Ashton Coal

2016 Annual Review

Table 1 Title Block

Name of Operation	Ashton Coal
Name of Operator	Ashton Coal Operations Limited
Development consent number	DA No. 309-11-2001-i
Name of holder of development consent	White Mining Limited (ACN 009 713 893
Mining Lease number	ML 1529 ML 1533 ML 1623
Name of holder of mining lease	ML 1529 -Ashton Coal Mines Limited, ML 1533 - White Mining Limited (ACN 009713893), White Mining (NSW) Limited (ABN 19 089 414 595), ICRA Ashton Pty Ltd ACN 097 499 780, ML 1623 - White Mining (NSW) Limited (ACN 089 414 595) Austral-Asia Coal Holdings Pty Ltd (ACN 110 038 663) and ICRA Ashton Pty Ltd (ACN 097 499 780) *
Water Licence Number	See Section 7
Name of holder of water licence	Ashton Coal Mines Limited
MOP / RMP start date	28 March 2013
MOP / RMP end date	31 December 2017
Annual Review Start date	1 January 2016
Annual review end date	31 December 2016
I, William Farnworth, certify that this Annual Review is a true and accurate record of the compliance status of Ashton Coal for the period 1 January 2016 to 31 December 2016 and that I am authorised to make this statement on behalf of Ashton Coal Operations Limited. Note: The Annual Review is an 'environmental audit' for the purposes of section 122B (2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000. The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or $22,000, or both).	
Name of Authorised reporting officer	William Farnworth
Title of authorised reporting officer	Operations Manager
Signature of authorised reporting officer	
Date	20 March 2017

*As of 31 December 2016, the Leaseholder names are correct. During 2014 Ashton Coal has undergone some ownership changes, and applications have been submitted to DRE for title changes.

Table of Contents

1 Statement of Compliance

The Annual Review is required to incorporate a statement of compliance which includes a summary table that highlights the compliance status of the operation with its relevant approval conditions, as at the end of the reporting period (**Table 2**).

Table 2 Statement of Compliance, as at 31 December 2016

Were all conditions of the relevant approvals complied with?	
Development Consent 309-11-2001-i	No*
ML 1529	No*
ML 1533	yes
ML 1623	yes

*non compliances are detailed in **Appendix 1**.

Non compliances are discussed in sections 11 and 12 and listed in **Appendix 1**.

2 Introduction

The Ashton Coal Project (ACP) is located approximately 14 kilometres north-west of Singleton in the Upper Hunter Valley, New South Wales (NSW). The ACP is adjacent to the Open-Cut mines of Glendell (Glencore), Rixs Creek and Rixs Creek North (Bloomfield Group), Hunter Valley Operations (Rio Tinto) and Ravensworth Operations (Glencore). Adjacent Underground mines include Glennies Creek and Ravensworth Underground Mine (Glencore).

The ACP is operated by Ashton Coal Operations Limited (ACOL), and includes a decommissioned open cut coal mine, an underground coal mine, a Coal Handling and Preparation Plant and a rail siding. The Ashton Underground Coal Mine is approved to produce 5.45 Mtpa of coal. In 2016 2.38 million tonnes of run of mine coal was produced. This coal was processed and exported through the Port of Newcastle, New South Wales.

ACOL hold the South East Open Cut Project (SEOC), to the south east of current surface operations. This project was approved by the Planning Assessment Commission (PAC) on the 4 October 2012, however was subsequently appealed. In 2014 the Land and Environment Court upheld the approval, subject to further conditions. The revised Development Consent was issued to Ashton Coal in April 2015. The SEOC approval has not been taken up and is not within the scope of this AR.

This AR details the ACP's environmental and community performance for the reporting period **1 January 2016 to 31 December 2016**. The operational area is shown in **Figure 1**.

This AR is a statutory approval requirement and has been prepared in accordance with the Ashton Coal Mine Project Approval (DA No. 309-11-2001-i; as modified, Schedule 5, condition 10) and the commitments outlined in the Mining Operations Plan (MOP). The AR is written in accordance with the NSW Government Annual Review Guideline as published in October 2015.

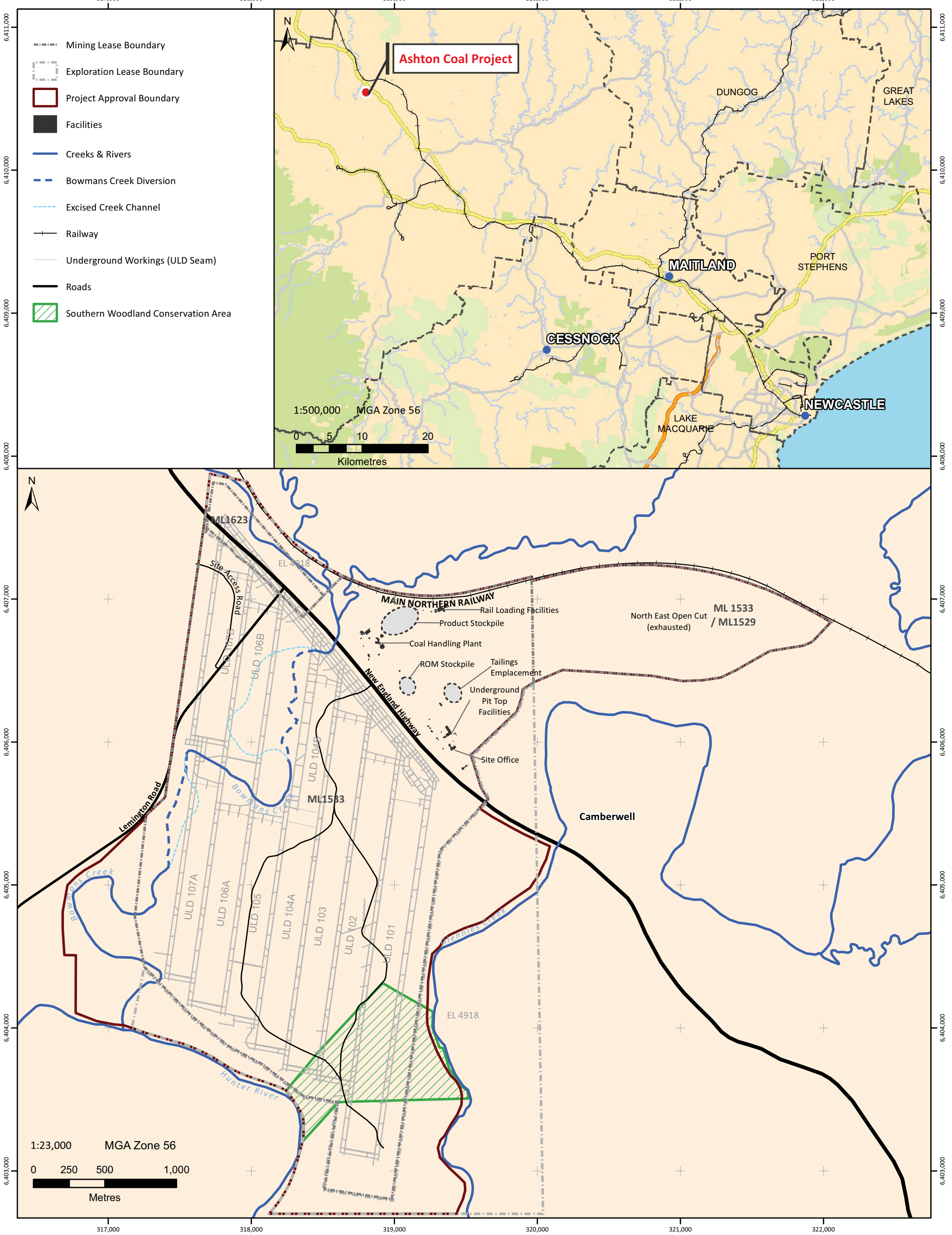


Figure 1 Regional site overview

Regional Site Overview

ACOL AEMR 2015 Period, Ashton Coal Project

Drawn: GW

8/03/2016

Map **C**

The AR is distributed to a range of stakeholders which include government authorities, the Ashton Coal Community Consultative Committee (CCC), other mines and ACOL employees. The report is also available on the Ashton Coal website at http://www.ashtoncoal.com.au.

2.1 Mine Contacts

Mine contacts can be found in Table 3.

Table 3: Mine Contact Details

Name	Role	Phone contact details
William Farnsworth	Operations Manager	(02) 6570 9104
Phillip Brown	Environment and Community Relations Manager	(02) 6570 9219 Mobile: 0439 909 952
Environment and Community Response Line	n/a	1800 657 639 Email: Ashton.environment&community@yancoal.com.au

3 Approvals

Details of ACP's existing statutory approvals as at 31 December 2016 are provided below in Table 4. Water licences held by the ACP are discussed in Section 7.

Table 4 ACOL's primary statutory approvals as at 31 December 2016

Approval	Description	Issue date	Expiry date
Development consents or project approvals issued by the DPE			
DA 309-11-2001-i	Development Consent for the ACP (as modified from time to time)	11/10/2002 Last modified 20/6/16	26/2/2024 or 12 years from recommencement of open cut operations, whichever is later.
Mining leases and exploration licences issued by the DRE			
ML 1533	Mining Lease	26/02/2003	26/02/2024
ML 1529	Mining Lease	10/09/2003	11/11/2021
ML 1623	Mining Lease	30/10/2008	30/10/2029
EL 5860*	Exploration Licence (EL)	21/05/2012	21/05/2015
EL 4918*	Exploration Licence	17/12/2010	17/12/2015
EPL issued by the EPA			
EPL 11879	Environment Protection Licence (EPL)	01/01 (anniversary date)	Not specified

* Renewals for exploration licences 5860 and 4918 were lodged with DRE on 15 May 2015 and 17 December 2015, respectively. No further correspondence has been issued from DRE on this matter since.

Table 5 ACOL's other statutory approvals as at 31 December 2015

Approval	Description	Expiry date
Radiation Management Licence		
RML5061098	Radiation Management Licence	06/04/17

Approval	Description	Expiry date
Aboriginal heritage		
Section 90 Consent Permits AHIP 1131017 AHIMS Permit ID 3436	Longwalls 1-4: Salvage excavations. Community collection. Harm to certain Aboriginal objects through proposed works. Certain Aboriginal objects must not be harmed	23/12/21
Section 90 Consents Permits AHIP 1130976	Longwalls 5-8: Movement only of certain Aboriginal objects. Test excavations. Salvage excavations. Community collection. Harm to certain Aboriginal objects through proposed works. Certain Aboriginal objects must not be harmed	26/08/31
Voluntary Conservation Agreement		
Conservation Agreement	Conservation agreement over the southern conservation area. Agreement between The Minister administering the NPW Act 1974 and Ashton Coal Mines Limited for Ashton Coal Mine.	Perpetuity
Tailings Emplacement approval		
S126 Approval	Emplacement of carbonaceous materials Ashton North East Open Cut (NEOC) Issued 08/04/04	Perpetuity
S126 Approvals	Emplacement of carbonaceous materials Ravensworth Void 4 Issued 17/01/07	Perpetuity
S100 Approval	Emplacement of coarse rejects materials in the NEOC void Issued 01/03/12	Perpetuity
S100 Approval	Emplacement of fine rejects in the Ravensworth Void No 4 Issued 2/01/2007	Perpetuity

3.1 Changes to approval documents

During the reporting period, modification 5 to DA 309-11-2001-i was approved by the Department of Planning and Environment (DPE). This has resulted in a number of significant changes to the approval, which are being addressed through a gap analysis and the review of management plans throughout 2016 and 2017.

EPL 11879 was also reviewed, taking a number of air quality monitoring sites out of the licence and requiring the relocation of other sites to better reflect an 'upstream / downstream' monitoring regime. Decommissioning and relocation of monitors will continue in the first quarter of 2017.

3.2 Mining Operations Plan

ACP has an approved MOP for a five year period from 28 March 2013 to 31 December 2017.

The MOP satisfies the requirements of ESG3 Mining Operations Plan (MOP) Guidelines as published September 2013. The MOP was revised and approved in May 2016. Due to mine planning changes, the MOP will be amended in early 2017.

3.3 Environmental Management Plans

ACOL has developed a range of environmental management plans to meet the requirements of DA 309-11-2001-i and are reviewed and maintained in accordance with Schedule 5 Condition 6. A summary of the status of the management plans is provided in **Table 6**.

Management plans required by the consent are published on http://www.ashtoncoal.com.au.

Table 6 Status of environmental management plans as at 31 December 2016

Environmental management plan	Condition	Approval date
Environmental Management Strategy	Schedule 5 condition 1	23/5/2016
Noise	Schedule 3 Condition 9	11/10/2016
Air Quality	Schedule 3 Condition 17	11/10/2016*
Archaeology and Cultural Heritage	Schedule 3 condition 34	19/06/2015
Flora and Fauna (Biodiversity)	Schedule 3 condition 28	11/10/2016
Water	Schedule 3 Condition 26	11/05/2016

*the AQMP was submitted for review and approval with DPE on the 28 October 2016. Approval is pending.

Schedule 5 condition 3 allows management plans to be updated under the conditions of the consent that applied prior to the approval of Modification 5, or otherwise with the approval of the Secretary.

4 Operations summary

During the reporting period there were no material changes to operations at the Ashton Coal Project. Open cut mining ceased in September 2011, with remaining open cut rehabilitation works completed between 2011 and 2012. There has been no topsoil works or overburden movement since this time. A summary of 2016 underground operations is provided below in Section 4.4.

4.1 Exploration

There were three (3) exploration holes drilled during 2016 in the far south eastern section of ML 1533. The holes were drilled to gain a better understanding of the thickness of interburden between the Upper Liddell Seam (ULD) and the Upper Lower Liddell Seam (ULLD) as well as assessing coal quality in the ULLD.

The results gained from these holes resulted in shortening LW 201 due to inadequate interburden depth between seams.

During the reporting period there were no material variations from the MOP related to exploration activities.

4.2 Construction

During the reporting period there were two (2) gas wells constructed to the Pikes Gully Seam goaf in the central and south-western part of ML1533.

Rehabilitation of all drilling sites and completed boreholes, involving sealing or capping with gate valves was undertaken, with rehabilitated sites monitored in accordance with ACP procedures. Boreholes that are yet to be grouted or that require additional testing have been secured with borehole caps.

During the reporting period there were no material variations from the MOP related to construction activities.

4.3 Hours of operation

Under Schedule 2, condition 8 of the Development consent DA 309-11-2001-i, surface construction works on the site is limited to day periods only in the case of construction of gas wells, and day and evening periods only in the case of all other construction activities.

4.4 Mining

The underground mine is approved to extract coal from the Pikes Gully (PG), Upper Liddell (ULD), Upper Lower Liddell (ULLD) and Lower Barrett (LB) coal seams. The underground mine utilises the longwall method of coal extraction, following continuous miner development of main headings and twin heading gate-roads. Seam thickness varies from about 1.8m to 2.8m high. All underground roadways are driven at approximately 2.6 m mined height. The longwall has been designed to allow extraction of the full seam thickness. The expected underground mine life is until approximately 2027.

During the reporting period, coal was mined from the Upper Liddell coal seams (LW 104, LW 105 and LW 106A). Approximately 2.4 million tonnes of run-of-mine (ROM) coal was mined from the underground operations, which is very close to the 2.5 million tonnes projected in the MOP for 2016. Table 7 provides a summary of the mine's performance figures for the reporting period.

Table 7 Mine performance data: 2016

Material	Approved Limit (DA 309-11-2001-i)	2016 (this reporting period)	2017 (MOP forecast)	2018 (MOP Forecast)
Topsoil stripped	-	0	0	0
Topsoil Spread	-	0	0	0
Overburden	-	0	0	0
ROM Coal (t)	-	2,378, 739	2,806,903	3,511,395
Coarse Reject (t)	-	1,097,224		
Tailings (t)	-	255,655		
Product Coal (t)	5,450,000	1,555,989	1,409,774	1,774,910

4.4.1 Gas management

During the reporting period, the ACP conducted gas drainage borehole drilling activities within the underground area, specifically designed to provide longwall panel goaf gas drainage. Two (2) longwall goaf large diameter gas drainage holes were completed during this period.

4.5 Next Reporting Period

During 2017 mining operations will continue to mine in LW 106A in the ULD seam before moving to LW 201 in the ULLD seam and progressing to LW 202. An extraction plan for LW 201- 204 was lodged for approval in November 2016, and a Mining Operations Plan (MOP) amendment is to be submitted in early 2017.

During 2017 there will be construction of a new back road fan shaft, a dewatering borehole to the ULLD seam and a fresh air bore in proximity to the gas drainage facility.

5 Actions required from previous review

There are a number of actions resulting from the 2015 AR as discussed below.

A number of commitments were made in the 2015 AR that commenced in 2016. Following the submission of the 2015 AR, the Department of Planning and Environment (DPE), and the Department of Resources and Energy (DRE) undertook a site inspection. The site inspection resulted in a number of actions that ACOL were required to address and report on in the 2016 Annual Review. These actions are documented in **Table 8**.

Table 8 Actions required from previous review

Action required from previous annual review	Source of Action	Action undertaken	Where discussed in annual review
Undertake an Independent Environmental Audit, as required by the development consent.	2015 AEMR	Complete	Section 11
Prepare, consult and lodge the Extraction Plan for the Upper Lower Liddell Seam LW 201 – 204	2015 AEMR	Complete. The Extraction Plan was lodged on the 8 November 2016. Approval is expected in quarter 1 of 2017.	Section 4.5
Complete EPL variations, as discussed with the EPA, and amend associated air quality and groundwater monitoring programs.	2015 AEMR	During 2016 the EPL was amended to modify the air quality monitoring program. During 2017 an EPL modification application will be made to change the groundwater monitoring program.	-
Facilitate the diversion of clean water runoff from the NEOC rehabilitated area.	2015 AEMR	Monitoring continued during 2016 to further understand potential impacts associated with diversion of clean water runoff from the NEOC. During 2017 an impact assessment will be prepared and consultation undertaken to progress this project.	Section 9
Recalibrate the Ashton Coal hydrogeological model.	2015 AEMR	Complete	Section 7.4.1
Continue maintenance program to remove green plastic tube stock guards around established trees within the Bowmans Creek Diversion.	2015 AEMR	Ongoing. Trees are monitored during annual rehabilitation surveys undertaken by qualified consultants and a program to remove tubes is triggered as required.	-
Review Fauna monitoring methodologies at Ashton Coal based on outcomes from the past 10 years of monitoring.	2015 AEMR	Not completed. Flora and Fauna monitoring practices continue to follow the established approved monitoring program.	Section 6.4
Include Heritage performance in future AEMRs	DPE Inspection letter	No European Heritage has been impacted by Ashton Coal's activities during 2016. Aboriginal cultural heritage is discussed in Table 9.	Table 9
The Department (DRE) requests that results of monitoring undertaken against the rehabilitation completion criteria as presented in the Mining Operations Plan is reported in the rehabilitation section and used to justify achievement of completion criteria in future Annual Reviews.	DRE Notice of satisfactory Annual Review letter	Noted. Rehabilitation completion criteria for each phase of rehabilitation are shown in Table 21 to Table 27.	Table 21 to Table 27
Ongoing rehabilitation maintenance of the Glennies Creek contour bank should be undertaken and included in the 2016 Annual Review (Photograph 4)	DRE Notice of satisfactory Annual Review letter	Complete. Contour banks on rehabilitation were re-topsoiled and seeded during 2016.	Section 9.4

Action required from previous annual review	Source of Action	Action undertaken	Where discussed in annual review
Ongoing sediment control and management of Topsoil Stockpile be undertaken and reported in the 2016 Annual Review (Photograph 11)	DRE Notice of satisfactory Annual Review letter	The stockpiled material is frequently used around site and is managed accordingly. From time to time stockpiles are pushed up and managed. Erosion and sedimentation fences have been erected around these stockpiles and will be maintained in accordance with the site water management plan.	-
The Department encourages grazing trails to be undertaken within the pasture rehabilitation domain.	DRE Notice of satisfactory Annual Review letter	No action taken. There is insufficient infrastructure at Ashton to facilitate grazing trials.	-
Obtain Mining Purposes Lease from the NSW Department of Energy and Resources for the Tailings Dam and associated infrastructure	2014 AEMR	The MPL application was lodged in first half of 2015. Final survey instructions were issued by DRE in November 2016. ACOL will lodge final survey in early 2017.	-
ACOL to commission an appropriately qualified geomorphologist to investigate the Western Diversion bed scour and recommend any remedial actions	2014 AEMR	This investigation and its peer review were completed in 2016. Further monitoring of the diversion, including recommendations from these reports will be undertaken in 2017 and will be discussed in the 2017 AR, along with the five year monitoring of the diversion.	Section 9.2

6 Environmental Performance

Table 9 outlines the key performance or management issues and how they were addressed, as well as the implementation of any management measures from the reporting period and proposed improvements for following years.

The environmental aspects covered require management plans under the current development consent, or are major environmental aspects covered by various procedures, plans and programmes.

Where practical, environmental management of the main environmental aspects managed at the ACP have been discussed in Table 9. Where tabulating the information is not practical, further detail is included in the following sections of the report.

Table 9 Environmental Performance summary

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
Noise (Section 6.2)	See Table 11	Compliant with EPL and Development Consent conditions. For more detail, see Table 11. During the reporting period there was one noise complaint, investigation indicated that it was not due to Ashton Coal's operations.	Noise monitoring results during the reporting period follow the trends of past years: Ashton Coal's operations are largely inaudible in the surrounding community and minimal noise complaints have occurred (one complaint received in 2016).	The Noise Management Plan will be reviewed and updated if necessary to ensure best practice noise management techniques appropriate to the current operational status of the ACP and the changes in consent conditions following the approval of modification 5.

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
Air Quality (Section 6.3)	See section 6.3.2 for detail on approval criteria and background levels.	Compliant with Development consent.	There was 100 per cent data capture for depositional dust gauges and high volume air samplers, and 99.7 per cent data capture with TEOMs. There were no events where Ashton Coal's operations contributed to 50ug/m^3 daily average. There were no air quality complaints or reportable incidents related to air quality in 2016.	The Air Quality Management plan and monitoring program will be updated during the next reporting period to address findings from the independent Environmental Audit and the introduction of modification 5.
Visual Amenity and Lighting	Implement reasonable and feasible measures to mitigate visual and offsite impacts of lighting, Ensure no unshielded light shines above the horizontal, and All external lighting must comply with Australian Standard AS4282 (INT) 1997.	Visual amenity and lighting management at ACOL are managed in accordance with the internal Lighting Management Plan. Fixed lighting is utilised to illuminate the areas around the underground surface facilities, CHPP and open cut workshop. Earthen bunds are constructed and tree screens planted as a visual screen for infrastructure screening where possible. During the reporting period, earthen bunds and tree screens were inspected and maintained as required. Supplementary planting of tree screens to improve visual amenity along the New England Highway was undertaken.	There have been no lighting or visual amenity related incidents or complaints during the reporting period. ACOL will continue to effectively manage lighting and visual amenity according to the Lighting Management Plan and the Mining Operations Plan.	Lighting will continue to be managed to minimise impacts on the local community and highway traffic while maintaining lighting levels necessary for operational and safety needs. Planned future works include maintenance of existing tree screens and the extension of tree screens where appropriate.

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
Waste management (section 6.6)	39. the applicant must: Minimise and monitor the waste generated by the development, Ensure appropriate storage, handling and disposal of waste, Manage onsite sewage treatment and disposal, Report on waste management and minimisation in the AEMR.	Waste management will continue to be managed in accordance with Ashton Coal's waste management plan and the conditions of consent. Waste Management followed similar trends to previous years, with no significant changes to waste volumes or management throughout the year.	Ashton Coal's waste management contractor continues to do weekly inspections of operational areas and these are provided in monthly reports. Any issues are rectified immediately or area supervisors notified if necessary. There were no reportable incidents or community complaints relating to waste, chemical or hydrocarbon management.	Waste management will continue to be managed in accordance with the waste management plan and the conditions of consent.
Spontaneous Combustion	16 (a) Ashton Coal must implement reasonable and feasible measures to minimise offsite odour, fume and dust emissions including those generated from spontaneous combustion.	During the reporting period there was no spontaneous combustion in the rehabilitation or the CHPP stockpile areas. Spontaneous combustion surrounding the Void 4 tailings storage facility was monitored and managed where possible. Earthworks were undertaken to excavate and cap areas to extinguish areas of spontaneous combustion. These areas will continue to be monitored to measure effectiveness, and ongoing management of spontaneous combustion will be undertaken.	The nature of the loosely compacted overburden containing high levels of carbonaceous material indicates that ongoing management and maintenance of spontaneous combustion at the Void 4 tailings facility is required. New outbreaks are relatively common, and some areas may extinguish without any management works undertaken.	Ashton Coal will continue to monitor and manage spontaneous combustion.
Aboriginal Cultural Heritage	There are stringent requirements for the management of Aboriginal Cultural Heritage at Ashton Coal. Requirements of the development consent and AHIP 1131017 (Longwalls 1-4) and AHIP 1130976 (Longwalls 5-8) are detailed in the Aboriginal Heritage	During the reporting period, salvage works were completed in the subsidence crack zone Longwall 106 and commenced in the subsidence crack zone for Longwall 201 (Q4). Artefact analysis works were undertaken by archaeologists and the Aboriginal community for a total of six weeks throughout the year. Skills developed with participants included artefact identification and recording techniques such as data entry, use of digital callipers and digital camera. Approximately 9,990 artefacts were recorded with the Aboriginal	As Ashton Coal is now predominantly mining under previously subsided land, the amount of cultural heritage fieldwork required is diminishing. Archaeological salvage works will continue in the subsidence crack zone for Longwall 201, prior to commencement of mining. ACOL is now focussing on the analysis of recovered artefacts and	During the next reporting period, ACOL plans to: • Continue artefact analysis with archaeologists and the aboriginal community • Continue effective consultation with the aboriginal

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
	Management Plan (ACHMP).	community representatives in the reporting period. There were two Aboriginal Community Consultation Forum (ACCF) meetings held during the reporting period. ACCF meetings discuss current mine operations, upcoming cultural heritage fieldwork, management of Cultural heritage, and provide the Aboriginal community an opportunity to contribute to cultural heritage matters at ACOL.	management of the Conservation Area and *in situ* archaeological sites in relation to Aboriginal Cultural Heritage Management	community through the ACCF • Continue to monitor and manage lands within the Conservation Area to preserve Aboriginal sites. • Conduct minor salvage works as required to meet operational requirements. • Continue salvage works along LW201 planned subsidence zones, as required.
Bushfire	Bushfire at ACOL is managed in accordance with the Bushfire Management Plan which documents fire prevention and control measures to reduce the risk of and protect the operations and surrounding neighbours from bushfire.	During the reporting period, firebreaks were slashed around fence lines, pipelines and other infrastructure. There were no bushfires recorded on ACOL owned or neighbouring lands.	There have been no bushfires recorded at ACOL over the past year.	The prevention of bushfire on ACOL owned lands will continue to be actively managed in accordance with the Bushfire Management Plan.
Biodiversity (Flora and Fauna)(Section 6.4)	See Section 6.4	All required biodiversity monitoring was undertaken during the reporting period. Further information is included in Section 6.4	Consistent with previous years, the Bowmans Creek Diversion rehabilitation is progressing well.	During the next reporting period the Flora and Fauna Management Plan (FFMP) will be reviewed and updated as required.

Aspect	Approval criteria/ EIS prediction	Performance during the reporting period	Trend / key management implications	Implemented / proposed management actions.
Bowmans Creek Diversion (Section 9.2)	See Section 9.2	Bowmans Creek Diversion is a major environmental aspect for ACOL. Performance during the reporting period is discussed in sections: • 6.4.2 Aquatic ecology – Bowmans and Glennies Creek, • 6.5 Pest Management, • 9.2 Bowmans Creek Diversion Management, • 9.1 Bowmans Creek Diversion Rehabilitation Monitoring Program, and • 9.5 Rehabilitation status.	See the following sections: • 6.4.2 Aquatic ecology – Bowmans and Glennies Creek, • 6.5 Pest Management, • 9.2 Bowmans Creek Diversion Management, • 9.1 Bowmans Creek Diversion Rehabilitation Monitoring Program, and • 9.5 Rehabilitation status.	A focus on weed control will continue to facilitate the ongoing success of the diversion rehabilitation.
Water – Surface water (Section 7.3)	See Section 7	Surface water quality trends indicate no adverse mining impacts on the water quality of the local waterways. The site water management plan was updated and approved during the reporting period.	There have been no reportable incidents or community complaints in relation to water quality during the reporting period. No TARPs under the Water Management Plan were triggered.	During the next reporting period, ACOL will continue to undertake monitoring and remedial works where required to commence the diversion of clean water off established rehabilitated areas, reducing the clean water diverted to in-pit storage.
Water – Groundwater (Section 7.4)	See Section 7	During the reporting period, the site water management plan, monitoring program and groundwater model were updated. No unpredicted impacts to groundwater systems were identified. An annual Groundwater Management Report is included as Appendix 2.	There have been no reportable incidents or community complaints in relation to groundwater during the reporting period. No TARPs under the Water Management Plan were triggered.	Groundwater will continue to be managed in accordance with the Water Management Plan. The Water Management Plan will be reviewed and updated if required during the next reporting period.

6.1 Meteorological Data

Meteorological data is used at Ashton to interpret environmental impacts and to understand rehabilitation and land management outcomes. Ashton has two established meteorological monitoring stations: Monitoring Site 1 (predominantly used to monitor for noise and air quality impacts in adverse weather conditions) and the Repeater Station (the main monitoring site) (Figure 4). A summary of meteorological data recorded at the Repeater monitoring station during the reporting period is provided in **Table 10**. Rainfall is included as **Figure 2** and seasonal wind roses as **Figure 3**.

Table 10: Summary of meteorological results from the Repeater monitoring station

Parameter	Units	2016	2015	2014
Total rainfall	mm	624	902	700
Maximum monthly rainfall	mm	138 (recorded in February)	270 (recorded in April)	157 (recorded in December)
Minimum monthly rainfall	mm	23 (recorded in August)	15 (recorded in September)	7 (recorded in January)
Maximum temperature	°C	40.9 (recorded in December)	39.3 (recorded in November)	43.9 (recorded in November)
Minimum temperature	°C	2.2 (recorded in July)	2.7 (recorded in July)	1.6 (recorded in May)

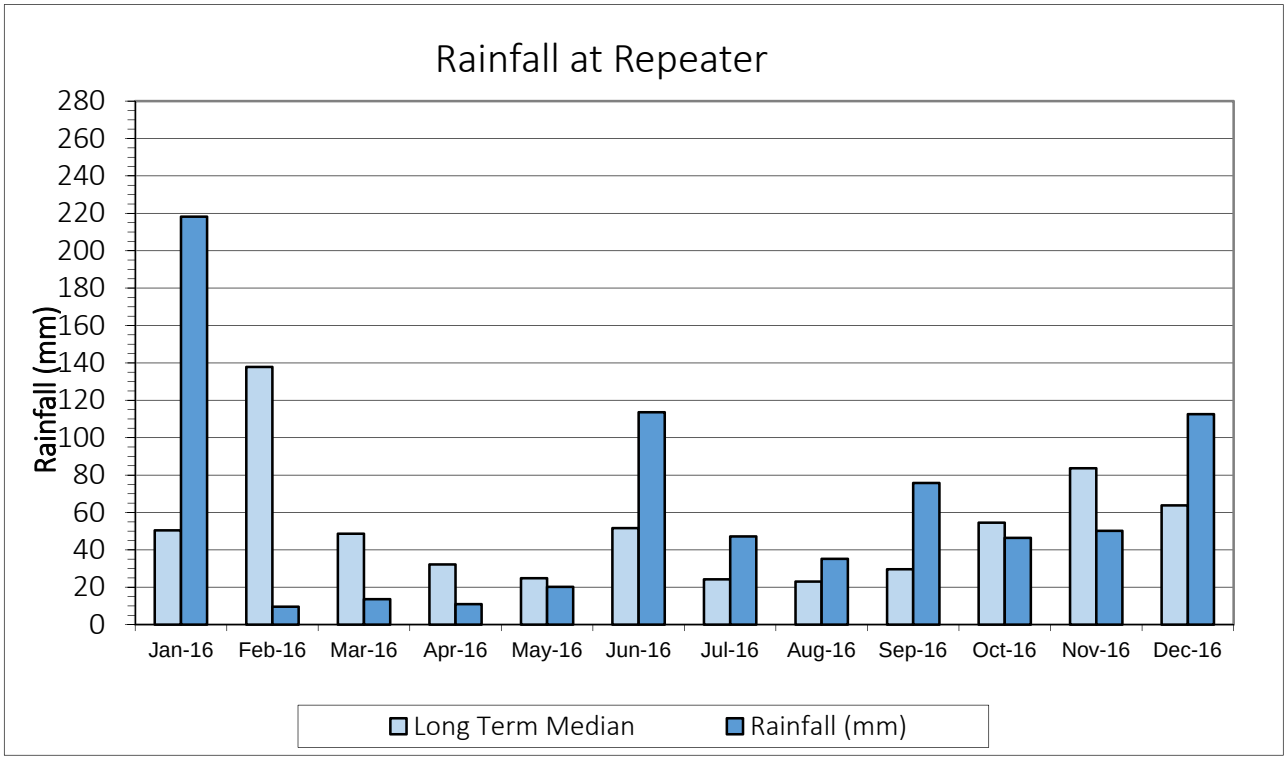


Figure 2 2016 Rainfall

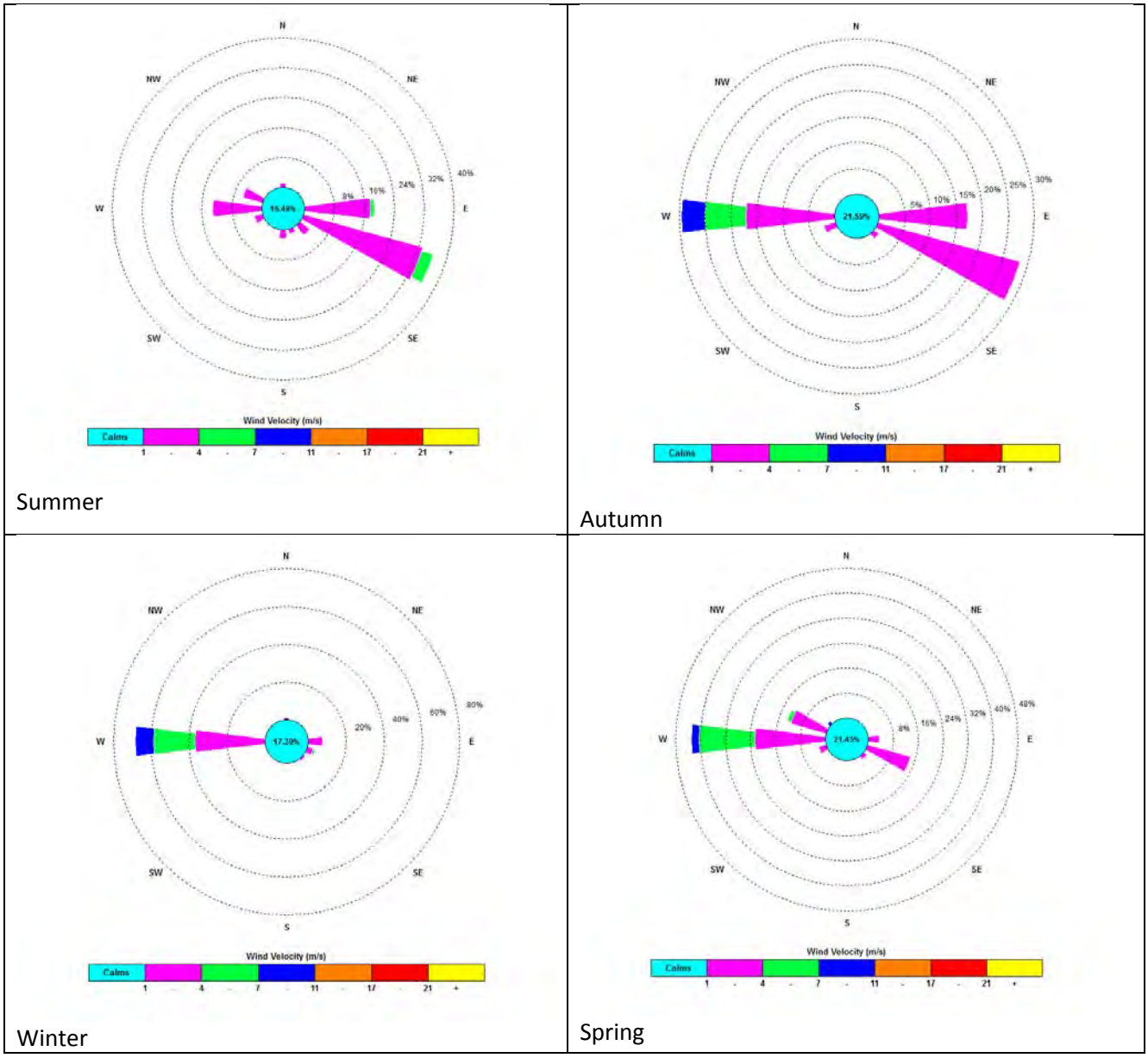


Figure 3 2016 seasonal wind roses, Repeater Station

6.2 Noise

6.2.1 Environmental Management

The operation's noise management plan details the relevant noise impact assessment criteria, compliance procedures and controls relating to mining activities.

Received levels from various noise sources are noted during attended monitoring and particular attention is paid to the extent of potential mine contribution. During 2016, potential noise generating activities from the ACP included underground mine related activities, maintenance of equipment, operation of the CHPP, train loading and land management activities. Noise mitigation measures include properly maintaining mobile plant, CHPP and ventilation fans, limiting hours of mobile noise generation (such as drilling activities), permanent noise mitigating engineering controls at the CHPP, and pit top facilities located below natural surface level.

6.2.2 Environmental Performance

Noise generated by the ACP must not exceed limits as specified in Appendix 6 of DA 309-11-2001-i and condition L2.1 of EPL 11879.

At each of the three monitoring locations, the mine's average noise energy over a 15 minute period (LAeq $_{(15min)}$), and the highest noise level generated for 0.6 seconds during one minute (LA1 $_{(1min)}$) (in the absence of any other noise), is measured on a monthly basis. When the mine was measurable and where meteorological conditions resulted in criteria applying (in accordance with the project approval), a low frequency noise assessment was conducted in accordance with the NSW Industrial Noise Policy.

An analysis of periodic attended noise monitoring results indicate operations were not audible at any monitoring location during monitoring, with the exception of March and May 2016, where monitored results were in compliance with relevant criteria.

Noise did not exceed the relevant L Aeq $_{(15\ min)}$ or L Aeq $_{(1min)}$ criterion at any location at any time, indicating nuisance and sleep disturbance noise generation was well within specified noise limits.

Analysis of all noise emissions from ACP showed that they complied with tonal, impulsive and low frequency modifying factor levels as per definitions in the NSW Industrial Noise Policy.

There was one community noise complaint received in September 2016. An investigation into noise levels and operations being undertaken at the time concluded that the noise was not likely to have been generated by Ashton Coal's operations.

A summary of results from the ACP's attended noise monitoring is provided in **Table 11**.

Table 11: Attended noise monitoring results

LAeq (15min)	N2	N3	N4
Noise impact criteria (Intrusive criteria) (LAeq (15min)) Night	36	36	36
Noise Impact criteria (LAeq (1min))Night	46	46	46
Predicted noise level for 2014 for each monitoring location (2002 EIS)	37	N/A	N/A
January	IA	IA	IA
February	IA	IA	IA
March	28	29	25
April	IA	IA	IA
May	31	30	23
June	IA	IA	IA
July	IA	IA	IA
August	IA	IA	IA
September	IA	IA	IA
October	IA	IA	IA
November	IA	IA	IA
December	IA	IA	IA

IA – Ashton Coal's operations were inaudible.

6.2.3 Trends and management measures

Noise monitoring results during the reporting period follow the trends of the past few years, where Ashton Coal's operations are largely inaudible in the surrounding community and minimal noise complaints have occurred. Noise generated by ACOL operations during the next reporting period are expected to remain consistent with the past three years.

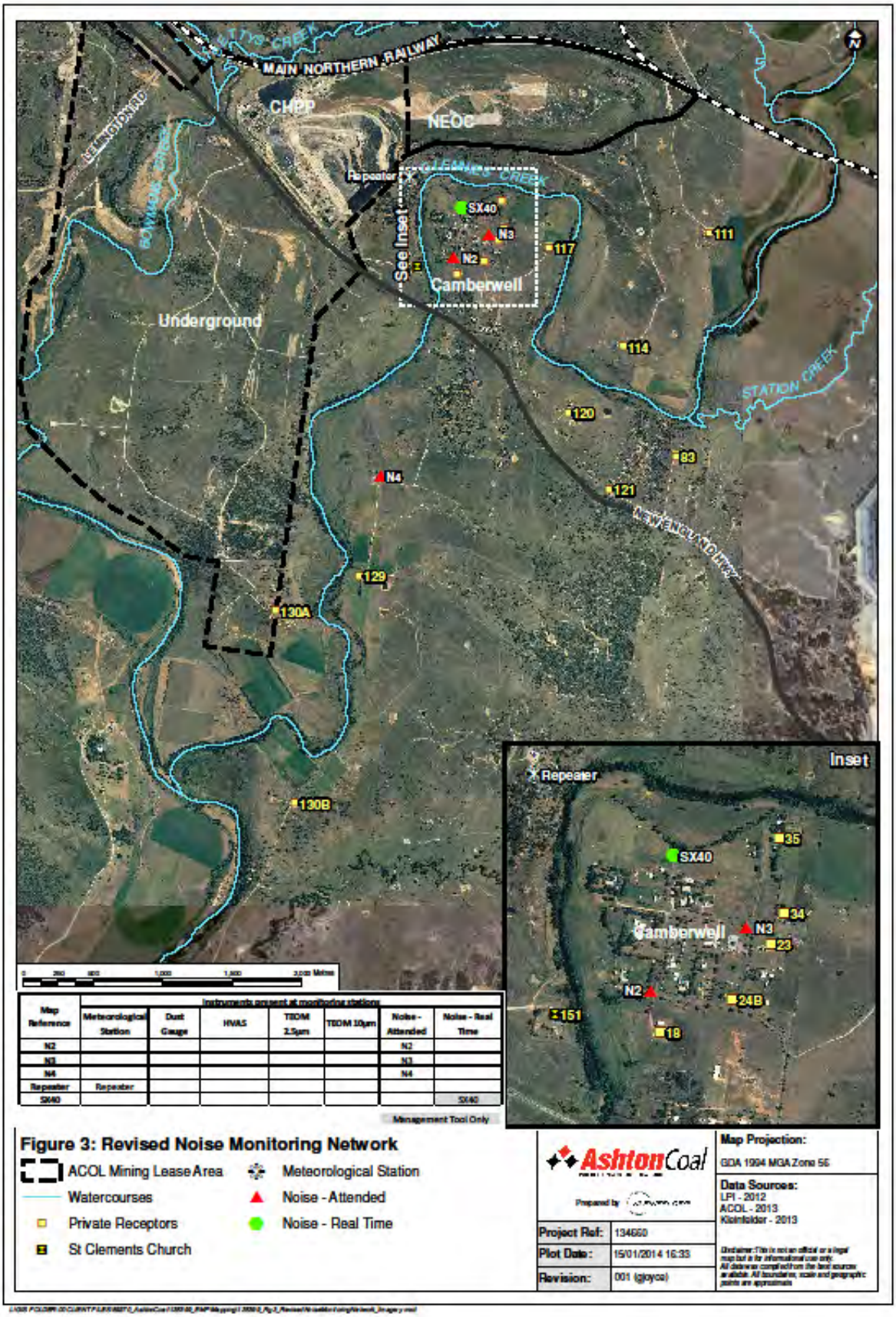


Figure 4 ACOL Meteorological and noise monitoring locations.

6.3 Air Quality

6.3.1 Environmental Management

The air quality monitoring network consists of depositional dust gauges, fine particle monitors that operate on a set schedule and real-time fine particulate monitors that operate continuously. The coupling of operational procedures and monitoring allows the ACP to take a proactive approach to dust management where necessary.

Depositional dust monitoring is carried out in accordance with *Australian Standard 3580.10.1:2003 Determination of particulates – Deposited matter – Gravimetric method* and analysed for insoluble solids and ash residue. Depositional dust samples are collected on a 30 day (plus or minus two days) basis from three approved depositional dust gauge monitoring sites in accordance with the approved Air Quality Management Plan (AQMP)

Total suspended particulates (TSP) are monitored using a high volume air sampler (HVAS). This monitor operates for 24-hours every six days in accordance with Australian Standard. HVAS measure cumulative dust levels from all sources.

One (1) statutory real-time tapered element oscillating microbalance sampler (TEOM) is used to record fine dust particles (i.e. particulate matter 10 microns and less (PM_{10})) on a continuous basis. There is also one TEOM used for operational management purposes, which is not reflective of impacts on sensitive receptors.

During 2016, in consultation with the EPA, EPL 11879 was revised to remove depositional dust gauges and high volume air samplers from the licence. A number of TEOMs were also removed from the licence and one TEOM will be relocated during 2017 to comply with the requirements of the revised EPL.

Following the changes to EPL 11879, ACP submitted a revised Air Quality management plan to the DPE for approval. Approval is expected during early 2017 and will result in a further reduction in air quality monitoring onsite in line with the optimisation of particulate monitoring associated with the Upper Hunter Air Quality Monitoring network (UHAQMN).

The cumulative reduction protocol outlined in the AQMP includes maintaining an open dialogue with neighbouring mining operations, sharing data and participating in the Upper Hunter Mining Dialogue Emissions and Air Quality working group.

The locations of air quality monitoring sites at Ashton Coal are shown in Figure 5.

Controls have been put in place in accordance with the approved management plan to reduce the potential for the generation and movement of dust from Ashton Coal's operation area. These controls are considered to have been adequate for the reporting period, and will continue to be applied during the next reporting period. The controls include:

- Large earth berms and tree plantations between the operations and the village have been constructed and trees established;
- At the closure of the mining operations in the NEOC, all available overburden dumps were bulk shaped and then rehabilitated during autumn 2012;
- Roads are clearly delineated and maintained and water carts utilised around the site to keep trafficked areas in a damp condition;
- All stockpiles are kept damp by the use of fixed or mobile water sprays under dry and windy conditions; and
- All diesel equipment used on site is maintained properly and fitted with appropriate pollution control devices.

