YANCOAL
兖煤澳大利亚有限公司

Duralie Coal Mine
Annual Review

2019

DURALIECOAL
Part of the Yancoal Australia Group

DURALIE COAL MINE

ANNUAL REVIEW

Reporting Period: 1st July 2018 to 30th June 2019

Table 1 – Annual Review Title Block

Name of operation	*Duralie Coal Mine*
Name of operator	*Yancoal Australia Ltd*
Development consent/ project approval #	*PA (08_0203) (Duralie Extension Project)*
Name of holder of Development consent/ project approval #	*Duralie Coal Pty Limited*
Mining lease #	*ML1427, ML1646*
Name of holding of mining lease	*CIM Duralie Pty Ltd*
Water licence #	*20BL168404, 20WA202053, various monitoring bore licences.*
Name of holder of water licence	*CIM Duralie Pty Ltd & Duralie Coal Pty Ltd*
MOP/ RMP start date	*18th March 2015*
MOP/ RMP end date	*31st December 2019*
Annual Review start date	*1st July 2018*
Annual Review end date	*30th June 2019*
I, John Cullen, certify this audit report is true and accurate record of the compliance status of Duralie Coal Mine for the period of 1st July 2018 to 30th June 2019 and that I am authorised to make this statement on behalf of Yancoal. *Note.* *a) The Annual Review is an 'environmental audit' for the purpose 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 the corporation, $1 million and for an individual $250,000.* *b) 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	*Mr John Cullen*
Title of authorised reporting officer	*Operations Manager – Duralie Coal*
Signature of authorised reporting officer	
Date	*30 September 2019*

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1 STATEMENT OF COMPLIANCE

This Annual Review has been prepared in accordance with NSW Project Approval 08_0203 Schedule 5, Condition 3 for the Duralie Coal Mine for the period 1 July 2018 to 30 June 2019. This report is also prepared in accordance with the annual reporting requirements for ML 1427 Condition 3 and ML 1646 Condition 4.

A summary of the non-compliances with Project Approval 08_0203, ML 1427 and ML 1646 during the reporting period are included in Table 3. During the reporting period there were no identified non-compliances or reportable incidents at the DCM.

Table 2- Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
Project Approval No. 08_0203	Yes
ML1427, ML1646	Yes

Table 3 – Summary of Non-compliances

Condition #	Condition Description/Non-Compliance	Compliance Status/Risk	Comment	Section addressed
Project Approval 08_0203				
	Nil			
ML 1427 & ML 1646				
	Nil			

Table 4 – Compliance Status Categories

Risk Level	Colour Code	Description
High	Non-Compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-Compliant	Non-compliance with potential for serious environmental consequences, but is unlikely to occur; or potential for moderate environmental consequences, but is likely to occur
Low	Non-Compliant	Non-compliance with potential for moderate environmental consequences, but is unlikely to occur; or potential for low environmental consequences, but is likely to occur
Administrative non-compliance	Non-Compliant	Non-compliance which does not result in any risk of environmental harm

2. INTRODUCTION

The Duralie Coal Mine (DCM) is located in the Gloucester Basin approximately 80km north of Newcastle in New South Wales, between the villages of Stroud Road and Wards River. Refer **Figure 1** (**Appendix 1**).

Duralie Coal Pty Ltd (DCPL), a wholly owned subsidiary of Yancoal Australia Limited (YAL), is the owner and operator of the DCM.

Development Consent for the mine was granted by the NSW Minister for Urban Affairs and Planning on 21 August 1997 and Mining Lease Number 1427 was issued by the NSW Minister for Mineral Resources on 6 April 1998.

In October 1998 a Statement of Environmental Effects (SEE) was produced to consider proposed alterations to the Duralie Mine. These proposed alterations were approved by the NSW Minister for Urban Affairs and Planning on 5 February 1999.

Construction commenced in June 2002 with mining production commencing in March 2003 and the first coal railed to the Stratford Mine for processing in the same month.

Duralie Coal Pty Ltd (DCPL) received Project Approval for the Duralie Extension Project (PA 08_0203) in November 2010 for mining activities to extend until 31 December 2021 and Mining Lease 1646 was issued on 4 January 2011. The Project Approval has since been modified on two occasions on 1 November 2012 and 5 December 2014.

Duralie Coal Mine consists of an open-cut, truck and excavator mine producing run of mine (ROM) coal, which is railed to the Stratford Mining Complex (SMC) and processed at the SMC Coal Handling and Processing Plant (CHPP).

This Annual Review (AR) has been prepared in accordance with the conditions of the Project Approval and Mining Leases, and in accordance with the Department of Planning and Environment (DPE) Annual Review Guidelines (October 2015).

The AR describes the environmental protection, pollution control and rehabilitation activities at the DCM for the period 1 July 2018 to 30 June 2019. As required by the Project Approval, comparisons of environmental monitoring results have been made against relevant statutory requirements, monitoring results of previous years and relevant predictions of Environmental Assessments. Environmental management activities planned for the next 12 months are also discussed.

2.1 MINE CONTACTS

The DCM is an owner operated mine site by DCPL Site personnel responsible for mining, rehabilitation and environmental issues at the end of the reporting period were:

Position	Name	Contact
Operations Manager, Stratford & Duralie Operations	Mr John Cullen	02 6538 4210
Environment & Community Superintendent	Mr Michael Plain	02 6538 4203

3. APPROVALS

3.1.1 Status of Leases, Licences, Permits and Approvals

The DCM operates in accordance with the approvals provided in Table 5.

Table 5 – Duralie Coal Mine - Leases, Licences and Approvals

Description	Date of Grant	Duration of Approval	Comment
NSW Project Approvals			
Duralie Extension Project – Project Approval (08_0203)	5/12/2014 (As Modified)	The Applicant may carry out mining operations on site until the end of 2021.	• Granted 26/10/2010. • MOD 1 (Rail Hours) 1/11/2012. • MOD 2 (Open Cut variations) 5/12/2014.
Mining Leases and Exploration Licences			
ML1427	06/04/1998	21 years. (06/04/2019)	Renewal lodged in April 2018.
ML1646	04/01/2011	21 years. (04/01/2032)	Variation of Conditions dated 20/06/2018
AUTH 315	14/10/2013	28 November 2017.	Renewal lodged 27/11/2017.
Environment Protection Licences			
Environment Protection Licence (EPL) 11701	4/9/2002	Until the licence is surrendered, or revoked.	As modified by subsequent variations (refer to EPA website).
Commonwealth Approvals			
Commonwealth Approval (EPBC 2010/5396)	22/10/2010	22/10/2020	Commencement of Action 14/01/2011.
Water Licences			
Water Supply Works Approval 20WA202053	1/7/2004	1 October 2028.	Coal Shaft Creek diversion and various on-site water management structures. Renewed 17/10/2018.
WAL 41518 (previously 20BL168404)	22/09/2002	Perpetuity	Groundwater Licence for the Duralie Open Cut extraction. Converted to WAL 41518 under WM Act 2000 on 14/12/2017.
Groundwater licences – various monitoring bores.	Various	Perpetuity	Monitoring purposes only.

Environmental Management Plans

Environmental Management Plans (EMPs) have been prepared and approved for the DCM. The current versions approved by DPIE are available on the Duralie Coal website.

- Environmental Management Strategy (revised). Approved 24 October 2017.
- Air Quality and Greenhouse Gas Management Plan (revised). Approved 23 June 2015.
- Biodiversity Management Plan (revised). Approved by DP&E 25 January 2019, DoEE 27 November 2018.
- Blast Management Plan (revised). Approved 24 October 2017.
- Giant Barred Frog Study. Approved 6 March 2012.
- Giant Barred Frog Management Plan (revised). Approved 5 September 2017.
- Heritage Management Plan (revised). Approved 23 June 2015.
- Noise Management Plan (revised). Approved 9 May 2018.
- Waste Management Plan. Approved 23 June 2015.
- Water Management Plan (revised). Approved 5 September 2017.
- Mining Operations Plan & Rehabilitation Management Plan (MOP) (revised). DRG approved 11 December 2017.
- Duralie Extension Project Study of Dust Emissions from Rail Transport under condition 21A of the Project Approval, approved 2012.
- Consultation Plan – Additional Rail Noise Mitigation Measures, approved December 2012.
- Pollution Incident Response Management Plan (revised), January 2019.

3.1.2 Amendments to Approvals/Licences during the Reporting Period

Table 6 lists approvals and amendments that were granted during the reporting period.

Table 6 – Amendments to Approvals/Licences

Licence/Approval	Amendment type	Date of amendment
Water Supply Works Approval 20WA202053	Renewal	Renewed by DPI Water on 17/10/2018.
Environmental Management Plans • Biodiversity Management Plan	Revised and updated during the 2018-19 reporting period	• Approved 25 Jan 2019

4. OPERATIONS SUMMARY

A summary of operations (Production), during the preceding and current reporting period as well as a forward forecast for the next reporting period is provided below in **Table 7**.

Table 7 - Production Summary

Material	Approved limit (specify source)	Previous reporting period (tonnes)	This reporting period (tonnes)	Next reporting period (tonnes)
Waste Rock/ Overburden (BCM) (DCM only)	N/A	2,268,264	225,969	400,000[1]
ROM Coal (DCM only	3 million tonnes per annum	715,073	172,170	0
Codisposal Reject (Includes Stratford Consent)	Approx. 12.3 million tonnes over life of project.	190,230	308,111	565,000
Saleable product (Includes Stratford Consent)	N/A (Process limit of 5.6 million tonnes per annum)	631,768	415,690	994,000

Note 1: Total includes 0.4MBCM of rehandled PAF overburden material during the next reporting period.

Product coal utilising Duralie ROM coal is produced at the SMC. Blending of Duralie ROM coal with other ROM coals and rewashed reject material occurred during processing to produce a saleable product coal. Saleable coal production, incorporating both SMC and DCM, for the period July 2018 to June 2019 was 415,690 tonnes comprising 139,097 tonnes of coking coal and 276,593 tonnes of thermal coal.

ROM production for the reporting period is listed in **Table 8** below by month.

Table 8: Monthly ROM Coal Production from the DCM

MONTH	ROM PRODUCTION (tonnes)
July 2018	63,701
August 2018	44,465
September 2018	60,724
October 2018	3,280
November 2018	0
December 2018	0
January 2019	0
February 2019	0
March 2019	0
April 2019	0
May 2019	0
June 2019	0
Total	**172,170**

Product coal production to date by month is shown in **Table 9**.

Table 9: Product Coal Produced by Month from SMC

MONTH	Coking Coal	Thermal Coal	Total Product Coal
July 2018	3,413	46,824	50,237
August 2018	4,895	37,595	42,490
September 2018	10,661	45,225	55,886
October 2018	14,160	30,989	45,149
November 2018	6,605	6,009	12,614
December 2018	12,471	21,069	33,540
January 2019	11,602	10,384	21,986
February 2019	5,889	3,133	9,022
March 2019	13,669	12,448	26,117
April 2019	14,269	15,063	29,332
May 2019	24,491	25,270	49,761
June 2019	16,972	22,584	39,556
Total Annual	**139,097**	**276,593**	**415,690**

4.1 EXPLORATION

No exploration activities were undertaken during the 2018-2019 reporting period. No exploration activities are proposed for Authorisation 315 during the 2018-2019 reporting period. Work within the exploration lease areas will focus predominately on data management, review and interpretation.

4.2 ESTIMATE MINE LIFE

In accordance with PA 08_0203, mining operations are permissible until 31 December 2021.

Mining operations including rehabilitation activities at the DCM are expected to continue during this period. ROM coal production at the DCM ceased in October 2018. Approximately 400kt of ROM coal is remaining in the Weismantel pit and this remaining coal is intended to be extracted between 2020 to 2021. The MOP includes the production schedule for the next three years.

4.3 MINING

The DCM is an open cut truck and shovel operation located approximately 20km south of the Stratford Mine facilities, producing ROM coal, which is railed to the SMC and processed at the SMC Coal Handling and Processing Plant (CHPP). Product coal is transported via train on the North Coast Railway to the Port of Newcastle

The operations extract ROM coal from the Weismantel and Clareval seams at the base of the Gloucester Coal Measures. The deposit forms a synclinal structure with the open cut area located at the southernmost crop line within the main axis of the Gloucester Basin. The operation is now situated on the west limb of the syncline with seams dipping at about 50 degrees east. Mining is undertaken within ML1427 and of ML1646 and includes the extension of the Weismantel pit to the north west and the inclusion of the Clareval seam parallel and to the west of the Weismantel seam.

Dips within the deposit vary from a shallow 5 degrees to an almost vertical profile. Consequently, a method of horizontal 3m to 4m benches is used as the primary extraction method. An average of 5m of free dig material is generally experienced at Duralie after which all waste material generally requires blasting.

Mining activities continued in the Weismantel pit during the 2018/19 reporting period. Mining in the Clareval pit was completed during September 2017 and waste from the Weismantel pit continued to be placed in the Clareval pit. Clearing in advance of mining has now been completed up to the

approved disturbance limit in both Weismantel and Clareval. Mining of ROM coal within the Weismantel pit ceased in October 2018. Approximately 400kt of ROM coal is remaining in the Weismantel pit and is intended to be extracted between 2020 to 2021.

During the reporting period DCPL complied with the approved operating hours. Mining operations are permitted 7 days per week, however mining is currently undertaken during Monday to Friday with no weekend work. Additionally, nightshift operations have ceased during 2018 and a day shift only operates at the DCM.

Surface facilities at the mine and current mine development as at 30 June 2019 are indicated within **Figure 4**, provided in **Appendix 1**.

4.3.1 Mining Equipment and Method

The mining equipment currently in use at DCM up until 30 June 2019 is listed in **Table 10** provided below.

Table 10: Current Mining Fleet*

Plant Item	Number
Excavators	2
Haul Trucks	4
Drills	0
Dozers	2
Water Carts	1
Graders	1
Loader (ROM feed)	1

*Total fleet not all used concurrently.

The truck fleet currently comprises predominantly Cat 785XQ model trucks supported by a lesser number of attenuated Cat 789C trucks.

In addition to the mobile plant listed in Table 10, a civil fleet is contracted at the DCM to undertake rehabilitation works. This fleet consists of small excavators, dozers, trucks and graders. The rehabilitation fleet are generally mobilised for individual campaigns of a few month at a time.

The mining sequence is summarised below and is conducted in accordance with the approved MOP and supporting approvals including relevant EMPs (refer Section 1.1) as required. The mining sequence generally occurs in the following manner:

- A vegetation clearance and ground disturbance plan is prepared. This included fauna/flora assessments and cultural heritage surveys.
- A sedimentation control plan is prepared for the area to be disturbed.
- Delineation of the proposed disturbance area is undertaken.
- Water infrastructure and sedimentation controls are implemented.
- Tree clearing is limited to the minimum required for ongoing operations and undertaken ahead of the advancing workings.
- Topsoil is removed in accordance with a topsoil stripping plan.
- Overburden removal is undertaken by a hydraulic excavator. Generally, the first one to five metres of subsoil/overburden is ripped and/or free-dug. Deeper overburden requires blasting prior to excavation.
- Overburden waste material is deposited either in out-of-pit waste emplacements or backfilled into mining voids.
- Following waste emplacement, shaping to the approved final landform in undertaken in preparation for rehabilitation works.

4.4 COAL HANDLING AND BENEFICATION

4.4.1 Duralie CHP Throughput & Rejects Management

ROM coal is initially handled at the Duralie Coal Handling Plant (CHP). Rock greater than 140 mm is removed from ROM coal using a rotary breaker at the CHP. The separated rock is conveyed to a rejects bin from which it is loaded out and trucked to be buried on site as potentially acid forming (PAF) waste. The ROM coal is then transferred via conveyor to a train loadout bin and railed to the SMC via a shuttle train.

