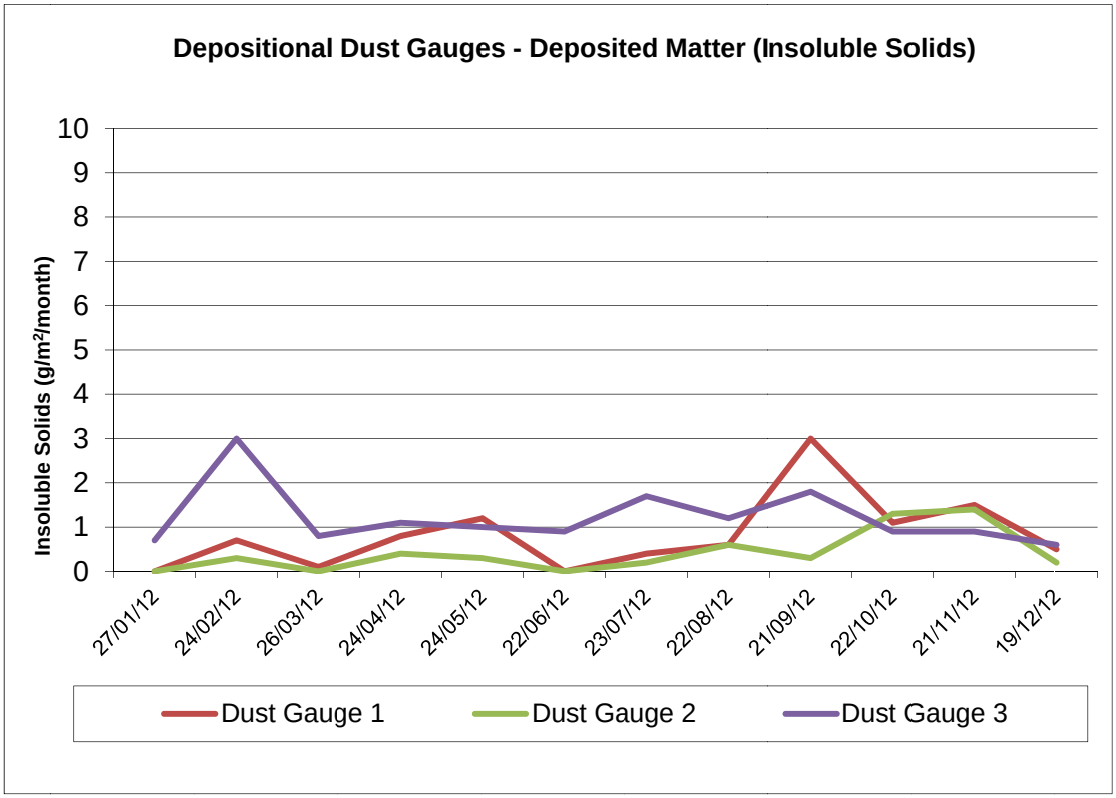

Figure 4 Depositional Dust Gauges 1, 2 and 3, 2012

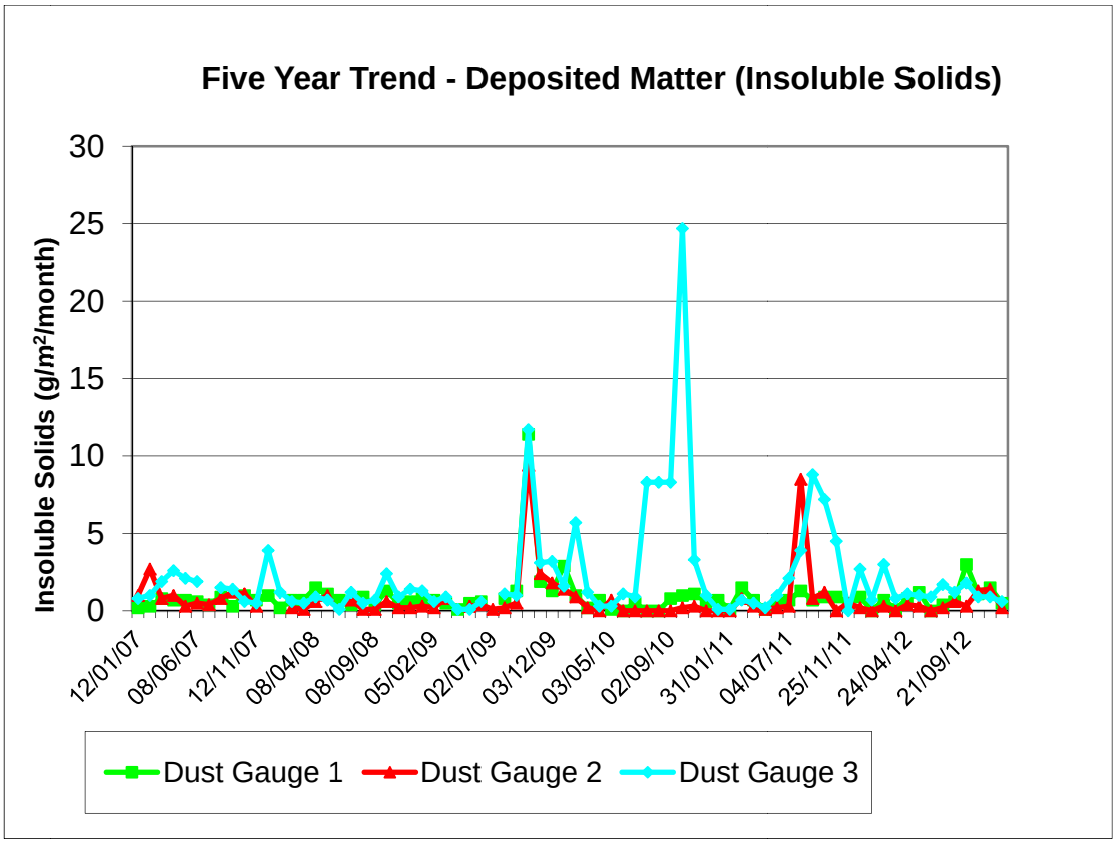

Figure 5 Depositional Dust Gauges - Six Year Trend

Dust monitoring data indicated that monthly dust deposition results for 2012 ranged from below the detection limit of 0.1 g/m^2/month to 3.0 g/m^2/month at DG 1 and DG 3. No data was recorded for DG 2 in March due to a broken sample bottle. Depositional dust gauge results for 2012 are shown in **Figure 4** with the six year trend shown in **Figure 5.**

The annual average insoluble solids for 2012 was 0.8 g/m^2/month at DG 1, 0.5 g/m^2/month at DG 2 and 1.2 g/m^2/month at DG 3. The results are all below the annual average air quality criteria of 4 g/m^2/month. The location of the dust gauges are identified as dust monitoring sites (DM1, DM2 and DM3) on the Clarence Colliery Pit Top Monitoring Locations figure, located in the document titled Environmental Monitoring Program.

3.3.2.2 TSP/PM_{10}

Monitoring for PM_{10} (Particulate Matter less than 10 micrometres in size) and TSP (Total Suspended Particulates) occurred during the reporting period as required under the Clarence Development Consent and the Environmental Air Quality Monitoring Program. A summary of monitoring results is provided below. No exceedances were recorded during the reporting period for measured maximum 24 hour average PM_{10} concentrations (criteria limit of 50 µg/m^3) or the average annual TSP (90 µg/m^3). The location of the TSP and PM_{10} monitoring site is identified on the Clarence Colliery Pit Top Monitoring Locations figure, located in the document titled Environmental Monitoring Program under the Management Plans section of the Clarence Colliery area of the Centennial website. TSP and PM_{10} monitoring is required to take place two times per year with each sample taken on every 6th day for a period of a month.

Following the review of data from the first period of monitoring, there was found to be erroneous data recorded by the E-sampler during 4 days during the first period of monitoring.

The E-sampler was sent for diagnostics and additional calibration in July 2012. It was found that the heater in the e-sampler was malfunctioning. The unit was repaired, tested and calibrated before being used for the second period of monitoring.

The results of the monitoring program are displayed in **Figure 6, Figure 7, Figure 8** and **Figure 9**.

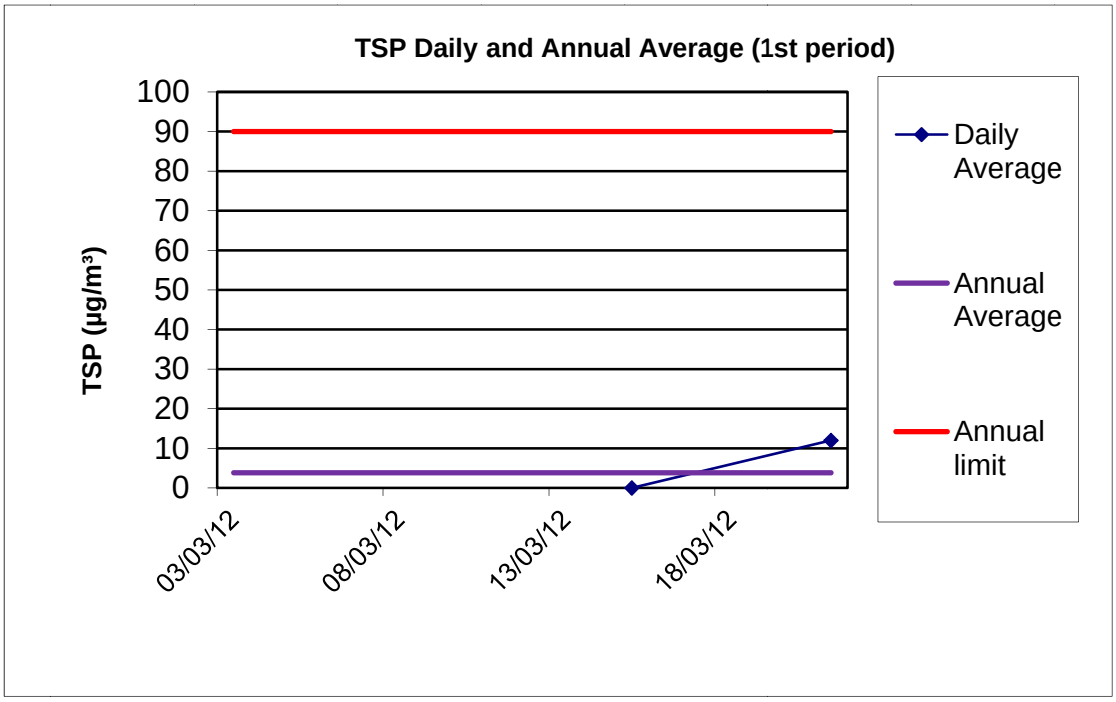

Figure 6 TSP daily and annual average, 1 period

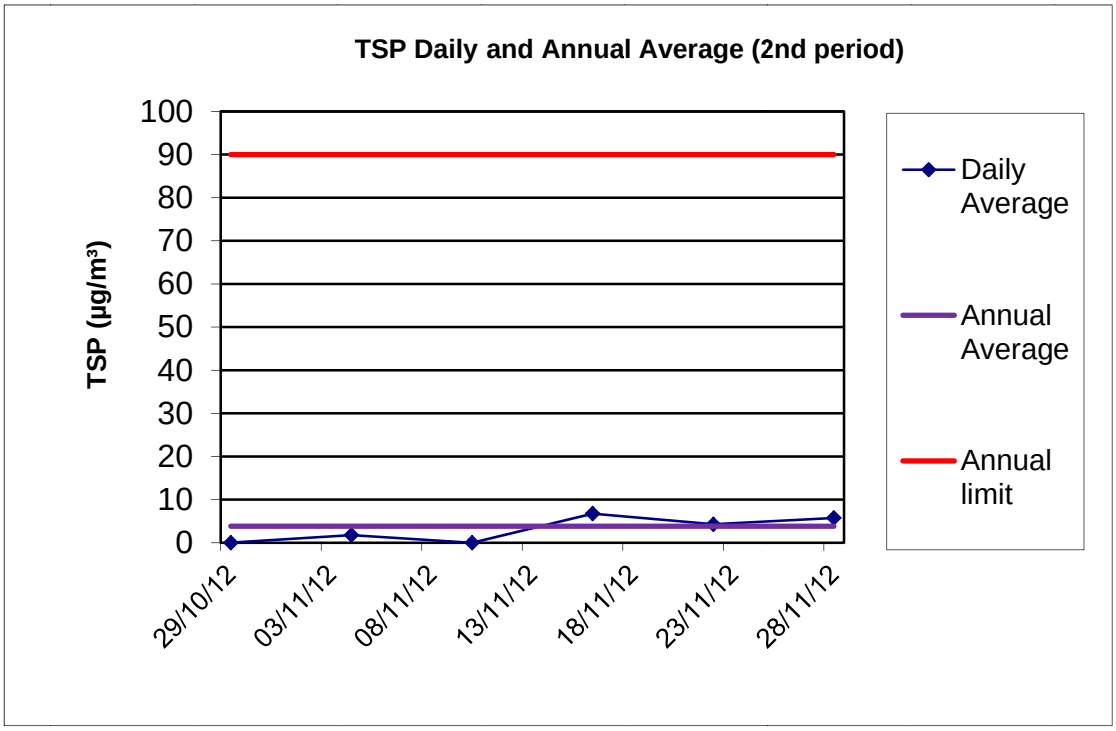

Figure 7 TSP daily and annual average, 2 period

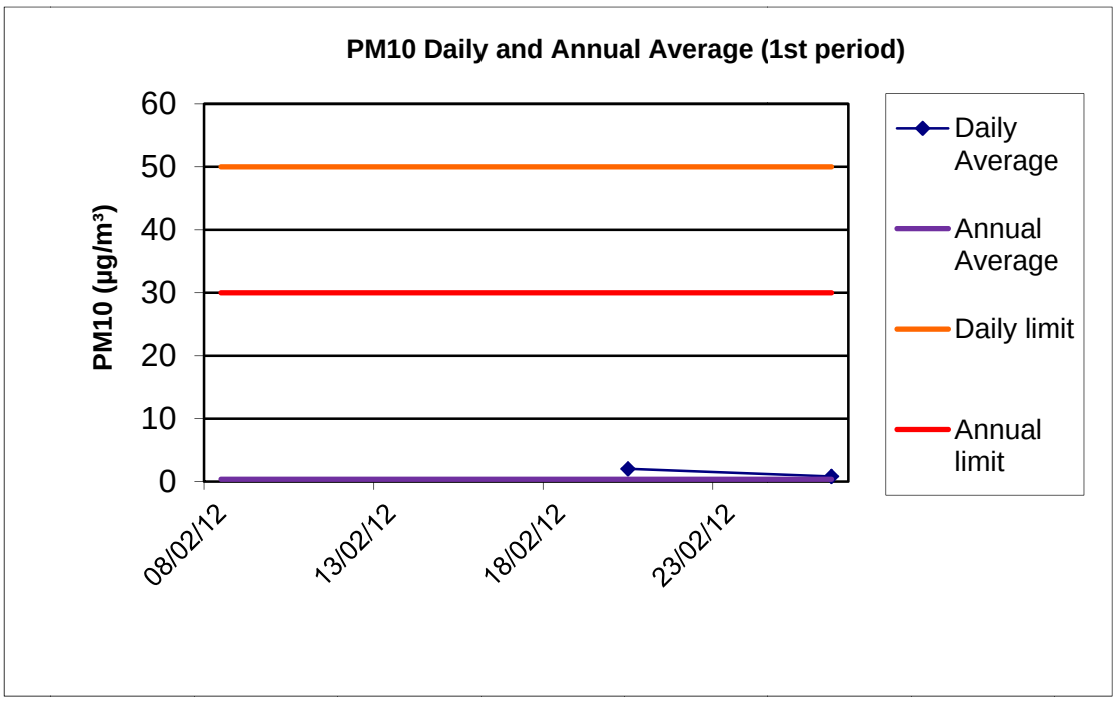

Figure 8 PM10 daily and annual average, 1 period of monitoring 2012

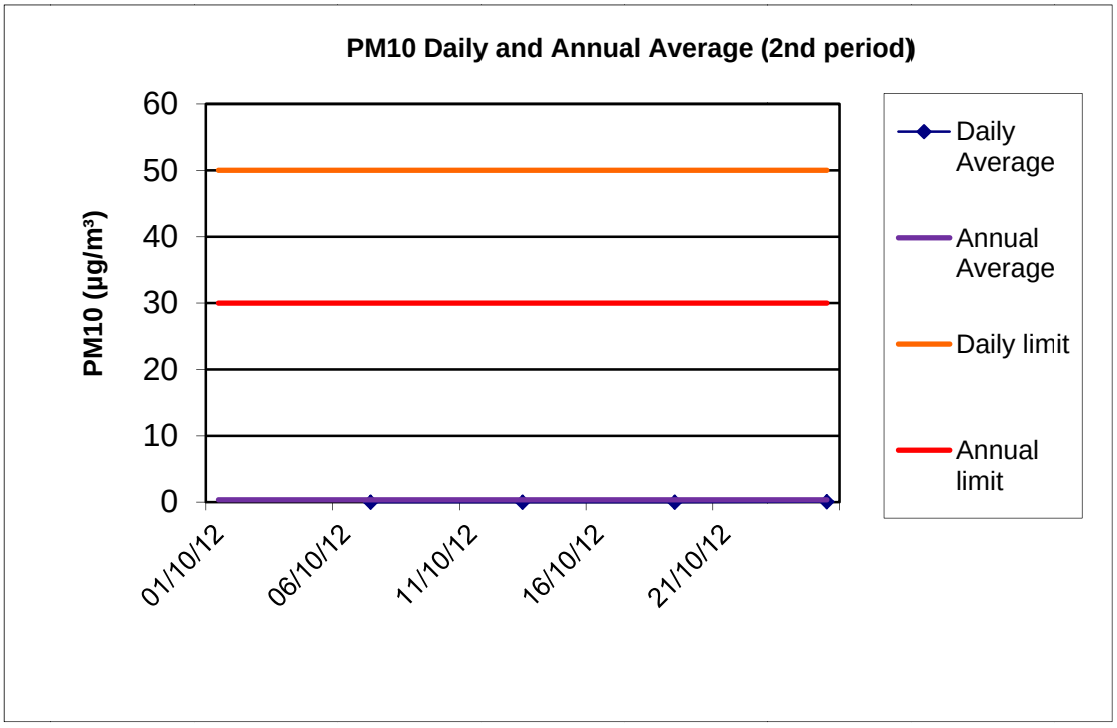

Figure 9 PM10 daily and annual average, 1 period of monitoring 2012

3.3.3 Control Measures

Conveyors from the underground coal workings are enclosed to prevent dust generation on route to the main stockpile at the Coal Handling Preparation Plant (CHPP). Sprinklers are positioned on gantries above the main stockpile and are used if conditions are windy to suppress dust on stockpile areas.

Dust generation around the CHPP and stockpile areas are managed using a water cart and/or fixed sprinklers (**Figure 10** and **Figure 11**). Throughout the reporting period, this control strategy has proved to be adequate to manage dust emissions.

Figure 10 REA Haul Road Sprinklers

Figure 11 Water Cart in use at Clarence Colliery REA IV

Dust generation from the Pit Top areas was considered a medium environmental risk, particularly, during dry and windy days. A road sweeper from Lithgow City Council is utilised to sweep the pit top monthly, reducing the volume of material potentially available to be mobilised to form airborne dust.

3.3.4 Dust BMP Particulate Determination

In 2011, the EPA required, through a Pollution Reduction Program, that Clarence Colliery provide a report which examines in detail the potential measures which could be employed to further reduce particulate emissions from the mine. This is part of a larger program which aims to reduce particulate emissions from the coal mining industry as a whole in NSW.

Emissions were required to be quantified using United States Environmental Protection Agency approved emission factors without controls applied. Emission controls currently in place at Clarence Colliery were identified, and the control efficiency afforded by each applied measure, obtained through a literature review and site specific data were applied to these emissions.

Particulate emission sources were ranked according to the scale of emissions over a one year period with sources contributing to 95% of total site TSP emissions identified and taken forward for further assessment. The assessment required that additional controls were investigated, and the feasibility of implementing each control option was assessed with consideration to implementation costs, regulatory requirements, environmental impacts, safety implications and compatibility with current processes and any proposed future developments.

Clarence completed the Dust Best Practice Particulate Determination and submitted to the EPA on the 28th September 2012.

Emission rates for coal stockpiles are based on generic US EPA emission factors for coal stockpiles which do not take into account the moisture content of coal. Clarence Colliery believes, through long-term experience that dust emissions from coal stockpiles and reject emplacement areas are reduced significantly due to the moisture content of the coal. It is therefore proposed by Clarence Colliery to perform a series of tests of ROM coal, Washed Coal and Rejects to determine the propensity for dust generation through appropriate testing (e.g. Dust Extinction Moisture (DEM)). This will allow an assessment of the likelihood of wind erosion more accurately than using generic emission factors.

Site specific testing will also allow more targeted dust mitigation strategies to be designed (e.g. Specific meteorological conditions under which water spraying is initiated) to minimise dust emissions from the site. Clarence Colliery proposes the following actions:

- Commence watering of stockpile pads (no chemical suppressants) within 3 months of the submission of the Dust BMP report.
- Assess stockpile and reject dust propensity (e.g. DEM) by 30 June 2013. Results will be submitted to EPA to provide details of the DEM of coal and rejects, and the wind erosion potential of each source. If the report indicates stockpiles and reject material are not conducive for dust generation no further action will be taken. If results indicate further action is required stockpile sprays will be commissioned.
- Investigate REA III options and submit to the EPA within 12 months of the submission of this report. Potential options include watering, rehabilitation, bunding and shaping.

3.3.5 Air Quality Impact Assessment

In response to a comment raised by the DP&I regarding the validity of historic site air quality data during the 2011 AEMR review Clarence will complete an Air Quality Impact Assessment in 2013 to update its current Air Quality Model and also the determine impacts (if any) of the proposed new Reject Emplacement Area. The assessment will include:

- A review the terrain and topography and identify surrounding sensitive receptors and land uses in all directions in relation to potential air quality impacts.
- Identify all air pollutants likely to be generated, including dust, TSP, PM10 and PM2.5,
- Obtain any existing air quality monitoring data for the estimation of background concentrations of pollutants including Deposited Dust, PM10 and TSP.
- Establish air quality goals for all relevant air quality emissions in accordance with the NSW OEH *"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales" (2005)* and other relevant legislation.

- Confirm operational scenarios including quantities, timelines, equipment inventory (both fixed and mobile), particulate control equipment, location of airborne pollutant generating activities and activity rates.
- For each potential source of particulate emissions, estimate emission rates, primarily using emission inventory data, including the National Pollutant Inventory (NPI) Emission Estimation Technique Manuals and, USEPA AP=42 Emissions Inventory documentation, as required.
- Using an appropriate atmospheric dispersion model, conduct predictive modelling to predict a maximum of four (4) target pollutants based on calculated emission factors. Predictions will be made to a maximum of 6 residential receivers.
- On the basis of the compliance goals established for the project, assess predicted impacts and recommend mitigation treatments where appropriate.
- Concentration isopleths will be presented to provide an overall indication of extent of impact (if any).

3.4 Surface Water

The Water Management Plan required under DA 504-00 and prepared in consultation with relevant government agencies, was originally approved by the then Department of Planning on the 25th July 2007. The latest version was approved by DP&I on 25th June 2012 following consultation with relevant government agencies.

During 2012 four exceedances of the filterable manganese limit occurred for LD2 from 26th March to 3rd July. The exceedances were a result of increased mine water discharge as discussed in **Section 2.8.3**. Clarence made significant improvements to the WTP and since 3rd July 2012 no filterable manganese exceedances have been recorded. As a result of the exceedances, the EPA issued Clarence Colliery with a Penalty Infringement Notice (PIN) on 5th November 2012

In 2011, Clarence had an incident where coal fines were identified within a man-made drainage channel connected to the south eastern most portion of the washed coal stockpile area. Clarence made an informal self-report to the Department of Environment, Climate Change and Water (DECCW, now OEH) on the 11th March 2011. An Official Caution was issued by DECCW on the 16th March 2011.

In response to the incident Clarence immediately installed a rock drain at the coal stockpile and sediment fences were installed downstream of the rock drain. Inspections take place twice-weekly to assess the operation of the sediment fences, and identify any deposits of coal fines and water flow in the general area. The twice-weekly inspections are created and recorded in the Clarence work order system. Any maintenance works are undertaken as required, again using the Clarence work order system.

Further construction activity was undertaken in May 2011 diverting the drainage line entering the hanging swamp to direct water to Leachate No.2 Dam in accordance with the development of Reject Emplacement Area (REA) IV. A Pit Top ecological due diligence survey was completed in December 2011 to identify the location and condition of other swamps around the Pit Top areas.

Clarence engaged a consultant to undertake remediation works in the swamp. A proposal has been developed and Clarence is now in the process of preparing a referral. During the 2012 reporting period Clarence engaged a consultant to outline the methods which would be used during the rehabilitation of the swamp. This will form the basis of a referral to the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) to determine if a formal assessment and

approval under the *Environment Protection and Biodiversity Conservation Act 1999* is required for the rehabilitation works.

Monitoring results for water sampling completed at the licensed discharge points are described below.

3.4.1 Monitoring and Performance Criteria

Clarence monitors surface water discharge from its licenced discharge points according the conditions set out in Environmental protection Licence (EPL) 726. The criteria for discharge water quality are outlined below in **Table 12.** A copy of EPL 726 is available in **Appendix 3**.

Table 12 EPL Licence Limit Parameters

Parameter	EPA Licence Limit
pH	6.5-8.5
Total Suspended Solids (mg/L)	30
Oil and Grease (mg/L	10
Arsenic (mg/L)	0.01
Boron (mg/L)	0.1
Cadmium (mg/L)	0.001
Chloride (mg/L)	25
Chromium VI (mg/L)	0.01
Copper (mg/L)	0.02
Filterable Iron (mg/L)	0.3
Filterable Manganese (mg/L)	0.5
Fluoride (mg/L)	1
Lead (mg/L)	0.005
Mercury (mg/L)	0.001
Selenium (mg/L)	0.01
Silver (mg/L)	0.001
Sulfate (mg/L)	250
Zinc (mg/L)	2.5

3.4.2 Results

3.4.2.1 Water performance against EIS Prediction

The Environmental Impact Statement (2000) identified the process of water extraction from the underground, treatment in the water treatment plant and discharge through LD2 as the main potential impact. Clarence had five exceedances at LD2 during 2012 that were associated with the process of treating mine water prior to discharge offsite through LD2. On the 8th March 2012 the Total Suspended Solids (TSS) at LD2 was 46 mg/L, greater than the 30 mg/L EPA licence limit. Between 26th March and 3rd July 2012, filterable manganese exceeded the 0.5 mg/L EPA licence limit on four occasions with the maximum result being 1.35 mg/L on 26th March. The TSS exceedence was a result of heavy rainfall and the filterable manganese exceedances a result of inadequate treatment by the water treatment plant.

There was one discharge event at LD3 on 8th March 2012. On this occasion exceedances were recorded for pH, TSS, cadmium, filterable manganese and zinc as shown in **Table 13** in **Section 3.4.2.21**.

LD4 did not discharge during the reporting period.

Environmental monitoring results for water samples collected at LD2 and LD3 are presented below. LD2 discharged treated water regularly during 2012 and the monitoring results are presented in graphs for the reporting period. LD3 discharged water on only one occasion; hence the monitoring results are presented in a table. LD4 did not discharge during the reporting period.

Note that all results less than the detection limit are shown as zero in the graphs.

3.4.2.2 pH LD2

The pH at LD2 remained within the 6.5-8.5 EPA licence limit during the reporting period.

Monitoring results for pH at LD2 are presented in **Figure 12**. The long term trend (**Figure 13**) indicates pH generally within the 6.5-8.5 pH range.

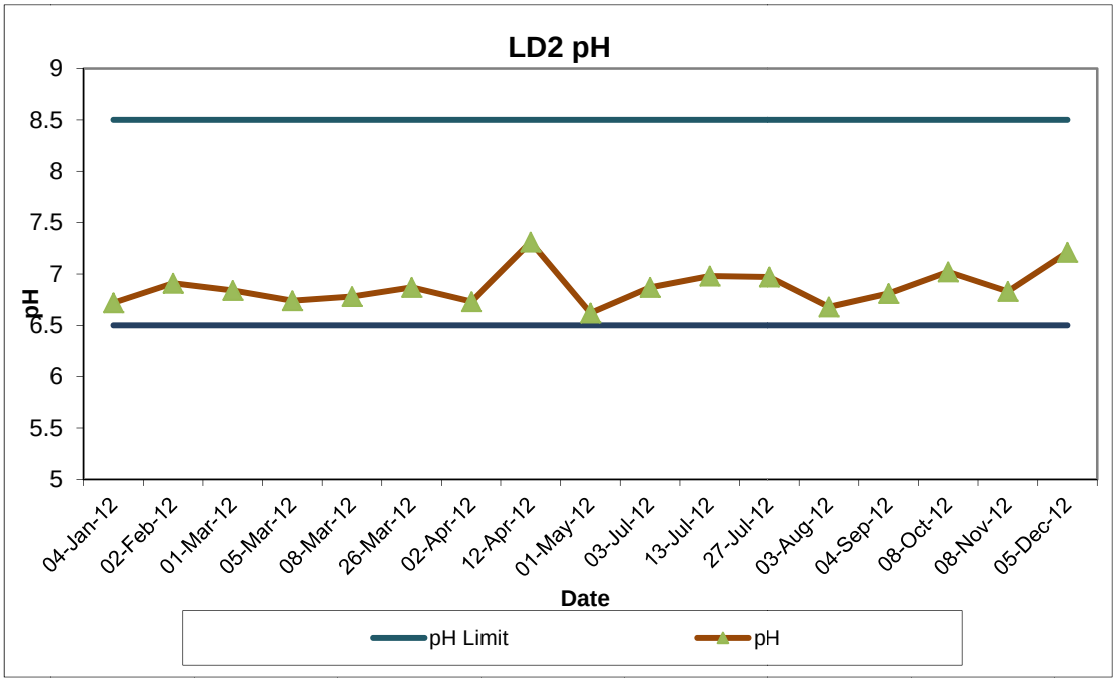

Figure 12 pH LD2 2012

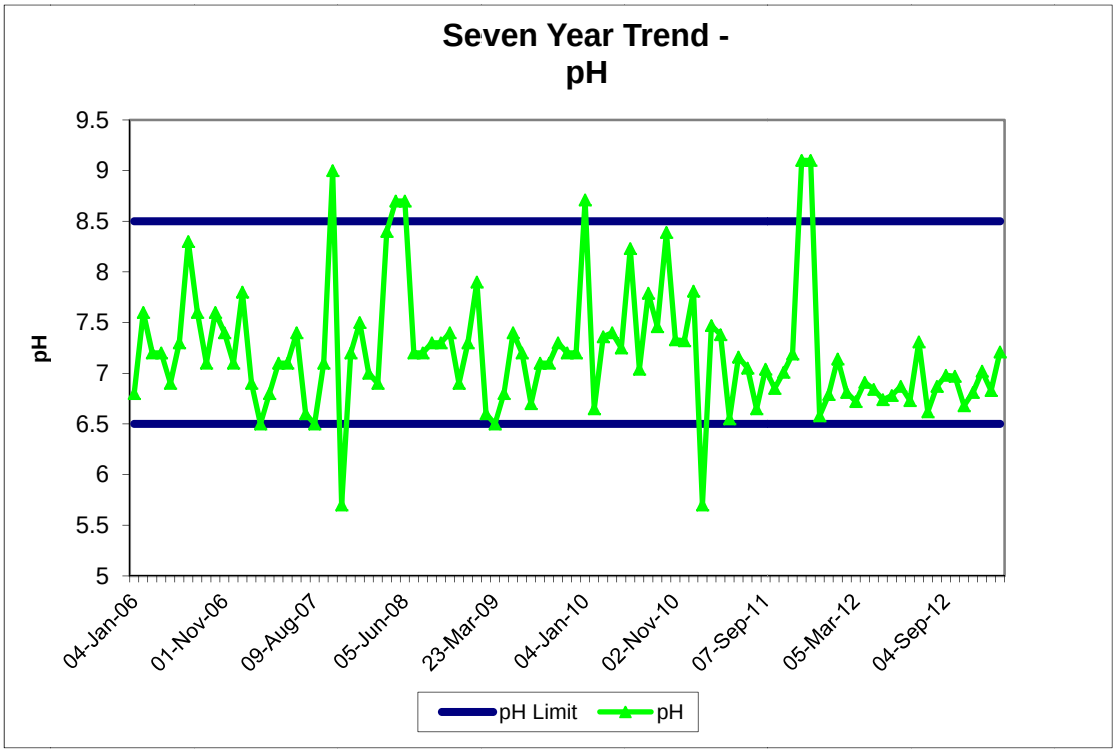

Figure 13 pH LD2 Seven year trend

3.4.2.3 Total Suspended Solids LD2

Total Suspended Solids (TSS) results for LD2 during the reporting period were generally below the 30 mg/L licence limit except for one discharge event on 8th March 2012 where 46 mg/L was recorded. There was 49mm of rainfall in the 5 days preceding the discharge.

In response to the TSS exceedance on 8th March 2012, further improvements were made to the surface water management system to better utilise existing water control structures. These improvements proved effective for the remainder of the reporting period with no further TSS exceedances recorded.

Monitoring results for TSS at LD2 are presented in **Figure 14** below**.** The long term trend (**Figure 15**) indicates TSS generally remains well below 30mg/L but with an occasional spike related to rainfall events.

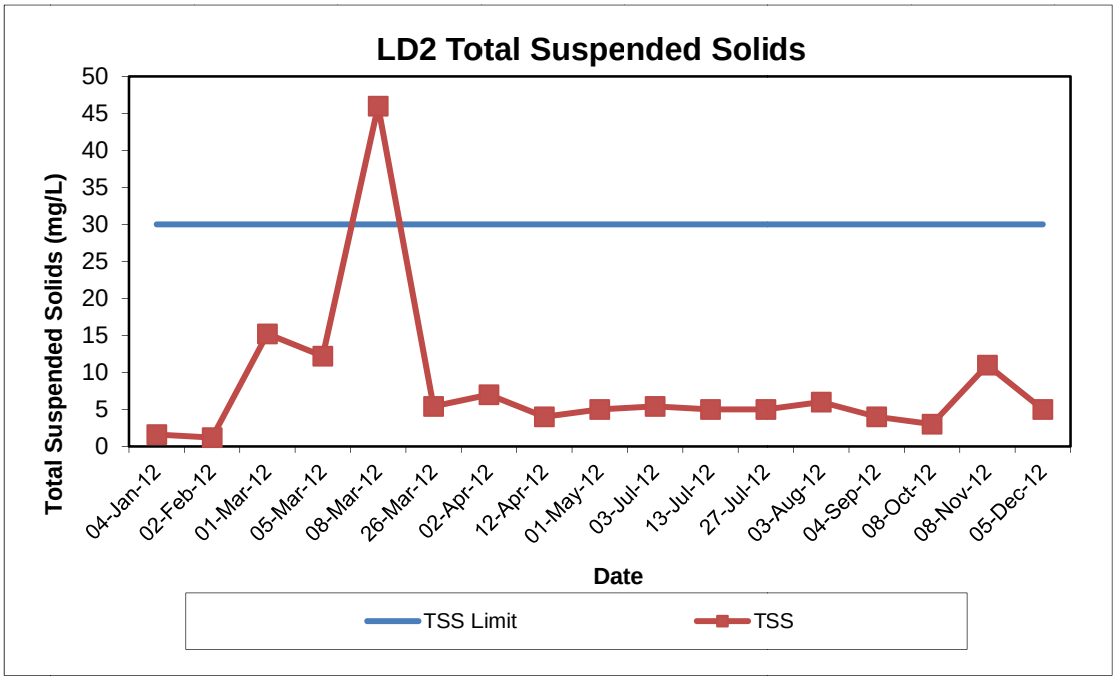

Figure 14 Total Suspended Solids LD2 2012

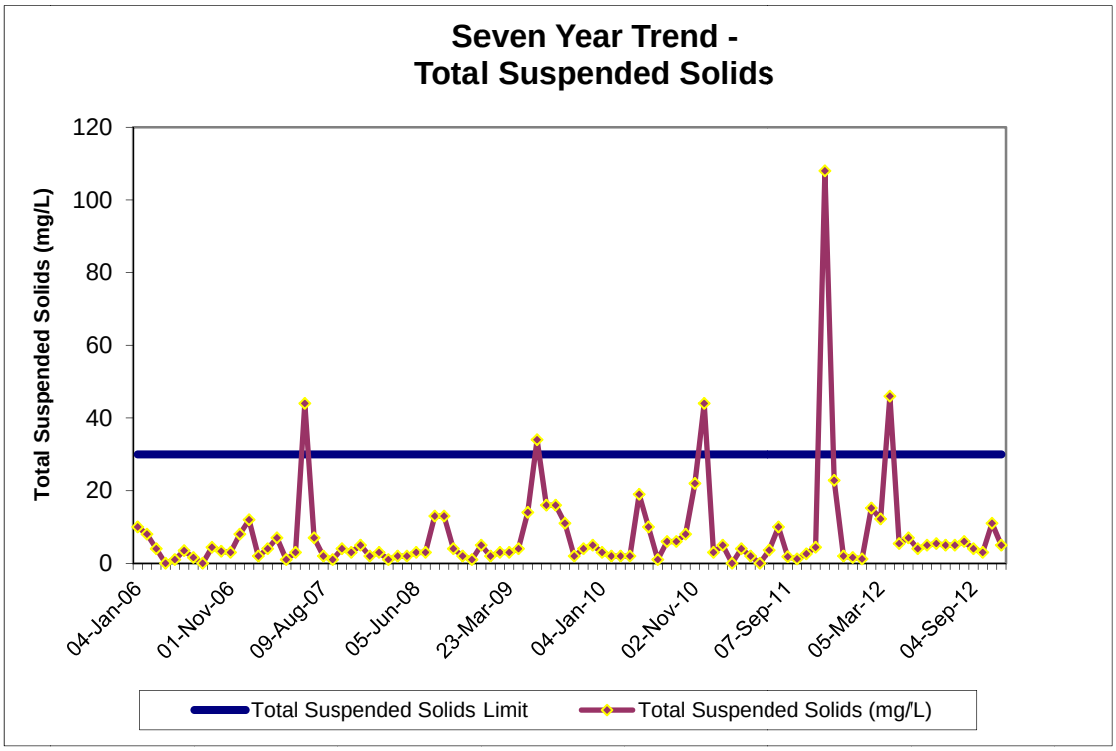

Figure 15 Total Suspended Solids LD2 Seven year trend

3.4.2.4 Oil and Grease LD2

Oil and Grease results for discharged water sampled at LD2 during the reporting period were below the prescribed limit (10mg/L) in EPL 726 and below the detection limit (5mg/L) on all occasions.