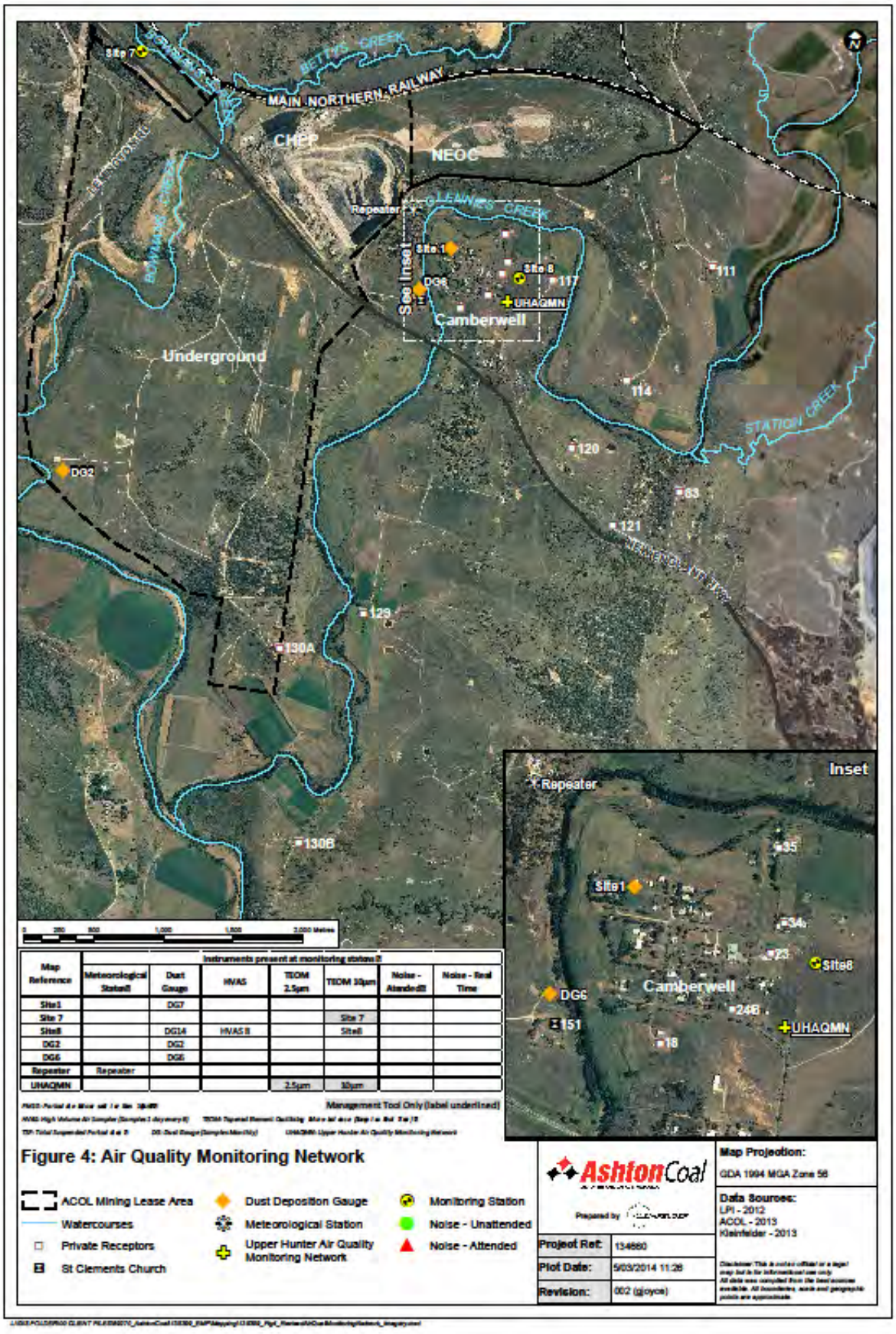


Figure 5 Location of air quality monitoring sites

During the reporting period ACOL continued to be a signatory to the Upper Hunter Air Quality Monitoring Network (UHAQMN). The collected data is provided to the community and industry through the Office of Environment and Heritage website.

6.3.2 Environmental Performance

6.3.2.1 Depositional Dust Gauges

Depositional dust gauge data capture rates for the reporting period were 100 per cent at all statutory sites.

In accordance with DA 309-11-2001-i, the criterion for the maximum total deposited dust level is 4 grams per square metre per month (g/m^2/month) over an annual averaging period. The criterion for the maximum increase in deposited dust levels due to ACP's operations over an annual averaging period at any one dust gauge is 2 g/m^2/month.

Table 12 shows the annual average insoluble solids for each gauge over the 2014 to 2016 reporting periods. There were no depositional dust gauges which exceeded the annual average of 4g/m^2/month for the 2016 reporting period.

Table 12: Comparison of annual average deposited dust results

Site reference	Location	2016 annual average g/m^2/month	2015 annual average g/m^2/month	2014 annual average g/m^2/month	Annual Average EIA Background Values g/m^2/month
D6	St Clements Church	3.0	3	3.59	1.5
D7	TEOM site 1 – Camberwell Village	3.6	3.2	3.03	N/A*
D14	TEOM site 8 – Camberwell Village	2.2	1.9	2.56	N/A*

* D7 and D14 were not contemplated in the Environmental Impact Statement.

Contamination by bird droppings, insects and vegetation is a common issue for depositional dust monitoring systems. During this reporting period there was one contaminated result, recorded in January 2016 at D6. A depositional dust gauge is deemed contaminated by an independent monitoring contractor or a National Association of Testing Authority (NATA) accredited laboratory. Results found to be contaminated are excluded from the annual average calculation.

6.3.2.2 High Volume Air Samplers

A summary of the results from the statutory HVAS TSP monitoring site for the reporting period is provided in **Table 13**. HVAS data capture rate was 100 per cent for the reporting period. In accordance with DA 309-11-2001-i, the long-term annual impact assessment criteria is 90 µg/m3 over an annual averaging period. There is no TSP short term 24-hour impact assessment criteria.

During the reporting period ACOL's statutory HVAS monitor remained below the long-term annual impact assessment criteria. The long term trends for HVAS results are presented in **Figure 6** and indicate that the trends recorded from the HVAS site during 2016 remain below the long- term trends.

Table 13: Summary of HVAS TSP results

Site name	Site reference	Minimum 24-hour result µg/m^3	Maximum 24-hour result µg/m^3	Reporting period annual average µg/m^3	Long term (annual average) criteria µg/m^3
Camberwell village (east)	8	5	189	65	90

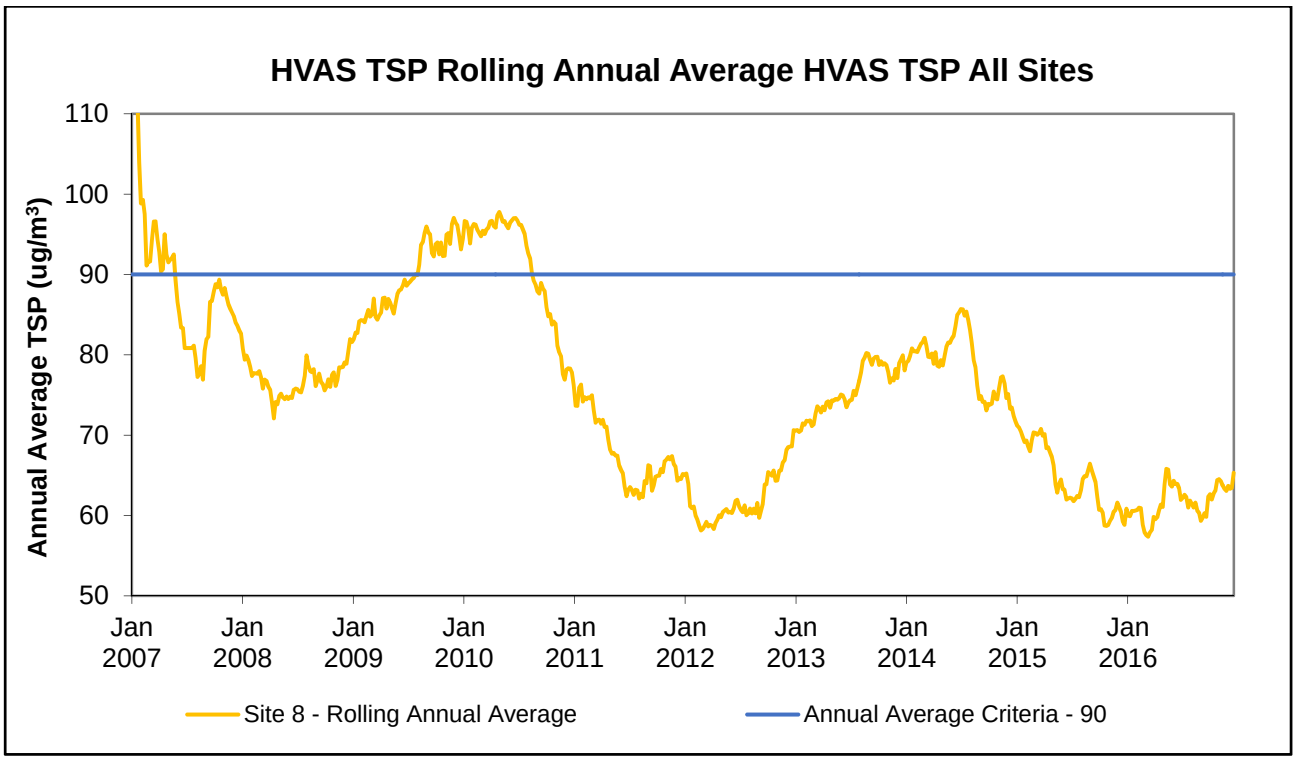


Figure 6: Long Term annual average TSP (HVAS) trends for site 8.

6.3.2.3 Tapered Element Oscillating Microbalance Samplers (TEOM)

Under the approved AQMP there is one statutory PM_{10} TEOM monitoring station in operation, as well as one operational TEOM and the local UHAQMN TEOM based in Camberwell village. Monitoring Location 7 is situated to the north of mining operations, immediately south of the Main Northern Railway and is intended to monitor the incoming concentrations of PM_{10} dust when the prevailing winds are from the northwest, which is the wind direction that presents the greatest risk of Ashton pit top facilities impacting the village of Camberwell.

Table 14: Locations and performance of TEOM sites.

Monitoring Station No	Particulates measured	Monitor Purpose	Location	Data capture (%)
7	PM_{10}	Background (upwind) Site (management tool)	Onsite at north-western end of rail siding	99.7
8	PM_{10}	Community Site - statutory	Camberwell village (east)	99.7
UHAQMN	PM_{10} and $PM_{2.5}$	Reference site only (not compliance related data).	Camberwell Village	99.1 98.0

TEOM data capture rates were high, with each site losing only one day's data. Data outages were caused by power outages, unexplained at Site 7 and due to an electrical storm at site 8.

A summary of the results from the statutory real-time PM_{10} TEOM monitoring site (Site 8) for the reporting period is provided in

Table 15. During the reporting period the short term 24-hour impact assessment criteria of 50 µg/m^3 was exceeded twice at Site 8, including air emissions from all sources. An investigation into each event was undertaken, including using wind direction data and upstream/ downstream monitoring points, as well as assessing regional air quality trends and localised influences or events at the time. For both events, results of

the investigation showed that the ACP's contribution was less than 50 µg/m^3. During the reporting period TEOM monitoring Site 8 remained below the long-term annual impact assessment criteria.

Table 15: Summary of TEOM PM_{10} results

Site reference	Minimum 24-hour result µg/m^3	Maximum 24-hour result µg/m^3	Short term Criteria µg/m^3	Reporting period annual average µg/m^3	Long term Criteria annual average µg/m^3
7 (background upwind site)	5.6	59.5	50	22.7	30
8 (community site)	3.0	52.5		20.8	
Camberwell UHAQMN (PM10)	4.4	65.7		24.5	
Camberwell UHAQMN (PM2.5)	1.8	21.1	25*	7.5	8*

* Advisory reporting standards only

The DPE have requested that mines report (within three working days) all instances where the mine's individual 24 hour average contribution exceeds 50µg/m^3 at any time. Ashton Coal did not report any instances where the mines contribution was 50µg/m^3 or greater during 2016.

6.3.3 Trends and key management implications

Monitoring results indicate that the ACP continues to meet air quality in accordance with DA 309-11-2001-i, indicating that current air quality management practices are effective.

There were no reportable incidents or community complaints relating to air quality during the reporting period.

6.3.3.1 Greenhouse gas reporting

Yancoal Australia Ltd reported greenhouse gas emissions results under the National Greenhouse and Energy Reporting Scheme (NGER) for the 2015-2016 reporting period. Overall ACOL emitted 364,427 tonnes CO_2 equivalent to a 26 per cent increase from the 2014-2015 reporting period. A summary of result variations is discussed below:

- Gas drainage contributions increased during the 2015-2016 financial year due to less flaring occurring during the reporting year. Gas drainage flow rates were in many instances too low to flare, resulting in higher emissions.
- Ventilation has contributed approximately 29 per cent more than in the previous reporting year, due to mining in deeper areas with a higher methane content.

6.4 Biodiversity (Flora and Fauna)

Each year the ACP undertakes extensive terrestrial and aquatic flora and fauna monitoring to track progress against management plan objectives. The monitoring program is aimed at tracking the condition of habitat areas over time and ensuring that the management plan's established performance indicators and project approval requirements are being met. The monitoring program includes terrestrial and aquatic monitoring, weed and vertebrate pest monitoring and associated management measures where required. This monitoring programme complements the rehabilitation monitoring of Bowmans Creek, North East Open Cut and the farmland over the underground mine which is discussed in Section 9. Monitoring includes areas within the Southern Conservation Area. A monitoring form as requested by the NSW Office of Environment and Heritage (OEH) is included as Appendix 3.

6.4.1 Fauna Monitoring

Fauna Monitoring surveys were undertaken in June and October of 2016 by independent qualified ecologists. Eight (8) survey sites were monitored consisting of four (4) sites that have been undermined in the past (impact) and four (4) in remnant vegetation that have had no mining activities (control). Each site was systematically sampled using a variety of fauna survey methodologies including small and medium mammal trapping, mammal hair sampling, funnel trapping for reptiles, echolocation recording for microchiropteran bat species, remote cameras detection, call playback surveys for nocturnal birds/mammals and active searches (diurnal and nocturnal) for amphibians, reptiles, mammals and birds.

Six (6) threatened species were recorded within the ACP site, being the grey-crowned babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*), speckled warbler (*Pyrrholaemus sagittatus*), scarlet robin (*Petroica boodang*), grey-headed flying-fox (*Pteropus poliocephalus*), brush-tailed phascogale (*Phascogale tapoatafa*) and the eastern bentwing bat (*Miniopterus schreibersii oceanensis*). Each of these species has been recorded in previous surveys within the ACP. Each of the species is listed as vulnerable under the *Threatened Species Conservation Act (NSW) 1995 (TSC Act),* and the grey-headed flying-fox is listed as vulnerable under the *Environment Protection Biodiversity Conservation Act (Cth) 1999* (*EPBC Act*).

The grey-crowned babbler is utilising each of the woodland remnants in the ACP site with seventy eight (78) observations (compared with forty four (44) in 2015) of this species and seven (7) nests (compared with twelve (12) nests in 2015), attributed to this species recorded during the 2016 survey period.

Among the eight (8) transects, the brush-tailed phascogale was captured at six (6) transects, detected by spotlighting at four (4) transects, recorded on remote camera at five (5) transects and detected at an additional (1) transect via hair funnel trap. This species was caught a total of thirty four (34) times in arboreal and terrestrial traps throughout the winter and spring surveys, was spotlighted and recorded on remote camera on four (4) and twelve (12) different occasions, respectively, and detected thirteen (13) times via hair funnel traps.

Analysis of pooled species data demonstrated similar species diversity between the controlled, analogue monitoring site (101) and mine impacted monitoring site (112). Based on this analysis, there is little indication from fauna monitoring results that mining is having an adverse impact in the ACP site. Similarly, comparison among faunal groups indicates that species diversity was consistent.

When compared to previous years, the species diversity among faunal groups remained generally consistent. The results of the fauna monitoring surveys within the ACP site indicate that threatened fauna species and their habitats have not been adversely impacted by mining. The threatened species diversity recorded in 2016 is different to that recorded in previous years however such variation is expected when monitoring a dynamic biological system.

6.4.2 Aquatic ecology – Bowmans and Glennies Creek

Aquatic ecology monitoring was undertaken during Spring and Autumn of 2016.

The overriding events for the aquatic ecology of both Bowmans and Glennies Creeks in 2016 were the succession of minor floods from November 2015 to January 2016 that resulted in scouring flood volumes through both Bowmans Creek and Glennies Creek prior to the autumn 2016 sampling and the overall dry conditions with long low to no flow periods in Bowmans Creek plus generally low flow conditions in Glennies Creek in the period leading up to the spring 2016 sampling.

For the Bowmans Creek Diversions (BCDs), significant volumes of the flood waters were diverted through the old creek sections as the upper block banks are still low, with the result that there was little or no impact to the developing riparian habitats of the BCDs and no significant damage to the structure or form of the BCD channels. For both Bowmans and Glennies Creek the pre-autumn 2016 flood volumes were sufficient to scour out or

mobilise aquatic biota to the effect that following cessation of floods the recolonisation of aquatic habitats would most likely have been initiated by opportunistic short-lived taxa. This results in higher swings in both diversity and macroinvertebrate streamhealth indices as they follow the rapid changes in the makeup of the assemblages post-flood. As the post flood period leading up to the spring sampling period was characterised by other opportunistic short-lived taxa (leading to additional swings in both diversity and macroinvertebrate streamhealth indices) as they follow the rapid changes in the makeup of the drought specialist assemblages. These compounding post-flood and post drought effects on aquatic biota assemblages are the main basis for a number of low performance index results over the two sampling seasons this year.

Notwithstanding the impacts on the aquatic macroinvertebrate assemblages, the overall quality of the aquatic ecosystems within the BCDs has continued to advance in 2016 with increased complexity and density of the riparian vegetation. The upper bank *Casuarina* woodland band plus the lower bank *Lomandra* sedge land continue to mature and natural locally sourced litter is building up and deepening the soil/litter cover over the sloping riparian rock cobble banks enhancing the growth of riparian grasses and herbs. Also notably, the density of *Casuarinas* and emergent sedges at and along the low flow riparian edge is now providing better shade to the riparian shallows in a number of places. Whilst there has been some increase in complexity of emergent and submerged vegetation, the November to January 2016 flood scouring removed some of the natural edge accumulated woody debris and vegetation litter noted during spring 2015, with little replacement over the intervening period through to spring 2016 due to the overall low flow regime.

Comparisons of the macroinvertebrate biota data for the natural creek and BCD channel survey pools over autumn and spring 2016 indicate that the diversion channel sites are supporting a macroinvertebrate biodiversity and complexity consistent with that encountered within the range of monitoring sites located up and downstream in the retained Bowmans Creek sections (the in-line sections). The diversity and abundance of fish recorded from within the diversions channels in 2016 match the overall diversity and distribution of fish in natural in-line creek pools up- between and down-stream of the diversions. The fish results demonstrate that both Glennies and Bowmans Creek provide fish passage during periods of extended flow and provide refuge habitat during periods of low flow.

6.5 Pest Management

Weed and pest management are undertaken at ACP in accordance with the MOP, FFMP and good land management principles.

6.5.1 Weed Management

Weed control programs at ACP target weeds that are locally declared under the *Noxious Weeds Act 1993*, including African boxthorn, Mother-of-millions, various ground cactus species, St John's Wort and other environmental weeds. Weed control on site has been consistent over the last few years, targeting the larger populations of weeds, the more invasive species and the riparian zones.

Priority areas for treatment included the mine site boundary, Bowmans and Glennies Creeks, rehabilitation areas and selected offset and conservation areas. Areas of weed control activities and the species treated are shown in Figure 7.

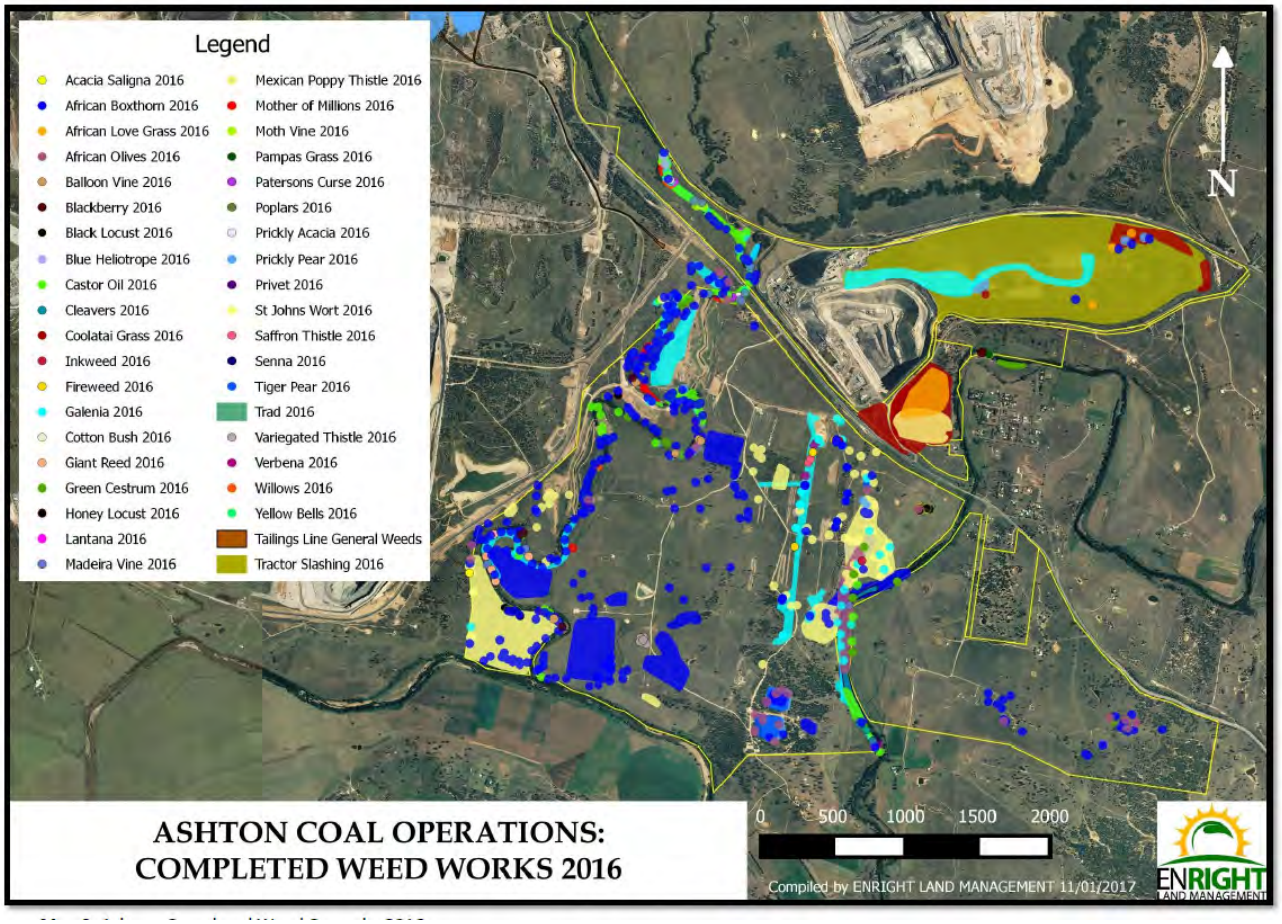


Figure 7 weed control works, 2016.

6.5.1 Vertebrate pest management

During the reporting period, the ACP continued an integrated control program to combat the presence of feral animals on ACP properties. Methods utilised during 2016 included site monitoring by means of Trail Cameras and Site Inspections, and a 1080 Baiting Program. Over the two trapping programs, 13 wild dogs and 64 foxes took baits.

6.6 Waste Management

Waste management will continue to be managed in accordance with the Waste Management Plan and conditions of consent. There were no significant changes to waste volumes or management throughout the year. ACP's waste management contractor continues to do weekly inspections of operational areas and these are provided in monthly reports. Any issues are rectified immediately or area supervisors notified if necessary. There were no reportable incidents or community complaints relating to waste, chemical or hydrocarbon management.

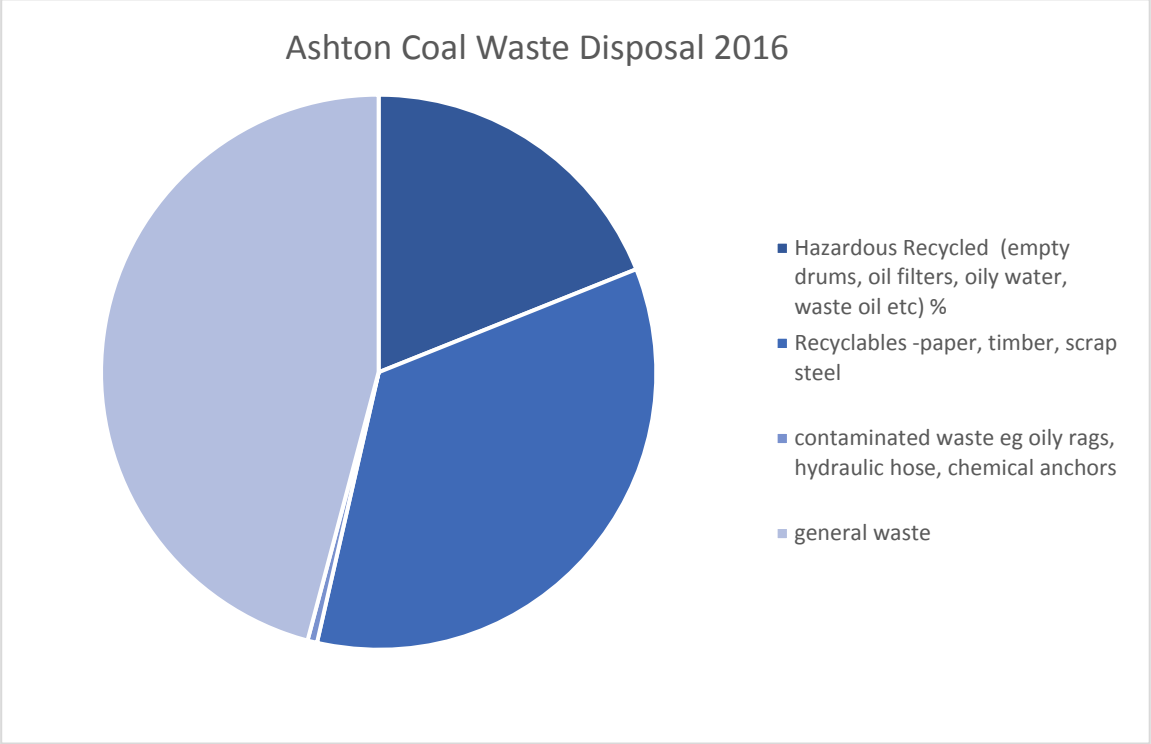


Figure 8 waste generation at ACOL, 2016

6.7 Heritage

There are stringent requirements for the management of Aboriginal Cultural Heritage at Ashton Coal.

Requirements under DA 309-11-2001-i, AHIP 1131017 (LW 1-4) and AHIP 1130976 (LW 5-8) are detailed in the Aboriginal Cultural Heritage Management Plan (ACHMP). Condition 34 (c) calls for regular consultation with the Aboriginal community in the conservation and management of Aboriginal cultural heritage.

During the reporting period, salvage works were completed in the LW 106 subsidence crack zone and commenced in the LW 201 subsidence crack zone (Q4). Artefact analysis works were undertaken by archaeologists and Aboriginal community representatives for a total of six (6) weeks throughout 2016. Skills developed with participants included artefact identification and recording techniques such as data entry, use of digital callipers and digital camera. Approximately 9,990 artefacts were recorded with the Aboriginal community representatives in the reporting period.

There were two Aboriginal Community Consultation Forum (ACCF) meetings held during the reporting period. ACCF meetings discuss current mine operations, upcoming cultural heritage fieldwork, management of cultural heritage, and provide the Aboriginal community an opportunity to contribute to cultural heritage matters.

Archaeological salvage works will continue in the LW 201 subsidence crack zone, prior to commencement of mining. Current works are now focussing on the analysis of recovered artefacts and management of the Conservation Area and in situ archaeological sites in relation to Aboriginal Cultural Heritage Management.

During the next reporting period, ACP plans to:

- Continue artefact analysis with archaeologists and the aboriginal community;
- Continue effective consultation with the Aboriginal community through the ACCF;

- Continue to monitor and manage lands within the Conservation Area to preserve Aboriginal sites and flora and fauna of the area;
- Conduct minor salvage works as required to meet operational requirements; and
- Continue salvage works along LW 201 and potentially LW 202 planned subsidence zones, as required.

7 Water Management

Ashton Coal manages water through its approved site Water Management Plan (WMP) and associated surface and groundwater monitoring programs, last approved on 11 May 2016. The ACP is situated between Bettys Creek in the north, the Hunter River in the south, Glennies Creek in the east and Bowmans Creek and its associated floodplain in the west. Bowmans Creek and Glennies Creek are tributaries of the Hunter River, while Bettys Creek is a tributary of Bowmans Creek. Monitoring of surface and ground water sites is conducted in accordance with the approved monitoring program.

7.1 Water Balance

ACP regularly monitors the water balance for the operation to assist in forecasting and modelling for different climatic and site scenarios. A series of flow meters and surveyed volumes are utilised to monitor the use and transfer of water between key water storages on-site. Water storages are surveyed on a regular basis to ensure the accuracy of water volume data. A schematic overview of the site's water management system can be found in Figure 9.

The water balance is reported annually in accordance with the Mineral Council of Australia's Water Accounting Framework for the Minerals Industry (2012) (MCA WAF) on a calendar year basis:

http://www.minerals.org.au/file_upload/files/resources/water_accounting/WAF_UserGuide_v1.2.pdf.

The MCA WAF allows sites to account for, report on and compare site water management practices in a rigorous, consistent and unambiguous manner that can easily be understood by non-experts. The MCA WAF focusses on the flows between the environment and the boundary of the operation i.e. the inputs, outputs and diversions.

7.1.1 Water Demands

The ACP has three main water demands:

- The supply for the Coal Handling and Preparation Plant (CHPP);
- The supply for underground operations; and
- The supply for above ground dust suppression.

A total of 2.38 million tonnes (Mt) of ROM coal was processed over the 2016 calendar year resulting in a CHPP demand of approximately 595 ML or 249 litres per feed tonne. Metered underground supply was 180 ML while dust suppression use over the 2016 calendar year was measured to be 31 ML.

7.1.2 Inputs and Outputs

Rainfall/runoff and aquifer interception are the principal water resources for the ACP with approximately 253 hectares (ha) captured by the surface water management infrastructure on site during the reporting period. Over the 2016 calendar year, modelling indicates rainfall/runoff accounted for 38.9% of the total water inputs to the water management system while groundwater interception and extraction accounted for approximately 41.5%. Water sourced from the Hunter River and Glennies Creek accounted for 13.5% while water entrained in the feed coal accounted for 6.2% of the total water inputs. Major outflows from the ACP over the 2016 calendar year included evaporation (18.4%), entrainment in product coal and rejects (36.9%), loss from the underground (22.2%) and seepage (22.5%).

7.2 Water take

DPI-Water requires water take to be reported over a financial year period (i.e. 1 July 2015 to 30 June 2016). Consequently, water take (section 7.2) is reported in a manner consistent with this requirements.

ACP measures its water take in accordance with the approved WMP. Measured water take is partitioned in accordance with the protocol detailed within the WMP which incorporates a combination of site observations, measurements and predictions of the site Groundwater Model.

Water take occurs via two separate methods: incidental (or passive) take, and pumped surface water take. Incidental take occurs through mining induced fracturing of aquifers which report to the underground workings. This water is removed from the mine by a network of dewatering pumps. Pumped surface water take involves active pumping from Glennies Creek and the Hunter River to provide higher quality water for a variety of uses including potable water and irrigation of rehabilitation, use in equipment and as fire-fighting water at the mine.

During the 2015 – 2016 water year ACOL continued to dewater underground workings. The water is stored in the Pikes Gully seam which overlies the current extraction in the Upper Liddell Seam. This water must be dewatered to mitigate the risk of safety issues associated with mining below it. The water has accumulated over a number of years and as such was effectively not taken during the 2015 – 2016 water year; however, it does inflate the apparent overall incidental take for the period. The total stored porous/hard rock water pumped from mine (not taken during 2014 – 2015 water year) was 221 ML. Despite this water not technically being taken during this water year, sufficient licence capacity was maintained to account for this water.

Table 16 Water Management Act 2000 Licences and associated water take for FY16.

Water Licence Number	DPI Water Reference	Water sharing Plan, source and management zone	Entitlement (ML)	Passive take / inflows (ML)	Active pumping (ML)	Total (ML)
984	20AL201282	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	9	0	0	0
997	20AL201311	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	11	0	0	0
1120	20AL201624	Whole Water Source (Hunter Regulated River Water Source)	3	0	0	0
1121	20AL201625	Hunter Regulated Water Sharing Plan, surface water, zone 1B (Hunter River from Goulburn River Junction to Glennies Creek Junction)	335	36	13	49
1358	20AL203056	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	4	0	0	0
6346	20AL203106	Hunter Regulated Water Sharing Plan, surface water, zone 1B (Hunter River from Goulburn River Junction to Glennies Creek Junction)	15.5	0	0	0
8404	20AL200491	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	80	0	0	0
15583	20AL204249	Hunter Regulated Water Sharing Plan, surface water, zone 3A (Glennies Creek)	354	27	222	249
19510	20AL211015	Hunter Regulated Water Sharing Plan, surface water, zone 1B (Hunter River from Goulburn River Junction to Glennies Creek Junction)	130		0	
23912	20AL211423	Hunter Unregulated and Alluvial Water Sources 2009, surface water, Whole Water	14	0	0	0

Water Licence Number	DPI Water Reference	Water sharing Plan, source and management zone	Entitlement (ML)	Passive take / inflows (ML)	Active pumping (ML)	Total (ML)
		Source (Jerrys Water Source) (Bowmans Creek)				
29566	20AL212287	Hunter Unregulated and Alluvial Water Sources 2009, Aquifer, Jerrys Management Zone (Jerrys Water Source)	358	12	0	12
36702	20AL212975	Hunter Unregulated and Alluvial Water Sources 2009, Surface water, Jerrys Management Zone (Jerrys Water Source) (Bowmans Creek)	116	0	0	0
36703	20AL212976	Hunter Unregulated and Alluvial Water Sources 2009, Surface water, Jerrys Management Zone (Jerrys Water Source) (Bowmans Creek)	150	20	0	20
TOTAL			**1579.5**	**95**	**235**	**330**

Table 17 Water Act 1912 Licences and associated water take

Water Licence Number	Water sharing Plan, source and management zone	Entitlement (ML)	Passive take / inflows (ML)	Active pumping (ML)	Total (ML)
20BL169508	Water Act 1912 Groundwater Licence	100	0	0	0
20BL173716	Water Act 1912 Groundwater Licence	511	385	0	385
20BL173735	Water Act 1912 Groundwater Licence	Nil - Monitoring Only	-	-	-

No compensatory water has been required or provided to private landholders in the reporting period.

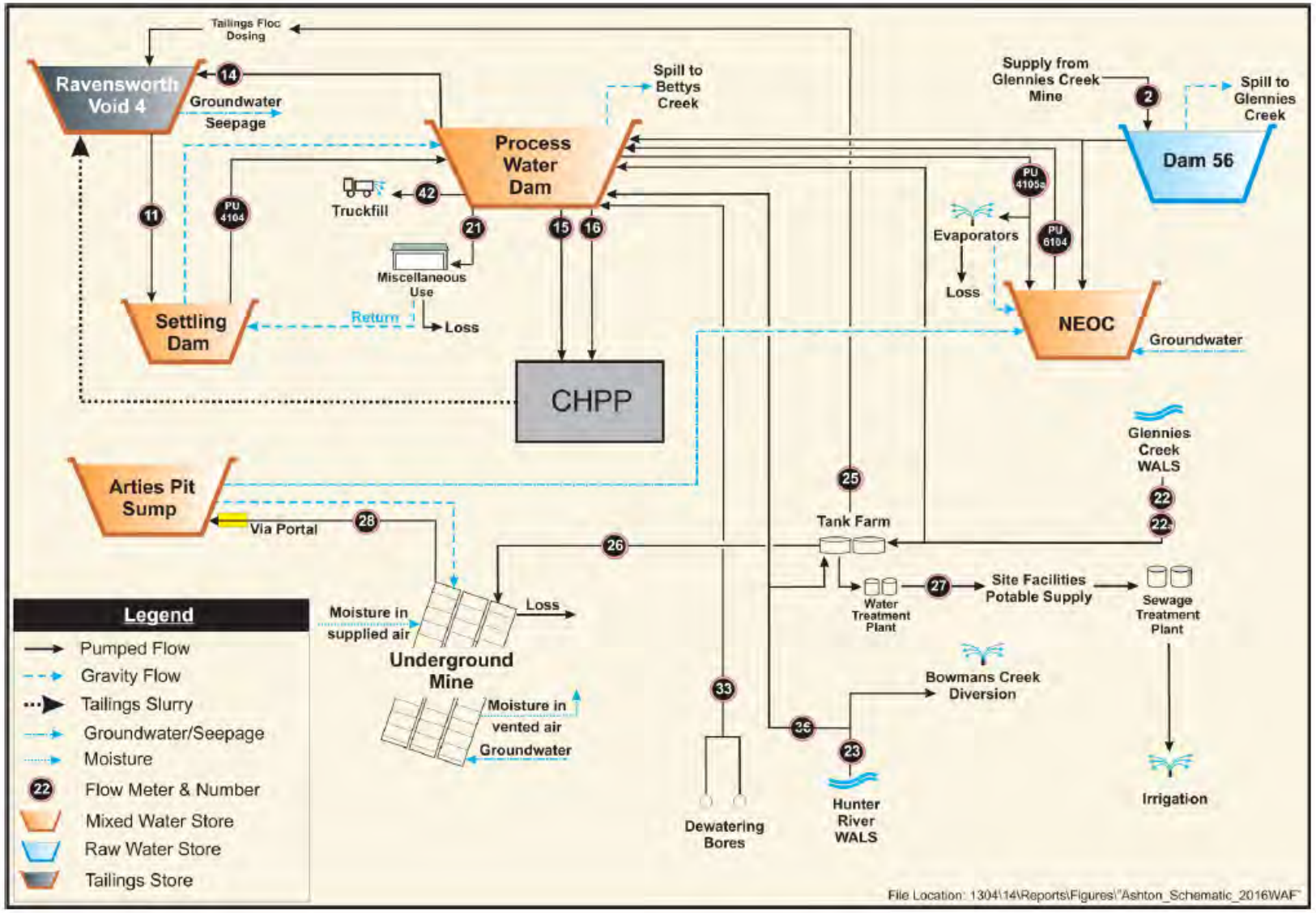


Figure 9 ACOL water schematic* *All dams must have spillways constructed to ensure dam wall stability. Dams at the ACP are managed to prevent spills occurring.

7.3 Surface Water

7.3.1 Environmental Management

Surface water at the ACP is managed in accordance with the approved WMP. Appropriate controls have been put in place to mitigate potential causes of water pollution. These controls are considered to have been adequate for the reporting period. Water quality for the creeks and rivers surrounding ACP operations is monitored by an independent consultant at fourteen (14) approved monitoring sites. The location of the surface water monitoring sites is shown in Figure 10 and described in Table 18. Analysis of all water samples collected is undertaken by a NATA accredited laboratory. Monthly water samples were collected and analysed during the reporting period for pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS) Total Hardness ($CaCO_3$), and Oil and Grease (O&G).

The ACP WMP aims to minimise any adverse impacts on receiving waters downstream of operations; including Glennies Creek, Bettys Creek and Bowmans Creek, all of which drain into the Hunter River. The WMP also outlines measures for managing water on site. The approved surface water monitoring program has established impact assessment criteria, described as trigger values which, if activated, would lead to a response in terms of more intensive monitoring, investigation and if required, remedial action.

7.3.2 Environmental Performance

The location of surface water monitoring sites and data capture rates are provided in **Table 18**. SM1 and SM2 in Bettys Creek were dry, which is typical for this watercourse. A summary of the surface water quality data for statutory sites during the reporting period is provided in **Table 19**.

Table 18: Surface water monitoring locations and data capture rates

Monitoring Station	Stream	Location	Data capture rate %
SM 1	Bettys Creek	Glendell land upstream of Ashton	0*
SM 2	Bettys Creek	Just upstream of confluence with Bowmans Creek	0*
SM 3	Bowmans Creek	Water pool at north west corner of mine lease	100
SM 4	Bowmans Creek	Water pool immediately downstream of New England Highway	100
SM 4a	Bowmans Creek	Former channel	100
SM 5	Bowmans Creek	Halfway down Ashton property	100
SM 6	Bowmans Creek	Just upstream of confluence with Hunter River	100
SM 7	Glennies Creek	Upstream of Ashton Mine	100
SM 8	Glennies Creek	Halfway down Ashton property	100
SM 9	Hunter River	Upstream of confluence with Bowmans Creek	100
SM10	Hunter River	Downstream of confluence with Bowmans Creek	100
SM 11	Glennies Creek	Upstream of confluence with Hunter River	100
SM 12	Hunter River	Downstream of confluence with Glennies Creek	100
SM 13	Hunter River	Upstream of confluence with Glennies Creek midway between Bowmans Creek and Glennies Creek	100
SM 14	Hunter River	Directly upstream of confluence with Glennies Creek	100

*SM1 and SM2 in Betty's Creek were dry for the duration of the reporting period

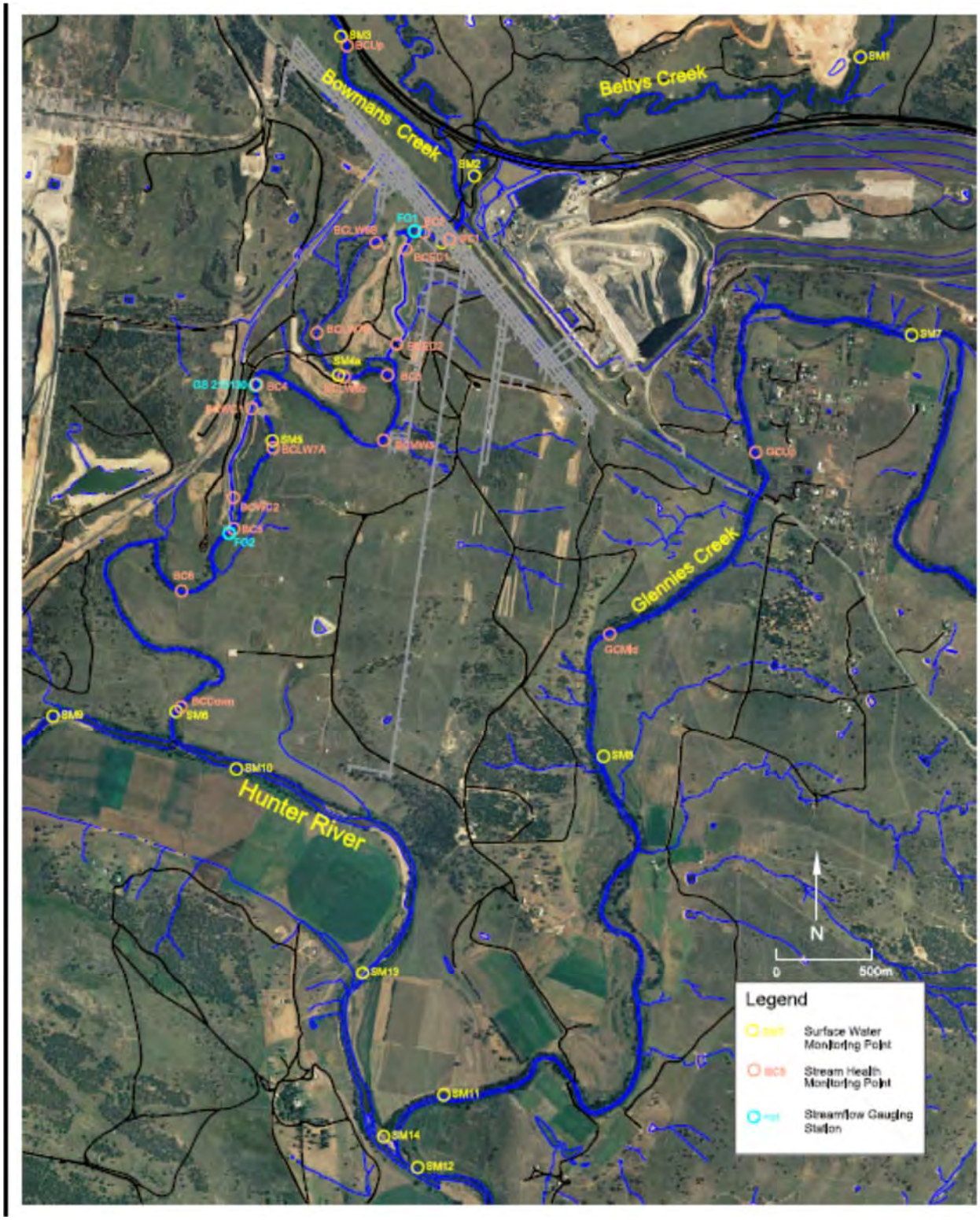


Figure 10: ACOL's surface water monitoring locations

Table 19: Summary of surface water quality monitoring results - 2016

Creek System		pH	EC µS/cm	TDS mg/L	TSS mg/L
Bettys Creek*	Minimum	-	-	-	-
	Maximum	-	-	-	-
	Average	-	-	-	-
Bowmans Creek	Minimum	6.7	271	203	1
	Maximum	7.7	1026	626	13
	Average	8.2	2040	1300	42
Glennies Creek	Minimum	7.0	276	148	3
	Maximum	7.8	534	326	12
	Average	8.2	804	489	22
Hunter River	Minimum	7.3	368	221	11
	Maximum	8.1	685	417	32
	Average	8.7	1108	700	62

*Bettys Creek was dry for the duration of the reporting period

7.3.2.1 pH

pH results were generally consistent with the past two year's results.

Surface water pH measured in Bowmans Creek (SM3, SM4, SM4a, SM5 and SM6) were neutral to slightly alkaline (ranging from 6.7 to 8.2) and did not trigger response levels as detailed in the SWMP.