Reject fractions from the ROM coal are generated at the SMC and deposited along with processing waste fractions produced from the washing of SMC coals. The Stratford Mine utilises a co-disposal method that combines the coarse rejects with the intermediate sized materials and tailings. The co-disposal area is managed in accordance with the SMC Life of Mine Reject Disposal Plan. Refer to the SMC Annual Reviews for further details.

4.4.2 ROM Coal Processing On Site

ROM coal is processed through a rotary breaker at the Duralie CHP to produce a coal fraction less than 140 mm. The essential elements of the coal processing plant on site and their design capacities are as follows:

ROM conveyor handling rate	1400 tph
Train load out rate	2400 tph

4.4.3 Coal Stockpile Capacity (ROM)

The ROM pad stockpile is utilised for temporary ROM coal storage which is transported by loader directly to the ROM hopper. Additionally, a temporary ROM coal stockpile (RL69), located within the approved surface development area, was utilised during the MOP term prior to being decommissioned. ROM coal temporarily stored at this stockpile is transported by truck to the DCM CHP. The capacities of these stockpiles are as follows:

Duralie ROM pad	20,000 t
Duralie RL69 ROM	150,000 t

4.4.4 Product Transport

All ROM coal is transported from site to the SMC by rail. The approved hours of operation of the Duralie shuttle train are between 6 am and midnight. In exceptional circumstances, the Duralie shuttle train may operate on the North Coast Railway between midnight and 1am in accordance with Condition 8, Schedule 2 of the Project Approval. DCPL complied with the operating hours and this condition was not utilised during the reporting period.

During the reporting period 176,000 tonnes of ROM coal was transported from the DCM to the SMC. A total of 72 train movements (Duralie-Stratford-Duralie circuit) occurred during the July 2018 to June 2019 period with the last coal transported in October 2018. There was a maximum daily movement of 3 trains. A summary of the ROM coal transported from site and the shuttle train movements is available on the Duralie Coal website in accordance with Condition 48, Schedule 3 of the Project Approval and is also shown in **Appendix 6.**

A summary of Product Coal transported during the reporting period is included in the SMC Annual Review as no product is transported directly from Duralie.

4.5 WASTE MANAGEMENT AND RECYCLING

A fully accredited waste contractor was engaged during the reporting period to manage all waste streams from the DCM. This contract includes general waste and recycling, scrap metal, hydrocarbons including waste grease and oil and hazardous waste.

During the reporting period a review of the waste handling/disposal requirements was undertaken with the waste management contractor following the reduction of operations at the DCM. Waste handling facilities have been supplied around the site as required.

The waste management contractor provides monthly reporting on all waste streams disposed from the DCM. The monthly reports also provide details of recycling achieved and hazardous substances. The waste management contractor undertakes routine inspections of waste disposal facilities to identify any management actions required.

4.5.1 Sewerage Treatment and Disposal

Sewage treatment at the mine site involves multiple septic systems at the offices and crib rooms that manage all generated sewage. Sewage is processed using Garden Master 7100 Elite Aerated Waste Water Treatment Systems. The systems works on the combined principles of primary settlement and aerobic treatment. Treated effluent is discharged via a spray system into a grassed area located to the southwest of the Main Office.

The sewage treatment facility is registered with MidCoast Council and serviced on a quarterly basis by an approved contractor.

4.5.2 Fuel, Oil and Grease Management and Disposal

Fuel (diesel) storage at the mine site consisted of two 100,000 litre capacity above ground double-skinned storage tanks (Transtanks). During the reporting period these tanks were relocated to the SMC and replaced with a single 70,000 litre double-skinned stored tank. An “Acknowledgement of Notification of Hazardous Chemicals on Premises” (Acknowledgement Number NDG 036328 was held for this facility during the reporting period. Potential hydrocarbon contaminated runoff from fuel fill points is captured on concrete pads and directed through an oil water separator. Dirty water runoff from the fuel pad is captured and directed to the main water dam.

Bulk oil is stored onsite within a bunded area and double-skinned tanks near the workshop. Used engine oils (lubricating oils), hydraulic oils and grease are recovered during plant and vehicle servicing in the workshop and in the field. Waste oil is stored in designated Transtanks and waste grease is stored in drums on bunded pallets.

Within the workshop area, separate bunded areas hold a 28,000 litre waste oil tank and bulk storage of oils, greases and lubricants (tanks and drums). A washpad is utilised to clean vehicles and plant either prior to leaving site or for general servicing/repair. Off the washpad is a concrete sump which serves to trap silt and from which oil is removed using an oil water separator. Waste oil collected is removed from site by a commercial contractor for subsequent recycling off-site.

4.5.3 Rubbish Disposal

All domestic rubbish (e.g. food scraps, paper etc.) are deposited in industrial rubbish bins which are periodically emptied by a waste contractor for subsequent disposal.

Scrap metal produced by the workshop is collected and transferred off site by a scrap metal merchant. The merchant collects the scrap metal following inspections by the waste contractor.

Paper, cardboard, aluminium drink cans and other recyclables are collected for recycling as part of site waste segregation. Waste is transported to licenced facilities and waste tracking sheets recorded.

4.6 HAZARDOUS AND EXPLOSIVE MATERIALS MANAGEMENT

Hazardous materials are stored and used in accordance with relevant safety data sheets (SDS). SDS's are kept in a file inside the First Aid Room and are available from an online database on the company intranet.

Bulk explosives are approved for storage within an explosives compound at site. During the reporting period blasting activities were completed at the DCM. All blasting products have been removed from site.

All hazardous waste is appropriately disposed of by a fully accredited waste contractor and waste tracking certificates are supplied to DCPL.

4.6.1 Status of Hazardous Chemicals Notification

An "Acknowledgement of Notification of Hazardous Chemicals on Premises" (Acknowledgement Number NDG 036328) issued by SafeWork NSW is held by Duralie Coal Pty Ltd. This Acknowledgement addresses:

- Above-ground tanks (diesel)
- External magazine (detonators and boosters)
- Above-ground tank (oxidising liquid)
- Roofless bulk storage (ammonium nitrate)

4.7 OTHER INFRASTRUCTURE MANAGEMENT

4.7.1 Prescribed Dams - Dams Safety Committee

The Main Water Dam, Auxiliary Dam 1 and Auxiliary Dam 2 are all prescribed under the Dams Safety Act 1978.

Management plans for the prescribed dams are combined into single documents. The DCM Prescribed Dams Operation and Maintenance Manual was updated and approved by the DSC during 2017. The Prescribed Dams Safety Emergency Plan (DSEP) was updated in consultation with the SES and approved by the DSC during 2017.

Routine visual inspections of the prescribed dams are undertaken three (3) times per week. Monthly monitoring of piezometers terminating beneath the dam's clay core and within the clay core is also undertaken and water levels interpreted. Monuments located along the crests of the dams were surveyed for any indication of movement during the reporting period. No significant movement has been identified in any of the dam walls during the reporting period. Routine maintenance of vegetation on the dam walls has been undertaken.

The 5-yearly prescribed dam surveillance reports were scheduled and completed during November 2017. The surveillance reports didn't identify any significant issues with the management and maintenance of the structures. The surveillance reports have been endorsed by the Dam Safety Committee in their letter dated 14 December 2017.

DCPL is currently preparing plans for the decommissioning of the prescribed dams. AD1 was dewatered during the previous reporting period and AD2 is planned to be dewatered during the next reporting period. Further detail regarding the decommissioning of the prescribed dams is included in the mine closure planning program in Section 8.5.

5. ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The then Department of Planning & Environment (DP&E) provided notification on 7 December 2018 that the DCM Annual Review 2017/2018 was generally in accordance with the Project Approval requirements with no further amendments or actions were required.

The Resources Regulator provided "Notice of Satisfactory AEMR" on 17 April 2019 with no actions required.

The Resources Regulator conducted a site inspection of the DCM on 31 May 2018. The inspection focused on compliance with rehabilitation and mine closure planning commitments in the approved MOP.
The Regulator's rehabilitation performance observations were communicated to DCPL in the letter advice dated 8 June 2018. The inspection observations are outlined below.

Observation	Description
Observation 1	Rehabilitation progress is generally in accordance with the Mining Operations Plan.
Observation 2	Environmental Superintendent Michael Plain Mine reported progress against mine closure planning study commitments in the Mining Operations Plan. Mine Closure Planning studies appear to be progressing in accordance with commitments in the Mining Operations Plan. The Regulator notes that a number of technical assessments are due to be completed by 31 August 2018.
Observation 3	The Regulator holds concerns regarding the level of onsite resourcing for rehabilitation at Yancoal operations and specifically the resourcing to manage detailed mine closure planning and rehabilitation operations at Duralie Coal Mine.
Observation 4	Inspectors Cooper and Newton noted that there are opportunities to develop completion criteria to demonstrate success for mature rehabilitation areas. The Regulator encourages lease holders to seek confirmation that rehabilitation is to the satisfaction of the Department.

6. ENVIRONMENTAL PERFORMANCE

6.1 REVIEW OF ENVIRONMENTAL PERFORMANCE

A brief review of environmental performance in relation to EPL 11701, together with Project Approval conditions, is provided below. This performance is further discussed in the sections on environmental management activities and environmental monitoring.

6.1.1 Development Consent or Approval Conditions

DCPL continues to operate in accordance with the existing PA 08_0203.

Development Consent conditions which were met during this reporting period are described in the following sections. These include administrative and reporting conditions, environmental management and monitoring conditions, community engagement and rehabilitation. Environmental monitoring data was regularly reported as required by the development consent and associated EMPs.

EMPs required in accordance with the conditions of PA 08_0203 have been prepared and continued to be implemented during the reporting period. A MOP has been prepared for the DCM and approved by the Secretary for DRG on 11 December 2017.

An Independent Environmental Audit of the DCM was not required during the reporting period. The last IEA of the DCM was conducted during December 2017. Further detail is included on Section 10.

6.1.2 EPA Environment Protection Licence 11701

DCPL continues to operate in accordance with the conditions of EPL 11701. During the reporting period there were no identified non-compliances at the DCM.

- All monitoring has been carried out in accordance with licence conditions.
- Records of environmental monitoring activities have been kept.
- A record of environmental and pollution complaints has been maintained.
- Dust suppression measures are in place. Dust monitoring to date (dust deposition gauges, high volume (PM10) air samplers and a TEOM monitor) shows that current dust suppression systems have been effective and dust levels were below limits set by EPA (upon exclusion of non-dust contamination of dust deposition gauges).
- Quarterly noise compliance monitoring was undertaken in July 2018, October 2018 and January 2019. The surveys determined that mine noise emissions at the time of the surveys complied with EPA noise level criteria at all monitored locations.
- No sediment dam spills occurred during the reporting period.
- A Pollution Incident Response Management Plan (PIRMP) was maintained and is available on the Duralie Coal website.
- An Annual Return for EPL 11701 was prepared.
- No reportable environmental incidents occurred at the DCM during the reporting period.

During the reporting period four complaints were received via the EPA hotline regarding odours. Responses were provided to the EPA and details are included in the Complaints Register in **Appendix 7**.

6.2 METEOROLOGICAL MONITORING

A meteorological station (i.e. weather station) is operated at the mine site as required by the Project Approval conditions. The location of the meteorological station and the two inversion monitoring towers is shown on **Figure 3** (**Appendix 1**).

6.2.1 Rainfall

Table 11 provided below summarises the rainfall record obtained from the site Weather Station rain gauge. Graphical representation of the historical average and monthly recorded rainfall during the reporting period is provided in **Appendix 2**.

Table 11: Duralie Mine - Monthly Rainfall Records

MONTH	YEAR				STROUD DISTRICT
	2019 (to end reporting period)		2018		AVERAGE[2]
	Monthly Total (mm)	No. of Rain Days/Month[1]	Monthly Total (mm)	No. of Rain Days/Month[1]	1889-2010
January	30.4	8	26.4	5	115.3
February	45.2	7	130.4	9	125.0
March	173.6	15	246.6	10	147.3
April	36.2	11	50.0	11	100.9
May	37.6	5	28.6	6	91.5
June	69.4	12	114	17	101.1
July			5.2	5	75.1
August			15.4	4	65.3
September			45.8	11	63.1
October			125.6	15	78.3
November			55.2	12	83.3
December			93.2	11	100.8
TOTAL	**392.4**	**58**	**936.4**	**116**	**1147.0**

Notes:
1. No. of Rain Days/Month - the number of days in the month on which rain fell.
   (When tipping bucket rain gauge data used, a "rain day" by definition requires a minimum recording of >0.25mm comprising dew, heavy fog or light rain (or a combination thereof).
2. Average based on Stroud Post Office records until mine site weather station commissioned in 2002.

The 2018 calendar year rainfall total was significantly lower than the long-term district average. Four of the twelve months in this period exceeded their respective long term average.

The rainfall total for the reporting period (July 2018 to June 2019) was 732.8 mm, significantly lower than the historical average.

6.2.2 Evaporation

Table 12 shows minimum, average and maximum evaporation rates for the reporting period. The graphical representation of the daily minimum, average and maximum evaporation rates recorded for each month during this review period is provided in **Appendix 2**.

Table 12: Monthly Minimum, Average and Maximum Evaporation Rates

MONTH	MINIMUM EVAPORATION RATE (mm/day)	AVERAGE EVAPORATION RATE (mm/day)	MAXIMUM EVAPORATION RATE (mm/day)
July 2018	0.4	1.8	3.7
August 2018	1.0	2.5	3.7
September 2018	0.8	2.7	6.4
October 2018	0.5	2.5	4.3
November 2018	0.9	3.9	7.2
December 2018	0.9	4.4	7.4
January 2019	0.7	5.2	6.9
February 2019	1.0	4.3	7.8
March 2019	0.5	2.9	5.1
April 2019	0.9	1.9	3.8
May 2019	0.6	1.8	3.4
June 2019	0.3	1.0	1.8

6.2.3 Wind Speed and Direction

Table 13 below indicates the monthly average and maximum wind speeds and dominant wind directions for the period July 2018 to June 2019, inclusive. The graphical representation of the daily average and maximum wind speeds recorded and monthly wind roses for each month during this period are provided in **Appendix 2.**

Table 13: Monthly Average and Maximum Wind Speeds and Dominant Wind Directions by Month

MONTH	AVERAGE WIND SPEED (k/hr)	MAXIMUM WIND SPEED RECORDED (k/hr)	DOMINANT WIND DIRECTIONS
July 2018	6.4	45.8	W-WSW
August 2018	8.8	49.9	W
September 2018	8.4	41.2	SSW
October 2018	8.5	47.5	NE
November 2018	9.5	53.6	SW
December 2018	9.3	66.9	NE
January 2019	8.8	43.4	NE-ENE
February 2019	9.4	41.6	ENE
March 2019	8.1	68.2	NE-ENE
April 2019	5.5	33.0	S-SSW
May 2019	7.3	64.8	W
June 2019	5.7	43.7	SW-WSW

6.2.4 Temperature

Table 14 summarises monthly air temperatures. The graphical representation of the daily minimum, average and maximum atmospheric temperatures recorded for each month is provided in **Appendix 2**.

Table 14: Monthly Minimum, Average and Maximum Air Temperatures

MONTH	MINIMUM AIR TEMP RECORDED (deg C)	AVERAGE AIR TEMP (deg C)	MAXIMUM AIR TEMP RECORDED (deg C)
July 2018	-1.2	11.5	24.6
August 2018	0.2	12.2	24.5
September 2018	2.4	15.2	31.9
October 2018	6.2	17.6	30.6
November 2018	10.4	20.6	35.4
December 2018	11.5	23.1	38.4
January 2019	18.6	27.0	43.0
February 2019	13.6	23.7	41.1
March 2019	12.5	22.3	37.2
April 2019	7.8	18.2	32.4
May 2019	4.8	15.3	26.4
June 2019	1.7	12.2	25.1

6.3 AIR QUALITY

6.3.1 Dust Control Procedures

DCM has an approved Air Quality and Greenhouse Gas Management Plan (AQMP) that establishes a dust management strategy which:

- Identifies air quality criteria;
- Outlines proactive and responsive dust management and control measures;
- Establishes dust management protocols;
- Formulates an air quality monitoring programme;
- Establishes stakeholder consultation protocols; and
- Details reporting and review requirements.