Monitoring results for oil and grease at LD2 are presented in **Figure 16** below. The long term trend is shown in **Figure 17**. The Oil and Grease limit was reduced from 20 mg/L to 10 mg/L on 19th December 2011. **Figure 16** indicates Oil and Grease has remained below 10mg/L.

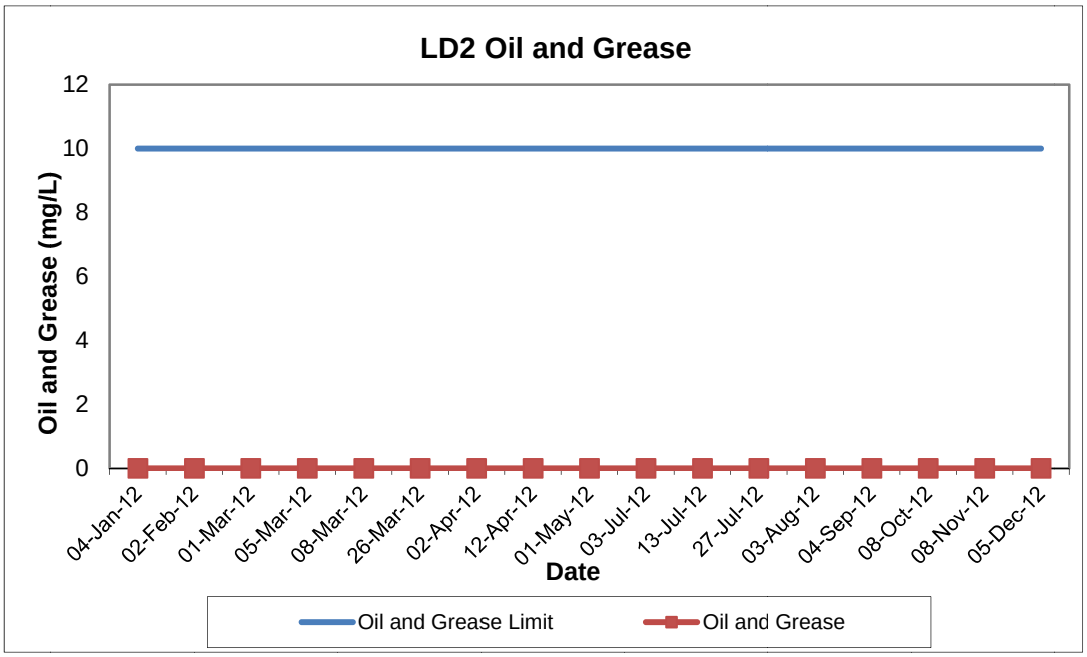

Figure 16 Oil and Grease LD2 2012

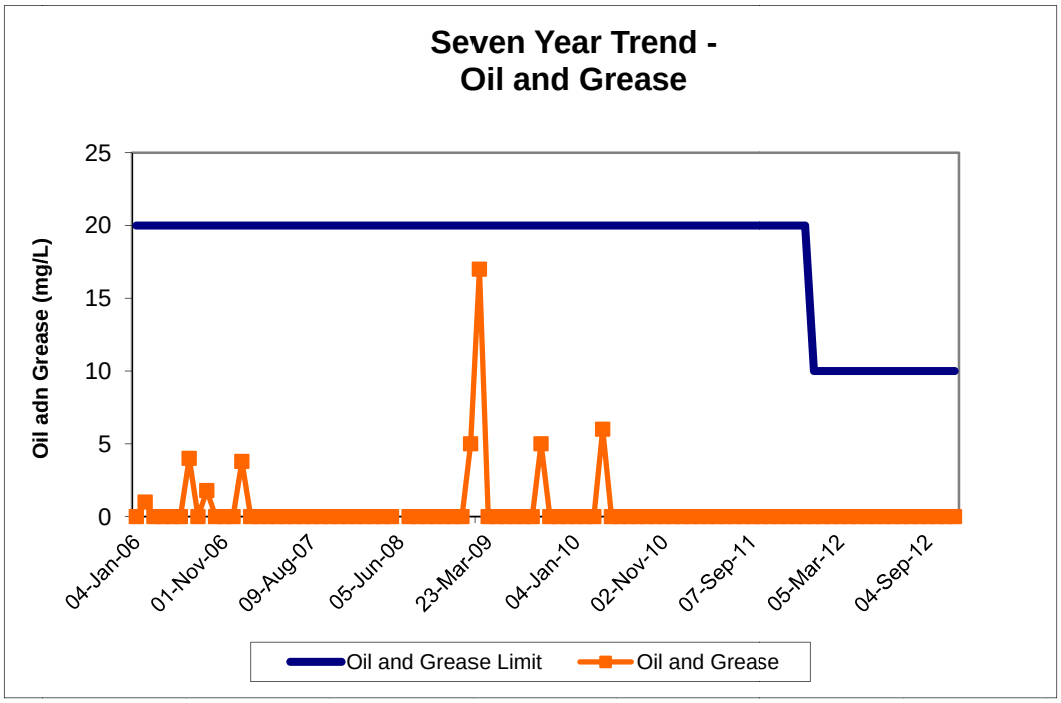

Figure 17 Oil and Grease LD2 Seven year trend

3.4.2.5 Filterable Manganese LD2

Four exceedances of the 0.5 mg/L filterable manganese limit occurred during 2012. The exceedances were a result of increased mine dewatering volumes and the Water Treatment Plant being unable to meet required discharge limits. As discussed in **Section 2.8.5**, modifications to the Water Treatment Plant improved the performance and no exceedances were recorded since 3rd July 2012.

Monitoring results for filterable manganese at LD2 are presented in **Figure 18** and **Figure 19** below. Note that the filterable manganese limit was varied in the EPL on 10th December 2010, hence the limit change on the graph.

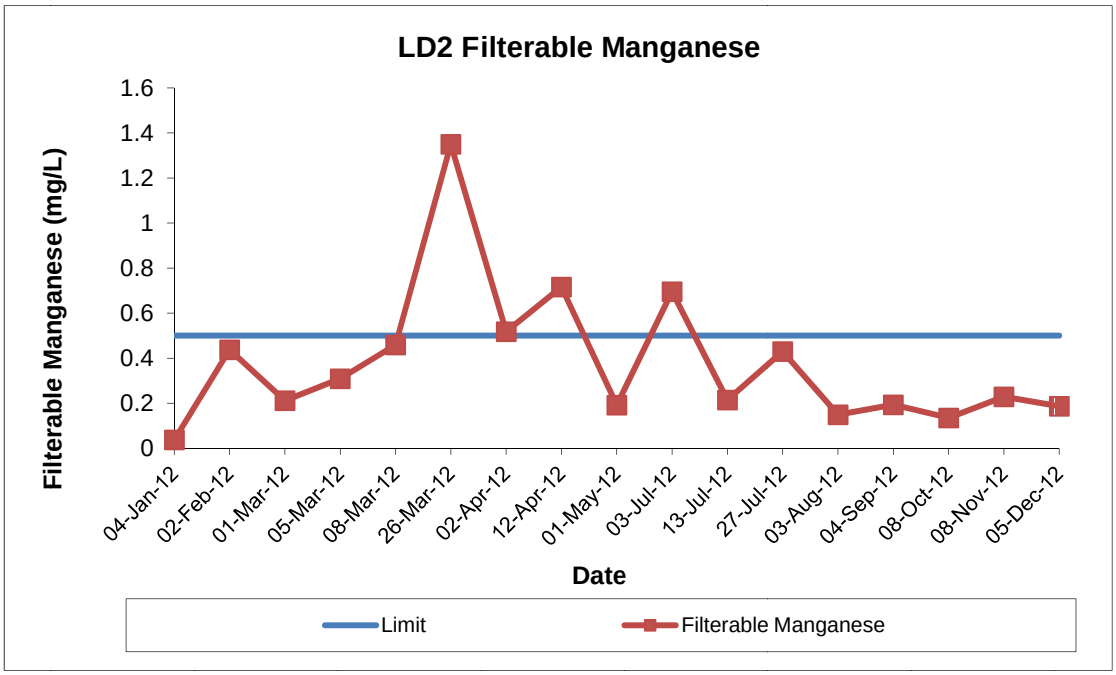

Figure 18 Filterable Manganese LD2 2012

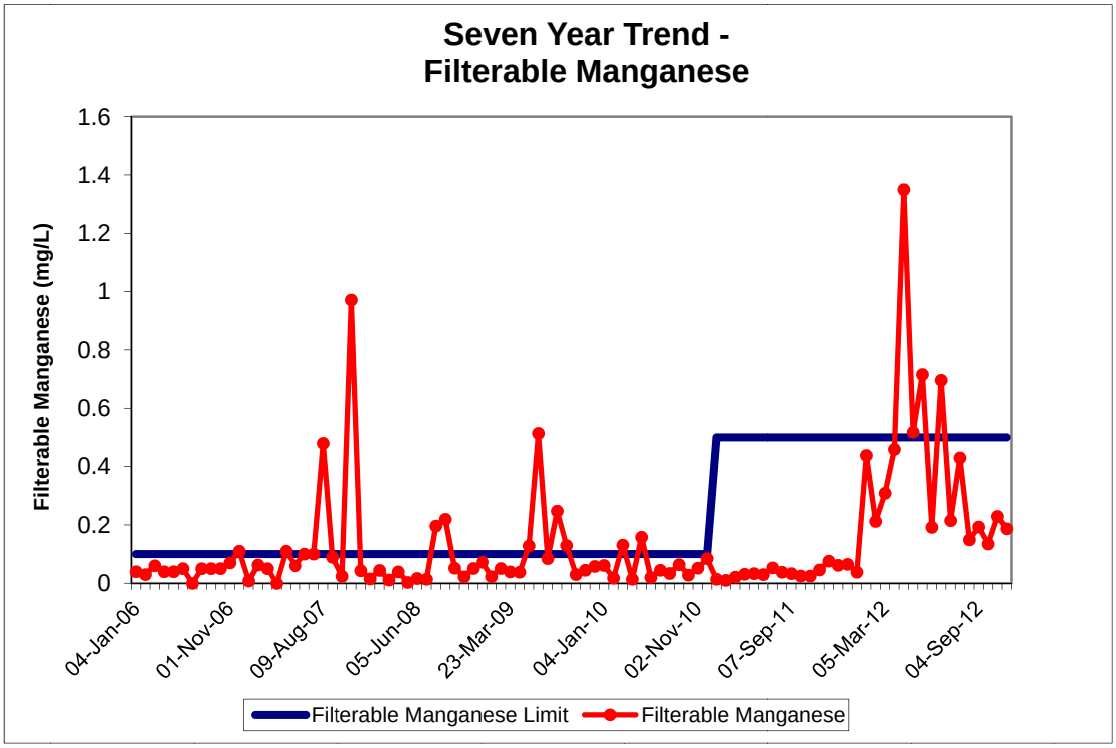

Figure 19 Filterable Manganese LD2 Seven year trend

3.4.2.6 Total Manganese LD2

The maximum total manganese result for 2011 was 1.84mg/L recorded on the 26th March 2012. There is no total manganese limit for discharged waters at licensed discharge points in EPL 726.

Monitoring results for total manganese at LD2 are presented in **Figure 20** below. Long term monitoring (**Figure 21**) indicates that total manganese levels in 2012 increased during the first half of 2012 but returned to below 0.5 mg/L in August.

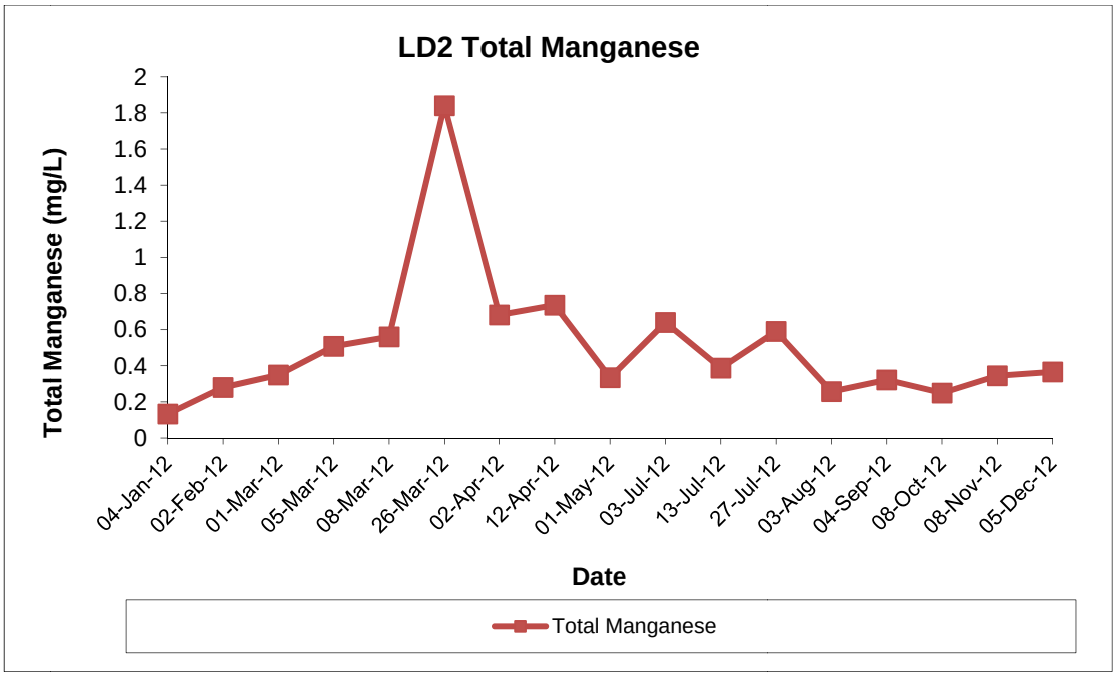

Figure 20 Total Manganese LD2 2012

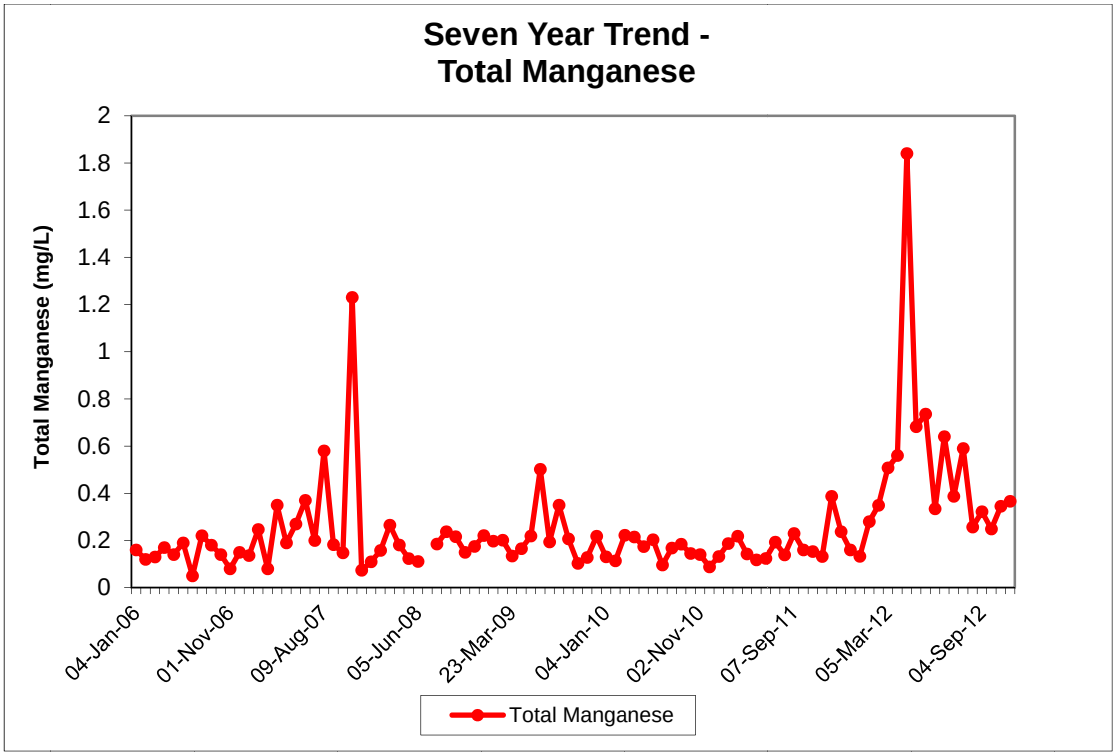

Figure 21 Total Manganese LD2 Seven year trend

3.4.2.7 Total Arsenic LD2

Total Arsenic results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.01mg/L) and below the detection limit (0.001mg/L) on all occasions.

Monitoring results for Total Arsenic at LD2 are presented in **Figure 22** below with the long term trend shown in **Figure 23**. The Total Arsenic limit was reduced from 0.05 mg/L to 0.01 mg/L on 19th December 2011.

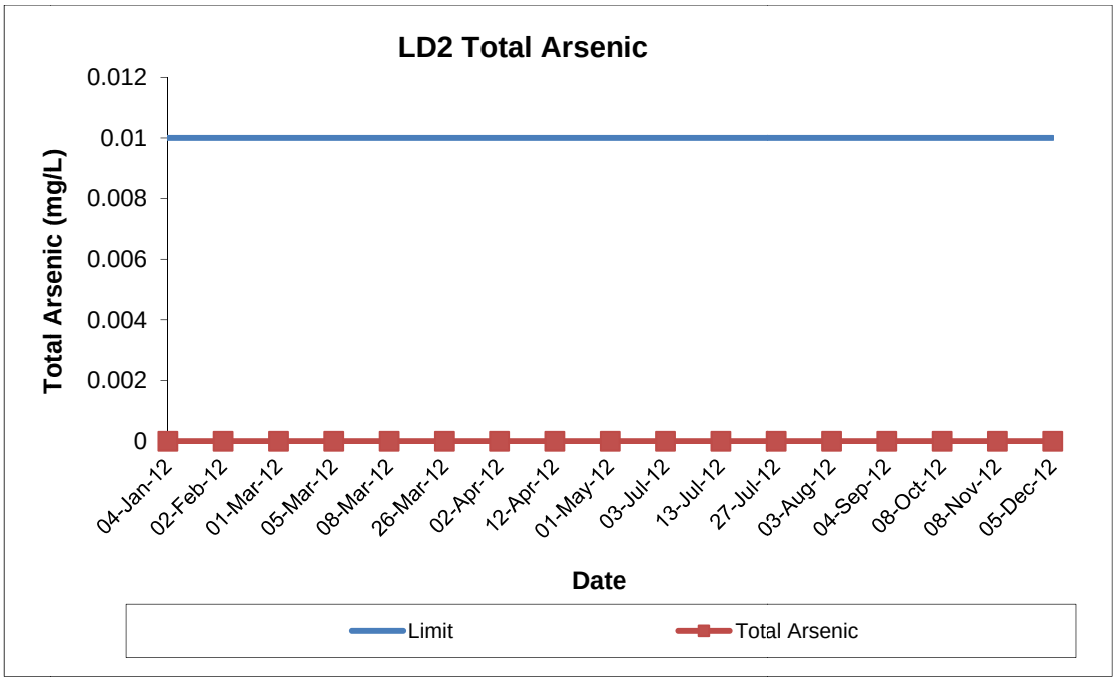

Figure 22 Total Arsenic LD2 2012

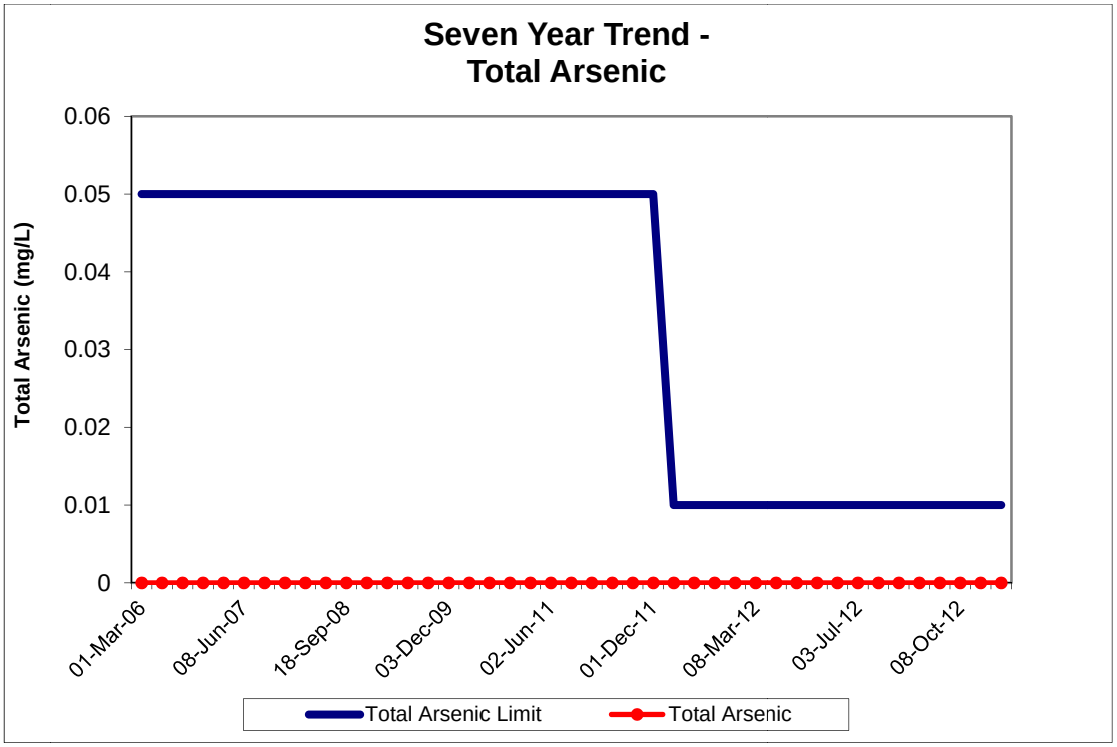

Figure 23 Total Arsenic LD2 Seven year trend

3.4.2.8 Total Boron LD2

Total Boron results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.1mg/L) and below the detection limit (0.05mg/L) on all occasions.

Monitoring results for Total Boron at LD2 are presented in **Figure 24** below with the long term trend shown in **Figure 25**. The Total Boron limit was reduced from 1 mg/L to 0.1 mg/L on 19th December 2011.

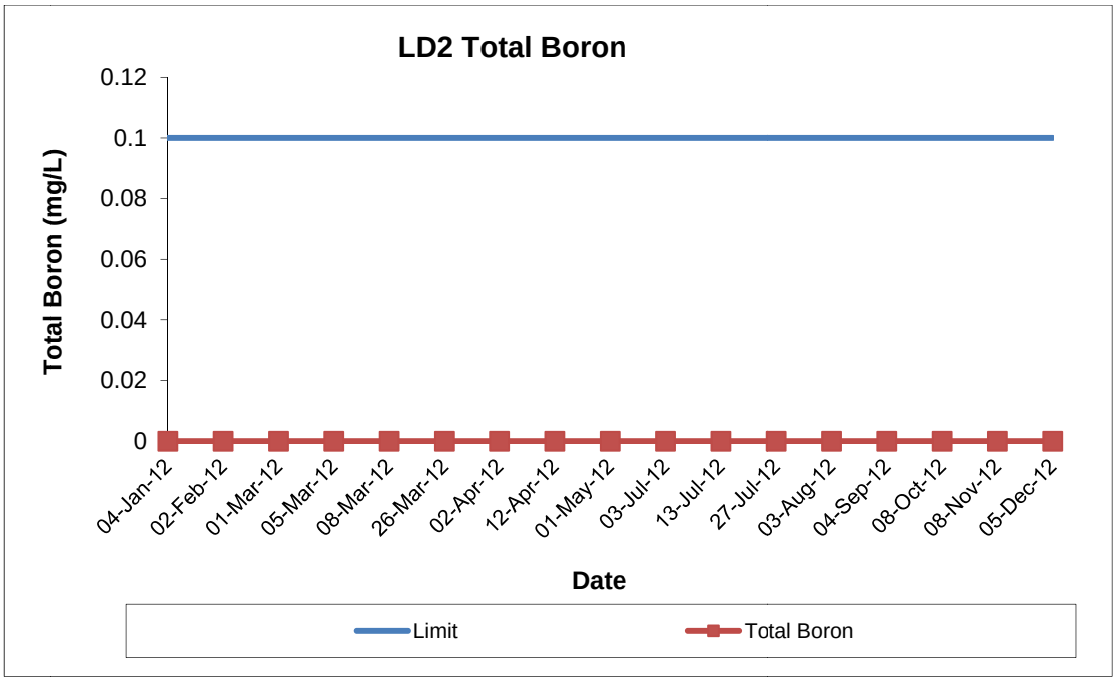

Figure 24 Total Boron LD2 2012

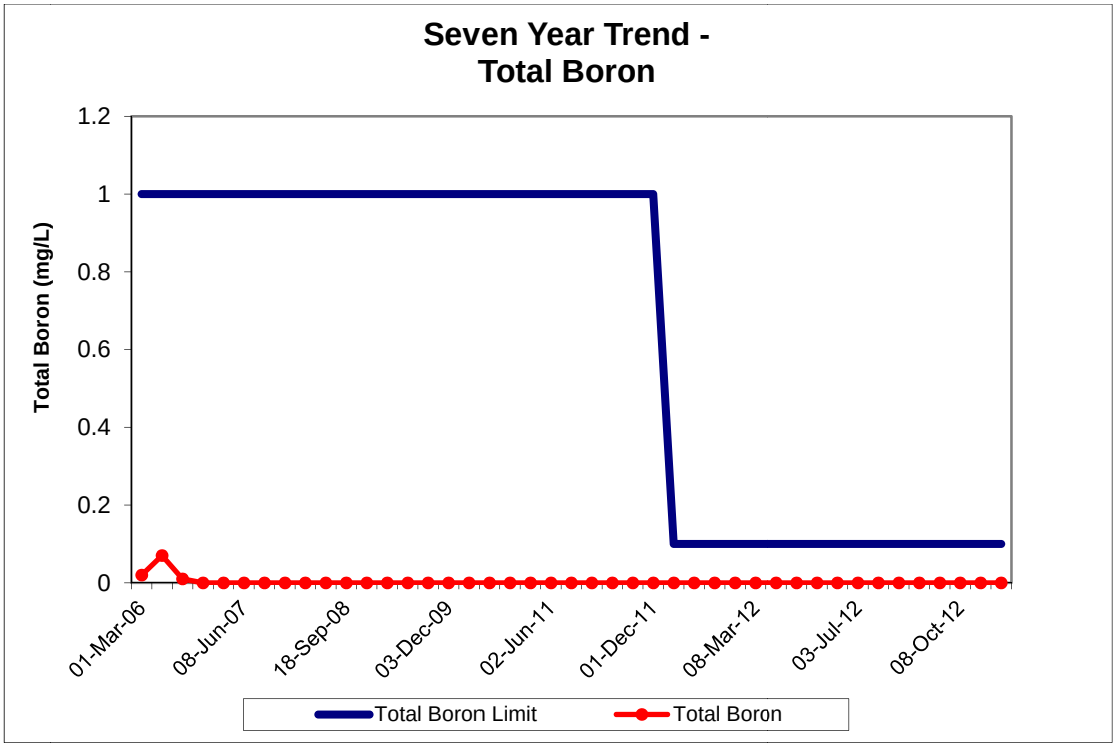

Figure 25 Total Boron LD2 Seven year trend

3.4.2.9 Total Cadmium LD2

Total Cadmium results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.001mg/L) on all occasions with the highest result being 0.0002mg/L on the 8th March and 2nd April 2012.

Monitoring results for Total Cadmium at LD2 are presented in **Figure 26** below with the long term trend shown in **Figure 27**. The Total Cadmium limit was reduced from 0.01 mg/L to 0.001 mg/L on 19th December 2011.

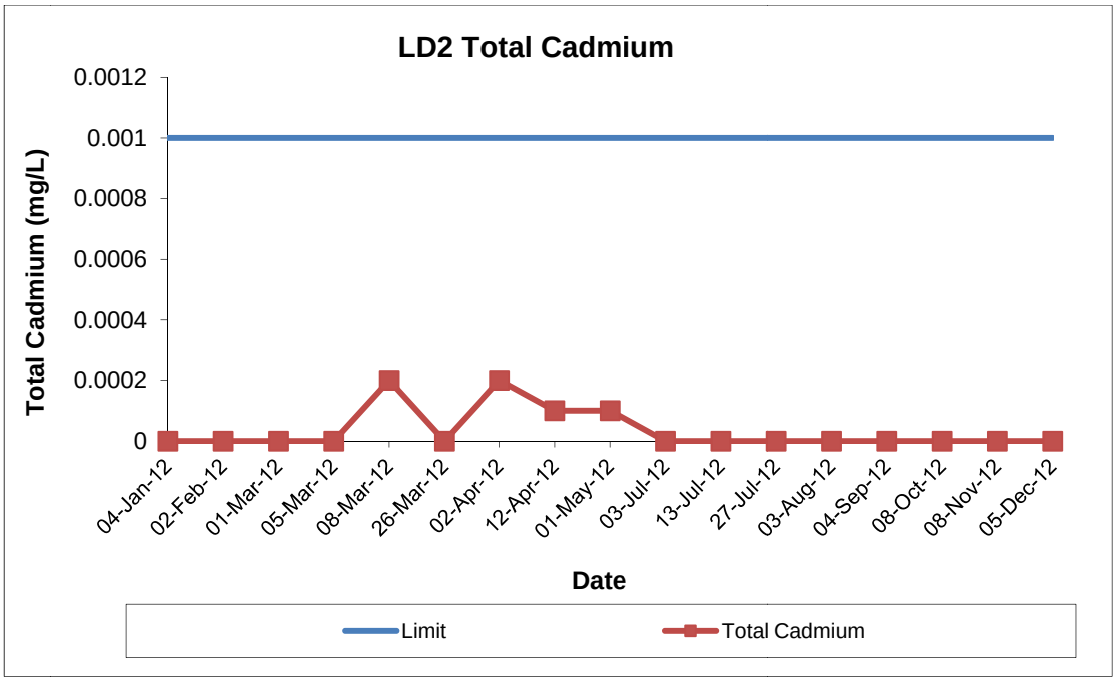

Figure 26 Total Cadmium LD2 2012

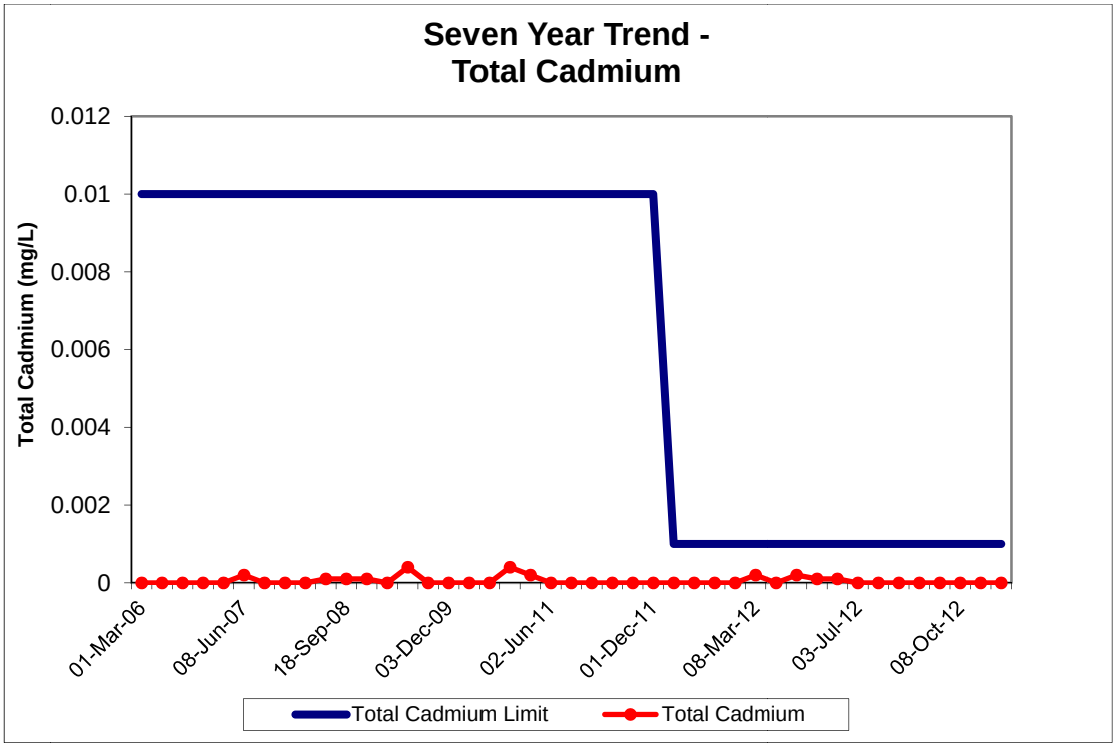

Figure 27 Total Cadmium LD2 Seven year trend

3.4.2.10 Total Chloride LD2

Total Chloride results for discharged water sampled at LD2 during the reporting period were below the licence limit (25mg/L) on all occasions with the highest result being 7 mg/L on 12th April 2012.

Monitoring results for Total Chloride at LD2 are presented in **Figure 28** below with the long term trend shown in **Figure 29**. The Total Chloride limit was reduced from 250 mg/L to 25 mg/L on 19th December 2011.

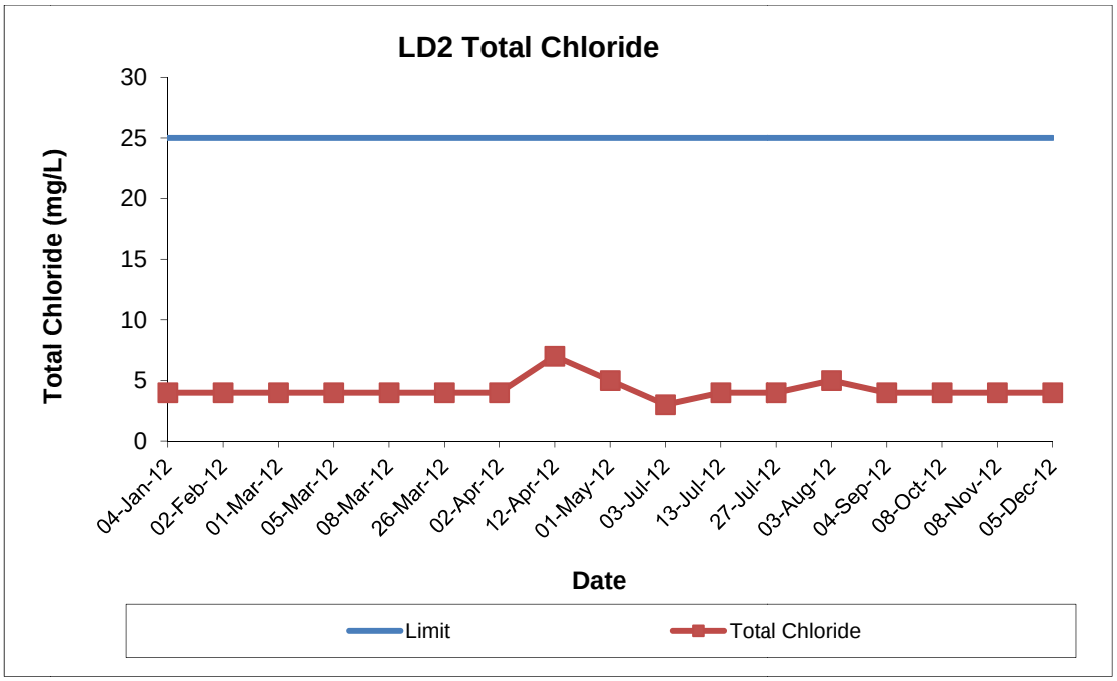

Figure 28 Total Chloride LD2 2012

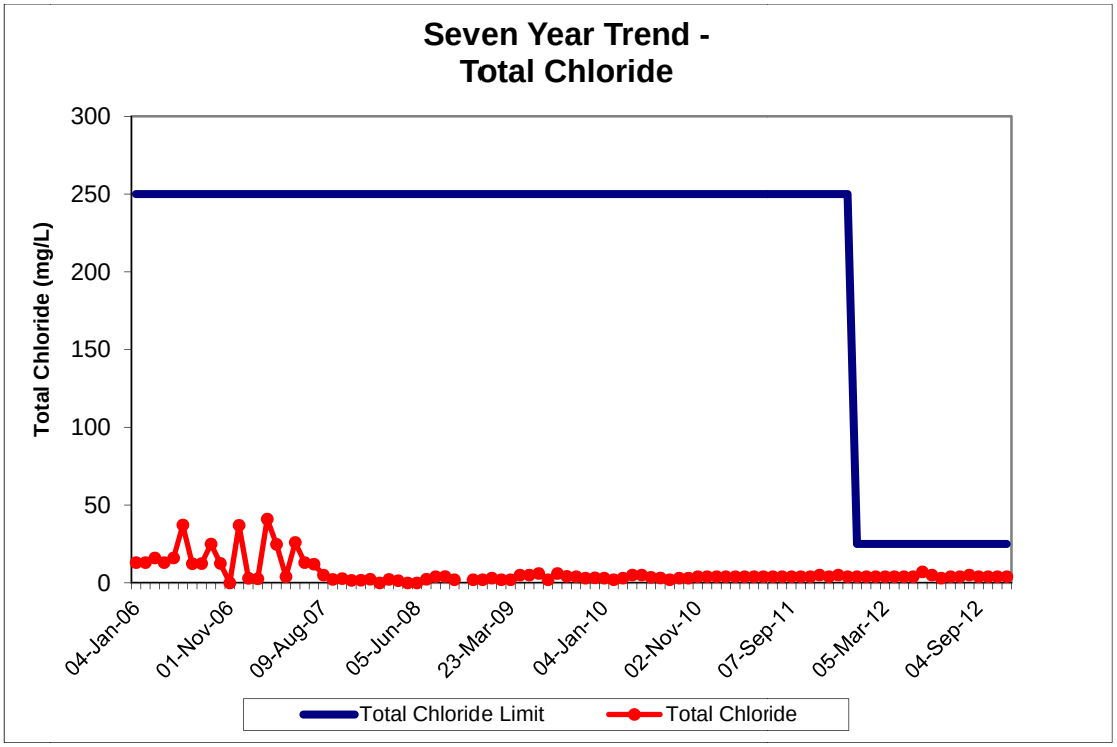

Figure 29 Total Chloride LD2 Seven year trend

3.4.2.11 Total Chromium (hexavalent) LD2

Total Chromium (hexavalent), also referred to as Total Chromium (VI), results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.01mg/L) and below the detection limit (0.01mg/L) on all occasions.