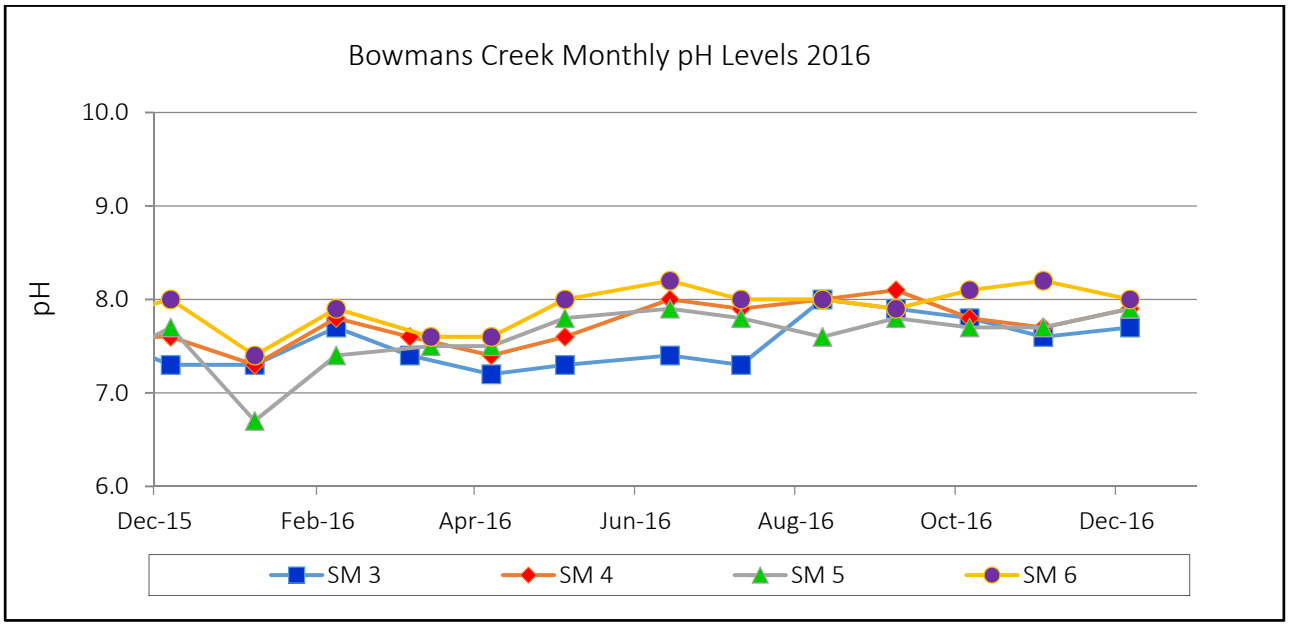


Figure 11: Bowmans Creek pH levels during 2016

Glennies Creek (SM7, SM8 and SM11) pH levels were neutral to slightly alkaline (ranging from 7.0 to 8.2) throughout the year. The pH levels remained within the acceptable pH range and no trigger responses were required during the reporting period.

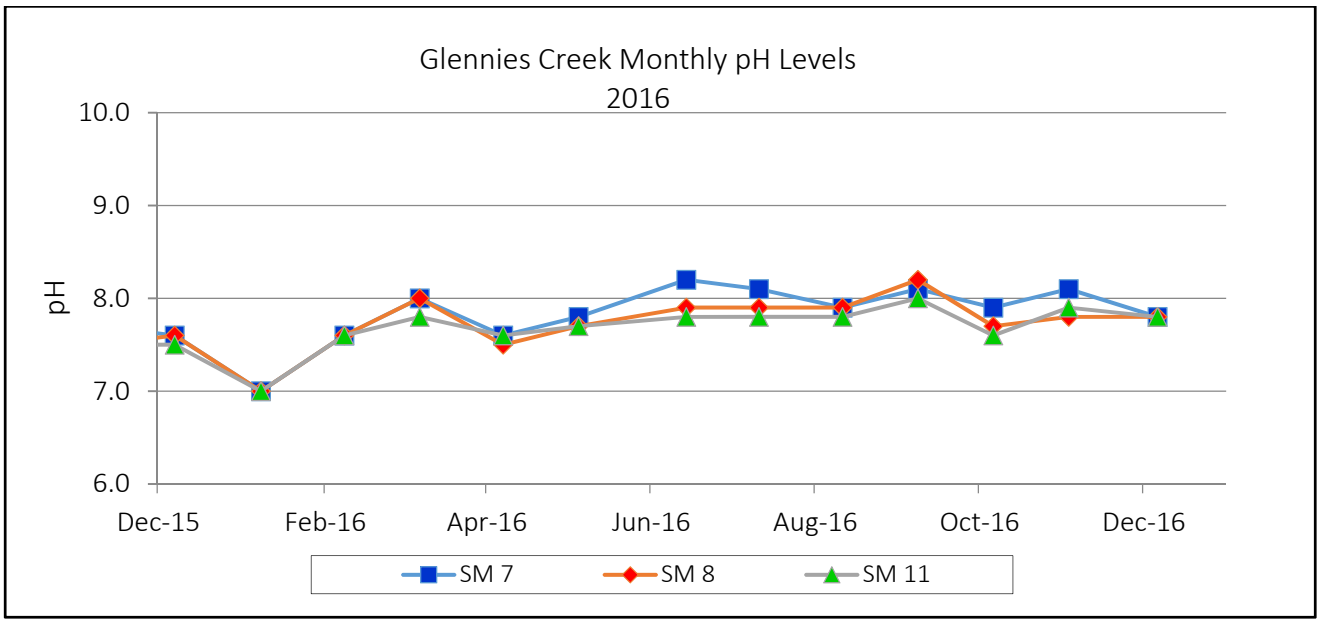


Figure 12: Glennies Creek pH levels during 2016

pH levels in the Hunter River (SM9, SM10, SM12, SM13 and SM14) were neutral to slightly alkaline (ranging from 7.3 to 8.7) with minimal variation between sites, and remained within the acceptable recommended pH range.

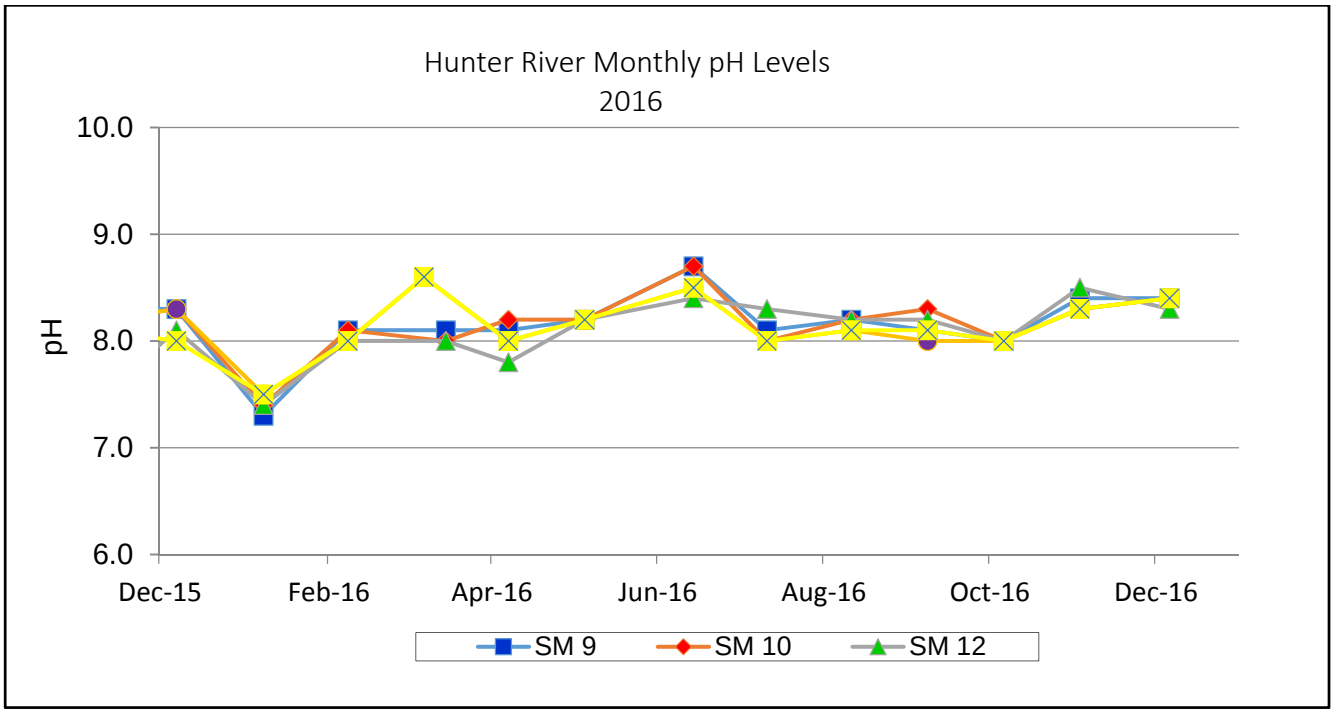


Figure 13: Hunter River pH levels during 2016

7.3.2.2 Electrical Conductivity (EC)

Surface water Electrical Conductivity (EC) results were generally consistent with results from 2015.

Typical of previous years, Bowmans Creek sites (SM3, SM4, SM5 and SM6) generally experienced higher EC results compared to other monitoring sites. This is due to a natural inflow of saline ground water which forms most of the flow during dry months and low surface flow periods, resulting in increased EC levels.

Bowmans Creek EC levels fluctuated between 271 - 2040µS/cm (Figure 14). Elevated levels of EC at SM4 have been observed previously and result from natural saline groundwater inflows to the pool. During periods of low flow in Bowmans Creek, the saline groundwater discharge becomes the dominant supply of water to the pool resulting in increasingly elevated EC levels. EC levels greater than 10,000 µS/cm have been historically observed at the site.

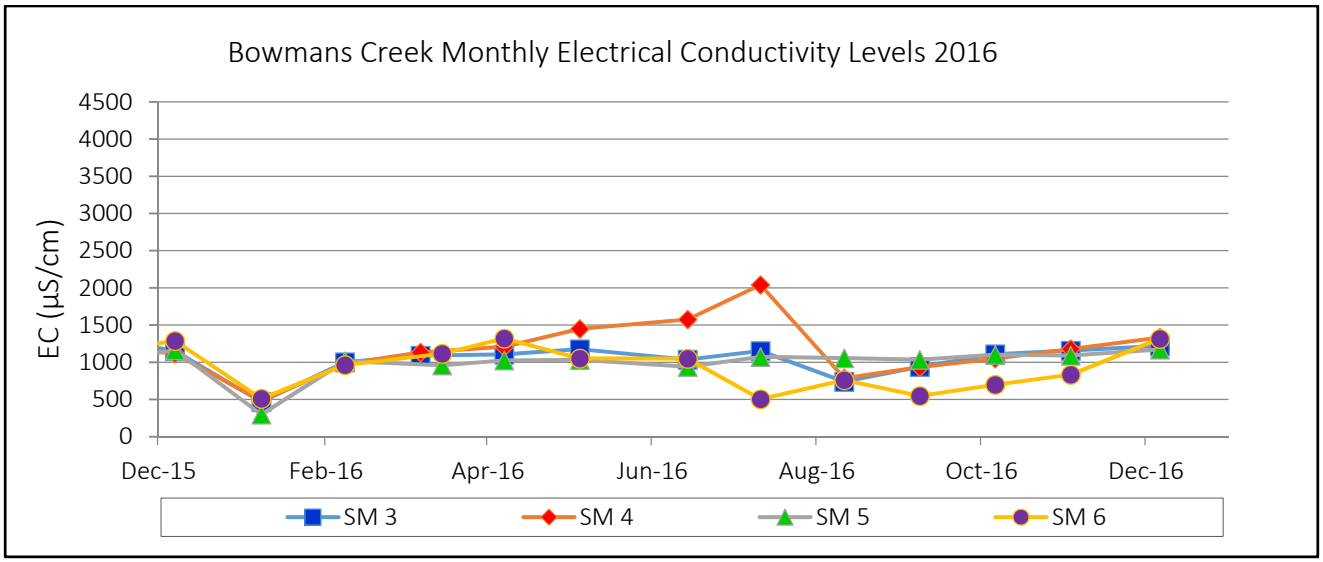


Figure 14: Bowmans Creek EC during 2016

Glennies Creek (SM7, SM8 and SM11) EC levels fluctuated throughout 2016 but remain stable between monitoring sites. EC ranged between 276 and 804 µS/cm.

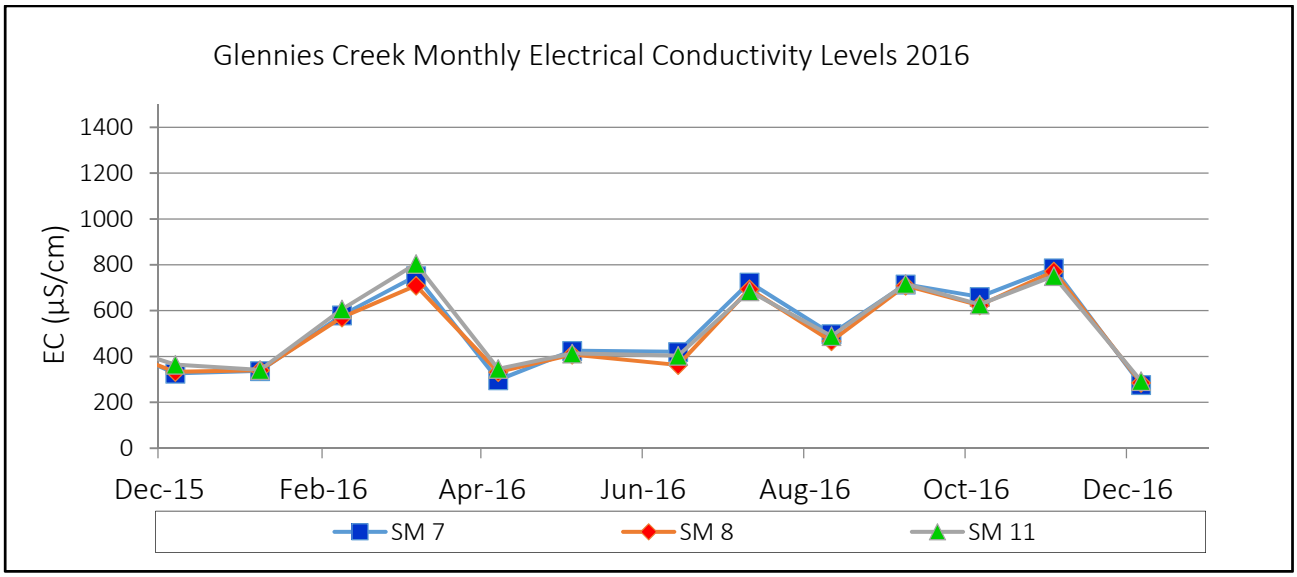


Figure 15: Glennies Creek EC during 2016

Hunter River (SM9, SM10, SM12, SM13 and SM14) EC levels were generally low throughout the year, fluctuating between 368 and 1108 µs/cm, as shown in Figure 16.

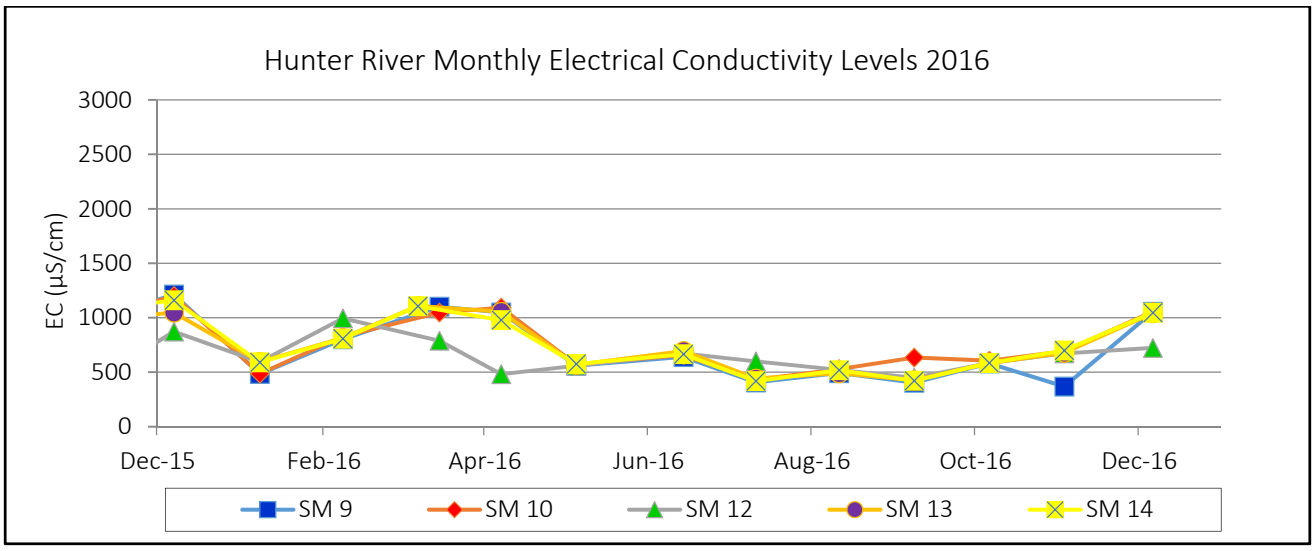


Figure 16: Hunter River EC during 2016

The monitoring data collected during the reporting period continued to indicate that there are no adverse impacts from mining on surface water quality around the mine site.

7.4 Groundwater

7.4.1 Environmental Management

The location of the groundwater monitoring sites is displayed in **Figure 17**. The monitoring network is spatially distributed across the underground mining area. Monitoring coverage is focussed in areas within and adjacent to the mining associated subsidence footprint, notably:

- Saturated quaternary sediments (alluvium) including Bowmans Creek Alluvium (BCA), Glennies Creek Alluvium (GCA) and Hunter River Alluvium (HRA).
- Shallow Permian sandstone and minor coal seams referred to in this report as coal measures overburden (CMOB).
- Permian coal measures of varying thickness targeted by mining.

The ACP WMP aims to minimise adverse impacts (other than those approved under the development consent) on aquifers in proximity to the operation, including the hard rock coal measures and the shallow alluvial deposits associated with the Hunter River, Glennies Creek and Bowmans Creek. The groundwater monitoring program includes groundwater level, piezometric pressure and field water quality parameters and has been carried out in accordance with the WMP approved in May 2016 and the requirements detailed under the conditions of Development Consent DA No. 309-11-2001-i and EPL 11879.

A groundwater model is utilised to predict impacts and changes to the hydrogeological regime of the site. During 2016 the groundwater model was updated and recalibrated using up to date monitoring data and mine plans. The model has worked well throughout the year with no exceedances of impacts from those modelled and approved.

ACOL's approved groundwater monitoring program has established impact assessment criteria. Impact assessment criteria can be described as trigger values that, if exceeded, would lead to a response in terms of more intensive monitoring, investigation and ultimately if required remedial action.

Monitoring of water levels and water quality parameters is undertaken on a monthly basis at selected monitoring bores. Physical parameters – pH, EC and temperature are monitored quarterly and chemical speciation is undertaken on relevant bores annually.

Further information on groundwater management during 2016 can be found in Appendix 2.

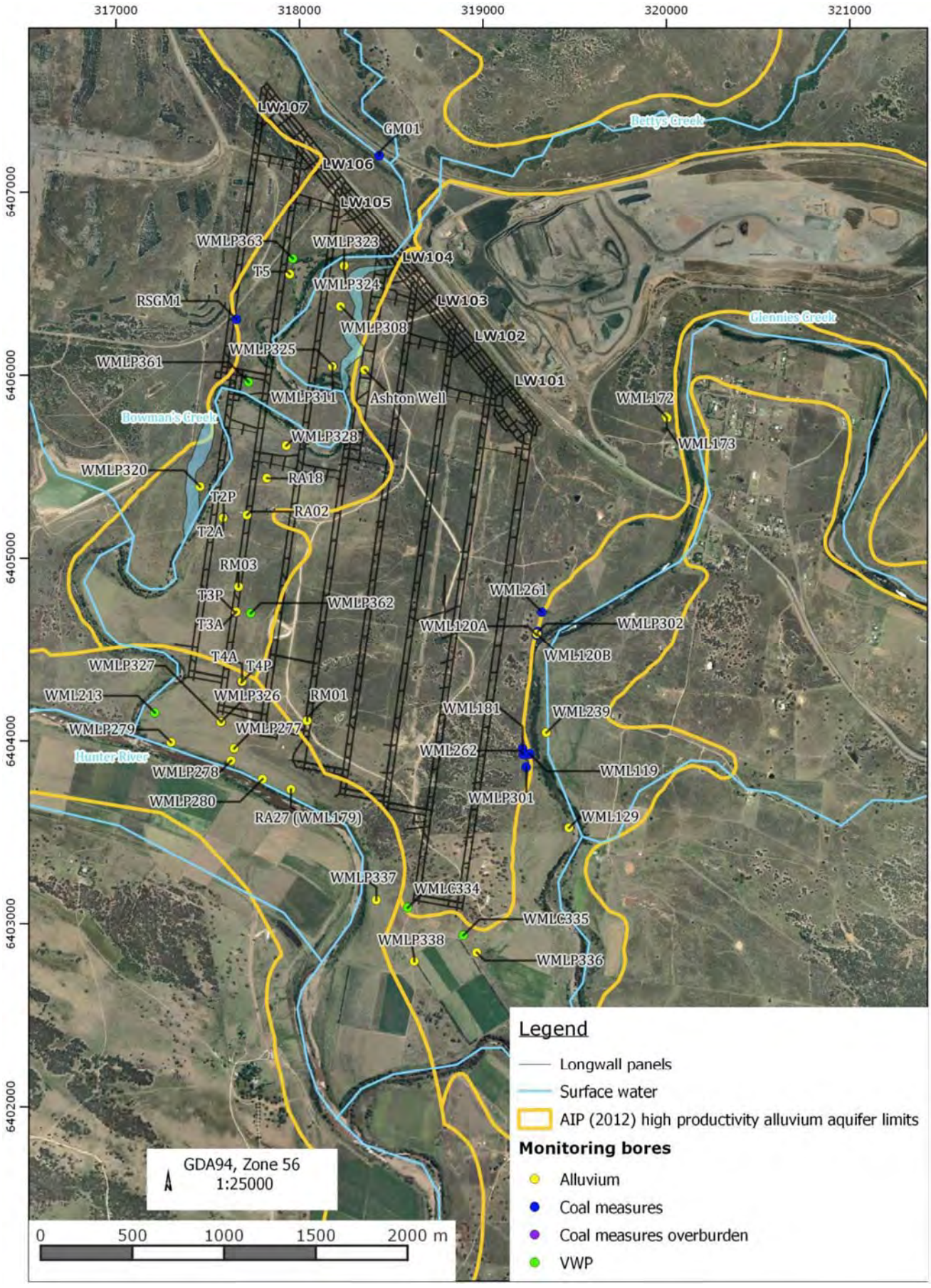


Figure 17: ACOL's groundwater monitoring locations

7.4.2 Environmental Performance Summary

An annual groundwater management review was undertaken by Australasian Groundwater and Environmental Consultants (AGE). This report is included as Appendix 2 to this AR. The key points of the annual groundwater monitoring review can be summarised as follows:

- No groundwater level within the alluvium was recorded below relevant trigger values.
- Two monitoring bores exceeded the WMP water quality trigger values. Site T3A EC levels are higher than other Bowmans Creek Alluvial (BCA) EC levels. The results are within historic ranges and appear to correlate loosely with Cumulative Rainfall Departure (CRD). No mining impacts are evident in the EC trend in T3A. The EC trend in this bore is subject of further investigation and the BCA trigger values will be reviewed in the WMP during 2017. WML173 exceeded both the pH and EC trigger values in 2016. This bore is the subject of further investigation. WML172 and WML173 pH and EC measurements are not typical of the Glennies Creek Alluvial (GCA) and these monitors should be removed from the WMP.
- Annual groundwater laboratory analysis results showed some minor exceedances of the ANZECC (2000) criteria for fluoride, TDS and EC. These exceedances are not likely to be a result of mining related impacts.
- Direct rainfall recharge within the alluvium are observed on all the sites, the overburden on the north east and the PG and Arties seams west of the underground.
- Groundwater conditions to the east of LW01 have recovered from the impacts of underground mining. The stabilisation of the groundwater pressures between the GCA and the PG seam indicates that the groundwater gradient has returned to a pre-mining state.
- Estimated groundwater inflows are slightly above the modelled inflow.

In conclusion, during the year 2016, groundwater impacts did not exceed the predictions made in the Bowmans Creek Diversion Environmental Assessment or the current groundwater model.

8 Mine Subsidence

During the reporting period, mining operations occurred in LW 104, 105, and 106A, all in the ULD seam.

Mining height was nominally in the 2.3m to 2.6m range. The seam dipped to the southwest at a grade of up to 1 in 10. Overburden ranges in thickness from 190m to 220m near the start and a thickness of 110 to 190m at the take-off ends of LW 104 to 106A respectively. The final extraction void is nominally 216m wide. This includes the 5.4m width of development drivage either side of the longwall block. Maingate chain pillars are nominally at a centre to centre width and length of 30m and 150m respectively. Tailgate chain pillars are at a centre to centre width and length of 30m and 150m respectively.

During the reporting period:

- LW104 began extraction on 23 July 2015 at chainage 2570 metres and was completed on the 8 April 2016;
- LW 105 began extraction on 17 May 2016 at chainage 1013 metres and completed extraction on 21 September 2016; and
- LW 106A commenced extraction on 17 May 2016 at chainage 1346 metres. At the end of January 2017 the mine was at chainage 815 metres, with a total of 531 metres of extraction during the reporting period.

There were no unexpected impacts to the environment or infrastructure during this reporting period.

The effects of subsidence were monitored in accordance with the approved Ashton Coal Project Upper Liddell Seam Extraction Plan, LW 1 to 8. Monitoring included both regular survey monitoring and visual inspection of environmental, land and infrastructure features.

Longwall operations commenced in February 2007. Mining of the Pikes Gully seam (LWs 1-8) and ULD seams LW 101 to LW 105 are completed. As at the end of the reporting period, operations are mining in LW 106A (in the ULD Seam). The progress of ULD LW extraction is shown in **Figure 18**.

Fortnightly subsidence reports were sent to key stakeholders during the reporting period in accordance with commitments set out in the approved extraction plans.

8.1 Subsidence Monitoring and Remediation

Monitoring of subsidence is conducted on the surface during the extraction of all Longwalls using longitudinal subsidence lines. Subsidence monitoring sections are located over the start and finish of each panel, a main cross line extending over all seven southern panels and a dedicated cross line extending over LW 6B, 7B and 8. All panels have monitoring data from each start and end line, and various cross lines relevant to panel, surface or strata features.

Table 20 outlines the maximum subsidence parameters predicted and recorded during regular survey of subsidence lines as the longwalls pass each location. The frequency and results of monitoring have been maintained in accordance with Ashton Mine Subsidence Monitoring Programme LW 101 to 104 and Ashton Mine Subsidence Effects Monitoring Program Upper Liddell Seam LW 105 to 107.

Table 20: Subsidence of ULD Longwall Panel 104 – 106A

	Incremental Subsidence (m)	Incremental Tilt (mm/m)	Incremental Strain (mm/m)
Longwall 104			
Predicted SMP/EP	2.40	110	44
LW104CL1 Measured	2.10	36	27
LW104CL2 Measured	1.95	88	44
XL5 Measured	1.78	27	9
Longwall 105			
Predicted SMP/EP	2.10	99	49
LW105CL1 Measured	1.70	27	9
LW105CL2 Measured	1.80	80	25
XL5 Measured	1.77	35	17
Longwall 106A			
Predicted SMP/EP	2.10	96	48
LW106CL1 Measured	1.50	41	25
XL5 Measured	-	-	-

The latest subsidence monitoring survey of LW 104 to LW 106A indicate a maximum of 2.1m of subsidence has been measured, which is less than predictions. The maximum measured values of tilt and strain are lower than the predicted maxima at the completion of mining LW 105.

Figure 18 Progression of ULD mining as at 31 December 2016

To manage subsidence impacts the 132kV power poles were reassessed and replaced with concrete poles prior to longwall extraction. The power lines have been fitted with rollers prior to longwall extraction. Visual and survey monitoring of the 132kV transmission line power poles was undertaken regularly whilst mining LW 103 and LW 104. Consistent with the 2015 AR, maximum subsidence of power poles were within stated predictions. There has been no adverse impacts on the power poles and the transmission line remains serviceable.

A section of primary Right of Way (ROW) alternate access to Property 130 was undermined by LW 104 during the reporting period. This section of ROW traversing the active longwall panel was predicted to suffer perceptible subsidence impacts (e.g. surface cracking). This section of access road was closed off prior to undermining and an alternate access was adopted, with a suitable detour being activated. Remediation works were completed and the ROW reopened. No damage was observed to farm gates, grids or fences during the reporting period.

Rehabilitation of the surface cracks has been occurring as extraction continues with a small excavator smoothing cracks. Affected surface roads have been repaired to smooth compression humps and minor cracks.

Ponding has become evident in some subsided areas after rainfall events, typically in those areas which were flat pre-mining. Remediation is planned in consideration of the currently approved multi seam mining which will see the same area undermined for a further three seams. Presently, the ponding does not present a significant risk and serves as a water source for stock which graze over the lease.

In general, the maximum subsidence movements detected were less than those predicted. There is no indication of any significant lateral movement of the steep slope adjacent to Glennies Creek or of the New England Highway road cutting.

9 Rehabilitation and Land Management

Rehabilitation and land management activities undertaken are outlined in the MOP amendment B, issued in May 2016. There were no notable variations in activities when compared with the MOP.

During the reporting period rehabilitation of gas drainage pipeline disturbance was undertaken. Following the success of previous years, slashing was undertaken on the North East Open Cut (NEOC) Rehabilitation to promote diversity of grass species. Contour banks on the NEOC were maintained, with topsoil and seed placed where required to ensure the minimisation of erosion and scour on the slopes.

Consistent with the MOP, there were no areas of rehabilitation relinquished or signed off by DRE during the reporting period.

During the next reporting period, rehabilitation will be monitored and maintenance conducted as required. Gas drainage pipelines will continue to be rehabilitated.

There are three main primary domains (or land management units) under active rehabilitation, monitoring and maintenance:

- Bowmans Creek Diversion – rehabilitation monitoring of the diverted creek sections is continuing in accordance with the commitments made in the Bowmans Creek Diversion Environmental Assessment, water management plan and MOP.

- Farmland above the underground mine – effective land management to ensure the land remains viable farmland is the focus over this area, which is managed in accordance with the MOP and the Flora and Fauna Management Plan (FFMP).
- North East Open Cut – rehabilitation has been completed in this area, monitoring and maintenance activities are ongoing in accordance with the MOP and the FFMP.

The MOP defines rehabilitation phases for each domain, and the completion criteria for each phase. For each domain, specific performance indicators have been established to allow the progress of rehabilitation to be measured. Consistent with MOP requirements, the performance indicators and current condition (measured during the 2016 rehabilitation monitoring) are described in Table 21 and Table 23 to Table 26 for Bowmans Creek Diversion, Trees over grass (underground)(Phases 4 and 5) and Pasture (underground), respectively.

9.1 Bowmans Creek Diversion Rehabilitation Monitoring Program

Construction of the Bowmans Creek Diversion (BCD) was completed in November 2012, with revegetation plantings commencing that year to establish two vegetation communities (River Oak Forest and Red Gum Woodland) within the BCD rehabilitation area.

Rehabilitation monitoring is conducted annually by independent ecological consultants (Kleinfelder) to provide details of the current condition of planted trees and shrubs, total vegetation and weed coverage and extent of any erosion issues or concerns that may affect the success of the revegetation.

A combination of permanent monitoring quadrats and photographic points to track vegetation growth and coverage, erosion transects and Landscape Functional Analysis (LFA) is used to determine the progress of revegetation and ecosystem function. Eleven monitoring quadrats have been established. Monitoring was performed in September 2016.

The 2016 survey recorded forty three (43) flora species of which twenty nine (29) were exotic and fourteen (14) were native. This is in comparison to fifty (50) species recorded over two surveys in 2015 of which thirty four (34) were exotic and sixteen (16) were native species. During 2016 the majority of the native species were planted canopy (Eucalypts), and shrubs. A reduced number of native grass and herb species were recorded from the previous annual survey of 2015. Shrub and midstorey species such as Acacias have survived, but are still very sparse.

Survival of the canopy species has stabilised with numbers similar to the previous the survey of 2015. Calculation of stem densities of the Forest Red Gum community demonstrate that woodland and forest densities of canopy will be achieved at maturation. The River Oak Forest community has a much higher rate of survival, and suppression of weedy understorey species due to shading and litter accumulation is occurring.

Average heights have increased substantially from the last survey of 2015, with *Casuarina cunninghamiana* trees visibly taller, many estimated to be between 6 and 7 m in height. Fruit and flowers have been observed on two species of Eucalypts, while *Acacia falcata* plants were observed with seed.

LFA indices have improved from the last survey of 2015. Higher litter accumulation under the *C. cunninghamiana* trees combined with previously recommended management practise of slashing in the Forest Red Gum community reducing litter accumulation has led to higher index scores in the River

Oak Forest community. This is particularly evident in the Nutrient Cycling Index, but is also apparent in the Stability and Infiltration Index scores.

Table 21 through to Table 27 are referenced from the approved MOP 2013 to 2017, and summarises Domain objectives, performance criteria, performance measures, completion criteria and current status for each Domain. Current status comments are based upon data and observations made during the annual survey conducted by Kleinfelder.

The monitored condition of the BCD is based upon eleven (11) monitoring plots (20 m x 10 m quadrats) located within the BCD itself. This report marks the end of Phase 1 of the rehabilitation of the BCD (Bowmans Creek Diversion Rehabilitation Strategy (ACOL, 2010).

Table 21 Domain - Bowmans Creek Diversion (BCD)

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Limit soil compaction and the spread of weeds by minimising site access by vehicles and stock.	Fencing	Adequate fencing is installed and maintained.	Vehicle access is restricted to nominated site access roads as far as practical.	ACOL Weed Management Plan *Noxious Weeds Act 1993* Australian and NSW Weed Strategies TSC Act - Key Threatening Processes	**Achieved** Fencing is intact and in good condition restricting access to designated tracks. Tracks are well delineated and maintained.
			Stock is excluded.		**Achieved** Stock have been successfully excluded.
Invasive species, weeds and feral animals are effectively controlled or eliminated from site.	Distribution and density of weeds	Annual Weed Inspection and findings reported in AEMR.	Weeds and pest animal species, and abundance are comparable to analogue sites.		**Partially Achieved - Ongoing** Control efforts are being undertaken – weed control is and will be an on-going task. African Boxthorn control efforts having a visible effect on this species occurrence.
	Distribution and number of feral animals	Annual vertebrate pest survey and findings reported in AEMR.		*Rural Lands Protection Act 1998* FFMP	Annual feral animal controls are undertaken at Ashton Coal. Further information can be found in section 6.5.1
	Damage caused by feral animals				**Achieved** No evidence of feral animal damage in the planted areas
Safety risks are eliminated as far as reasonably practicable.	Bushfire hazard	Bushfire hazard reduction activities reported in AEMR.	Fire breaks and perimeter trails are maintained. The bushfire hazard is managed in	*Rural Fires Act 1997*	**Achieved** Fire breaks and perimeter trails are adequately maintained

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
			accordance with the ACOL EMS.		
Establish vegetation profile consistent with the planned final land use.	Revegetation species mix applied in accordance with Table 22	Rehabilitation/planting activities reported in AEMR including date of seeding and species mix used.	Species mix used aligns to the intended final land use.	Florabank Guidelines (1999)	**Achieved** Species that have been planted to date are in accordance with Table 22 of the MOP. Numbers and dates of plantings to be supplied by ACOL.
	Structural complexity scores	Reporting and monitoring protocol as per the Bowmans Creek Diversion Rehabilitation Strategy (ACOL, e) employing a modified vegetation complexity assessment method (Newsome & Catling 1979).	Groundcover includes tussock grass clumps, areas of open ground and fallen timber.	Bowmans Creek Diversion Rehabilitation Strategy (ACOL, e)	**Not Achieved - yet** As per Bowmans Creek Diversion Rehabilitation Strategy (ACOL, e) Groundcover still predominantly composed of exotic grasses and herbs
			Mid-stratum is very open to sparse, > 2 metres in height.		**Partially Achieved** Established mid-storey species are very sparse. Many are now > 2 m tall at this stage, and are mature. Requires more diversity.
			Over-storey structure ranges from forest (i.e. riparian corridor) to woodland (i.e. floodplain areas), with a diverse yet clumped species composition that is consistent with reference sites.		**Achieved** Overstorey establishment has been largely successful. River Oak Forest overstorey successful – **Achieved.** Red Gum Woodland successful – new planting has extended the area of this vegetation community on the BCD. But this community is still young and requires time to mature – **Achieved.**

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
			Structural complexity scores are broadly comparable to reference sites.		**Not Achieved - Yet** Revegetation is in Phase 1 (first 2-3 years) of a long term rehabilitation project. Vegetation is still too young to be compared to mature reference sites. This measure cannot be achieved for several years to come.

9.2 Bowmans Creek Diversion Management

The two reaches of the BCD (Eastern and Western), have been constructed in the underground mining area as shown in Figure 10. Construction commenced on the Eastern diversion in March 2011 and on the Western diversion in February 2012. Both were commissioned with flow through each diversion in November 2012. Temporary low level block banks have been constructed across the original channel of Bowmans Creek, directing low flows into the diversion reaches. High (flood) flows are designed to overtop the temporary block banks in order that such flows not pass through the diversion until full vegetation establishment. The construction program has been completed (engineering sign off obtained) with the exception of permanent block banks which will be constructed twelve (12) months prior to mining LW 106B (in the ULD Seam).

The vision for the diversions, outlined in the Bowmans Creek Rehabilitation Strategy, is to establish an ecologically healthy riparian corridor between the New England Highway and the Hunter River, on land owned by ACOL. Fulfilment of this requirement includes the construction, landscaping and ongoing monitoring and management which, compared to the characteristics and conditions of the pre-diverted creek, will provide:

- flow channels that mimic the hydraulic and geomorphic characteristics and provide similar resilience;
- for fish passage and a diversity of aquatic habitat;
- an enlarged area of ecologically diverse, naturally vegetated, riparian corridor; and
- a free draining floodplain that is vegetated to a standard consistent with the final intended land use.

In addition to general land management and environmental monitoring, there are a number of rehabilitation and monitoring commitments specific to the BCD that are reported in this AR, as shown in Table 22.

Table 22 Bowmans Creek Diversion commitments

Commitment	Status	Further detail
Survey of bed and banks including bed samples at six months, one year, two years and at five yearly intervals, or after a flood with a peak flow of greater than 150m3/s. (Development consent, Schedule C, 7.1 and 7.2)	The last survey was carried out in 2014, and is next due in late 2017.	Not applicable to this reporting period.
Fish passage and aquatic ecology in stream diversions are monitored and remain within acceptable levels, or appropriate remedial measures considered.	Fish results detailed in section 6.4.2 demonstrate that the diversion channels have continued to provide fish passage during periods of extended flow and provide refuge habitat during periods of low flow.	See section 6.4.2
Community structure in the diversion channels are monitored bi-annually to record growth rates, species abundance as well as percentage cover to determine a final structural complexity index.	Annual monitoring was undertaken in 2016.	See section 9.1

9.2.1 Geomorphology surveys of Bowmans Creek diversion

During the 2015 reporting period, further investigation was undertaken in the western diversion by a qualified geomorphologist, outlining the extent of the scour identified during the 2014 reporting period. The report identified that some remedial actions may be required to ensure the future sustainability of the diversion. The report was peer reviewed by a geomorphologist in 2016 in order to identify the most effective management practise for the diversion and maintenance of the scoured areas.

Recommendations included a three dimensional comparison of as constructed digital terrain models with the current stream bed and banks, further assessment of rock bars along the diversions, and minor changes to improve the existing monitoring program. These recommendations will be instigated in 2017, along with the five- yearly survey of the diversion.

9.3 Farmland rehabilitation monitoring (pastures above underground mining)

Rehabilitation objectives outlined in condition 41 of DA 309-11-2001-i state that agricultural land should be restored and maintained to the same of higher land capability and agricultural suitability than prior to mining.

The farmland area over underground mining operations is stocked with agisted cattle. Cattle are managed in accordance with good land management practices. Creeks are fenced and stock excluded, and areas of subsidence resulting in ponding are utilised as stock watering points.

Results of the transect monitoring showed that underground mining was not affecting the productivity of the pasture areas. Minor subsidence features were observed at four points along transects in the form of small sinkholes, but these had not affected vegetation, altered drainage or caused erosion. Vegetative groundcover was uniformly high on both transects with an average groundcover of 93%. LFA results were very similar between the Pasture LFA and the Grassland Reference LFA sites indicating that underlying biodynamic processes were not affected by mining.

Recommendations from the farmland monitoring report include the continuation of on-going weed control measures and the exclusion of cattle from areas where tree corridors are being established.

Measured against the Domain Objective, Performance and Status criteria outlined in the MOP, the Pasture – Underground Mining Domain (in Phase 5 - Ecosystem and Landuse Sustainability of the Rehabilitation) has achieved five of the six criteria, with only “weed species and abundance” criteria rated as partially achieved due to the on-going presence of weeds and regrowth.

Domain 2 Trees over Grass – Underground Mining Area has areas in two phases, Phase 4 - Ecosystem and Landuse Establishment and Phase 5 - Ecosystem and Landuse Sustainability. Measured against the Phase 4 criteria, only two of the four criteria were relevant to this report, both of which were rated as partially achieved.

Table 23 to Table 25 are taken from the MOP 2013 – 2017 (tables 30 and 31) and are based on the relevant rehabilitation phases outlined in the MOP in accordance with the current status of each domain.

Table 23 Trees over Grass - underground mining, Phase 4 Ecosystem and landuse establishment

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Invasive species, weeds and feral animals are effectively controlled or eliminated form site	Distribution and density of weeds	Annual Weed inspection and findings reported in AEMR	Weeds and pest animal species and abundance are comparable to analogue sites	ACOL *Weed Management Plan* *Noxious Weeds Act 1993* Australian and NSW Weed Strategies TSC Act – Key Threatening Processes *Rural Lands Protection Act 1998* FFMP	**Partially Achieved** – African Boxthorn and Olive are widespread, weed control measures are evident but require continual effort
	Distribution and number of feral animals	Annual vertebrate pest survey and findings reported in AEMR			No significant damage. Controls ongoing. See section 6.5.1 for further information.
	Damage caused by feral animals				
Safety risks are eliminated as far as reasonably practicable	Bushfire hazard reduction works	Bushfire hazard reduction activities reported in AEMR	Bushfire management activities undertaken in accordance with the consent agreement	*Rural Fires Act 1997*	Firebreaks are installed and maintained along fence lines and other infrastructure.
Establish a vegetation profile consistent with the planned final land use	Revegetation species mix applied in accordance with Table 22 (MOP Table 22)	Rehabilitation/planting activities reported in AEMR including date of seeding and species mix used.	Species mix used aligns to the intended final land use.	DA Schedule 2, Condition 3.49	**Partially achieved** – natural regeneration of some of the common canopy species is occurring, but shrub species are largely absent

Table 24 Trees over grass - Underground mining area, Phase 5 Ecosystem and landuse sustainability

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Ecological Diversity will be maintained or enhanced	Foliage Cover	Annual Farm land Report	Vegetation structure & complexity is broadly comparable to that of analogue sites	CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004) DA Schedule 2, Condition 3.55 DA Schedule 2, Condition 3.55	**Partially achieved –** Eastern corridor - Achieved West and Central corridors – Partial – shrub layer is largely absent due to grazing
	Tree Diversity		Diversity of maturing tree and shrub species is broadly comparable to that of analogue sites		**Partially achieved –** Eastern corridor - Achieved West and Central corridors – Partial – shrub layer is largely absent due to grazing, or *A. luehmannii* monocultures hinder diversity
	Tree Density		Density of maturing tree and shrub species is broadly comparable to that of analogue sites		**Partially achieved – All areas** East corridor – denser to young age West & Central – too sparse in places or denser due to *A. luehmannii* monocultures
	Tree Health/condition		Vegetation condition is broadly comparable to that of analogue sites		**Partially achieved –** Eastern corridor - Achieved West and Central corridors – Partial due to grazing and compaction
	Flowers, fruit, new growth				
Ecosystem function is restored	LFA Organisation Index		Index is broadly comparable to that of analogue sites		**Not measured this survey – will be undertaken next survey**
	LFA Stability Index				
	LFA Infiltration Index				

Table 25 Pasture - Underground Mining, Phase 5 Ecosystem and Landuse sustainability

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Restored and maintained to the same or higher land capability and agricultural suitability than prior to mining	LFA Organisation Index	Annual Rehabilitation Monitoring Report	Performance indicator is broadly comparable to that of analogue sites.	CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004) DA Schedule 2, Condition 3.55 DA Schedule 2, Condition 3.55	**Achieved**
	LFA Stability Index				**Achieved**
	LFA Infiltration Index				**Achieved**
	Land Capability Class		Field data results are used to define land capability and include: Climate Soil texture Position Slope Erosion pH Drainage Rock		**Achieved**
Final Landform is sustainable and resilient to environmental pressures	Weed species abundance and diversity		Performance indicator is broadly comparable to that of analogue sites		**Partially achieved -** African Boxthorn and Galenia are common on both analogue and pasture areas
	Groundcover				**Achieved**

9.4 North East Open Cut rehabilitation monitoring program

The NEOC rehabilitation program has been in place since 2007. Monitoring is conducted annually. Fieldwork was conducted during May 2016 by Kleinfelder.

Open cut mining operations in the NEOC ceased in late 2011, with landform shaping and planting aspects of the rehabilitation completed in July 2012, excluding the NEOC void that remains in use. Maintenance of rehabilitation is on-going.

The approved MOP (2013 – 2017), requires that monitoring occur within domains defined by land use and function and geophysical characteristics. The MOP defines two domains on the NEOC; Pasture - NEOC and Trees over Grass - NEOC. The objectives of the two domains are set out within the MOP and include:

Pasture – NEOC

- Restored and maintained to the same or higher land capability and agricultural suitability than prior to mining.
- Final landform is sustainable and resilient to environmental pressures.

Trees over Grass – NEOC

- Ecological diversity will be maintained or enhanced.
- Ecosystem function is restored.

Pasture – NEOC area findings are summarised as follows.

A full floristic survey was conducted, mainly due to the very simplified floristics of the NEOC – Pasture areas. When compared to the Grassland Analogue plots, there was a simple assemblage of species recorded, dominated by hardy exotic grasses such as *Chloris gayana* (Rhodes Grass), *Paspalum dilatatum* (Paspalum), *Pennisetum clandestinum* (Kikuyu) and *Megathyrsus maximus* (formerly *Panicum maximum* - Guinea Grass). Analogue plots had greater diversity and were dominated by native grasses. There was again a noted lack of nitrogen-fixing legume species on the NEOC – Pasture areas.

The key performance indicators (KPIs), derived from the analogue plots include:

- The performance measure of weed species abundance was achieved with the pasture plots having a similar abundance of listed and environmental weeds to analogue sites;
- Vegetative cover was partially achieved across the pasture areas. The northern slopes having good coverage but the southern slopes have some patchy coverage that requires further investigation into causes;
- LFA indices of Landscape Organisation Index, Stability Index and Infiltration/Runoff Index were recorded as broadly comparable to the analogue sites and as such have been achieved; and
- Land Capability Class was assessed as being achieved as per objectives.