The following dust control procedures are used during mining operations to control dust emissions from wind erosion on exposed areas and dust generated from mining, handling and processing activities:

- Minimising topsoil stripping operations ahead of the pre-strip to minimise the area of exposed ground;
- Progressive rehabilitation including prompt reshaping, topsoiling and revegetation;
- Watering of haul roads and other trafficked areas;
- Watering dig faces prior to and during digging;
- Fitting drills with dust suppression equipment including aprons and sprays;
- Water sprays on the ROM dump hopper and transfer point between the ROM and train loading bins;
- Water sprays during train coal loading;
- Real-time monitoring with alarm triggers set to enable implementation of reactive dust control management measures; and
- Modifying operations during adverse weather conditions.

6.3.2 Dust Monitoring and Criteria

DCPL monitors air quality (dust) surrounding the mine site by means of a network of nine (9) static dust fallout gauges, four (4) high volume PM_{10} air samplers, one real-time dust monitor (TEOM) and a meteorological monitoring station (i.e. weather station). The locations of these monitoring sites are shown on **Figure 3** (**Appendix 1**).

Monthly dust fallout levels are measured so that dust deposition rates in g/m^2/month can be determined at each monitoring site. The EPA annual average limit for dust deposition is 4.0g/m^2/month.

The high volume air samplers (HVAS) (PM_{10}) are located at locations representative of surrounding sensitive receivers, along Johnsons Creek Road ("Hattam" – located to the northeast of the mine, "Twin Houses" – located to the east of the mine and "High Noon" – located to the south of the mine). A HVAS unit is also located on private land along the Bucketts Way ("Edwards" – located west of the mine).

HVAS sampling occurs for a 24 hour period every 6 days in accordance with AS 2724.3. The EPA goal for air quality is an annual average limit of 30*u*g/m^3/day and a National Environmental Protection Measure (NEPM) 24-hour average limit of 50*u*g/m^3/day.

A Tapered Element Oscillating Microbalance (TEOM) analyser measuring PM_{10} and $PM_{2.5}$ is used to continuously measure particulate matter. Real-time air quality monitoring data is used to identify when ambient PM_{10} levels in the surrounding environment are elevated and require contingency action. Real-time response triggers have been established and are designed to provide a system to warn operation personnel (via SMS) when particulate emissions are approaching a relevant criterion and to implement a hierarchy of management/control actions to mitigate potential impacts.

6.3.3 Review of Dust Monitoring Results

6.3.3.1 Dust Deposition Gauges

Table 15 shows the dust deposition results for nine (9) dust deposition gauges. Gauge D7 is located within the Village of Wards River. **Table 16** shows the annual average dust deposition results at the end of the reporting period (June 2019).

Table 15: Dust Deposition Gauge Results

	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19
D3	$3.7^{I,B}$	2.1	1.5	$7.9^{I,S}$	0.8	2.5	1.6	$9.9^{I,V,S}$	$7.1^{I,V,S}$	$6.8^{I,B,V,S}$	$9.2^{I,V,S}$	$4.4^{I,V,S}$
D4	0.6	2.3	0.6	0.4	2.1	1.0	1.7	1.4	0.8	0.5	0.4	0.3
D5	$6.9^{I,V,S}$	3.0	0.5	4.8	$7.0^{I,V,B,S}$	1.8	1.8	2.5	3.7	2.1	0.2	1.3
D7	0.9	0.6	0.8	0.2	0.4	1.2	2.0	2.0	1.8	1.1	0.4	0.6
D8	0.4	0.4	0.7	0.1	0.6	0.9	1.7	1.8	1.3	1.5	0.4	0.3
D9	$4.9^{I,B,V,S}$	$10.2^{I,B,V,S}$	3.4	0.4	0.4	2.6	1.8	1.3	1.3	1.3	1.2	0.9
D10	$1.5^{I,V,O}$	0.7	1.5	0.3	0.8	1.4	2.7	1.6	1.2	0.6	0.5	0.8
D12	1.3	0.5	1.0	0.2	0.5	1.2	1.7	1.7	1.6	1.5	0.7	0.4
D13	$3.8^{I,B,V}$	1.1	2.0	0.3	0.6	0.8	2.3	1.2	2.3	3.4	$3.9^{B,V}$	0.6

Notes/excluded results, Visual Description Guide:
D=Dirt: Subhedral to euhedral crystalline grains including fine sand, clay and other fine mineral particulates.
C=Coal: Black sharp angled grains with glossy conchoidal fractures or dull with cellular feature.
I=Insects: Whole insects e.g. spiders, ants, moths or outer parts of insects including wings, legs and exoskeletons.
S=Polysaccharide Slime: Slimy gelatinous material including decomposed soft body parts of insects and vegetation.
V=Vegetation: Plant debris and algae including trichomes, decomposed organic matter and particulates showing characteristic cellular structures.
B=Bird droppings: The most common contamination.
O=Other contaminants not included above.

Dust levels recorded had an average value of 1.3 g/m^2/month (contaminated results not counted). Elevated values were at times affected by various degrees of contamination from insects, bird droppings, vegetation (seeds/grasses) and algae. An elevated result at Gauge D5 in October 2018 was

observed and was found not to be contaminated by bird droppings or vegetation. Consistently low HVAS results at the nearby Twin Houses site during the month and low results at all other dust gauges would support an outlying result conclusion. Nevertheless, this result has been included in the annual average calculation.

Table 16: Annual Average Dust Deposition Gauge Results

D3	D4	D5	D7	D8	D9	D10	D12	D13	EPA Limit
1.7	1.0	2.2	1.0	0.8	1.5	1.1	1.0	1.5	4.0

Results compared with the EPA annual average upper limit of 4 g/m^2/month indicate no exceedances against criteria at the end of the reporting period. Graphical representation of dust gauge results and annual rolling averages are provided in **Appendix 3**.

Results of depositional dust monitoring were generally similar to previous reporting periods and are in concurrence with the DCM Environmental Assessment (EA) (2010) which predicts the annual average criteria of 4 g/m^2/month will not be exceeded at any receiver and that project only incremental increases in annual average dust deposition will not exceed the applicable 2 g/m^2/month EPA criterion at any receiver.

6.3.3.2 High Volume (PM10) Air Samplers

Table 17 shows the PM_{10} HVAS monitoring results for the four HVAS in ug/m^3/day (24 hours) for the monitoring sites during the reporting period.

Results show that all monitoring locations (in terms of monitored days) did not exceed the National Environmental Protection Measure (NEPM) of 50ug/m^3/day during the reporting period listed under Condition 19, Schedule 3 of the Project Approval.

Table 17: High Volume Air Sampler (PM_{10}) Results

Date	High Noon	Twin Houses	Hattam	Edwards
6-Jul-18	4	6	5	5
12-Jul-18	2	5	4	4
18-Jul-18	21	35	13	26
24-Jul-18	12	27	14	11
30-Jul-18	5	16	13	17
5-Aug-18	21	26	24	23
11-Aug-18	8	13	11	11
17-Aug-18	9	17	14	17
23-Aug-18	8	19	14	16
29-Aug-18	8	12	10	10
4-Sep-18	2	4	2	2
10-Sep-18	6	10	11	8
16-Sep-18	16	25	25	23
22-Sep-18	7	9	8	9
28-Sep-18	6	9	5	5
4-Oct-18	8	8	12	11
10-Oct-18	6	19	6	7
16-Oct-18	6	7	6	7
22-Oct-18	8	9	8	8
28-Oct-18	13	16	14	16
3-Nov-18	19	22	25	20
9-Nov-18	7	10	8	10
15-Nov-18	15	23	28	14
21-Nov-18	8	7	8	8
27-Nov-18	8	15	10	12

Date	High Noon	Twin Houses	Hattam	Edwards
3-Dec-18	17	27	23	24
9-Dec-18	13	17	17	16
15-Dec-18	7	9	7	9
21-Dec-18	10	14	13	10
27-Dec-18	7	10	9	11
2-Jan-19	11	14	12	12
8-Jan-19	10	13	11	11
14-Jan-19	5	12	7	8
20-Jan-19	12	14	12	16
26-Jan-19	15	22	27	20
1-Feb-19	11	9	9	9
7-Feb-19	5	8	6	6
13-Feb-19	30	43	36	38
19-Feb-19	20	33	25	24
25-Feb-19	11	13	11	12
3-Mar-19	5	8	7	8
9-Mar-19	12	14	14	16
15-Mar-19	11	15	12	13
21-Mar-19	8	11	10	10
27-Mar-19	11	15	13	13
2-Apr-19	6	5	4	4
8-Apr-19	10	16	9	11
14-Apr-19	7	9	8	8
20-Apr-19	6	5	7	7
26-Apr-19	13	27	14	17
2-May-19	9	13	10	9
8-May-19	10	11	10	11
14-May-19	3	7	6	6
20-May-19	3	10	5	4
26-May-19	7	10	9	8
1-Jun-19	5	7	6	7
7-Jun-19	4	7	6	6
13-Jun-19	6	9	6	5
19-Jun-19	1	5	3	2
25-Jun-19	2	3	2	3
22-Oct-18	8	9	8	8
Annual Rolling Average	**9.2**	**13.8**	**11.3**	**11.5**

Annual averages for all sampling locations were below the 30 µg/m^3/day criterion set under the Project Approval. Graphical representation of the annual rolling average for the four HVAS including PM10 and TSP during the reporting period is provided in **Appendix 3**. The HVAS rolling averages remained generally steady throughout the reporting period. The rolling average at the end of the reporting period for "High Noon" was 9.2, "Twin Houses" was 13.8, "Hattam" was 11.3 and Edwards was 11.5 ug/m^3/day. Thus, annual averages for all sampling locations were well below the 30 ug/m^3/day criterion.

Results of HVAS monitoring are in concurrence with the DCM EA (2010) which predicts the annual average PM_{10} criterion of 30 µg/m^3 will not be exceeded at any receiver and that project only 24 hour PM_{10} concentrations will not be above the 50 µg/m^3 criterion at any privately owned receiver with the exception of "Hattam" which is now mine owned and in close proximity to the mining operations. All results at all sites were below the 50 µg/m^3 24 hour criterion during the reporting period. The HVAS annual rolling averages remained low and fluctuations generally reflect changes in meteorological conditions throughout the year, i.e. rainfall and wind.

6.3.3.3 High Volume (TSP) Air Calculation

Concentrations of TSP are calculated, based on the results of the PM_{10} HVAS and the assumption that 40% of TSP is PM_{10}, as per the relationship obtained from co-located TSP and PM_{10} monitors operated in the Hunter Valley (NSW Minerals Council, 2000) as per the approved AGMP.

The derived TSP annual rolling averages for the four HVAS are shown in **Appendix 3**. The TSP rolling average at the end of the reporting period for "High Noon" was 23.0, "Twin Houses" was 34.4, "Hattam" was 28.2 and Edwards was 28.7 ug/m^3/day. Thus, annual averages for all sampling locations were below the 90 ug/m^3/day criterion.

6.3.3.4 TEOM (PM_{10}) Monitoring

A TEOM which measures PM_{10} and $PM_{2.5}$ on a real-time continuous basis is utilised as a management tool for operations to guide proactive and reactive mitigation measures. Real-time air quality monitoring data is used to identify when ambient PM_{10} levels in the surrounding environment are elevated and require contingency action. Real-time response triggers have been established and are designed to provide a system to warn operation personnel (via SMS) when dust levels are approaching a relevant criterion and to require management/control actions to mitigate potential impacts.

24 hour average results for the reporting period and graphical representation of the running/cumulative average of PM_{10} results are provided in **Appendix 3.** The annual average from 1 July 2018 to 30 June 2019 is 13.1 ug/m^3 for $PM_{10.}$ The TEOM results are generally consistent with those measured by the HVAS units.

A register was maintained recording any trigger alarms from the TEOM system and the response implemented by DCPL. All alarms during the reporting period resulted from either external events such as bushfires, strong winds and regional dust storms or system calibration and maintenance. A real-time dust monitoring response register for the reporting period is provided in **Appendix 3.**

6.3.4 Complaints

Four (4) air quality related complaints were received during the reporting period. The air quality complaints received were all related to odour. No complaints were received relating to dust. A detailed complaints list is provided in **Appendix 7**. All complaints are responded to promptly and details of the complaint responses and outcomes are provided in **Appendix 7**.

6.4 BIOREMEDIATION

Operations at the DCM are conducted with the aim of minimising the potential for land contamination. The management of hydrocarbon contaminated soils is detailed in the Duralie Coal PIRMP. DCM has previously operated an onsite bioremediation area for hydrocarbon contaminated soil where biological degradation of hydrocarbons is used to reduce the hydrocarbon concentration in the soil to an acceptable level.

The bioremediation area at the DCM was decommissioned during the previous reporting period, following the ceasing of operations and maintenance activities at the DCM. A logbook was previously kept which covers deposition, maintenance and disposal of materials from the bioremediation area. Following testing of the soils placed in the bioremediation facility, soils with suitably low hydrocarbon levels are removed and disposed in the pit.

6.5 BIODIVERSITY

The DCM Annual Biodiversity Report 2019 provides a review of the effectiveness of measures in the Biodiversity Management Plan (BMP) for the annual year ending 30 June 2019 in accordance with Section 7.2 of the BMP. This report covers biodiversity management activities across both the Mining Lease areas and the Biodiversity Offset Areas. In accordance with Condition 33, Schedule 3 of the Project Approval, DCM is required to implement the Offset strategy and achieve the broad completion criteria to the satisfaction of the Secretary of the DP&E.

Following the DCM Independent Environmental Audit undertaken in December 2017 a revision of the BMP was prepared for the three year period between August 2018 and July 2021 and includes broader concepts for the longer term (6+ years) management since commencement of the BMP in 2012. The key changes to the BMP include relevant updates to the performance and completion criteria tables with consideration to the works which have been completed to date.

In accordance with the BMP, the DCM Annual Biodiversity Report 2019 is included in **Appendix 8**. A brief summary of main findings and conclusions are provided in the subsections below.

6.5.1 Vegetation Clearance Report

Vegetation clearance is undertaken in accordance with the BMP Section 5.4 Vegetation Clearance Plan. Prior to any clearance operations a Clearing Plan is prepared, and vegetation pre-clearance surveys are undertaken.

Vegetation clearance for the Duralie Extension Project was finalised in 2017. During the 2018/2019 reporting period, no vegetation clearance was undertaken.

The area of disturbance at the end of June 2019 is shown in the DCM Annual Review 2019 **Figure 4 (Appendix 1)**.

Information obtained during vegetation clearance activities (i.e. habitat features, hollows cleared and fauna observed) has been used to determine the requirements for nest box replacement in the Biodiversity Offset Areas (refer Section 4).

6.5.2 Nest Box Program

Nest box management is undertaken in accordance with the BMP Section 6.4. Nest boxes have been installed to provide habitat opportunities in the short to medium-term for a number of arboreal fauna species including the Squirrel Glider.

AMBS Ecology & Heritage (AMBS) was commissioned to implement the Nest Box Program as described in the BMP Section 5.4.2 and Section 6.4.