Monitoring results for Total Chromium (VI) at LD2 are presented in **Figure 30** below with the long term trend shown in **Figure 31**. The Total Chromium (VI) limit was reduced from 0.05 mg/L to 0.01 mg/L on 19th December 2011.

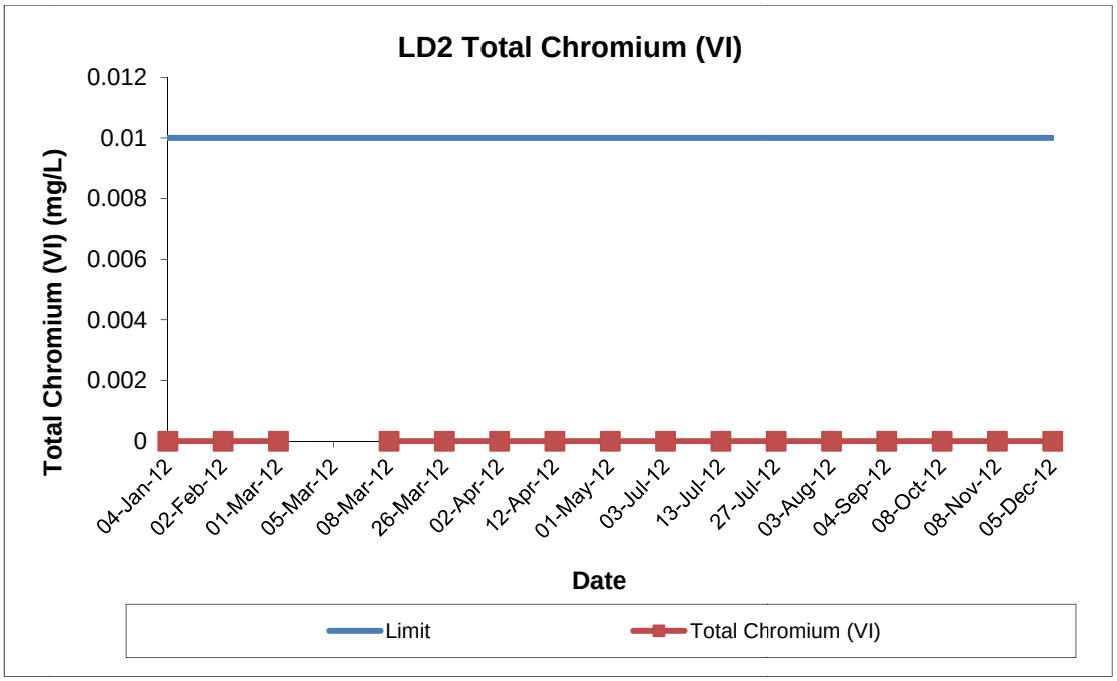

Figure 30 Total Chromium (VI) LD2 2012

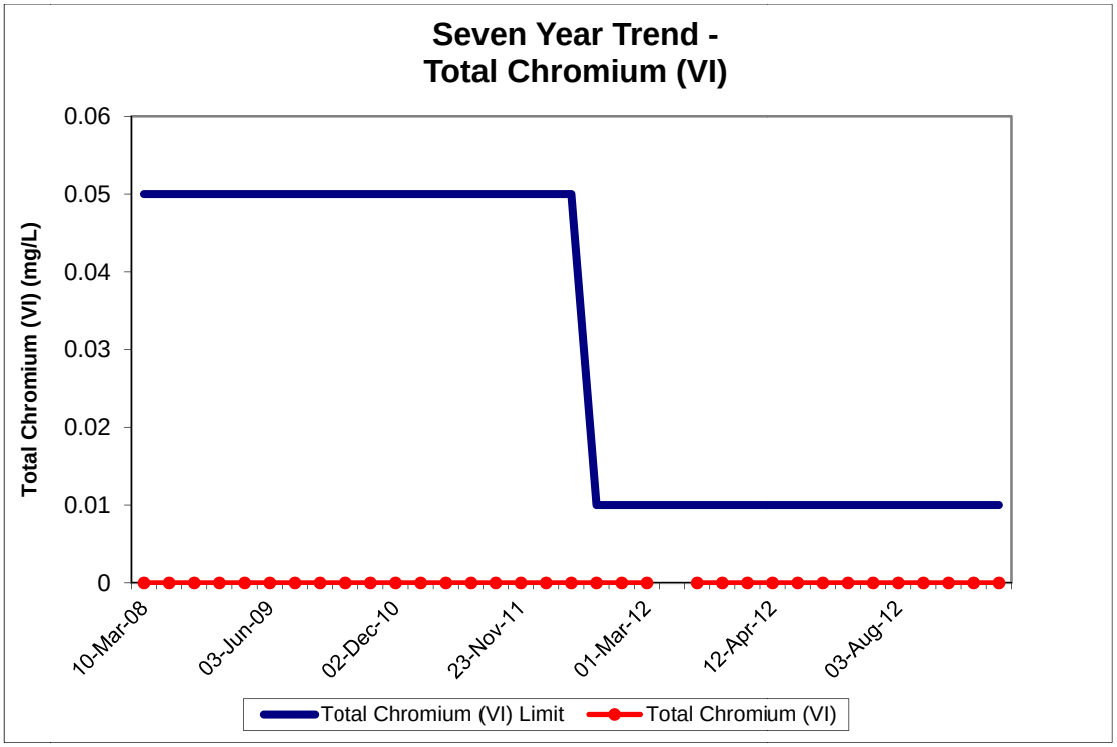

Figure 31 Total Chromium (VI) LD2 Seven year trend

3.4.2.12 Total Copper LD2

Total Copper results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.02mg/L) on all occasions with the highest reading of 0.004mg/L recorded on the 8th March 2012.

Monitoring results for Total Copper at LD2 are presented in **Figure 32** below with the long term trend shown in **Figure 33**. The Total Copper limit was reduced from 1.0 mg/L to 0.02 mg/L on 19th December 2011.

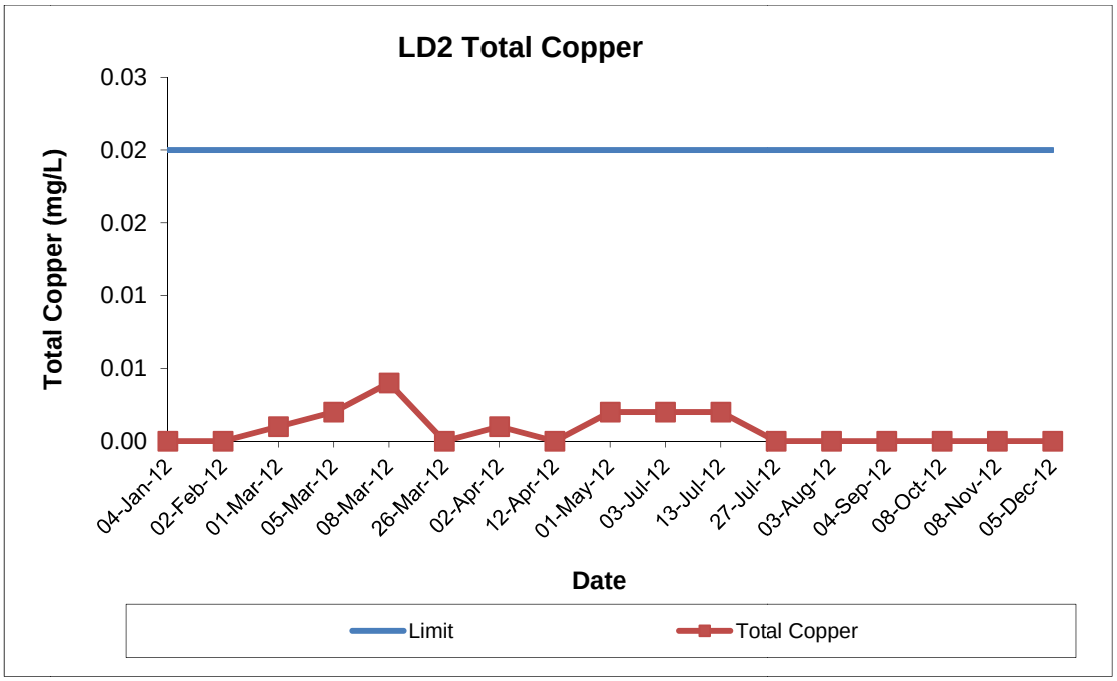

Figure 32 Total Copper LD2 2012

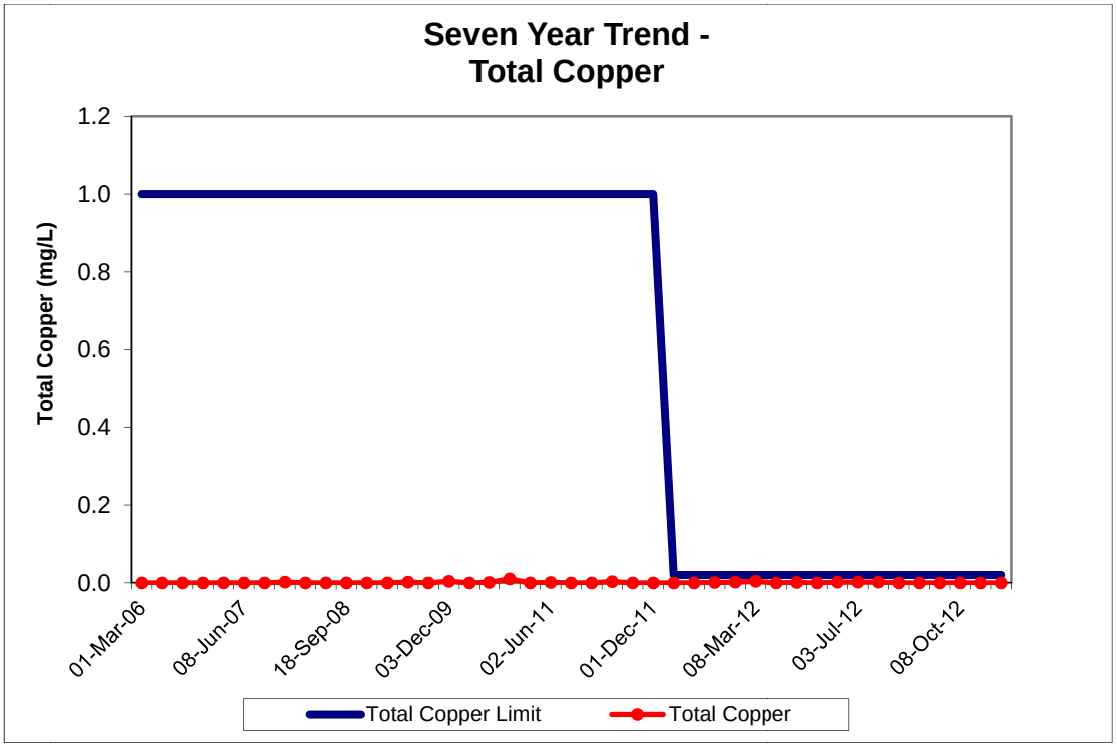

Figure 33 Total Copper LD2 Seven year trend

3.4.2.13 Filterable Iron LD2

Filterable Iron results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.3mg/L) on all occasions with the highest reading being 0.06 mg/L on 3rd July 2012.

Monitoring results for Filterable Iron at LD2 are presented in **Figure 34** below with the long term trend shown in **Figure 35.**

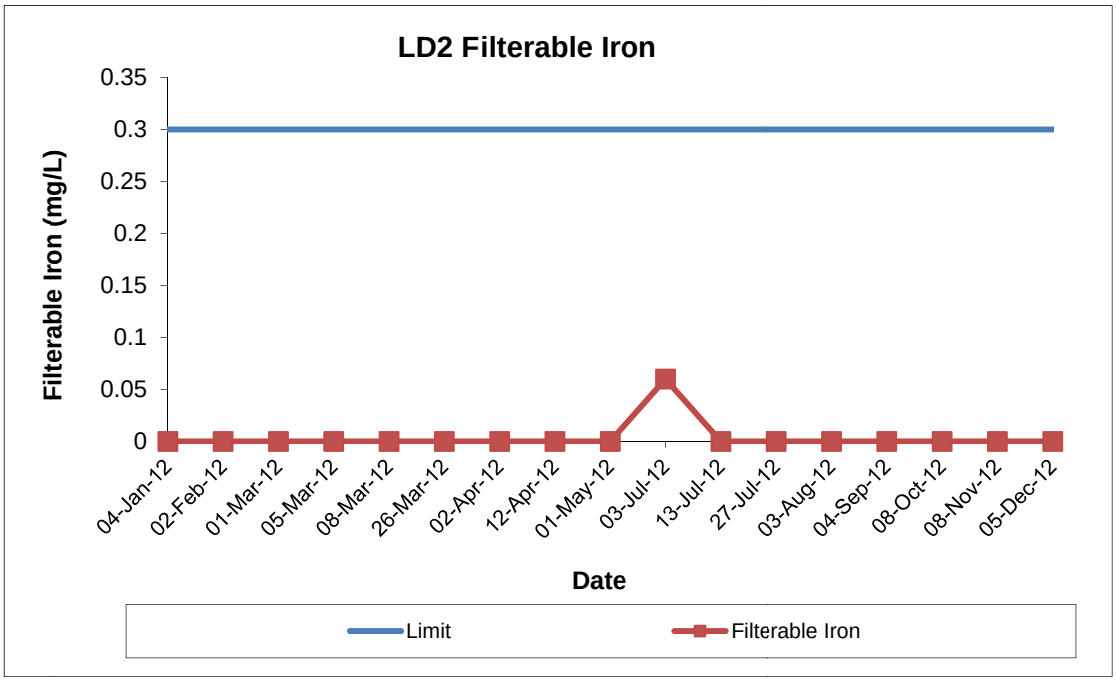

Figure 34 Filterable Iron LD2 2012

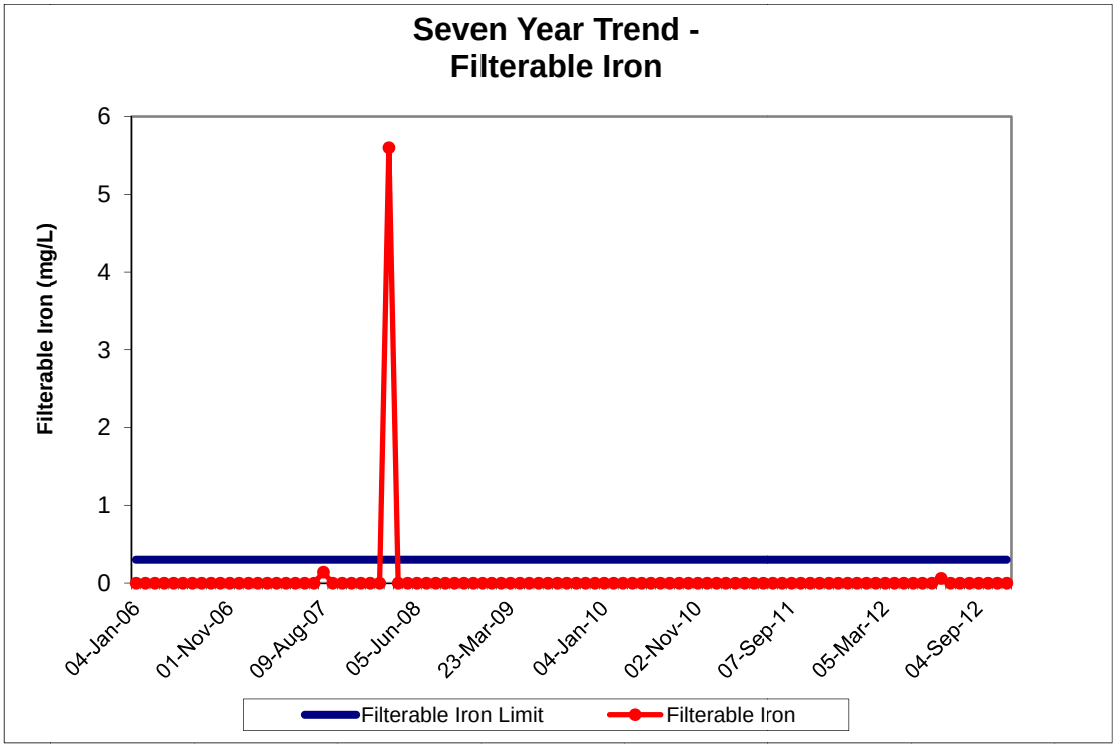

Figure 35 Filterable Iron LD2 Seven year trend

3.4.2.14 Total Fluoride LD2

Total Fluoride results for discharged water sampled at LD2 during the reporting period were the below licence limit (1mg/L) on all occasions with the highest reading being 0.3 mg/L on 1st May 2012.

Monitoring results for Total Fluoride at LD2 are presented in **Figure 36** below with the long term trend shown in **Figure 37**. The Total Fluoride limit was reduced from 1.5 mg/L to 1 mg/L on 19th December 2011.

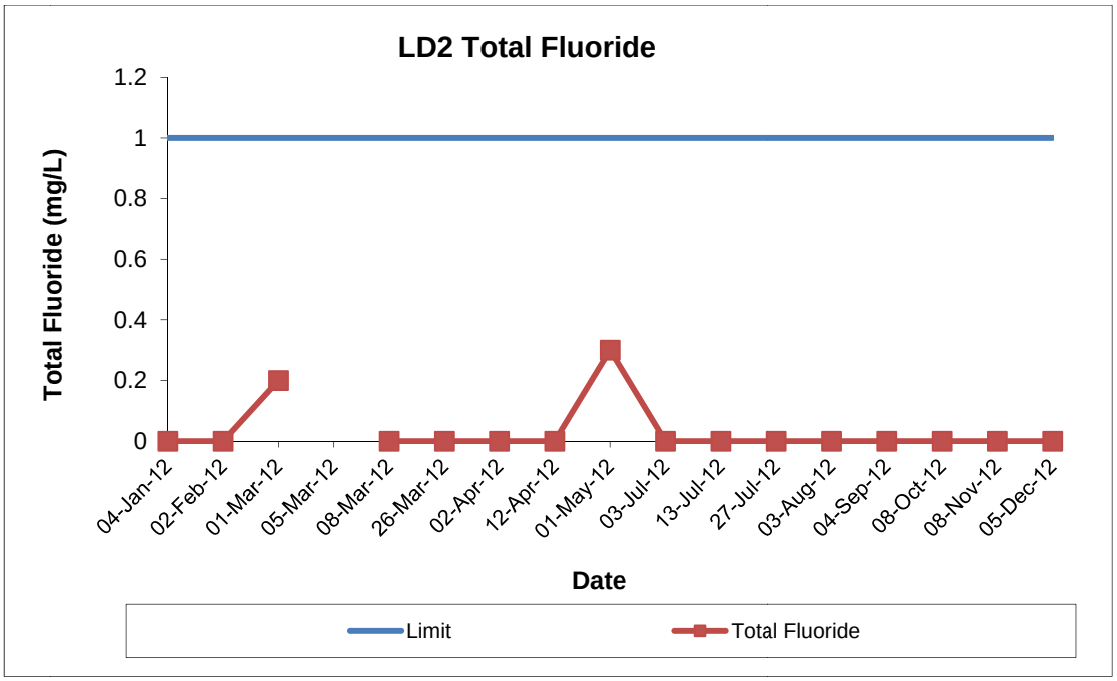

Figure 36 Total Fluoride LD2 2012

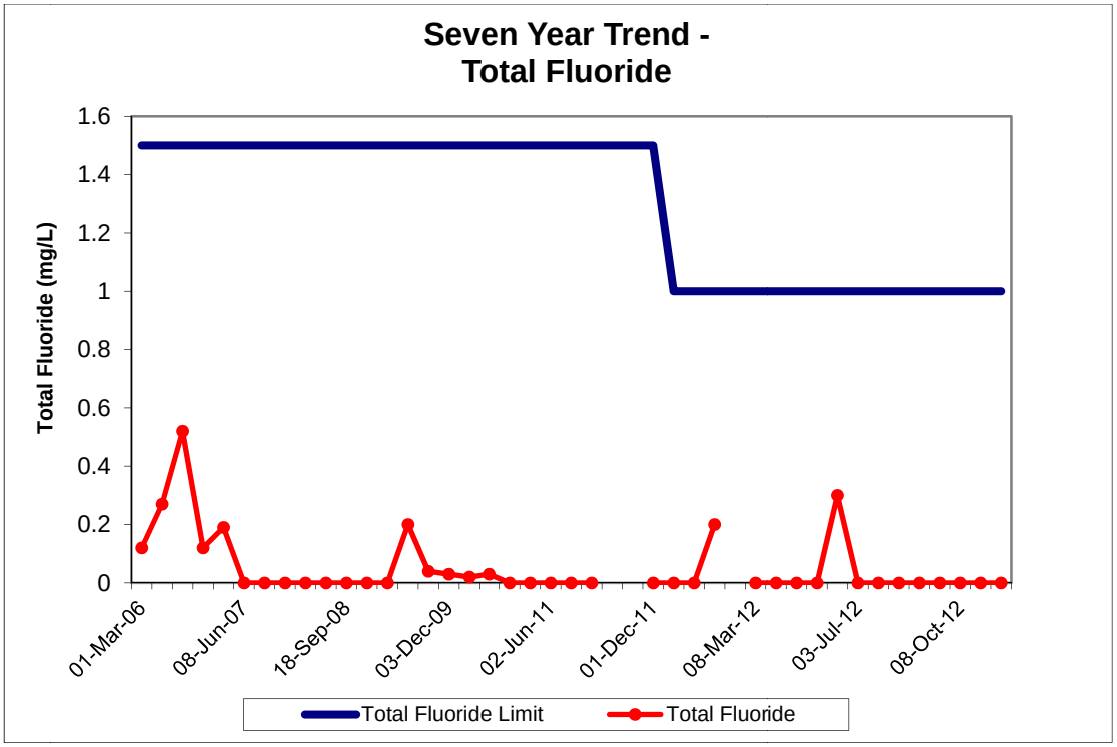

Figure 37 Total Fluoride LD2 Seven year trend

3.4.2.15 Total Lead LD2

Total Lead results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.005mg/L) on all occasions with the highest reading being 0.004 on 1st May 2012.

Monitoring results for Total Lead at LD2 are presented in **Figure 38** below with the long term trend shown in **Figure 39**. The Total Lead limit was reduced from 0.05 mg/L to 0.005 mg/L on 19th December 2011.

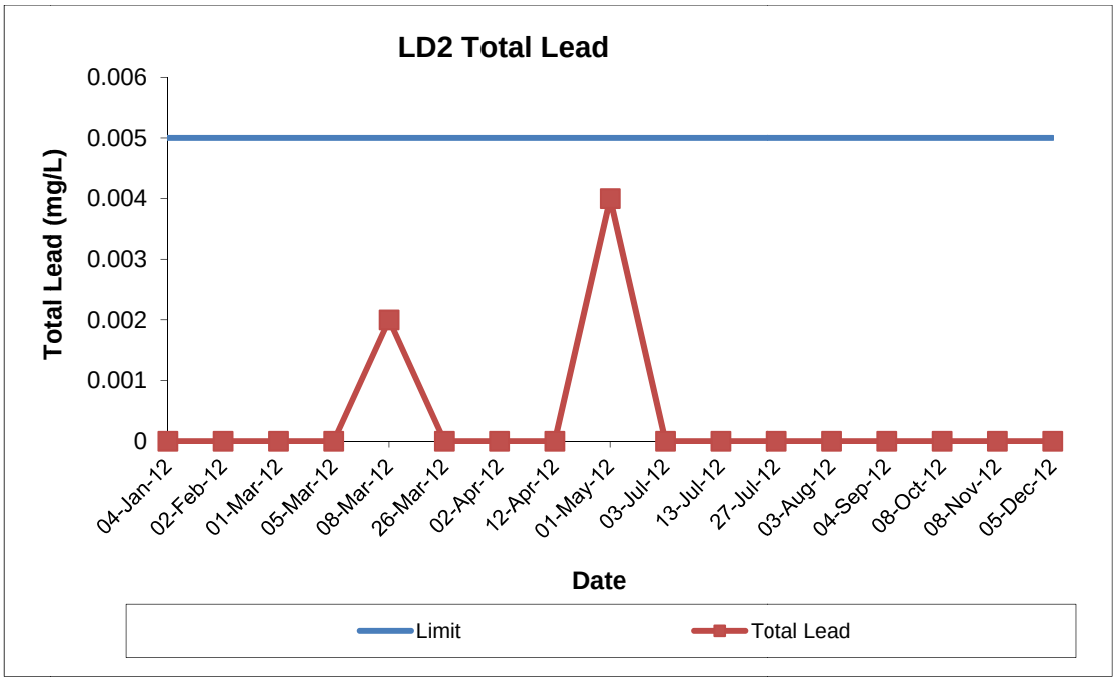

Figure 38 Total Lead LD2 2012

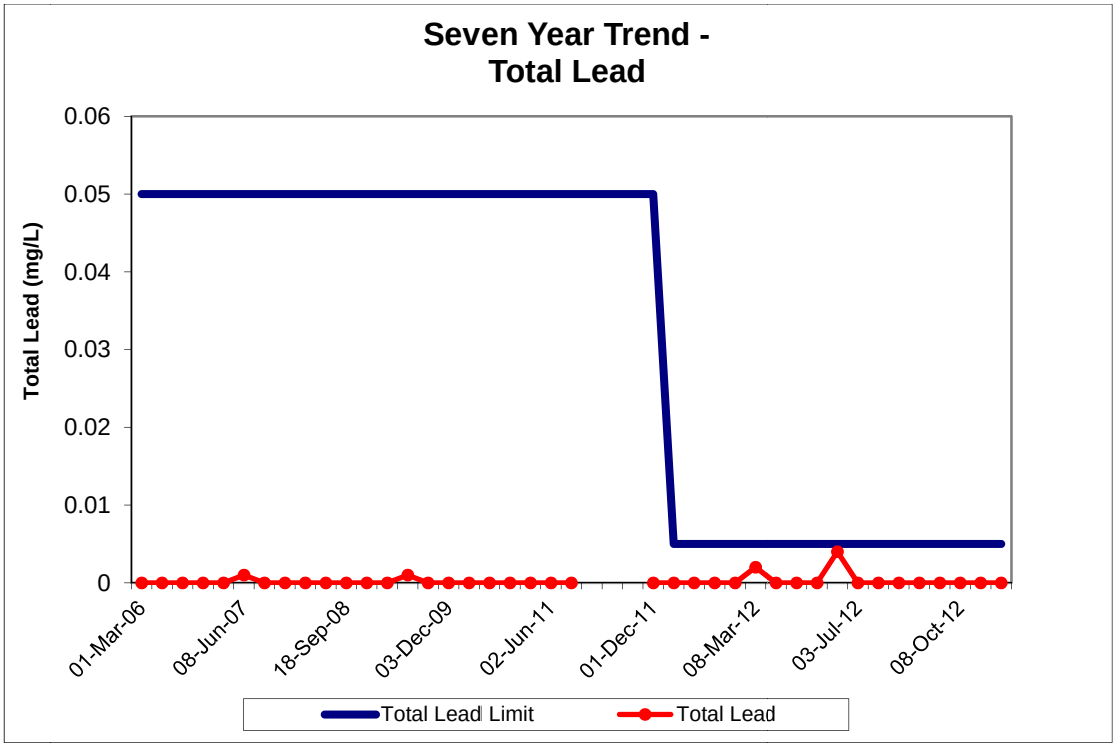

Figure 39 Total Lead LD2 Seven year trend

3.4.2.16 Total Mercury LD2

Total Mercury results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.001mg/L) and below the detection limit (0.0001mg/L) on all occasions.

Monitoring results for Total Mercury at LD2 are presented in **Figure 40** below with the long term trend shown in **Figure 41.**

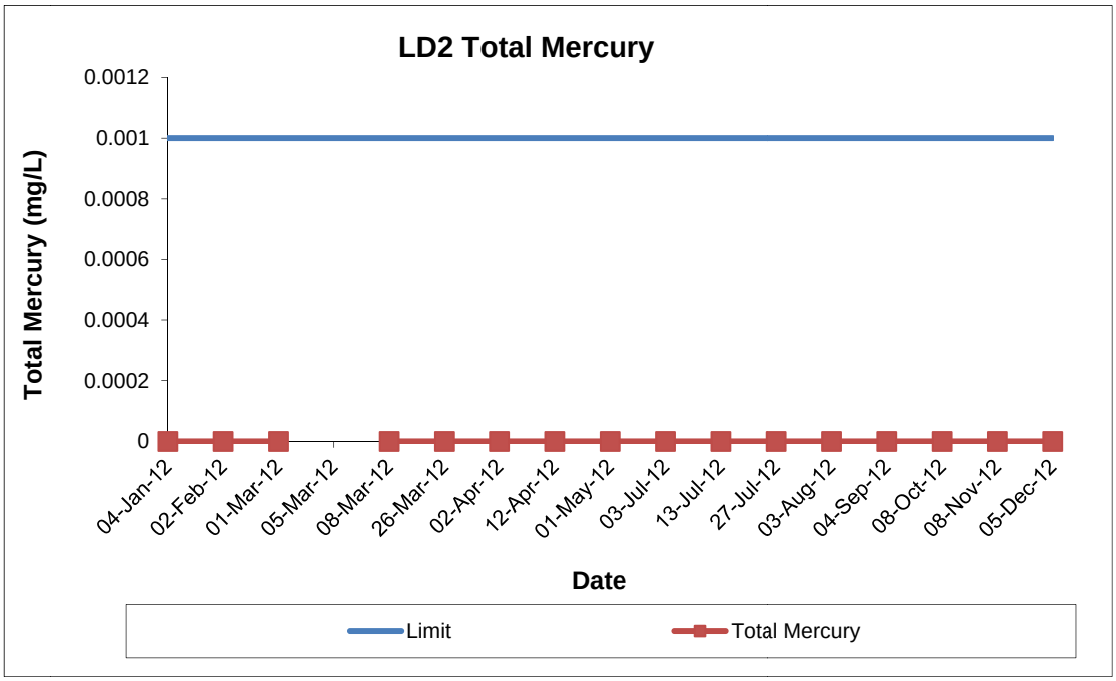

Figure 40 Total Mercury LD2 2012

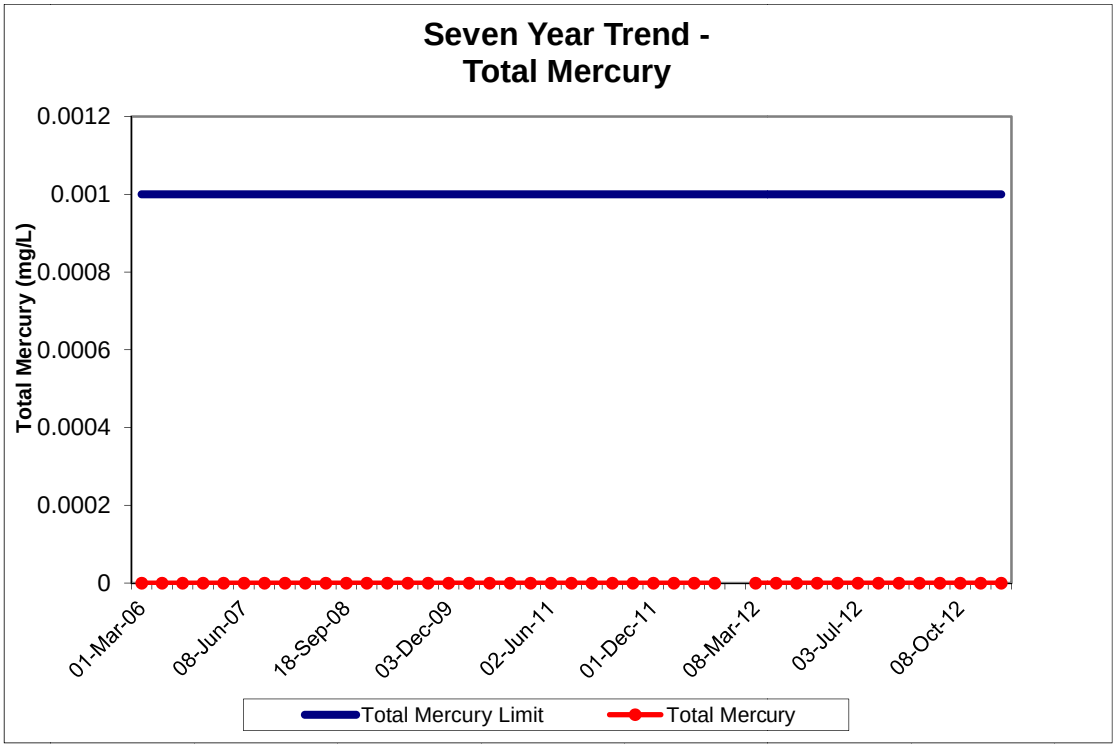

Figure 41 Total Mercury LD2 Seven year trend

3.4.2.17 Total Selenium LD2

Total Selenium results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.01mg/L) and below the detection limit (0.01mg/L) on all occasions.