Trees over Grass (ToG) areas findings are summarised as follows:

- Foliage cover and Tree densities are partially achieved mainly due to denser seeding of midstorey and shrub species in the ToG areas, particularly on the sloping areas;
- Tree Diversity has been increased on the ToG areas with a greater number of species recorded compared to analogue plots - achieved;

- Tree health and condition as well as observation of new growth both achieved, with fruit observed again this survey; and
- LFA indices of Landscape Organisation Index, Stability Index and Infiltration/Runoff Index were recorded as broadly comparable to the analogue sites and as such have been achieved.

Recommendations for the management of the rehabilitated areas include:

- Continue the existing weed control program to address African Boxthorn and cacti in particular; and
- Seed pasture legumes into the NEOC pasture areas, inoculated with commercially available microbial symbionts to both increase the sustainability of the pasture itself, and help counteract the alkalinity of the soil by introducing natural acidifying agents;

Table 26 is taken from the MOP 2013- 2017 and is based on the Pasture – NEOC being in Phase 5 – Ecosystem and landuse sustainability.

Table 27 is also taken from the MOP 2013- 2017 and is based on the trees over grass – NEOC, in phase 5 – Ecosystem and landuse sustainability.

Table 26 Pasture - NEOC, Phase 5 Ecosystem and Landuse sustainability

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Restored and maintained to the same or higher land capability and agricultural suitability than prior to mining.	LFA Organisation Index	Annual Rehabilitation Monitoring Report	Performance indicator is broadly comparable to that of analogue sites.	CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004) DA Schedule 2, Condition 3.55	**Achieved**
	LFA Stability Index				**Achieved**
	LFA Infiltration Index				**Achieved**
	Land Capability Class		Field data results are used to define land capability and include: - Climate - Soil texture - Position - Slope - Erosion - pH - Drainage - Rock	DA Schedule 2, Condition 3.55	**Partially Achieved.** • pH is assumed to still be high • Establishment of grazing trials would determine if successful
Final Landform is sustainable and resilient to environmental pressures	Weed species abundance and diversity		Performance indicator is broadly comparable to that of analogue sites.		**Achieved** • Abundances and diversity comparable to analogue plots.
	Groundcover				**Partially Achieved** • Still some areas of patchy groundcover.

Table 27 NEOC Trees over grass, Phase 5 – Ecosystem and Landuse Sustainability

Domain Objective	Performance Indicator	Performance Measure	Completion Criteria	Justification/Source	Current Status
Ecological diversity will be maintained or enhanced	Foliage Cover	Annual Rehabilitation Monitoring Report	Vegetation structure and complexity is broadly comparable to that of analogue sites.	DA Schedule 2, Condition 3.55 CSIRO Methodology for Ecosystem Function Analysis (Tongway, 2004)	**Partially Achieved –** some areas have been over seeded with midstorey and shrub species.
	Tree Diversity		Diversity of maturing tree and shrub species is broadly comparable to that of analogue sites.		**Achieved.**
	Tree Density		Density of maturing tree and shrub species is broadly comparable to that of analogue sites.		**Partially Achieved –** midstorey and shrubs in higher density in parts of the ToG areas.
	Tree health/condition		Vegetation condition is broadly comparable to that of analogue sites.		**Achieved.**
	Flowers, fruit, new growth				**Achieved** – fruit visible again on some canopy species.
Ecosystem function is restored	LFA Organisation Index		Index is broadly comparable to that of local remnant vegetation.		**Achieved.**
	LFA Stability Index				**Achieved**
	LFA Infiltration Index				**Achieved**

9.5 Rehabilitation status

During the reporting period approximately 1700 metres of gas drainage pipeline disturbance was rehabilitated. Rehabilitation included topsoiling and seeding areas over pipelines, with additional topsoiling, weed management and seeding being undertaken on previous sections as required. No open cut rehabilitation was undertaken as it was completed in 2013. Rehabilitation maintenance was carried out on the NEOC rehabilitation to enhance species diversity. Maintenance activities included slashing to promote species diversity as well as maintenance of some contour banks through re-topsoiling and seeding where required. Rehabilitation status is outlined in Table 28.

During 2017 the following rehabilitation activities are planned:

- Maintenance focussing on weed management in the Bowmans Creek Diversion rehabilitated area
- Ongoing rehabilitation of pipelines, gas boreholes and old ventilation fan sites
- Works to divert water off NEOC rehabilitated areas into surrounding streams, if viable.

Table 28 Rehabilitation status

Mine area type	Previous Reporting Period (Actual) (ha)	This reporting period (Actual) (ha)	Next reporting period (Forecast) (ha)
	2015	2016	2017
Total mine footprint[1]	909.6	909.6	909.6
Total Active disturbance area[2]	177.3	177.3	177.3
Land being prepared for rehabilitation[3]	0	0	0
Land under active rehabilitation[4]	732.2	732.2	732.2
Completed rehabilitation[5]	0	0	0

[1] Total Mine Footprint: includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities. As such it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in the DRE MOP/RMP guidelines). Subsidence remediation areas are excluded.

[2] Total Active Disturbance includes all areas ultimately requiring rehabilitation such as: on-lease exploration areas, stripped areas ahead of mining, infrastructure areas, water management infrastructure, sewage treatment facilities, topsoil stockpile areas, access tracks and haul roads, active mining areas, waste emplacements (active/unshaped/ in or out of pit), and tailings dams (active/unshaped/uncapped).

[3] Land being prepared for rehabilitation – includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in the DRE MOP/ RMP guidelines)

[4] Land under active rehabilitation – includes areas under rehabilitation and being managed to achieve relinquishment – includes the following rehabilitation phases as described in the DRE MOP/RMP guidelines – 'ecosystem and land use establishment' (area seeded or surface developed in accordance with final use) and 'ecosystem and land use sustainability' (revegetation assessed as showing signs of trending towards relinquishment or infrastructure development).

[5] Completed rehabilitation – requires formal sign-off by DRE that the area has successfully met the rehabilitation land use objectives and completion criteria.

9.6 Research

No research was undertaken during the reporting period. ACOL is participating in an ACARP research project: *C25031 Closure Criteria for River Diversions: An Alternative to Reference Sites.* Fieldwork and sampling along the Bowmans Creek Diversion was undertaken by researchers during 2016 with the final report expected late in 2017.

The broad aim of this research is to move from the use of reference sites in environmental assessment to a more pragmatic and robust methodology through designing realistic closure criteria based around the use of microbial communities as indicators of environmental condition.

Figure 19 NEOC rehabilitation

10 Community

ACP is committed to minimising the impacts of its operations and is an active participant and contributor to community projects that benefit local people.

10.1 Complaints

There was one complaint received during 2016 in relation to noise. A thorough investigation was conducted into this call and it was found to be highly unlikely that the noise was generated from ACP.

ACP has a procedure for receiving, investigating, responding to and reporting complaints received from the community. The operation invites feedback about its activities through a free-call 24-hour Community Response Line (**1800 657 639**) which is advertised in the local phone directory and newspapers, and at www.ashtoncoal.com.au.

There was one non-compliance relating to complaints during 2016. The modification approval dated 20 June 2016 includes the requirement to have a complaints register on the Ashton Coal website. This was not actioned during the year, however was put on the website early in 2017.

A comparison of complaints received during previous years is shown in Figure 22.

AshtonCoal — AECOM

317,000 318,000 319,000 320,000 321,000 322,000

6,409,000 6,408,000 6,407,000 6,406,000 6,405,000 6,404,000 6,403,000

Mining Lease Boundary
Exploration Lease Boundary
Project Approval Boundary
Railway
Roads
Water Courses
Mined Area (2016)
Goaf (ULD)
Trees over Grass - SWCA
Pasture - Open Cut
Trees over Grass - Open Cut
Tailings Emplacement Facility

Rehabilitation Phases

Phase 1 - Decommissioning
Phase 2 - Landform Establishment
Phase 3 - Growing Media Development
Phase 4 - Ecosystem and Landuse Establishment
Phase 5 - Ecosystem and Landuse Sustainability
Phase 6 - Rehabilitation Complete

Primary Domains

Bowmans Creek Riparian Zone
Bowmans Creek Diversion
Infrastructure Areas
Water Management Area
Pasture - Underground Mining Area
Trees over Grass - Underground Mining Area

Secondary Domains

Bowmans Creek
Southern Woodland Conservation Area
Trees over Grassland
Pasture
Infrastructure
Water Management Area

0 150 300 600
Metres
MGA Zone 56

N

1:20,000

Figure 20: Disturbance and Rehabilitation, 2016

Mining and Rehabilitation - 2016 Period

ACOL AEMR 2016 Period, Ashton Coal Project

Aerial Imagery Source: ACOL 2013

Drawn: GW
27/02/2017
Map **A**

317,000 318,000 319,000 320,000 321,000 322,000

Mining Lease Boundary
Exploration Lease Boundary
Project Approval Boundary
Railway
Roads
Water Courses
Scheduled Underground Mining Area (2017)
Goaf (ULD)
Goaf (ULLD)
Trees over Grass - SWCA
Pasture - Open Cut
Trees over Grass - Open Cut
Tailings Emplacement Facility

Rehabilitation Phases

Phase 1 - Decommissioning
Phase 2 - Landform Establishment
Phase 3 - Growing Media Development
Phase 4 - Ecosystem and Landuse Establishment
Phase 5 - Ecosystem and Landuse Sustainability
Phase 6 - Rehabilitation Complete

Primary Domains

Bowmans Creek Riparian Zone
Bowmans Creek Diversion
Infrastructure Areas
Water Management Area
Pasture - Underground Mining Area
Trees over Grass - Underground Mining Area

Secondary Domains

Bowmans Creek
Southern Woodland Conservation Area
Trees over Grassland
Pasture
Infrastructure
Water Management Area

6,409,000 6,408,000 6,407,000 6,406,000 6,405,000 6,404,000 6,403,000

ML1623
EL 4918
MAIN NORTHERN RAILWAY
ML 1533 / ML1529
New England Highway
ULD 107B
ULD 106B
ULD 104B
ML1533
Bowmans Creek
ULD 107A
ULD 106A
ULD 105
ULD 104A
ULD 103
ULD 102
ULD 101
Glennies Creek
EL4918
Hunter River

317,000 318,000 319,000 320,000 321,000 322,000

0 150 300 600
Metres
MGA Zone 56
N
1:20,000

Figure 21 Disturbance and Rehabilitation Planned in 2017

Scheduled Mining and Rehabilitation - 2017 Period
ACOL AEMR 2016 Period, Ashton Coal Project
Aerial Imagery Source: ACOL 2013

Drawn: GW
27/02/2017
Map **B**

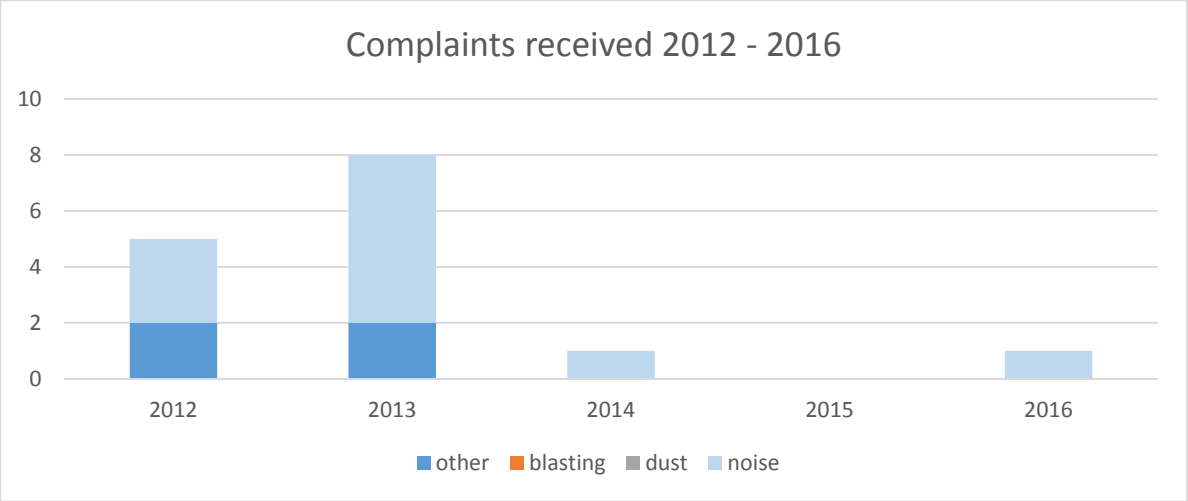


Figure 22: Comparison of complaints received during current and previous years

10.2 Community support program

Ashton Coal is committed to making a positive contribution in the areas in which it operates. To help facilitate this commitment, a Community Support Program has been established to provide assistance to local initiatives within the Singleton Local Government Area (LGA) and surrounding communities. The aim of the Community Support Program is to help benefit a wide range of community needs such as education, environment, health, infrastructure projects, arts, leisure and research. The following community groups / projects were supported by Ashton Coal in 2016:

- Macquarie University – Motor Neurone Disease
- Weston Preschool
- Cancer Council relay for life – Team McInerney
- Singleton Amateur Swimming Club
- Singleton Neighbourhood Centre
- Whitmore Enterprises
- Singleton Public School P&C
- Clontarf Foundation
- Mark Hughes Foundation

10.3 Local neighbours

Neighbours, particularly those that have the potential to be directly impacted by operations are kept up to date with operations and key projects through phone calls, regular emails and face to face meetings as required.

10.4 Website and community hotline

The broader community has access to information about the operation through its website, www.ashtoncoal.com.au. Included on the site are project approval documents, CCC meeting minutes, community complaint records, environmental monitoring information, environmental audits, environmental management plans and annual environmental management reports.

Ashton Coal's free-call 24-hour Community Response Line (**1800 657 639**) continued to operate during the reporting period to allow the community to contact the operation directly to ask questions or raise concerns about mining activities.

11 Independent audit

During 2016 an Independent Audit of operations was undertaken against the conditions of modification 10, DA 309-11-2001-i.

A total of 1550 conditions and commitments were assessed as part of this audit. Twenty Five (25) issues resulted in twenty seven (27) non-compliances. Sixteen (16) of the non-compliances were administrative. Some of the non-compliances noted in this audit relate to the same issue which, due to the duplication of commitments between consent documents and management plans, raise the same non-compliance several times.

A basic risk assessment was conducted for all non-compliances with Low/Medium/High risk levels as results. For the non-compliances that were not administrative there was one (1) Low, and ten (10) medium results. No High risks were identified in the audit.

A summary of findings and proposed actions resulting from the audit are included as Appendix 1.

12 Incidents and non-compliances during the reporting period

There were no reportable incidents during the reporting period. Non-compliances identified in the Independent Environmental Compliance Audit are outlined in **Appendix 1**.

During the reporting period, DA 309-11-2001-i was modified with approval of modification 5. As a result:

- All management plans require review to comply with new conditions;
- The website requires review and update; and
- The Community Consultative committee requires the introduction of an independent chair and changes to reporting requirements.

ACP will continue to work towards compliance to all conditions during 2017.

13 Activities to be completed in the next reporting period

Activities to be addressed and completed during the next reporting period of 2017 include:

- Progress with addressing non-compliances identified in the 2016 Independent Environmental Audit
- Develop a new MOP, due at the beginning of 2018;
- Amend the Environmental Protection Licence 11879;
- Continue to enact changes to environmental management as a result of the approval of modification 5 including the review and update of management plans;
- Progress the diversion of runoff from the North East Open Cut rehabilitated area;
- Progress the approval of LW 201 – 204 Extraction Plan; and
- Install the backroad ventilation fan to service the ULLD seam.

14 References

Spectrum Acoustics (2016) *Noise Monitoring results, Jan – Dec 2016*.

Umwelt (2017) *2016 Fauna Monitoring Program, Ashton Coal*.

Marine Pollution Research (2017) *Ashton Coal AEMR 2016 Aquatic Ecology monitoring, Bowmans and Glennies Creeks*.

Enright Land Management (2016) *Ashton Coal Operations 2016 Wild Dog and Fox Baiting Report.*

Enright land management (2017) *Ashton Coal operations 2016 Completed Weed Control Report.*

J R Richards (2016) *Ashton Coal Mine Waste Statistics December 2016.*

HEC (2017) *Ashton Coal Mine MCA 2016 Water Accounting Framework Report*.

Fluvial Systems (2016) *Geomorphic condition assessment of Bowmans Creek Diversion (draft).*

Kleinfelder (2017) *2016 Bowmans Creek Diversion Annual Report*

Kleinfelder (2016) *Bowmans Creek – Original Channel and River Red Gum Population Monitoring report*

Kleinfelder (2017) *May 2016 Annual Pasture – Underground Monitoring and Habitat Corridor Walkover report*

Kleinfelder (2016) *2016 NEOC annual Monitoring*

Kleinfelder (2017) *Southern Voluntary Conservation Area Flora Monitoring*

Horn, Peter (2016) *Independent Environmental Audit, Ashton Coal Operations*

Ashton Coal Operations Limited (December 2015) *Ashton Coal Project, Upper Liddell Seam Extraction Plan LW 105-107*.

Ashton Coal Operations Limited, Environmental Management Strategy and Management plans, http://www.ashtoncoal.com.au/page/publications/environmental/environmental-management-plans/

Department of Planning and Environment (2016) Development consent for the Ashton Coal Project (DA 309-11-2001-i)

Appendix 1. 2016 Independent Environmental Audit Actions

The table below indicates the actions required from the 2016 compliance audit. There are further findings from the audit that do not require actions. These can be found on the Ashton Coal website at www.ashtoncoal.com.au

Table 29 Summary of audit findings and proposed actions

Approval and Condition	Requirement	Evidence	Audit Finding	Proposed Action	Due date
DA 309-11-2001-i Condition 2.4	A copy of the MOP, excluding commercial in confidence information, shall be forwarded to SSC and the Director-General within 14 days of acceptance by DRE.	MOP approved 10 May 2016,submission to DG sighted, email submission of MOP to SSC not provided as evidence	Not Compliant Administrative	Send SSC a link to the MOP on the ACOL website.	28/12/16 Action Completed
DA 309-11-2001-i 4.7a	be prepared in consultation with EPA, NoW, DRE and Council by suitably qualified and experienced persons whose appointment has been approved by the Director-General;	Sighted consultation with NOW, no evidence of consultation with DRE or EPA provided.	Not Compliant Administrative	Ensure that the review of the site water management plan due in June 2017 includes consultation with EPA and DRE.	15/7/17
EPL11879 condition O1.1	Licensed activities must be carried out in a competent manner. This includes: a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.	Site inspection, staff interviews, etc. and the rest of this audit. Minor breach identified with drum of hydrocarbon material not fully bunded at CHPP, rectified in the presence of the auditor.	Not Compliant	Toolbox talks will reiterate the importance of containing all hydrocarbons in bunds. Hydrocarbon management was included in the recent environmental awareness training package provided to all employees.	31/3/17

Approval and Condition	Requirement	Evidence	Audit Finding	Proposed Action	Due date
EPL11879 Condition O4.1	Stormwater Management Scheme A Stormwater Management Scheme must be prepared for the development and must be implemented. Implementation of the Scheme must mitigate the impacts of stormwater runoff from and within the premises following the completion of construction activities. The Scheme should be consistent with the Stormwater Management Plan for the catchment. If a Stormwater Management Plan has not yet been prepared the Scheme should be consistent with the guidance contained in Managing Urban Stormwater: Council Handbook (available from the EPA).	SWMP is consistent with the Blue Book Guideline as is site management except for a small area adjacent to the rail line. This area is now rehabilitated and the water exiting site is free of sediment. There is evidence of saline seepage in this area.	Not Compliant **Recommendation** - water at this point should be sampled in storm events to show that no pollution of local streams is occurring. ACOL should seek to ha**ve the area declared "safe" to return water to natural flow paths**.	Water at this point will be sampled in storm events to show that no pollution of local streams is occurring. ACOL will seek to divert the clean water catchment off the NEOC to natural watercourses and ensure that the impacts are acceptable.	31/12/17
MOP Section 3.15	Oils, fuels, greases and chemicals are labelled and stored in designated, impermeable bunded areas or approved storage facilities and are only used on a prescribed basis. Appropriate barriers are in place to eliminate the potential for soil contamination. Bunded fuel and oil storage areas are located near the NEOC Workshop CHPP Store and on the workshop level of the Underground Pit Top Facility.	Site Inspection - one drum stored incorrectly at the CHPP small drum store.	Not Compliant	Pre start talks will reiterate the importance of containing all hydrocarbons in bunds. Hydrocarbon management was included in the recent environmental awareness training package provided to all employees.	31/03/17

Approval and Condition	Requirement	Evidence	Audit Finding	Proposed Action	Due date
MOP condition 8.2.3.1	Pasture Productivity Assessment In areas with a post mining landuse aligned to pasture, pasture sampling is undertaken in accordance with the collection technique guidelines – Form Collect1-Version No.2-01/11/07 supplied by the NSW Department of Primary Industries (DPI) (2007). Samples are to be sent to an accredited laboratory for analysis to determine the quality of feed available. Based on the testing results on the feed quality, pasture productivity will be calculated aligned to stocking rates and farm size assessment tools relevant for Beef cattle in the Hunter Valley, which in turn determine sustainable carrying capacities.	No evidence provided	Not Compliant Administrative	Review the methodologies outlined in the MOP to assess farmland productivity to ensure that the intent of the commitment can be addressed in further studies.	30/06/17
MOP Condition 8.2.3.2	Land Capability Assessment The land capability system is applied to the survey area in accordance with the guideline called Systems used to classify rural lands in New South Wales (Cunningham et al. 1986). Data will be collected on a range of factors and assessed to determine land capability. These will include climate, soils, geology, geomorphology, soil erosion, topography and the effects of past landuses.	Noted, the Agricultural Productivity Audit references the Land Class guideline, not the Land Capability Guideline. There was no evidence of the application of the Land Capability guideline at ACOL.	Not Compliant	Future pasture productivity assessments should be carried out consistent with the MOP.	31/12/17
AQMP Section 4.1	Emergency Contacts	Contacts are out of date and require changes to	Not Compliant Administrative	Update contacts in next AQMP review.	30/06/17

Approval and Condition	Requirement	Evidence	Audit Finding	Proposed Action	Due date
		reflect personnel changes			
FFMP Section 1.11	Undertake bi-annual weed monitoring surveys within the Bowmans Creek riparian corridor immediately following the commencement of rehabilitation works. Bi-annually during mine operations and for at least 5 years following the completion of longwall mining under Bowmans Creek.	Weed Monitoring survey as part of Weed Management Plan undertaken annually.	Not Compliant Administrative	Amend the FFMP to reflect current practices (annual weed monitoring rather than six monthly).	30/6/17
NMP Section 5.8C	Advice to Existing and Future Tenants Existing and future tenants are to be provided with the following: • Direction to access the online ACOL noise monitoring results. • The Environmental Hotline number. • Contact details for the Ashton Community Consultative Committee members. New tenants OR Following approval of an updated NMP, or changes to other listed details OR Where noise monitoring or modelling of existing or future development shows an increase in noise levels above the noise impact criteria (Table 4 of Noise Management Plan)	This has not been done.	Not Compliant	Work with current property manager to deliver appropriate advice to existing and future tenants.	30/6/17

Approval and Condition	Requirement	Evidence	Audit Finding	Proposed Action	Due date
WMP Section 5.5A, Page 13	Waste tyres will be: • Used as road boundaries. • Removed from site for offsite recycling. Management and disposal of waste tyres	2 waste tyres sighted in yards over underground (near blue house)	Not Compliant	Tyres to be removed from site for recycling or otherwise utilised in accordance with the internal waste management plan.	31/12/17
SWMP section 7.2	In the event of a surface water assessment criterion (Table 15) being exceeded, the following protocol in the SWMP will be followed: Any loss of baseflow in excess of predictions would be further offset against ACOL's WALs. ACOL could purchase additional WALs if required. Any exceedances and responses taken to ameliorate these exceedances will be reported in the AEMR.	Sighted the process that ACOL followed in the audit period. Preliminary investigation showed no potential impact form site was responsible. The TARP process is not followed completely by the site as it is not practicable (auditor agrees). **Recommendation** - the WMP Surface Water TARP requires review.	Not Compliant Administrative	Review Surface water TARP	30/6/17

Approval and Condition	Requirement	Evidence	Audit Finding	Proposed Action	Due date
EOP report section 19	Access to Information Within 3 months of the submission of an End of Panel Report (as required by Condition 18) or the approval of a plan, programme or strategy required under this Approval or the SMP (or any subsequent revision of these documents), the Leaseholder must, to the satisfaction of the Director General: a) provide a copy of these document/s to all relevant agencies; b) ensure that a copy of the relevant documents is made publicly available at the Leaseholder's regional office; and c) put a copy of the relevant document/s on the Leaseholder's website. *Note: Relevant agencies currently include MSB, EPA, NOW and DP&I.*	No evidence for satisfaction of DG.	Not Compliant Administrative	Consider writing to the DG requesting documented satisfaction relating to lodgement of documentation.	30/6/17

Reference	Summary of Non-compliance	Recommendation	Action	Proposed Action	
2013 Audit DA 309-11-2001-i Condition 3.36	Ensure the ACHMP summarises the commitments made in relevant documents listed in Condition 1.2 of the development consent, and shows how consistency has been achieved with these. Revise Figure 1 included in the ACHMP to show the location of the VCA. **Recommendation**: Ensure the ACHMP summarises the commitments made in relevant documents listed in Condition 1.2 of the development consent, and shows how consistency has been achieved with these. Revise Figure 1 included in the ACHMP to show the location of the CA.		Not Compliant Administrative	Add the CA to Figure 1 at next document review.	30/6/17

Appendix 2. Groundwater Management Report

Australasian
Groundwater
and Environmental
Consultants Pty Ltd
(AGE)

Report on

Ashton Coal Project

Groundwater Monitoring Review for January to December 2016

Prepared for
Yancoal Australia Limited

Project No. G1758K March 2017
www.ageconsultants.com.au ABN 64 080 238 642

Document details and history

Document details

Project number	G1758K
Document title	Ashton Coal Project Groundwater Monitoring Review for January to December 2016
Site address	Camberwell NSW
File name	G1758K Ashton AEMR_report_Draft_v01.05.docx

Document status and review

Edition	Comments	Author	Authorised by	Date
Draft	First draft to client	BM	CC	27/01/2017
v01.02	Issued to client	BM	CC	10/02/2017
v01.05	Response to comments	TW	CC	21/03/2017
v02.03	Final	CC	CC	30/03/2017

Australasian Groundwater and Environmental Consultants Pty Ltd

AGE Head Office
Level 2 / 15 Mallon Street,
Bowen Hills, QLD 4006, Australia
T. +61 7 3257 2055
F. +61 7 3257 2088
brisbane@ageconsultants.com.au

AGE Newcastle Office
4 Hudson Street,
Hamilton, NSW 2303, Australia
T. +61 2 4962 2091
F. +61 2 4962 2096
newcastle@ageconsultants.com.au

Table of contents

Table of contents
(continued)

Page No.

List of figures

Table of contents
(continued)

Page No.

List of tables

List of appendices

Report on

Ashton Coal Project

Groundwater Monitoring Review for January to December 2016

1 Introduction

The Ashton Coal Project (ACP) is located 14 km west of Singleton in the Hunter Valley region of New South Wales (NSW) (Figure 2-1). The ACP consists of decommissioned open cut and active underground mining to access a series of coal seams within the Permian Foybrook Formation. Ashton Coal Operations Ltd (ACOL) is wholly owned and operated by Yancoal Australia Limited (Yancoal).

Between 2003 and 2011, coal was recovered from eleven seams of varying thickness, down to and including the Lower Barrett Seam, from an open cut mine known as the North-East Open Cut (NEOC). Between 2007 and 2016, underground longwall mining extracted coal from the Pike's Gully (PG) Seam and underlying Upper Liddell (ULD) seam. Currently, Longwall Panel LW106A is being mined within the ULD as of October 2016.

To manage surface water mining impacts and to minimise effects on underground mining, Bowmans Creek, which overlies the western area of underground workings, has been diverted into two excavated and lined channels. The channels have re-routed Bowmans Creek above abandoned longwall panels.

The ACOL development consent (DA 309-11–2001-i) last modified June 2016, requires that groundwater be monitored for potential impacts from mining. In 2015, the Department of Planning and Environment (DPE) approved the current water management plan (WMP; Ashton document – HSEC Management System – Plan – Doc. No. 3.4.1.8 – dated 11 May 2016). The WMP outlines the groundwater monitoring program and establishes trigger values for groundwater levels and quality in the various groundwater systems located within the ACP site.

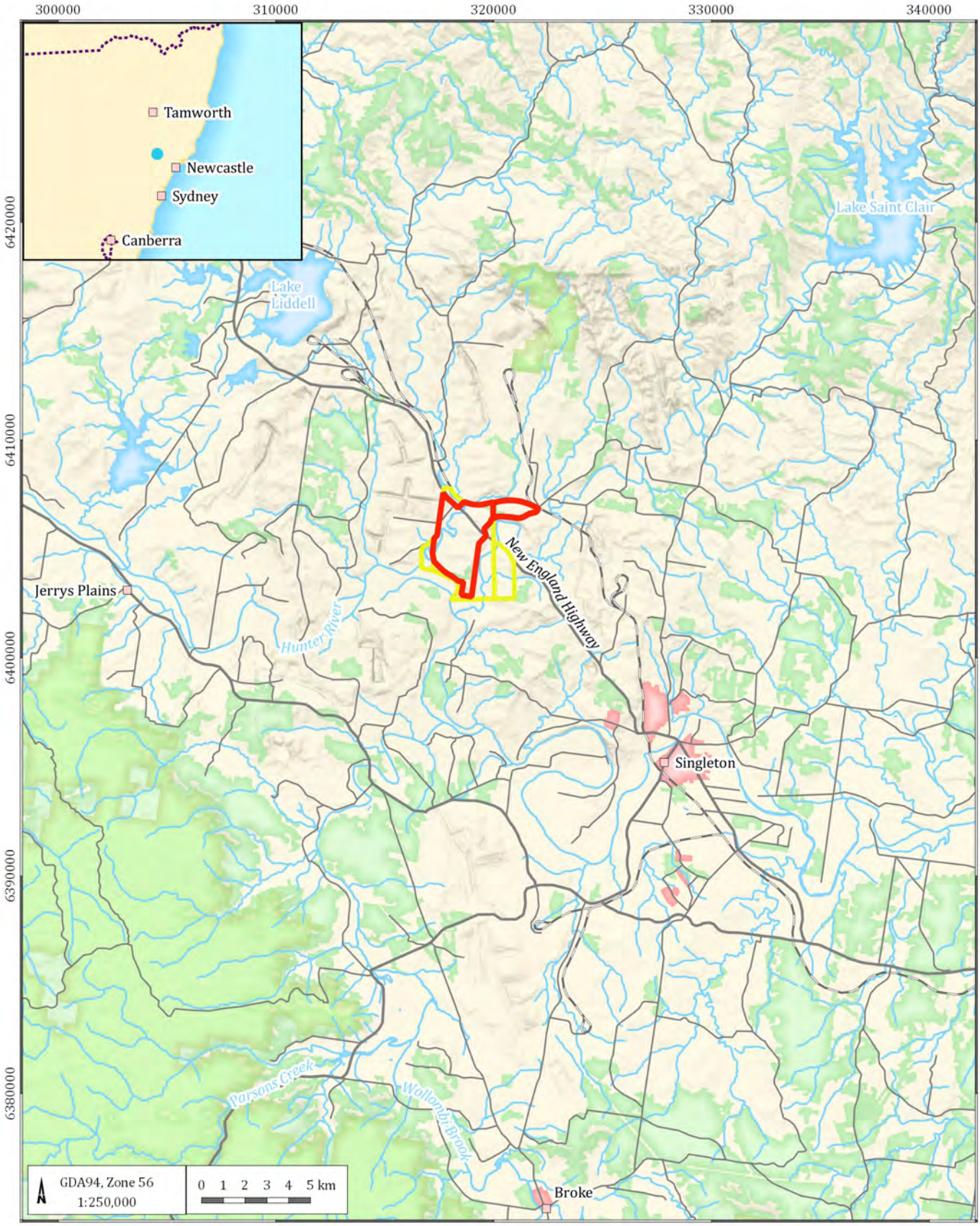
This report provides a review of the groundwater monitoring undertaken during 2016 (01 January 2016 to 31 December 2016) and was prepared by AGE at the request of ACOL.

2 Project settings

2.1 Mining

The Ashton underground mine is located south of the New England Highway, bounded by the Hunter River to the south and two Hunter River tributaries - Bowmans Creek and Glennies Creek to the east and west, respectively (refer to Figure 2-1). Underground operations intend extracting four coal seams, Pikes Gully (PG), Upper Liddell (ULD), Upper Lower Liddell (ULLD) and Lower Barrett (LB), via a longwall arrangement.

The first series of underground workings (LW1 to LW8) extracted coal from the PG seam. LW1 is located in the east of the mining lease (ML) close to the PG subcrop, Glennies Creek and the Glennies Creek alluvium. The final LW panel within the PG (LW8) is located down dip in the western portion of the ML. Currently; longwall mining is taking place within the ULD, which underlies the PG. Gate road development has commenced within the Upper Lower Liddell seam (ULLD). LW panels within the ULD are denominated LW101, LW102, etc.; and panels within the ULLD are denominated LW201, LW202, etc.



LEGEND

- Ashton mining lease
- Ashton exploration lease
- Study area location
- Populated place
- Built up area
- Major road
- Minor road
- Rail
- Watercourse
- Water area
- Reserve
- Vegetation
- Land

Yancoal Ashton - AEMR (G1758K)

Site location

DATE 17/01/2017

FIGURE No: 2-1

N:/Groundwater Jobs/G1858B.Yancoal Ashton Compliance reporting 2017/3_GIS/Workspaces/01_G1858B_Ashton_location.qgs

Generally, the western half of the underground workings (LW5 to LW8, LW105 to LW107) are located below areas of Bowmans Creek alluvium, the creek itself and two sections of creek diversions. LW6B is an area of historically, elevated groundwater inflows and is located in the north western section of the underground mine area. The overburden thickness above LW5 to LW8 varies due to the west-south-westerly dip of the coal seams. Cover to the PG workings ranges between approximately 100 m over the northern end of LW6B, and approximately 200 m over the southern end of LW7A.

In 2016, ACP mined LW104 and LW105 and is currently mining LW106A, all of which are in the ULD. The LW panels are the fourth to sixth panels to recover coal from the ULD. LW104, LW105 and LW106A underlie the previously mined PG LW4, LW5and LW6A. The longwall panels accessing the ULD are generally offset 60 m to the west of the overlying PG goaf. This offset is designed to reduce the resulting subsidence and associated impacts to the surrounding environment. That said, a portion of the northern section of LW104 main gate road is located directly below the LW4 main gate road, resulting in a "stacked edge" and subsidence impacts are slightly more noticeable at the surface than elsewhere.

Timing of longwall panel coal extraction to date is summarised in Table 2-1.

Table 2-1 Longwall panel schedule

Longwall panel	Mined seam	Start date	End date
LW1	Pikes Gully	12/03/2007	15/10/2007
LW2	Pikes Gully	10/11/2007	21/07/2008
LW3	Pikes Gully	20/08/2008	3/03/2009
LW4	Pikes Gully	2/04/2009	15/10/2009
LW5	Pikes Gully	4/01/2010	7/06/2010
LW6A	Pikes Gully	9/07/2010	22/11/2010
LW7A	Pikes Gully	23/03/2011	5/08/2011
LW7B	Pikes Gully	3/10/2011	17/01/2012
LW8	Pikes Gully	27/02/2012	5/06/2012
LW101	Upper Liddell	3/08/2012	16/06/2013
LW6B	Pikes Gully	14/07/2013	27/10/2013
LW102	Upper Liddell	10/11/2013	7/08/2014
LW103	Upper Liddell	22/08/2014	15/07/2015
LW104	Upper Liddell	1/08/2015	23/04/2016
LW105	Upper Liddell	5/08/2016	26/09/2016
LW106A	Upper Liddell	18/10/2016	

2.2 Climate and rainfall

Based on the updated Köppen-Geiger climatic classification (Peel *et al.,* 2007), the climate of the Ashton area is characterised as 'temperate without a dry season and hot summers'.

The temperature statistics for 2016 are summarised in Table 2-2. The 2016 daily temperature minima and maxima are presented graphically in Figure 2-2.

Table 2-2 2016 Temperature statistics

Period	April - September (cooler months)		January - March October - December (warmer months)	
Statistics	Minima	Maxima	Minima	Maxima
Lowest	2.2	10.4	6.9	18.6
Highest	18	34.3	24.3	40.9
Mean	10.4	20.4	16.4	29.9
Median	10.9	19.8	16.9	29.8

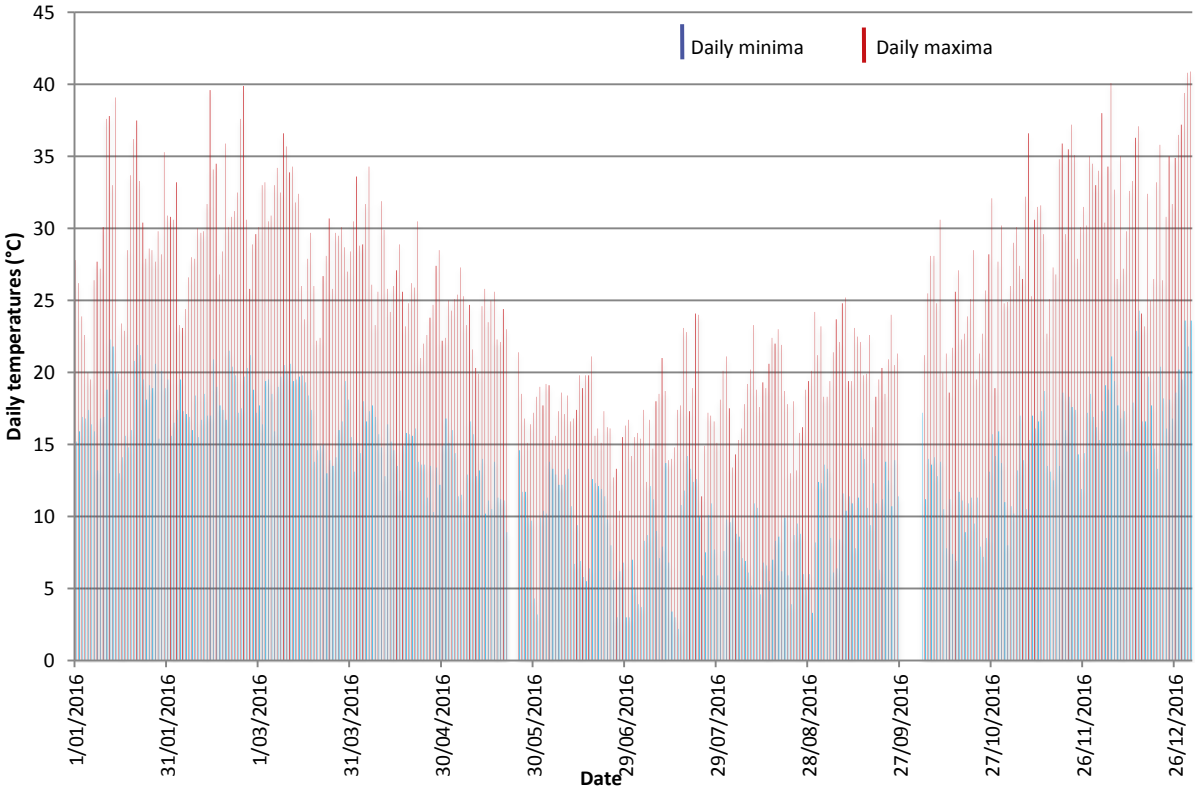


Figure 2-2 Temperature minima/maxima between January and December 2016

The 2016 and long-term average monthly rainfall is summarised in Table 2-3 and presented graphically in Figure 2-3. The data in Table 2-3 is a composite of data from the:

- Ashton Weather Station for the period 1 July 2006 to 31 December 2016; and
- SILO database (QLD government, 2015) for the periods of 1 January 1889 to 30 June 2006, and 2 February 2015 to 1 March 2015.

The SILO data was assessed for a representative area located approximately 9 km south of Ashton (coordinates: latitude -32.45°, longitude: 151.50°).

Precipitation is predominant in October and February; whereas, the winter months are generally drier with a slight rainfall increase in June and July. The long-term annual average rainfall over 127 years (1889 – 2015) is **649 mm/year**.

An evapotranspiration (EVT) rate of 765 mm/year was sourced from the Bureau of Meteorology (BOM) database for the Ashton area.

Table 2-3 Long-term average (1889-2016) and total monthly rainfall (2016)

Monthly rainfall (mm)	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Average (1889-2015)	76	72	63	50	42	50	42	37	40	50	60	67	649
Monthly totals (2016)	218.2	9.6	13.6	11	20.2	113.6	47.2	35.2	75.8	46.4	50.2	112.6	754

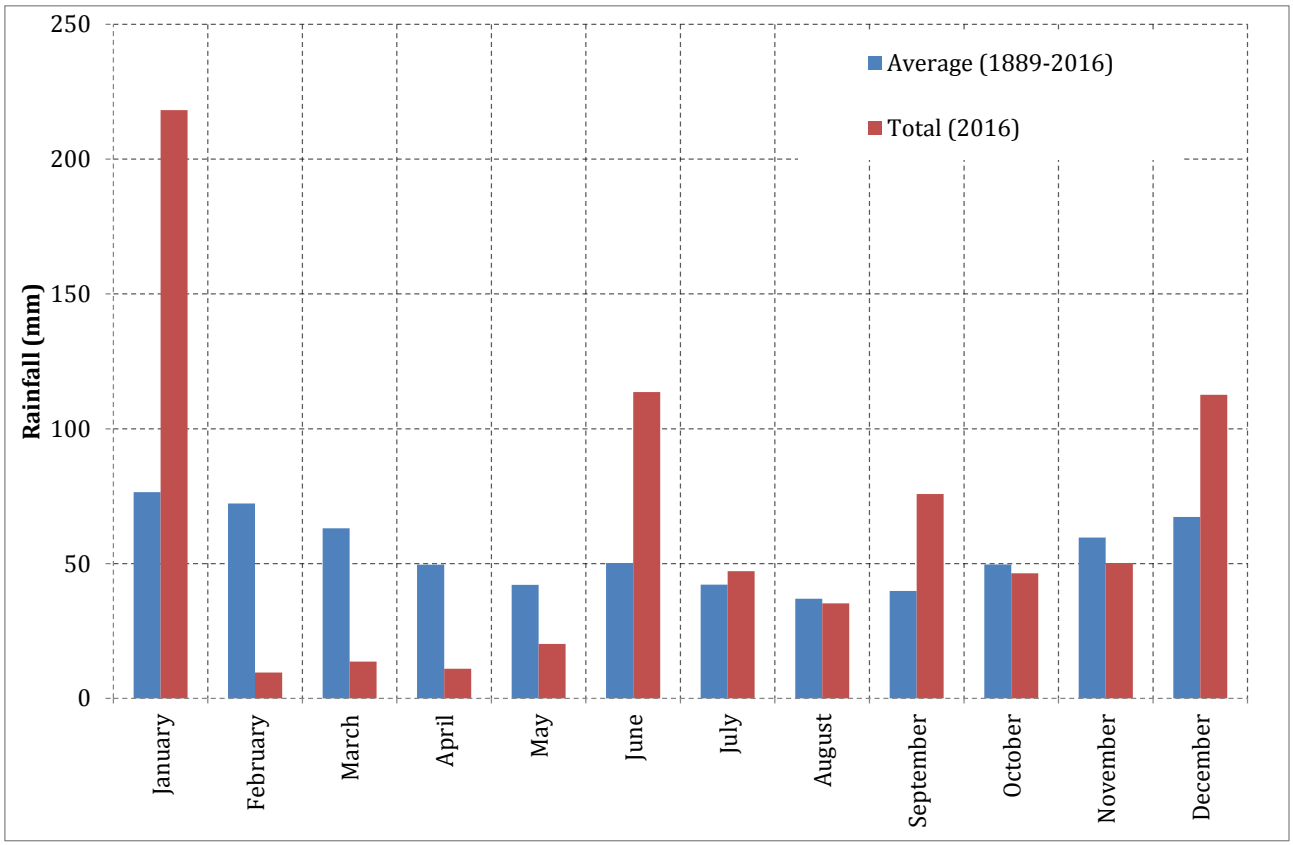


Figure 2-3 Comparison of 2016 monthly rainfall and long-term average

Long-term rainfall trends can be characterised using the Cumulative Rainfall Departure (CRD) method (Bredenkamp *et al.*, 1995). CRD shows trends in rainfall relative to the long-term monthly average and provides a historical record of wetter and drier periods. A rising trend in slope in the CRD plot indicates periods of above average rainfall, while a declining slope indicates periods of below average rainfall. CRD has been used in this study to give context to variations in groundwater levels and chemistry. The CRD and monthly rainfalls between 2006 and 2016 are graphed in Figure 2-4. Two main CRD trends were observed:

- Average rainfall between mid-2006 and mid-2009, except the summer 2006-2007 which was drier.
- Rainfall predominantly below average between mid-2009 and mid-2015. Specifically, the area is noted to have periods of prolonged below average rainfall between mid-2009 and mid-2011, and between mid-2012 and mid-2015.