The nest box program currently involves:

- 18 nest boxes targeting the Squirrel Glider (Petaurus norfolcensis), installed during February 2013;
- 106 nest boxes targeting a variety of hollow-dependent species, installed during August 2013;
- 45 nest boxes targeting a variety of hollow-dependent species, installed during September 2014; and
- 42 nest boxes targeting a variety of hollow-dependent species, installed during September 2016.

Results of the *2017 - 2018 Nest Box Programme for the Duralie Offset Area Report (AMBS, June 2018)* are summarised below;

"Fourteen species were recorded or shown signs of previous occupation during the current reporting period, including the Squirrel Glider, Sugar Glider, Feathertail Glider, Brush-tailed Phascogale, Brown Antechinus, Common Brushtail Possum, Mountain Brushtail Possum, Common Ringtail Possum, Gould's Wattled Bat, Lesser Long-eared Bat, Australian Wood Duck, Masked Owl, White-throated Treecreeper and Australian Owlet-nightjar. The record of the Mountain Brushtail Possum is the first for the Nest Box Programme. Species recorded previously but not during the current reporting period include the Bush Rat [probable], Gould's Long-eared Bat, a Free-tailed Bat, Australian King-Parrot, Eastern Rosella, Peron's Tree Frog, Lace Monitor, Common Tree Snake and Diamond/Carpet Python). Twenty-three vertebrate species have now been recorded within nest boxes during the Nest Box Programme.

Three of the species recorded utilising the nest boxes are listed as vulnerable under the NSW Biodiversity Conservation Act 2016 (BC Act), the Squirrel Glider, Brush-tailed Phascogale and Masked Owl. Other threatened species recorded during the surveys in offset areas but not within nest boxes included the Varied Sittella, Square-tailed Kite, Glossy Black-Cockatoo and Koala. These are listed as vulnerable under the BC Act, while the Koala is also listed as vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

The majority of nest boxes were in good condition, although two nest boxes required replacing during September 2018. This included one Phascogale nest box at C4 and one Feathertail Glider nest box at A45. Minor degradation was noted on several other nest boxes, such as peeling or splitting of the plywood, slight warping of the lid, disintegration of the brace plate, chewing of entrance holes, small cracks on the outside of the nest box, and moisture appearing inside the nest box. One nest box is likely to required replacing during the next monitoring survey.

Overall, a total of 182 out of 210 nest boxes, or approximately 87%, have been occupied or shown signs of occupancy since their installation. This includes 100% of the Squirrel Glider nest boxes installed in February 2013, 76% of the additional nest boxes installed in August 2013, 91% of the additional nest boxes installed in September 2014, and 83% of the additional nest boxes installed in September 2016.

Occupancy of the nest boxes installed in August 2013 is lower than the other nest box groups, mostly due to the low occupation rate of animals within Feathertail Glider nest boxes, and the original single, double and four-chambered Microbat nest boxes. When these nest box designs are removed from the calculations, occupancy of the remaining nest boxes installed in August 2013 is 99%, and overall occupancy is 170 out of 175 nest boxes (approximately 97%). We recommend replacing the existing Feathertail Glider nest boxes with a design that has been demonstrated to be successful within the study area for occupation by fauna, as well as relocating microbat nest boxes that have been installed for 2 or more years and not shown signs of occupancy.

A total of twenty-three vertebrate species have now been recorded within nest boxes during the Nest Box Programme. This includes thirteen species of mammal, six species of bird, one species of frog, and three species of reptile."

6.5.3 Weed Control and Monitoring

The weed control program aims to manage weeds to minimise their impact on native flora and fauna.

A contractor is engaged at the DCM to undertake weed management activities on an ongoing basis. Follow-up weed treatment of all remnant enhancement and regrowth management Vegetation Management Units (VMUs) recommenced in October 2018 and continued through to May 2019. Additional weed management activities within the Mining Lease areas recommenced in September 2018. The key species targeted included blackberry, lantana, privet, wild tobacco and Giant Parramatta grass. This is the sixth round of weed control activities in the offset areas.

During 2017/2018, the removal of privet and wild tobacco adjacent to Mammy Johnsons River in the Biodiversity Offset areas was undertaken using mechanical removal (slashing), and chemical spraying in accordance with previous advice from the MidCoast Council (MCC) Weeds Officer.

Weeds monitoring to evaluate the effectiveness of control measures is undertaken in conjunction with the annual vegetation monitoring and is documented in the *Duralie Coal Mine Biodiversity Offsets Monitoring of Landscape Function and Vegetation Structure, January 2019*.

Monitoring of the VMUs including the effectiveness of weed control will continue to be undertaken in conjunction with the Landscape Function Analysis (LFA) and vegetation monitoring. The 2019 monitoring report indicates that:

> *The installation VMUs generally consisted of exotic grasses and forbs, and observations of weeds were limited to environmental weeds. These included Blackberry, Camphor Laurel, Lantana, Privet and Wild Tobacco. Ongoing weed control works has resulted in only sparse occurrences of these weeds, except for VMU P and the remnant vegetation VMUs where steep slopes and access issues have allowed Lantana to become denser in places.*
>
> *Recommendation:*
> - *Targeted weed control in the remnant patches to prevent outcompeting the re-establishing native vegetation, with more widespread control works elsewhere.*

6.5.4 Feral Animal Control and Monitoring

The objective of feral animal control program is to manage feral animals to minimise their impact on native flora and fauna in the Biodiversity Offset Areas or the impact on agricultural production in other surrounding areas.

MDP Vertebrate Pest Management has been engaged by DCPL since 2016 to implement wild dog and fox control programs across property owned by DCPL including both the Stratford & Duralie Mining Leases and the Stratford & Duralie Biodiversity Offset Areas. During the reporting period wild dog control was undertaken between August 2018 to September 2018 and in May 2019. The program involved a combination of trapping and shooting.

In accordance with the BMP Section 5.10 a follow-up feral animal survey was undertaken by AMBS Ecology & Heritage (AMBS) during April 2017 to monitor the success of control programs and determine priorities for ongoing control measures. A summary of the survey results is included in the Annual Biodiversity Report 2019 (**Appendix 8**).

6.5.5 Controlling Access and Managing Grazing

The BMP requires works to be undertaken to exclude livestock and control access to the Biodiversity Offset Areas.

During the reporting period contractors were engaged to undertake maintenance activities on access tracks, culverts, gates and fences. The works included slashing of tracks, firebreaks and repairs to damaged gates and culverts. Additional signage was also installed on the key access points to the Biodiversity Offset Areas.

Livestock continue to be excluded from the Biodiversity Offset areas with the exception of ‘crash grazing’ programs in preparation for revegetation activities following a field assessment by a qualified consultant. However, during inspections of the Biodiversity Offset area, cattle were identified to have entered through damaged fencing on the eastern and northern boundaries. The cattle were removed and maintenance work was undertaken to repair the fencing.

6.5.6 Bushfire Management

The objective of bushfire management in the Biodiversity Areas is to prevent impacts from unplanned bushfire and to use fire to promote biodiversity.

To assist with bushfire management, access tracks and firebreaks have been constructed and maintained as shown in the BMP Figure 9.

DCPL engaged the NSW Rural Fire Service (RFS) in August 2015 to assist in the development of a burn plan for hazard reduction burning in select areas of the Biodiversity Offset areas and surrounding mine owned properties. The burn plan considered areas where fire was to be excluded for bush regeneration in the Biodiversity Offset areas and areas were burning was required for hazard reduction prior to revegetation activities. A hazard reduction burn was undertaken by the RFS along Johnsons Creek Road on 13 August 2017.

Continued discussions have been held with the RFS to conduct fire management activities and any such activities will be assessed and implemented to ensure the most appropriate period for ecological burn activities whilst also giving due consideration to personnel and asset safety.

Monitoring of fuel loads to evaluate bushfire risk and guide bushfire hazard reduction activities is undertaken in conjunction with the annual vegetation monitoring.

6.5.7 Seed Collection and Propagation

Revegetation in the BMP Revegetation Areas has occurred via seed and tubestock. Local endemic species are preferentially used where a seed supply is available, however consideration will be given to the use of a high quality seed sourced further from the site as required.

Where possible, seed required for revegetation activities has been collected from within the Biodiversity Offset area and surrounds. Specific tree and shrub species which have not been available for collection have been sourced through external third-party suppliers. Further seed collection may be undertaken if found necessary to meet the completion criteria of the BMP offset revegetation and mine site rehabilitation.

Kleinfelder and Cumberland Plain Seed have been engaged to assist in the propagation of native plant species with tube-stock grown under controlled nursery conditions and delivered to site as required for revegetation works.

6.5.8 Revegetation and Regeneration Management

The aim of revegetation is to establish a range of habitat niches including native canopy, and understorey, with the goal of achieving self-sustaining vegetation communities as well as increasing the resilience to identified risks such as fire, herbivory and future weed
invasion.

Revegetation works in the Duralie biodiversity offset have been undertaken progressively since the implementation of the BMP.

Revegetation trials were undertaken during December 2016 and included ground preparation and direct seeding of approximately 80 hectares. Due to the inability to undertake controlled burning, slashing was undertaken as an alternative option prior to direct and broadcast seeding.

Tubestock was propagated during Summer 2016/2017 in preparation for Autumn planting in 2017. VMUs Y, AD and S, (approximately 40 hectares), located on alluvial flats near Mammy Johnsons River were prepared for planting by slashing, spraying for weeds and ripping. This was followed by the planting of approximately 7,200 tube-stock in April 2017. The results of the re-vegetation activities are reported in the *DCM Biodiversity Offsets Revegetation Program Report Spring 2016 - Autumn 2017*.

Following the hazard reduction burning in August 2017, revegetation works in VMUs Z, AB and AC were undertaken. In September 2017, direct seeding of approximately 52 hectares was completed, followed by harrowing.

Tube-stock planting of VMUs F, V, W and X was proposed for Autumn 2018 including approximately 16,000 plants over 61 hectares. The native tree seed was propagated over the Summer of 2017/2018 by Cumberland Plain Seeds. However, due to the slower than expected establishment of the tubestock, planting has been postponed during winter and completed in September 2018. The results of the 2018 re-vegetation activities are reported in the *DCM Biodiversity Offsets Results of Spring 2018 Planting Report*.

During Spring 2019, further revegetation works are proposed to reach the required woodland density and species diversity in VMUs F, V, W, X and AH. A total of approximately 14,400 trees and shrubs over 61 hectares will be planted and the tubestock is currently being grown.

6.5.9 Biodiversity Offset Monitoring and Reporting

The BMP monitoring program aims to monitor and report on the effectiveness of the BMP management measures and progress against the detailed performance and completion criteria. As described in the Section 7 of the BMP an annual report reviewing DCPL's environmental performance and progress against the requirements of the BMP including monitoring and reporting is prepared annually and appended to this *Duralie Coal Mine Annual Review*.

The DCM Annual Biodiversity Report 2019 for the annual year ending 30 June 2019 is included in **Appendix 8** and reports on monitoring for:

- Effectiveness of revegetation in the offset area;
- Usage of the offset by fauna;
- Effectiveness of weed control;
- Effectiveness of feral animal control;
- Nest box monitoring program.

Habitat and vegetation condition monitoring is undertaken to quantitatively measure the change in habitat and vegetation condition over time. The visual monitoring and photo monitoring programs are undertaken concurrently with the vegetation monitoring to provide additional information on the change of the Biodiversity Areas over time and inform maintenance requirements.

Initial vegetation surveys were undertaken in 2013 and 2014. The annual vegetation and landscape function monitoring was repeated in March 2019 and the results are provided in the *DCM Biodiversity Offset Monitoring of Landscape Function and Vegetation Structure 2019*. A summary of the survey results is included in the Annual Biodiversity Report 2019 (**Appendix 8**). The next round of monitoring is scheduled for early 2020.

Monitoring of fauna usage within the Biodiversity Areas is conducted every three years to document the fauna species response to improvement in vegetation and habitat in the Biodiversity Areas and assess the performance in providing habitat for a range of vertebrate fauna. The surveys include an assessment of habitat complexity, species richness and abundance.

AMBS was engaged to undertake fauna monitoring within the Biodiversity Offset areas and mine rehabilitation areas during February 2018. The results are provided in the *DCM Fauna Surveys of the Offset and Mine Rehabilitation Areas, February 2018*. A summary of the survey results is included in the Annual Biodiversity Report 2019 (**Appendix 8**).

6.5.10 Long Term Security and Conservation Bond

Long-term Security

In accordance with Condition 42, Schedule 3 of the Project Approval, DCPL is required to make suitable arrangements for the long-term security of the Duralie Extension Project Biodiversity Offset Area. DCPL used the mechanisms available under section 88E(3) of the NSW Conveyancing Act, 1919, namely:

- Registration of a Positive Covenant under section 88E(3) of the NSW Conveyancing Act, 1919; and
- Registration of a Restriction on the Use of Land by a Prescribed Authority under section 88E(3) of the NSW Conveyancing Act, 1919.

Public Positive Covenants and Restrictions on the Use of Land for the Biodiversity Offsets have been registered on title with NSW Land and Property Information (LPI) in May 2015.

Conservation Bond

In accordance with Condition 44, Schedule 3 of the Project Approval, DCPL is required to lodge a Conservation Bond with the DP&E which covers the cost of implementing the Biodiversity Offset Strategy detailed in the BMP.

The conservation bond for the Biodiversity Offset areas was calculated by Greening Australia and verified by Rider Levett Bucknell in December 2013. The terms of the conservation bond in the form of a Bank Guarantee were approved by then DP&E on 12 December 2013. The Bank Guarantee has been subsequently provided to DP&E.

In December 2017 an Independent Environmental Audit of the DCM was undertaken in accordance with PA 08_0203. A revision of the BMP was approved in January 2019 in accordance with Condition 4, Schedule 5 of the Project Approval . Following this, a revision of the conservation bond will be prepared and lodged with DP&E in accordance with Schedule 3 Condition 45. The revised conservation bond will be lodged in the next reporting period.

6.5.11 Complaints

No complaints related to the management of biodiversity were received during the reporting period. A full detailed complaints list is provided in **Appendix 7**.

6.6 GIANT BARRED FROG MANAGEMENT

Management and monitoring of the Giant Barred Frog population is conducted in accordance with the approved Duralie Coal Mine Giant Barred Frog Management Plan (GBFMP). The GBF monitoring has been undertaken to establish baseline data of the frog population and monitor whether a greater than negligible impact on the Giant Barred Frog population has occurred as a result of rainfall runoff from the mine's irrigation areas. Monitoring results are used to assess the DCM against performance measures detailed in the GBFMP.

Annual monitoring and reporting on the implementation of the Giant Barred Frog Management Plan was undertaken between 2011 and 2016.

During a previous reporting period (2015/2016), the GBFMP was revised with proposed changes to the GBF monitoring program. The GBFMP was approved by DP&E on 17 December 2015 and by the Commonwealth Department of the Environment (DotE), on 4 January 2016 and is available on the Duralie Coal website.

As stated in Section 7 of the GBFMP the timing and frequency of monitoring will be triggered upon

commencement of irrigation within the Duralie Extension Project irrigation areas. To date, the DCM has yet to begin irrigation activities associated with the Duralie Extension Project and as such, the Project has not presented a potential impact on the Giant Barred Frog population.

No further monitoring of the Giant Barred Frog was required during 2018/19 in accordance with the GBFMP. An assessment of any future irrigation activities within the approved irrigation areas will be undertaken on an annual basis to inform ongoing survey effort.

In accordance with Condition 31A, Schedule 3 of the Project Approval and the GBFMP, DCPL is required to prepare a long-term study on the life-cycle and population of the GBF. This study will be prepared during the next reporting period.

6.7 BLASTING

6.7.1 Blast Criteria and Control Procedures

Blasting at the DCM is conducted in accordance with Conditions 8-15, Schedule 3 of the Project Approval and respective EPL conditions and the approved Blast Management Plan (BLMP).