Monitoring results for Total Selenium at LD2 are presented in **Figure 42** below with the long term trend shown in **Figure 43.**

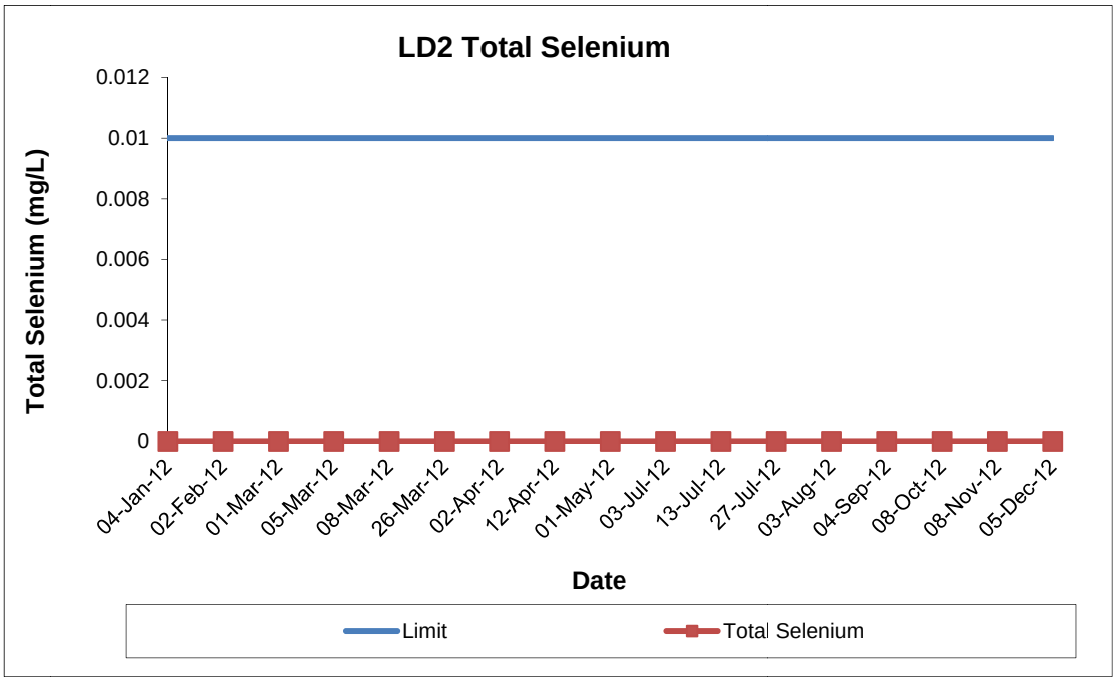

Figure 42 Total Selenium LD2 2012

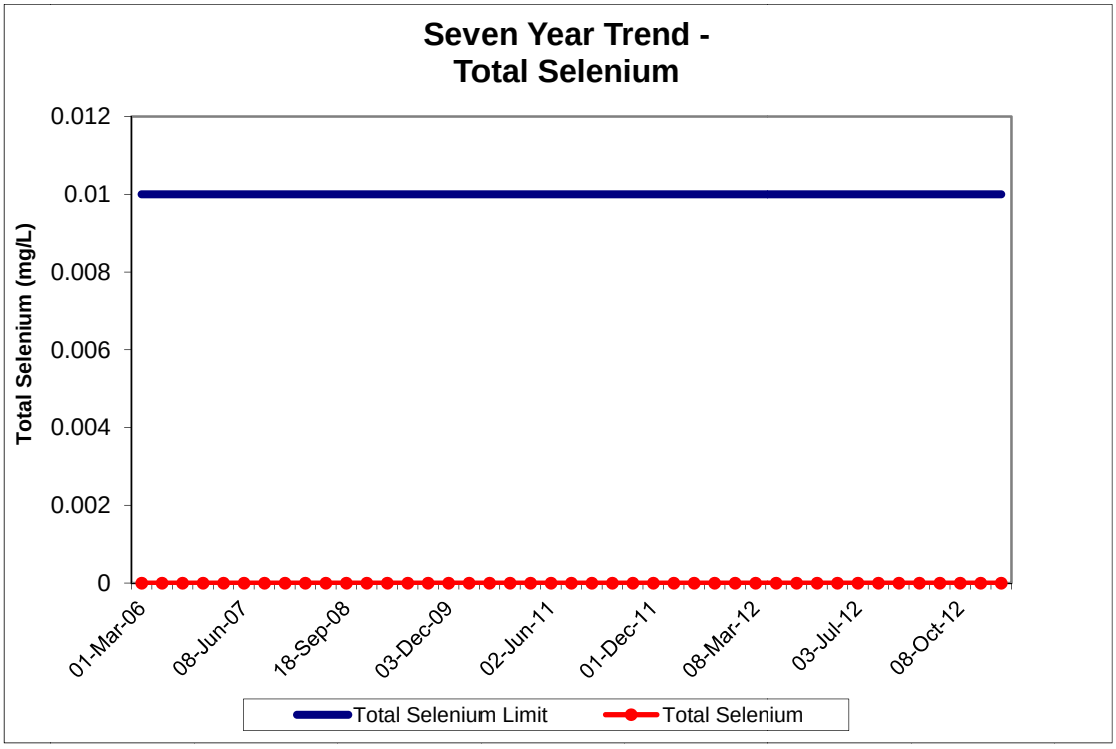

Figure 43 Total Selenium LD2 Seven year trend

3.4.2.18 Total Silver LD2

Total Silver results for discharged water sampled at LD2 during the reporting period were below the licence limit (0.001mg/L) and below the detection limit (0.001mg/L) on all occasions.

Monitoring results for Total Silver at LD2 are presented in **Figure 44** below with the long term trend shown in **Figure 45**. The Total Silver limit was reduced from 0.05 mg/L to 0.001 mg/L on 19th December 2011.

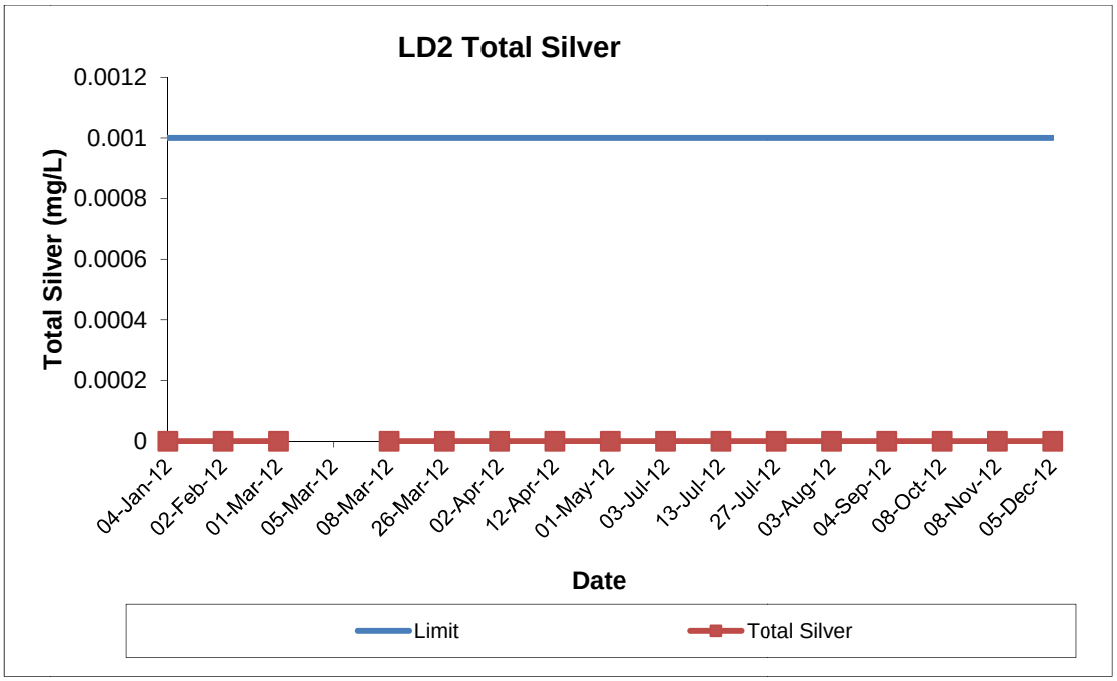

Figure 44 Total Silver LD2 2012

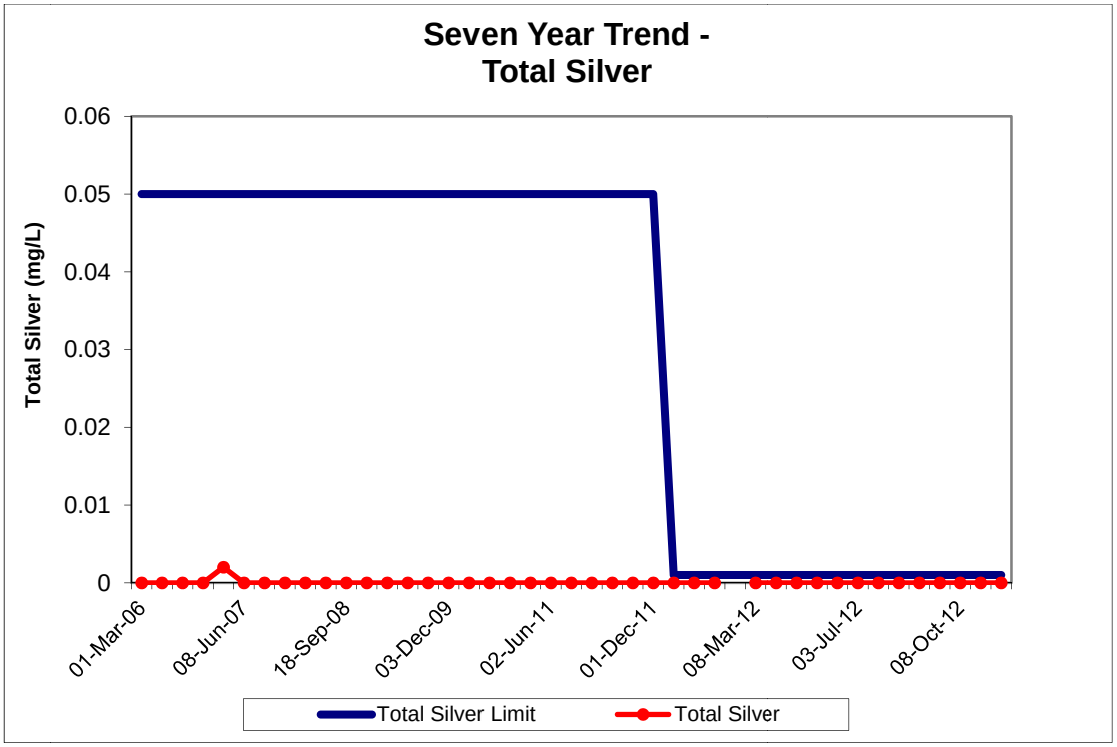

Figure 45 Total Silver LD2 Seven year trend

3.4.2.19 Total Sulfate LD2

Total Sulfate results for discharged water sampled at LD2 during the reporting period were below the licence limit (250mg/L) on all occasions with the highest result being 223 mg/L on the 8th October 2012.

Monitoring results for Total Sulfate at LD2 are presented in **Figure 46** below with the long term trend shown in **Figure 47**.

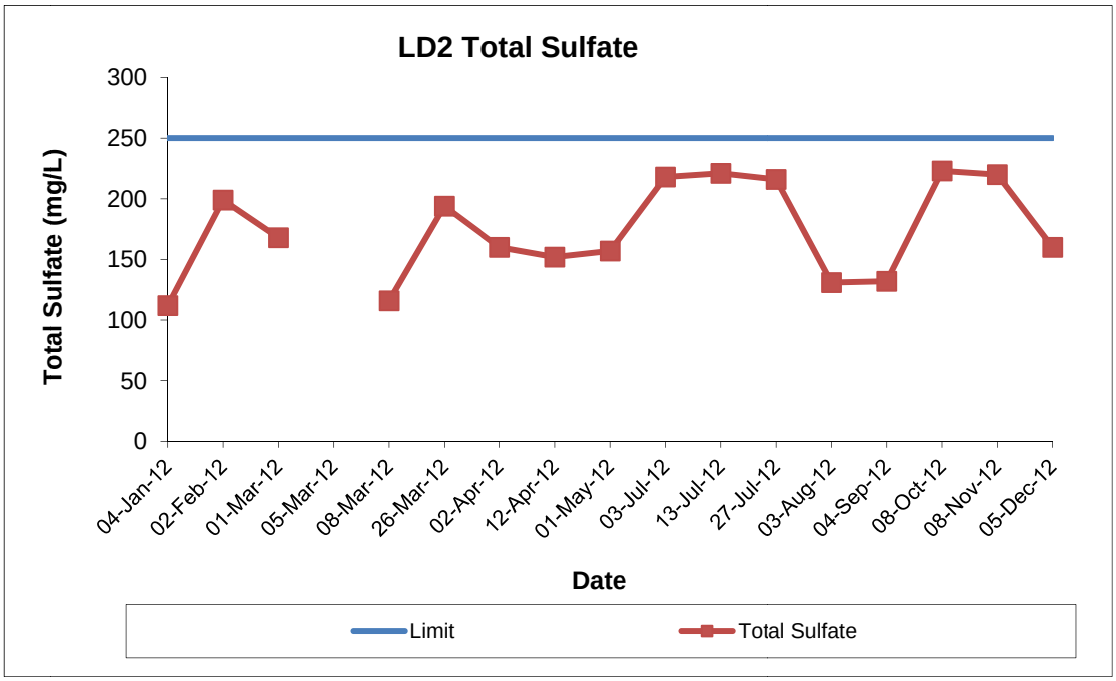

Figure 46 Total Sulfate LD2 2012

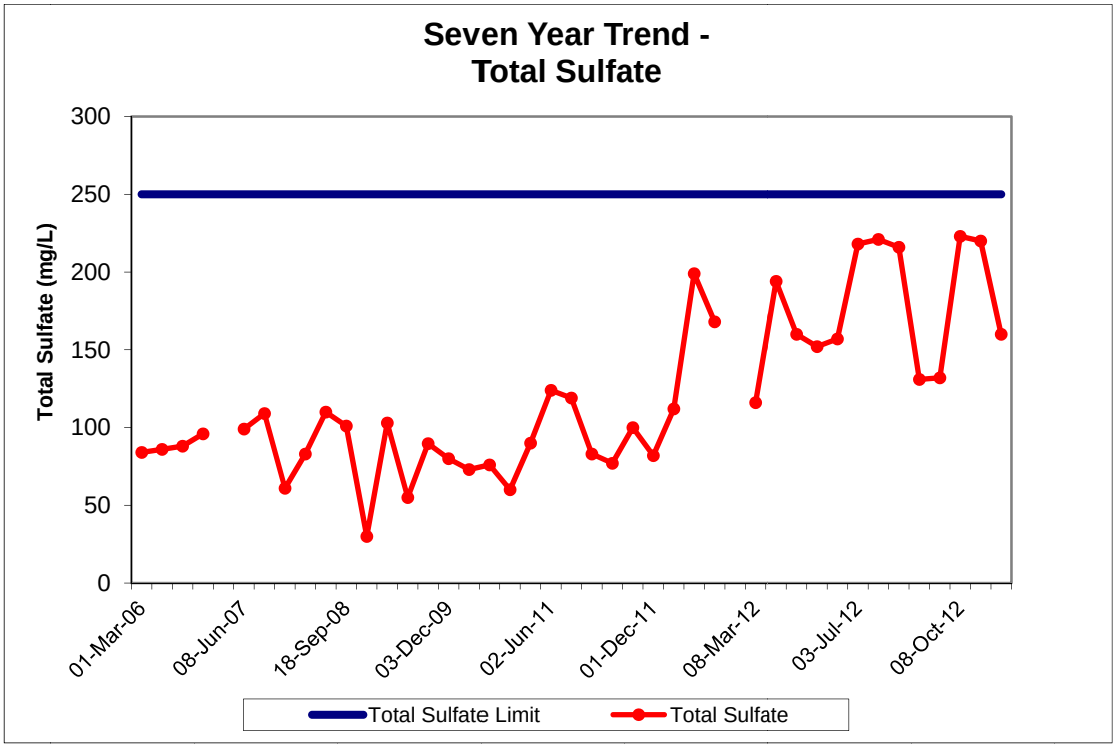

Figure 47 Total Sulfate LD2 Seven year trend

3.4.2.20 Total Zinc LD2

Total Zinc results for discharged water sampled at LD2 during the reporting period were below the licence limit (2.5mg/L) on all occasions with the highest result being 0.712 mg/L on the 2nd April 2012.

Monitoring results for Total Zinc at LD2 are presented in **Figure 48** below with the long term trend shown in **Figure 49**. The Total Zinc limit was reduced from 5 mg/L to 2.5 mg/L on 19th December 2011.

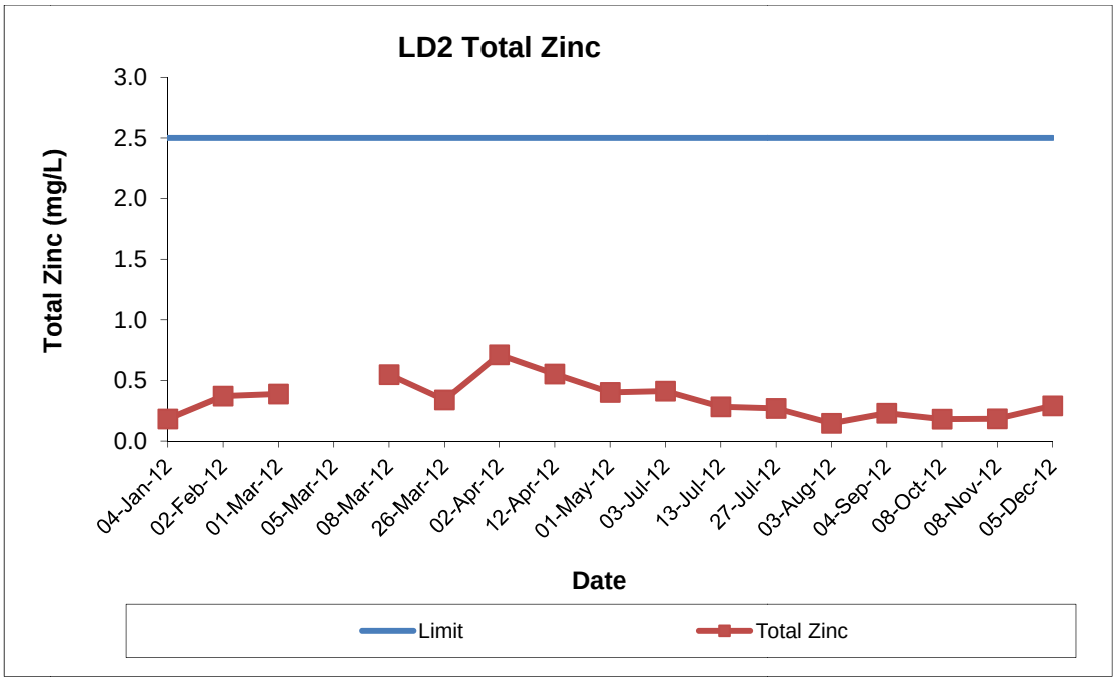

Figure 48 Total Zinc LD2 2012

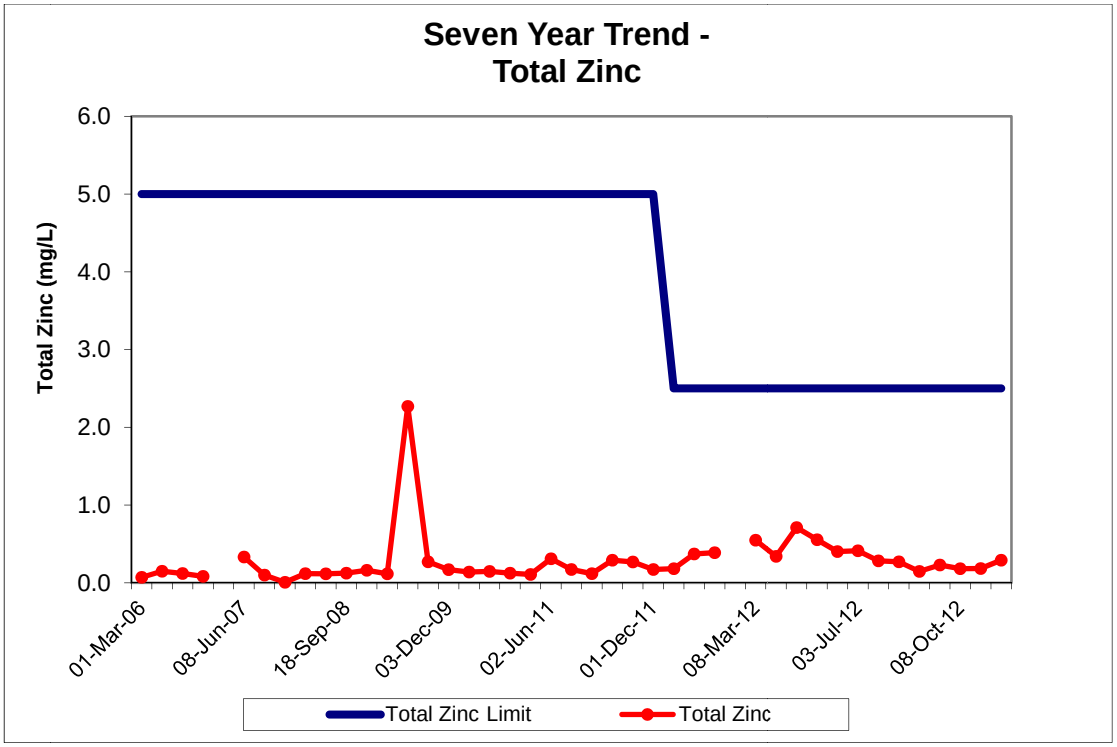

Figure 49 Total Zinc LD2 Seven year trend

3.4.2.21 LD3

Water discharged through LD3 at Leachate Dam No.1 on only one occasion during the reporting period. The discharge occurred on the 8th March 2012 during a rainfall event. The discharge of water at LD3 was sampled during the discharge event. The discharge event exceeded the limit for pH, Total Suspended Solids (TSS), Cadmium, Filterable Manganese and Zinc as shown in **Table 13** below. The meteorological station at Clarence Colliery recorded 49 mm of rainfall in the 5 days prior to the discharge event. No environmental harm occurred from the exceedances.

In response to the exceedances, the surface water management system was modified to redirect Polishing Lagoon Water directly to LD2 when the quality of water is suitable, thereby reducing water leading to Leachate Dam No.1 and preventing overflow from the dam. Leachate Dam No.1 did not discharge for the remainder of the reporting period.

Table 13 LD3 Results for 8th March 2012

Parameter	Result	EPA Licence Limit
pH	5.4	6.5-8.5
Total Suspended Solids (mg/L)	38	30
Oil and Grease (mg/l	<5	10
Arsenic (mg/L)	<0.001	0.01
Boron (mg/L)	<0.05	0.1
Cadmium (mg/L)	0.0013	0.001
Chloride (mg/L)	4	25
Chromium VI (mg/L)	<0.01	0.01
Copper (mg/L)	0.02	0.02
Filterable Iron (mg/L)	0.11	0.3
Filterable Manganese (mg/L)	2.2	0.5
Fluoride (mg/L)	<0.1	1
Lead (mg/L)	0.003	0.005
Mercury (mg/L)	<0.0001	0.001
Selenium (mg/L)	<0.01	0.01
Silver (mg/L)	<0.001	0.001
Sulfate (mg/L)	128	250
Zinc (mg/L)	2.57	2.5

3.4.2.22 LD4

LD4 is the overflow for Leachate Dam No.2. Leachate Dam No.2 did not overflow during 2012 and consequently there are no results for LD4.

3.4.3 Management

3.4.3.1 Erosion and Sediment

The Erosion and Sediment Control Plan was approved by the Department of Planning in November 2007. It forms part of the site Water Management Plan and is reviewed every 12 months. The Water Management Plan has been updated and subsequently approved by DP&I following consultation with relevant government agencies. The Water Management Plan identifies all activities that could cause erosion and describes the location, function and capacity of erosion and sediment control measures. An addition to the Water Management Plan was a plan identifying clean water, dirty water and leachate water drainage lines on the Pit Top created from field investigations conducted during the reporting period.

There are three areas of potential soil erosion and sediment transport within the Clarence Colliery lease area:

- Pit Top Surface Facilities (e.g. stockpile areas, conveyor belts, lay down areas, Reject Emplacement Area);
- Underground Workings; and
- Surface areas potentially affected by subsidence (areas above mine workings).

The greatest potential for erosion and sediment transport from disturbed areas comes from coal distribution and stockpiling.

The soils at Clarence have a moderate to high erosion potential due to their sandy nature and occurrence on moderate to steep slopes. Several types of erosion control measures have been implemented on the site with the aim of preventing soil erosion and the entry of sediments into the surrounding water bodies. The existing surface water management system includes a series of clean water diversion channels, sediment control structures and water treatment facilities. Erosion control measures are described below.

3.4.3.2 Drainage Channels

Drains are constructed with either a parabolic or trapezoidal cross section to minimise erosion. Where possible, channels have been constructed with an adjacent earth bank, or in some cases have been completely concrete lined.

Flow channels in soil materials are limited to 0.5% gradient and where steeper gradients are unavoidable, concrete weirs, gabion weirs, concrete pipes and run-off control channels are installed to control the water flow.

All channels are inspected monthly during the environmental inspection. Maintenance is then initiated as required to repair damage caused by scour, sediment deposition or channel obstruction.

A clean water by-pass channel allows water from upstream of the site to pass through without coming into contact with disturbed areas. This reduces the quantity of water that has potential to cause erosion and require treatment.

All water emanating from disturbed areas flow through collection pipes/drains/channels to a number of sediment control structures. These structures are detailed below.

Improved sediment and erosion control measures were installed in the newly constructed drainage channels for REA IV and in stream works completed in the Leachate Dam No. 2 drainage channel (**Figure 50** and **Figure 51**). The control measures included the installation of check dams, lining channels with jute mesh and using coir logs to reduce flow velocity.

Figure 50 REA IV Drainage Works completed in 2012

Figure 51 In stream works completed at the Leachate Dam No. 2 Drainage Channel.

3.4.3.3 Sediment Basins

Several sediment basins have been constructed within the dirty water system. The sediment control basins have been designed and located to contain dirty water from disturbed areas on site. The primary purpose of these basins is to contain sediment from normal rainfall events as well as reduce flow velocity during high rainfall events.

There are several sediment control structures on site. These include:

- Conveyor Sediment Traps;
- Pit top grit trap;
- Primary separator and B Thickener;
- Polishing Lagoon;
- Leachate Dams; and
- Underground Settling Ponds.

These structures are regularly maintained and cleaned out once the capacity has reduced by approximately thirty percent. The structures are inspected after major rainfall events and any erosion of the spillway is remediated.

In response to the TSS exceedances on 8th March 2012, further improvements were made to the surface water management system to better utilise existing water control structures. These improvements proved effective for the remainder of the reporting period with no further TSS exceedances recorded.

In addition to improvements to the surface water management system, Clarence undertook a review of sediment basins on site and assessed their capacity against the requirements of Type D sediment retention basins for mines and quarries as defined in the publication Managing Urban Stormwater: Soils and Construction (Landcom 2006). The assessment report was completed on 2nd October 2012 and recommendations out of the report will be implemented as appropriate in 2013.

3.4.3.4 Maintenance

The Grit Trap and Primary Separator are checked for sediment on a twice weekly basis or following rainfall. All other sediment control structures and drainage lines are checked monthly or following rainfall.

Sediment control structures are cleaned out when their capacity is reduced by 30% including the pit top grit trap and primary arrestor. Material is placed in the Reject Emplacement Area (REA) as either waste or where coal content is sufficiently high mixed with product.

Channels are inspected on a monthly basis for blockage, scour, sediment deposition or channel obstruction. Repairs are initiated as required.

For potential subsidence areas, regular inspections are made of the overlying topography prior to, during and after an area has been mined to identify any areas of surface cracking. In the highly unlikely event that surface cracks are found that may pose an erosion risk, works will be undertaken to fill the cracked areas and prevent soil erosion. This will be particularly important in areas with soils that have high water erosion potential.

3.5 Groundwater

Groundwater monitoring is undertaken in accordance with Clarence Water Management Plan, Environmental Monitoring Program and Subsidence Management Approvals.

Currently measured groundwater monitoring sites are outlined in **Table 14** below. The location of the sites is provided in **Appendix 1**.

Table 14 Groundwater Monitoring Piezometers Summary

Piezometer	Installed	Area
CLRP1	2004	Eastern Area SMP, within 330 Area
CLRP2	2004	Eastern Area SMP, above 611E panel
CLRP3	2006	Eastern Area SMP, above 612 panel
CLRP4	2008	South of mining areas
CLRP5	2008	700 Area SMP, north of 700 area panels
CLRP6	2008	700 Area SMP, above 702/704 panels
CLRP7	2008	700 Area SMP, south of 700 area panels
CLRP10	2008	700 Area SMP, above 706 panel
CC113	2008	700 Area SMP, south of 700 area panels
CLRP8	Existing bore	Clarence Township. Piezo installed 2009
CC114	2009	800 Area SMP Application Area
CC115	2009	800 Area SMP Application Area
HV1	2009	Happy Valley Swamp (700 Area SMP)
HV2	2009	Happy Valley Swamp (700 Area SMP)
HVU1	2009	Happy Valley Upper Swamp (700 Area SMP)
HVU2	2009	Happy Valley Upper Swamp (700 Area SMP)
CLRP11	2010	700 West SMP Area
CLRP12	2010	700 West SMP Area
CLRP13	2010	800 Area SMP Application Area
CLRP14	2011	800 Area SMP Application Area
CLRP15	2011	Lithgow No.2 Dam
CLRP16	2011	Lithgow No.2 Dam

In August 2004, nested piezometer sites CLRP1 and CLRP2 were installed as baseline monitoring for the Eastern Area SMP. CLRP3 was then installed as an additional site in January 2006. CLRP1, CLRP2 and CLRP3 have been used to measure background groundwater levels and the subsequent impact from mining over a number of years.

CLRP4, CLRP5 CLRP6 CLRP7 CLRP10 and CC113 were installed to measure any potential impact from mining within the 700 Area. The first panel in the 700 Area (702 panel) completed extraction in early December 2009.

CLRP8 was an existing borehole located in the Clarence Township. Clarence Colliery installed a piezometer in the bore to measure potential impacts on the water supply for the Clarence village.

CC114 and CC115 were installed to collect background data for the 800 Area SMP application. These piezometers have not been undermined, but do provide data with the potential to detect groundwater related impacts beyond the mining area.

Shallow piezometers were installed in Happy Valley Swamp (HV1 and HV2) and Happy Valley Upper Swamp (HVU1 and HVU2) in December 2009. The two piezometers in each Swamp directly measure any impact on groundwater baseflows from undermining each swamp.

CLRP11, CLRP12 and CLRP13 were installed to collect further baseline data for the 700 West/800 Area SMP Application. Again, these piezometers have not been undermined, but do provide data with the potential to detect groundwater related impacts beyond the mining area.

CLRP15 and CLRP16 are located either side of the Lithgow No.2 Dam and are used to monitor potential impact on the dam from mining (including the currently approved first workings) within the Dam Notification Area.

The location of all piezometers is presented in **Appendix 1**.

3.5.1 Open Hole Piezometers

Open hole piezometers include CLR4, CLRP5, CLRP7, CLRP8, CLRP10, CLRP 15 and CC113. All groundwater levels (except CLRP4) in the open hole piezometers installed in the Clarence Aquifer showed slow, generally very consistent, rises in groundwater level during the period. CLRP4 and CLRP15 continued to show a flat trend.

Groundwater levels in all of these holes stand at generally high levels in the data record extending back to 2008, related to the generally wetter conditions since late 2010. It is noted that since around March 2012 there has been below average rainfall experienced.

There is no evidence of any mining-related impacts on any of these piezometers, based on the continuing uniform responses of the piezometers.

Monitoring results for piezometric height at CLRP4, CLRP5, CLRP6, CLRP7, CLRP8, CLRP10 and CC113 is presented in **Figure 52** below.

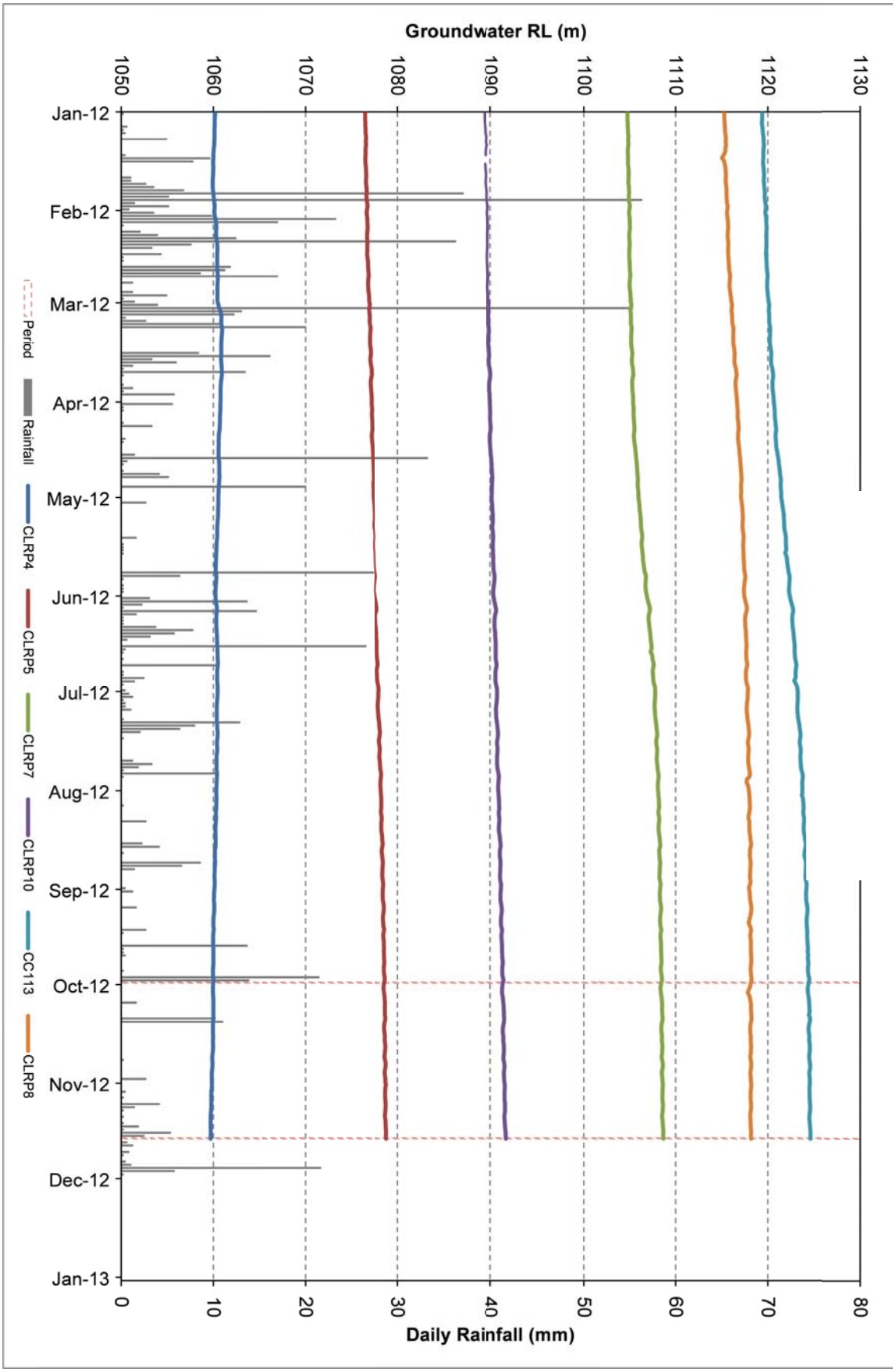

Figure 52 CLRP4, CLRP5, CLRP6, CLRP7, CLRP8, CLRP10 and CC113 Piezometric Height

3.5.2 Multi-Level Piezometers

3.5.2.1 CLRP1

Pillar removal was carried out in Panel 330 immediately to the north of this bore in late 2004. This resulted in a significant depressurisation of the Katoomba seam, as measured by piezometer 1, and a temporary fall in pressure in the piezo immediately above the seam, due to relaxation of the strata. There was no evidence of any permanent mining-related impacts in the three piezometers higher up in the bore (including the two in the Banks Wall Sandstone), although piezometer 2 just above the roof of the seam did show partial depressurisation followed by near-complete recovery. Since that time there have been no further indications from the data recorded to date of any mining-related impacts.

Monitoring results for piezometric height at CLRP1 is presented in **Figure 53** below.

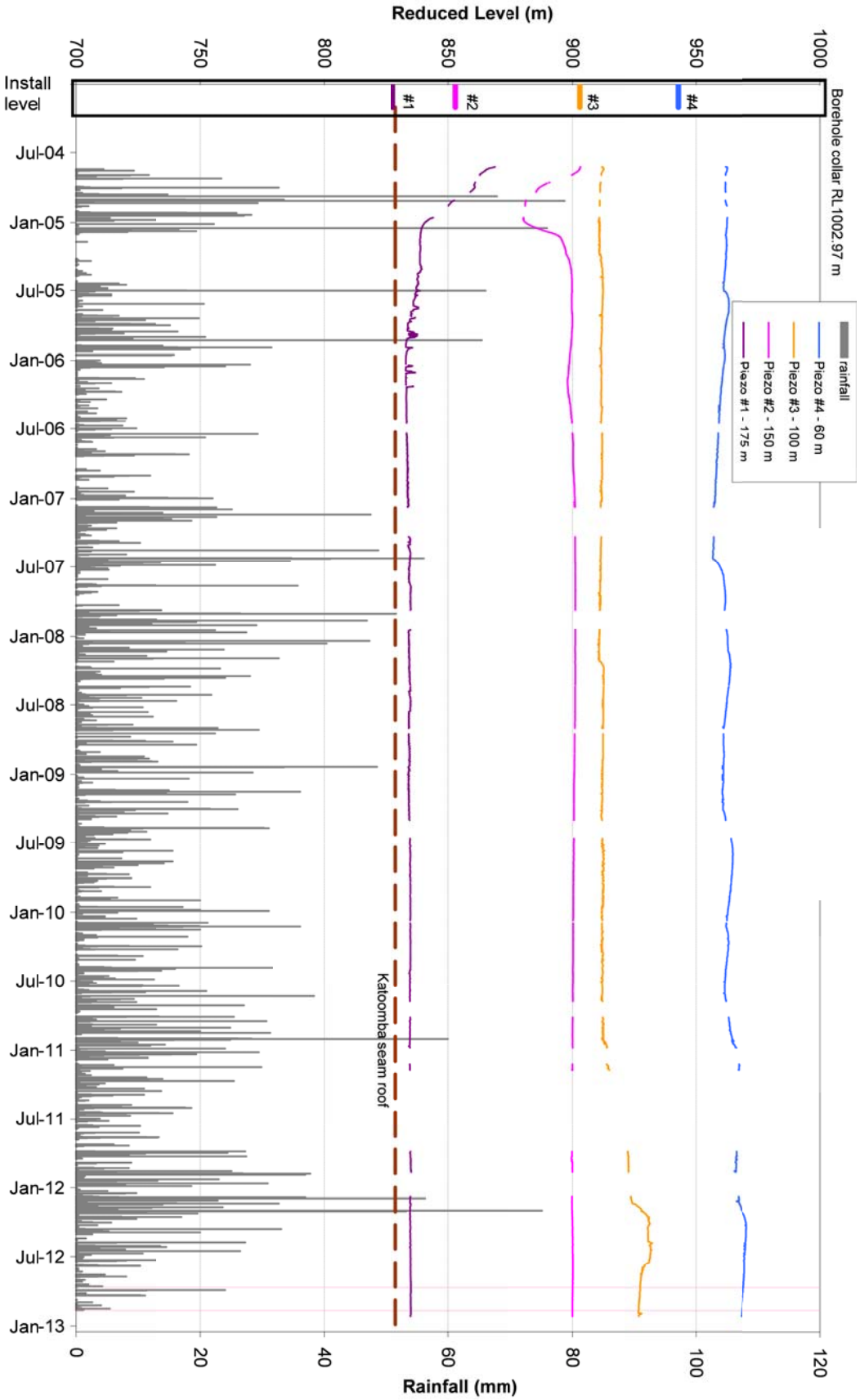

Figure 53 CLRP1 Piezometric Height

3.5.2.2 CLRP2

Total depressurisation occurred in piezometer 1 in the coal seam in August 2007 after mining below the borehole, as would be expected. The other three piezometers showed no impact from mining at the time, and continued to show no impact from mining.