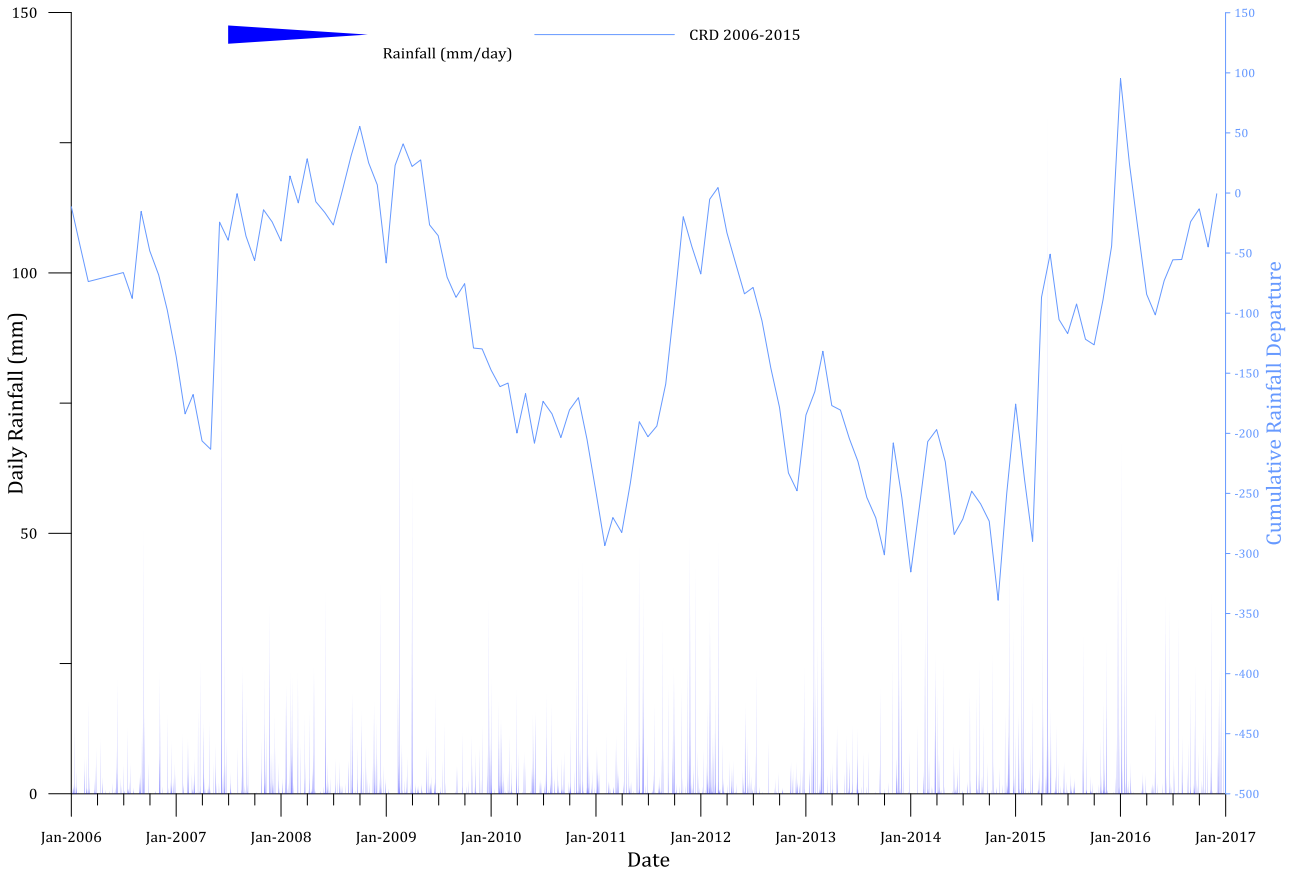


Figure 2-4 Comparison of monthly rainfall and CRD

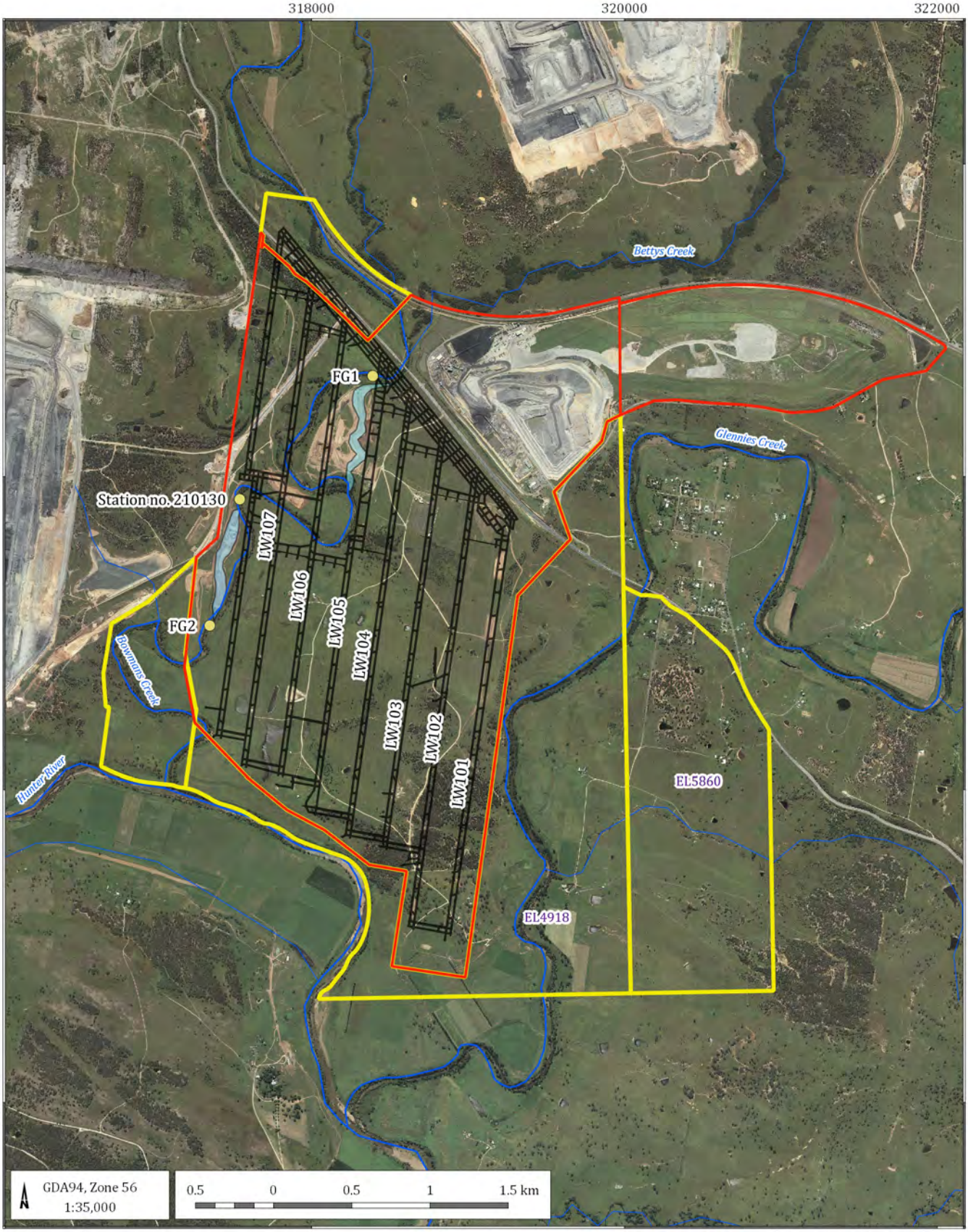
2.3 Surface water

Ashton lease is bounded by Bowmans Creek on the west, Bettys Creek (tributary of Bowmans creek) on the north, Glennies Creek on the west side and Hunter River on the south. Both Bowmans and Glennies Creeks are an affluent of the Hunter River. The three main water courses are shown on Figure 2-5 and described below:

- Hunter River is the main surface water body with a catchment area at Bowmans Creek of 13,590 km^2. The flow is regulated by Glenbawn dam and by other licensed extractions and releases.
- Glennies Creek and its associated alluvium are located to the east of the underground workings and the Pike's Gully sub-crop area. The catchment area is approximately 600 km^2 and up to half of the Glennies Creek catchment feeds into Lake St. Clair, located within the far north eastern section of the catchment. Water from Lake St. Clair discharges into Glennies Creek under controlled release.
- Bowmans Creek natural channel is above the longwall panel LW6B/LW106B and its associated alluvium are over LW5 to LW8. It is the main water course over the underground working area. Bowmans creek was diverted in two locations to minimise the impact of mining on the creek and the potential inflows to the underground workings. The construction of the eastern diversion commenced in March 2011 and the western diversion commenced in February 2012. Both diversions were commissioned in November 2012 and are within the Bowmans Creek Alluvium (BCA). The diversions were designed to replicate the natural creek setting in terms of channel cross sectional variability in bed level and ecological features (i.e. resting pools). There were lined with a geosynthetic clay liner in order to minimise leakage from the creek.
- Bowmans Creek flow is not regulated and is monitored following the WMP. The stream flow gauging station no. 210130, from the NSW Office of Water, was installed in October 1993 and is used as a flow baseline for Bowmans creek with a catchment area of 240 km^2. This station is localised in the middle section of the creek on the mining lease, upstream to the western diversion. The annual discharges for the last 21 years are summarised in Table 2-4. The catchment area of Bowmans Creek at Hunter River is approximately 300 km^2.

Table 2-4 Bowmans Creek annual discharge (Station no. 210130)

Year	Total discharge (ML)
1995	6,102
1996	6,006
1997	Not available
1998	82,489
1999	23,520
2000	Not available
2001	Not available
2002	1,559
2003	3,034
2004	410
2005	1,497
2006	Not available
2007	55,132
2008	Not available
2009	13,368
2010	10,767
2011	Not available
2012	17,667
2013	30,468
2014	Not available
2015	Not available
2016	Not available
Average	**19,386**
Median	**10,767**
Minimum	**410**
Maximum	**82,489**



LEGEND

- Flow gauge locations
- ULD workings
- Coal title boundaries
- Lease boundary
- Surface water

Yancoal Ashton - AEMR (G1758K)

Surface water

DATE 17/01/2017

FIGURE No: **2-5**

N:/Groundwater Jobs/G1758K.Yancoal Ashton AEMR 2016/3_GIS/Workspaces/02_05_G1758K_Surface_water.qgs

2.4 Geology

The stratigraphic sequence in the region comprises two distinct units, Quaternary alluvium and Permian sediments.

- The **Permian sediments** comprise of coal seam sequences with overburden and interburden consisting of sandstone, siltstone, tuffaceous mudstone, and conglomerate. The Middle Permian strata form a regular layered sedimentary sequence, with the Whittingham Coal Measures containing the main economic coal seams. Ashton is located in the central Hunter Valley of NSW where the lower sequences of the Whittingham Coal Measures (Singleton Supergroup) sub-crop. The underground operations target seams between the Pikes Gully and Lower Barrett. The stratigraphic sequence of the Permian coal measures in the Hunter Valley is shown in Figure 2-6.
- The **Quaternary alluvium** unconformably overlies the Permian sediments and consists of silt, sand and gravel in the alluvial floodplains of the Hunter River, Glennies Creek and Bowmans Creek. The Bowmans and Glennies Creek alluvium are likely to be in direct connection to the Hunter River alluvium. Figure 2-7shows the extents of the Quaternary alluvium. It is important to note that the mapping of the alluvium does not accurately define the extent of alluvium, as large-scale mapping often incorporates desktop assessment with limited ground truthing. The alluvium extents were sourced from the Aquifer Interference Policy (2012) and the 1:25,000 Singleton Geological Map (McIlveen, 1984).

The 1:100,000 Hunter Valley Coalfields geological map shows that the major structural features within the Ashton area include the Rix's Creek Syncline and the Bayswater Syncline, which bound the mine site to the east and west, respectively. These two structures have caused the geology to dip uniformly to the west-southwest. The area is also bound to the north by the Hebden thrust fault.

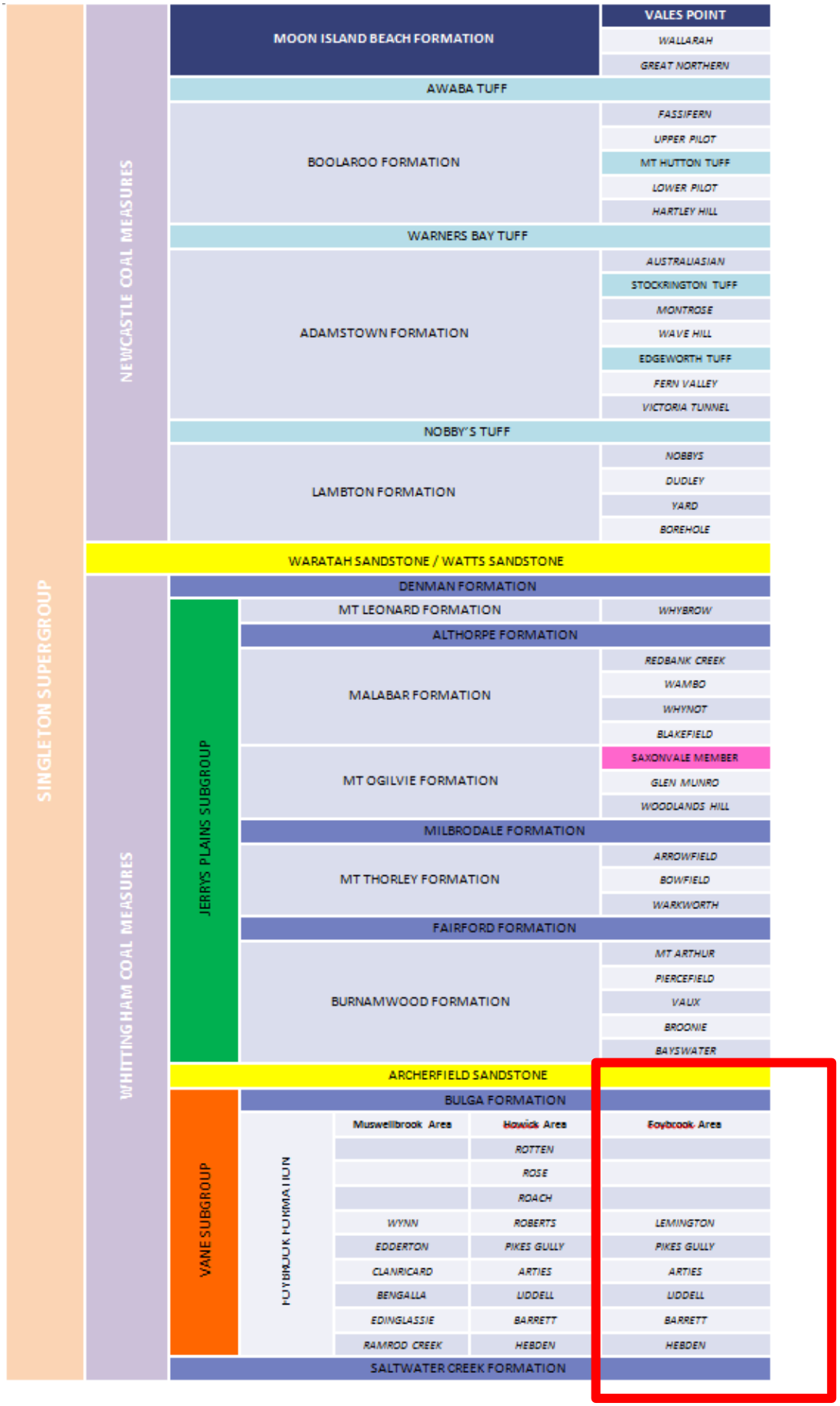
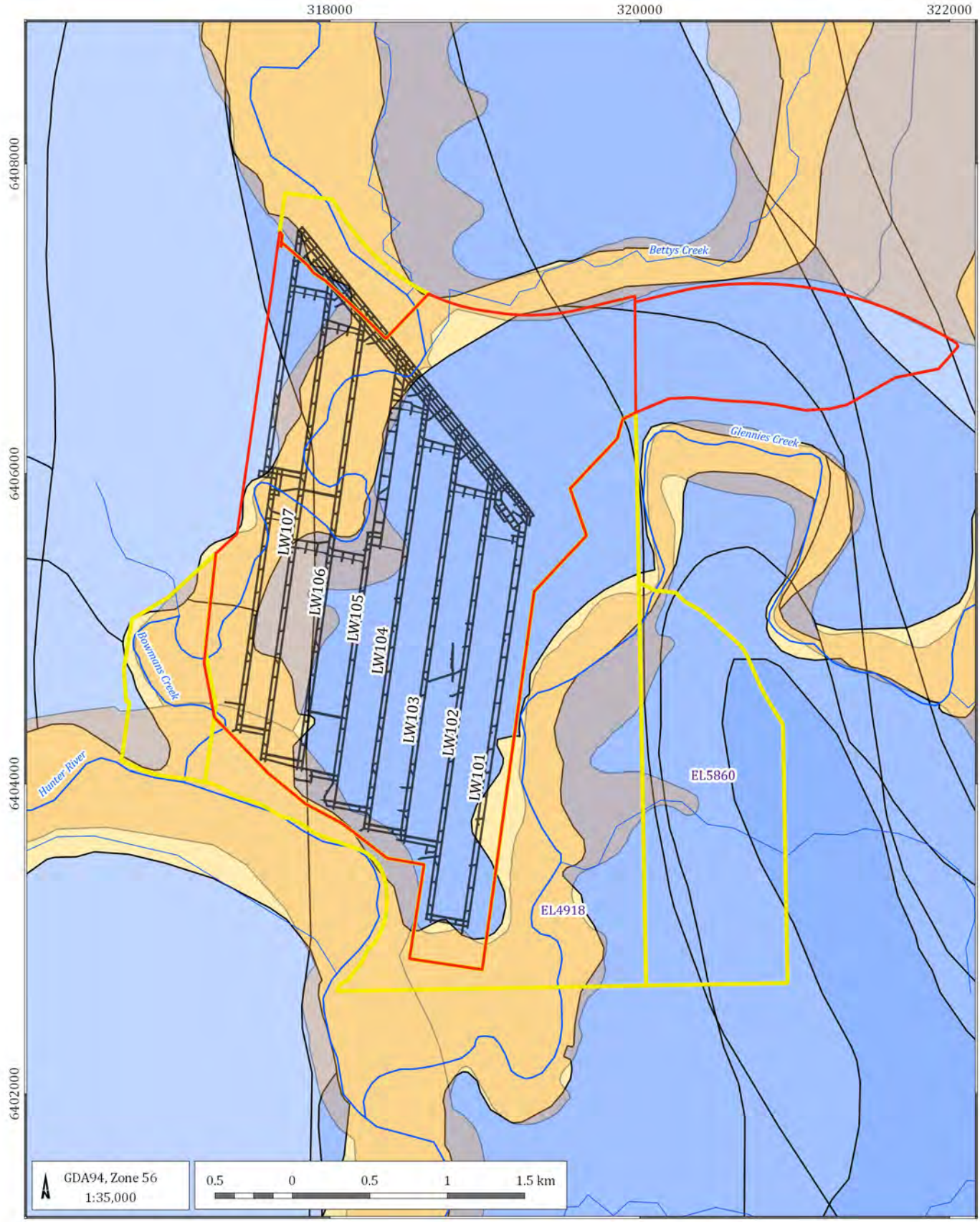


Figure 2-6 Stratigraphy of the Singleton Supergroup



LEGEND

- ULD workings
- Coal title boundaries
- Lease boundary
- Surface water

Alluvium (AIP)

- Highly productive

Regional geology

- Qa - Quaternary Alluvium
- Pswj - Denman Formation, Jerry's Plains Subgroup
- Pswv - Archerfield Sandstone, Vane Subgroup
- Pswc - Wittingham Coal Measures, Saltwater Creek Formation

Yancoal Ashton - AEMR (G1758K)

Regional geology

DATE: 17/01/2017

FIGURE No: **2-7**

N:/Groundwater Jobs/G1758K.Yancoal Ashton AEMR 2016/3_GIS/Workspaces/02_07_G1758K_Regional_geology.qgs

2.5 Hydrogeology

2.5.1 Aquifer systems

The two main water bearing systems within the Ashton area are the fractured Permian coal measures and the unconsolidated alluvial sediments of the Hunter River, Glennies Creek and Bowmans Creek.

2.5.1.1 Permian coal measures

The hydraulic conductivity and storativity of the Permian coal measures is variable. The Permian coal measures can be categorised into the following hydrogeological units:

- **Coal Measures (CM)**. Coal seams are the prime water bearing strata within the Permian coal measures, typically ranging in thickness from 0.5 m to 10 m. It is low to moderately permeable with recorded horizontal hydraulic conductivity (Kxy) values in the Singleton area between 0.6 m/d ($7x10^{-6}$ m/s) and $4.0x10^{-3}$ m/d ($5x10^{-8}$ m/s) (Rust PPK, 1997 and MER, 2005). The coal seams form a series of aquifers alternated by aquitard (interburden).
- **Regolith** or **Coal measures overburden (CMOB)**. It is defined as hydrogeologically "tight" and hence very low yielding sandstone, siltstone and conglomerate that comprise the majority of the Permian interburden/overburden. From previous studies (Rust PPK, 1997, MER, 2005 and AGE, 2010), the hydraulic conductivity of the low yielding interburden / overburden has been recorded between $1x10^{-4}$ m/d ($1x10^{-9}$ m/s) and $1x10^{-5}$ m/d ($1x10^{-10}$ m/s). However, as presented by Kendorski (1993), longwall extraction results in collapse of the overlying rock strata. A previous AGE report (AGE, 2015) discusses geotechnical properties pertaining to disturbance zones and highlights the potential extent of caved, fractured, dilated and constrained zones within the overburden above Pikes Gully seam and the Upper Liddell seam. This subsidence has the potential to increase the hydraulic conductivity of the overburden and potentially connect different aquifers (i.e. coal seams and alluvium) post-mining. Site permeability testing was carried out by SCT in 2009 to assess the permeability of the overburden material pre and post longwall mining. The pre-mining test results ranged between $1x10^{-11}$ m/s and $1.5 x 10^{-7}$ m/s. Only three tests were able to be repeated post mining due to drilling difficulties related to loss of drilling fluids; however, of these tests, permeability increased by at least one order of magnitude in the deeper tests (SCT, 2009).

2.5.1.2 Quaternary alluvium

The unconsolidated alluvium aquifers system associated with the Quaternary alluvium of the Hunter River and its tributaries is generally 10 m to 15 m thick, thinning to 0 m to 5 m towards the edges of the alluvial plain. There are three main alluvial deposits in the Ashton area:

- **Bowmans Creek alluvium (BCA)** is located over the western part of the underground workings, primarily over LW5 to LW8. The BCA is the main alluvium formation over the Ashton area and has been investigated in 2008 by Aquaterra (renamed later RPS). The current channel over the mine can be divided into three portions; namely the northern, central and southern. The northern portion (over LW6B) has the greatest median thickness of saturated alluvium (3.6 m) and the greatest hydraulic conductivity of 4.45 m/d (5 $x10^{-5}$ m/s). Oppositely, the southern portion extends to the Hunter River alluvium and has the lowest median saturated thickness (2.3 m) with lower hydraulic conductivities of 0.75 m/d (9 $x10^{-6}$ m/s). The hydraulic conductivity repartition along the creek illustrates coarser grained material at the upper portion and finer material near the Hunter River alluvium (HRA).

  Sediments associated with the Bettys Creek alluvium deposits are localised on the northern edge of the open pit (NEOC) and join Bowmans Creek on the north west of the pit.

- **Glennies Creek alluvium (GCA)** is situated within a small alluvial floodplain immediately east of the underground mine. It is adjacent to the LW1 and joins the Hunter River alluvium on the southern part of the longwall.

- **Hunter River alluvium (HRA)** is located on the southern edge of the underground mine.

2.5.2 Recharge

Groundwater recharge at the site primarily occurs as result of rainfall infiltration at outcrop of the coal measures and the alluvium and lateral flow through from the alluvium to the coal measures (Aquaterra, 2009 and AGE 2016). The Whittingham Coal Measures are known to subcrop below the Hunter River and the BCA and GCA, the hydraulic connectivity between the Whittingham Coal Measures and the alluvium is not precisely understood. However, it is likely that this geological contact is a source of recharge to the underlying coal measures.

Additionally, localised recharge to the Bowmans and Glennies creeks alluvium via lateral seepage from the Hunter River occurs during periods of high flows.

3 Monitoring program

3.1 Groundwater monitoring network

The ACOL groundwater monitoring network consists of more than 100 monitoring bores, of which a maximum of 49 are monitored as part of the water management plan (WMP) during any one monitoring campaign, including longwall panel specific monitoring bores and vibrating wire piezometer (VWP) installations. The WMP outlines a monitoring plan and key monitoring locations in areas which are potentially sensitive to mining impacts.

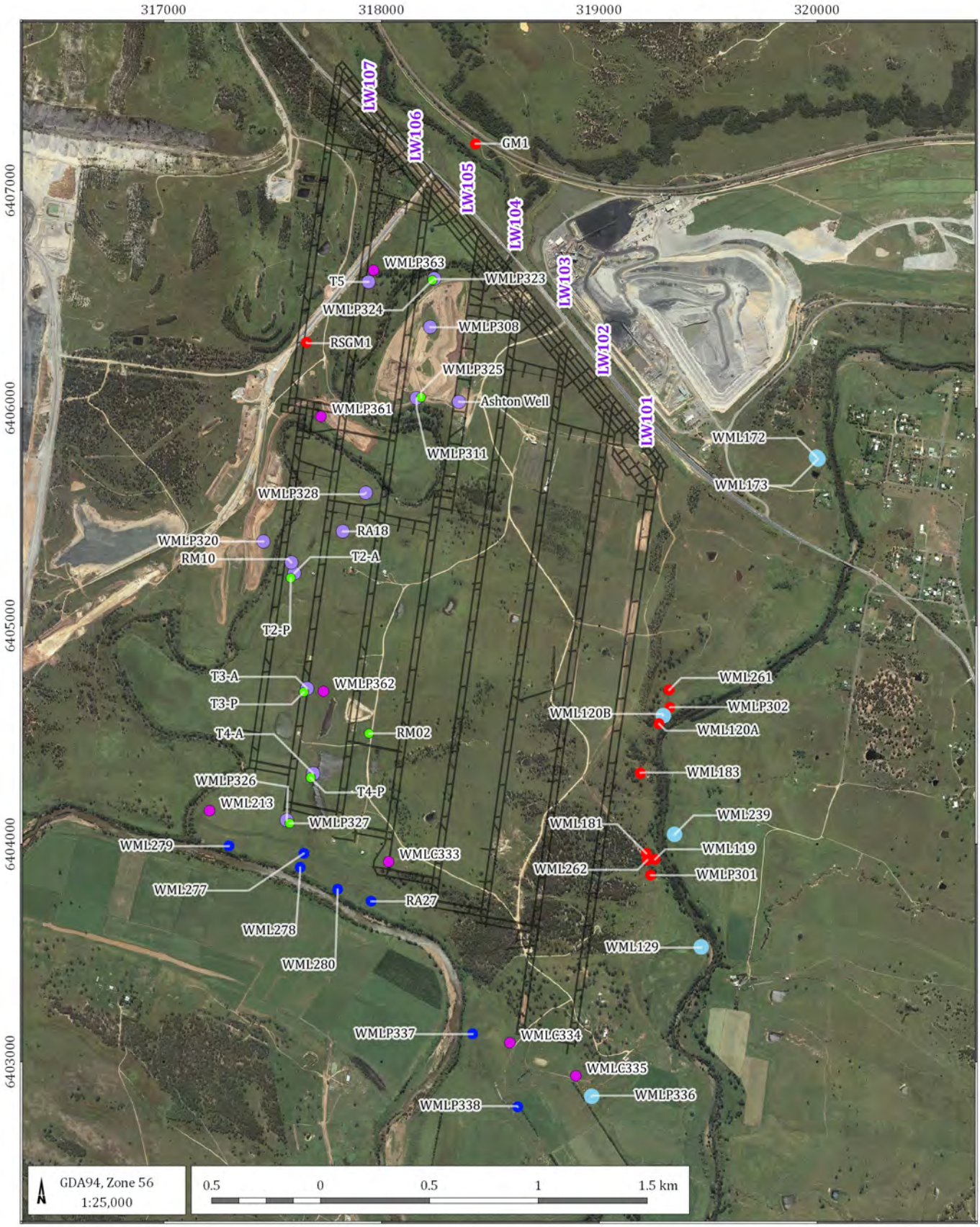
The WMP monitoring locations and respective monitoring targets are presented in Figure 3-1. Detail of the groundwater monitoring plan, including monitoring parameters and frequency, is summarised in Appendix A.

The groundwater monitoring program includes the monitoring of:

- groundwater (piezometric) pressures;
- field water quality parameters – pH and electrical conductivity (EC);
- groundwater sampling for comprehensive chemical analysis; and
- monitoring of groundwater level and EC as required by Environmental Protection Licence 11879 (EPL 11879).

Monitoring frequency is as follows:

- monthly monitoring at selected alluvial piezometers for water level and field water quality;
- monthly monitoring of water level and piezometric pressure in longwall-specific piezometers during active extraction at relevant longwalls;
- quarterly monitoring at selected piezometers for water level, piezometric pressure and field water quality;
- six-monthly for bores specified by EPL 11879; and
- annual sampling at selected piezometers for comprehensive chemical analysis.



LEGEND

Longwall panels (ULD)

Monitoring bores

- BCA - Bowman's Creek alluvium
- CMOB (Regolith) - Coal measure overburden
- Coal measures
- GCA - Glennies Creek alluvium
- HRA - Hunter River alluvium

VWPs

- WML213 (Bay, Lem, PG, LD, Bar)
- WMLC333 (Lem, Art, LD, Bar)
- WMLC334 (Lem, Art, LD, Bar)
- WMLC335 (Lem, PG, Art, LD, Bar)
- WMLP361 (Lem, Art, ULD)
- WMLP362 (PG*)
- WMLP363 (Lem, ULD)

Yancoal Ashton - AEMR (G1758K)

WMP groundwater monitoring network

DATE 18/01/2017

FIGURE No: **3-1**

N:/Groundwater Jobs/G1758K.Yancoal Ashton AEMR 2016/3_GIS/Workspaces/03_01_G1758K_WMP_groundwater_monitoring_network.qgs

3.2 Trigger values of groundwater management plan

Triggers for groundwater level and water quality (EC and pH) have been developed for monitoring bores in the Bowmans Creek Alluvium (BCA), Glennies Creek Alluvium (GCA) and the Hunter River Alluvium (HRA). These triggers have been included in the last water management plan which was issued in May 2016, after being updated in November 2015.

Groundwater level triggers were established based on predicted mining related drawdowns at alluvial bores and on observed natural variations (RPS 2014). Since the validation of the WMP in May 2015 and until the end of mining in the ULD, a recorded water level below the defined trigger level at a monitoring bore, sustained for three consecutive months, would trigger a response under the WMP. Groundwater elevation trigger levels are summarised in Table 3-1.

Table 3-1 Groundwater elevation trigger levels for alluvial monitoring bores

Aquifer	Monitoring bore	Interpolated base of alluvium (mAHD)	Assigned trigger value end of mining Upper Liddell Seam (mAHD)
BCA	WMLP323	57.7	58.4
	WMLP311	54.9	56.2
	T2A	51.8	52.5
	WMLP328	54.7	55.2
GCA	WML120B	50	51.7
	WML129	45	50.4
	WML239	45.4	50.8
HRA	WMLP279	37.4	49
	WMLP280	43.3	48.8
	WMLP337	45.6	47.8

As for groundwater levels, trigger values for EC and pH have been developed in the last WMP based on the 20th and 80th percentile of the historical data for all the bores in the alluvium. A response would be triggered if recorded values of pH or EC are outside the allocated triggers for a period of three consecutive monthly measurements. Additionally, if a recorded value at a monitoring bore is extremely different than the previous three readings without any unusual event that could have caused the change, a response would be triggered. The triggers values allocated for pH and EC are in Table 3-2.

Table 3-2 Groundwater quality trigger levels for alluvial monitoring bores

Aquifer	pH trigger	EC trigger
BCA	< 6.5 or > 8.0	> 2,000 µS/cm
GCA	< 6.2 or > 8.0	> 2,000 µS/cm
HRA	< 6.2 or > 8.0	> 3,100 µS/cm**

Note: *** > 3,000 µS/cm before 1st November 2015*

4 Groundwater levels

Groundwater levels in key monitoring bores in the BCA, GCA, HRA and fractured rock monitoring locations have been measured manually and using automated data loggers. In order to assess mining related impacts on groundwater levels within the Ashton area, hydrographs have been prepared using data from monitoring bores in discrete areas around the underground footprint. Each hydrograph presents data from alluvium bores, fractured rock bores and vibrating wire piezometers (VWP).

The water levels monitored were plotted against time and compared to CRD. In order to compare groundwater levels with triggers defined in the WMP, hydrographs per alluvium formation and the longwall specific groundwater monitoring program were prepared (from Figure 4-1 to Figure 4-6).

Section 4.2 compares the water level measurements of alluvium and fractured rock bores within the three alluvial groundwater source areas. The intent is to contrast alluvial groundwater levels (that tend to show impact from mining) against fractured rock groundwater levels (that often show mining related depressurisation).

4.1 WMP compliance water level review

4.1.1 Alluvial groundwater level compliance bores

Groundwater levels in key monitoring bores have been measured both manually and using automated pressure transducers. The groundwater level trends and trigger levels for the BCA, GCA and HRA monitoring bores are presented graphically in Figure 4-1, Figure 4-2 and Figure 4-3, respectively. Longwall specific water level measurements are presented graphically in Figure 4-4. Daily rainfall measurements have also been plotted and used to compare water level trends. The pressure transducer data as a continuous line and manual measurements for the same locations as points of the same colour.

Figure 4-2 and Figure 4-3 present manual measurements only, as no pressure transducers were deployed in these monitoring bores.

The following observations can be noted for 2016:

- No exceedances have been noted that require the groundwater management protocol to be enacted.
- All BCA and HRA monitoring bore water levels generally correlate with the CRD. A marked response to rainfall events can be seen in all bores, most notably in January. WMLP311 data shows three distinct spikes in groundwater level over the course of the month; these are likely caused by localised rainfall run-off.
- All GCA monitoring bore groundwater levels appear relatively static and only rise or fall in response to significant weather events.
- No mining related impact has been observed within the alluvium.

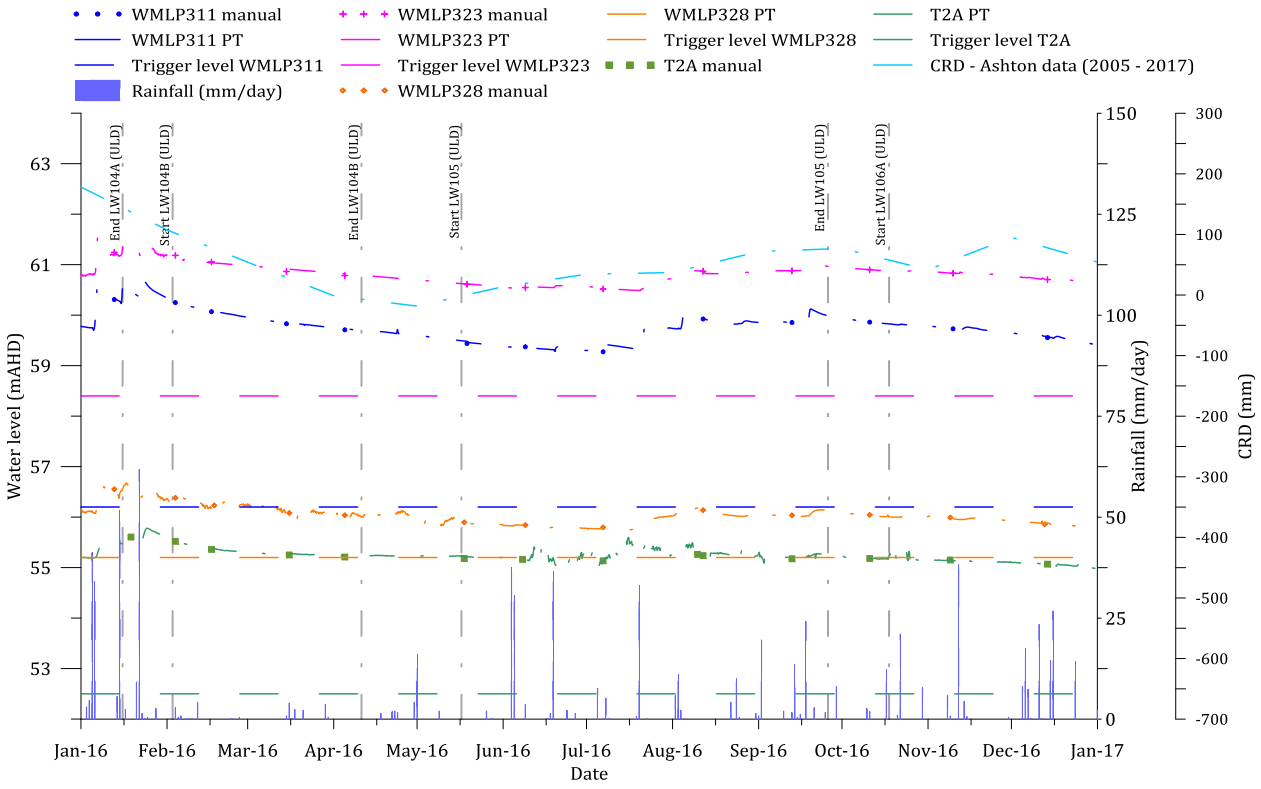


Figure 4-1 Bowmans Creek alluvium (BCA) hydrograph

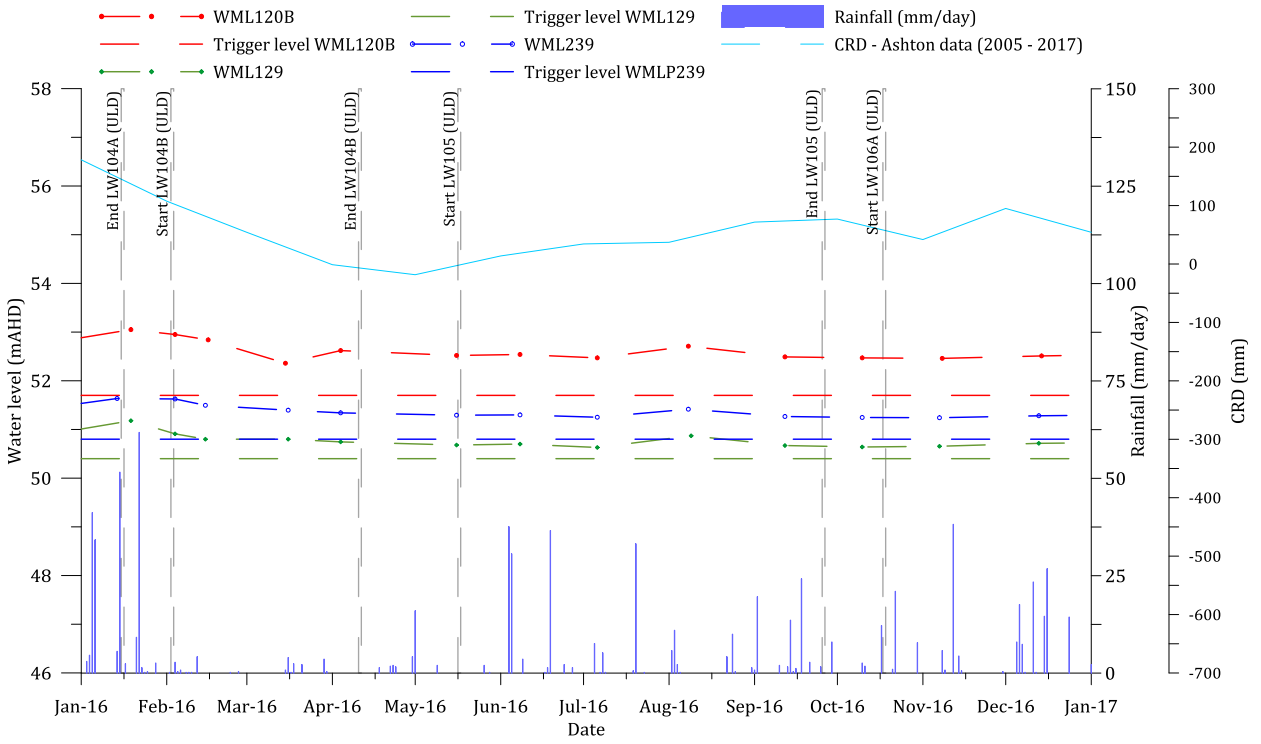


Figure 4-2 Glennies Creek alluvium (GCA) hydrograph

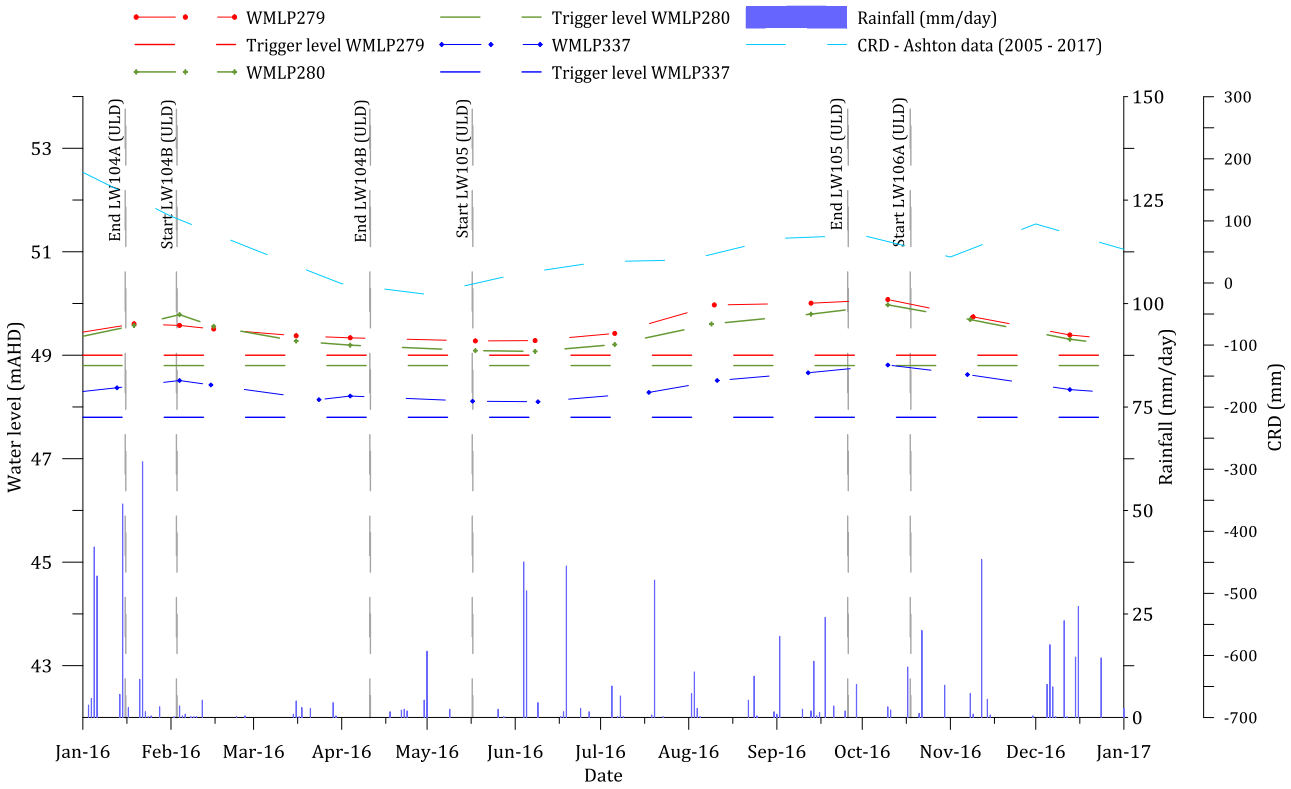


Figure 4-3 Hunter River alluvium (HRA) hydrograph

4.1.2 Longwall specific bores and VWPs

Longwall-specific monitoring bores and VWPs are used to assess any potential groundwater level response relative to the longwall panel extraction. LW104, LW105 and LW106A were mined in 2016. The groundwater levels of the longwall-specific monitoring bores and VWPs are plotted in Figure 4-4 and Figure 4-5, respectively.

The main observations are as follows:

- There are no obvious mining related impacts to groundwater levels in the longwall specific monitoring bores.
- The monitoring bores screened within the alluvium have water levels that are influenced by major rainfall events (eg January 2016).
- In mid-May, VWP363 head data shows a step. This step is due to the sensors being connected to a data logger for constant measurement of pressure head.
- VWP installation WML213 is situated at the Hunter River/Bowmans Creek confluence. The head measured in the 48 mBGL sensor (Bayswater Seam) displays the same trends as the HRA monitoring bores. The heads measured in Lemington 8-9, Pikes Gully, Upper Liddell show a gradual decline over 2016. This is likely due to mining in the Pikes Gully and Upper Liddell seams.
- VWP installation WMLP363 pressure head trends are steady over the 2016 monitoring period, with the exception of VWP sensor at 20 m depth from surface. This sensor shows a single decrease in head of almost 10 m in late 2016, after the start of mining in LW106A.