The BLMP establishes a blast management strategy which:

- Identifies blasting criteria;
- Outlines blast management and control measures;
- Establishes blast management protocols;
- Formulates a blast monitoring programme;
- Details reporting and review requirements.

EPL condition L5 and Condition 8 of the Project Approval state that overpressure caused by blasting at monitored locations may exceed 115 dB(L) for no more than 5% of blasts during the reporting period and must not exceed 120 dB(L) at any time. Similarly, ground vibration at monitored locations caused by blasting may exceed a peak particle velocity of 5 mm/s for no more than 5% of blasts during the reporting period and not exceed 10 mm/s. Additionally, blasting must not exceed 5mm/s at Mammy Johnson's grave or 10mm/s at Former Weismantel's Inn.

In accordance with Condition 13(b) of the Project Approval, a dedicated blasting hotline is available to provide current scheduled blasting times for the DCM. Persons living within two (2) kilometres of an active or approved operational area may also request advice of scheduled blasting activities.

The permitted blasting hours and frequency are prescribed in the Project Approval. Blasting is permitted between 9am and 5pm on Monday to Saturday only. Additionally, a maximum of 1 blast per day is permitted on site and an annual average of 3 blasts per week.

A total of 5 blasts were undertaken on site during the 2018/19 reporting period. During the reporting period DCPL were compliant with the permitted blast hours and frequency. The full results are provided in **Appendix 5**. Blasting activities at the DCM ceased in August 2018

Blasting activities are designed and managed in accordance with the BLMP.

6.7.2 Review of Blast Monitoring Results

The locations of blast monitoring units are shown on **Figure 3 (Appendix 1)**. Blast monitors are located on the following residences:

- Schultz Property (Bucketts Way, south west of mine);
- Moylan Property (West);
- Fisher-Webster Property (North); and
- Former Weismantels Inn (West).

Airblast overpressure and ground vibration results for all blasts undertaken during the reporting period are provided in **Appendix 5** and summarised below.

Overpressure Results

During the reporting period (period ending 30 June 2019) there were no blasts events which exceeded the overpressure criteria limit of 120 dBL. There were also no blasts where overpressure exceeded 115 dBL during the reporting period.

Vibration Results

During the reporting period (period ending 30 June 2019) there were no blasts where ground vibration exceeded 5 mm/s.

The 2010 EA provides predictions on blast emissions for various residential receivers. The blasting predictions indicate that blasting emissions would generally comply with airblast criterion of 115 dBL and ground vibration of 5 mm/s at nearby private receivers. During the reporting period, predicted blast emissions were generally consistent with measured values.

Fume Results

During the reporting period, no fume was recorded from any blasts.

6.7.3 Property Inspections & Investigations

Building condition surveys of several privately owned dwellings located in the vicinity (within 2kms) of the mine are routinely carried out by an independent structural engineer. In addition, surveys may be commissioned following a request by a landowner concerned about dwelling damage which they consider may be related to blasting activity (Condition 11, Schedule 3).

During the reporting period, no building inspections of private residences were undertaken. No requests were received from any landowners to undertake a building inspection or to update a previous inspection report.

Blasting activities at the DCM ceased during the reporting period.

Former Weismantel's Inn is a heritage listed building owned by DCPL An inspection of the Former Weismantel's Inn was undertaken in October 2017 and reported there is no evidence that the former Weismantel Inn building has been affected by blast-induced ground vibrations

6.7.4 Complaints

No blast related complaints were received during the reporting period. A full detailed complaints list is provided in **Appendix 7**.

6.8 NOISE

6.8.1 Noise Criteria and Control Procedures

DCM has an approved Noise Management Plan (NMP) that establishes a noise management strategy which:

- Identifies noise criteria;
- Outlines proactive and responsive noise management and control measures;
- Formulates a noise monitoring program;
- Establishes data assessment protocols; and
- Details reporting and review requirements.

Noise emissions from the DCM are managed in accordance with the criteria and procedures described in the NMP. The noise criteria are specified in PA 08_0203 and EPL 11701. The NMP was revised and updated during the previous reporting period to reflect the ongoing monitoring requirements at times when no operations are occurring at the Duralie mine.

DCPL implements measures to ensure noise from the DCM is managed to approved levels, through a combination of the following:

- ensuring best management practices are implemented and reviewed;
- implementing noise controls to reduce noise from the source and attenuate noise transmission; and
- if necessary, implementing measures to control noise at receivers following a review of monitoring data.

Mining operations are permitted 24 hours per day and 7 days per week in accordance with the EA 2010. During the reporting period SCPL complied with the approved operating hours.

During the reporting period mining was undertaken during Monday to Friday with no weekend work. Additionally, nightshift operations ceased during July 2018 and the remaining day shift operations ceased in October 2018. Since this time only rehabilitation day works have been undertaken.

The noise monitoring program includes both attended noise surveys and real-time noise monitoring. The results of compliance attended monitoring are used to assess compliance with relevant noise impact assessment criteria in the NMP. Real-time noise monitoring results are used for ongoing performance assessment and will assist in the implementation of pre-emptive management actions to avoid potential non-compliances.

DCPL undertakes quarterly attended noise monitoring surveys in accordance with the NMP in order to determine the status of compliance with noise limits. Attended noise surveys were conducted during the reporting period. These surveys were conducted during July 2018, October 2018 and January 2019. Attended noise monitoring has now ceased following the cessation of mining operations in accordance with the NMP.

A Sentinex real-time noise (RTN) monitor provides a management tool for operations to measure mine contribution noise emissions and implement management controls as outlined under the approved NMP.

The noise monitoring program also includes rail noise monitoring and mobile plant monitoring. The locations of noise monitoring sites are shown on **Figure 3 (Appendix 1)**.

6.8.2 Review of Attended Noise Monitoring Results

The summary results of the attended noise surveys undertaken during the reporting period are provided in **Tables 18 to 22**. Noise monitoring locations are shown on **Figure 3** (**Appendix 1**). The full Noise Survey Reports are available at the Duralie Coal website (www.duraliecoal.com.au).

Note that the noise criteria do not apply on sites which are DCPL owned or if there is a written agreement between DCPL and the landowner (refer to footnotes).

July 2018 Survey

Table 18: Noise Performance Assessment – Operations – July 2018 Survey

Location	Estimated DCM LAeq(15minute) Contribution dBA			Noise Criteria LAeq(15minute) dBA			Compliance		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
NM1 Woodley	I/A	28	31	35	35	35	Yes	Yes	Yes
NM4 Fisher-Webster	I/A	I/A	<25	35	35	37	Yes	Yes	Yes
NM5 Moylan	I/A	I/A	34	35	35	35	Yes	Yes	Yes
NM6 Oleksiuk and Carmody	I/A	I/A	<25	35	35	39	Yes	Yes	Yes
WR1 Wards River Village	I/A	<25	<25	35	35	35	Yes	Yes	Yes

I/A = Inaudible

Table 19: Performance Assessment – Sleep Disturbance – July 2018 Survey

Location	DCM LA1(1minute) Contribution	Noise Criteria LA1(1minute)	Compliance
NM1 Woodley	36	45	Yes
NM4 Fisher-Webster	28	45	Yes
NM5 Moylan	42	45	Yes
NM6 Oleksiuk and Carmody	27	45	Yes
WR1 Wards River Village	31	45	Yes

Compliance with the relevant noise criteria was achieved at all noise monitoring locations during the day, evening and night periods during the July 2018 surveys.

Based on the measured DCM noise contribution, compliance with the relevant sleep disturbance noise criteria was achieved at all noise monitoring locations during the night-time noise monitoring period.

October 2018 Survey

Table 20: Noise Performance Assessment – Operations – October 2018 Survey

Location	Estimated DCM LAeq(15minute) Contribution dBA			Noise Criteria LAeq(15minute) dBA			Compliance		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
NM1 Woodley	I/A	I/A	I/A	35	35	35	Yes	Yes	Yes
NM4 Fisher-Webster	I/A	I/A	I/A	35	35	37	Yes	Yes	Yes
NM5 Moylan	I/A	I/A	I/A	35	35	35	Yes	Yes	Yes
NM6 Oleksiuk and Carmody	I/A	I/A	I/A	35	35	39	Yes	Yes	Yes
WR1 Wards River Village	I/A	I/A	I/A	35	35	35	Yes	Yes	Yes

I/A = Inaudible

Table 21: Performance Assessment – Sleep Disturbance – October 2018 Survey

Location	DCM LA1(1minute) Contribution	Noise Criteria LA1(1minute)	Compliance
NM1 Woodley	I/A	45	Yes
NM4 Fisher-Webster	I/A	45	Yes
NM5 Moylan	I/A	45	Yes
NM6 Oleksiuk and Carmody	I/A	45	Yes
WR1 Wards River Village	I/A	45	Yes

I/A = Inaudible

Compliance with the relevant noise criteria was achieved at all noise monitoring locations during the day, evening and night periods during the October 2018 surveys.

Based on the measured DCM noise contribution, compliance with the relevant sleep disturbance noise criteria was achieved at all noise monitoring locations during the night-time noise monitoring period.

January 2019 Survey

Table 22: Noise Performance Assessment – Operations – January 2019 Survey

Location	Estimated DCM LAeq(15minute) Contribution dBA	Noise Criteria LAeq(15minute) dBA	Compliance
	Day	Day	Day
NM1 Woodley	I/A	35	Yes
NM4 Fisher-Webster	I/A	35	Yes
NM5 Moylan	I/A	35	Yes
NM6 Oleksiuk and Carmody	I/A	35	Yes

I/A = Inaudible

Compliance with the relevant noise criteria was achieved at all noise monitoring locations during the day during the January 2019 surveys.

The 2010 EA and 2014 EA provide predictions on mine contributed noise emissions for various operational years. Year 5 (2015) was predicted as the maximum operational noise levels for the Modification Project with reduced operational noise from 2016 to 2019. In terms of the four monitoring locations ("Woodley", "Fisher-Webster", "Moylan" and "Oleksiuk & Carmody") predicted mine contributed noise emissions were consistent with measured values for all locations factoring in the current fleet operating at the DCM.

6.8.3 Real Time Noise Monitoring System

A real-time noise monitoring response protocol is described in the NMP Section 7.3.5. Real-time monitoring is used as a management tool to assist DCPL to take proactive management actions and implement additional noise mitigation measures to avoid potential non-compliances. Noise investigation triggers have been established which send alarms when noise emissions are approaching levels which may exceed the noise criteria at privately-owned receivers. Details of any RTN alarms and the operational responses implemented by DCPL are recorded in the RTN Response Register.

During the previous reporting period weekend operations were ceased at the DCM. Additionally, during the 2018/19 reporting period nightshift operations ceased during July 2018 and the remaining day shift operations ceased in October 2018. Since this time only rehabilitation day works have been undertaken. The RTN monitor located to the north of the DCM was decommissioned

during the reporting period in accordance with the NMP following the cessation of mining operations.

In general, alarms during the reporting period related to abnormal meteorological conditions such as wind and rain or other ambient noise sources such as vehicle traffic, birds and insects. Additionally, several of the alarms were received at times when no operations were occurring, i.e. weekends.

To address any noise alarms regardless of inversion presence, DCM implemented the management measures described in the NMP Section 6. Additionally, DCM implement operational management measures in accordance with the real-time noise monitoring response protocol described in the NMP Section 7.3.5.

6.8.4 Rail Noise Monitoring

The NMP requires that rail noise monitoring is undertaken on a quarterly basis at the existing Wards River and Craven locations during shuttle train operations. Rail noise monitoring is reported against rail noise criteria described in Section 4 of the NMP and is undertaken for general information purposes only (i.e. they are not DCM compliance requirements).

Rail operations aim to progressively reduce noise levels to the goals of 65dB(A)Leq, (daytime from 7am – 10pm), 60dB(A)Leq (night-time from 10pm –7am) and 85dB(A) (24hr) max pass-by noise, at one metre from the façade of affected residential properties. Additionally, Condition 4(e), Schedule 3 of the Project Approval includes a notification requirement for affected residents were the maximum rail pass-by noise exceeds 85dB(A).

Rail noise monitoring was conducted during the July 2018 and October 2018 Noise Surveys when shuttle trains were operating. Rail Noise Survey results are included in the Noise Survey reports which are available at the Duralie Coal website (www.duraliecoal.com.au). Attended noise measurements were conducted at all three locations, TN1 (Craven), TN2 (Wards River Village North) and TN3 (Wards River Village South).

During the July 2018 and October 2018 surveys, maximum Duralie Shuttle rail pass-by noise levels were below 85dBA at all receiver locations, excluding the sounding of horns on approach to level crossings. Notifications requirements in accordance with the NMP relate to the L_{Amax} levels and were deemed to be compliant for the annual reporting period.

The transport of ROM coal from the DCM via shuttle train ceased during October 2018 with the last train railed on 4 October 2018.

6.8.5 Mobile Plant Noise Assessments

The DCM fleet of mobile plant including haul trucks, excavators, dozers, graders and other items are required to be assessed annually for sound power levels (SWL) in accordance with the NMP. SWL's are compared to the target SWL's referred to in the 2010 EA and 2014 EA and are also compared to historical results to track performance over time. Availability of mobile plant for noise testing is subject to production requirements and servicing/maintenance/breakdowns.

The current mining fleet is shown in Section 4.3.1 of this report.

During the reporting period mining operations were progressively ceased and the mobile plant has mostly been relocated from site. Much of the mobile plant fleet has been relocated to the nearby Stratford Mining Complex and the DCM will maintain minor civil equipment for dayshift works. These changes have significantly reduced the overall sound power level from the mobile plant operations.

No mobile plant sound power monitoring has been required during the reporting period.

6.8.6 Complaints

No noise related complaints were received during the reporting period. The complaints list is provided in **Appendix 7**.

6.9 LANDSCAPING AND VISUAL SCREENING

The overall visual impacts of the DCM are described in the EA 2010 are generally considered low. However, some local impacts will occur and undertakings such as the following have been, and will continue to be, adopted to lessen these impacts:

- Minimising (where possible) disturbance to native vegetation, especially where such vegetation is providing visual screening;
- Retention specifically of ridge Open Forest and regrowth forest (where possible);
- Retention of all riparian vegetation along Mammy Johnsons River and those out of pit sections of Coal Shaft Creek;
- Ensuring out of pit emplacement design produces a landform which integrates with the adjoining natural landform;
- Painting of substantial fabricated infrastructure with a colour ("Rivergum") that assists it to blend in with the adjoining landscape;
- Maintenance of infrastructure to retain the ability of such infrastructure to blend into the surrounding landscape over the life of the project; and
- Placement, configuration and direction of lighting to reduce offsite nuisance effects of stray light;
- Prioritising rehabilitation of exposed and outer batters of waste emplacements;
- Vegetation would be established around the perimeter of the open pit voids to provide visual screening.

In accordance with Condition 51, Schedule 3 of the Project Approval, a visual screen has been constructed and maintained along a section of the Bucketts Way to the north-west of the mine in consultation with DPE, RMS, Great Lakes Council and DCM CCC. As predicted some additional vantage points of the mine have been exposed through the clearing of the northern extent of the Weismantel pit and landscaping works and progressive rehabilitation will continue to reduce the visual impact.

The rehabilitation principles and objectives at the DCM are included in the Project Approval and described in the DCM MOP. This includes requirements for landscaping and visual screening to ensure the final landforms are visually consistent with the surrounding environment and meet community and regulatory expectations. The rehabilitation will be generally consistent with the proposed rehabilitation strategy described in the EA.

6.9.1 Complaints

No visual amenity related complaints were received during the reporting period. The complaints list is included in **Appendix 7**.