The data does not indicate any adverse impact on the near-surface aquifers. If there was any serious, adverse impact, then the plot of the piezometric pressures would show a rapid decline. The increase in pressure suggests that there has not been any cracking which could serve to drain the strata downwards into the mine. The magnitude of the pressure increases measured in the upper aquifers is not sufficient to cause hydraulic fracturing in the strata, especially given the in-situ confining pressure.

Monitoring results for piezometric height at CLRP2 is presented in **Figure 54** below.

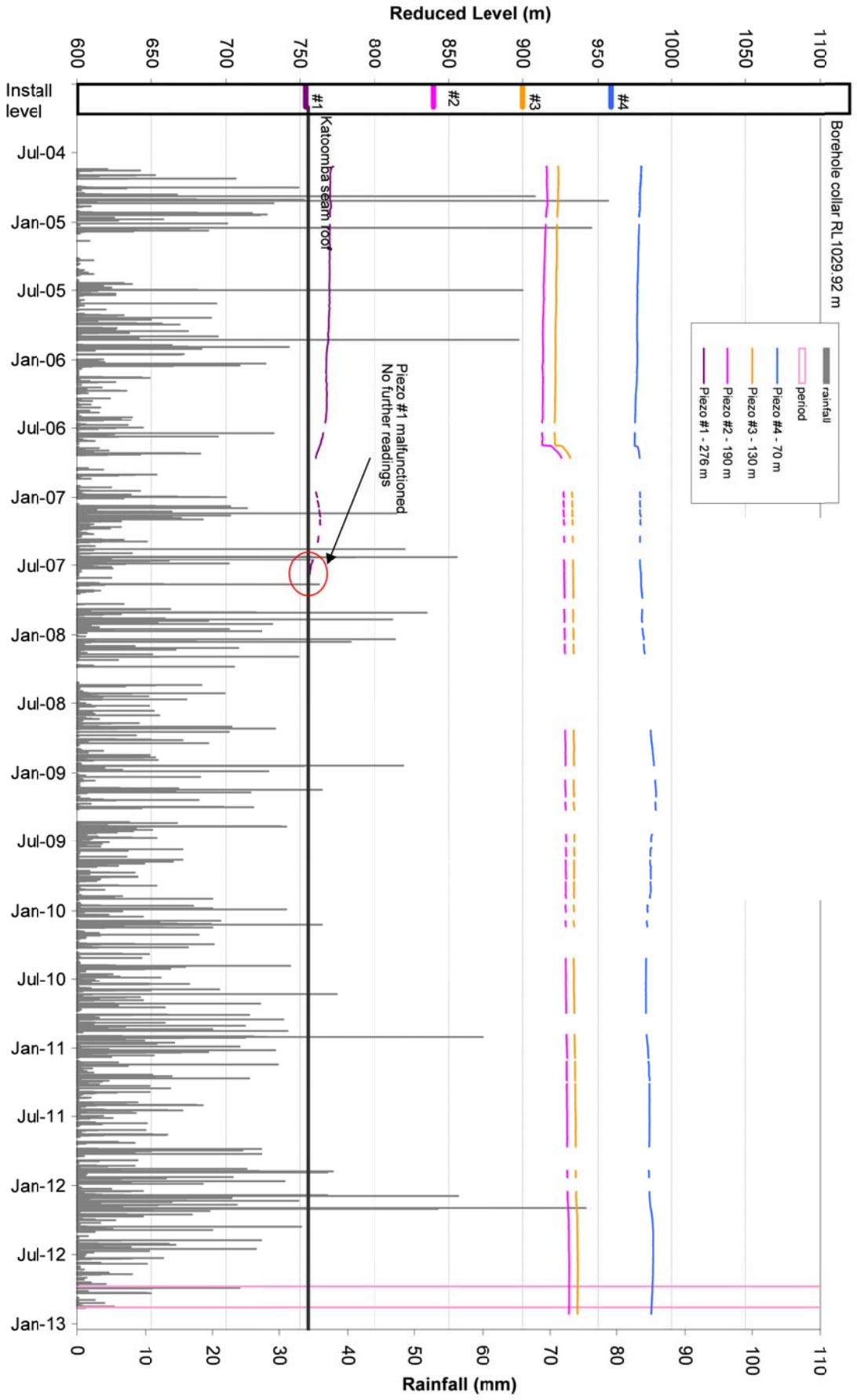

Figure 54 CLRP2 Piezometric Height

3.5.2.3 CLRP3

This borehole was undermined shortly after it was installed in 2006, with no mining-related impacts evident in the data up to the present.

Monitoring results for piezometric height at CLRP3 is presented in **Figure 55** below.

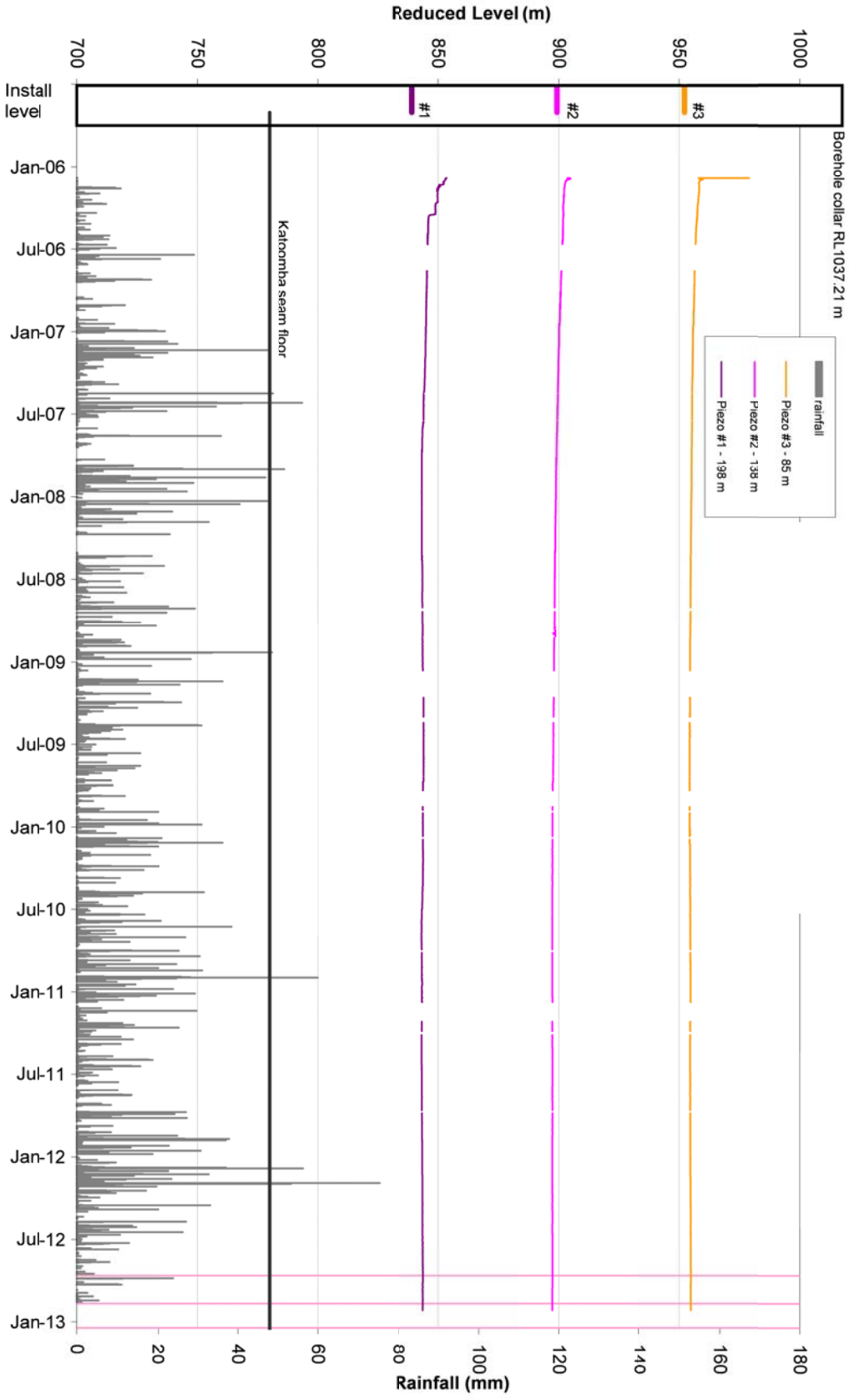

Figure 55 CLRP3 Piezometric Height

3.5.2.4 CLRP6

Partial extraction occurred in September 2009 directly beneath this borehole, and the adjacent panel was partially extracted in December 2009. There is no evidence from the data of any adverse mining-related impacts on the strata containing the two functional piezometers during the extraction of either of these panels. The data continue to suggest that there is no evidence of any adverse mining-related impacts on the strata from subsequent mining.

Monitoring results for piezometric height at CLRP6 is presented in **Figure 56** below.

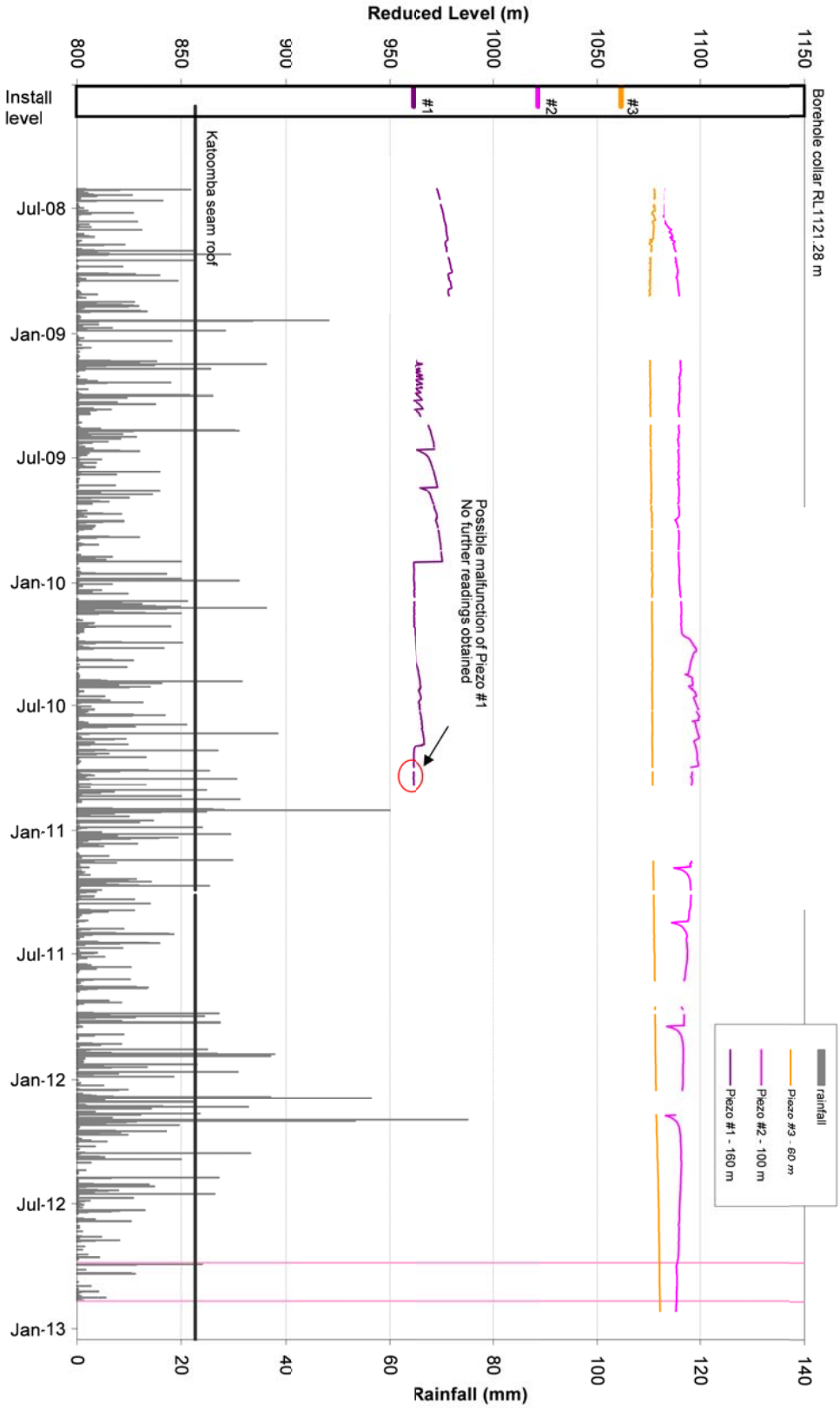

Figure 56 CLRP6 Piezometric Height

3.5.2.5 CLRP15

First workings occurred in panel 716 panel over 500 m northeast of the borehole in September 2011 with no further development since this time. The level trends and indication of flow towards the reservoir indicate that there is no recognisable impact from mining.

Monitoring results for piezometric height at CLRP15 is presented in Figure 57 below.

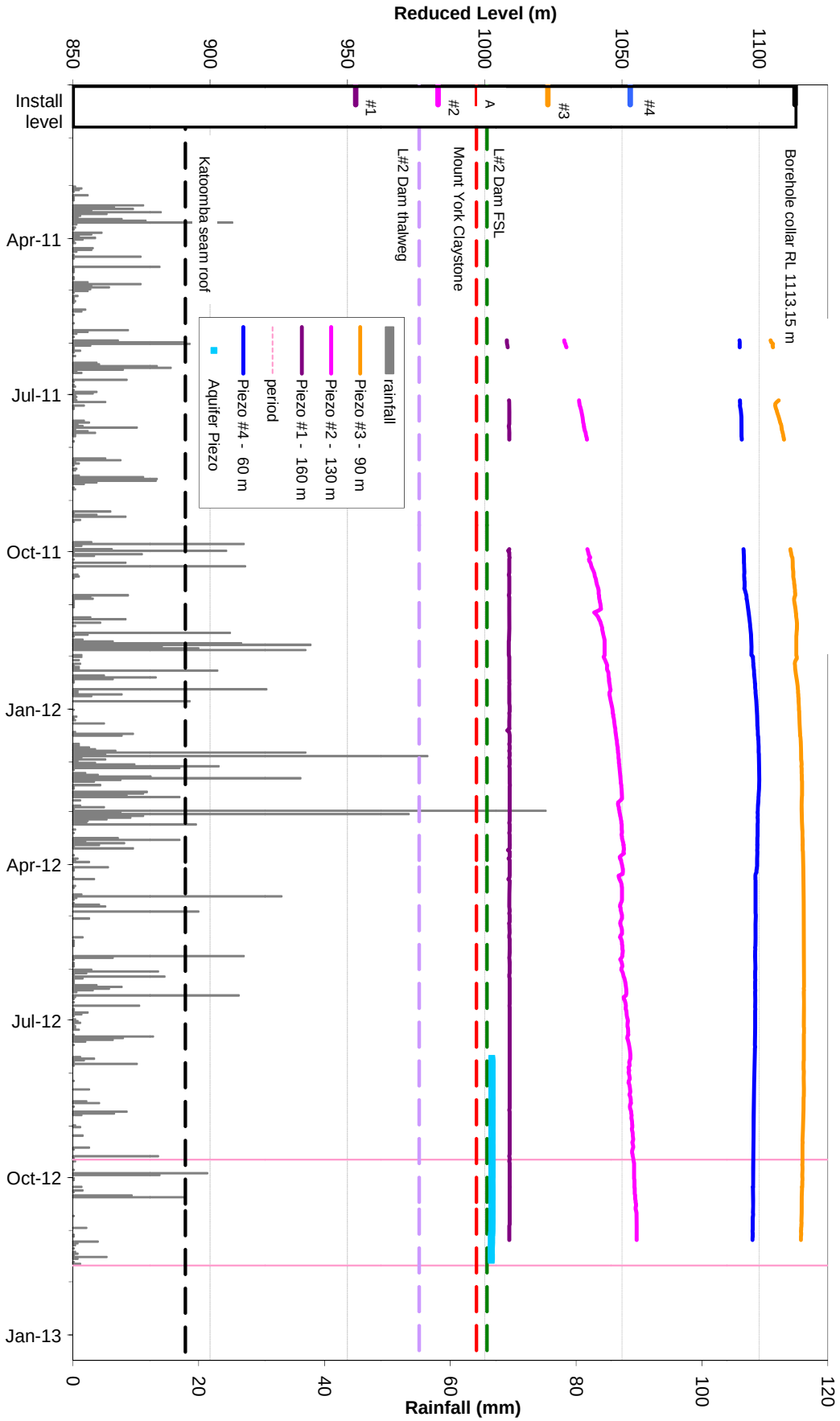

Figure 57 CLRP15 Piezometric Height

3.5.2.6 CLRP16

First workings in 700 panel were 750 m east of the borehole in June 2011 with no further development since this time. There is no evidence of mining impact in the groundwater record. The change in trend in piezometer 1 is not seen in piezometer CLRP15, which is located closer to the workings. As a result, it is highly unlikely to be caused by mining effects.

Monitoring results for piezometric height at CLRP16 is presented in **Figure 58** below.

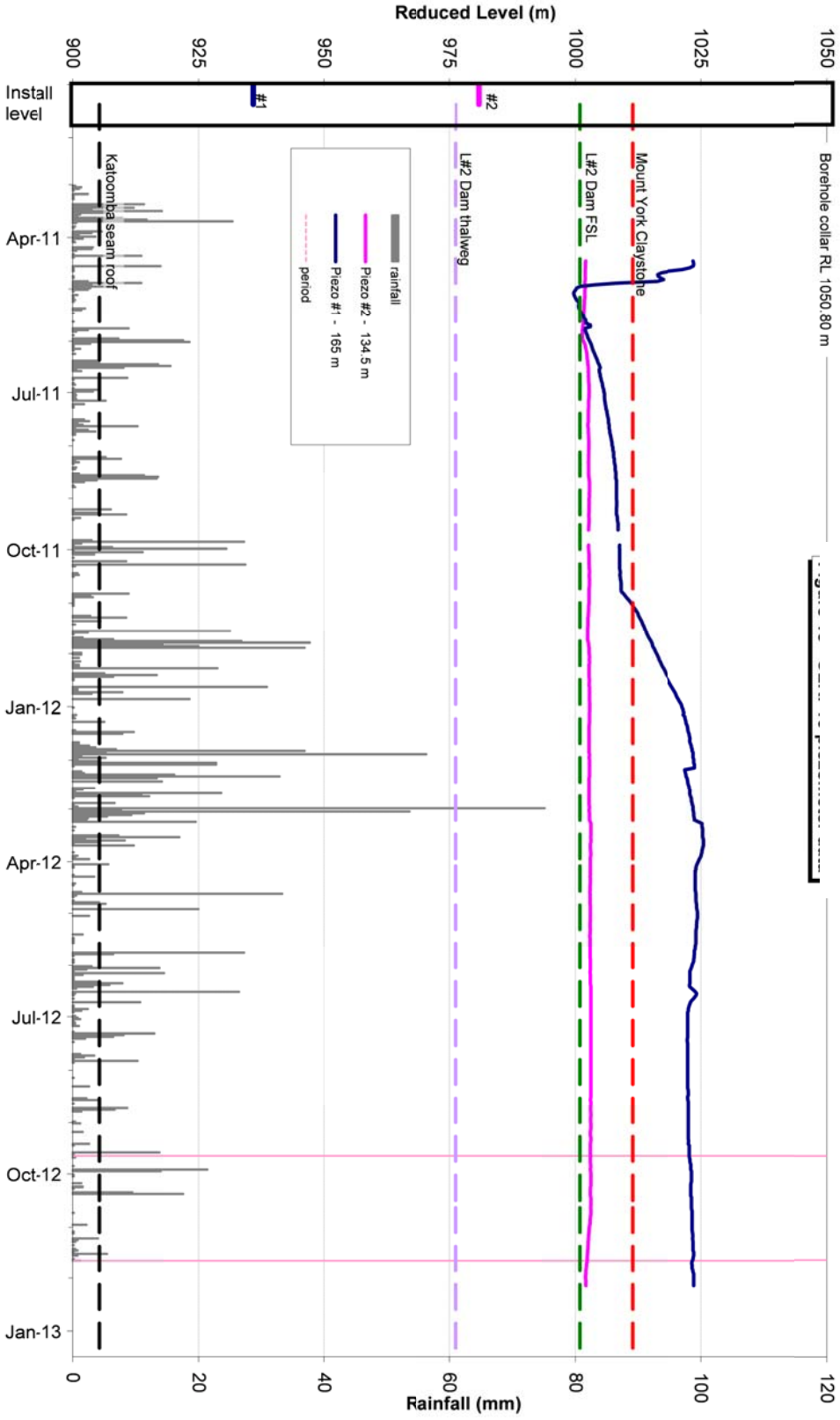

Figure 58 CLRP16 Piezometric Height

3.5.3 Shallow Groundwater Monitoring in Swamps

Happy Valley Upper Swamp was undermined in March 2010, when partial pillar extraction was carried out in panel 704. In April 2011, partial pillar extraction occurred in panel 708, c. 300 m west of the swamp. In January 2011, first workings were driven in panel 712, c. 700 m west of the swamp. In September 2011, first workings occurred in panel 706 immediately west of HVU2.

There is no evidence from the data of any impact on the groundwater levels in the swamp that could be attributed to the mining. Continuing monitoring shows groundwater level behaviour that is typical for these swamps in areas that have not been undermined. Changes in the measured groundwater levels appear to be due solely to prevailing weather conditions.

Monitoring results for piezometric height at HV1, HV2, HVU1 and HVU2 is presented in **Figure 59** below.

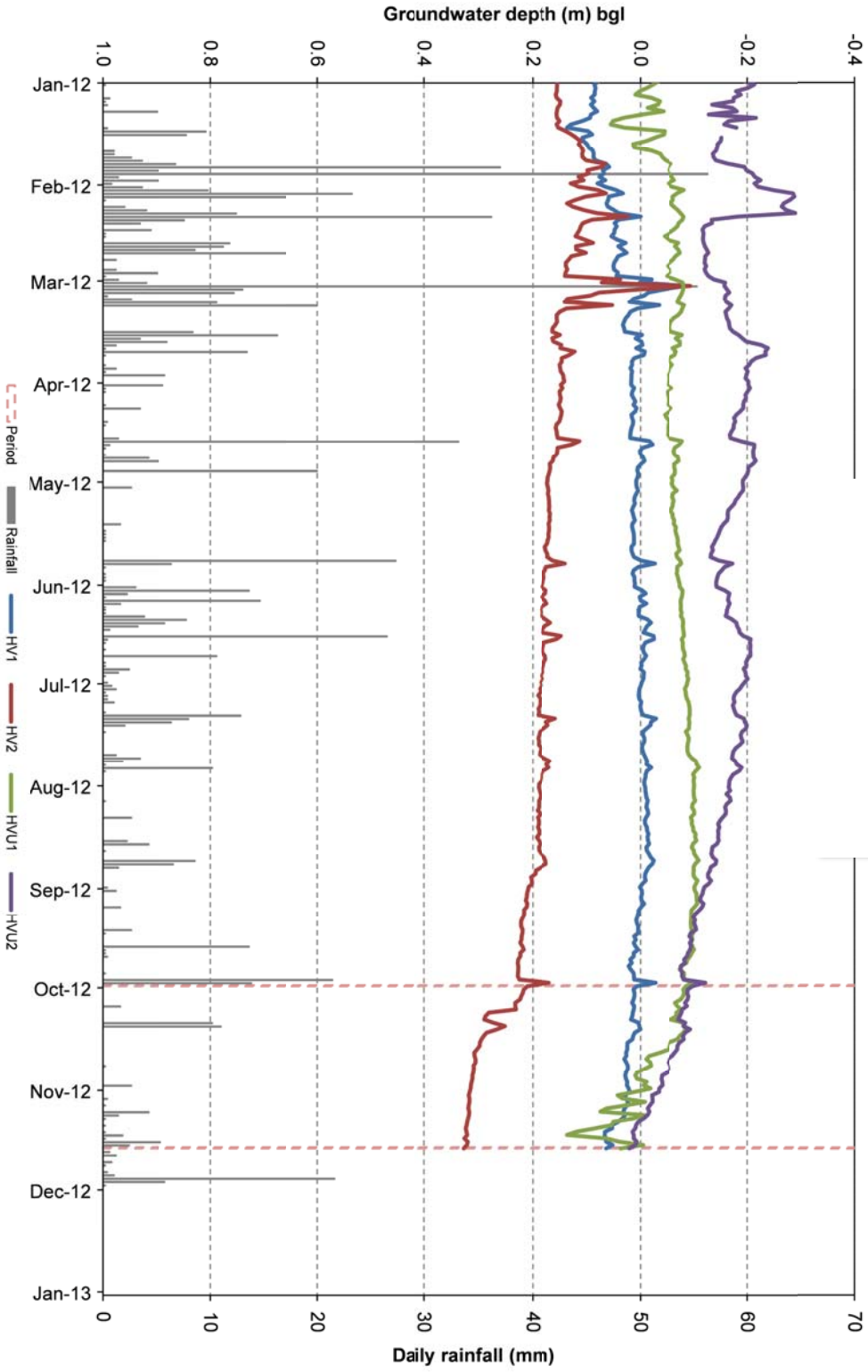

Figure 59 HV1, HV2, HVU1 and HVU2 Piezometric Height

3.6 Threatened Flora

3.6.1 Flora Monitoring Surveys

Flora monitoring fieldwork at Clarence Colliery's pagoda, heath and wet gully sites is undertaken by Roger Lembit of Gingra Ecological Surveys. Flora monitoring field work within swamp vegetation communities is undertaken by the University of Queensland (**UQ**). Swamp vegetation communities include Newnes Plateau Shrub Swamps (mapping unit MU50) and Newnes Plateau Hanging Swamps (mapping unit MU51). A report for swamp vegetation monitoring covering all Centennial sites mining underneath the Newnes Plateau is compiled and reported by the Centre for Mined Land Rehabilitation at the UQ. Fieldwork is undertaken three times per year – autumn, spring and summer.

Results for 2012 surveys across all swamp sites on the Newnes Plateau are presented in the report *Annual 2012 Flora Report for Angus Place, Springvale and Clarence Mines, Lithgow, NSW*. The Clarence swamp monitoring sites are described in **Table 15** below. A map of the monitoring sites is included in **Appendix 1**.

Table 15 Clarence Swamp Flora Monitoring Site Reference Name and Location

Site	Swamp
BNS01	Bungleboori North 1
BNS02	Bungleboori North 2
CLA01	Banksia Swamp
CLA02	Banksia Swamp
CLA03	Prickly Swamp
CLA04	Prickly Swamp
CLW02	Piezo #2 Swamp
CLW03	Happy Valley Swamp
CLW04	Swamp
CLW05	Pine Swamp

3.6.2 Swamp Vegetation

The vegetation monitoring being undertaken is conducted in a manner which allows assessment against a number of indicators which may provide evidence of an effect of subsidence. These indicators are:

- Species richness - allows for a quick measure of a site's complexity and can be compared across both season and year;
- Species composition - shows the movement of sites in relation to their species composition across the seasons within 2012;
- Exotic species - exotic plant species, or weeds, can be used as indicators of ecosystem change as they generally only occur in vegetation that has had some level of disturbance (particularly human mediated); and
- Relationship between condition and abundance for selected species - compares the condition of dominant species with scores recorded in previous monitoring and with time since undermining.

- Swamp vegetation monitoring in 2012 was undertaken in February (summer), May (autumn) and October (spring).

No swamp monitoring sites were directly undermined during the reporting period. Site CLW03 is located on the barrier between panels 710 and 708. Extraction within panel 710 occurred adjacent to CLW03 in October 2010 and extraction in panel 708 adjacent to the site in December 2010.

3.6.3 Species Richness

Species richness at each monitoring site is presented in **Figure 60**.

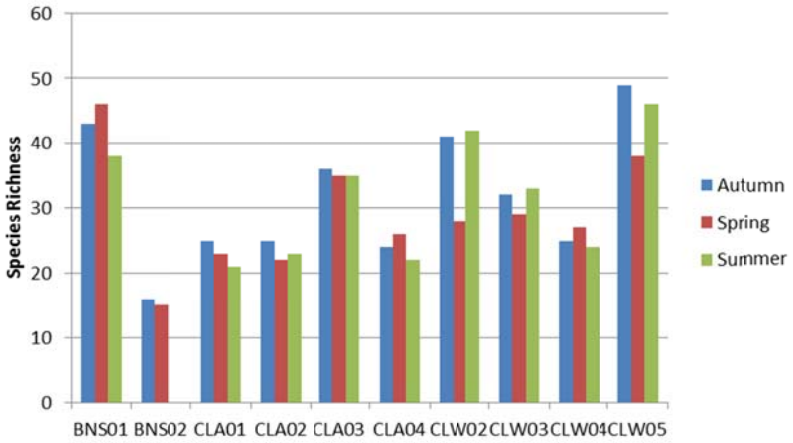

Figure 60 Species richness at each site for each 2012 season at Clarence sites (UQ, 2012)

At Clarence, site CLW05 again demonstrated the greatest number of species recorded each season throughout the year, with 49 species the highest recorded in autumn. Site CLW05 is classified as a Newnes Plateau Shrub Swamp, and is a relatively open and weedy site close to a pine plantation. Site BNS02 continues to have the lowest species richness of the Clarence sites.

3.6.4 Species Composition

Composition of species at each site was examined using PRIMER and MDS analysis. This analysis shows the movement of sites in relation to their species composition across the summer, autumn and spring of 2012. The data is presented in **Figure 61**.

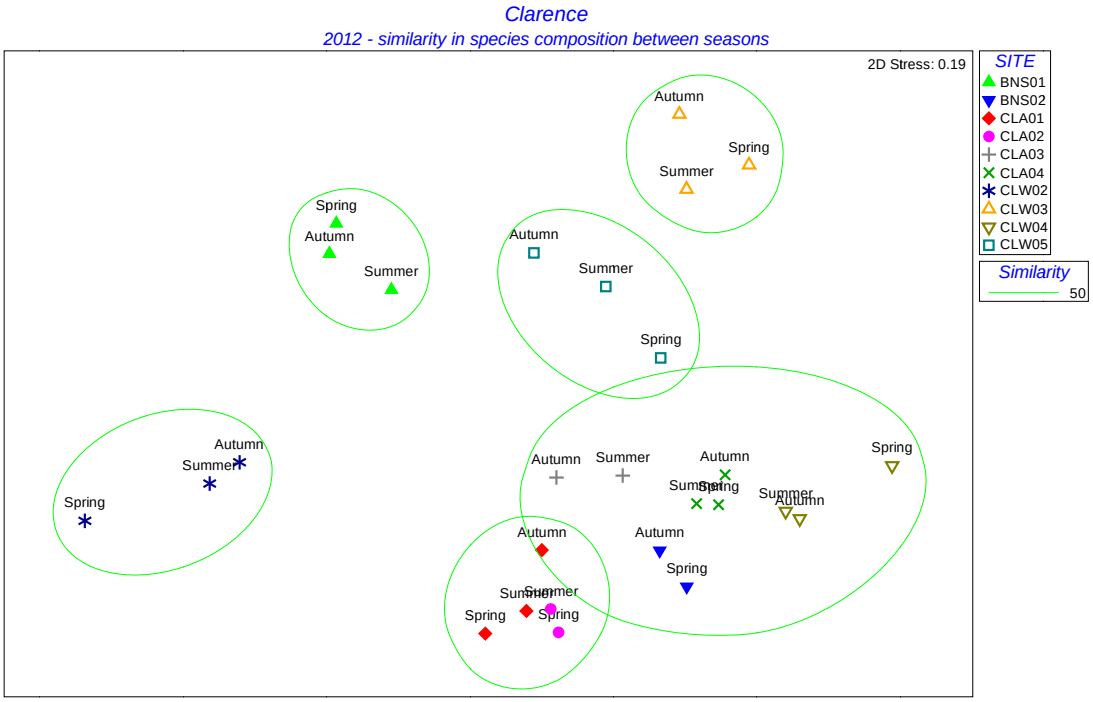

Figure 61 Clarence Species Composition 2012 (UQ, 2012)

Sites BNS01, CLW03, CLW05 and CLW02 continue to have different species composition from the bulk of the sites at Clarence as demonstrated by the figure above. Although BNS01 and CLW03 are classified as Newnes Plateau Shrub Swamps (NPSS) and are dominated by *Leptospermum grandifolium*, as are many of the other NPSS sites at Clarence, CLW03 also has a high cover/abundance of *Baumea rubiginosa* and *Hemarthria uncinata* (Matgrass) which separates it from the other sites. Similarly, BNS01 although dominated by *Leptospermum grandifolium* has a high abundance/cover of *Eucalyptus mannifera* and *Pinus radiata*. Site CLW02, classified as a NPHS (MU51) is unlike the NPSS sites in that is dominated by low growing *Lepidosperma limicola* and *Patersonia fragilis* with occasional shrubs.

Overall, many of the small progressive changes in species composition between years at individual plots (both undermined and controls) that have been found appear to be driven by small increases in species diversity detected over time within plots. Closer analysis of the PRIMER data revealed small increases in the detection frequency of a wide variety of different herb, grass and even shrub, species over time. These increases apply to both damp habitat and drier habitat species in both undermined and control plots and so therefore do not appear likely to be indicative of hydrology-driven changes in species composition linked to undermining. It is also possible that species composition variations are due to climatic changes over the seasons and years.

While the general trend of increasing species diversity detected across monitoring plots may reflect a real change, this result may also have been contributed to by changes in field staff, increases in search effectiveness over time due to observer learning, or increases in the total search effort per survey over time. Before 2009, plot surveys were conducted by one person. Since 2009, plot surveys have routinely been carried out by two or more field staff, using the same sampling methodology. In 2012 search intensity may have been inadvertently increased due to the use of new field staff and the trialling of an additional, more intensive, quantitative vegetation survey method within plots.

3.6.5 Exotic species richness

Exotic species richness is presented in **Figure 62**.

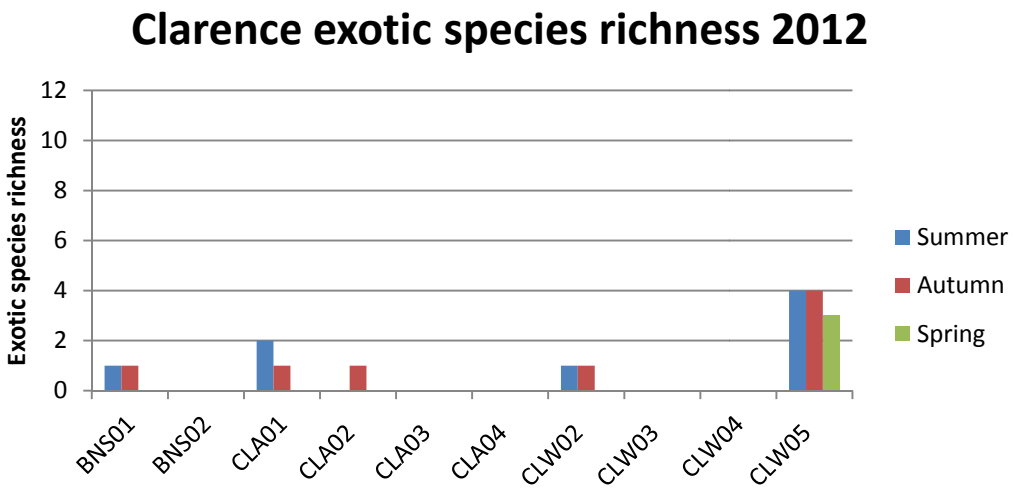

Figure 62 Clarence exotic species richness 2012

The greatest exotic species richness at Clarence was again recorded at site CLW05; this is in keeping with previous assessments. This site is located beside a road and down slope from a pine plantation and is likely subjected to increased nutrient flow and run off which may have contributed to the increased presence of exotic species at this site. In comparison with last year the presence of exotic species at this site has decreased by approximately 3 species. The presence of standing water at this site during late 2011 is thought to have contributed to the overall reduction in species richness and consequently reduction in exotic species also. Several sites including BNS02, CLA03, CLA04, CLW03 and CLW04 remain weed free.

3.6.6 Relationship between condition and abundance for selected species

Figure 63 and **Figure 64** below compare the condition of dominant species (using the condition scale) with scores recorded in previous monitoring and with time since undermining.

Abundance scores for the same plant species as measured for the condition scale have also been shown below to establish if any trends are apparent between the two scales. Selected sites are those that have been undermined. At some sites particular species have not been measured for condition each season and so data is not available for these seasons. This problem has since been rectified, by having a set list of dominant species measured for condition each season in addition to any others that the observers feel should be recorded.