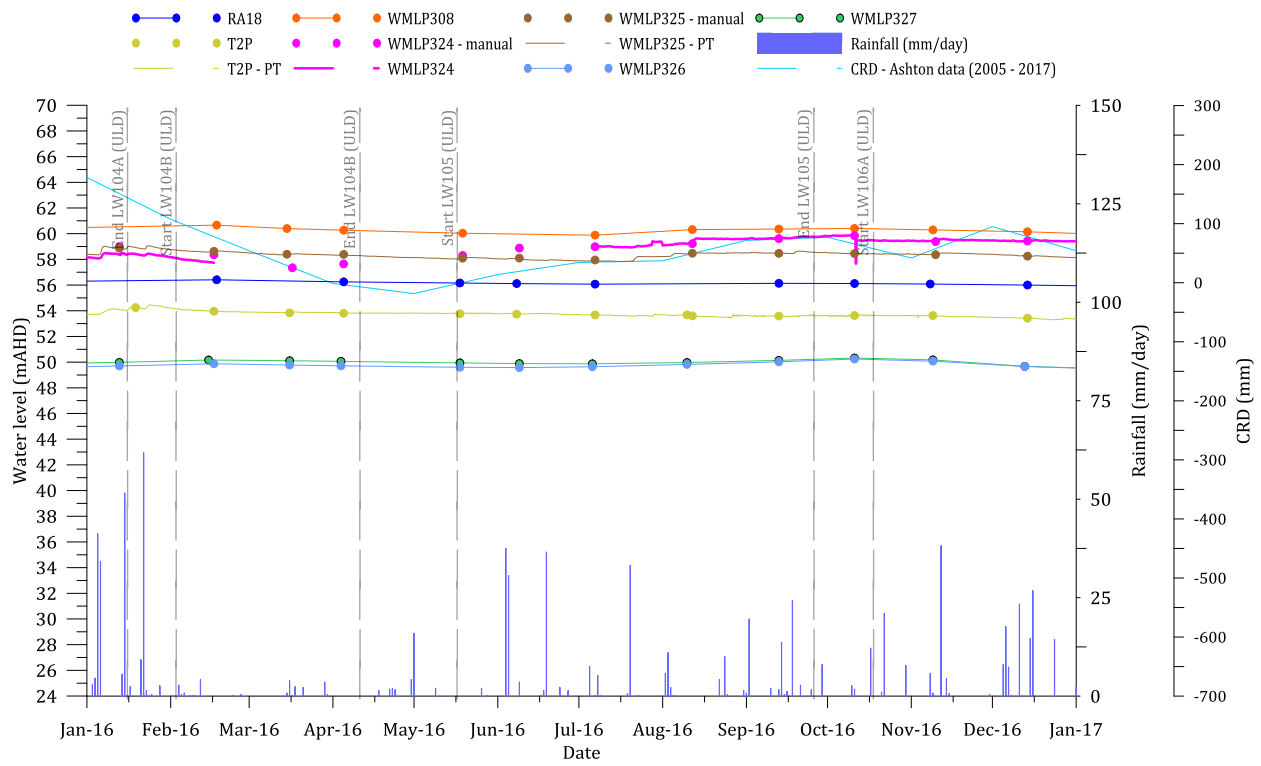


Figure 4-4 Longwall specific monitoring bore hydrographs (LW106)

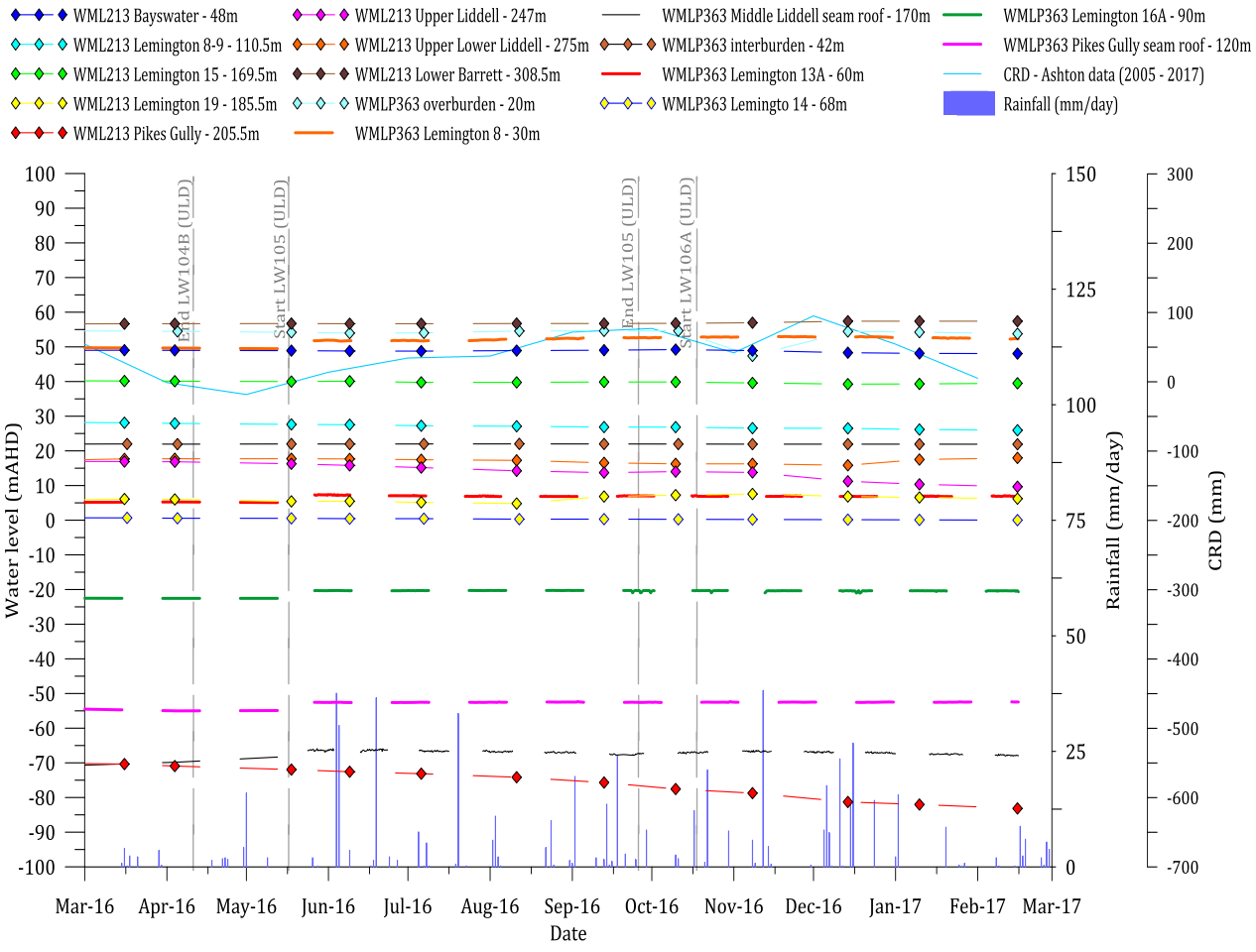


Figure 4-5 Longwall specific VWP hydrographs (LW106)

4.2 Comparison of alluvium and fractured rock bores

This section compares the water level measurements of alluvium and fractured rock bores within the three alluvial groundwater source areas. The intent is to contrast alluvial groundwater levels (that tend to show impact from mining) against fractured rock groundwater levels (that often show mining related depressurisation).

The groundwater level trends for alluvium and fractured rock bores in the BCA, GCA and HRA groundwater sources are presented graphically in Figure 4-6, Figure 4-7 and Figure 4-9, respectively.

4.2.1 BCA groundwater source area

BCA groundwater source area screened in the BCA, the coal measures overburden (weathering profile/regolith) and within the fresh units of the coal measures. The main observations are as follows:

- Groundwater levels in the three monitoring bores appear to fluctuate slightly in response to rainfall.
- Water levels in T4A and T4P, BCA and Coal measure monitoring bores respectively, increased in December 2016. These bores are located over LW6A/LW106A which is currently being mined. Subsidence movement and associated cracking causing movement of waters between geological units may be the cause of the water level increase. The surface water body adjacent this site was dry at the time of these results. It was assumed that the surface water body had gone dry due to the hot summer in 2016/2017. This surface water body should be monitored for recovery.
- The remaining bores do not appear to have been impacted by mining during 2016.

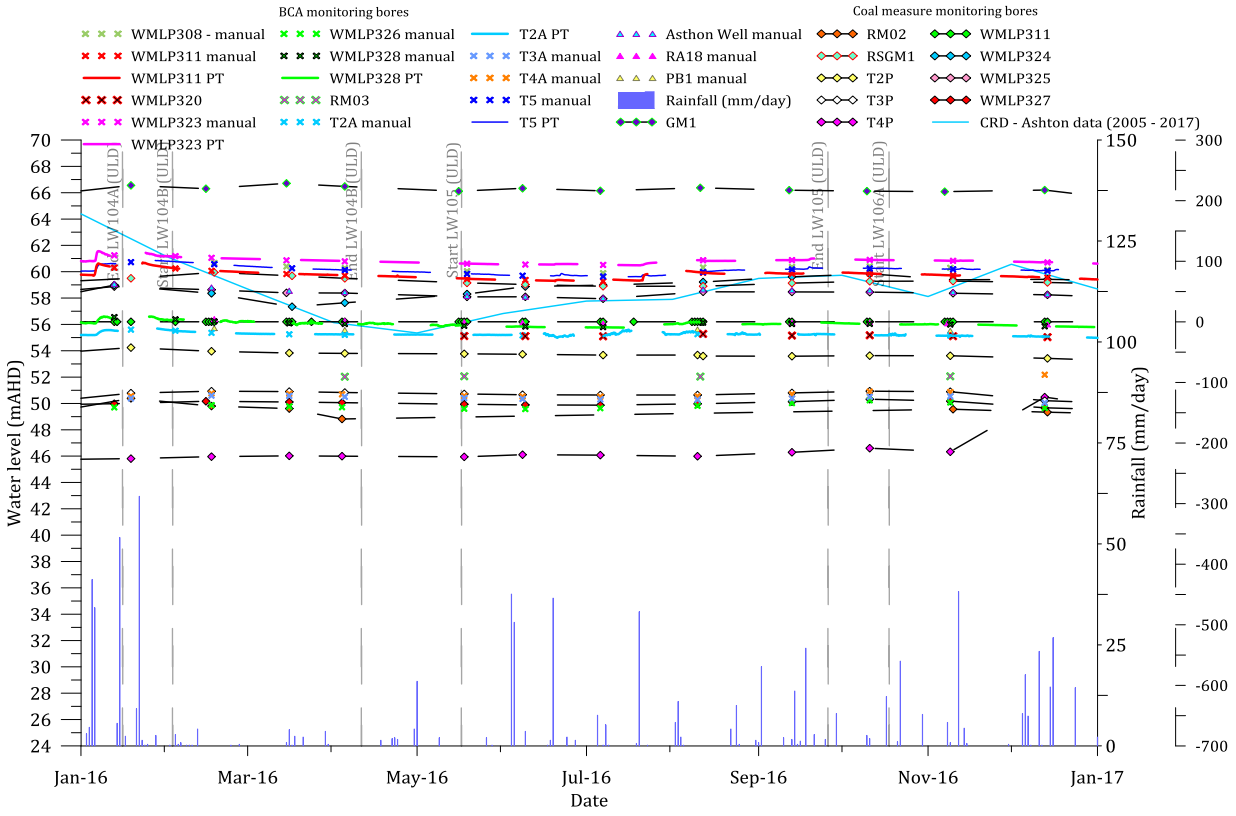


Figure 4-6 BCA groundwater source area bore hydrographs

4.2.2 GCA groundwater source area

GCA groundwater source area bores include targets such as the GCA, Pikes Gully and Arties seams. Water level observations during 2016 are the following:

- Water levels within the Glennies Creek alluvium, Pikes Gully and Arties seams have similar fluctuations that correlate to rainfall events.
- Groundwater elevation in WML120A and WML120B (screened in the Pikes Gully and GCA, respectively) are at the same level indicating that there is a high degree of connection between the two units in this location.
- WML119, coal measure monitoring bore, shows a water level change in October 2015. This is due to the bore top of collar reference changing when AGE took over the sampling contract. Previous sampling contactors measured the water level from an unsafe PVC stickup length.
- Groundwater elevation in WML239 and WML119 (screened in the Pikes Gully and GCA, respectively) are separated by approximately 10 m. WML239 is located a short distance from the limit of the GCA, indicating that the hydraulic connection between the BCA and the Pikes Gully seam decreases with distance from the BCA boundary.
- Water level in WML262 (ULD) is decreasing at a constant rate due to the dewatering in this coal seam. During 2016, the water elevation in this bore has decreased from 31.76 mAHD (19 Jan) to 30.99 mAHD (13 Dec).
- Monitoring bores WML172 and WML173 were believed to be screened in the GCA. This review has shown that the water levels in these bores are not consistent with other GCA bores. Further investigation showed that these bores are screened in consolidated rock and not Glennies Creek alluvium. Also, the water level in WML173 has been very regular and without the seasonal fluctuations one would expect from a monitoring bore. A review of the bore construction showed that the water level in this bore is likely to be only the water in the bore sump (refer Appendix C for geological logs). These bores are the subject of a separate investigation.
- WML183 screened within the Pikes Gully shows phases of impact from mining. In the case of this review, the impact can be seen in May 2015 (refer Figure 4-8). Currently, the water level in this bore is relatively stable. The entire data set for this bore from 2007 to 2016 is presented in Figure 4-8. The entire data set shows the initial phases of mining between 2007 and late 2011 and subsequent dewatering of the PG seam in 2014 and 2015, prior to mining the underlying ULD seam. Monitoring bore WML183 shall be included in future versions of the WMP. The bore is representative of the Pikes Gully Seam in this area, and demonstrates the impact of mining and the post-mining recovery.
- The remaining bores do not appear to have been impacted by mining during 2016.

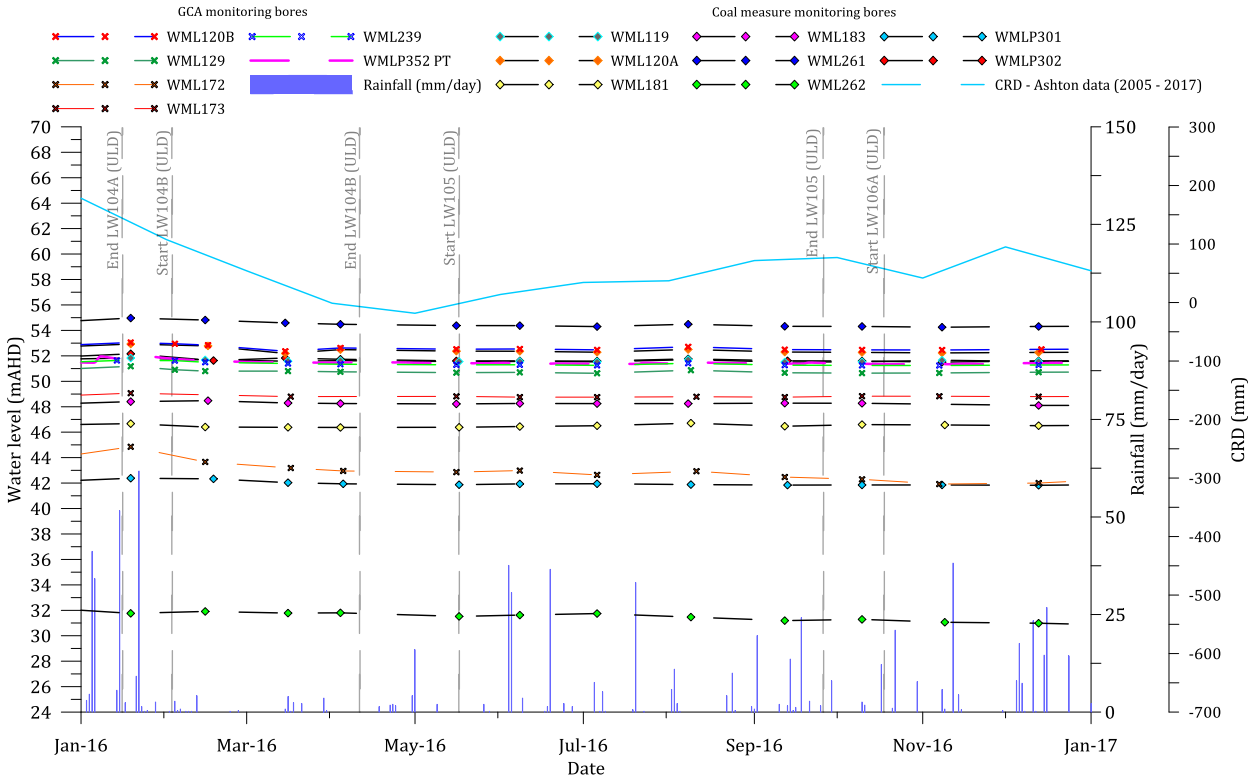


Figure 4-7 GCA groundwater source area bore hydrographs

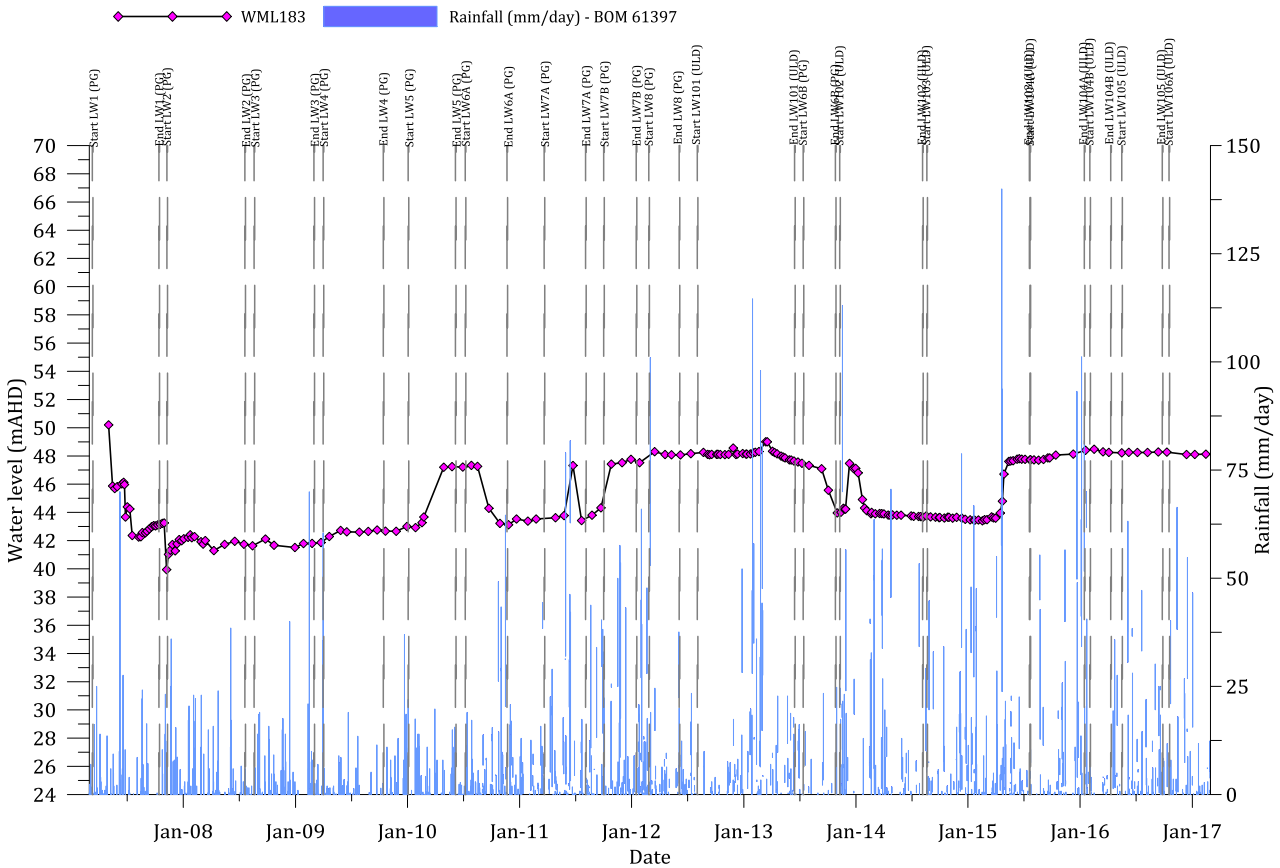


Figure 4-8 Pikes Gully monitoring bore WML183 groundwater level trends (2007-2016)

4.2.3 HRA groundwater source area

HRA groundwater source area monitoring locations include three VWP installations screened in Lemington, PG, Arties, ULD, Lower Liddell, Upper Barrett and lower Barrett seams and monitoring bores in the HRA.

Due to the number of water levels represented, the hydrograph was divided in three figures: Figure 4-9, Figure 4-10 and Figure 4-11. The observations of water levels during the year 2016 are the following:

- HRA and CMOB have similar water level fluctuation and elevation that correlate with CRD. The bores do not appear to be impacted by mining activity.
- As discussed in Section 4.1.2, VWP installation WML213 is situated at the Hunter River/Bowmans Creek confluence. The head measured in the 48 mBGL sensor (Bayswater Seam) displays the same trends as the HRA monitoring bores. The heads measured in Lemington 8-9, Pikes Gully, Upper Liddell show a gradual decline over 2016. This is likely due to mining in the Pikes Gully and Upper Liddell seams.
- Groundwater levels in WMLC334 (Arties Seam, Upper Liddell Seam and Upper Lower Liddell Seam) have also declined over 2016 due to mining related dewatering.
- Groundwater levels in the HRA and WMLC335 (Lemington 15B, Upper Lower Liddell and Upper and Lower Barrett seams) are generally constant during the year and do not appear impacted by mining. The groundwater level in WMLC335 (Lemington 17) declined following commencement of LW105 (May 2016) from approximately 43m to ~ 40m AHD, starting in September 2016. The seam groundwater level have stabilised at ~40m for the remainder of 2016. Groundwater levels in WMLC355 (Pikes Gully Seam, Arties Seam and Upper Liddell Seam) have steadily declined over the course of 2016, and appear to be depressurising due to mining.
- There exists a contrast between the Upper Lower Liddell Seam in WMLC334 and WMLC335. The former shows a groundwater level which trends downward over time (albeit erratically), whilst WMLC335 appears stable and unaffected by mining.

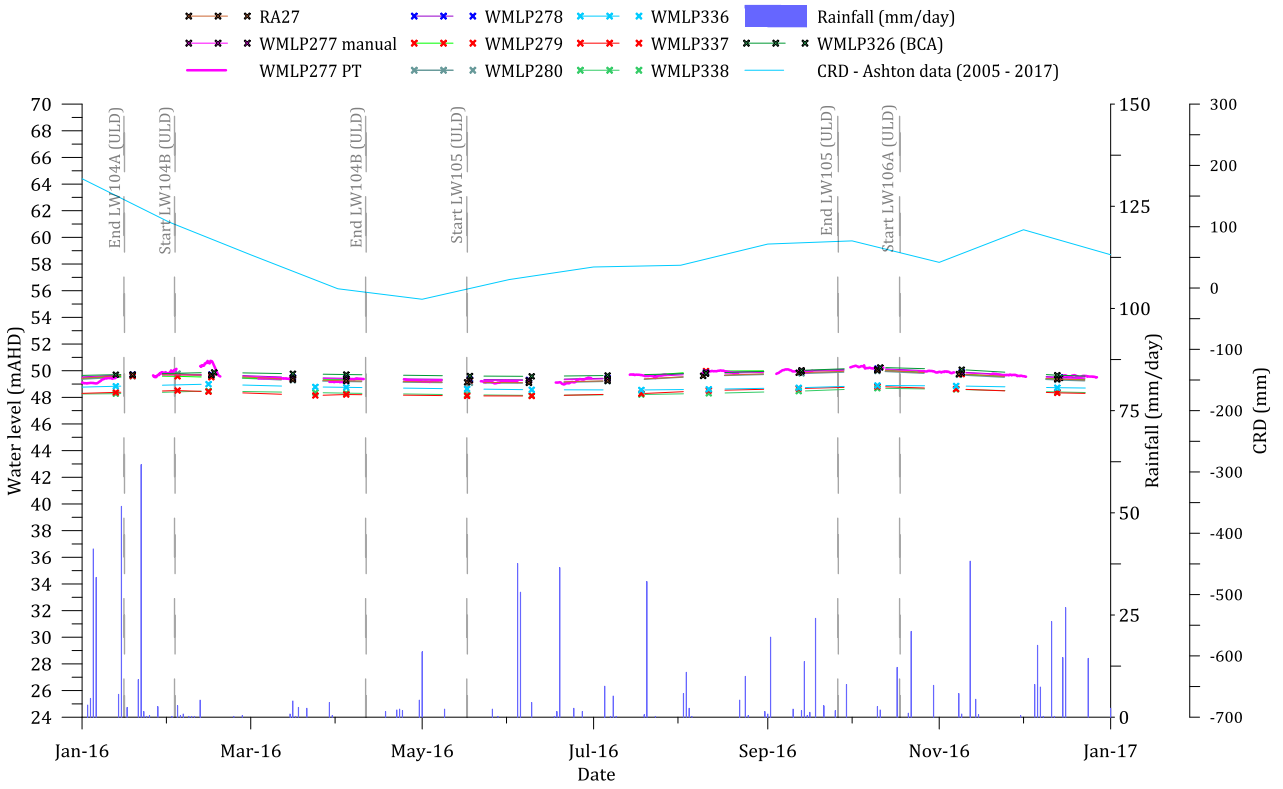


Figure 4-9 HRA groundwater source area bore hydrographs

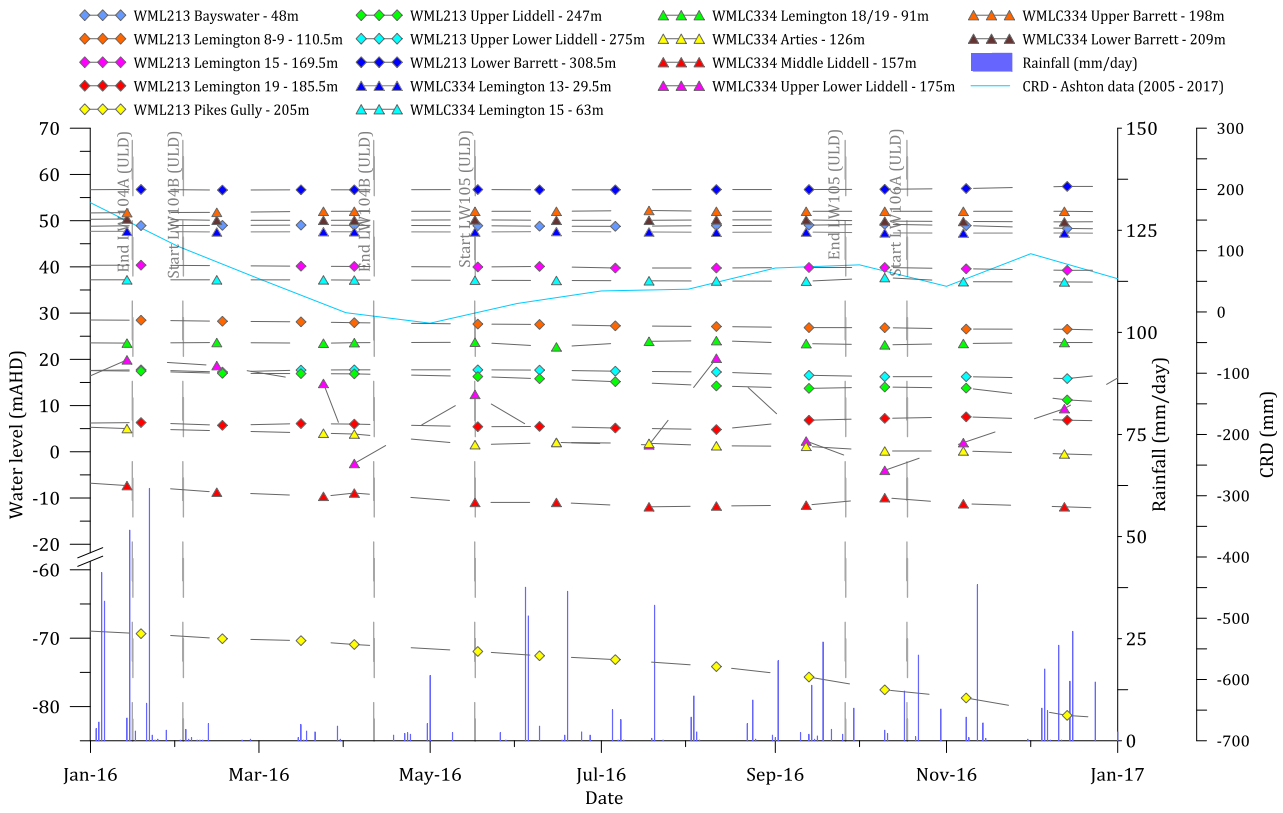


Figure 4-10 HRA groundwater source area VWP hydrographs (WML213 and WMLC334)

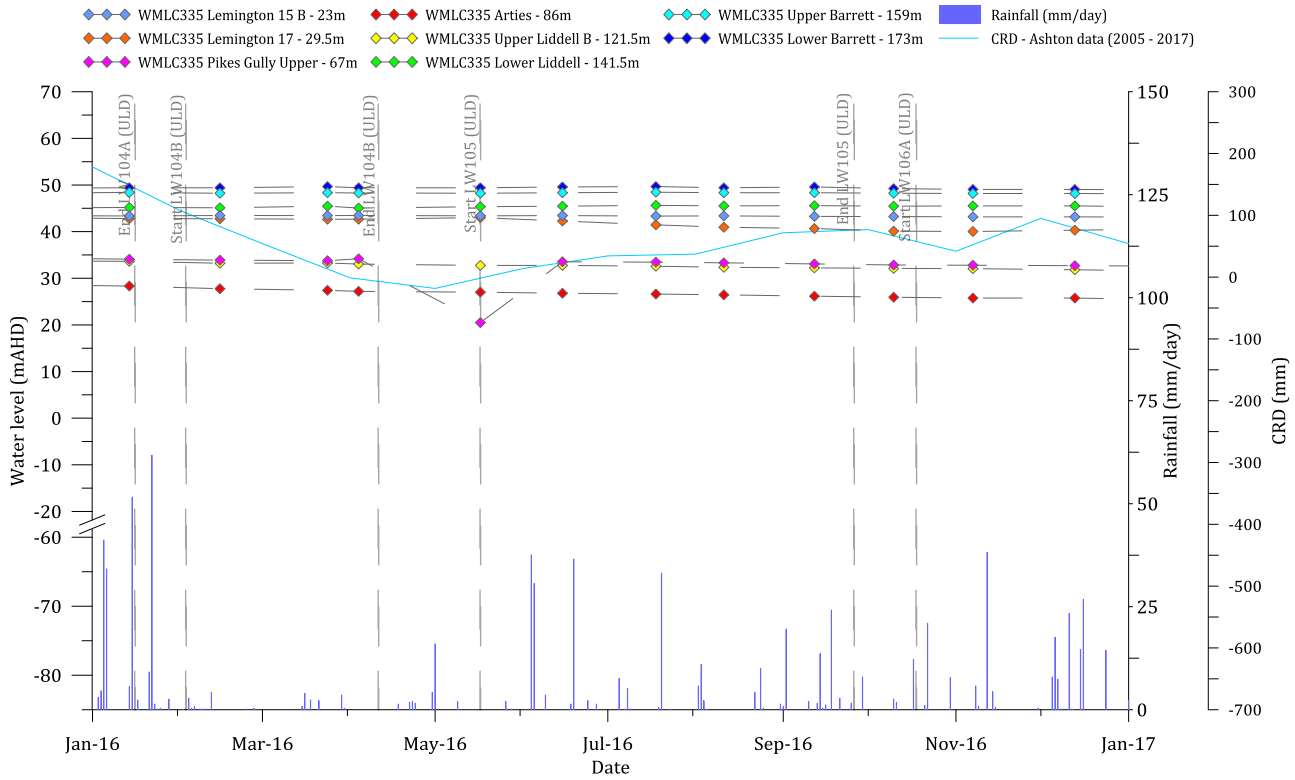


Figure 4-11 HRA groundwater source area VWP hydrographs (WMLC335)

5 Groundwater quality

The BCA, GCA and HRA water quality monitoring data is discussed in the following sections. The BCA, GCA and HRA water quality monitoring data (pH and EC) is presented graphically and discussed in Sections 5.1 to 5.3. Additionally, longwall specific and fractured rock bore quality data is presented graphically and discussed in Sections 5.4 and 5.5.

The trigger values for pH and EC for the alluvial bores are included in the graphs to verify compliance with the WMP. Additionally, the CRD and daily rainfall are also shown in order to identify any water quality or water level variation that may be unrelated to mining.

Laboratory results and interpretation are summarised in Section 5.6.

5.1 BCA monitoring bores

The BCA pH and EC monitoring data is presented graphically in Figure 5-1 and Figure 5-2, respectively, together with their respective WMP triggers. The observations regarding water quality during the year 2016 are the following:

- pH is highly variable and the trends generally match seasonal variation. Periods of low rainfall are characterised by low pH (< 7 pH units) and vice versa for periods of elevated rainfall.
- There are no obvious impacts from mining to the pH measured on these monitoring bores during the Year 2016.
- WMLP325 and WMLP311, screened in the overburden and the Bowmans Creek alluvium, respectively, display similar trends in pH. WMLP311 displayed pH values below the trigger level of 6.5 in May 2016, however has since stabilised at around pH 7.
- T3A EC levels are higher than other BCA EC levels and above the BCA EC trigger; however, the results are within historic ranges and no mining impacts are evident in the EC trend. The EC trend in this bore is subject of further investigation.
- T4A EC levels are generally higher than other BCA EC levels, as per T3A. A notable decrease in EC is evident from November 2016 onward. This coincides with an increase in water level in the bore. T4A is located over LW6A/LW106A and mining in this panel commenced on 18 October 2016. The change in EC is most likely related to subsidence impacts and cracking causing increase movement within and between aquifers in this location.

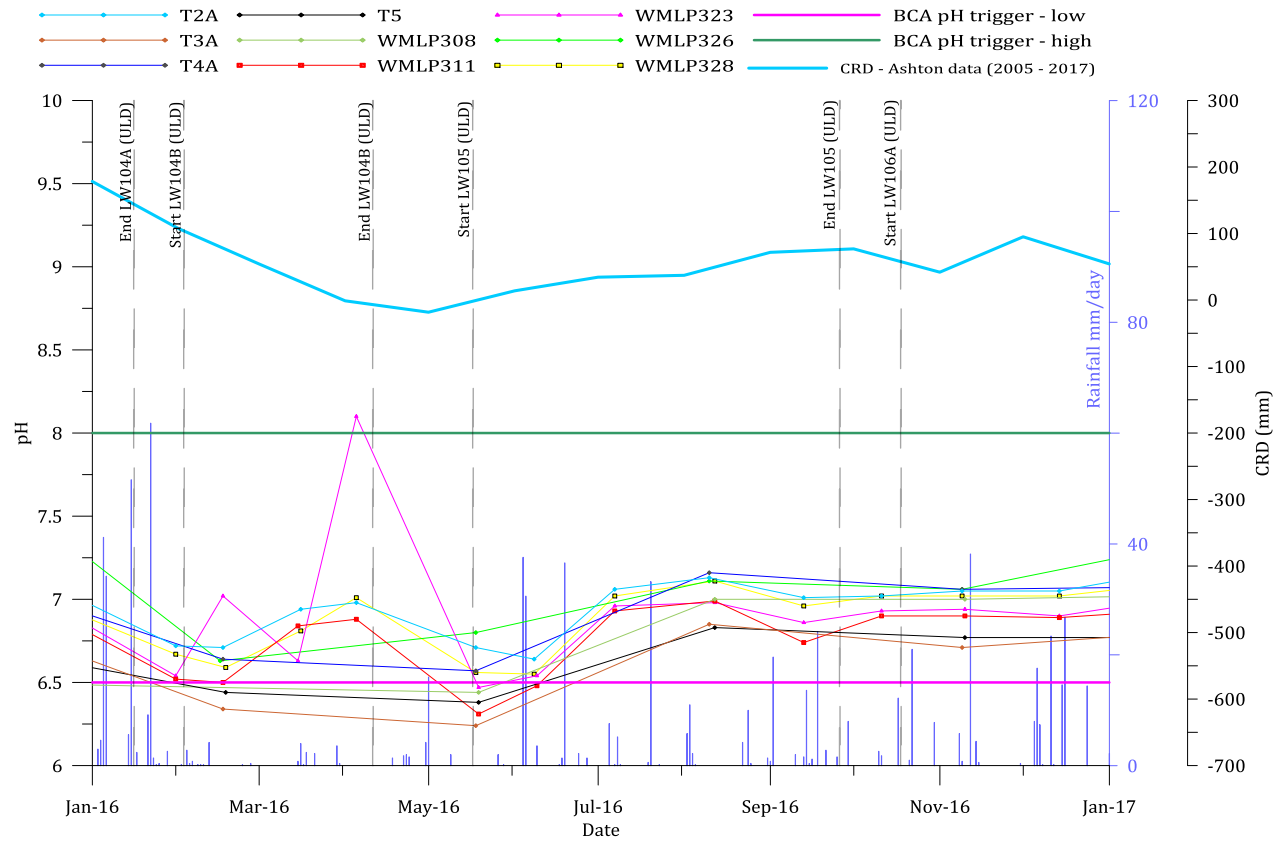


Figure 5-1 BCA pH trends

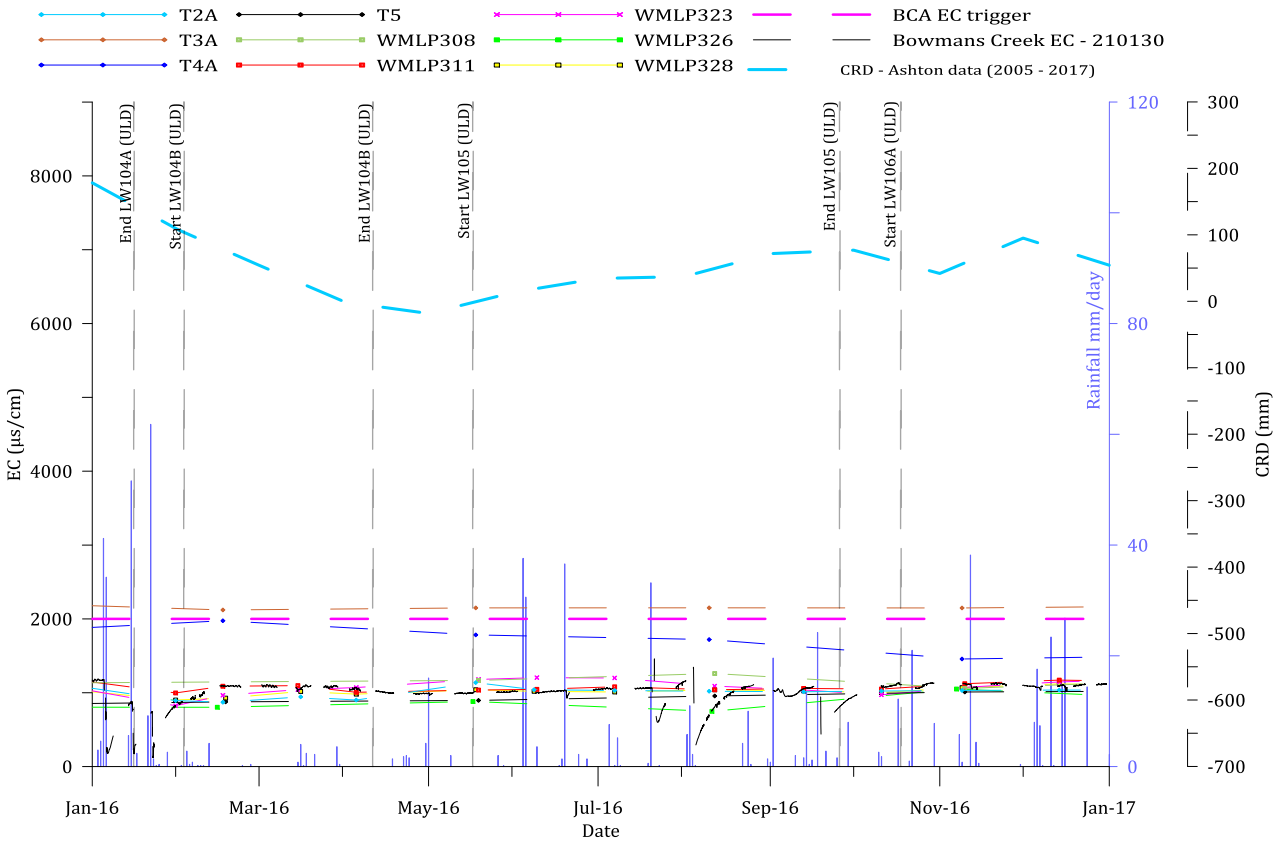


Figure 5-2 BCA EC trends

5.2 GCA monitoring bores

The GCA pH and EC monitoring data is presented graphically in Figure 5-3 and Figure 5-4, respectively, together with their respective WMP triggers. The observations regarding water quality during the year 2016 are the following:

- GCA pH and EC trends generally correlate with CRD.
- WMLB120B dropped to below the trigger level of 6.2 in June 2016; however, the bore has since stabilised in line with the other bores in this location.
- WML173 exceeded both the pH and EC trigger values in 2016. This bores is the subject of further investigation. WML172 and WML173 have presented pH and EC measurements not typical of the GCA. This review (including review of water levels) has shown WML172 and WML173 to not be representative of the GCA. These bores will be removed from the WMP at the next review.
- No mining related impacts are visible in the groundwater quality trends.

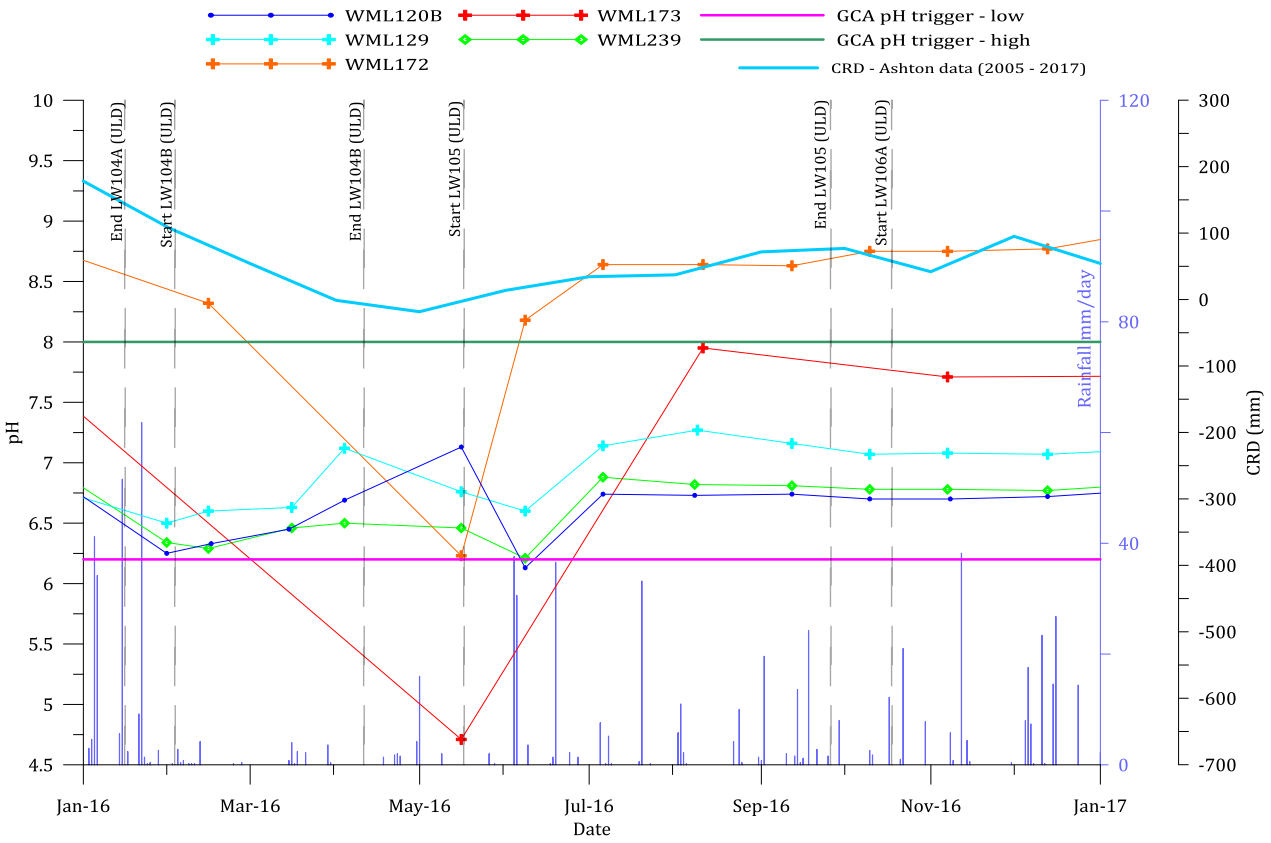


Figure 5-3 GCA pH trends

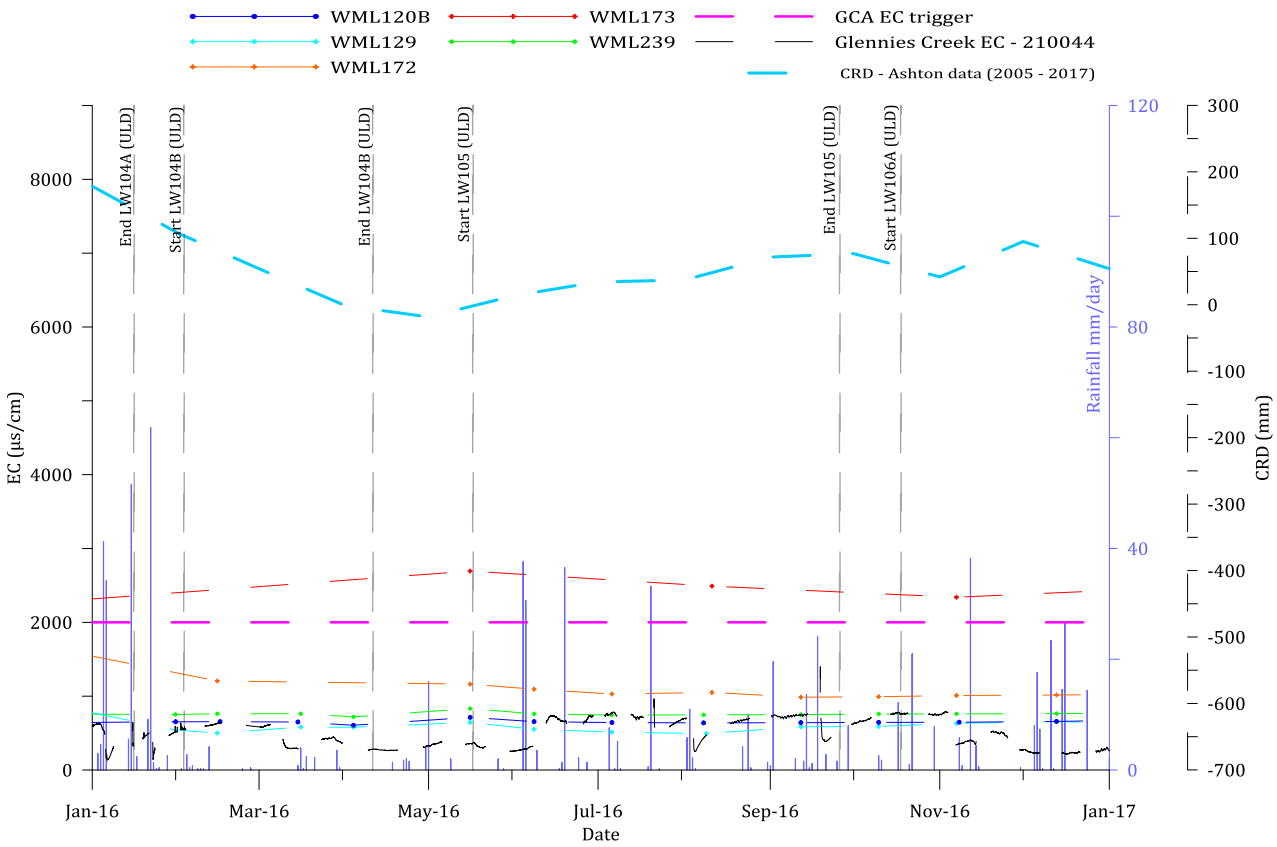


Figure 5-4 GCA EC trends

5.3 HRA monitoring bores

The GCA pH and EC monitoring data is presented graphically in Figure 5-5 and Figure 5-6, respectively, together with their respective WMP triggers. The observations regarding water quality during the year 2016 are the following:

- GCA pH and EC trends display similar trends to each other and are in line with the rainfall.
- WMLP336 (HRA / CMOB) shows the largest variation in pH of all the monitoring bores, with values ranging between 6.05 and 8.92 for the year. This is likely attributable to the bore being screened in the coal measures overburden and possibly close to a coal seam subcrop. WMLP337 displayed a moderate fluctuation in pH over the first half of 2016, whilst the last half of the year saw pH stabilise. WMLP338 showed a trend similar to WMLP337. Both bores exceeded the minimum pH criteria in May 2016.
- HRA bores show variable EC concentrations, with WMLP336 displaying EC values less than 1,000 µS/cm, whilst the latter half of the year saw WMLP337 EC values stabilise around 2,700 µS/cm WMLP336 and WMLP337 EC values generally display a slightly different trend to other HRA monitoring bores. This is a result of screened sections of Hunter River alluvial sandy clay of lower permeability and longer groundwater residence time. Other HRA monitoring bores are screened within higher permeability gravelly sand.
- No mining related impacts are visible in the groundwater quality trends.