6.10 CULTURAL AND NATURAL HERITAGE CONSERVATION

Cultural and natural heritage at the DCM are managed in accordance with the approved Heritage Management Plan (HMP). The purpose of the HMP is to address the requirements of Condition 46, Schedule 3 of the Project Approval. The aim of the HMP is to ensure that the development does not cause any direct or indirect impact on identified Aboriginal or Non-Aboriginal heritage sites located outside the approved disturbance area of the development on the site. The HMP has also been prepared to manage potential impacts on items of heritage significance at the DCM in the vicinity of the surface development.

Archaeological surveys conducted at the Duralie Mine site in the 1980's and 1990's did not identify any Aboriginal sites or items with the exception of one site. A tree, to be subsequently referred to as the "honey tree" was the subject of a site inspection involving various parties including representatives of NPWS in November 1998. The consensus at the time of inspection was that the "honey tree", an old ironbark, had had timber pieces inserted into the trunk in a spiral pattern to allow someone to scale the tree and access the crown – possibly to collect honey. It was not clear whether such timber insertion would have been performed by an Aboriginal person or early European settler. The "honey tree" was subsequently listed on the NPWS Aboriginal Heritage Information Management System (AHIMS) database.

The EA 2010 identified 9 sites of Aboriginal heritage significance (DM2, DM3, DM4, DM5, DM6, DM9, DM10, DM11 and the "Honey Tree") on the Mining Lease. The heritage sites outside the approved disturbance area have been protected by way of signpost and fencing where required. In addition, 4 sites (DM1, DM7, DM8 and Mammy Johnson's Grave) were identified outside of the Mining Lease.

In accordance with the HMP, topsoil disturbance during earthworks, construction and operation of the mine has been monitored utilising officers of the Karuah Local Aboriginal Land Council (KLALC). During the reporting period no topsoil disturbance was undertaken.

In accordance with the HMP, monitoring of the Aboriginal heritage sites at the DCM was conducted each quarter during 2018/19.

Table 23: Aboriginal Heritage Sites within EA Study Area

Site Code (refer EA documentation)	Site Type	Status
DM2	Isolated Artefact	Salvaged by KLALC
DM3	Scarred Tree	Existing, no disturbance.
DM4	Scarred Tree	Existing, no disturbance
DM5	Scarred Tree	Salvaged by KLALC
DM6	Isolated Artefact	Existing, not located by KLALC
DM9	Open Artefact Scatter	Existing, no disturbance
DM10	Scarred Tree	Existing, no disturbance
DM11	Isolated Artefact	Disturbed, not located by KLALC.
38-1-0033	Scarred Tree – Honey Tree	Existing. No disturbance

Former Weismantels Inn is a heritage listed building owned by DCPL. A building inspection of the Weismantels Inn is conducted every two years.

An inspection of the Former Weismantels Inn was undertaken in October 2017 and reported there is no evidence that the former Weismantel Inn building has been affected by blast-induced ground vibrations.

The next building inspection is scheduled for late 2019.

6.11 SPONTANEOUS COMBUSTION

Any incidences of spontaneous combustion at the DCM are managed in accordance with a Spontaneous Combustion PMHMP. This plan provides a comprehensive overview of processes implemented at the DCM to manage identified hazards associated with spontaneous combustion. Management and mitigation practices generally involve reducing the interaction of potentially reactive materials with water and oxygen by appropriate dumping practices, profiling and capping any materials likely to heat and reducing the time coal faces are exposed prior to mining.

During the previous reporting period isolated events of spontaneous combustion were identified in the open cut pits and waste emplacements. Actions were taken to address the spontaneous combustion which included removing the affected material and extinguishing followed by dozing or capping of the area with inert material to restrict air flow and further heating.

DCPL had previously identified areas of self-heating on the Potentially Acid Forming (PAF) waste emplacements and continue to undertake remedial works to these areas.

Four (4) air quality complaints related to odour were received during the reporting period. A detailed complaints list is provided in **Appendix 7**. DCPL responded to the complaint promptly and provided information on the specific issues.

6.12 AGRICULTURAL REPORT

An assessment of the Agricultural and Rural Suitability of the land surrounding the DCM was undertaken in the EA 2010. The Project is located in a rural area characterised by cattle grazing on native and improved pastures. Areas managed for forestry, conservation, poultry farming and other types of agricultural production also occur in the wider area.

The Agricultural Land Use Rehabilitation Objective for the DCM is to establish the land capability classification for the relevant nominated agricultural pursuit.

Rural Land Capability
The Rural Land Capability classification system is used to determine the various classes of rural land on the basis of the capability of the land to remain stable under particular uses. Land is allocated to one of eight classes, with emphasis on the erosion hazards in the use of the land. The majority of land within the existing DCM and Project area is classified as Class IV using the rural land capability classification with the major factors in determining the classes being slope and soil stability in water.

Agricultural Suitability
The Agricultural Suitability system is used to classify land in terms of its suitability for general agricultural use. Agricultural land is classified by evaluating biophysical, social and economic factors that may constrain the use of land for agriculture. The agricultural land classification mapping classifies the majority of lower slopes of the DCM area as Class 3 land, and the upper slopes as Class 4. The land in the far south of ML is classified as Class 5 agricultural suitability.

The rehabilitated areas on the Duralie Waste Emplacement are proposed for Class 4 agricultural suitability. Class 4 Agricultural Suitability is defined as (NSW Agriculture, 2002):
Land suitable for grazing but not for cultivation. Agriculture is based on native pastures and improved pastures established using minimum tillage techniques. Production may be seasonally high but the overall production level is low as a result of major environmental constraints.

Agricultural lands on and surrounding the DCM including DCPL owned land continues to be managed for agricultural production. DCPL implements a property management strategy which includes grazing & pasture management and weed and pest control measures. The majority of agricultural lands are grazed under agistment/lease contracts.

There have been no changes to the agricultural land suitability during the reporting period. Further information on agricultural rehabilitation areas is included in Section 8.

7. WATER MANAGEMENT

Water management is undertaken in accordance with the approved Water Management Plan (WMP) and sub-components of the plan including surface water, ground water and site water balance required under Condition 29, Schedule 3 the Project Approval.

The main objectives of the water management system on-site are:

- protect the integrity of local and regional water resources;
- operate such that there is no uncontrolled overflow of contained water storages;
- maintain separation between runoff from areas undisturbed by mining and water generated within active mining areas; and
- provide a reliable source of water to meet the requirements of the DCM.

The main principles of the water management system on-site are to:

- Minimise the generation of dirty water and divert clean water around disturbed areas;
- Minimise storage requirements by maximising re-use of dirty water;
- Remove potential impacts on downstream water resources by provision of secure containment on site and disposal by irrigation re-use;
- Implement a fail-safe system, whereby under extreme events in excess of design capacity, dirty waters would spill to the mine pit and not to the clean water catchments; and
- Not allow sediment laden water having an elevated suspended solids concentration to be discharged off site.

7.1.1 Water Supply and Demand

The DCM water management system operates under a surplus water balance, with a trend for increasing water storage on-site over time. The main water supply storage on-site for use in irrigation and dust suppression is the Main Water Dam (MWD) (monitoring point SW3) located to the northwest of the Industrial Area. The MWD, Auxiliary Dam 1 (AD1) and Auxiliary Dam 2 (AD2) are the principal permanent mine water storages on-site. Water from these dams comprises pit produced water (runoff to/rainfall/seepage to), water from specific sediment dams and surface water runoff from the Industrial area.

The principal water losses in the water system are:

- Water applied to land by means of irrigation.
- Water used for dust suppression.
- Evaporation from the Main Water Dam, Auxiliary Dam 1 and Auxiliary Dam 2.
- Water retained in ROM coal and railed to Stratford.

The Main Water Dam's current storage capacity is approximately 1405 ML whilst Auxiliary Dam 1 can contain approximately 460 ML and Auxiliary Dam 2 has an estimated storage capacity of approximately 2720 ML.

At the completion of the reporting period (30-Jun-2019) the Mine Water Dam contained 994 ML (76.8%), Auxiliary Dam 1 contained 0 ML (0%) and Auxiliary Dam 2 contained 1908 ML (73.6%). No mine water was disposed of to watercourses during the reporting period.

7.1.2 Site Water Balance Review

A water balance model of the Duralie Extension Project mine operations was developed by HEC based on an operational model of the DCM water management system. The site water balance model of the DCM water management system has been developed to simulate the behaviour of the water management system to the end of the approved mine life.

A site water balance review is undertaken annually and captures all inflows and outflows from the water management system. The water which accumulates in the open pits through rainfall or

groundwater seepage is measured at the point of dewatering. An independent Annual Water Balance Review (Hydro Engineering & Consulting, 2019) for the DCM was conducted for the 2018 calendar year and a summary is provided below.

Contained Water Storages

A water balance analysis review of the Main Water Dam, AD1 and AD2 water balance 2018 is as follows: Figures are based on Duralie Mine Site Water Balance Review for the 2018 calendar year.

Inflows (mL/pa)

Rainfall runoff	713
Pumped from open cut pits	0
Pumped from other storages	0
MWD diversion seepage	41
First flush capture	93*
Total Inflow	**847**

Outflows (mL/pa)

Evaporation	613
Haul Road dust suppression	81
Irrigation loss	81
Total Outflow	**774**
INFLOW - OUTFLOW	**73**

Start of 2018 year total storage volume	2,986
End of 2018 year total storage volume	2,981
Change in Storage	**-5**

*Excluding 4 days' missing data

The above values indicate virtually no change in stored water volume in the storage dams during 2018. Note that this does not include any increase in stored water volume in the Weismantel pit (estimated volume stored approximately 470 ML) and the adjacent waste rock emplacement (estimated volume stored possibly up to approximately 5,900 ML). The estimated volume of water contained in the Weismantel pit itself (based on recorded water levels) appears to have remained fairly steady throughout 2018. Long term RL trend charts for Main Water Dam, AD1 and AD2 are provided in **Appendix 4**.

Open Cut Pits

A mine pit water balance analysis was undertaken for the open cut pits using data recorded during 2018. The volume of groundwater estimated reporting to Weismantel and Clareval pits in 2018 was negligible. If groundwater inflow had occurred, the "predicted" volume would increase above the "measured" volume. This contrasts with a volume of 155 ML volume predicted from the groundwater model developed as part of the Duralie Extension Project (GCL, 2010).

Groundwater Licencing

DCPL holds an existing Bore Licence (20BL168404) issued by the NSW Department of Primary Industries, that allows for up to 300 ML of groundwater to be extracted from "works" in any 12 month period.

Table 24: Water Take

Water Licence #	Water sharing plan, source and management zone (as applicable)	Entitlement	Estimated Take Previous Period – 2017 (ML)Total	Estimated Take Current Period - 2018 (ML)Total
WAL 41518 (NOW ref: 20AL213502) - Duralie Pit (Weismantel and Clareval)	Gloucester Basin Groundwater Source - North Coast Fractured and Porous Rock Groundwater Source 2016	300ML extraction.	0ML	0ML

7.2 SURFACE WATER

7.2.1 Surface Water Management

Surface water management is managed in accordance with WMP: Appendix 2 Surface Water Management Plan (SWMP) under Condition 29, Schedule 3 of the DEP Approval and is divided into the management of clean water and mine water as outlined below. Dirty water comprises both mine water and sediment laden/turbid water.

7.2.1.1 Erosion and Sediment Control

The primary objectives of the erosion and sediment control at the DCM are to:

- minimise and control soil erosion and sediment generation in areas disturbed by ongoing mining and associated activities at the DCM; and
- minimise the potential for sediment generated from site activities to adversely affect the water quality of the Mammy Johnsons River or the Karuah River.

Sediment generation and erosion is primarily controlled by:

- Maximum separation of runoff from disturbed and undisturbed areas;
- Timely progressive rehabilitation and vegetation establishment on disturbed areas (e.g. completed sections of the overburden dump) to minimise the area exposed to erosion;
- Construction of surface drains to facilitate the efficient transport of surface runoff;
- The direction of runoff from disturbed areas into sediment dams for settlement of suspended solids; and
- The placement of silt fences down slope of other disturbed areas (e.g. down slope of topsoil stockpiles before a grass cover has been established).

DCM had the following dedicated erosion and sediment control structures in use during the reporting period:

- Two (2) rail siding sediment dams – designated as RS1 and RS6
- One (1) waste emplacement (rehabilitation) sediment dam – designated as VC1
- Temporary Sediment Dams in advance of mining operations (none active at the end of the reporting period).

Sediment dam sizing is described in the SWMP Section 7.1 Erosion and Sediment Control Plan. Erosion and sediment control structures are designed and constructed in consideration of the recommendations for site drainage works presented in "*Managing urban storm water – Soils and Construction Volume 1*" (Landcom, 2004) and "*Managing urban storm water – Soils and Construction Volume 2e*" (DECC, 2008).

Runoff in excess of the design capacity will result in a dam spilling in accordance with the design criteria. It should be noted that pumping (where possible) of sediment dams in order to prevent or limit the amount of spilling water was undertaken. Prioritisation of pumping operations also took into account the likely quality of spilling water when a dam was considered vulnerable to spilling. The quality of water collecting within sediment dam is managed (where practicable) to minimise suspended sediment load.

Sediment dams are inspected following receipt of sufficient rain whereby such dams have the potential to spill. Diversion structures and drains are also maintained, including vegetation management, to ensure integrity of the structures and capacity for flow.

During the reporting period there were no spills from sediment dams at the DCM.

In addition to dedicated sediment dams, clean water is directed around disturbed areas (where practicable) using diversion drains/bunds or in the case of Coal Shaft Creek, a creek diversion (refer discussion under *Water Management*) in order to minimise sediment laden water.

All elements of sediment control are regularly monitored and maintained. Sediment dams are cleaned out when the storage volume is substantially reduced by sediment deposition (i.e. when 30% of storage volume is lost to sediment build up) and inspected after major rainfall events.

Inspection of diversion structures and sediment control dams occurred during and following heavy rainfall events. The site contained all mine water on site within its water management system and control structures remained effective.

A photographic surveillance record of key structures along the existing Coal Shaft Creek diversion is undertaken annually and was conducted during January 2019. Regular inspections of the CSC diversion are also undertaken and in general the diversion is stable and no signs of erosion or sedimentation have been identified. Maintenance activities including weed spraying and vegetation control was undertaken on the clean water diversion drains and around the prescribed dams during the reporting period.

7.2.1.2 Clean Water Management

The main objective of clean water management is the segregation of clean water from mine related water by the construction of diversion drains around disturbed areas, thereby minimising the quantity of 'dirty' water generated.

Surface water controls aim to prevent clean runoff water from entering the open mining pit and overburden dumping areas where practical. The main structures are:

- Diversion of Coal Shaft Creek. The diversion channel (built in stages) is required until the creek can be re-established at the conclusion of mining;
- Main Water Dam (MWD) diversion drain. This drain intercepts runoff from the catchment above the MWD and delivers that water to Coal Shaft Creek;
- Auxiliary Dam 1 (AD1) and Auxiliary Dam 2 (AD2) diversion drains;
- Clareval western diversion drain;
- Flood control embankments to prevent inundation of mining areas;
- A culvert under the Main Coal Haul Road which allows Coal Shaft Creek to flow through the site; and
- Various runoff control drains/bunds about disturbed areas, designed to divert clean water runoff around those areas.

The main elements of the clean water diversion system are shown in **Figure 3** (**Appendix 1**).

Inspections of diversion structures were undertaken during and after rainfall. Remedial and maintenance works were completed as required within the diversion drains and dams during the reporting period.

7.2.1.3 Mine Related Water Management

Mine related water management refers to the control, collection and re-use of water which may have become contaminated by mining operations and associated activities. This water comprises mine water and sediment laden/turbid water. Mine water is water that has come into contact with mining activities. Sediment laden/turbid water has come into contact with disturbed areas but predominantly not core mining areas. Mine waters are typically characterised by higher salinity and on occasion lower pH. Sediment laden waters are characterised by elevated suspended solids and elevated turbidity.