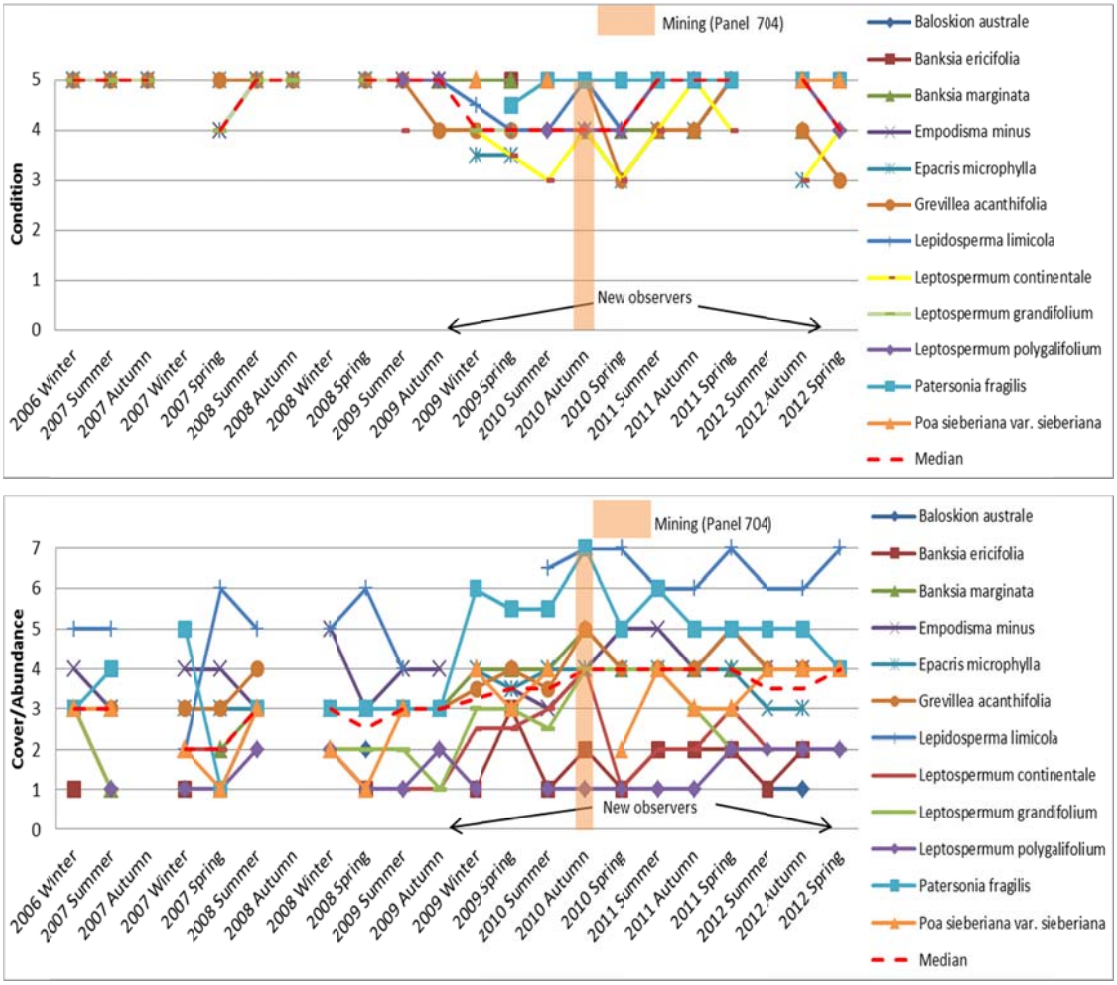

Figure 63 Condition (a) and Cover/Abundance (b) of species at CLW02

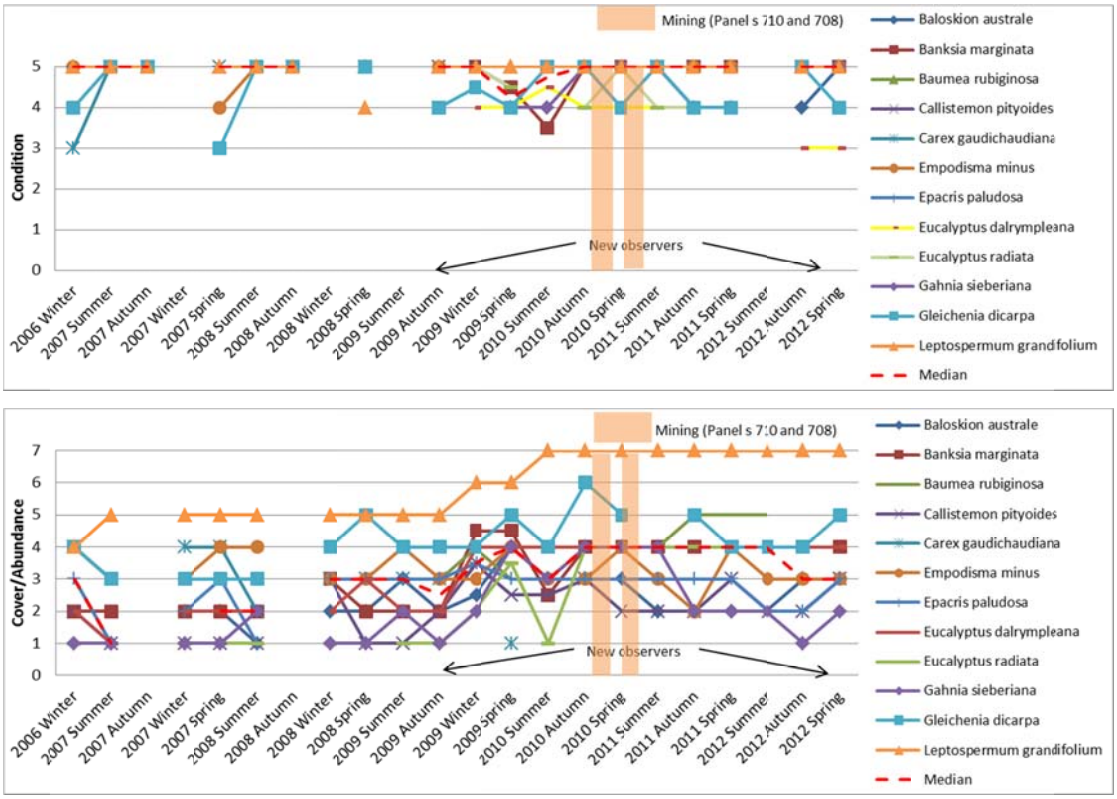

Figure 64 Condition (a) and Cover/Abundance (b) of species at CLW03

While the figures shown below are primarily being compared with time since undermining or the change in observers, care should be taken to also consider climate. Since 2005, all years, with the exception of 2007 and 2010 have shown below average rainfall anticipated for the Newnes Plateau. The data show that fluctuation in the condition and cover/abundance of species over time is common across sites. This may be due to a number of factors including:

- climatic conditions such as temperature, rainfall, snowfall or frost (as is often the case for frost sensitive species such as *Gleichenia dicarpa*),
- the observers' interpretation of the assessment scales,
- disturbance due to undermining or
- another mechanism (e.g. emergency discharge events, pine plantation fertiliser runoff, recreational trail bikes, fire etc.)

It is apparent that a change in observers may result in a change in cover/abundance and condition scores, as can be seen throughout the following figures when observers were introduced in autumn 2009. There was little apparent change in the cover/abundance or condition scores associated with the introduction of new observers in spring 2012. Average condition scores are presented for the first time as medians, rather than means, as this is a more robust measure for the ordinal data presented here.

Two sites were assessed at Clarence for condition and abundance. Site CLW02 showed an improvement in average condition when compared with 2010 with an increase in condition for species *Leptospermum continentale*, *Empodisma minus* and *Leptospermum polygalifolium*. Abundance of species at this site remained stable, the most abundant species being *Lepidosperma limicola*. Site CLW03 remained stable for both condition and abundance, at this site the most abundant species was *Leptospermum grandifolium*.

The general increases in both condition and abundance are most likely attributable to improved conditions, such as constant rainfall for species at these sites.

The two sites assessed at Clarence for condition and abundance, and CLW03. At both sites, the vegetation condition and cover/abundance scores were stable throughout 2012. There were no changes of greater than one class, and there was no obvious pattern in the direction of those changes.

3.6.7 Swamp Vegetation Monitoring Conclusion

Results presented in 2012 generally concur with those of the 2009, 2010 and 2011 annual reports. There is no evidence of potential effects from subsidence upon swamp vegetation.

3.6.8 Heath/Pagoda Flora Monitoring Survey Results

Heath and pagoda sites are monitored three times per year in summer, autumn and spring. Monitoring surveys involve recording of vegetation structure, dominant species, estimated cover and height for each stratum, full floristics, an estimated cover abundance for each species using a modified Braun-Blanquet scale and condition ranking for plant species observed to be outside the normal range of plant health. Observations of general condition of vegetation in less sensitive forest and woodland habitats were also recorded where relevant, as are fauna sightings.

3.6.8.1 700 SMP and Eastern SMP Areas

A total of six sites in the Eastern area (with two control sites) and two sites in the Clarence 700 area (with one control site) are monitored. **Table 16** provides a summary of the sites monitored throughout 2012.

Table 16 700 Heath/Pagoda Flora Monitoring Sites (Eastern and 700 Areas)

Site	Location	Easting (AMG)	Northing (AMG)
Clarence East			
PAG01	Gorilla Rock	246648	6299845
PAG02	Gorilla Rock	246650	6299734
PAG03	Waratah East	247146	6300517
PAG04	Waratah East	246938	6300594
PAG05 (C)	Waratah North	247857	6303770
PAG06 (C)	Waratah North	247783	6303720
Clarence West (700 Area)			
CLW01	Heath	241669	6295394
CLW06 (C)	Heath - Paddy's Creek ridge	240367	6298981

Note: (C) denotes control site

Throughout 2012, plants were found generally to be in good condition, however the autumn period noted leaf yellowing and die back more prevalent than observed in previous monitoring periods. There was no evidence of death or dieback which could be attributed to an effect of subsidence.

Plant species richness records were within the range previously recorded across sites. There was no diverging trend between impact and control sites. The only trending noted was that relating to seasonal conditions. **Figure 65** shows species richness trends recorded since Summer 2009.

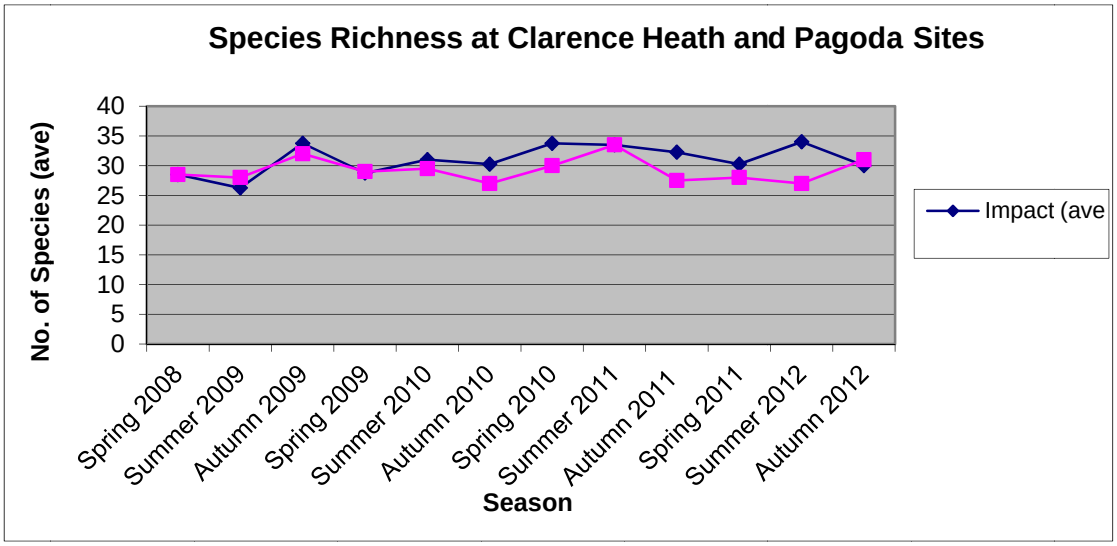

Figure 65 Species Richness at Clarence Heath and Pagoda Sites (Eastern and 700 Areas)

No exotic species were recorded at any of the sites throughout 2012.

A number of species have either increased or decreased in cover/abundance within sites, although all species previously recorded as having changed in abundance have been stable over the past twelve months. No consistent trend has been observed that would indicate an effect of subsidence.

3.6.8.2 Outbye SMP Area

Four vegetation monitoring quadrats have been established within the heath vegetation in the Outbye Area. There are also two control sites. Locations of these sites are presented in **Table 17.**

Table 17 700 Area Heath/Pagoda Flora Monitoring Sites (Eastern and 700 Areas)

Site	Location	Easting (MGA)	Northing (MGA)
CLAO01	Above 307 south of Bungleboori Creek	245023	6297763
CLAO02	Above 307 south of Bungleboori Creek	245092	6297707
CLAO03	Above 402, north of Bungleboori Creek (completed June 2009)	245504	6298627
CLAO04	Adjacent to 602, north of Bungleboori Creek (completed April 2009)	245294	6299168
PAG05 (C)	North of Waratah Ridge;	247962	6303960
PAG06 (C)	North of Waratah Ridge;	247888	6303910

Note: (C) denotes control site

Plants in the Outbye area (associated with the monitoring program) were generally in good condition. There were signs of dieback within the control sites and also some die back at CLA002. The condition of the plants across the Outbye sites reflects the seasonal conditions which prevailed over 2012.

Species richness at the outbye sites has generally been higher than the baseline levels established in Spring 2008 with very little variation in average richness across the sites of the year. **Figure 66** shows species richness trends recorded since spring 2008.

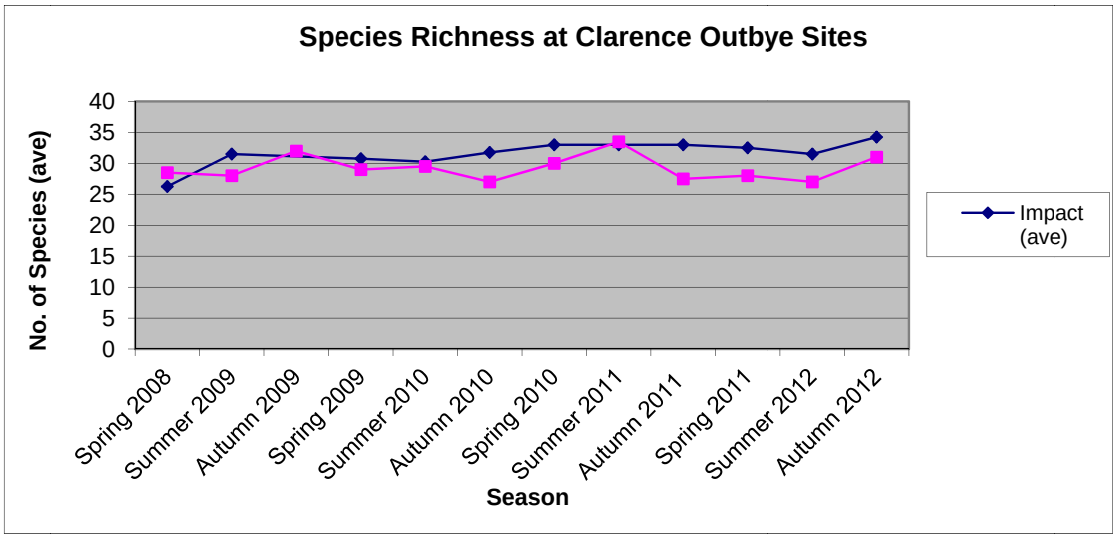

Figure 66 Species Richness at Clarence Heath and Pagoda Sites (Outbye Areas)

There was no evidence of weed invasion over the monitoring period.

A number of species have either increased or decreased in cover/abundance within sites, although all species previously recorded as having changed in abundance have been stable over the past twelve months. No consistent trend has been observed that would indicate an effect of subsidence.

There is no indication that subsidence associated with mining of the Outbye Area is having an impact on the health of vegetation. The species composition is stable, there was no evidence of dieback at Outbye sites and there was no evidence that other potential indicators of an effect are in operation. Further, no surface expression of subsidence was observed in or near the monitoring sites.

3.6.8.3 800 SMP Area

Clarence also undertakes flora monitoring of eight sites within the 800 Area. As no mining has taken place, this monitoring (which commenced in Autumn 2009) continues to build on the baseline set of data. The sites sample a range of flora monitoring habitats including riparian, open forest vegetation, NPSS and heath vegetation. Results from the monitoring will not be reported as the area is yet to be approved and there is no approved environmental monitoring program.

3.7 Threatened Fauna

Fauna monitoring at Clarence Colliery is undertaken by Biodiversity Monitoring Services. Fieldwork is undertaken three times per year – autumn, spring and summer.

Long term fauna monitoring sites were established in 2004 for sites within the Eastern SMP Application area and in 2008 for sites within both the Outbye and 700 SMP Application Areas to identify impacts (if any) of mining induced subsidence on native fauna. Fauna monitoring for the 314/316 Panel SMP area is covered under the Outbye Areas monitoring. In 2009, further sites were established for background monitoring within the proposed 800 Area. Mining in the 800 Area has not commenced and therefore these results are not reported.

Extraction within the first panel of 700 Area (702 panel) was completed in December 2009. During the reporting period secondary (partial) extraction occurred within panels 707 and 714. No extraction occurred within the Outbye SMP Areas or Eastern SMP Area during 2012.

Locations of fauna monitoring sites can be seen in **Appendix 1**.

Fauna monitoring undertaken uses the methods of setting traps including Elliot traps, tomahawk cage traps, glider traps, reptile funnel traps and also spotlighting, hair funnels, bird surveys, call broadcasting, herpetological searches, bat call detection, animal track recognition and opportunistic observations. Pit traps have not been established due to difficulty in establishing pits in stony ground associated with pagoda areas.

Data analysis criteria used to monitor fauna following surveys are described in **Section 3.7.1**.

3.7.1 Criteria Used to Monitor Fauna

Data analysis criteria used to monitor fauna following surveys are:

- *Species richness of faunal groups* - The number of species within each faunal group provides an index of its biodiversity. The higher the species richness, the higher the biodiversity. A high biodiversity index indicates an area containing a variety of natural habitats in good condition. Three main faunal groups have been identified including native mammals, reptiles and birds.
- *Diversity indices of faunal groups* - A diversity index combines species richness and individual numbers to provide a better indication of biodiversity. The closer the Simpson's Index of Diversity is to one, the higher the biodiversity and, by implication, the better the area for fauna.
- *Capture rates of individual species* - Small mammals captured in Elliott traps provide a capture rate (expressed as % of trap-nights) that can be used as a rough estimate of an index of population size.
- *Population status of species* - Derivation of the local population status of species requires a relatively large dataset. Population status is based upon the numbers and distribution of each species within the SMP areas.
- *Contribution to the faunal assemblages by threatened species, species dependent upon woodland and by species declining in the Central West* - Lists are available of bird species that are considered to be declining and/or woodland dependent in the Central West. These lists were used to calculate the proportion of birds located within the SMP Areas that are considered to be under threat. The higher the proportion, the greater the value that can be placed on the present habitat in the area.
- *Habitat complexity scores* - Measurements of habitat characteristics derived from trap site descriptions have been used to provide an index of habitat complexity that can be helpful in determining changes over time of the habitats surveyed in the SMP Areas. The walking transects can also provide an index, but such transects are difficult to undertake in swamps and do not provide clear results. One system used to assess habitat values is that developed by Catling and Burt (1995), called the Habitat Complexity Score. This system scores the following parameters: Tree cover, tall and low shrub cover, ground cover, logs/rocks and litter cover. The scores range from 0 to 3, hence the maximum score is 18.
- *Comparisons between Treatment and Control sites* – Compares sites that have been undermined (treatment sites) with those outside mining areas (control sites).

3.7.2 Western 700 Area

Six long term fauna monitoring sites have been established within the 700 SMP Area to identify impacts (if any) of mining induced subsidence on native fauna as presented in **Table 18** below.

Table 18 700 Area Fauna Monitoring Sites

Site	Type	Landscape	Undermining Status
CLW01	Control	Pagoda	Not undermined
CLW02	Treatment	Swamp	Undermined November 2009
CLW03	Treatment	Swamp	Undermined October 2010
CLW04	Control	Swamp	Not undermined
CLW05	Control	Swamp	Not undermined
CLW06	Treatment	Pagoda	Undermined November 2011

3.7.2.1 Species Located in the Western 700 Area

A total of 72 bird, 10 reptile, five amphibian and 21 native (plus five introduced) mammal species were located within the Clarence Colliery Western SMP Application areas (the 700 Area) during the 2012 surveys. A total of 109 bird, 22 reptile, 34 native mammal and seven amphibian species have been recorded from the areas. Six threatened species were located during 2012.

The diversity of all species was relatively high, including amphibian species. The dry warm conditions throughout most of 2012 may have assisted in the use of Newnes Plateau by some species.

A number of new species were located within the SMP area in 2012. This is indicative of the increased productivity in this part of Newnes Plateau. Additions to the listings are the Collared Sparrowhawk, Black-shouldered Kite, Lewin's Rail, Pilotbird, Shining Bronze-Cuckoo, Rose Robin, White-winged Triller, Olive-backed Oriole, Lesueur's Tree Frog, Peron's Tree Frog, Eastern Water Dragon, Southern Scaly-foot, Black Rock Skink, Water Rat and Feral Pig. Both the Lewin's Rial and Water Rat are new recorded species in Newnes Plateau. The number of species located has increased over the years, as expected with continued surveys. It is expected that a number of new species located each year will continue to occur as the surveys continue.

Twenty threatened species have been located within Clarence Colliery Western SMP Application areas as a result of the surveys up to 2012. These are the Gang-gang Cockatoo, Glossy Black-cockatoo, Brown Treecreeper, Hooded Robin, Scarlet Robin, Flame Robin, Varied Sittella, Masked Owl, Powerful Owl, Squirrel Glider, Eastern Pygmy-possum, Large-eared Pied Bat, Greater Broad-nosed Bat, Large-footed Myotis, Eastern False Pipistrelle, Eastern Bentwing Bat, Little Pied Bat, Blue Mountains Water Skink, Giant Burrowing Frog and the Giant Dragonfly . Some of these species are dependent upon large areas of native woodland for populations to survive. In the Newnes Plateau region woodland habitat has been retained (albeit logged), and these threatened species are still to be located. Several of the threatened species are found in most years e.g. Gang-gang Cockatoo, Flame and Scarlet Robins, Brown Treecreeper and Eastern Bentwing Bat.

Few of the threatened species would be directly affected by subsidence-induced changes to their preferred habitat, with exception of the Large-eared Myotis, Eastern Bent-wing Bat, Blue Mountains Water Skink and Giant Dragonfly. The bats can roost in caves and overhangs and the Blue Mountains Water Skink and Giant Dragonfly are associated with wet swamps. Both habitats can be directly affected by

subsidence effects (cliff collapse and swamp drainage) but there is no evidence of such impacts occurring in the Clarence West SMP areas. Despite searching preferred habitats during the warmer months in 2012, there was no evidence of the presence of the Blue Mountains Water Skink and Purple Copperwing Butterfly in the area.

3.7.2.2 Species Richness of Faunal Groups

The species richness for the three groups over 2006 to 2012 is presented in **Figure 67**.

The trend lines for species richness show that all three groups have increasing species diversities over the years.

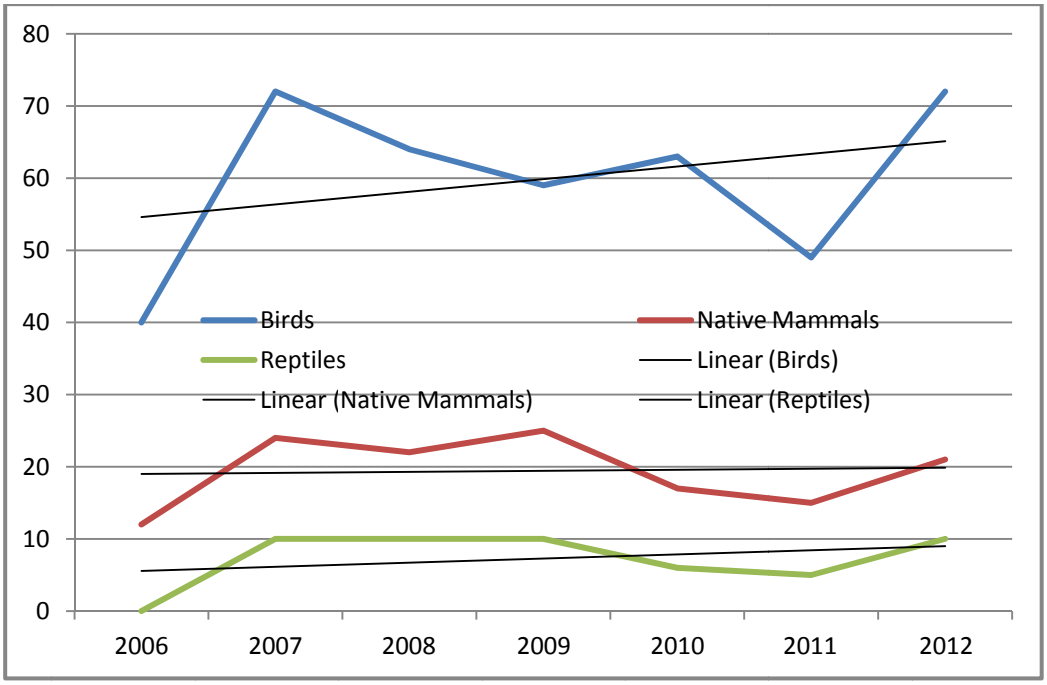

Figure 67 Species Richness at Clarence Colliery Western (700) SMP areas

3.7.2.3 Diversity Indices

Simpson's Index of Diversity and Evenness for the three main faunal groups are presented in **Figure 68** and **Figure 69** respectively.

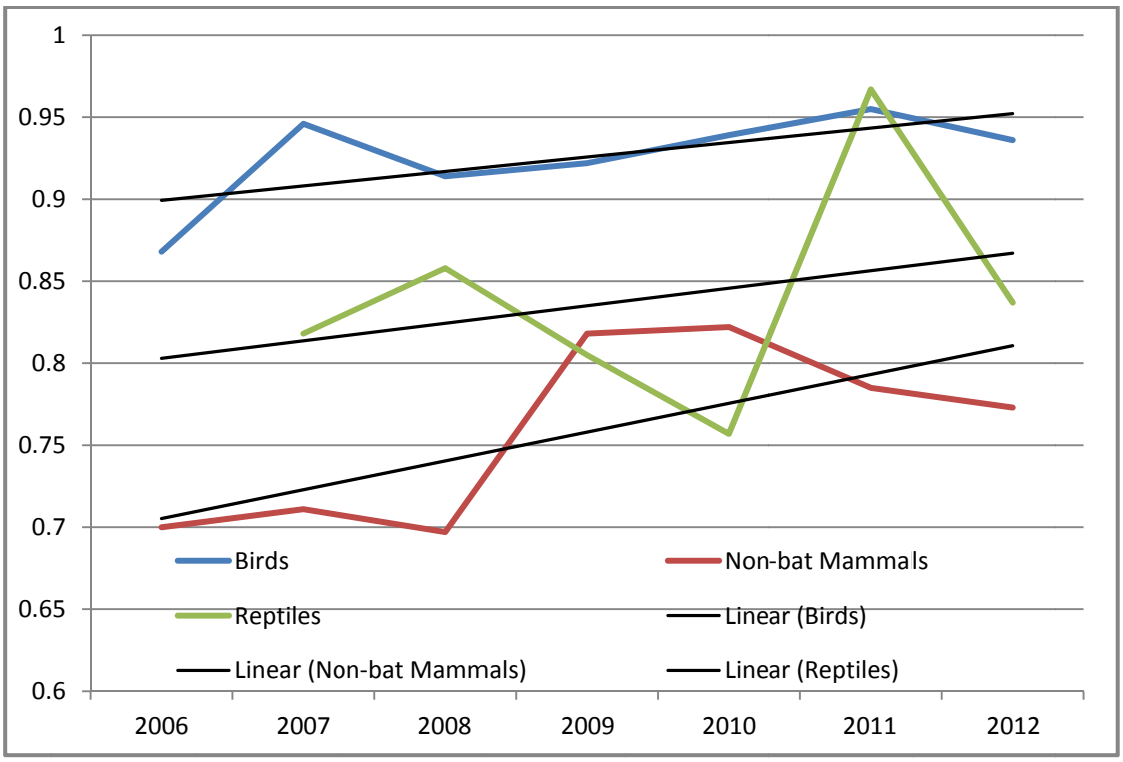

Figure 68 Simpson's Index of Diversity (1-D) between 2006 and 2012

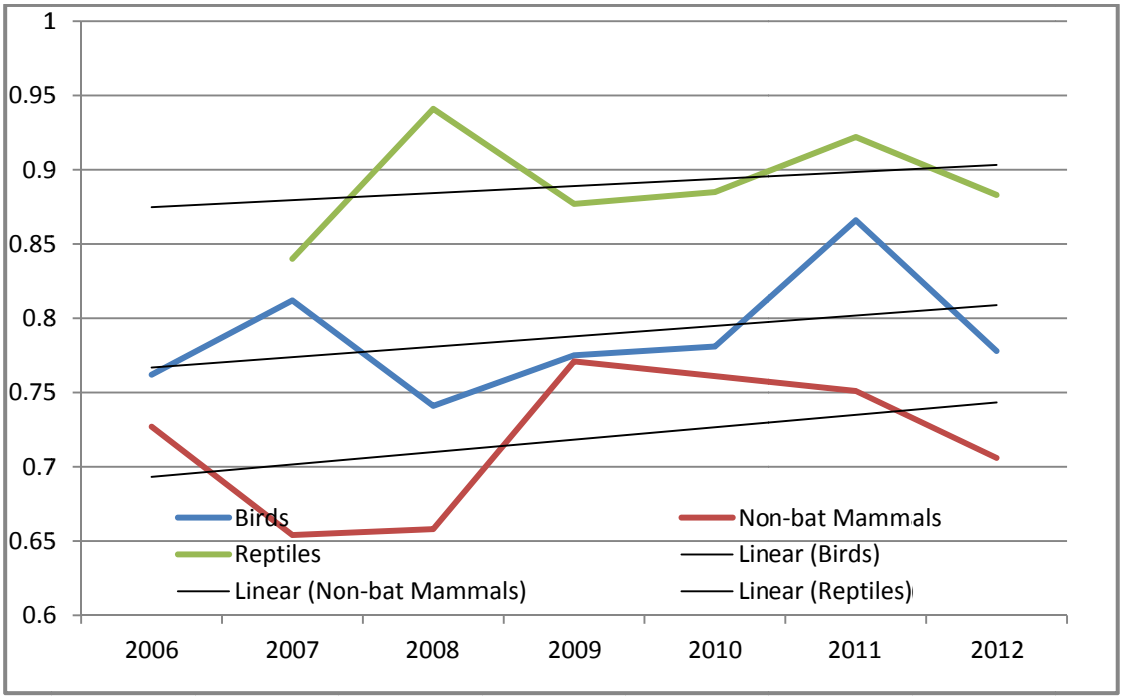

Figure 69 Evenness Scores between 2006 and 2012

Simpson's Indices of Diversity for birds, mammals and reptiles have been trending upwards over the years. At present, there are no statistical differences for diversity or evenness over the years for the three groups (ANOVA). There is a relationship between the Simpson Index and evenness i.e. as evenness falls so does the Simpson's Index. This relationship is seen with the native mammals where high numbers of a particular species exist.

3.7.2.4 Capture Rates of Individual Species

Overall capture rates for 2012 and for 2006 to 2011 are presented in **Figure 70**. There are no statistical differences between the years (non-parametric Kruskal-Wallis One Way ANOVA on Ranks), although there has been an increase in trapping rates over the years.

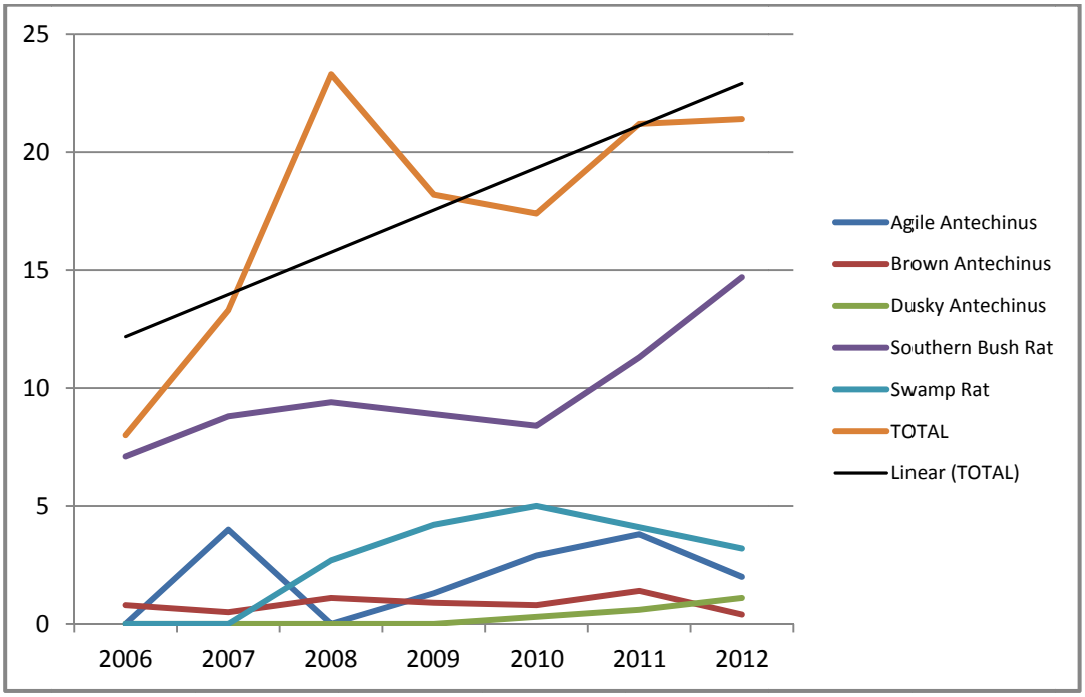

Figure 70 Total Trapping Rates at Clarence Colliery Western SMP areas

Contribution to the faunal assemblages by threatened species, species dependent upon woodland and by species declining in the Central West

The proportion of woodland dependent birds with declining populations and woodland dependent birds is presented in **Figure 71**.

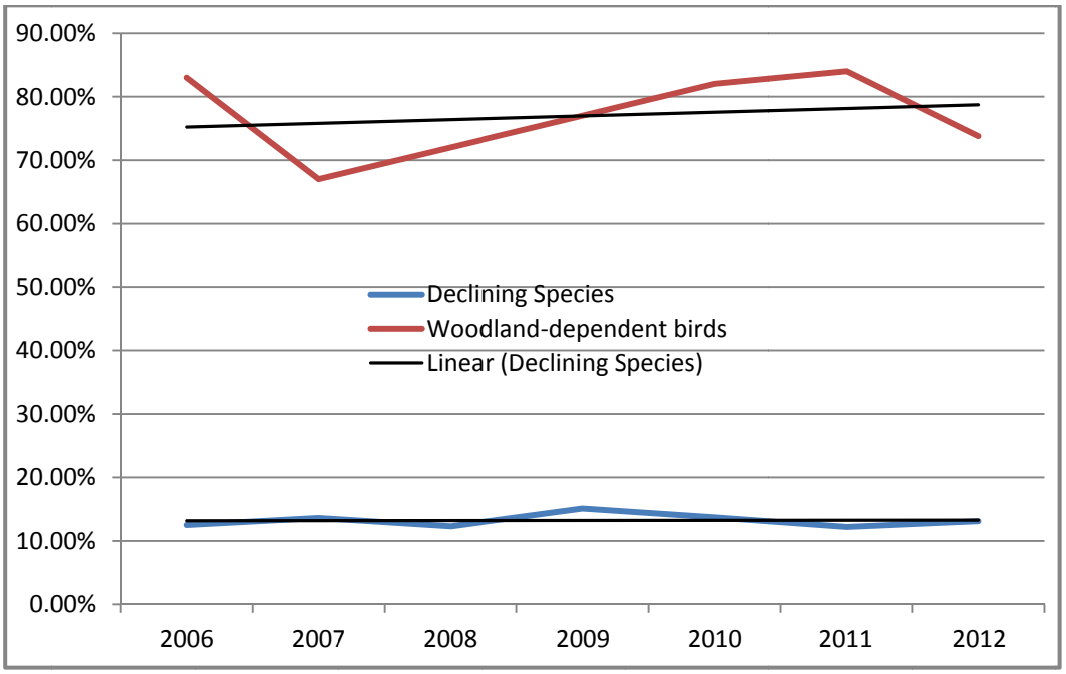

Figure 71 Proportion of Declining and Woodland Dependant Bird Species

This indicates that more than 70% of the bird fauna located within the Western SMP areas is dependent upon the woodland habitat and that more than 10% are considered to be of conservation concern i.e. declining populations. Significant changes to this figure over time may indicate changes to the condition of the woodland habitat. In general, there appears to be a slight increase in the proportion of woodland dependant and declining bird species over time.

3.7.2.5 Habitat Complexity Scores

Habitat complexity scores (out of 18) are presented below in **Figure 72**.