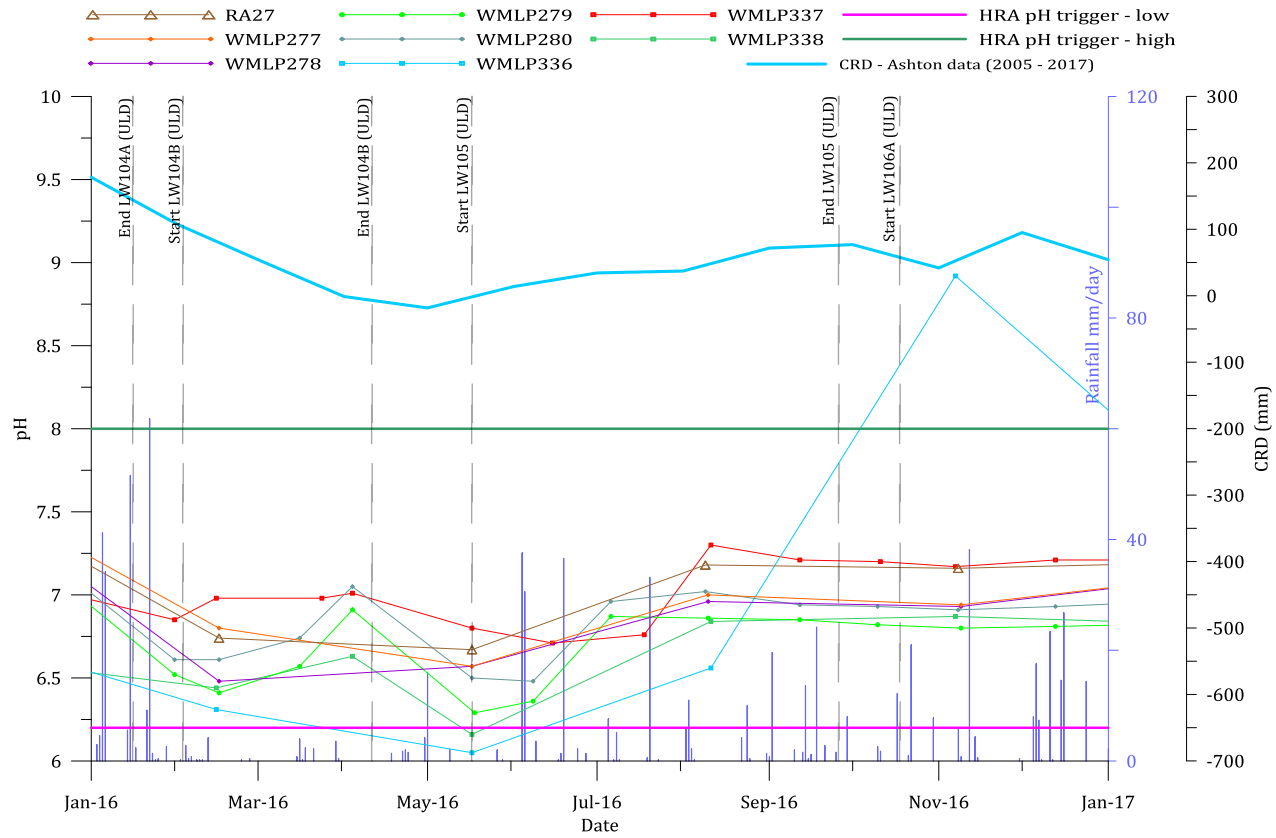


Figure 5-5 HRA pH trends

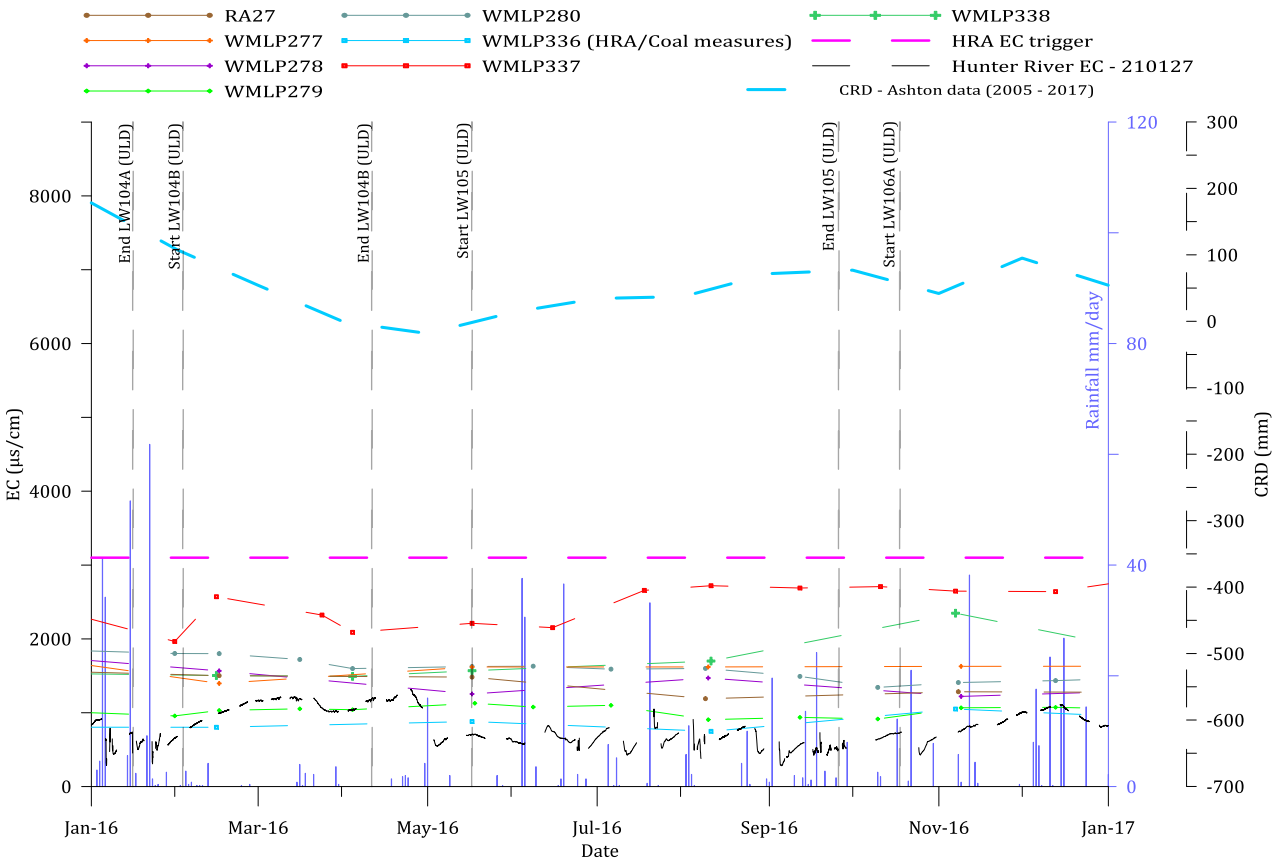


Figure 5-6 HRA EC trends

5.4 Longwall specific bores

The water quality data of a series of BCA and fractured rock monitoring bores over LW6/LW106 is presented graphically in Figure 5-7 and Figure 5-8, respectively. These bores are discussed specifically with the intent to assess for mining related impacts associated directly with the extraction of LW106. The observations regarding water quality during the year 2016 are the following:

- pH trends appear to correlate well with the CRD;
- EC values have remained constant over 2016;
- The WMP was update in May 2016. The monitoring suite for WML327 was changed to water level only and water quality is monitored only annually as of May 2016; and
- No mining related impact are evident in the groundwater quality trends.

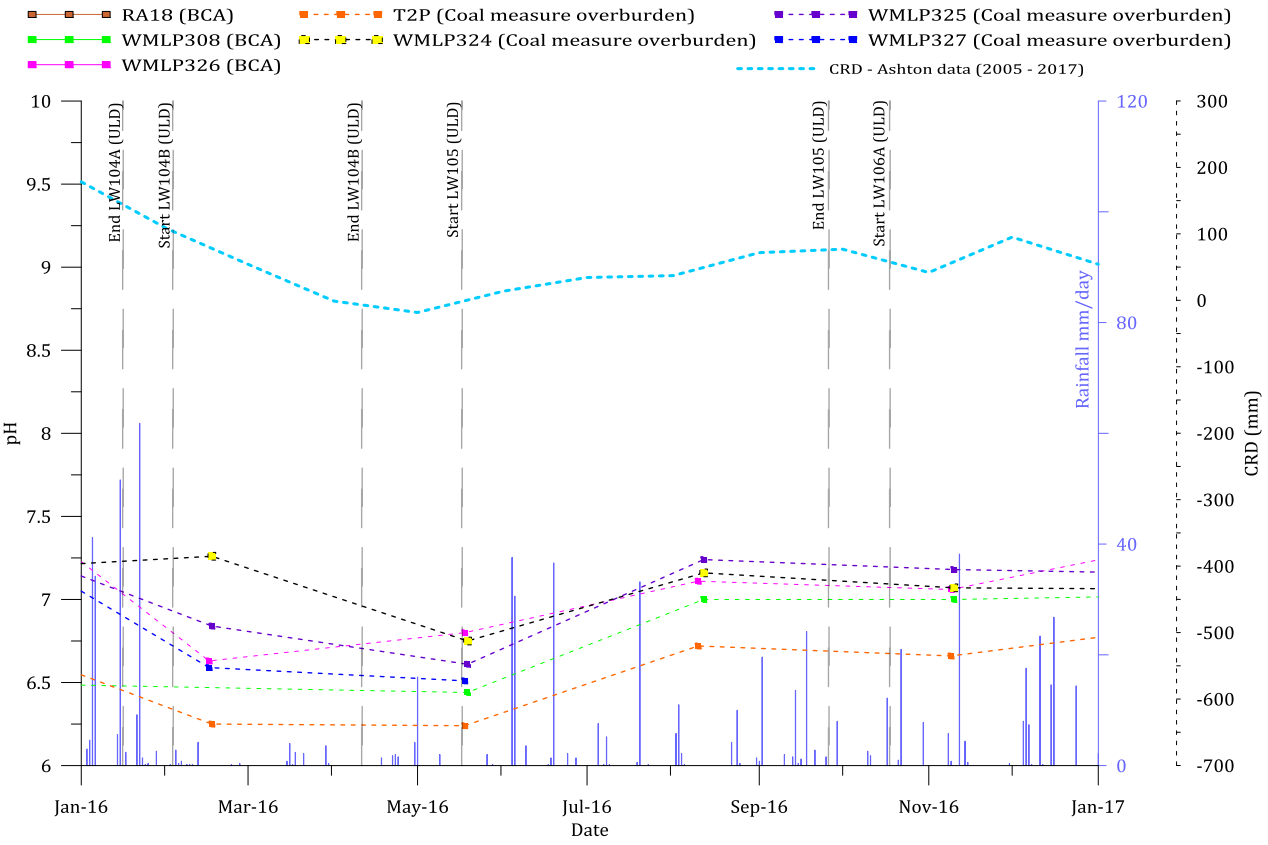


Figure 5-7 Longwall specific bores – pH trends

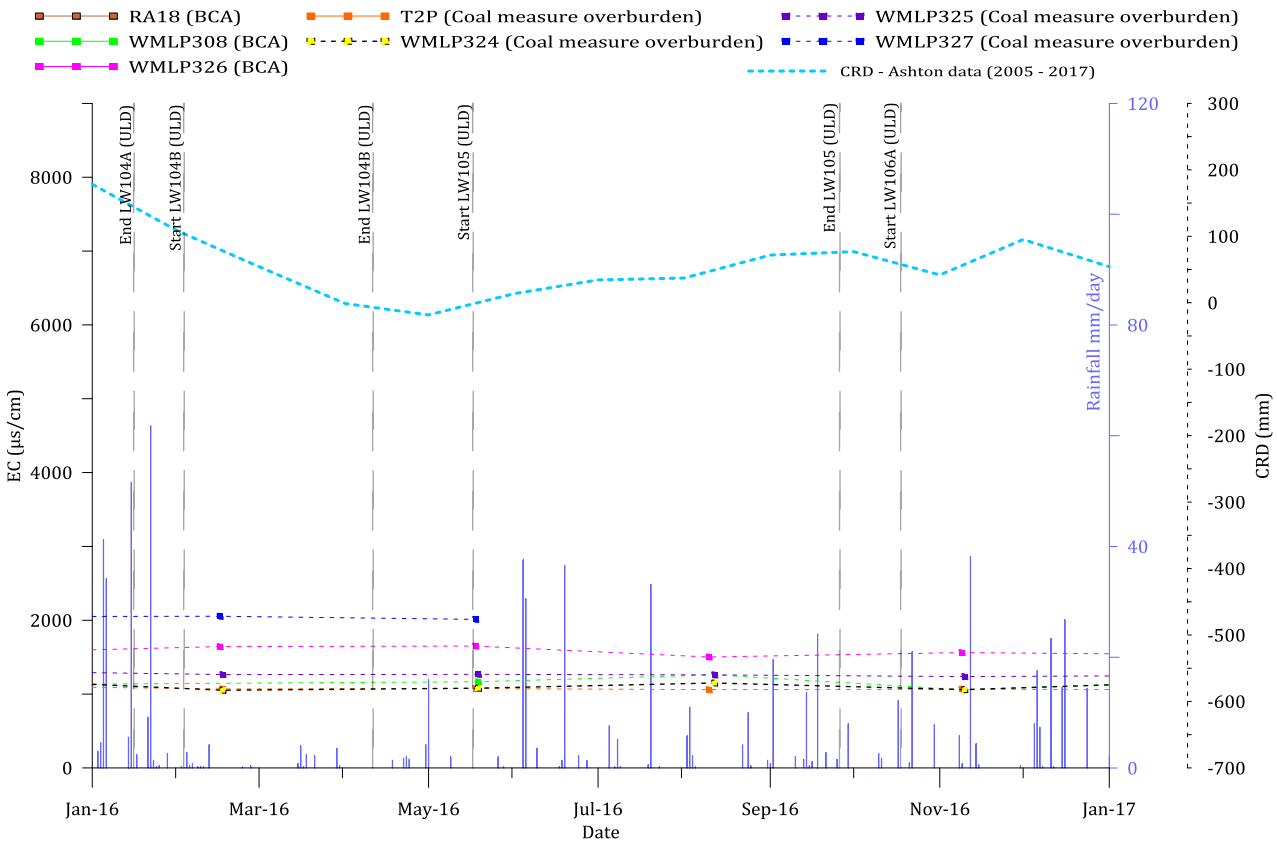


Figure 5-8 Longwall specific bores – EC trends

5.5 Fractured rock bores

The water quality data for fractured rock monitoring bores not discussed in previous sections is presented graphically in Figure 5-9 and Figure 5-10, respectively. The observations regarding water quality during the year 2016 are the following:

- pH trends appear to correlate well with the CRD, with the exception of WML120A and WML261. WML120A (Pikes Gully seam) and WML261 (Upper Liddell seam) show an increase in pH in June 2016. This is not likely to be mining related as the effect is not continuous nor repeated.
- EC values have remained constant over 2016, with the exception of WML181, WML261 and WMLP301. WML181 (PG seam) and WMLP301 (Arties Seam) display a decline in EC. Both seams are likely to be impacted by mining and the decline in EC is likely due to infiltration of less saline water into the seams via the subsidence fracturing. WML261 may be impacted in a similar manner; however, the infiltration of less saline water occurs to a lesser degree and only intermittently (e.g. between Q3 and Q4 of 2016). Also, WMLP301 is a bore that presents very turbid water samples, even after purging. This turbidity may be an indication of poor construction or damage and may be the cause of the declining EC. WML181, WML261 and WMLP301 should be developed, although a low and slow recovering water level is anticipated.

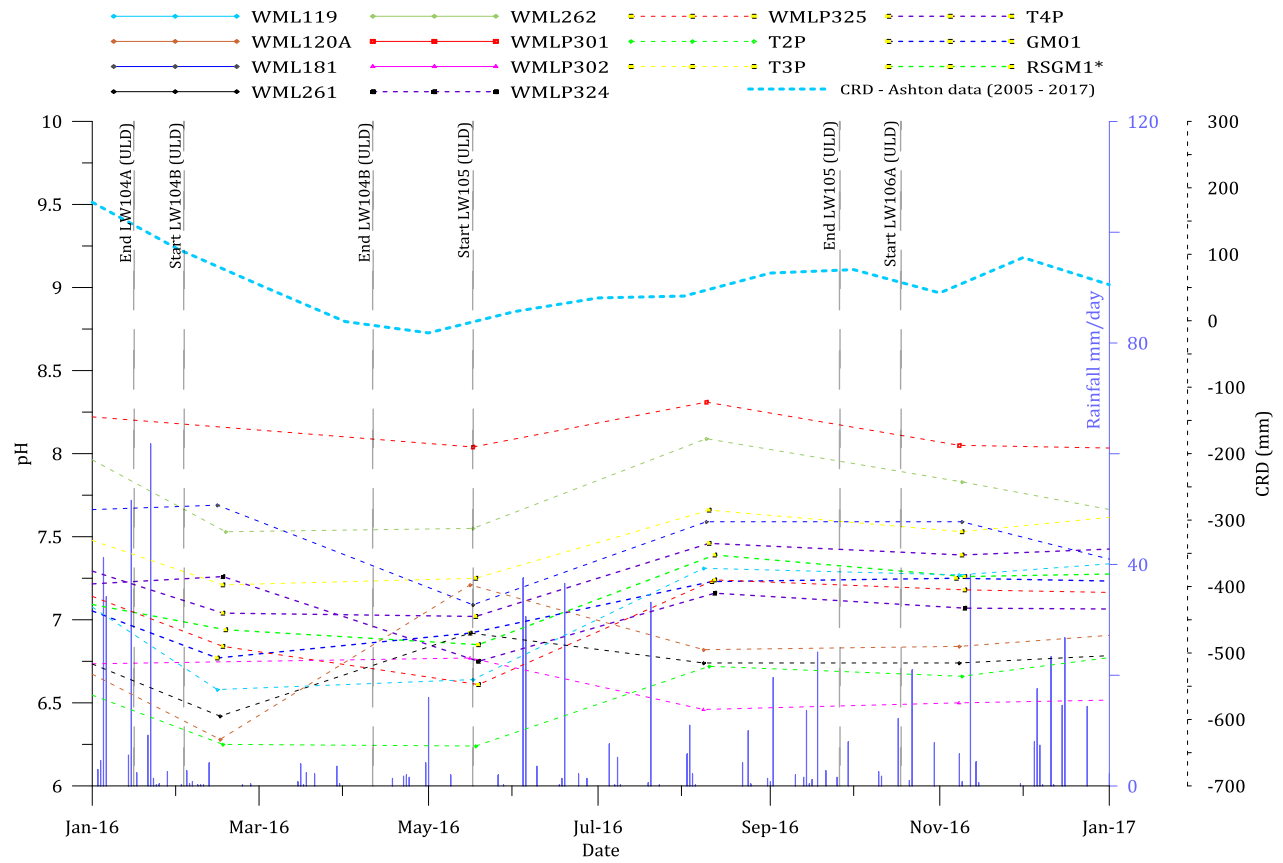


Figure 5-9 Fractured rock bores – pH trends

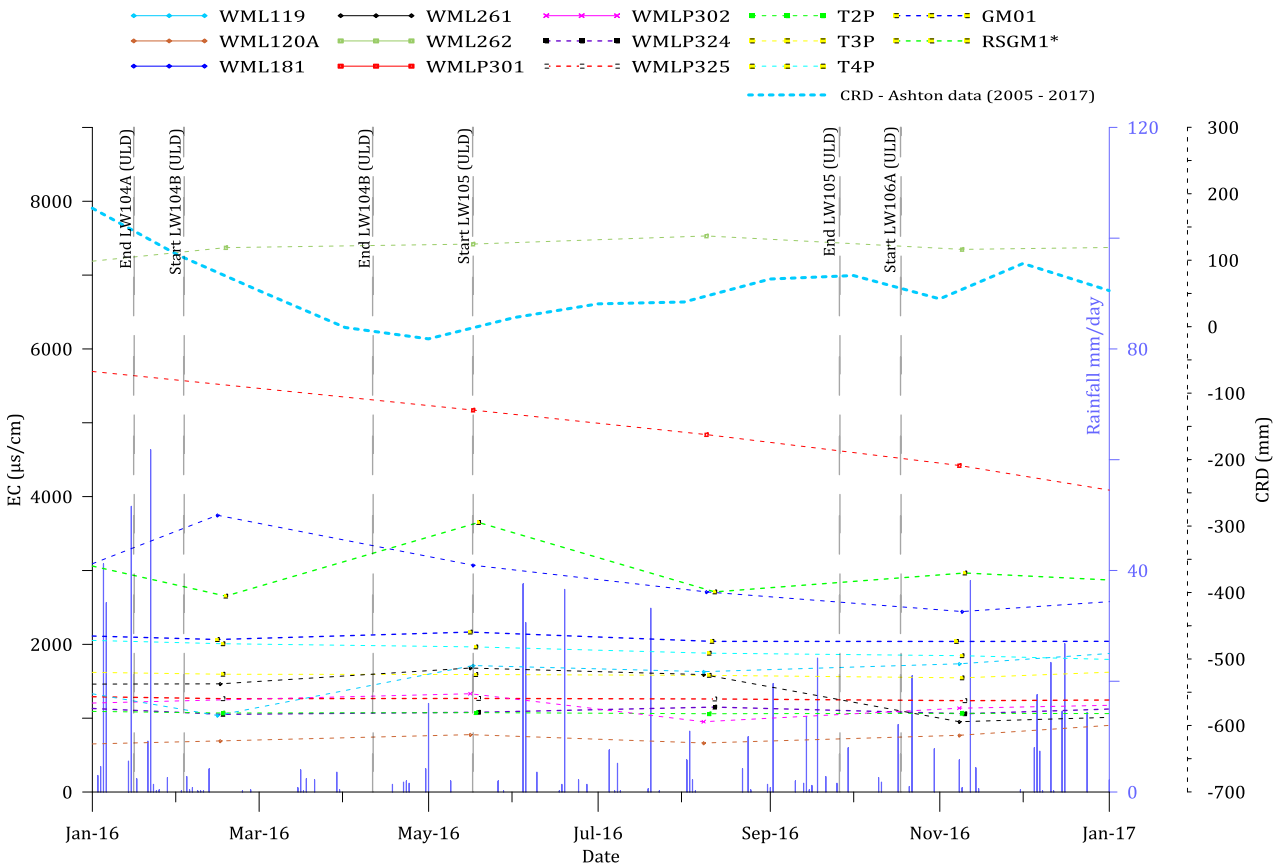


Figure 5-10 Fractured rock bores – EC trends

5.6 Laboratory analysis

Selected monitoring bores are sampled annually for NATA accredited laboratory analysis. The site WMP highlights 43 bores for annual comprehensive analysis and these bores were sampled in August 2016. The list of analytes are summarised in Table 5-1.

Table 5-1 Summary of laboratory analytes

Analysis type	Parameter
Physical parameters	• pH • Electrical conductivity (EC) • Field temperature • Total dissolved solids (TDS) • Turbidity
Cations / Anions / Alkalinity	• Sodium • Magnesium • Potassium • Calcium • Fluoride • Chloride • Sulphate • Total alkalinity • Hardness / alkalinity as HCO^3
Nutrients	• Nitrate • Nitrite • Total nitrogen • Total phosphorous
Metals	• Copper • Lead • Zinc • Nickel • Iron • Manganese • Arsenic • Selenium • Cadmium • Chromium

The laboratory results were compared with the ANZECC Guidelines 2000 for recreational use, livestock and short term irrigation guideline values. The guideline value exceedances are summarised in Table 5-2 and the analysis results are attached in Appendix B.

The groundwater types (cation / anion ratios) are plotted as a piper plot in Figure 5-11.

Table 5-2 ANZECC guideline exceedance summary

Bore ID	Date	Target	Fluoride (mg/L)	Total dissolved solids	EC (µS/cm)
ANZECC livestock			2	*4000**	*5970*
WML262	09/08/2016	Upper Lower Liddell Seam	3	4260	7530
WMLP301	09/08/2016	Arties Seam	-	7780	-

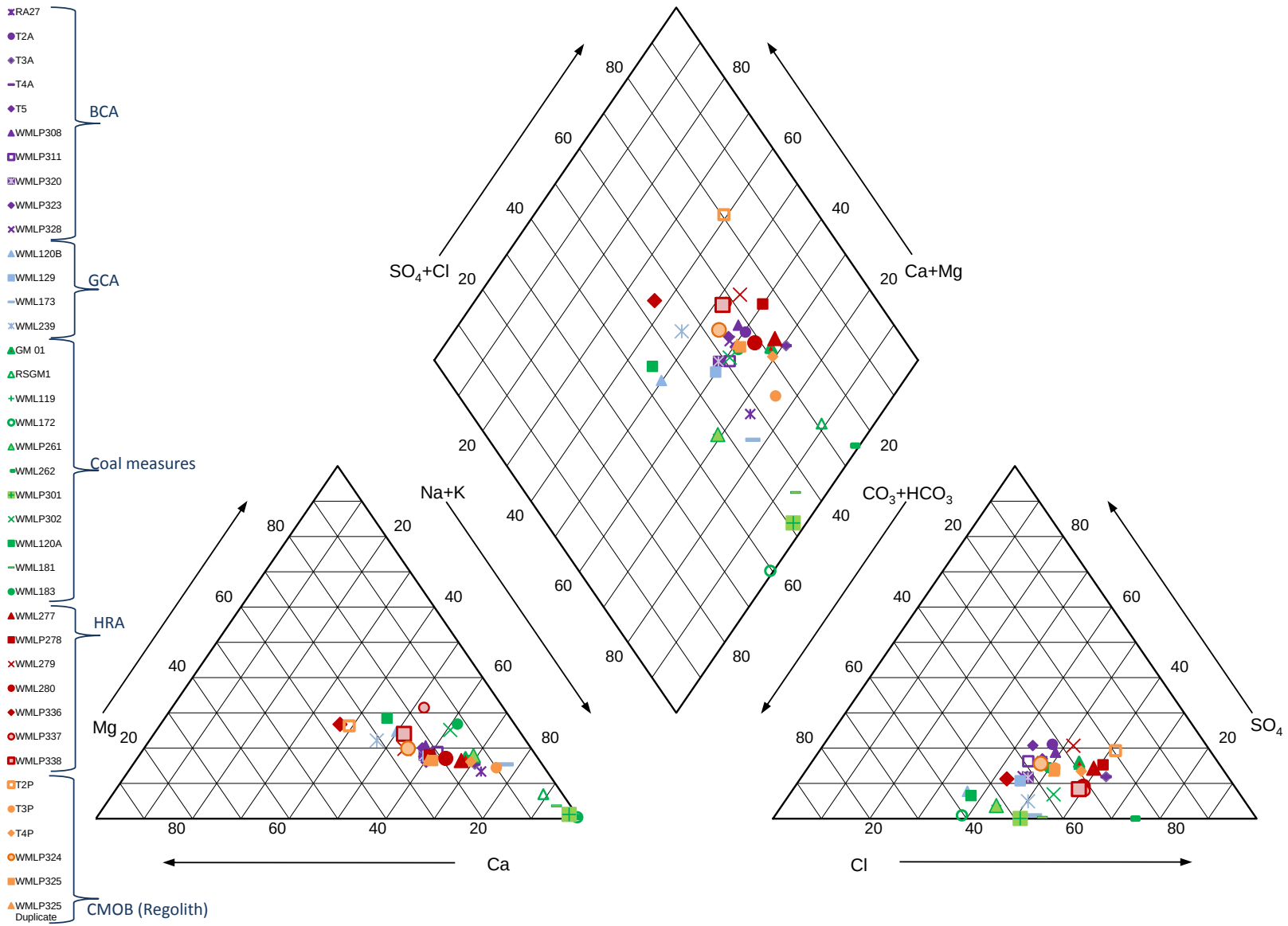


Figure 5-11 Piper plot - 2016

The groundwater quality observations can be summarised as follows:

- Generally, groundwater bores located in the source unit plot close to each other on the piper diagram. This is an indication that the groundwater in each area likely from the same or similar source(s). Exceptions to this are the CM bores that have a more varied water type, indicating that the coal seams have a more varied water source. The coal seam bores are also more Na dominant that the other bores.
- WML120A and WML120B are screened in the GCA and PG, respectively, and have similar chemical composition but differ from the general results from the other monitoring bores. This indicates that, locally, the alluvium and PG are naturally hydraulically connected.
- The BCA bores and the regolith bores are located in the area; however, the groundwater composition is slightly different between the two series of bores. The regolith bores appear to be slightly more Na-Cl water type than the BCA bores. This shows that the BCA bores are recharged predominantly by rainfall and surface runoff, whereas the regolith bores are recharged also from underground sources.
- Overall, monitoring bores within HRA, BCA, CMOB (regolith) and two coal measures have similar water composition (Na-Cl water types) which indicate that there is some mixing of water between the alluvium and the other groundwater bearing units, with the exception of:
    - CMOB (regolith): T4P;
    - Coal Measure: RSGM1 (Bayswater seam beneath BCA), WML181 and WML119 both monitoring bores below the GCA, near the LW101; and
    - BCA: T3A.

These bores are likely not in direct connection with alluvium recharge sources (RSGM1, WML181 and WML119) or close to coal seam groundwater sources (T3A and T4P).

6 Mine inflow

Ashton underground mine inflows are calculated through a review of dewatering abstraction volumes and a water balance assessment. The water balance assessment is the most appropriate tool to assess mine inflows as the volume of abstracted water comprises water from a number of sources, including but not limited to groundwater, surface water, incidental take and groundwater transitioning from the point of entry to the abstraction point. The transition time of this "stored" water is assumed to be in the order of years and is normally not considered inflow that has occurred in the past year. It is considered that the stored water is largely from the groundwater sources (predominantly hardrock) rather than surface water. This year the proportion of abstracted water that is understood to have in-flowed prior to 2016 is small (in the order of 16 ML). For the purposes of the water balance, the stored water volume has not been deducted from the incidental take, as with previous years, and is included in the 2016 take.

Data utilised in the assessment includes:

- metered water volumes pumped to the mine from the various sources;
- metered water abstracted from the mine;
- partitioned water takes from the surface water sources and the separate groundwater sources; and
- estimate of stored water pumped from the mine.

These volumes are summarised in Table 6-1. In 2016, Ashton pumped a total of 415 ML of incidental water take that is considered to have entered the mine from the groundwater source. A small proportion of this water is likely to have been stored in the goaf since prior to 2016.

The inflow rate of the incidental take is 13.1 L/s, which is slightly above the modelled inflow of 13 L/sec.

Table 6-1 Breakdown of abstracted water volumes

Water source		Volume (ML)	
Total water abstracted from mine	Mine water input	182	596
	Abstracted groundwater (Total Incidental Water Take)	415	

7 Conclusions

The key points of the annual groundwater monitoring review can be summarised as follows:

- No groundwater level within the alluvium was recorded below the triggers value.
- Two monitoring bores exceeded the WMP water quality trigger values. T3A EC levels are higher than other BCA EC levels. The results are within historic ranges and appear to correlate loosely with CRD. No mining impacts are evident in the EC trend in T3A. The EC trend in this bore is subject of further investigation and the BCA trigger values will be reviewed in the next review of the WMP. WML173 exceeded both the pH and EC trigger values in 2016. This bore is the subject of further investigation. WML172 and WML173 pH and EC measurements are not typical of the GCA and should be removed from the WMP.
- Annual groundwater laboratory analysis results showed some minor exceedances of the ANZECC (2000) criteria for fluoride, TDS and EC. These exceedances are not likely to be a result of mining related impacts.
- Direct rainfall recharge within the alluvium are observed on all the sites, the overburden on the north east and the PG and Arties seams west of the underground.
- High level of inferred hydraulic connection between the Glennies Creek alluvium and Pikes Gully seam on the eastern part of the underground mine, which does not translate as observed inflows into the underground mine.
- Groundwater conditions to the east of LW01 have recovered from the impacts of underground mining. The stabilisation of the groundwater pressures between the GCA and the PG seam indicates that the groundwater gradient has returned to a pre-mining state.
- Groundwater level variations were noted in the seams from Lemington 19 to Upper Liddell on the south side of the underground working area. The variations in head pressures are likely due to the mining related subsidence.
- Groundwater level variations were noted in the majority of monitoring locations targeting the Upper Liddell seam.
- Estimated groundwater inflows are slightly above the modelled inflow.

In conclusion, during the year 2016, there was no groundwater impact related to mining exceeding the predicted impacts from the Bowman's Creek Diversion Environmental Assessment (BCD EA). The BCD EA is key to the requirement of the DA Condition. The impact of the pumping and ground subsidence related to mining in the ULD extends to the Lemington seam plies in the south part of the mine.

8 References

Australian and New Zealand Environment and Conservation Council, "*Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 1*", The Guidelines (chapter 1-7), October 2000

Ashton Coal, "*Water Management Plan, HSEC Management System-Plan*", Doc No. 3.4.1.8, November 2015

Australasian Groundwater and Environmental Consultants Pty Ltd, "*Groundwater Inflow Assessment and Monitoring Network Review*", Project No. G1738, June 2015

Australasian Groundwater and Environmental Consultants Pty Ltd, "*Ashton End of Panel Report _LW103",* Project No. G1738, October 2015

Australasian Groundwater and Environmental Consultants Pty Ltd, "*December 2015 Groundwater Monitoring Report*", Project No. G1758, December 2015

RPS, "*Ashton Coal Groundwater Model update*", May 2014

Office of Water NSW, Real-time data, Rivers and Streams
http://realtimedata.water.nsw.gov.au/water.stm?ppbm=DAILY_REPORTS&dr&3&drkd_url

Appendix A Summary of Water Management Plan - Monitoring Locations

Table A 1 GWMP monitoring bore locations

Monitoring target	Bore	Easting (MGA94 Zone56)	Northing (MGA94 Zone56)	Collar (mAHD)
Bowmans Creek Alluvium (BCA)	RSGM1	317655	6406302	65.6
Bowmans Creek Alluvium (BCA)	T2-A	317583.4*	6405217.4*	60.7*
Bowmans Creek Alluvium (BCA)	T3-A	317654.2*	6404708.1*	59.6*
Bowmans Creek Alluvium (BCA)	T4-A	317686.1*	6404323.2*	58.2*
Bowmans Creek Alluvium (BCA)	T5	317946	6406549.4	65.33
Bowmans Creek Alluvium (BCA)	WMLP311	318179	6406048	63.64
Bowmans Creek Alluvium (BCA)	WMLP323	318242	6406595	64.47
Bowmans Creek Alluvium (BCA)	WMLP326	317571	6404103	59.29
Bowmans Creek Alluvium (BCA)	WMLP328	317927	6405611	62.76
Glennies Creek Alluvium (GCA)	WML120B	319294	6404588	60.12
Glennies Creek Alluvium (GCA)	WML129	319468	6403528	55.34
Glennies Creek Alluvium (GCA)	WML172	319997	6405775	65.77
Glennies Creek Alluvium (GCA)	WML239	319345	6404045	60.14
Glennies Creek Alluvium (GCA)	WMLP336	318965	6402842	60.64
Hunter River Alluvium (HRA)	RA27	317952	6403738	59.79
Hunter River Alluvium (HRA)	WML277	317643	6403958	60.184
Hunter River Alluvium (HRA)	WML278	317626	6403894	59.916
Hunter River Alluvium (HRA)	WML279	317299	6403992	62.196
Hunter River Alluvium (HRA)	WML280	317798	6403793	59.92
Hunter River Alluvium (HRA)	WMLP337	318418	6403129	59.9
Hunter River Alluvium (HRA)	WMLP338	318625	6402794	58.8
Coal Measures	GM01	319266	6406944	73.44
Coal Measures	WML119	319255	6403930	75.5
Coal Measures	WML120A	319292	6404580	61.5
Coal Measures	WML173	320004	6405767	64.71
Coal Measures	WML181	319215	6403958	59
Coal Measures	WML183	319188	6404325	71.8
Coal Measures	WML261	319320	6404706	62.40
Coal Measures	WML262	319220	6403928	63.2
Coal Measures – VWP	WMLP334	318589	6403087	75.92
Coal Measures – VWP	WMLP362	317744	6405963	63.95
Coal Measures – VWP	WMLP363	317694	6404635	59.8
Permian Overburden (regolith)	RM02	317942	6404506	61.05
Permian Overburden (regolith)	RM10	317585.9^	6405291.4^	61.55

Monitoring target	Bore	Easting (MGA94 Zone56)	Northing (MGA94 Zone56)	Collar (mAHD)
Permian Overburden (regolith)	T2-P	317587.2*	6405222.4*	60.8*
Permian Overburden (regolith)	T3-P	317650.1*	6404701.6*	59.6*
Permian Overburden (regolith)	T4-P	317682.6*	6404319.1*	58.2*
Permian Overburden (regolith)	WMLP324	318240	6406594	64.5
Permian Overburden (regolith)	WMLP325	318181	6406050	64.5
Permian Overburden (regolith)	WMLP327	317573	6404103	64.5

** Resurveyed post mining ^ Field coordinates not surveyed*

Table A 2 GWMP monitoring bore / VWP locations (Longwall panel specific monitoring)

Monitoring target	Bore	Easting (MGA94 Zone56)	Northing (MGA94 Zone56)	Collar (mAHD)
Alluvium	Ashton well	318355	6406029	62
Alluvium	RA18	317821.8*	6405434.2*	62.6*
Alluvium	RA27	317952	6403738	59.79
Alluvium	WMLP308	318223	6406373	65.69
Alluvium	WMLP320	317457	6405388	61.5
Alluvium	WMLP326	317571	6404103	59.82
Coal Measures	WML262	319220	6403928	63.2
Coal Measures	WMLP301	319235	6403858	60.2
Coal Measures	WMLP302	319300	6404600	59.7
Permian Overburden (regolith)	T2-P	317587.2*	6405222.4*	60.8*
Permian Overburden (regolith)	WMLP324	318240	6406594	64.5
Permian Overburden (regolith)	WMLP325	318181	6406050	64.5
Permian Overburden (regolith)	WMLP327	317573	6404103	64.5
Coal Measures – VWP	WML213	317210	6404154	61.5
Coal Measures – VWP	WMLC334	318588.9	6403087.6	75.92
Coal Measures – VWP	WMLC335	318892	6402936	64.53
Coal Measures – VWP	WMLP361	317744	6405963	63.95
Coal Measures – VWP	WMLP362	317694	6404635	59.8
Coal Measures – VWP	WMLP363	317944	6406442	66

Table A 3 Summary of monthly groundwater monitoring program

Bore ID	Data logger	Bore purpose	Lithology	Parameters
Ashton Well	No	Piezometer	Bowman's Creek alluvium	Water level only
GM01	No	Piezometer	Coal measures	Water level only
RA18	No	Piezometer	Bowman's Creek alluvium	Water level only
RA27 (WML179)	No	Piezometer	Hunter River alluvium	Water level only
RSGM1*	No	Piezometer	Coal measures	Water level only
T2A	Yes	Piezometer	Bowman's Creek alluvium	Water level and field parameters
T2P	No	Piezometer	Coal measures overburden	Water level only
T3A	No	Piezometer	Bowman's Creek alluvium	Water level only
T3P	No	Piezometer	Coal measures overburden	Water level only
T4A	No	Piezometer	Bowman's Creek alluvium	Water level only
T4P	No	Piezometer	Coal measures overburden	Water level only
T5*	No	Piezometer	Bowman's Creek alluvium	Water level only
WML119	No	Piezometer	Pikes Gully	Water level only
WML120A	No	Piezometer	Pikes Gully	Water level only
WML120B	Yes	Piezometer	Glennies Creek alluvium	Water level and field parameters
WML129	No	Piezometer	Glennies Creek alluvium	Water level and field parameters
WML172*	Yes	Piezometer	Glennies Creek alluvium	Water level and field parameters
WML173	No	Piezometer	Glennies Creek	Water level only
WML181	No	Piezometer	Pikes Gully	Water level only
WML213	No	VWP†	BW, Lem8-9, Lem15, Lem19, PG ULD, ULLD, LB	Pressure head
WML239	No	Piezometer	Glennies Creek alluvium	Water level and field parameters
WML261	No	Piezometer	Upper Liddell	Water level only
WML262	No	Piezometer	Upper Liddell	Water level only
WMLP277	No	Piezometer	Hunter River alluvium	Water level only
WMLP278	No	Piezometer	Hunter River alluvium	Water level only
WMLP279	Yes	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP280	Yes	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP301	No	Piezometer	Arties	Water level only
WMLP302	No	Piezometer	Arties	Water level only
WMLP308	No	Piezometer	Bowman's Creek alluvium	Water level only
WMLP311	Yes	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLP320	No	Piezometer	Bowman's Creek alluvium	Water level only

Bore ID	Data logger	Bore purpose	Lithology	Parameters
WMLP323	Yes	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLP324	No	Piezometer	Coal measures overburden	Water level only
WMLP325	No	Piezometer	Coal measures overburden	Water level only
WMLP326	No	Piezometer	Bowman's Creek alluvium	Water level only
WMLP327	No	Piezometer	Coal measures overburden	Water level only
WMLP328	Yes	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLC334	No	VWP†	Lem10, Lem15, Lem19, ART, ULD, ULLD, UB, LB	Pressure head
WMLC335	No	VWP†	Lem15A, Lem17, UPG, ART, ULD, ULLD, UB, LB	Pressure head
WMLP336	No	Piezometer	Hunter River alluvium / Coal measures	Water level only
WMLP337	No	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP338	No	Piezometer	Hunter River alluvium	Water level only
WMLP361	No	VWP†	Lem5-6, ULD, ART, Lem 15A, Lem 8	Pressure head
WMLP362	No	VWP†	Coal measures	Pressure head
WMLP363	Yes	VWP†	COB, Lem6, Lem7, Lem 8, Lem 13, Lem15, Lem19, ART	Pressure head

Note: **Per EPL 11879 † Vibrating Wire Piezometer*

Table A 4 Summary of quarterly groundwater monitoring program

Bore ID	Data logger	Bore purpose	Lithology	Parameters
Ashton Well	No	Piezometer	Bowman's Creek alluvium	Water level only
GM01	No	Piezometer	Coal measures	Water level and field parameters
RA02*	No	Piezometer	Bowman's Creek alluvium / Coal measures	Water level and field parameters
RA18	No	Piezometer	Bowman's Creek alluvium	Water level only
RA27 (WML179)	No	Piezometer	Hunter River alluvium	Water level and field parameters
RM01*	No	Piezometer	Bowman's Creek alluvium	Water level and field parameters
RM03*	No	Piezometer	Bowman's Creek alluvium / Coal measures	Water level and field parameters
RSGM1*	No	Piezometer	Coal measures	Water level and field parameters
T2A	Yes	Piezometer	Bowman's Creek alluvium	Water level and field parameters
T2P	No	Piezometer	Coal measures overburden	Water level and field parameters
T3A	No	Piezometer	Bowman's Creek alluvium	Water level and field parameters
T3P	No	Piezometer	Coal measures overburden	Water level and field parameters

Bore ID	Data logger	Bore purpose	Lithology	Parameters
T4A	No	Piezometer	Bowman's Creek alluvium	Water level and field parameters
T4P	No	Piezometer	Coal measures overburden	Water level and field parameters
T5*	No	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WML119	No	Piezometer	Pikes Gully	Water level and field parameters
WML120A	No	Piezometer	Pikes Gully	Water level and field parameters
WML120B	Yes	Piezometer	Glennies Creek alluvium	Water level and field parameters
WML129	No	Piezometer	Glennies Creek alluvium	Water level and field parameters
WML172*	Yes	Piezometer	Glennies Creek alluvium	Water level and field parameters
WML173	No	Piezometer	Glennies Creek	Water level and field parameters
WML181	No	Piezometer	Pikes Gully	Water level and field parameters
WML213	No	VWP	BW, Lem8-9, Lem15, Lem19, PG ULD, ULLD, LB	Pressure head
WML239	No	Piezometer	Glennies Creek alluvium	Water level and field parameters
WML261	No	Piezometer	Upper Liddell	Water level and field parameters
WML262	No	Piezometer	Upper Liddell	Water level and field parameters
WMLP277	No	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP278	No	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP279	Yes	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP280	Yes	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP301	No	Piezometer	Arties	Water level and field parameters
WMLP302	No	Piezometer	Arties	Water level and field parameters
WMLP308	No	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLP311	Yes	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLP320	No	Piezometer	Bowman's Creek alluvium	Water level only
WMLP323	Yes	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLP324	No	Piezometer	Coal measures overburden	Water level and field parameters
WMLP325	No	Piezometer	Coal measures overburden	Water level and field parameters
WMLP326*	No	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLP327	No	Piezometer	Coal measures overburden	Water level only

Bore ID	Data logger	Bore purpose	Lithology	Parameters
WMLP328	Yes	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLC334	No	VWP	Lem10, Lem15, Lem19, ART, ULD, ULLD, UB, LB	Pressure head
WMLC335	No	VWP	Lem15A, Lem17, UPG, ART, ULD, ULLD, UB, LB	Pressure head
WMLP336	No	Piezometer	Hunter River alluvium / Coal measures	Water level and field parameters
WMLP337	No	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP338	No	Piezometer	Hunter River alluvium	Water level and field parameters
WMLP361	No	VWP	Lem5-6, ULD, ART, Lem 15A, Lem 8	Pressure head
WMLP362	No	VWP	Coal measures	Pressure head
WMLP363	Yes	VWP	COB, Lem6, LEm7, Lem 8, Lem 13, Lem15, Lem19, ART	Pressure head

Note: **Per EPL 11879*

Table A 5 Summary of annual groundwater monitoring program

Ashton Well	Datalogger	Piezometer	Bowman's creek alluvium	Water level only
GM01	No	Piezometer	Coal measures	Water level, field parameters and comprehensive analysis
RA02*	No	Piezometer	Bowman's Creek alluvium / Coal measures	Water level and field parameters
RA18	No	Piezometer	Bowman's Creek alluvium	Water level only
RA27 (WML179)	No	Piezometer	Hunter River alluvium	Water level, field parameters and comprehensive analysis
RM01*	No	Piezometer	Bowman's Creek alluvium	Water level and field parameters
RM03*	No	Piezometer	Bowman's Creek alluvium / Coal measures	Water level and field parameters
RSGM1*	No	Piezometer	Coal measures	Water level, field parameters and comprehensive analysis
T2A	Yes	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
T2P	No	Piezometer	Coal measures overburden	Water level, field parameters and comprehensive analysis
T3A	No	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
T3P	No	Piezometer	Coal measures overburden	Water level, field parameters and comprehensive analysis
T4A	No	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
T4P	No	Piezometer	Coal measures overburden	Water level, field parameters and comprehensive analysis
T5*	No	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
WML119	No	Piezometer	Pikes Gully	Water level, field parameters and comprehensive analysis