During the reporting period all mine water was contained on site and no spills occurred from mine water storage dams.

The main objectives of the mine related water control facilities are:

- Segregation of clean water from mine related water, to minimise the quantities of mine related water to be managed;

- On site storage to prevent escape to Coal Shaft Creek and Mammy Johnsons River; and
- Management of the stored quantity of dirty water by irrigation.

The principal sources of mine related water are:

(a) Mine Water
- Incident rainfall
- Groundwater seeping into mining pits;
- Rainfall induced runoff and seepage from active sections of the overburden dump; and
- Rainfall induced runoff from the Industrial Area.

(b) Sediment Laden Water
- Rainfall induced runoff from roads;
- Rainfall induced runoff from areas stripped of topsoil (typically exposing clays); and
- Rainfall induced runoff from areas yet to adequately vegetate within sediment dam catchments.

Mine related water uses and losses are:
- Evaporation and seepage losses from water storages;
- Haul road dust suppression;
- Railed coal dust suppression;
- Water retained in ROM coal railed to the Stratford Mine; and
- Stored water applied to land via irrigation (evapotranspiration) including evaporative sprays.

The dirty water storages on site are:
- Main Water Dam (MWD)
- Auxiliary Dam 1 (AD1)
- Auxiliary Dam 2 (AD2)
- Sediment Dam VC1 (rehabilitated waste dump)
- Sediment Dams RS1 and RS6 (rail siding dams)

The locations of mine and sediment laden water storage areas are shown in **Figure 3** (**Appendix 1**).

7.2.2 Surface Water Monitoring

DCPL monitors surface water quality on and surrounding the mine site by sampling from a series of selected locations. These locations comprise both streams and water storage structures. A meteorological monitoring station (i.e. weather station) provides site rainfall data. The locations of these monitoring sites are shown on **Figure 3 (Appendix 1).**

Surface water monitoring is conducted in accordance with the approved SWMP and EPL 11701.

Surface water is sampled and analysed on a weekly, monthly, event basis or following a sediment dam spill.

Water sampling is not undertaken in no-flow conditions. Collected waters are analysed for a suite of physical and chemical parameters. Results are compared with water quality triggers for the DCM developed in accordance with the methodology in ANZECC/ARMCANZ (2000). "Gilberts & Associates 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project" and EPA requirements (DCM Surface Water Management Plan Appendix B).

7.2.2.1 Review of Local Streams Monitoring Results

Reference should be made to accompanying data tables provided in **Appendix 4**. The routine surface water monitoring sites at the DCM are:

- *SW2 – Coal Shaft Creek (CSC)*
- *SW2 Rail Culvert – Coal Shaft Creek Downstream*
- *SW6 – Former RS3/4 Culvert*
- *SW9 – Un-named Tributary (UNT)*
- *SW10 – Coal Shaft Creek Upstream*
- *GB1 – Mammy Johnsons River (MJR)*
- *Highnoon – Mammy Johnsons River (MJR)*
- *Site 9 – Karuah River (KR)*
- *Site 11 – Mammy Johnsons River (MJR)*
- *Site 12 – Mammy Johnsons River (MJR)*
- *Site 15 - Mammy Johnsons River (MJR)*
- *Site 19 – Karuah River* (KR)
- *North Drain*
- South Drain

Assessment of Performance Indicators

The surface water monitoring results are used to assess the DCM against the performance indicators and performance measures as detailed in Table 7 of the SWMP. If data analysis indicates a performance indicator has been exceeded or is likely to be exceeded, an assessment will be made against the performance measure. If a performance measure is considered to have been exceeded, the Contingency Plan will be implemented (WMP Section 10). If data analysis indicates that the performance measure has not been exceeded, DCPL will continue to undertake monitoring.

Table 25 and **26** provide a summary of the surface water analysis of the monitoring data during the reporting period. The summarised data is used to assess against the surface water performance indicators and measures outlined in Table 7 of the SWMP.

Table 25: Summary of Surface Water Monitoring Results and Trigger Levels – pH, EC and TSS

Site	**pH**			**EC**		**TSS**	
MJR	20th%ile	80th%ile	Trigger	80th%ile	Trigger	80th%ile	Trigger
Site 11	7.3	7.9	**7.1-7.6**	417	**370**	18	**15**
GB1	7.0	7.6		323		41	
Site 12	7.1	7.6		320		32	
CSC							
SW2 (RC)	6.8	7.6	**7.1-7.9**	580	**544**	34	**80**
SW10	7.1	7.1		69		24	
UT							
SW9	7.0	7.0	**6.4-7.1**	225	**461**	75	**57**
SW10	7.1	7.1		69		24	

Note: SW9 & SW10 one sample only

Table 26: Summary of Surface Water Monitoring Results and Trigger Levels – Copper, Turbidity, Zinc and Aluminium

Site	**Copper**		**Turbidity**		**Zinc**		**Aluminium**	
MJR	80th%ile	Trigger	80th%ile	Trigger	80th%ile	Trigger	80th%ile	Trigger
Site 11	0.001	**0.002**	25	**24**	0.005	**0.011**	0.34	**1.24**
GB1	0.002		63		0.007		0.41	
Site 12	0.001		36		0.005		0.38	
CSC								
SW2 (RC)	0.002	**0.003**	65	**119**	0.067	**0.064**	0.52	**3.02**
SW10	0.006		111		0.008		1.16	
UT								
SW9	0.003	**0.004**	75	**94**	0.018	**0.024**	0.6	**2.96**
SW10	0.006		111		0.008		1.16	

Note: SW9 & SW10 one sample only

Assessment of the Performance Indicators and Performance outcomes are presented in **Table 27.**

Table 27: Surface Water Monitoring Performance Outcomes – 2018-19 Reporting Period

Performance Measure	Monitoring of Environmental Consequences			Data Analysis to Assess against Performance Indicators	Performance Indicators	Assessment of Performance Indicators	Assessment of Performance Measure	Relevant Management and Contingency Measures
	Sites	Parameters	Frequency					
No more than a negligible impact on water quality in Mammy Johnsons River as a result of the Duralie Extension Project	• Site 11 • GB1 Site 12	• EC, pH, turbidity, Copper (total), Zinc (total), Aluminium (total). Hardness, TSS, BOD and DO.	• Monthly / Event	The 80th percentile concentration calculations for EC, pH, total copper, turbidity, total zinc, total aluminium, and TSS in addition to The 20th percentile value of pH at Site 11, GB1 and Site 12 are presented in Tables 25 & 26	Water quality at Site 11 is not worse than the pre-irrigation water quality at Site 11 whilst water quality is better at GB1 and Site 12 compared to the pre-irrigation water quality at these sites.	Data analysis indicates Site 11 exceeded the performance indicator for pH, EC TSS and Turbidity. Analysis of the monitoring data shows EC to be elevated on occasion under low flow conditions. EC was also elevated at upstream sites GB1 and Site 12 on these occasions. Whilst EC at Site 11 slightly exceeded the 80th%ile trigger it was found to not be significantly higher than EC concentrations at GB1 and Site 12. Hence similar trends observed upstream and downstream. Analysis of the monitoring data also shows similar trends observed upstream and downstream for pH, TSS and Turbidity. Whilst pH at Site 11 exceeded the 80th%ile trigger it was found not to be significantly higher than the average pH at the upstream sites GB1 and Site 12. The performance indicator for DO was not exceeded except for one reading at the three sites in October 2018. Other than one result, DO is consistently below 85% at Site 11, Site 12 and GB1.	No further requirement for assessment of Performance Measure.	Continue monitoring.

Table 27 (Continued): Surface Water Monitoring Performance Outcomes – 2018-19 Reporting Period

Performance Measure	Monitoring of Environmental Consequences			Data Analysis to Assess against Performance Indicators	Performance Indicators	Assessment of Performance Indicators	Assessment of Performance Measure	Relevant Management and Contingency Measures
	Sites	Parameters	Frequency					
No more than a negligible impact on water quality in Coal Shaft Creek as a result of the Duralie Extension Project	• SW2 (RC) • SW10	• EC, pH, turbidity, Copper (total), Zinc (total), Aluminium (total). Hardness, TSS, BOD and DO.	• Monthly / Event	The 80th percentile concentration calculations for EC, pH, total copper, turbidity, total zinc, total aluminium, and TSS in addition to the 20th percentile value of pH at SW2 (RC) and SW10 are presented in Tables 25 & 26	Water quality at Site SW2 (RC) is not worse than the pre-irrigation water quality at Site SW2 (RC) whilst water quality is better at SW10 compared to the pre-irrigation water quality at that site.	Data analysis indicates Site SW2 (RC) exceeded the performance indicator for EC and Zinc. Analysis of the monitoring data shows EC to be elevated on occasion under low flow conditions. Zinc was also elevated on one occasion under low flow conditions at SW2 (RC). Whilst EC and Zinc at SW2 (RC) slightly exceeded the 80th%ile trigger it is difficult to compare to SW10 EC and Zinc results as SW10 was dry for all sampling events except one in the reporting period. The performance indicator for DO was exceeded on one occasion. The performance indicator for DO was also elevated upstream at SW10 on this sampling event.	No further requirement for assessment of Performance Measure.	Continue monitoring.

Table 27 (Continued): Surface Water Monitoring Performance Outcomes – 2018-19 Reporting Period

Performance Measure	Monitoring of Environmental Consequences			Data Analysis to Assess against Performance Indicators	Performance Indicators	Assessment of Performance Indicators	Assessment of Performance Measure	Relevant Management and Contingency Measures
	Sites	Parameters	Frequency					
No more than a negligible impact on water quality in Unnamed Tributary as a result of the Duralie Extension Project	• SW9 • SW10	• EC, pH, turbidity, Copper (total), Zinc (total), Aluminium (total). Hardness, TSS, BOD and DO.	• Monthly/ Event	The 80th percentile concentration calculations for EC, pH, total copper, turbidity, total zinc, total aluminium, and TSS in addition to the 20th percentile value of pH at SW9 and SW10 are presented in Tables 25 & 26	Water quality at Site SW9 is not worse than the pre-irrigation water quality at SW9 whilst water quality is better at SW10 compared to the pre-irrigation water quality at that site.	Data analysis indicates SW9 exceeded the performance indicator for TSS. Analysis of the monitoring data shows TSS to be elevated on the one occasion where sampling was undertaken. SW9 and SW10 were dry for all sampling events except one in the reporting period. The performance indicator for DO was exceeded once at Site SW9 and elevated upstream at SW10.	No further requirement for assessment of Performance Measure.	Continue monitoring.

The above results were consistent with previous year's monitoring results and the predictions made in the EA 2010. The EA 2010 indicated that water quality in Mammy Johnsons River was variable, but was generally good. It was also found that the salinity of the stream was higher during periods of low flow and generally showed a relative reduction in EC during higher flow periods (Gilbert, 2010). The current monitoring results are consistent with these observations.

Table 27 indicates some occurrences of exceedances of the performance indicators. If data analysis indicates a performance indicator has been exceeded or is likely to be exceeded, an assessment will be made against the performance measure. The data analysis shows monitoring data also shows similar trends observed upstream and downstream, i.e. exceedances were not due to DCM. Accordingly, no further assessment of the performance measure is required.

Historical monitoring data presented in the DCM Environmental Assessment, Surface Water Assessment (Gilbert, 2010) show that Coal Shaft Creek is generally more saline than Mammy Johnsons River and the Karuah River. Results during the reporting period concur with these observations. It is considered that Coal Shaft Creek is generally more saline due to its ephemeral nature and the outcropping/sub-cropping of coal seams within the catchment.

7.2.2.2 Review of Mine Water Monitoring Results

The management of mine related water is described in Section 7.2.1.3 of this report. Mine water comprises water that is generated within the mine workings, waste rock emplacements (prior to reshaping and topsoiling), storage areas for such water and runoff from areas where coal is handled. Mine water is generally characterised by elevated EC, elevated sulphate concentrations and low turbidity/TSS.

The three principal mine water storage areas are the Main Water Dam (sampling location SW3 major), Auxiliary Dam 1 (AD1) and Auxiliary Dam 2 (AD2). Monitoring of mine water quality is also conducted within the Weismantel pit (sampling location SW4) and the Clareval pit (sampling location Clareval).

No overflows or discharges of mine water occurred during the 2018/19 reporting period.

Monitoring for SW3 (major) during the reporting period indicated, on average, a moderate EC (2866 uS/cm), slightly alkaline pH (8.3) and low miscellaneous metals concentration. Reference should be made to **Table 28** and the water monitoring results in **Appendix 4**. AD1 was dewatered prior to the reporting period and no samples were required.

Table 28: Summary of Mine Water Monitoring Results – pH, EC and TSS

	pH		EC (µS/cm)		TSS (mg/L)	
Site	**Range**	**Average**	**Range**	**Average**	**Range**	**Average**
MWD (SW3)	7.6-8.9	8.3	2500-3470	2866	<5-42	10
AD2	6.9-8.7	8.1	2710-3700	3058	*	*
Clareval	**	**	**	**	**	**
Weismantel (SW4)	6.6-7.8	7.2	4300-6110	4991	<5-8	20

Notes * = TSS not monitored at AD1 and AD2
** = No safe access to Clareval Pit during the reporting period
*** = AD1 dewatered during previous reporting period.

The simulated water quality for the Main Water Dam was prepared for the EA 2010 including a salinity balance and an assessment of the suitability for irrigation water (Gilberts, 2010). Mine water pH has remained generally near neutral or slightly alkaline for the life of the project. The Mine Water Dam EC trend has been generally consistent with the simulated EC showing a slightly increasing trend up to 2015 and then decreasing towards 2019, however the average EC (2866 uS/cm) in 2019 has remained higher than the predicted EC of 2140 uS/cm. This is predominantly due to the higher EC water from the Clareval pit. No pumping form the open cut pits occurred during the reporting period. Clareval Pit was not monitored during the reporting period due to no safe access into the pit since operations were completed in September 2017.

The electrical conductivity (EC) performance indicator in Table 7 of the Surface Water Management Plan (SWMP) was exceeded during the reporting period in the MWD. As a requirement of the SWMP, the increasing salinity triggered an assessment of performance measure. Hollingsworth (2019) concluded that there has been no significant detrimental effect on soil properties, or suitability of soil in irrigated areas for future agricultural use.

An assessment of the irrigation water quality was undertaken in the *2019 Irrigation Area Monitoring Report* (Horizon Environmental, 2019) and is included in Section 7.4.1. Irrigation and soil monitoring in 2019 concluded that there has been no significant detrimental effect on soil properties, or suitability of soil in irrigated areas for current or future agricultural use. Additionally, the monitoring found no detectable adverse impact from irrigation management on pasture cover or composition.

7.2.3 Biological Monitoring

As part of Duralie Coal's environmental monitoring program, Invertebrate Identification Australasia was commissioned to conduct biological (aquatic ecology – macroinvertebrates) monitoring of the streams near the DCM. Biological monitoring has been conducted each year since the start of mining operations.

Monitoring during this reporting period was conducted in September 2018 and February 2019 and involved sampling from seven sites. The September survey identified a total of 42 families of aquatic invertebrates which represents a small increase in number of families across all sites except for Site M8. For the February survey a total of 37 families of aquatic macroinvertebrates were recorded representing a substantial decrease in number of families across all sites compared with the previous spring survey except for Site M6. The report summaries are provided below.