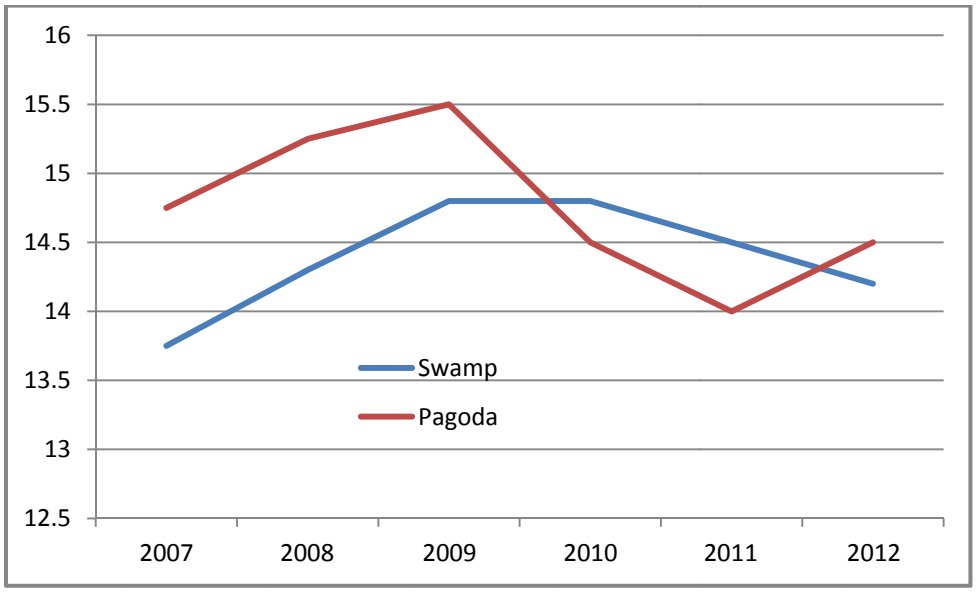

Figure 72 Changes in Habitat Complexity Scores in Swamp and Pagoda Sites between 2007 and 2012

The Habitat Complexity Scores were relatively high throughout between 2007 and 2009, then there has been a falloff in the scores from most of the sites. Because the scores for the control sites fell as well as the treatment sites, the falloff is not the result of underground mining (in fact many the sites at Clarence West have not yet been undermined). Rather, it is possibly the result from the prolonged dry years prior to 2009. However, there are no significant differences between the scores from the control and potential treatment sites at present (mean values of 14 and 14.7 respectively). The main benefit from these approaches is the production of a single number that represents habitat values. By tracking such numbers over time some insight into changes in habitat values may be possible.

3.7.2.6 Comparisons between Treatment and Control Sites

The sites surveyed in the Clarence Colliery Western SMP areas cover land where secondary extraction (partial extraction for Clarence) has occurred (treatment sites) and where mining has not occurred (control sites). Treatment sites are CLW02 (undermined in November 2009), CLW03 (undermined October 2010) and CLW06 (undermined November 2011). These sites sample two swamps and one pagoda habitat. The three control sites also sample two swamps and one pagoda habitat. These are CLW01, CLW04 and CLW05. Thus it is now possible to compare the results from the 2012 surveys of the two clusters of sites i.e. control versus treatment. The results from the bird surveys have been used, as these provide the best data.

There are no significant differences between the two groups (non-parametric Mann Whitney Rank Sum Test). The results are presented in **Figure 73** and **Figure 74**.

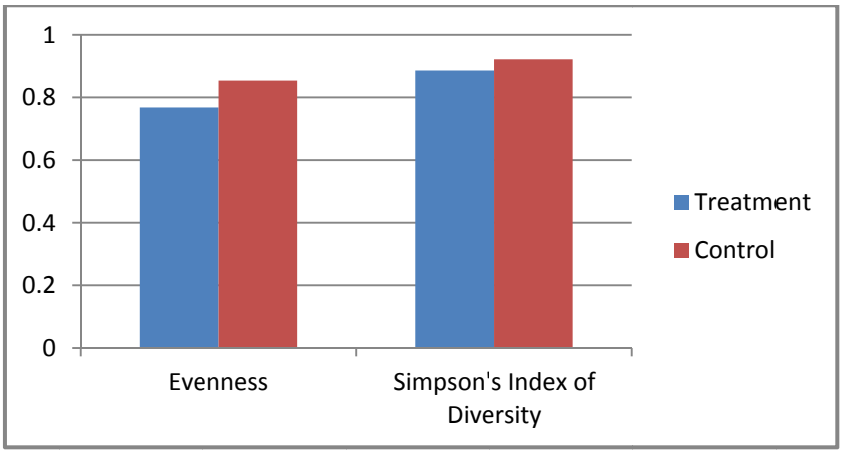

Figure 73 Evenness and Simpson's Index of Diversity at Treatment and Control Sites 2012

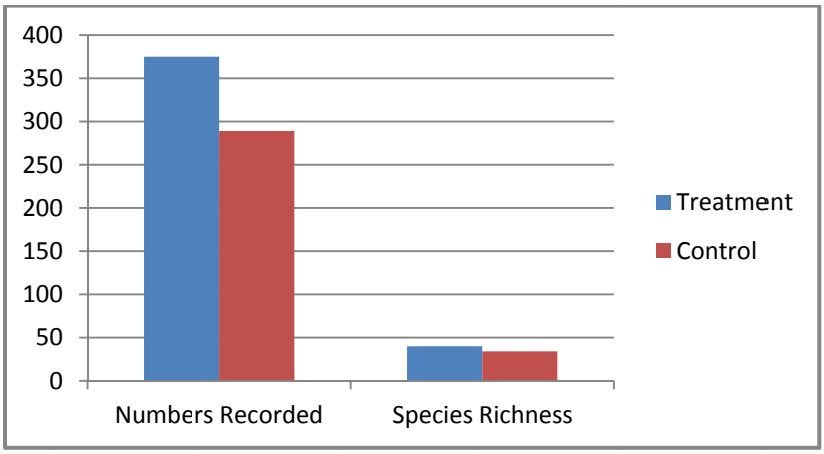

Figure 74 Numbers of Birds Recorded and Species Richness at Treatment and Control Sites 2012

3.7.2.7 Fauna Monitoring Conclusion – Western 700 SMP Area

The Western SMP areas appear to be productive, in terms of fauna diversity values. At this stage 20 threatened species are known to occur within the area and there are several species that have been located that are considered as being of conservation concern in this region e.g. Beautiful Firetail, Rufous Fantail, Long-nosed Bandicoot. The area can be considered to be heavily disturbed by recreational activities, particularly trail bikes, and this must be brought into consideration when assessing any changes in the future.

At present, there appears to be no evidence of potential effects from subsidence upon the fauna diversity at Clarence Colliery.

3.7.3 Outbye Areas SMP

Three sites have been established within the Outbye SMP Area:

- Heath 1 (North): Located adjacent to 602 panel. Samples Sandstone Plateaux Tea Tree – Dwarf Sheoak – Banksia Rock Heath, Sandstone Plateau and Ridge Scribbly Gum Silvertop Ash Shrubby Woodland communities.
- Gully Site: Located adjacent to 602 panel. Samples Pagoda Rock Sparse Shrubland and Newnes Sheltered Peppermint – Brown Barrel Shrubby Forest communities.
- Heath 2 (South): Located adjacent to 307 panel. Samples Exposed Blue Mountains Sydney Peppermint – Silvertop Ash Shrubby Woodland communities.

Fauna monitoring for the 314/316 panels is covered by the Outbye Areas monitoring.

Monitoring locations are shown in **Appendix 1**. A summary of 2012 results are provided below.

3.7.3.1 Threatened Species Located

A total of 77 bird, 23 native mammal, 15 reptile and two amphibian species have been located within the Clarence Colliery Outbye SMP Application area since 2008. During 2012, a total of 49 bird, five reptile, one amphibian and 18 native (plus two introduced) mammal species were located within Clarence Colliery Outbye SMP Application area during the 2012 surveys.

Although the number of amphibian species has been low over the years (possibly due to the cold conditions during most surveys), bird, reptile and mammal species diversities were typical of that expected from the Central Tablelands.

Three threatened species were recorded during the 2012 surveys including the Gang-gang cockatoo, Eastern Bent Wing Bat and the Eastern Pygmy Possum.

None of the threatened species should be directly affected by subsidence-induced changes to their preferred habitat and there is no indication that underground mining at Clarence Colliery has affected the population status of this threatened species or any other species.

Despite searching preferred habitats during the warmer months, there was no evidence of the presence of the Giant Dragonfly and Purple Copperwing Butterfly in the area, nor of the Blue Mountains Water Skink.

3.7.3.2 Species Richness of Faunal Groups

The species richness values obtained during 2008 to 2012 are presented in **Figure 75**.

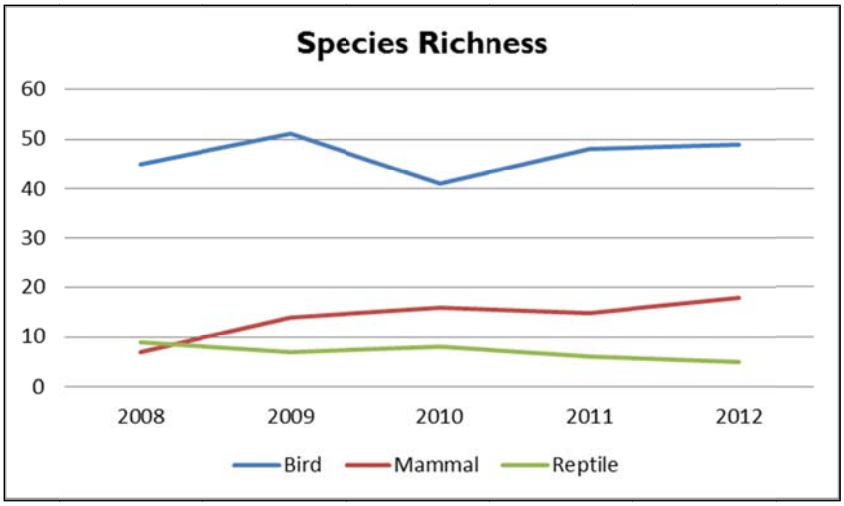

Figure 75 Species Richness from 2008 to 2012

The species richness values for all three groups have stayed relatively constant over the years and there are no significant differences between the years (non-parametric Kruskal-Wallis One Way Analysis of Variance on Ranks). In 2008 no bat call records were analysed due to technical difficulties so the species richness is low for that year.

3.7.3.3 Diversity indices of faunal groups

The Evenness scores for non-bat mammals and reptiles were low due to the large number of Southern Bush Rats and Copper-tailed Ctenotus that were located. This influenced the Simpson's Index, which was also low. If the records for the two abundant species are removed then the Simpson's Index increases to similar past values. This is similar to that obtained when the Bush Rats are removed from the 2009 to 2011 data. With the two abundant species removed then the Simpson's Index of Diversity for the three groups can be compared and this is shown in **Figure 76**. Overall, the diversity indices for birds, native mammals and reptiles have risen over the years.

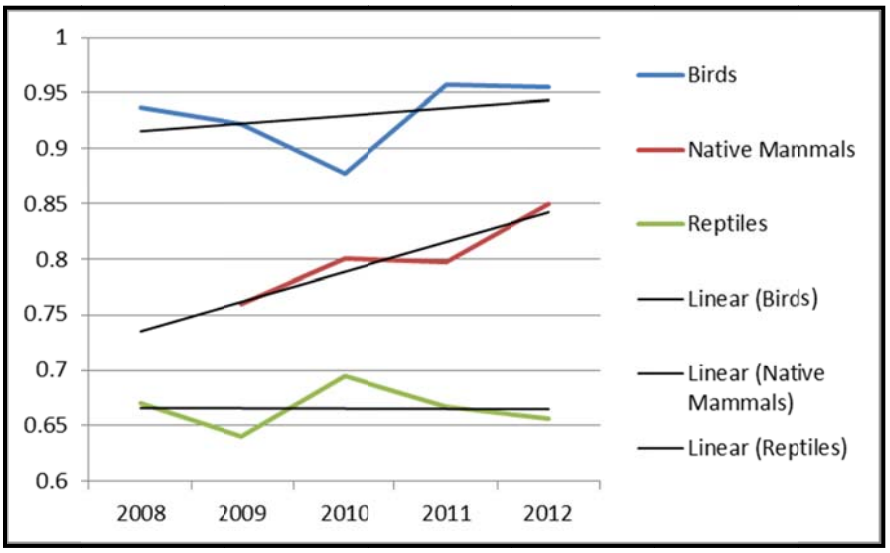

Figure 76 Simpson's Index of Diversity for Birds, Native Mammals and Reptiles between 2008 and 2012

3.7.3.4 Capture Rates of Individual Species

Capture rates for 2008, 2009, 2010, 2011 and 2012 are presented in **Figure 77.**

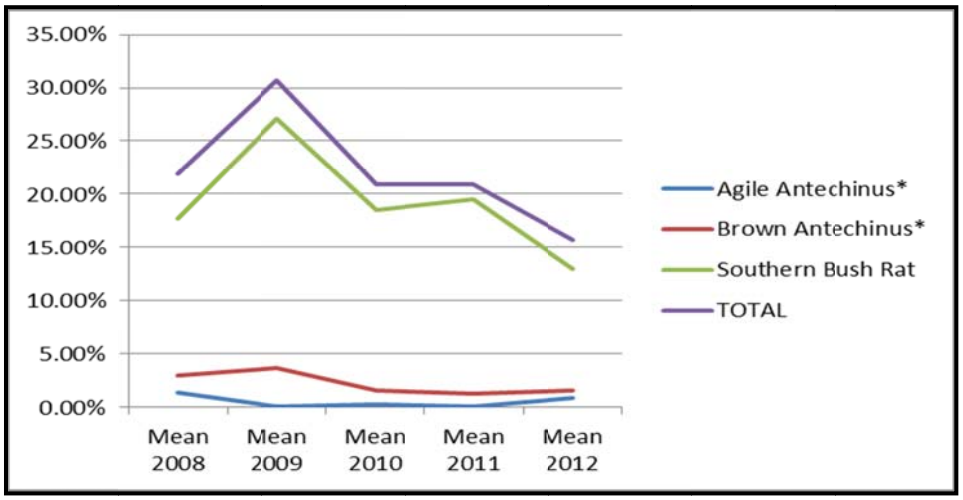

Figure 77 Trapping Rates between 2008 and 2012 at Clarence Outbye Area

* There are difficulties in identifying differences between these two species at Newnes Plateau and they could probably be grouped as 'Antechinus". Work is currently being undertaken during these surveys to develop a method of identification by use of flesh measurements.

Although it can be seen that the overall trapping rates have decreased since 2009, the total trapping rates are driven by the capture rates of the Southern Bush Rat which fell from 2009 onwards. However, there are no significant differences in the trapping rates over the years (non-parametric Kruskal-Wallis One Way Analysis of Variance on Ranks). Asset

3.7.3.5 Contribution to the faunal assemblages by threatened species, species dependent upon woodland and by species declining in the Central West

Proportions of bird species of conservation concern located in 2008, 2009, 2010, 2011 and 2012 are presented in **Table 19**.

Table 19 Proportion of Woodland Birds Located

Bird Type	2008	2009	2010	2011	2012
Woodland-dependent birds with declining populations	11%	13%	11%	8.4%	9.5%
Woodland-dependent birds	73%	83%	76%	85%	78.6%

Approximately 80% of the bird fauna located within the Outbye SMP Area are dependent upon the woodland habitat and that about 10% are considered to be of conservation concern i.e. declining populations. Significant changes to this figure over time may indicate changes to the condition of the woodland habitat.

3.7.3.6 Habitat Complexity Scores

The Habitat Complexity Scores are relatively high for all years (as presented in **Table 20**), indicating good habitat for woodland birds and ground mammals. The main benefit from these approaches is the production of a single number that represents habitat values. By tracking such numbers over time some insight into changes in habitat values may be possible.

Table 20 700 Habitat Complexity Scores Derived from Trap Site Descriptions

	Mean 2008	Mean 2009	Mean 2010	Mean 2011	Mean 2012
Scores out of 18	15.2	15.6	15.3	14.7	15.5

Whilst the three sites sample land that has not been directly undermined, Site 1 (Outbye Heath 1) and Site 2 (Outbye Gully) are located immediately adjacent to Panel 602 where partial extraction was completed in April 2009. Site 2 (Outbye Heath 2) is located adjacent to 307 where no secondary extraction has occurred. The above analyses in the previous sections show that there have been no significant differences in the various indices over the years and no differences between the results from 2008 and the ensuring years.

3.7.3.7 Fauna Monitoring Conclusion – Outbye Areas

The three survey sites established in 2008 adequately sample the two major environments within Clarence Colliery Outbye SMP Application Area that are most sensitive to subsidence i.e. pagoda and water courses.

At present, there appears to be no evidence of potential effects from subsidence upon the fauna diversity at Clarence Colliery.

3.7.4 Eastern Area SMP

The sites sampled in 2012 were the same as that surveyed in previous years i.e. BNS02, PAG01/02 and PAG03/04. The summer surveys concentrated on the swamp site, as this survey targeted threatened species associated with wetter habitats. The sites are described as:

- BNS02 (Bungleboori North 1) – a swamp located within the pine forest east of Waratah Ridge Road. The swamp supports a mix of swamp and Blue Mountains Sandstone Plateau Forest.
- PAG01/02 – a pagoda and steep hill overlooking Bungleboori Creek. This site samples Pagoda Complex and Blue Mountains Sandstone Plateau Forest vegetation, as well as habitats unique to the cliffline environment.
- PAG03/04 – a pagoda and steep hill overlooking Bungleboori Creek, similar to PAG01/02.

Monitoring locations are shown **Appendix 1**.

The two pagoda sites cover land where secondary extraction has occurred (i.e. PAG01/02 and PAG03/04). These sites are classed as treatment sites. The swamp site BNS02 samples land not yet affected by underground mining and, at present, can be classed as a control site. A summary of results is provided below.

3.7.4.1 Threatened Species Located

A total of 53 bird, seven reptile, two amphibian and 14 native (plus five introduced) mammal species were located within the Clarence Colliery Eastern SMP Application area during the 2012 surveys. A total of 98 bird, 26 reptile, 31 native mammal and five amphibian species have been recorded from the Area since 2004.

Apart from a spike in bird species richness recorded in 2005, the values for all four groups have been relatively constant each year (the trend lines are basically level). Over time, the average number of bird species located each year is 53, for native mammals it is 18 and for reptiles 10 species.

Only one new species was located within the SMP area this year, as surveys have been undertaken annually for eight years. The new species located in 2012 was Bibron's Frog. Although this species is new for Clarence East it has been recorded throughout Newnes Plateau. As expected, the number of new species located each year has levelled out

Twelve threatened species have been located within the Clarence Colliery Eastern SMP Application Area as a result of the surveys between 2004 and 2012. These are the Gang-gang Cockatoo, Glossy Black-cockatoo, Powerful Owl, Brown Treecreeper, Hooded Robin, Flame Robin, Scarlet Robin, Varied Sittella, Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bentwing Bat and the Large-footed Myotis. Most of these species are dependent upon large areas of native woodland for populations to survive. In the Newnes Plateau region woodland habitat has been retained (albeit logged), and these threatened species are still located. Some threatened species have been located consistently over the years e.g. Large-eared Pied Bat, Eastern Bentwing Bat, Flame and Scarlet Robins and Gang-gang Cockatoo. In 2012, three threatened species were located - Gang-gang Cockatoo, Scarlet Robin and the Eastern Bent-wing Bat.

None of the threatened species would be directly affected by subsidence-induced changes to their preferred habitat, except for the Large-footed Myotis. This species roosts within rock shelters, such as caves and rocky overhangs, and hunts over water. Both of these habitats are found in the Clarence Eastern SMP Area but, at this stage, there is no indication that underground mining at Clarence Colliery has affected the population status of this threatened species or any other species. Mining activities at Clarence result in 3 – 10cm of subsidence and ongoing surveys have shown that this amount of subsidence (including tilts and strains) is not sufficient to cause negative consequences on rock shelters, pagodas and clifflines.

Despite searching preferred habitats during the warmer months, there was no evidence of the presence of the Giant Dragonfly, Giant Burrowing Frog and Purple Copperwing Butterfly in the area, nor of the Blue Mountains Water Skink.

3.7.4.2 Species Richness of Faunal Groups

The species richness values obtained during 2012 are presented in **Figure 78**.

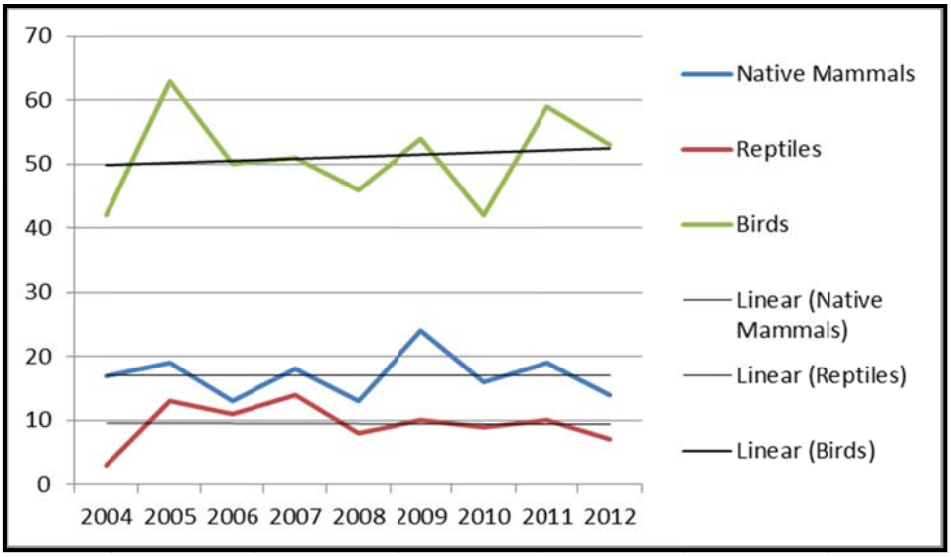

Figure 78 Species Richness between 2004 and 2012 within Eastern SMP Area

A non-parametric Kruskal-Wallis One Way Analysis of Variance on Ranks shows that there are no statistical differences between the species richness values over the six years. **Figure 78** shows that there is some variation in species richness values over the years. The changes probably reflect changes in the climatic conditions between 2004 and 2006 i.e. the impacts from the dry conditions experienced in 2006. The levels appear to be constant from 2006 onwards with a slight fall in 2010, possibly due to extreme weather conditions, then an increase in later years.

3.7.4.3 Diversity indices of faunal groups

A diversity index combines species richness and individual numbers to provide a better indication of biodiversity. The closer the Simpson's Index of Diversity is to one, the higher the biodiversity and, by implication, the better the area for fauna. Simpson's Index of Diversity and Evenness for the three main faunal groups are presented in **Figure 79** and **Figure 80**.

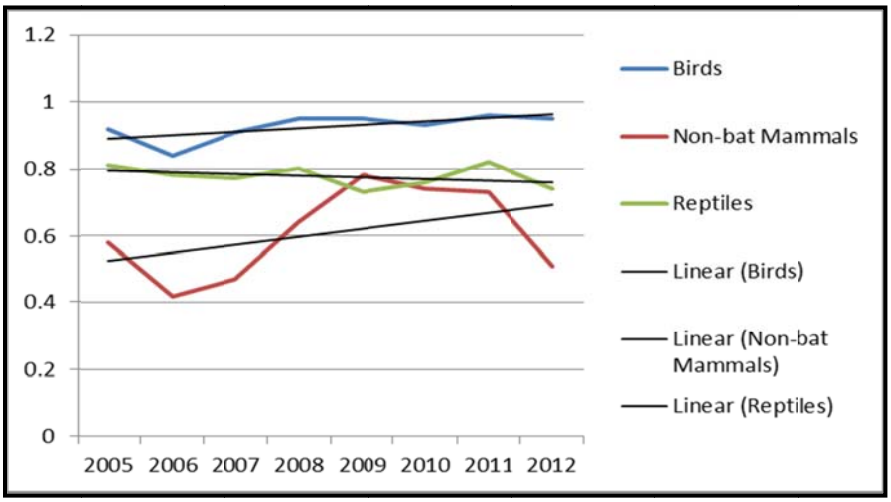

Figure 79 Simpson's Index of Diversity (1-D) between 2005 and 2012

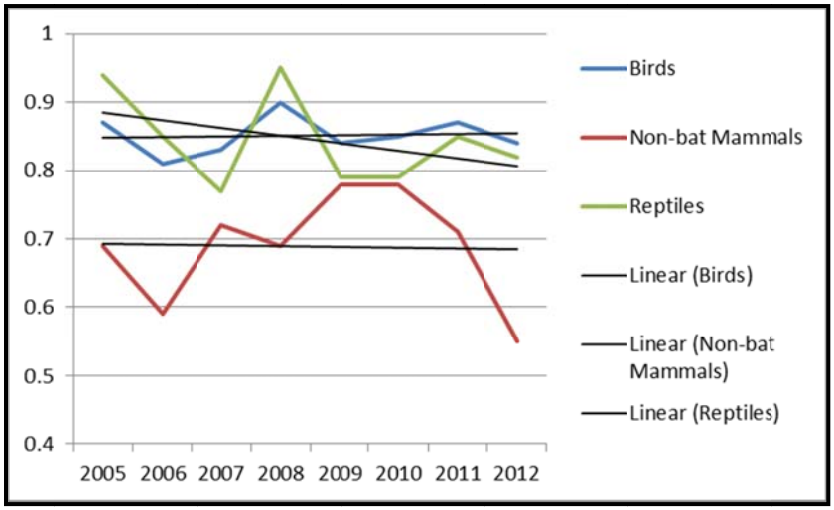

Figure 80 Evenness Scores between 2005 and 2012

Simpson's Index of Diversity is relatively stable over the years for all three groups (there are no statistical differences using ANOVA). There is some variation over the years that is attributed to broad environmental changes experienced in this period (e.g. low and high rainfall and temperatures) and to variations in the Evenness index (i.e. high numbers of one species – Southern Bush Rat in 2012). However, the Simpson's Index of Diversity and Evenness scores have risen over the years for both birds and native mammals.

3.7.4.4 Capture Rates of Individual Species

Small mammals captured in Elliott traps provide a capture rate (expressed as % of trap-nights) that can be used as a rough estimate of an index of population size. These are presented in **Figure 81** for the overall capture rates 2005 to 2012. There are no statistical differences between the years (non-parametric Kruskal-Wallis One Way ANOV on Ranks), although there has been a loss of several species trapped over the years (Swamp Rat, House Mouse). The total trapping rate has increased since 2011 mainly due to an increase in the Southern Bush Rat captures. The pagoda sites have been partially undermined whereas the swamp is still a control site. Consequently any changes in the trapping rates (although not significant) is due to some factor other than the mining activities.

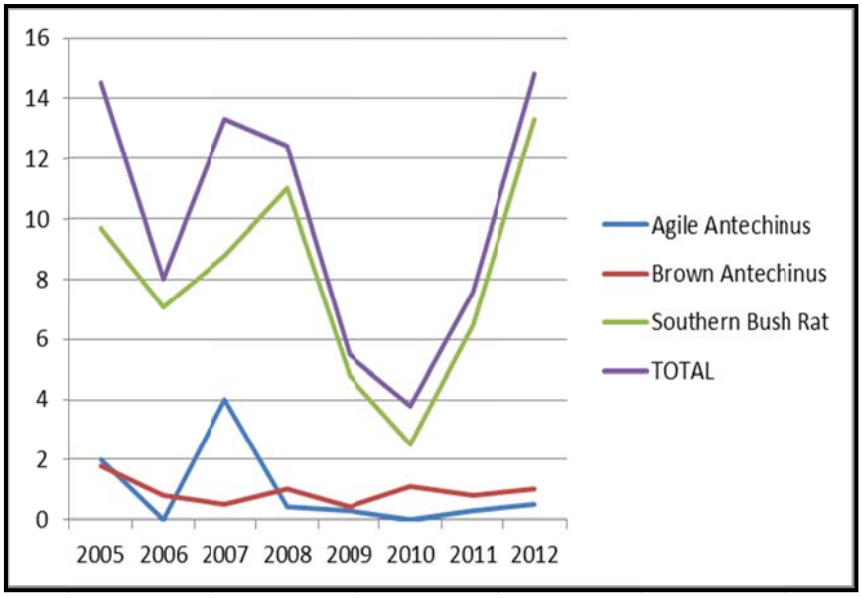

Figure 81 Trapping Rates of Small Mammals at Clarence East 2005 to 2012

Contribution to the faunal assemblages by threatened species, species dependent upon woodland and by species declining in the Central West

Proportions of bird species of conservation concern located in 2012 are presented in **Table 21**, together with the results from 2004 to 2012.

Table 21 700 Birds of Conservation Concern within Clarence Eastern SMP Area

Bird Type	2004	2005	2006	2007	2008	2009	2010	2011	2012
Woodland-dependent birds with declining populations	9.5%	11.1%	12%	10.3%	7.0%	14.6%	13.8%	12.5%	11.6%
Woodland-dependent birds	73.8%	66.7%	70%	72.4%	74.4%	77.1%	80.8%	91.2%	81.4%

The results indicate that 80% of the bird fauna located within the Eastern SMP Area is dependent upon the woodland habitat and that more than 10% are considered to be of conservation concern i.e. declining populations. Significant changes to this figure may indicate changes to the condition of the woodland habitat. The increase in the proportion of woodland-dependant birds over the last nine years is an indication that these species have not been affected by any mining (or other) activities.

3.7.4.5 Habitat complexity scores

The Habitat Complexity Scores for each year are presented in **Figure 82**.

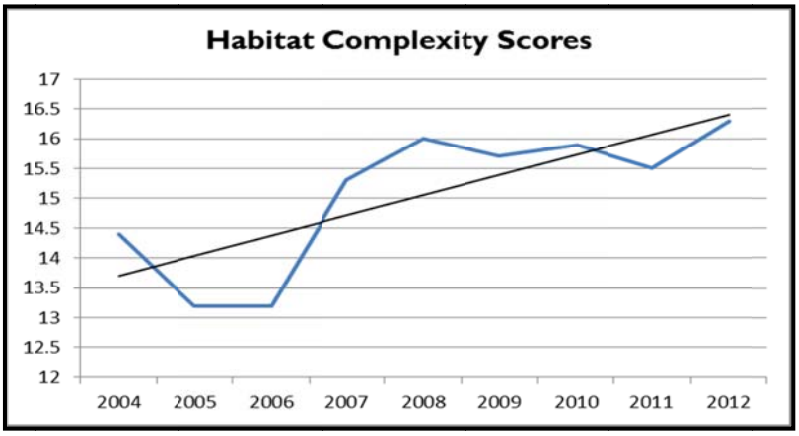

Figure 82 Habitat Complexity Scores between 2004 and 2012

The Habitat Complexity Scores have been relatively high throughout the survey period, with a decline in 2005 and 2006 and a rise in 2007 onwards. This fits in with the general climatic condition of the area during these years i.e. dry conditions in 2005 and 2006, then wetter conditions onwards. The main benefit from these approaches is the production of a single number that represents habitat values. By tracking such numbers over time some insight into changes in habitat values may be possible.

3.7.4.6 Comparisons between Treatment and Control Sites

The two pagoda sites surveyed in the Clarence Colliery Eastern SMP Area cover land where underground mining (partial extraction) has occurred (i.e. PAG01/02 and PAG03/04). These sites are classed as treatment sites. The swamp site BNS02 samples land not yet affected by underground mining and, at present, can be classed as a control site. Comparisons with sites in other parts of Clarence Colliery assist in obtaining a comparative assessment of changes due to underground mining activities.

3.7.4.7 Fauna Monitoring Conclusion – Eastern SMP Area

The configuration of survey sites established in previous years adequately samples the two major environments within the Clarence Colliery Eastern SMP Application Area i.e. pagoda and wetland (swamp). These sites provide the best possible data for the long-term monitoring of terrestrial vertebrates. The survey techniques used have been successful in locating a wide range of species, including new records for the Newnes Plateau region.

As data continues to accumulate from the on-going surveys, it will be possible to track changes to the terrestrial vertebrate fauna within the Clarence Colliery Eastern SMP Application Area. As extraction in the Eastern SMP Area was completed early in 2009, it is evident from the above analyses that there have been no significant differences in the indices measured over the years. At present, there is no evidence of potential effects from subsidence upon the fauna diversity at Clarence Colliery.

Nineteen threatened species have been located within Clarence Colliery Western SMP Application areas as a result of the surveys up to 2011. These are the Gang-gang Cockatoo, Glossy Black-cockatoo, Brown Treecreeper, Hooded Robin, Scarlet Robin, Flame Robin, Varied Sittella, Masked Owl, Powerful Owl, Squirrel Glider, Eastern Pygmy-possum, Large-eared Pied Bat, Greater Broad-nosed Bat, Large-footed Myotis, Eastern False Pipistrelle, Eastern Bentwing Bat, Little Pied Bat, Blue Mountains Water Skink and Giant Burrowing Frog. Some of these species are dependent upon large areas of native woodland for populations to survive. In the Newnes Plateau region woodland habitat has been retained (albeit logged), and these threatened species are still to be located. Several of the threatened species are found in most years e.g. Gang-gang Cockatoo, Flame and Scarlet Robins, Brown Treecreeper and Eastern Bentwing Bat.

Few of the threatened species would be directly affected by subsidence-induced changes to their preferred habitat, with exception of the Large-eared Myotis and the Eastern Bentwing Bat, which can roost in caves and overhangs and the Blue Mountains Water Skink that is associated with wet swamps. Despite searching preferred habitats during the warmer months, there was no evidence of the presence of the Blue Mountains Water Skink, Giant Dragonfly and Purple Copperwing Butterfly in the area.

Six threatened species were located during 2011, these were the Eastern Pygmy-possum, Flame Robin, Gang-gang Cockatoo, Giant Burrowing Frog and Scarlet Robin.

3.7.4.8 Fauna Monitoring Conclusion

There is no evidence of potential effects from subsidence upon the fauna diversity at Clarence Colliery.

3.8 Weeds

Clarence carried out spraying to manage identified weeds during 2012. The spraying campaigns targeted declared and environmental weeds occurring onsite and was undertaken by appropriately qualified contractors.

Areas targeted during the campaigns across the Clarence pit top included the CHPP, administration buildings, water storages, drainage lines, access roads and rehabilitation areas. Spraying around the edge of water storages was completed on foot with individual plants being spot sprayed.

Weeds identified to occur on the site include:

- Pampass Grass (Cortaderia selloan);
- Scotchbroom (Cytisus scoparius);
- Pussywillow (describes a number of willow species); and
- A range of annual and perennial exotic herbaceous weeds.
- An area identified during the 2011 AEMR inspection on the North Western shore of the Main Dam was unable to be completed as safe access to the site could not be guareenteed.

3.9 Blasting

No blasting on the surface is undertaken at Clarence Colliery. Some shot firing is undertaken in the underground workings to excavate material to establish ventilation for the underground roadways.

3.10 Noise performance against Environmental Impact Statement Prediction

Clarence Environmental Impact Statement (2000) predicted no additional noise impacts from the operation would occur giving consideration to the underground extraction of coal, pit top and CHPP operation, and haulage by road or rail. Clarence monitoring to date has indicated that the Colliery has not impacted on noise in the environment. Noise monitoring results for 2012 is provided in Table **23** and historical noise monitoring data (2007-2011) is provided in **Table 24.**

3.10.1 Control Measures

The basic measures employed to control and limit noise emissions from the site include:

- correct and efficient operation of all surface machinery;
- regular servicing and maintenance of all machinery;
- education of all drivers hauling materials through residential areas; and
- registering all noise related complaints to identify any actions that may be necessary to further reduce noise emissions from the site.

Several options to minimise noise associated with rail loading and rail operations on the Clarence Colliery loop have been developed and implemented in the past. These include:

- Scheduling coal train movements within day time hours where practical (this can be achieved for approximately 70% of trains);
- Scheduling coal train movements within evening hours in preference to night hours (this can be achieved for approximately 20% of trains);
- Instructing coal train operators to decelerate and accelerate slowly and smoothly when approaching rounding and departing the rail loop;
- Filling the train loading bin during daylight hours and maintaining the bin at greater than 60% during train loading operations (so as not to create excess noise from filling the bin); and
- Maintaining the train loading infrastructure by including weekly inspections on the coal loading conveyor belt system to detect wearing and noisy rollers, monthly inspections on the drive motors and belts for early detection of failing parts, and yearly structural inspections on the belt gantry and associated infrastructure to detect and repair loose components potentially leading to noise. Corrective action required as a result of these inspections is managed through the mine planning corrective action system.

3.10.2 Monitoring and Interpretation

Condition 15 of Schedule 3 of DA 504-00 states that, noise generated by the development, excluding train-loading facilities and rail operations, should not exceed the noise impact assessment criteria at any residence on privately owned land. The criteria are listed in **Table 22**.

Table 22 Noise impact assessment criteria

Frequency	Receptor	Duration	Outcome
Annual (March of each Year)	Closest Residence	1 Day Attended, 1 Evening Attended, 1 Night Attended	LAeq, LA90, LA10, LA1 and LAeq,15min (dB(A)) for day, evening and night.

Noise monitoring results to date indicate that noise levels from the colliery operations are below those stated in Condition 15 of Schedule 3 of DA 504-00.