Ashton Well	Datalogger	Piezometer	Bowman's creek alluvium	Water level only
WML120A	No	Piezometer	Pikes Gully	Water level, field parameters and comprehensive analysis
WML120B	Yes	Piezometer	Glennies Creek alluvium	Water level, field parameters and comprehensive analysis
WML129	No	Piezometer	Glennies Creek alluvium	Water level, field parameters and comprehensive analysis
WML172*	Yes	Piezometer	Glennies Creek alluvium	Water level, field parameters and comprehensive analysis
WML173	No	Piezometer	Glennies Creek	Water level, field parameters and comprehensive analysis
WML181	No	Piezometer	Pikes Gully	Water level, field parameters and comprehensive analysis
WML213	No	VWP	BW, Lem8-9, Lem15, Lem19, PG ULD, ULLD, LB	Pressure head
WML239	No	Piezometer	Glennies Creek alluvium	Water level, field parameters and comprehensive analysis
WML261	No	Piezometer	Upper Liddell	Water level, field parameters and comprehensive analysis
WML262	No	Piezometer	Upper Liddell	Water level, field parameters and comprehensive analysis
WMLP277	No	Piezometer	Hunter River alluvium	Water level, field parameters and comprehensive analysis
WMLP278	No	Piezometer	Hunter River alluvium	Water level, field parameters and comprehensive analysis
WMLP279	Yes	Piezometer	Hunter River alluvium	Water level, field parameters and comprehensive analysis
WMLP280	Yes	Piezometer	Hunter River alluvium	Water level, field parameters and comprehensive analysis
WMLP301	No	Piezometer	Arties	Water level, field parameters and comprehensive analysis
WMLP302	No	Piezometer	Arties	Water level, field parameters and comprehensive analysis
WMLP308	No	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
WMLP311	Yes	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
WMLP320	No	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
WMLP323	Yes	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
WMLP324	No	Piezometer	Coal measures overburden	Water level, field parameters and comprehensive analysis
WMLP325	No	Piezometer	Coal measures overburden	Water level, field parameters and comprehensive analysis
WMLP326*	No	Piezometer	Bowman's Creek alluvium	Water level and field parameters
WMLP327	No	Piezometer	Coal measures overburden	Water level only
WMLP328	Yes	Piezometer	Bowman's Creek alluvium	Water level, field parameters and comprehensive analysis
WMLC334	No	VWP	Lem10, Lem15, Lem19, ART, ULD, ULLD, UB, LB	Pressure head
WMLC335	No	VWP	Lem15A, Lem17, UPG, ART, ULD, ULLD, UB, LB	Pressure head

Ashton Well	Datalogger	Piezometer	Bowman's creek alluvium	Water level only
WMLP336	No	Piezometer	Hunter River alluvium / Coal measures	Water level, field parameters and comprehensive analysis
WMLP337	No	Piezometer	Hunter River alluvium	Water level, field parameters and comprehensive analysis
WMLP338	No	Piezometer	Hunter River alluvium	Water level, field parameters and comprehensive analysis
WMLP361	No	VWP	Lem5-6, ULD, ART, Lem 15A, Lem 8	Pressure head
WMLP362	No	VWP	Coal measures	Pressure head
WMLP363	No	VWP	COB, Lem6, Lem7, Lem 8, Lem 13, Lem15, Lem19, ART	Pressure head

Note: **Per EPL 11879*

Appendix B Summary of Annual Comprehensive Groundwater Analysis

Sample ID	Date	pH value (lab)	EC µS/cm*	Total Dissolved Solids	Turbidity	Hydroxide Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Bicarbonate Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Sodium	Potassium	Arsenic	Cadmium	Chromium	Copper	Lead	Manganese	Nickel	Selenium	Zinc	Iron	Total Cyanide	Fluoride	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Kjeldahl Nitrogen as N	Total Nitrogen as N	Total Phosphorus as P	Total Anions	Total Cations	Ionic Balance
ANZECC livestock **(mg/L)**			*5970**	4000						1000		1000				0.5	0.01	1	1	0.1		1	0.02	20			2	30	1500							
GM01	11/08/2016	7.23	2040	1240	9.3	0.5	0.5	359	359	160	404	56	40	293	2	0.0010	0.00005	0.0005	0.0005	0.0005	0.37	0.0010	0.005	0.0025	0.620	0.002	0.3	0.01	0.07	0.07	0.5	0.6	0.04	21.9	18.9	7.4
RA 27	9/08/2016	7.18	1190	775	1950	0.5	0.5	291	291	65	183	32	19	196	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.06	0.0010	0.005	0.0025	0.025	0.002	0.4	0.01	0.77	0.77	3.4	4.2	2.80	12.3	11.7	2.7
RSGM 1	12/08/2016	7.39	2710	1680	539	0.5	0.5	440	440	186	493	21	22	536	0.5	0.0040	0.00005	0.0005	0.0005	0.0005	0.01	0.0020	0.010	0.0025	0.025	0.002	1.1	0.01	0.62	0.62	0.2	0.8	0.29	26.6	26.2	0.8
T2A	10/08/2016	7.13	1020	606	343	0.5	0.5	179	179	94	156	44	22	139	2	0.0005	0.00005	0.0005	0.0005	0.0005	0.01	0.0005	0.005	0.0110	0.025	0.002	0.3	0.01	0.23	0.23	0.2	0.4	0.11	9.9	10.1	0.8
T2P	10/08/2016	6.72	1060	666	6.6	0.5	0.5	117	117	92	215	69	32	89	2	0.0050	0.00005	0.0005	0.0005	0.0005	0.34	0.0005	0.005	0.0270	4.390	0.002	0.1	0.01	0.03	0.03	0.1	0.1	0.01	10.3	10.0	1.6
T3A	10/08/2016	6.85	2150	1400	1890	0.5	0.5	134	134	125	543	55	47	310	0.5	0.0005	0.0001	0.0005	0.0005	0.0005	0.01	0.0005	0.010	0.0080	0.025	0.002	0.4	0.01	1.60	1.60	1.0	2.6	0.74	20.6	20.1	1.2
T3P	10/08/2016	7.66	1580	880	79.7	0.5	0.5	314	314	103	271	33	29	286	3	0.0005	0.00005	0.0005	0.0005	0.0005	0.02	0.0005	0.005	0.0100	0.130	0.002	0.5	0.01	0.04	0.04	0.5	0.5	0.04	16.1	16.6	1.5
T4A	10/08/2016	7.16	1720	1110	8000	0.5	0.5	245	245	91	357	46	31	268	1	0.0020	0.00005	0.0005	0.0005	0.0005	0.71	0.0020	0.005	0.0025	0.060	0.002	0.5	0.01	0.59	0.59	5.6	6.2	4.07	16.9	16.5	1.0
T4P	10/08/2016	7.46	1880	982	12.9	0.5	0.5	320	320	115	360	53	36	292	3	0.0005	0.00005	0.0005	0.0005	0.0005	0.03	0.0005	0.005	0.0025	0.300	0.002	0.5	0.01	0.03	0.03	0.4	0.4	0.03	18.9	18.4	1.5
T5	12/08/2016	6.83	956	614	138	0.5	0.5	184	184	84	130	44	18	128	1	0.0005	0.00005	0.0005	0.0005	0.0005	0.05	0.0020	0.005	0.0310	0.025	0.002	0.2	0.01	0.99	0.99	0.4	1.4	0.07	9.1	9.3	1.0
WML119	8/08/2016	7.31	1630	914	115	0.5	0.5	549	549	31	273	43	36	261	4	0.0005	0.00005	0.0005	0.0005	0.0005	0.10	0.0005	0.005	0.0025	0.060	0.002	0.4	0.01	0.04	0.04	1.7	1.7	0.13	19.3	16.6	7.7
WML120A	8/08/2016	6.82	664	354	7.6	0.5	0.5	195	195	18	77	34	23	70	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.41	0.0010	0.005	0.0250	1.710	0.002	0.5	0.01	0.02	0.02	0.1	0.1	0.05	6.4	6.6	1.5
WML120B	8/08/2016	6.73	638	338	8.2	0.5	0.5	192	192	21	73	32	19	72	0.5	0.0005	0.00005	0.0005	0.004	0.0005	0.01	0.0010	0.005	0.0340	0.100	0.002	0.3	0.01	0.06	0.06	0.1	0.1	0.04	6.3	6.3	0.3
WML129	9/08/2016	7.27	493	314	370	0.5	0.5	107	107	21	66	21	10	63	2	0.0005	0.00005	0.0005	0.0005	0.0005	0.14	0.0010	0.005	0.0025	0.025	0.002	0.2	0.01	0.14	0.14	1.9	2.0	0.54	4.4	4.7	2.5
WML172	11/08/2016	8.64	1050	559	37.1	0.5	22.0	359	381	5	150	0.5	0.5	229	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.00	0.0005	0.005	0.0025	0.025	0.002	1.5	0.01	0.01	0.01	0.6	0.6	0.08	11.8	10.0	8.7
WML173	11/08/2016	7.95	2490	1440	2200	0.5	0.5	706	706	11	485	35	44	415	3	0.0020	0.0002	0.0005	0.0005	0.0005	0.08	0.0005	0.005	0.0025	0.025	0.002	1.4	0.01	0.01	0.01	3.2	3.2	1.26	28.0	23.5	8.8
WML181	9/08/2016	7.59	2710	1430	62.9	0.5	0.5	694	694	5	509	16	12	583	3	0.0005	0.00005	0.0005	0.0005	0.0005	0.02	0.0005	0.020	0.0025	0.025	0.002	1.3	0.01	0.02	0.02	1.1	1.1	0.06	28.3	27.2	2.0
WML227	10/08/2016	7.00	1620	814	16.3	0.5	0.5	246	246	105	320	52	32	248	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.10	0.0030	0.005	0.0290	0.520	0.002	0.6	0.01	0.31	0.31	0.1	0.3	0.09	16.1	16.0	0.4
WML239	8/08/2016	6.82	747	424	86.7	0.5	0.5	195	195	17	128	46	20	80	1	0.0005	0.00005	0.0005	0.002	0.0005	0.02	0.0020	0.005	0.0340	0.025	0.002	0.6	0.01	0.07	0.07	0.1	0.1	0.05	7.9	7.5	2.7
WML278	10/08/2016	6.96	1470	786	5.2	0.5	0.5	204	204	102	299	62	31	194	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.04	0.0020	0.005	0.0300	0.400	0.002	0.3	0.01	0.72	0.72	0.2	0.9	0.06	14.6	14.1	1.9
WML279	10/08/2016	6.86	906	485	12.1	0.5	0.5	138	138	82	152	46	21	108	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.03	0.0020	0.005	0.0220	0.300	0.002	0.2	0.01	0.88	0.88	0.2	1.1	0.06	8.8	8.7	0.2
WML280	9/08/2016	7.02	1600	922	4.3	0.5	0.5	286	286	66	318	59	32	226	0.5	0.0005	0.00005	0.0005	0.0005	0.0005	0.15	0.0020	0.005	0.0240	0.670	0.002	0.4	0.01	0.50	0.50	0.1	0.6	0.09	16.0	15.4	2.1
WML326	10/08/2016	7.11																																		
WMLP183	8/08/2016	7.02	4470	2360	48.4	0.5	0.5	964	964	308	785	112	154	662	8	0.0005	0.00005	0.0005	0.0005	0.0005	0.16	0.0030	0.005	0.0300	0.420	0.002	0.5	0.01	0.03	0.03	1.3	1.3	0.07	47.8	47.3	0.6
WMLP261	8/08/2016	6.74	1590	821	8.2	0.5	0.5	330	330	44	325	40	40	234	3	0.0005	0.00005	0.0005	0.001	0.0005	0.05	0.0005	0.005	0.0220	1.420	0.002	0.4	0.01	0.03	0.03	0.4	0.4	0.03	16.7	15.5	3.5
WMLP262	9/08/2016	8.09	7530	4260	2780	0.5	0.5	1010	1010	0.5	1690	16	4	1610	4	0.0030	0.00005	0.0005	0.0005	0.0005	0.06	0.0020	0.005	0.0025	0.060	0.002	3	0.01	0.04	0.04	6.7	6.7	209.00	67.8	71.3	2.4
WMLP301	9/08/2016	8.31	4840	7780	49200	0.5	49.0	1310	1360	0.5	856	15	7	1090	4	0.0070	0.00005	0.0005	0.0005	0.0005	0.02	0.0020	0.005	0.0025	0.025	0.002	1.6	0.01	0.04	0.04	44.8	44.8	783.00	51.3	48.8	2.5
WMLP302	8/08/2016	6.46	952	476	4	0.5	0.5	214	214	30	177	26	28	127	2	0.0005	0.00005	0.0005	0.0005	0.0005	0.03	0.0005	0.005	0.0430	1.650	0.002	0.3	0.01	0.03	0.03	0.4	0.4	0.04	9.9	9.2	3.8
WMLP308	12/08/2016	7.00	1260	774	165	0.5	0.5	234	234	108	208	53	31	163	2	0.0060	0.00005	0.0005	0.0005	0.0005	0.16	0.0005	0.005	0.0025	0.540	0.002	0.2	0.01	0.17	0.17	1.8	2.0	0.39	12.8	12.3	1.8
WMLP311	12/08/2016	6.99	1040	579	16.5	0.5	0.5	225	225	74	150	40	23	140	2	0.0005	0.00005	0.0005	0.0005	0.0005	0.01	0.0005	0.005	0.0160	0.060	0.002	0.2	0.01	0.21	0.21	0.3	0.5	0.04	10.3	10.0	1.2
WMLP320	12/08/2016	6.94	1160	655	2.3	0.5	0.5	274	274	61	181	53	25	154	2	0.0005	0.00005	0.0005	0.0005	0.0005	0.01	0.0005	0.005	0.0210	0.025	0.002	0.2	0.01	0.15	0.15	0.2	0.4	0.02	11.8	11.4	1.7
WMLP323	12/08/2016	6.98	1090	636	4.9	0.5	0.5	217	217	81	167	48	26	140	2	0.0005	0.00005	0.0005	0.001	0.0005	0.01	0.0005	0.005	0.0140	0.025	0.002	0.3	0.01	0.72	0.72	0.2	0.9	0.01	10.7	10.7	0.3
WMLP324	12/08/2016	7.16	1150	660	5.2	0.5	0.5	239	239	80	180	59	28	144	2	0.0020	0.00005	0.0005	0.0005	0.0005	0.18	0.0005	0.005	0.0150	0.090	0.002	0.2	0.01	0.07	0.07	0.1	0.1	0.01	11.5	11.6	0.2
WMLP325	12/08/2016	7.24	1260	677	6.2	0.5	0.5	248	248	78	213	53	24	168	2	0.0010	0.00005	0.0005	0.0005	0.0005	0.32	0.0005	0.005	0.0130	0.850	0.002	0.4	0.01	0.04	0.04	0.1	0.1	0.04	12.6	12.0	2.5
WMLP328	12/08/2016	7.11	1040	552	11.7	0.5	0.5	209	209	74	160	46	23	134	2	0.0005	0.00005	0.0005	0.0005	0.0005	0.02	0.0005	0.005	0.0230	0.050	0.002	0.2	0.01	0.38	0.38	0.1	0.4	0.02	10.2	10.1	0.8
WMLP333	12/08/2016	7.26	1260	642	5.5	0.5	0.5	250	250	76	213	59	26	177	2	0.0005	0.00005	0.0005	0.0005	0.0005	0.31	0.0005	0.005	0.0170	0.940	0.002	0.4	0.01	0.04	0.04	0.2	0.2	0.05	12.6	12.8	1.0
WMLP336	11/08/2016	6.56	748	494	7.6	0.5	0.5	186	186	36	101	49	22	56	3	0.0005	0.00005	0.0005	0.002	0.0005	0.02	0.0010	0.005	0.0410	0.025	0.002	0.2	0.01	5.64	5.64	1.3	6.9	0.30	7.3	6.8	3.9
WMLP337	11/08/2016	7.30	2720	1850	2700	0.5	0.5	540	540	106	603	85	99	308	4	0.0005	0.00005	0.002	0.0005	0.0005	0.14	0.0040	0.005	0.0260	0.025	0.002	0.4	0.01	0.12	0.12	0.5	0.6	0.21	30.0	25.9	7.4
WMLP338	11/08/2016	6.84	1700	1070	1750	0.5	0.5	332	332	67	351	75	45	183	1	0.0010	0.00005	0.0005	0.0005	0.0005	0.77	0.0040	0.005	0.0150	0.060	0.002	0.5	0.01	0.23	0.23	0.8	1.0	0.14	17.9	15.4	7.5

Appendix C WML172 and WML173 Geological logs

BORE NAME: White Mining Ltd WML172 PAGE 1

GEOLOGICAL DESCRIPTION OF STRATA		EST'THICK.	EST.DEPTH	RECOVERED	REMARKS
SOIL	light orange, clayey, low strength.	1.000	1.000	0.000	Spud 27/02/2007
COAL	Weathered.	1.000	2.000	0.000	LLLD
CLAY	light orange cream, weathered, low strength.	5.000	7.000	0.000	Base of weathering
COAL	Undifferentiated.	2.000	9.000	0.000	UB
IGNEOUS ROCK	light grey to blue, very high strength.	6.000	15.000	0.000	
SILTSTONE	dark grey to grey.				Top of water at
		12.000	27.000	0.000	20.00m
COAL	Undifferentiated.	3.000	30.000	0.000	LB, water
SANDSTONE	50% light grey, medium grained.				
SILTSTONE	50% dark grey.				
	high strength, thinly bedded.				TD 27/02/2007,
		3.430	33.430	0.000	Piezometer

BORE NAME: White Mining Ltd WML173 PAGE 1

GEOLOGICAL DESCRIPTION OF STRATA		EST'THICK.	EST.DEPTH	RECOVERED	REMARKS
SOIL	light brown to orange, clayey, low strength.	1.000	1.000	0.000	Spud 27/02/2007
CLAY	light orange.	5.000	6.000	0.000	
COAL	Weathered.	1.000	7.000	0.000	
SANDSTONE	light orange, fine grained, moderately weathered, medium strength.	1.000	8.000	0.000	Base of weathering
IGNEOUS ROCK	light grey to blue, very high strength.	6.000	14.000	0.000	
SILTSTONE	dark grey, high strength.	1.000	15.000	0.000	
IGNEOUS ROCK	light grey, basalt.				Top of water, H2S present, piezometer,
		1.150	16.150	0.000	TD 27/02/2007

Appendix 3. OEH Conservation Area Monitoring Form

APPENDIX 3 OEH MONITORING FORMS

MONITORING REPORT FORM

This form is being completed for the following reason:

- ☐ Annual Report by landholder (self reporting)
- ☐ Routine visit by OEH with landholder
- ☐ Compliance visit by OEH with landholder
- ☐ Change of ownership visit by OEH with landholder
- ☐ Conservation Agreement
- ☐ Wildlife Refuge
- ☐ Property Agreement

Please make three copies of the completed form and any additional information. One to be retained by the landowner, one for the local Area office of NPWS and the third to go to Conservation Partnerships Delivery Unit, OEH, PO Box A290, Sydney South NSW 1232.

A LANDOWNER AND PROPERTY DETAILS

Property Owner	Ashton Coal Operations Pty Ltd
Property Name	Southern Woodland Conservation Area
Property Address	New England Hwy, Camberwell
CA number	
Area (ha)	65 ha
CMA Region	Hunter
Agreement signed	
Date of last monitoring visit	19 May 2015
Date of visit	8 June 2016
Officer undertaking visit	Dr Nigel Fisher (Kleinfelder)

B LANDHOLDER OVERVIEW SINCE LAST VISIT

1 LANDHOLDER EXPERIENCES RELATING TO THE IMPLEMENTATION OF THE CONSERVATION AGREEMENT /WILDLIFE REFUGE

Points to note	*Comments*

☐ Please place an X in this box if new issue(s)/problem(s) require management help

2 WORKS UNDERTAKEN SINCE LAST VISIT

Description of work undertaken	*Source of funding and amount*	*Date completed*
Wild Dog Control, Weed control	Landowner funded	ongoing

3 FIRE HISTORY MONITORING

Date of fire	*Area burnt (% of c.a./approx ha)*	*Reason (hazard red./wild)*	*Intensity (low/medium/high)*

4 VISITATION

Average No. of Visitors per year	*Purpose of Visitation*	*Visitation effects*	*Strategies to overcome effects*

5 COMMUNITY CONSULTATION AND INPUT INTO DECISION MAKING

Type of Involvement	*Numbers involved*	*Outcomes*

C CONSERVATION VALUES

	Conservation Values noted in Agreement and its significance	Current condition ** (I = improving M= maintain D= declining) *Anecdotal evidence only available at present*	Current and emerging threats	Level (*severe, high, moderate or low*) and extent (*throughout, widespread, scattered or localised*) of threats	New findings; any other relevant information.
Landscape/ Catchment - World/national heritage listings - Landscape & scenic values					
Biological - Vegetation Communities - Flora - Fauna & habitat - Water bodies	EEC Vegetation Community Woodland Birds	Maintaining	Weeds such as African Boxthorn, Olive, Cactus, Galenia, Balloon Vine and Madeira Vine	High, Throughout the VCA – manageable but requires ongoing works to control	
Geological	Erosion Subsidence	Declining Maintaining	Rills, some gullying Cracks visible	Low, localised – but increasing, requires control works	

	Conservation Values noted in Agreement and its significance	Current condition ** (I = improving M= maintain D= declining) *Anecdotal evidence only available at present*	Current and emerging threats	Level (*severe, high, moderate or low*) and extent (*throughout, widespread, scattered or localised*) of threats	New findings; any other relevant information.
				Low - Scattered in VCA, requires assessment	
Cultural Heritage - Aboriginal - Historic					
Research/ education					
Other					

** Current Condition: determine change by comparison with previous Condition Assessments (Pages 5 to 8). Carry out new assessment if not done previously. Biometric can also be used.

D MANAGEMENT ISSUES

	Describe the Issue (short description of current extent of impacts, new sightings and any other relevant information	Description of planning and implementation of control measures being and to be undertaken, and duration
Weeds (where applicable, infestation can be given as a % of total vegetation)	African Boxthorn – forming infestations at base of large canopy trees Olive – forming infestations at base of large canopy trees and excluding other species Balloon and Madeira Vines – encroaching from water courses, where presently is smothering other vegetation Galenia – scattered throughout VCA, but localised areas where forms dense mats or carpets excluding other species	
Pest Animals - Feral - Domestic - Native	Feral animals are controlled by a combination of baiting and habitat management.	1080 baiting program and removal of grazing.

Fire Management		Firebreaks are maintained around the property that contains the conservation area.
Threatened species; endangered ecological communities etc		
Cultural Heritage Management		Cultural Heritage Management Plan is implemented.
Visitor Impact Management		
Community Consultation and input into decision making.		
Research/ Education programs		
Other permitted uses -vehicle access - use of timber -seed collection - etc	Underground mining results in minor subsidence impacts that need to be remediated form time to time.	Subsidence repair with small earthmoving equipment.

E WORKPLAN TO ADDRESS MANAGEMENT ISSUES (in priority order)

Action to be completed or ongoing action (discuss on site and where necessary confirm details later)	*Cost and possible funding sources*	*Completion Date*	*Responsibility (landholder, OEH, other)*
Ongoing weed control and pest management as required	Owner funded	Ongoing	Landholder

F ATTACHMENTS

- Map showing location of activities referred to above eg weed infestations; fire; location of past and future management actions.

List further attachments if relevant:

- Photos from previously/new identified photopoints
- Rapid Assessment Sheets for previous/new sites.
- Other Monitoring results.

I/we confirm a field inspection has been undertaken and this form is a summary of the conservation values and management issues discussed.

Signature Landowner

Date report completed: 30 March 2017

Level of threat definition

Table 4 Description of the level of impact categories (adapted from State of the Parks 2007 Guidelines)

Impact of the threat	Description of category
Severe	The threat will lead to loss of property value(s) in the foreseeable future if it continues to operate at current levels
High	The threat will lead to a significant reduction of property e values(s) if it continues to operate at current levels.
Moderate	The threat is having a detectable impact on reserve values(s) but damage is not considered significant.
Mild	The threat is having minor or barely detectable impact on property value(s).

Extent of threat definition For cultural heritage places, sites and objects, classify the extent the impact is having on the place/site/object itself.

Table 5: Description of the extent categories (adapted from State of the Parks 2007 Guidelines)

Extent of the threat	Description of category
Throughout	The impact is occurring in 50% or more of property area/cultural place/site/object.
Widespread	The impact is occurring in more than 15% but less than 50% of reserve area/cultural place/site/object.
Scattered	The impact is occurring in between 5 and 15% of reserve area/cultural place/site/object.
Localised	The impact is occurring is less than 5% of reserve area/cultural place/site/object.

CONDITION ASSESSMENT NATIVE VEGETATION

For native bushland and grassland sites and paddocks containing scattered shade trees

Site number or name: MFarm06	**Monitoring date: 8 June 2016**
A ssessment questions	**Answer Yes, No or N/A**
1. Is the area fenced to manage stock access and grazing? *Healthy bush should be rested for long periods to allow regeneration. To achieve this, it should be fenced off.*	**Yes**
2. Is there regeneration of native trees and shrubs, or if in grassland, regular germination of native herbs eg perennials such as lilies or orchids and annuals such as daisies? *Regeneration of trees and shrubs is necessary for the bush to maintain health, diversity and a range of habitats. An understorey of shrubs encourages small insect eating birds and other native animals.*	**Yes**
3. Is there a diverse range of tree and shrub species present, e.g. more than 20 (coast), 15 (tablelands), 10 (western slopes and plains)? (Note: healthy river red gum forest may have only one tree and 5-10 shrub species present). *Diversity encourages a range of native animals and helps the bush withstand attacks of insects and other adverse conditions.*	**No**
4. If grassland, is there a diverse range of grasses and broad leaf herbs present?	**NA**
5. Is there adequate ground cover, e.g. leaves, bark and twigs, or litter (dead grasses)? *Ground cover indicates whether the area is being disturbed by stock and is a measure of tree canopy density and the domination of exotic grasses and weeds.*	**Yes**
6. Are mosses or lichens on rocks, fallen branches and the ground surface, or are these species, along with liverworts, forming a crust on bare soil?	**Yes**
7. Are weeds uncommon, sparsely scattered, absent, or mainly around edges of the area? *The understorey may have exotic weeds present. Too many are undesirable and you may need a management plan for their control. Weeds compete with native plants for light, space, water and nutrients.*	**No**
8. Is there a very low incidence of pest animals, e.g. foxes and rabbits? *Remnant bush can be a refuge for pest animals as well as natives. The feral animals should be controlled.*	**Yes**
9. Is the patch shape a block or part of a corridor more than 30 metres wide rather than a thin strip? *Blocks of native vegetation have less edge area than strips, so they are less influenced by changes in levels of weeds, predators, noise and climatic effects.*	**Yes**
10. Is the area greater than 1 ha (coast), 5 ha (tablelands), 10 ha (western slopes), 20 ha (plains), 50 ha (Western Division)?	**Yes**

11. Is the remnant linked to other remnants by corridors, e.g. roadside vegetation, or scattered trees no more than 50 m apart? *Corridors provide shelter and pathways for native organisms (other than birds) to move over the landscape for feeding, breeding, roosting and expanding territory*.	**Yes**
12. Is there a mix of tree ages present, i.e. saplings through to old growth with hollows? *A range of ages and conditions means the bush is regenerating itself and each stage of growth is suitable habitat for native organisms.*	**No**
13. If trees are present is an understorey also present? *An understorey of shrubs encourages small insect eating birds and other native animals.*	**Yes**
14. Is the understorey mostly comprised of native shrubs and / or grasses and broad leaf herbs?	**Yes**
15. Area there standing trees (alive or dead) with hollows, present in the remnant or paddock? *Dead trees with hollows are essential for roosting and nesting of a large range of native birds such as parrots and of bats.*	**Yes**
16. Are the trees mainly healthy, with little or no dieback? *Dieback is apparent if there are bare twigs at the outer part of the tree canopy. It is usually a sign of severe insect attack.*	**Yes**
17. Are there less than 20 % of trees affected by mistletoe? *Mistletoe is a parasite that invades trees and causes them to lose vigour. Where many trees in an area are affected it is likely to indicate that the area of vegetation is under severe stress.*	**No**
18. Are there logs and fallen timber on the ground? *Logs and dead material are essential habitat for smaller native organisms. But they can also be a harbour for pest animals.*	**Yes**
19. If scattered paddock trees are unfenced, are stock camps absent? *Bare ground, bare tree roots or the movement of soil all can indicate erosion which needs to be managed and controlled.*	**NA**
20. If scattered paddock trees are unfenced, is evidence of stock ringbarking or rubbing absent?	**NA**
21. Is the area free of herbicide, insecticide or fertiliser overspray from adjoining areas? *Herbicides and insecticides can kill native plants and small organisms. Fertiliser encourages exotic species by raising nutrient levels.*	**Yes**
22. Is the area free from the threat of salinity and / or high water tables?	**Yes**
23. Are patches of vegetation left unburnt as wildlife breeding habitat?	**Yes**
Total number of 'yes' answers	**16**

Condition rating - native vegetation				
Number of 'yes' answers			**Vegetation condition rating**	**Need for management attention**
Remnant bushland	**Remnant grassland**	**Scattered paddock trees**		
15 +	10 +	13 +	**Healthy**	Maintain current management
9 - 14	6 - 9	8 - 12	Good	Needs some management attention
5 - 8	3 - 5	5 - 7	Fair	Needs a significant level of management attention
0 - 4	0 - 2	0 - 4	Poor	Urgent management necessary if you wish to retain area as stock shelter

CONDITION ASSESSMENT NATIVE VEGETATION

For native bushland and grassland sites and paddocks containing scattered shade trees

Site number or name: RWood03	**Monitoring date: 8 June 2016**
Assessment questions	**Answer Yes, No or N/A**
1. Is the area fenced to manage stock access and grazing? *Healthy bush should be rested for long periods to allow regeneration. To achieve this, it should be fenced off.*	**Yes**
2. Is there regeneration of native trees and shrubs, or if in grassland, regular germination of native herbs e.g. perennials such as lilies or orchids and annuals such as daisies? *Regeneration of trees and shrubs is necessary for the bush to maintain health, diversity and a range of habitats. An understorey of shrubs encourages small insect eating birds and other native animals.*	**Yes**
3. Is there a diverse range of tree and shrub species present, e.g. more than 20 (coast), 15 (tablelands), 10 (western slopes and plains)? (Note: healthy river red gum forest may have only one tree and 5-10 shrub species present). *Diversity encourages a range of native animals and helps the bush withstand attacks of insects and other adverse conditions.*	**Yes**
4. If grassland, is there a diverse range of grasses and broad leaf herbs present?	**NA**
5. Is there adequate ground cover, e.g. leaves, bark and twigs, or litter (dead grasses)? *Ground cover indicates whether the area is being disturbed by stock and is a measure of tree canopy density and the domination of exotic grasses and weeds.*	**Yes**
6. Are mosses or lichens on rocks, fallen branches and the ground surface, or are these species, along with liverworts, forming a crust on bare soil?	**Yes**
7. Are weeds uncommon, sparsely scattered, absent, or mainly around edges of the area? *The understorey may have exotic weeds present. Too many are undesirable and you may need a management plan for their control. Weeds compete with native plants for light, space, water and nutrients.*	**Yes**
8. Is there a very low incidence of pest animals, e.g. foxes and rabbits? *Remnant bush can be a refuge for pest animals as well as natives. The feral animals should be controlled.*	**Yes**
9. Is the patch shape a block or part of a corridor more than 30 metres wide rather than a thin strip? *Blocks of native vegetation have less edge area than strips, so they are less influenced by changes in levels of weeds, predators, noise and climatic effects.*	**Yes**
10. Is the area greater than 1 ha (coast), 5 ha (tablelands), 10 ha (western slopes), 20 ha (plains), 50 ha (Western Division)?	**Yes**

11. Is the remnant linked to other remnants by corridors, e.g. roadside vegetation, or scattered trees no more than 50 m apart? *Corridors provide shelter and pathways for native organisms (other than birds) to move over the landscape for feeding, breeding, roosting and expanding territory*.	**Yes**
12. Is there a mix of tree ages present, i.e. saplings through to old growth with hollows? *A range of ages and conditions means the bush is regenerating itself and each stage of growth is suitable habitat for native organisms.*	**No**
13. If trees are present is an understorey also present? *An understorey of shrubs encourages small insect eating birds and other native animals.*	**Yes**
14. Is the understorey mostly comprised of native shrubs and / or grasses and broad leaf herbs?	**Yes**
15. Area there standing trees (alive or dead) with hollows, present in the remnant or paddock? *Dead trees with hollows are essential for roosting and nesting of a large range of native birds such as parrots and of bats.*	**Yes**
16. Are the trees mainly healthy, with little or no dieback? *Dieback is apparent if there are bare twigs at the outer part of the tree canopy. It is usually a sign of severe insect attack.*	**Yes**
17. Are there less than 20 % of trees affected by mistletoe? *Mistletoe is a parasite that invades trees and causes them to lose vigour. Where many trees in an area are affected it is likely to indicate that the area of vegetation is under severe stress.*	**Yes**
18. Are there logs and fallen timber on the ground? *Logs and dead material are essential habitat for smaller native organisms. But they can also be a harbour for pest animals.*	**Yes**
19. If scattered paddock trees are unfenced, are stock camps absent? *Bare ground, bare tree roots or the movement of soil all can indicate erosion which needs to be managed and controlled.*	**NA**
20. If scattered paddock trees are unfenced, is evidence of stock ringbarking or rubbing absent?	**NA**
21. Is the area free of herbicide, insecticide or fertiliser overspray from adjoining areas? *Herbicides and insecticides can kill native plants and small organisms. Fertiliser encourages exotic species by raising nutrient levels.*	**Yes**
22. Is the area free from the threat of salinity and / or high water tables?	**Yes**
23. Are patches of vegetation left unburnt as wildlife breeding habitat?	**Yes**
Total number of 'yes' answers	**19**

Condition rating - native vegetation				
Number of 'yes' answers			**Vegetation condition rating**	**Need for management attention**
Remnant bushland	**Remnant grassland**	**Scattered paddock trees**		
15 +	10 +	13 +	**Healthy**	Maintain current management
9 - 14	6 - 9	8 - 12	Good	Needs some management attention
5 - 8	3 - 5	5 - 7	Fair	Needs a significant level of management attention
0 - 4	0 - 2	0 - 4	Poor	Urgent management necessary if you wish to retain area as stock shelter

CONDITION ASSESSMENT NATIVE VEGETATION

For native bushland and grassland sites and paddocks containing scattered shade trees

Site number or name: RGrass04	**Monitoring date: 8 June 2016**
Assessment questions	**Answer Yes, No or N/A**
1. Is the area fenced to manage stock access and grazing? *Healthy bush should be rested for long periods to allow regeneration. To achieve this, it should be fenced off.*	**Yes**
2. Is there regeneration of native trees and shrubs, or if in grassland, regular germination of native herbs e.g. perennials such as lilies or orchids and annuals such as daisies? *Regeneration of trees and shrubs is necessary for the bush to maintain health, diversity and a range of habitats. An understorey of shrubs encourages small insect eating birds and other native animals.*	**Yes**
3. Is there a diverse range of tree and shrub species present, e.g. more than 20 (coast), 15 (tablelands), 10 (western slopes and plains)? (Note: healthy river red gum forest may have only one tree and 5-10 shrub species present). *Diversity encourages a range of native animals and helps the bush withstand attacks of insects and other adverse conditions.*	**NA**
4. If grassland, is there a diverse range of grasses and broad leaf herbs present?	**No**
5. Is there adequate ground cover, e.g. leaves, bark and twigs, or litter (dead grasses)? *Ground cover indicates whether the area is being disturbed by stock and is a measure of tree canopy density and the domination of exotic grasses and weeds.*	**Yes**
6. Are mosses or lichens on rocks, fallen branches and the ground surface, or are these species, along with liverworts, forming a crust on bare soil?	**NA**
7. Are weeds uncommon, sparsely scattered, absent, or mainly around edges of the area? *The understorey may have exotic weeds present. Too many are undesirable and you may need a management plan for their control. Weeds compete with native plants for light, space, water and nutrients.*	**No**
8. Is there a very low incidence of pest animals, e.g. foxes and rabbits? *Remnant bush can be a refuge for pest animals as well as natives. The feral animals should be controlled.*	**Yes**
9. Is the patch shape a block or part of a corridor more than 30 metres wide rather than a thin strip? *Blocks of native vegetation have less edge area than strips, so they are less influenced by changes in levels of weeds, predators, noise and climatic effects.*	**Yes**
10. Is the area greater than 1 ha (coast), 5 ha (tablelands), 10 ha (western slopes), 20 ha (plains), 50 ha (Western Division)?	**Yes**

11. Is the remnant linked to other remnants by corridors, e.g. roadside vegetation, or scattered trees no more than 50 m apart? *Corridors provide shelter and pathways for native organisms (other than birds) to move over the landscape for feeding, breeding, roosting and expanding territory*.	**Yes**
12. Is there a mix of tree ages present, i.e. saplings through to old growth with hollows? *A range of ages and conditions means the bush is regenerating itself and each stage of growth is suitable habitat for native organisms.*	**NA**
13. If trees are present is an understorey also present? *An understorey of shrubs encourages small insect eating birds and other native animals.*	**NA**
14. Is the understorey mostly comprised of native shrubs and / or grasses and broad leaf herbs?	**No**
15. Area there standing trees (alive or dead) with hollows, present in the remnant or paddock? *Dead trees with hollows are essential for roosting and nesting of a large range of native birds such as parrots and of bats.*	**No**
16. Are the trees mainly healthy, with little or no dieback? *Dieback is apparent if there are bare twigs at the outer part of the tree canopy. It is usually a sign of severe insect attack.*	**NA**
17. Are there less than 20 % of trees affected by mistletoe? *Mistletoe is a parasite that invades trees and causes them to lose vigour. Where many trees in an area are affected it is likely to indicate that the area of vegetation is under severe stress.*	**NA**
18. Are there logs and fallen timber on the ground? *Logs and dead material are essential habitat for smaller native organisms. But they can also be a harbour for pest animals.*	**No**
19. If scattered paddock trees are unfenced, are stock camps absent? *Bare ground, bare tree roots or the movement of soil all can indicate erosion which needs to be managed and controlled.*	**NA**
20. If scattered paddock trees are unfenced, is evidence of stock ringbarking or rubbing absent?	**NA**
21. Is the area free of herbicide, insecticide or fertiliser overspray from adjoining areas? *Herbicides and insecticides can kill native plants and small organisms. Fertiliser encourages exotic species by raising nutrient levels.*	**Yes**
22. Is the area free from the threat of salinity and / or high water tables?	**Yes**
23. Are patches of vegetation left unburnt as wildlife breeding habitat?	**Yes**
Total number of 'yes' answers	**10**

Condition rating - native vegetation				
Number of 'yes' answers			**Vegetation condition rating**	**Need for management attention**
Remnant bushland	**Remnant grassland**	**Scattered paddock trees**		
15 +	10 +	13 +	Healthy	Maintain current management
9 - 14	6 - 9	8 - 12	Good	Needs some management attention
5 - 8	3 - 5	5 - 7	Fair	Needs a significant level of management attention
0 - 4	0 - 2	0 - 4	Poor	Urgent management necessary if you wish to retain area as stock shelter

CONDITION ASSESSMENT - WATER BODIES

For creeks, rivers, farm dams and natural or artificial wetlands

N/A

Site number or name:	**Monitoring date:**
Assessment questions	**Answer Yes, No or N/A**
1. Is all or part of the site fenced to control stock access?	
2. Is there a diverse range of native tree and shrub species present upslope of the dam or wetland, or along the creek?	
3. Are there any standing trees (dead or alive), with hollows near to, or within the dam or wetland, or along the creek?	
4. Is the site linked to remnant vegetation by corridors, eg. roadside or scattered trees no more than 50m apart?	
5. Is the site free of herbicide, insecticide or fertiliser overspray or run off?	
6. Are weeds uncommon, sparsely scattered or absent from the site?	
7. Is there an earthen or floating island within the dam?	
8. Does the dam have an irregular margin?	
9. Does 50% of the dam edge have a gentle slope?	
10. Is 50% of the dam less than 800mm deep when the dam's full?	
11. Are there any native fish species present in the dam or creek?	
12. Are introduced fish species (eg. carp) absent from the dam or creek?	
13. Are there hollow logs, rocks and litter around the dam or along the creek?	
14. Is more than 50% of the creek corridor vegetated with native species?	
15. Are the creek banks stabilised by vegetation?	
16. Are there wider patches of native vegetation along the creek corridor eg 20-30m wide?	
17. Is the area immediately adjacent to the creek free from cultivation?	
18. Are aquatic insects present under small to medium rocks or logs within the creek?	
19. Is the creek's water free from regular algal blooms?	
20. Does foliage of trees or shrubs hang over the creek, dam or wetland?	
21. Is there any regeneration of reeds and rushes upslope of the dam or wetland?	
22. Is there a buffer zone of ungrazed vegetation around the wetland?	
23. Is the area free of irrigation tailwater or polluted stormwater?	
24. Is the area free of fire during bird breeding seasons?	

25 Are patches of vegetation left unburnt as wildlife breeding habitat?	
26 If the area has original vegetation, has the water regime remained largely unmodified?	
27. Does the water level fluctuate regularly (seasonally)?	
Totals number of 'yes' answers	

Condition rating - water bodies

Number of 'yes' answers			**Water resource condition rating**	**Need for management attention**
Dam	**Creek**	**Wetland**		
11 +	13 +	10 +	Healthy	Maintain current management
7 – 10	9 - 12	7 - 9	Good	Needs some management attention
4 – 6	5 - 8	4 - 6	Fair	Needs a significant level of management attention
0 – 3	0 - 4	0 - 3	Poor	Urgent management required to improve the resource condition

MONITORING POINT LOCATIONS AND CORRESPONDING VEGETATION COMMUNITIES REPRESENTED AS AT 8 JUNE 2016

Photo Point	Quadrat No.	Easting/Northing GDA 94 MGA 56	Photo bearing degrees	Vegetation Community Represented
MFarm 06	MFarm06	318969E 6404047N	135	Narrow-leaved Ironbark – Bulloak – Grey Box shrub – grass open forest of the Central and Lower Hunter (PCT ID 1603; BVTID HU817)
RWood 03	RWood03	318430E 6403727N	225	
RGrass 04	RGrass04	319228E 6403712N	040	

BIOMETRIC VEGETATION TYPE BENCHMARKS AND BASELINE QUADRAT SCORES AS AT 8 JUNE 2016

Photo Point	Quadrat No.	Native species richness	Overstorey cover %pfc	Mid-storey cover %pfc	Ground cover – grasses %pfc	Ground cover – shrubs %pfc	Ground cover – other %pfc	Proportion overstorey regen.	Exotic cover
Narrow-leaved Ironbark – Bulloak – Grey Box shrub – grass open forest of the Central and Lower Hunter (PCT ID 1603; BVTID HU817)									
Insert Benchmark values		41	15-40	5-20	30-50	5-10	20-40	x	xx
01	**MFarm06**	16	16	15	38	10	16	10	7
	RWood03	16	28	7.5	60	8	10	50	6
	RGrass04	4	0	0	30	0	0	0	100

Monitoring Data Sheet

Monitoring Point Number	MFarm06	**Date**	8 June 2016
Vegetation Community	**Narrow-leaved Ironbark – Bulloak – Grey Box shrub – grass open forest of the Central and Lower Hunter (PCT ID 1603; BVTID HU817)**		
1. Site Photo(s)Taken	**Error! Reference source not found.**		

2. Floristic BioMetric attributes	
Native cover	
Overstorey:	16
Midstorey:	15
Groundcover(grass):	38
Groundcover (shrub):	10
Groundcover (other):	16
Native species richness:	16
Proportion of canopy species regenerating	10
Exotic cover	7

3. Observations	**GPS coordinates**	**Photo number**	**Observations**
Natural regeneration of disturbed areas			Advanced regrowth
Threatened species sightings			Nil
Fire event/fuel			Nil
Weeds			*Lyceum ferocissimum* (African Boxthorn), *Opuntia aurantiaca* (Tiger Pear), *Galena pubescens* (Galena)
Pest animals			Nil
Visitor impact/vehicles			Nil
Rubbish dumping			Nil

Monitoring Data Sheet

Monitoring Point Number	RWood03	**Date**	8 June 2016
Vegetation Community	**Narrow-leaved Ironbark – Bulloak – Grey Box shrub – grass open forest of the Central and Lower Hunter (PCT ID 1603; BVTID HU817)**		
1. Site Photo(s)Taken	**Error! Reference source not found.**		

2. Floristic BioMetric attributes	
Native cover	
Overstorey:	28
Midstorey:	7.5
Groundcover(grass):	60
Groundcover (shrub):	8
Groundcover (other):	10
Native species richness:	16
Proportion of canopy species regenerating	50
Exotic cover	6

3. Observations	**GPS coordinates**	**Photo number**	**Observations**
Natural regeneration of disturbed areas			Advanced regrowth – some large trees but no hollows
Threatened species sightings			Nil
Fire event/fuel			Nil
Weeds			*Opuntia stricta* (Prickly Pear)
Pest animals			Nil
Visitor impact/vehicles			Nil
Rubbish dumping			Nil

Monitoring Data Sheet

Monitoring Point Number	RGrass04	**Date 8 June 2016**	8 June 2016
Vegetation Community	**Narrow-leaved Ironbark – Bulloak – Grey Box shrub – grass open forest of the Central and Lower Hunter (PCT ID 1603; BVTID HU817)**		
1. Site Photo(s)Taken	**Error! Reference source not found.**		

2. Floristic BioMetric attributes	
Native cover	
Overstorey:	0
Midstorey:	0
Groundcover(grass):	30
Groundcover (shrub):	0
Groundcover (other):	0
Native species richness:	0
Proportion of canopy species regenerating	0
Exotic cover	100

3. Observations	**GPS coordinates**	**Photo number**	**Observations**
Natural regeneration of disturbed areas			Nil, grasses browned off, difficult to ID individual species
Threatened species sightings			Nil
Fire event/fuel			Lots of grass litter fuel
Weeds			Nil
Pest animals			Nil
Visitor impact/vehicles			Near vehicle access tracks, and powerline easement
Rubbish dumping			Nil