The noise monitoring results for 2012 is presented **Table 23** with historical results (2007-2012) presented in **Table 24**

Table 23 Noise Monitoring Results 2012

Day	LA_{eq}	Estimated Mine Contribution LA_{eq} (15 minute)	DA Consent Limit (Daytime)	Description of Noise Emissions
11:18 AM	37	35	38	Traffic noise from Chifley road (intermittent) 39; Birds 44-52;
12:56 PM	39	37	38	Traffic noise from Chifley road (intermittent) 39-41; Birds 40-62; Aircraft 39-40; Trees in wind 38-40;
1:16 PM	43	37	38	Traffic noise from Chifley road (intermittent) 40-41; Local road traffic from Sandham road 60-64; Aircraft 39; Trees in wind 36-38;
1:49 PM	40	38	38	Birds 44; Trees in wind 36-38; Coal Train shunting 40-51;
6:00 PM	39	33	36	Traffic noise from Chifley road (intermittent) 36-40; Local road traffic from Sandham road 50-59; Birds (intermittent) 35-39; Trees in wind 35-36; Train pass by 36-45;
6:30 PM	38	34	36	Traffic noise from Chifley road (intermittent) 36-44; Birds (intermittent) 34-54; Trees in wind 35-36; Train pass by 45-63;
7:00 PM	38	34	36	Traffic noise from Chifley road (intermittent) 37-40; Birds (intermittent) 36-39; Insects/frogs (constant) 33-37;
7:30 PM	40	32	36	Local road traffic from Sandham road 61; Birds (intermittent) 34; Insects/frogs (constant) 33-34; Dog barking 41; Aircraft 41-50;

Table 24 Historical Noise Monitoring Results 2007-2011

Date	Time	Leq (dB(A))	Estimated Mine Contribution LAeq,15min (dB(A))*
15-Mar-07	Day	40.2	20.5
	Evening	47.4	19.8
	Night	37.9	21.5
01-May-08	Day	50.9	38.0
	Evening	46.7	32.8
	Night	40.7	27.8
17-Mar-10	Day	36	33
	Evening	37	33
	Night	38	35
28-Mar-11	Day	40-44	36
	Evening	36-37	30-33
	Night	39	30

3.11 Visual or Stray Light

Visual or stray light is not considered a risk under the Environmental Risk Register in **Section 3.19.1**.

Clarence commissioned an audit against Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting. The audit found that Clarence is generally in compliance with the Standard.

3.12 Aboriginal Heritage

No archaeological sites were disturbed during the reporting period. With subsidence levels less than 100mm using the partial extraction mining method, no impacts on Aboriginal Heritage sites are expected from underground mining.

Archaeological assessments (including ground trothing of listed sites) were undertaken in 2012 for preparation of the Review of Environmental Factors for four exploration boreholes within the 800 Area.

A summary of the location and type of archaeological sites is provided below in Table 25.

Table 25 Location and Type of Archaeological Sites

Mining Lease Area	Description	Number Identified
Eastern portion of ML1583	Open Camp Site	1
	Isolated Artefact	2
	Scarred Tree	1
Western portion of ML1583	Axe Grinding Groove, Shelter with Deposit	1
	Open Camp Site	14
	Shelter with Art	2
	Shelter with Deposit	2
	Artefact Scatter	1
ML1353	Axe Grinding Groove, Rock Engraving, Shelter with Deposit	1
ML1354	Open Camp Site	3
	Axe Grinding Groove, Shelter with Art	2
	Shelter with Art	1
	Open Camp Site, Stone Arrangement	1
CCL705	Open Camp Site/Stone Arrangement	5
	Axe Grinding Groove	2
	Shelter with Art, Shelter with Deposit	4
	Open Camp Site	4

3.12.1 European Heritage

European Heritage items include the Zig Zag Railway and associated buildings, the Clarence Tunnel and the old Newnes Railway formation which crosses the existing lease near the ventilation fan, the northern portion of ML1583. There has been no mining in these areas during the reporting period.

3.12.2 Natural Heritage

Newnes State Forest occupies a large portion of the area above the Clarence coal leases. The natural heritage values of the area have been reviewed and characterised as inputs for the subsidence management planning process. The significant values consisted of swamps, creeks and endangered flora and fauna.

3.13 Spontaneous Combustion

When coal is exposed to air, the reactive components of the coal oxidise in an exothermic reaction. When this rate of heating is balanced or exceeded by the rate of cooling, the coal will remain stable indefinitely. It is only when the rate of heating exceeds the rate of cooling that spontaneous combustion can occur.

Clarence Colliery mines coal from the Katoomba seam, which is known to have a low propensity for spontaneous combustion. The low propensity for spontaneous combustion is identified from coal self-heating laboratory testing and a historical absence of spontaneous combustion at Clarence Colliery.

No incidents of spontaneous combustion occurred during the reporting period. Clarence has no record of a heating event at the CHPP or in the underground.

3.14 Bushfire

Clarence reviewed its Bushfire management Plan in 2012 with representatives from the NSW Rural Fire Service, the Clarence-Dargan Bushfire Brigade and the Clarence Fire team members. The review included the inspection and maintenance of:

- Building Gutters;
- Access Roads and Paths;
- CHPP Facilities;
- Surface Facilities;
- Asset Protection Zones (Defined in the Management Plan); and

3.15 Mine Subsidence

Appendix 1 contains the location of environmental monitoring sites related to subsidence.

3.15.1 SMP Applications and Variations

During 2012, the following SMP applications and variations occurred:

- Submission of SMP Variation Application for Eastern Areas SMP on 30th January 2012 to reduce extent.
- Endorsement and recommendations from the Dams Safety Committee (DSC) on 14th March 2012 to undertake partial extraction of panel 716 within the Lithgow No.2 Dam Notification Area (Clarence-2) and subsequent approval from Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS) on 28th March 2012.
- Variation Approval for Eastern Areas SMP (to reduce extent) on 26th March 2012.
- Endorsement and recommendations from the DSC on 22nd May 2012 to undertake partial extraction of panel 707 within the Lithgow No.2 Dam Notification Area (Clarence-3) and subsequent approval from DTIRIS on 28th May 2012.
- SMP Approval for 700 West only from DTIRIS on 18th June 2012.
- Application to vary 700 West SMP (Variation 1) submitted on 28th June and approved on 7th August 2012 (to allow extraction of 716 and 707 Panels within Lithgow No.2 Dam Notification area following DSC approval).
- Application to reduce length of 714 panel within 700 West SMP (Variation 2) submitted on 14th September and approved on 16th October 2012 due to poor geological conditions.
- Minor variation (Variation 1) application to DTIRIS for Clarence-3 Lithgow No.2 Dam Notification Area approval submitted on 23rd July 2012. Variation approved on 1st August 2012.
- Minor variation (Variation 2) application to DTIRIS for Clarence-3 Lithgow No.2 Dam Notification Area approval submitted on 9th August 2012. Variation approved on 13th August 2012.

- Approval of the Limited Subsidence Monitoring Program for 700 West SMP area (covering panels 707, 714 and 716) on 6th August 2012 with modification approved on 23rd October 2012.
- Approval of the Environmental Management Plan for the 700 West SMP area on 7th August 2012.
- Approval of the Public Safety, Infrastructure and Property Management Plan for 700 West SMP (covering panels 707, 714 and 716) on 6th August 2012.

3.15.2 Summary of Subsidence Monitoring

During the 2012 reporting period the following monitoring was undertaken in relation to subsidence:

The following subsidence monitoring was undertaken in 2012.

- Resurvey of the 700A, 700B, 700C, 700D and 700E subsidence monitoring lines on 30th January 2012 (700A, 700B, 700D, 700E) and 15th February 2012 (700C) to coincide with 3 months post extraction of 712 panel, 12 months post extraction 710 panel and 24 months posts extraction of 702 and 704 panels.
- Resurvey of rock marks around Lithgow No.2 Dam on 7th February 2012 as another pre-mining survey.
- Resurvey of the H and I subsidence monitoring lines on 27th February 2012 for longer term subsidence monitoring.
- Resurvey of the 609 A and 609 D subsidence monitoring lines on 26th-27th March 2012 for longer term monitoring.
- Resurvey of the 605 subsidence monitoring line on 16th April 2012 for 36 months post extraction of 602 panel.
- Resurvey of the U subsidence monitoring line on 4th June 2012 for 36 months post extraction of panels 400, 402 and 403.
- Resurvey of rock marks around Lithgow No.2 Dam on 7th June 2012 as another pre-mining survey.
- Resurvey of the 314/316 panel rock marks on 14th August 2012 for 12 months post extraction of these panels.
- Resurvey of the 700A and 700B subsidence monitoring lines on 7th and 6th September 2012 respectively for 6 months post development of 714 panel (under DSC approval).
- Resurvey of the W and Z subsidence monitoring lines on 25th September 2012 for 36 months post extraction of 306 panel.
- Resurvey of the rock marks around Lithgow No.2 Dam on 27th July, 23rd August, 6th September and 2nd October under DSC approval (two weekly during extraction of 707 panel then monthly), 5th November and 7th December.
- Resurvey of the Lithgow No.2 Dam wall on 10th May, 16th July, 22nd August, 5th September, 9th October under DSC approval (two weekly during extraction of 707 panel then monthly), 6th November, 13th November and 3rd December.
- Valley closure monitoring of the Lithgow No.2 Dam Wall carried out on 10th May, 16th July, 22nd August, 5th September, 9th October under DSC approval (two weekly during extraction of 707 panel then monthly), 6th November, 13th November and 3rd December.

- Surface subsidence management inspections.

All subsidence monitoring has been carried out in accordance with the relevant Subsidence and Environmental Monitoring Programs as stipulated by the various SMP approvals as outlined in **Section 1.1**.

3.15.3 Subsidence Results

All subsidence monitoring results for 2012 were within the 100mm maximum predicted in the SMP for all panels relevant to the 700 West Area, 700 Area, Outbye Areas and 314/316 panels and within the elastic limit of the overburden strata (100±25mm, Strata Engineering Australia 2005). The subsidence monitoring results are in accordance with those predicted in the Environmental Impact Statement (2000).

Table 26 Maximum recorded subsidence for each Panel/Area.

Panel/Area	Maximum Recorded Subsidence	Comments
Extracted Panels 2012		
Panel 707	14mm	707 Extraction commenced 14 August 2012 and finished 20 November 2012.
Panel 714	60mm	Extraction within 714 panel commenced on 5th September 2012 and finished 18th December 2012
Previously Extracted Areas		
Panel 612	97mm	Surveyed 24 February 2011
700 Area	43mm	Surveyed January 2012 recorded over 702 and 704 Panels.
306 Panel	28mm	Surveyed 25 September 2012
Panels 400, 402 and 403	30mm	Surveyed 4 June 2012
Panel 605	28mm	Surveyed 16 May 2012
609 Area	92mm	Surveyed 27 March 2012
608, 610, 612, and 614 Panels	99mm	Surveyed 27 February 2012
314 and 316 Panels	20mm	Surveyed 14 August 2012

3.15.4 Flora and Fauna Results

Flora and fauna monitoring has shown no measurable impact from mining during 2012. Results for flora and fauna monitoring can be found in Section 3.6 and Section 3.7 respectively.

3.15.5 Groundwater Monitoring Results

Groundwater monitoring results during 2012 did not indicate any adverse impact on the near-surface aquifers. Full details on groundwater monitoring are provided in **Section 3.5.**

3.15.6 Photographic Monitoring and Surface Inspections

During 2012, extraction occurred beneath Happy Valley Swamp (714 panel in September), Farmers Swamp (714 panel in April) and Farmers South Swamp (707 panel in October). The photographic monitoring events undertaken during the reporting period are detailed below for each swamp.

Happy Valley Swamp

- 1st 4 monthly post-mining 712 panel on 20th January
- Last 4 monthly post-mining 708 panel on 20th January
- 2nd 4 monthly post-mining 712 panel on 22nd May
- Undermining for 714 on 13th September
- Final 4 monthly post-mining 712 panel on 13th September
- 500m post mining 714 panel on 19th October

Farmers Swamp

- Undermining of 714 panel on 5th April
- 500m post mining of 714 panel on 11th December

Farmers South Swamp

- Pre-mining for 707 panel on 28th August
- Undermining for 707 on 8th October
- 500m post mining for 707 panel on 31st October

There was no evidence of any mining related impacts detected during 2012 from photographic monitoring of swamps.

3.16 Contaminated Land Management

3.16.1 UPSS Removal and Validation

Three Underground Petroleum Storage Systems (UPSS) were decommissioned during the 2011 reporting period, including 2 underground storage tanks on the pit top which were decommissioned by removal and one underground storage tank at the CHPP which was decommissioned *in situ*.

As a part of the decommissioning a validation assessment design to comply with NSW EPA *Guidelines for Assessing Service Station Sites and Protection of the Environment Operations (UPSS) Regulation 2008*. The validation report was completed in 2012.

The report concluded that the UPSS infrastructure at Clarence was appropriately decommissioned and whilst the identified associated residual soil impact did not appear to represent an unacceptable risk.

3.16.2 Phase 2 Environmental Site Assessment

Clarence completed a targeted Phase 2 Environmental Site Assessment (ESA) during 2012. The objective of the ESA was to assess the presence of soil and groundwater contamination in targeted areas identified as areas of potential concern within the CHPP and Pit Top areas.

The assessment included soil sampling, installation of seven groundwater monitoring wells, groundwater sampling and surface water sampling. Gathered information and analysis was used to create a conceptual site model which identifies impact media, contaminant transport pathways, exposure routes and exposed receptors to evaluate the risks associated with contamination.

The ESA recommended the following additional investigations which would be required to develop appropriate remedial strategies:

- Document the nature and location of the identified residual soil impact in Clarence's Environmental Management System;
- Assess the vertical and lateral delineation of the petroleum impacted soils in a southerly direction from the decommissioned underground tank at the CHPP;
- Conduct additional water assessment to delineate the dissolved metal impacts in the surface and groundwater down gradient of the Polishing Lagoon and Pit Top.
- Conduct ongoing biannual monitoring of the groundwater downgradient of the CHPP and Pit Top Areas.

An action plan will be developed during the 2013 reporting period to address identified risks.

3.17 Methane Drainage

Methane has not been detected by any of Clarence's gas monitoring systems. This suggests that the region of the Katoomba coal seam that Clarence operates in is void of Methane gas. The monitoring systems include hand held gas detectors, real time gas monitoring throughout the mine, and routine monthly gas bag sampling of the underground environment with analysis by a gas chromatograph.

Methane drainage is not required at the Clarence Colliery.

Clarence has a conventional Ventilation system consisting of a two main fans, exhausting air from the mine through a ventilation shaft. The mine has 2 intake access drifts and one intake ventilation shaft. Air is directed to each mining area using a system of stoppings, regulators and overcasts. Air is directed to the mining face areas using a system of brattice stoppings and wings. Air quality monitoring is conducted by mining supervisors using hand held devices, and in real time from the control room. There were no major issues or changes to the Ventilation system at Clarence in 2012.

3.18 Public Safety

Public safety risks associated with the mine are largely from public trespass on land around the Pit Top area. The site is fenced and sign posted. Security gates, operated by personal pin numbers, are on both roads into the Pit Top area.

The main access areas to the site are fully fenced with six foot man proof fencing. The fencing runs along the southern boundary of the site beside the rail loop and up the western side of the pit top to the main car park area.

All visitors to site are required to sign in at the main office, under the site representative they are visiting.

All people required to carry out work on the site must be inducted and if required to carry out work underground, complete an underground induction. All contractors to site must sign in at the computer in the lamp room or CHPP crib room. They must have a valid purchase order number to sign in under before any work can begin, they must have completed the required safe work method statements for the task and supplied Workers Compensation and insurance details to their site representative.

During the reporting period there were no incidents relating to public safety.

3.19 Other Issues and Risks

3.19.1 Risk Management

Environmental risks were considered within the Clarence Environment and Community Risk Assessment in 2011. The Risk Assessment is reviewed biennially inclusive of the current Environmental Risk Register (ERR) 22.

The identification of risks from the Risk Assessment and ERR are the components for identification of required actions within the Clarence Environmental Management System and Annual Business Plan. Clarence was reviewed following the Environment and Community Risk Assessment in 2011. The Risk Assessment identifies risks by mining area and activities similarly to those in **Table 27.**

Table 27 Environmental Risk Identification for Clarence Colliery

	Mining Activity						
	Drilling	Underground Mining	Coal Preparation Plant	Workshop	Stores	Ancillary	Rehabilitation
Air Pollution Dust/Other	L	L	M	N/A	L	L	L
Erosion/Sediment Control	L	L	M	N/A	N/A	M	L
Surface Water Pollution	L	L	M	L	L	M	L
Ground Water Pollution	L	L	N/A	L	N/A	L	N/A
Contaminated Land	L	N/A	L	L	L	L	L
Threatened Flora Protection	L	L	N/A	N/A	N/A	L	L
Threatened Fauna Protection	L	L	N/A	N/A	N/A	L	L
Weed Control and Management	L	N/A	N/A	N/A	N/A	L	L
Operational Noise	L	L	L	N/A	N/A	N/A	N/A
Vibration and Air Blast	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Visual Amenity, Stray Light	L	N/A	L	N/A	N/A	N/A	N/A
Aboriginal Heritage	L	L	N/A	N/A	N/A	N/A	L
Natural Heritage Conservation	L	L	N/A	N/A	N/A	N/A	N/A
Spontaneous Combustion	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bushfire	M	M	L	L	L	N/A	L
Mine Subsidence	N/A	L	N/A	N/A	N/A	N/A	N/A
Hydrocarbon Contamination	L	M	M	M	M	L	L
Methane Drainage/Venting	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Public Safety	L	L	L	L	L	L	L
Leachate/Reject Management	N/A	N/A	L	N/A	N/A	L	N/A
Subsidence and SMP Risks	N/A	L	N/A	N/A	N/A	N/A	N/A

3.20 Greenhouse Gases

Clarence undertakes monitoring of greenhouse gas emissions for reporting under the National Greenhouse and Energy Reporting (NGER) Program. Under the Program Clarence reports on:

- greenhouse gas emissions ;
- energy production; and
- energy consumption.

Of the six greenhouse gases identified in the Kyoto Protocol, Clarence Colliery produces one of these, carbon dioxide (CO_2).

Greenhouse gas emissions reported through the NGER reporting program for the 2012 financial year reporting period (as reported) are listed in **Table 28** below.

Scope 1 emissions refer to direct emission sources from Clarence. Scope 2 emissions refer to indirect emissions from the consumption of energy or heat produced by another organisation.

Table 28 Greenhouse Gas Emissions 2011 Reporting Period (CO_2 -e T)

Financial Year 2012	Financial Year 2011	Financial Year 2010	Financial Year 2009	Scope
8 925	7 133	15 418	14 559	Scope 1
33 007	31 764	27 413	27 682	Scope 2

Note: A calculation error led to higher Scope 1 emissions being reported in 2009 and 2010.

3.20.1 Energy Efficiency Projects

Clarence has identified and developed several projects targeted to reducing greenhouse gas emissions. The projects are outlined in **Table 29, Table 30, Table 31, Table 32** and **Table 33.**

Table 29 Workshop Lighting Renewal

Mine/Colliery	Clarence
Project Number	2012027
Project Name	Workshop Lighting Renewal
Project Status	Under Investigation
Project Type	EEO Project
Project Description	Replace existing High Bay and Flood Lights in Workshops, Store and CHPP with LED Lights
Project Costs in $	$70,000
Demand Savings in kVA	0
Maintenance Cost Savings in $/yr	$36,200
Energy Type (Diesel/Electricity)	Electricity
Energy Saving in kWh/year or l/year	251,111
Project Completion Date	01/06/2013

Table 30 CHPP water Recycling project

Mine/Colliery	Clarence
Project Number	2012026
Project Name	CHPP Water Recycling
Project Status	Under Investigation
Project Type	EEO Project
Project Description	Recycle discharge water of CHPP after primary cleaning. Saves 45l/s water which was previously transferred underground and requiring pumping (266m head = 195kW) over 4380 operating hours (12h/day)
Project Costs in $	$25,000
Demand Savings in kVA	190
Maintenance Cost Savings in $/yr	$5,000
Energy Type (Diesel/Electricity)	Electricity
Energy Saving in kWh/year or l/year	836,944
Project Completion Date	01/07/2013

Table 31 Compressed Air Optimisation

Mine/Colliery	Clarence
Project Number	2012025
Project Name	Compressed Air Optimization
Project Status	Implementation Commenced
Project Type	EEO Project
Project Description	Air Leak Survey, Pressure Profiling and Compressed Air Audit to determine Energy Efficiency Opportunities
Project Costs in $	$52,000
Demand Savings in kVA	100
Maintenance Cost Savings in $/yr	$10,000
Energy Type (Diesel/Electricity)	Electricity
Energy Saving in kWh/year or l/year	890,000
Project Completion Date	01/12/2012

Table 32 Bath House Heater Project

Mine/Colliery	Clarence
Project Number	2012023
Project Name	Bath House Heater Project
Project Status	Implementation Commenced
Project Type	EEO Project
Project Description	Using heat discharge from compressors to assist in heating bath house hot water
Project Costs in $	$712,882
Demand Savings in kVA	1,180
Maintenance Cost Savings in $/yr	$120,000
Energy Type (Diesel/Electricity)	Electricity
Energy Saving in kWh/year or l/year	423,889
Project Completion Date	01/12/2012

Table 33 Water Strategy Review

Mine/Colliery	Clarence
Project Number	2012022
Project Name	Water Strategy Review
Project Status	Implementation Commenced
Project Type	EEO Project
Project Description	Underground Water Management Review, install fire tanks adjacent to the mine water treatment plant and reduce pump head by 30m.
Project Costs in $	$240,000
Demand Savings in kVA	40
Maintenance Cost Savings in $/yr	$35,000
Energy Type (Diesel/Electricity)	Electricity
Energy Saving in kWh/year or l/year	1,563,056
Project Completion Date	01/12/2014

4 Community Relations

4.1 Environmental Complaints

Clarence has received one complaint in 2012 during August. The caller indicated concern over visual dust emanating from Reject Emplacement Area IV (REA IV) during high winds experienced on the day. REA IV receives wet course reject from the Coal Handling and Processing Plant (CHPP) which is not conducive for dust generation. Dust suppression including the REA haul road sprinkler system and water cart were in use on the day of concern. The EPA were notified of the complaint and supplied with photos and a report of dust management on site. It was indicated in correspondence from the EPA on 5 September 2012 that no further action would be taken regarding the complaint.

4.2 Community Liaison

Clarence undertakes community engagement through planned and unplanned activities outlined in the Clarence Stakeholder Engagement Plan and are outlined below.

During 2012 Clarence contributed through monetary and in kind donations to local community events and organisations. During the 2012 period community events and organisations supported are outlined in below:

- Rylstone/Kandos Show Society
- Portland Easter Family Festival
- Lithgow Show Society
- Henbury Golf Club Associates
- Big Air Skate Day in Kandos
- Kandos Rylstone Waratahs
- District Renta Scooter Inc
- Mid-Western Regional Seniors
- Rydal Village Association Inc
- Rylstone Women's Bowling Club
- Portland Easter Family Festival
- Scots School Pipes & Drums
- Lithgow City Band
- Lithgow's Community Kitchen
- Clarence/Dargan Rural Fire Brigade
- PCYC Lithgow
- St Patrick's School Lithgow P&F
- St Joseph’s School Portland
- Lithgow Athletics Club
- Kandos Rylstone Men's Shed
- Lithgow & District Volunteer Rescue Squad
- Australia Roof Bolting & Coal Shovelling Titles 2012
- Blinky Bill Portland Child Care Centre
- Mt Victoria Great Train Weekend
- Mingaan Aboriginal Corporation - NAIDOC week
- Ride for the Chopper - Westpac Helicopter Rescue
- Pink Ball Wallerawang
- The Rylstone Club Ltd
- Lithgow Public School P&C Association

- Rylstone & District Historical Society
- Mountain Cruizers Car Club
- Kandos Rylstone Men’s Shed
- Three Tree Lodge
- Portland Central School
- Central West Vision Team
- Rylstone Street Feast
- Mid-Western Regional Sheepdog
- St Patricks School P & F Association
- Springvale Children's Xmas Club
- Lithgow Show Society
- Kandos High School.
- Rotary Club of Rylstone
- Rylstone Public School
- Wallerawang Public School
- Wallerawang - Lidsdale P&C Association
- Ilford Public School
- Kandos Public School
- Rylstone Kandos Street Machine Club
- Portland Development Association
- Rydal A, H & P Society
- Wallerawang Public School
- Lithgow Workmen's Valley Women’s Bowling Club
- Lithgow & District Cancer Support Group
- Lithgow High School
- Cancer Council Relay for Life
- Rylstone/Kandos Family Fun Day
- Lithgow Community Private Hospital
- Henbury Open Golf Tournament
- 2012 Celebrate Lithgow Festival
- Anglican Parish of Rylstone-Kandos

4.2.1 Celebrate Lithgow

Centennial participated in the annual Celebrate Lithgow activities held in November 2012. Centennial had an information stall set up in the street fair. Representatives from each of Centennials Western Operations and Projects were available to provide information regarding operations and environmental management at each site.

Clarence provided information regarding the proposed 900 SMP Area and recent rehabilitation activities undertaken.

Figure 83 Centennial Information Stall at the Celebrate Lithgow Street Fair

4.2.2 Pink Ribbon Day

Clarence Colliery in association with Valley Longwall International held a BBQ and provided pink t-shirts with the workforce giving donations towards the fundraiser. It was great to see the entire workforce being involved and supporting a great cause.

Pink Ribbon Day helps raise awareness about breast cancer, as well as funds, in support of the many thousands of Australians affected by this disease. Pink Ribbon Day is a day when all Australians can come together to show their support for the many thousands of family's battling breast cancer. An amount of $4607 was raised on the day.

Figure 84 Day Shift Crew at Clarence Colliery Donning Pink Shirts to raise money and awareness for Breast Cancer

4.2.3 NAIDOC

Centennial supplied representatives to run the BBQ during Lithgow NAIDOC celebrations held in September 2012. 2012 NAIDOC celebrations organized by Mingaan Aboriginal Corporation included Wiradjuri dance, Koori Sports, the Taronga Zoo mobile, as well as information stalls, displays and activities.

Figure 85 Clarence Representatives participating in Lithgow NAIDOC Celebrations

4.2.4 The Biggest Morning Tea

Clarence Colliery participated and raised money for the Cancer Council in the Biggest Morning Tea. A BBQ was held at each shift and Cancer Council merchandise purchased which raised a total of $1500.

Figure 86 Biggest Morning Tea Donation Ladder

4.2.5 Movember

Team Clarence Colliery raised a total of $2085 during 'Movember" 2012. 'Movember' raises money and awareness for Men's Health issues.

4.2.6 Clarence Landcare

A new partnership with Clarence Dargan Bell Landcare Group has seen 50 new trees planted in the Kerma Swamp in the Clarence Village. In August 2012 Clarence provided tube stock and tree guards from the Lithgow and District Community Nursery for the group's most recent gathering, and helped to plant a total of 50 Tea Tree and Lomandra's.

The local active and passionate community-based organisation plays a key role in raising awareness about land management practices and swamp restoration, and helps to deliver local environmental outcomes. The group meets monthly and conducts activities such as weed removal and tree planting in the local Clarence area.

Figure 87 Members of the Clarence-Dargan Landcare during August's tree planting

4.2.7 Community Consultative Committee

The Clarence Colliery Community Consultative Committee (CCC) was established in 2006. Committee meeting minutes are available online at the Centennial Coal website (www.centennialcoal.com.au). The Clarence CCC met four times during 2012. Information presented in the meetings include operational, environmental and community performance updates.

Specific items discussed during committee meetings in 2012 include:

- The Subsidence Management Plan Development for 900 Area;
- The proposed modification to DA-504.00 for the construction of a new proposed Reject Emplacement Area;
- Rehabilitation Activities;
- Water Management Activities and Improvements
- 800 Area Exploration Program
- Community Activities; and
- Environmental incidents/complaints;

5 Rehabilitation

5.1 Buildings

Given that the mine has coal reserves to sustain current production levels for in excess of 20 years and that all site buildings are required, no buildings are scheduled for removal in the near future.

5.2 Rehabilitation of Disturbed Land

5.2.1 Reject Emplacement Area IV

To complete the final two wall lifts on REA IV, an additional 1.2 ha was cleared. According to best management rehabilitation practices stripped topsoil and subsoil was applied directly on the completed lower two batters of REA IV. Direct application of topsoil and cleared vegetation Subsoil was applied at 0.5m in depth and covered with 100mm of topsoil. Cleared vegetation was placed on the rehabilitated surface to provide erosion protection and create ‘patches’ for nutrient accumulation to enhance rehabilitation outcomes. A sterile cover crop was applied to also aid in erosion protection and assist in nutrient accumulation.

Sediment control dams and drains were installed around REA IV to control generated run-off during the establishment of vegetation on the rehabilitated surface.

Figure 88 below illustrates the rehabilitation progress and initial success. EFA will be employed to monitor the progress of rehabilitation and track against analogue sites to ensure the final meets the requirements set out in Clarence’s Mine Closure and Rehabilitation Plan.

Figure 88 Rehabilitation Progress of REA IV in 2012

Monitoring of the rehabilitated area has identified the following juvenile shrub species present on the rehabilitated batters in December 2012:

- *Acacia terminalis*
- *Hakea dactyloides*
- *Hakea salicifolia*
- *Entolasia marginate*

Figure 89 Juvenile Endemic Shrub Species on the Rehabilitated Area

A rehabilitation plan is shown in **Appendix 1** and a rehabilitation summary for Clarence is given in **Table 34.**

5.2.2 Newnes Plateau

As discussed in **Section 2.1**, no exploration activities occurred during 2011 and no areas were disturbed on the Newnes Plateau. No further rehabilitation is required at this stage however inspections are made to monitor the progress of previously rehabilitated areas.

When drilling does occur, exploration boreholes with piezometers are rehabilitated through a specific grouting process undertaken by the drilling contractor. A specific grout mix is applied to the bottom of the borehole through a 20mm grout pipe. The grouting is carried out in stages using separate grout pipes permanently in the hole. The pipes are installed at typically 70 to 100m intervals, but not more than 100m intervals. The grout is pumped into the bottom pipe and a known volume is added to bring the grout level to a theoretical level 10m above the next pipe. The pipe above is flushed with water immediately after grouting to dilute any grout at this level to allow further grouting from this level after an initial cure period. Once the piezometers are all grouted in then the mix is thickened by the addition of further cement to obtain a quicker set while filling the top of the hole to surface.

5.3 Rehabilitation Monitoring

Clarence Colliery established a monitoring program for current and previously rehabilitated lands at Clarence Colliery including REA I, II, and III.

The monitoring programme involved the application of the CSIRO developed Ecosystem Function Analysis (EFA) tool, vegetation monitoring components, and the AECOM-developed Visual Monitoring tool.

The EFA methodology creates indices based on simple field indicators that reflect the measured variables of stability, water infiltration and nutrient cycling, in turn monitoring the functional status of the landscape. The methodology used does not replace the traditional methods of monitoring vegetation and fauna, but adds a functional interpretation to link vegetation structure and organisation more closely with soil function and the development of habitat for native fauna. Utilising the EFA method, scientifically robust data is provided on the rehabilitation sites, which when compared to the data collected from analogue sites, accurately reflects if the site is

on a trajectory towards a sustainable ecosystem. The interpretation of this data enables the development of land management recommendations to address those sites having lower EFA rankings.

Permanent transects and associated photo reference sites were established in areas of post-mining rehabilitation and correspondingly in adjacent undisturbed areas to provide analogue/reference sites. The analogue sites are selected to represent as close as possible the slope, aspect and proposed vegetation characteristics of the revegetation areas. The analogue site also provides data on the long-term goal for the revegetation area.

Assessing the analogue sites is an integral part of monitoring rehabilitation and is used to generate a "band" of values depending on seasonal effects as well as stochastic events like storms, droughts and fire. In addition, data recording the response and recovery dynamics to stochastic disturbances of the analogue site would provide a test of the resilience of a rehabilitated site (rate of recovery of function after specified disturbance).

The data derived from the monitoring programme provides a scientifically robust platform against which the effectiveness of post mining rehabilitation techniques can be assessed and, where applicable, amended. This is done with the aim of achieving sustainable post mining vegetation communities

which are aligned to the proposed post mining land use for the project area.

Rehabilitation activities at Clarence aimed to re-establish a native forest/ecosystem which is consistent with the surrounding vegetation communities. The local surrounding vegetation is dominated by Sandstone Slopes Sydney Peppermint Shrubby Forest/Woodland.

Six Study Transects were established in 2012 including 3 rehabilitation transects located on the previously rehabilitated REA I and REA II, and the partly rehabilitated REA III. Three analogue transects were established on undisturbed land surrounding the REA's.

Figure 90 Analogue and Rehabilitation Transects

Clarence plans to continue EFA rehabilitation monitoring in 2013 and expand the program to include the rehabilitated lower batters of REA IV.

5.4 Mine Closure & Rehabilitation Plan

In 2012 Clarence developed a Conceptual Rehabilitation and Rehabilitation and Mine Closure Plan for the site. The purpose of the plan is to document the methodologies currently undertaken and proposed for the ongoing rehabilitation of the site and to also document the mine closure assumptions used by Clarence to make appropriate financial provisions for the eventual decommissioning and rehabilitation of the site. Its primary aim is to ensure that rehabilitation and closure planning incorporates suitable ecosystem and biodiversity management strategies linked to a suitable post mine closure land use. This will ensure that at the completion of mining, the land can be returned to a long term stable and sustainable post-mining landform.

Further to the above, Schedule 3 Condition 28 of the Clarence Development Consent (DA 504 -00) states the requirement for Clarence to prepare a Mine Closure Strategy. This plan is to be completed at least 3 years prior to the cessation of mining, it requires that Clarence prepare the Strategy, in consultation with council, I&I NSW, Sydney Catchment Authority and Department of Climate Change and Water.

The general objectives adopted in the development of the Conceptual Rehabilitation and Closure Plan were to derive the most appropriate option(s) for closure in terms of

performance and cost. The development of this Plan is based on a process whereby the desired closure and post closure options are evaluated. The strategy involves:

- Establishment of an overall vision for closure with objectives for each component of the project (e.g. social, environmental, employees etc.);
- Identification of options and evaluation against the vision to assess their viability;
- Definition of the preferred options for closure and assumptions for further research as the site moves towards the detailed closure planning phase;
- Definition of objectives and targets to achieve the preferred options; and
- Description of the communication and consultation process for the preferred options.

It is recognised that the most effective Rehabilitation and Mine Closure Plans are those that are integrated with the long term operational plans of the mine and are subject to regular review to accommodate regulatory, technological, social and economic change.

Table 34 Rehabilitation Summary Clarence

MINE LEASE AREA	Area Affected/Rehabilitated (hectares)			
	To Date	Last Report	Next Report (estimated)	
A1: Mine Lease(s) Area	7740			
B: Disturbed Areas				
B1: Infrastructure area (other disturbed areas to be rehabilitated at closure including facilities, roads)	39	39	39	
B2: Active Mining Area, (excluding items B3-B5 below)	0	0	0	
B3: Waste emplacements (active/unshaped/in or out-of-pit)	11	9.8	11	
B4: Tailings emplacements, (active/unshaped/in or out-of-pit)	0	0	0	
B5: Shaped waste emplacement (awaits final vegetation)	14	14	14	
ALL DISTURBED AREAS	64	62.8	64	F1
C: REHABILITATION PROGRESS				
C1: Total Rehabilitated Area (except for maintenance)	19.5	18.6	19.5	F2
D: REHABILITATION ON SLOPES				
D1: 10 to 18 degrees	0	0	0	
D2: Greater then 18 degrees	0	0	0	
E: SURFACE OF REHABILITATED LAND				
E1: Pasture and grasses	0	0	0	
E2: Native forest/ecosystems	19.5	18.6	19.5	
E3: Plantations and crops	0	0	0	
E4: Other (include non vegetative outcomes)	0	0	0	

Table 35 Maintenance Activities on Rehabilitated Land- Clarence

NATURE OF TREATMENT	Area Treated (ha)		
	Report Period	Next Period	Comment/control strategies/ treatment detail
Additional erosion control (drains re-contouring, rock protection)	0.2	0.1	Re-contouring of REA IV drains, installation of additional sediment control structures, installation of mesh and seeding.
Re-covering (detail-further topsoil, subsoil sealing etc)	0.9	0	Progressive Rehabilitation of complete REA IV Batters.
Soil Treatment (detail-fertiliser, lime, gypsum etc)	0	0	
Treatment/Management (detail-grazing, cropping, slashing etc)	0	0	
Re-seeding/Replanting (detail-species density, season etc)	0.9	0	Sterile cover crop applied aid in endemic vegetation establishment and provide erosion control
Adversely Affected by Weeds (detail-type and treatment)	19.5	19.5	Hand spraying for all environmental and noxious weeds. .
Feral animal control (detail – additional fencing, trapping, baiting etc)	0	0	

6 Activities Proposed in the Next AEMR Period

The activities proposed for 2013 are generally in accordance with the current MOP, and include:

- Seek a modification to DA-504.00 to allow the construction of a new Reject Emplacement Area (REA VI);
- Seek approval for the 800 Area Subsidence Management Plan and 900 Area Subsidence Management Plan;
- Continued planning for progressive decommissioning and rehabilitation of Reject Emplacement Area III and Reject Emplacement Area IV;
- Continued Ecosystem Function Analysis (EFA) rehabilitation monitoring;
- Continued of planning for life of mine reject emplacement;
- Conduct a four hole exploration program within the '800 area' on the Newnes Plateau;
- Submission of the Mining Operations Plan to cover the period 2014-2020;
- Complete required actions outlined in the site specific Best Management Practice particulate determination to reduce particle emissions from the premises;
- Complete action plan to prioritise required actions from the Phase 2 Environmental Site Assessment Report;
- Continued Water Strategy Team Meetings and Improvements to the Clarence Water Management System; and
- Internal operation of the Water Treatment Plant and continued improvement to operation, monitoring and maintenance systems.

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