The September 2018 report concluded that;

> *"the results of the current survey confirm what has previously been predicted and demonstrated, i.e. that the aquatic biodiversity is continuing to show the same or similar trends to that recorded in previous years and under similar environmental conditions. The continued presence of moderate numbers of EPT taxa recorded at most river sites above and below the mining operations (9-10 taxa per site) indicates that both river systems are still healthy. The other off-river sites recorded lower values than the river sites. However, as they are much smaller systems they do not have the same scale of resources, permanence of flow levels and variety of niches to support more complex biodiversity. They are also more impacted by decreases in flow or changes in environmental conditions. In conclusion, the results from the current survey suggest that the overall biodiversity and river environmental conditions have remained good and that there are no apparent adverse effects on the aquatic macroinvertebrate fauna in the Mammy Johnsons River as a result of any activities arising from the operations of the Duralie Mine. The only significant impact to the river in addition to the very low to no flows was the presence of cattle at Site M1 which has impacted water quality, habitat availability and the riverbed, bank and riparian structure" (Invertebrate Identification Australasia 2018).*

The February 2019 report concluded that;

> *"the results of the current survey confirm what has previously been predicted and demonstrated, i.e. that the aquatic biodiversity is continuing to show similar trends to that recorded in previous years and under similar environmental conditions. The moderate to low numbers of EPT taxa recorded at most river sites above and below the mining operations (9-10 taxa per site) indicates that while both river systems have been impacted by the low to no flow conditions the biodiversity is being maintained, particularly in the Karuah and the lower sections of the Mammy Johnsons River. The other off-river sites recorded lower values than the river sites, however, as they are much smaller systems, they do not have the same scale of resources, permanence of water levels and variety of niches to support more complex*

biodiversity. They are also more impacted by decreases in flow or changes in environmental conditions. In conclusion, the results from the current survey suggest that while the overall biodiversity and river environmental conditions has declined, there are no apparent adverse effects on the aquatic macroinvertebrate fauna in the Mammy Johnsons River as a result of any activities arising from the operations of the Duralie Mine. The only significant impact to the rivers in addition to the very low to no flows was the presence of cattle at Site M1 which has impacted water quality, habitat availability and the riverbed, bank and riparian structure" (Invertebrate Identification Australasia 2018).

Biodiversity values have been generally similar to those noted from prior reporting periods. Biological monitoring reports to date have not indicated any significant adverse effects on the aquatic ecosystem as a result of the mine's operations as per predictions made in the environmental assessments.

7.2.4 Riparian Vegetation Monitoring

The Riparian Vegetation "Health" Monitoring program is conducted in accordance with the SWMP. Visual monitoring and photography is conducted in order to detect any potential change in the quality and quantity of riparian vegetation. The unnamed Tributary, Coal Shaft Creek and Mammy Johnsons River are monitored on an annual basis in conjunction with the biological monitoring for signs of leaf scorching, desiccation and dieback. Riparian health monitoring includes the development of a photographic database of riparian vegetation at fixed photo points.

Riparian vegetation health monitoring was conducted in September 2018. Results for the reporting period are generally similar to results from last year with some minor seasonal variation. Monitoring continues to demonstrate negligible impact related to mining operations on riparian vegetation. Seasonal changes generally reflect climatic conditions. The photographic database is maintained at the DCM.

7.2.5 Ecotoxicity Testing Program

In accordance with the Surface Water Management Plan and Condition 29(b) of Project Approval (08_0203), DCM have undertaken ecotoxicity testing of samples taken from selected water monitoring sites in Mammy Johnsons River, Coal Shaft Creek and DCM Main Water Dam since 2013. The ecotoxicity testing programme was initially required to be undertaken quarterly and then revised following analysis of the monitoring results. The ecotoxicity tests were undertaken by Ecotox Services Australasia during 2013 to 2015. A review of the ecotoxicity monitoring data was undertaken by the University of Queensland Centre for Mined Land Rehabilitation in May 2014 and again in October 2015. A review of the monitoring data collected up to 2015 concluded the following;

> *"The results for ecotoxicity testing of five aquatic species of Coal Shaft Creek, Mammy Johnsons River at four sampling times during 2014 -2015 show that there was no evidence for any significant toxicity and no connection with any effects from mining. The Main Water Dam at Duralie Coal Mine showed that sporadic effects to some test species, but not all. This is considered to indicate the potential for minor effects to occur on an on-going basis but does not show affects from the offsite natural waters. If the Main Water Dam water is discharged, it should be tested for aquatic toxicity.*
>
> *Based on the evidence from the aquatic testing in the Main Water Dam it is recommended that the Ecotoxicity Testing Program be reduced to yearly sampling corresponding to the commencement of summer using sampling at the same four sites for a further two years. If any water release is undertaken from Duralie Mine site, the mine site and downstream waters should be tested before and after release."*

In accordance with the recommendation above ecotoxicity monitoring is undertaken annually. Monitoring was undertaken in December 2016 and March 2018. The March monitoring was postponed from December 2017 due to persistent no flow conditions. A review of the ecotoxicity monitoring data

was undertaken by the University of Queensland Centre for Mined Land Rehabilitation in April 2019. The review of the monitoring data collected up to 2018 concluded the following;

> *"The results continue to show there was no evidence of any significant toxicity and no connection with any effects from mining. The Main Water Dam showed that sporadic effects to some test species occurred, but not all. This is considered to indicate the potential for minor effects to occur on an on-going basis but does not show affects from the offsite natural waters.*
>
> *Based on the consistent evidence from 2013-2018 for aquatic testing in the Main Water Dam it is recommended that the Ecotoxicity Testing Program is no longer required. If any irrigation activity were to be undertaken from the Main Water Dam at Duralie Mine site, the mine site and downstream waters would require ecotoxicity testing before and after application".*

Full reports are available on request.

7.3 GROUNDWATER

7.3.1 Groundwater Management

A Groundwater Management Plan (GWMP) (WMP Appendix 3) has been prepared to control potential impacts on local and regional groundwater resources and includes and a monitoring program to validate and review the groundwater model predictions.

The groundwater systems within which the SDCM lies, specifically relate to:

- Gloucester Basin Water Source (i.e. porous rock aquifer) under the Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016.
- Karuah River Water Source (i.e. alluvial aquifers) under the Water Sharing Plan for the Lower North Coast Unregulated and Alluvial Water Sources 2009.

Groundwater characteristics of the mine have been studied prior to and over the life of the DCM and most recently for the EA 2014. A hydrogeological characterisation of the Gloucester Basin is included in the GWMP.

7.3.2 Groundwater Monitoring Results

Groundwater monitoring is conducted in accordance with the DCM Water Management Plan (WMP) Appendix 3 Groundwater Management Plan (GWMP).

DCM monitors groundwater quality on and surrounding the mine site by sampling from a series of selected monitoring bore locations. The location of these bores is shown in **Figure 3 (Appendix 1).**

Collected waters are analysed for a suite of physical and chemical parameters. Results are evaluated for observable trending and compared to the predicted results from the EA 2010.

A summary of groundwater monitoring results for the reporting period can be found in **Table 29** and **Appendix 4**. Comments on analysed parameters for monitoring conducted during the reporting period are as follows:

- Depth to groundwater was comparable with recent historical data for most monitored wells and consistent with predicted levels.
- pH is comparable with historical data with minor fluctuations apparent. pH in the reporting period varied from a slightly acidic 5.3 (DB10W in May 2019) to a neutral 7.3 (DB9W in May 2019);
- Electrical conductivity generally showed a high degree of variability across many of the wells as has historically been the case. This would appear to reflect the cycle of dry and wet conditions. Shallow wells intercept generally low conductivity alluvial aquifers, whilst deep wells associated with coal measures generally have higher conductivity;
- Calcium and magnesium concentrations across all wells tended to fluctuate within reasonably tight ranges;
- Sulphate concentrations varied across wells. SI2W exhibited the widest range of any bore spanning over 319mg/l;
- Aluminium concentrations are quite low (often being close to the limit of analytical detection) in all the deeper wells but comparatively higher in the shallower wells. The highest concentration recorded was 108 mg/l (DB3W in February 2019);
- Iron concentrations showed no common trend with rises and falls across wells generally. Concentrations showed a wide range from a low of <0.05 mg/l (SI1W) to a high of 161.0 mg/l (DB3W in February 2019);
- Manganese concentrations across all wells were not high with the highest being 2.67 mg/l within WR2 in May 2019; and
- Zinc concentrations were essentially low and consistent with available historical data.

Table 29: Summary of Groundwater Monitoring Results – Average depth, pH and EC.

Site	Depth (m)	pH	EC (µS/cm)
DB1W	16.0	6.0	4198
DB2W	13.7	6.2	1511
DB3W	3.6	6.3	122
DB4W	6.5	6.8	3653
DB5W	12.0	5.8	2333
DB6W	20.6	6.7	5310
DB7W	10.8	7.0	2811
DB8W	19.5	*	*
DB9W	20.8	7.2	3308
DB10W	12.8	5.6	4013
DB11W	10.8	7.0	3208
BH4BW	5.1	6.2	263
SI1W	9.9	7.1	2850
SI2W	19.5	7.2	3143
SI3W	28.1	6.9	7088
WR1	9.5	6.5	2341
WR2	70.4	7.1	5893

Note * = Depth only monitored at DB8W

It should be noted that the EA (2010) described groundwater in the Project area as being characterised by the following parameters/ranges:

- pH – 6.0 to 8.0
- Electrical conductivity – 100 to 7600 uS/cm

Results for the reporting period are provided in **Appendix 4**. In summary, hydrographic plots (Graph 1, Graph 2 and Graph 3), indicate that groundwater monitoring results for the period are generally consistent with predicted outcomes as assessed in the EA (2010). Further review occurred in line with the GWMP where inflows to pits and water levels within bores were consistent with modelled predictions and indicators as per the GWMP. No trigger levels or exceedance of performance measures were identified during the reporting period. No complaints related to groundwater were received during the reporting period.

Depth to water information from piezometer monitoring indicates that bore water levels are generally consistent between bores and are generally consistent with EA (2010) predictions.

The four bores to the west of the open cut pit (SI1W, SI2W, SI3W & DB6W) are all above or close to maximum predicted levels.

No depressurisation has been observed to date at Bore DB11W, located north of operations.

Groundwater quality results for the reporting period indicate results consistent with EA predictions and historical groundwater data trends. For this reporting period, the groundwater pH range for bores likely to be influenced by the coal measures was between 5.3 and 7.3. This is a generally similar range to that noted in the EA. Similarly, the electrical conductivity range for the bores was 103 to 8510 uS/cm. These results are generally similar to and within the range noted in the EA.

Irrigation bores (SI Series) indicate no obvious signs of deep drainage generated from irrigation activities. Irrigation activities ceased during 2018 and no impacts from deep drainage would be expected.

No indication of an increase in connectivity between alluvial bores (DB3W and BH4BW) and the deeper groundwater system has been observed based on monitoring results for water quality and groundwater table level.

The waste emplacements bores (WR Series) indicate signs of recharging of the backfilled void,

particularly at WR1. This is consistent with the numerical modelling of the post-mining groundwater levels (EA 2010) which shows slow but complete recovery of the groundwater system over many decades and that the Clareval void, once filled with water, would act as a sink, while the Weismantel void lake would act as a flow-through lake system. Additional detail is available within the EA for the DEP Modification 2 approved in December 2014.

Assessment of Performance Indicators

Groundwater monitoring results are assessed against Performance Indicators and Measures as described Section 7.1 and Table 6 of the GWMP. Monitoring data for the reporting period was in accordance with the performance measures which indicate:

- No more than a negligible impact on stream baseflow as a result of the Duralie Project;
- No more than a negligible impact on water levels in groundwater production bores on private land.

Refer **Table 30** below.

Table 30: Groundwater Monitoring Performance Outcomes – 2018-19 Reporting Period

Performance Measure	Performance Indicators	Assessment of Performance Indicators	Assessment of Performance Measure
No more than negligible impact on stream baseflow and/or natural river leakage of Mammy Johnsons River to the deeper groundwater system as a result of the Duralie Extension Project (incorporating the Open Pit Modification).	Groundwater inflows to open pits are consistent with Duralie Open Pit Modification Environmental Assessment (EA) predictions.	Data analysis indicates groundwater inflows to open pits have been less than the Duralie Open Pit Modification Environmental Assessment (EA) predictions. Refer to the site water balance review for 2018. .	No further requirement for assessment of Performance Measure.
	Groundwater levels in alluvium bores are consistent with Duralie Open Pit Modification EA predictions (accounting for temporal changes in rainfall recharge).	Data analysis of daily alluvium bore pressure sensors indicates groundwater levels in alluvium bores are consistent with Duralie Open Pit Modification EA predictions (accounting for temporal changes in rainfall recharge). Refer to groundwater monitoring data.	No further requirement for assessment of Performance Measure.
No more than negligible impact on water levels in groundwater production bores on privately-owned land as a result of the Duralie Extension Project (incorporating the Open Pit Modification).	No groundwater related complaints received	No groundwater related complaints were received during the reporting period.	No further requirement for assessment of Performance Measure.

7.3.3 Groundwater Inflows to Open Cut Mining Operations

Groundwater seepage inflows to mining voids is directed and collected in pit sumps along with rainfall and surface water runoff and seepage through backfilled pit areas. Water level and water quality analysis of the pit sumps is undertaken on a monthly basis. The volumes of water extracted from the pit sumps is recorded where practicable.

The water quality monitoring results for the open cut pits during the reporting period is included in Section 7.2.2.2 of this report.

A site water balance review is undertaken on an annual basis to monitor the status of inflows (including groundwater inflows to open pits), storage and consumption. A summary of the 2018 site water balance review is included in Section 7.1.2 of this report.

No dewatering from the open cut pits was undertaken during the reporting period, however transfer of water between the Weismantel and Clareval was undertaken to continue mining operations. Mining activities have currently ceased in both Weismantel and Clareval pits.

7.4 IRRIGATION

The Duralie Coal Mine operates under a continual stored water surplus. The Project Approval conditions precludes the disposal of mine water from the approved project approval boundary and Duralie is managed as a zero discharge site.

Irrigation at the DCM is managed in accordance with the WMP, specifically Appendix 2 Surface Water Management Plan Attachment 1 Irrigation Management Plan (IMP). Irrigation consists of a network of fixed sprays in the Type I, II and IV irrigation areas supported by evaporative fans in the Type I and Type V irrigation areas (waste rock emplacement) only.

During the 2017 reporting period the fixed spray system was removed from the Type IV area (rehabilitated waste emplacement). The evaporative sprays were also removed from the Type I and Type V (waste rock emplacement area) during the 2017 reporting. No irrigation has occurred within Type III irrigation areas located in the catchment of Coal Shaft Creek above Dam 3.

During 2018 all irrigation activities at the DCM were ceased. ROM coal mining in the Clareval Pit was finalised in September 2017 and the void space has now become available for water storage and waste rock backfill. Since this time open cut dewatering to the Main Water Dam has also ceased with water preferentially transferred to the Clareval void. As such, the demand for irrigation to reduce the total site water storage has reduced and all irrigation activities on site have now ceased. Mine water will be progressively transferred from the mine water dams to the voids as discussed in the mine closure planning section.

The irrigation system management controls were maintained until the cessation of irrigation activities in 2018. An overview of the site irrigation system is outlined in the WMP,

During the 2018 calendar year a total of 81 ML of mine water was irrigated within Type I, II, IV & V areas (compared with 256 ML 2017 calendar year). The reduced volume was due to the ceasing of irrigation.

Monitoring of irrigation supply water quality from the Main Water Dam (“SW3”) was undertaken on a monthly basis during the review period. Analytical results are shown in Section 7.2.2.2 and also in **Appendix 4**. Results for the MWD irrigation water quality was assessed against the relevant performance measures from the WMP by Horizon Environmental Soil Survey (refer extract within 7.4.1 below).

7.4.1 Irrigation Area Soil and Vegetation Monitoring

Irrigation area monitoring is conducted in accordance with the WMP which incorporates the Irrigation Management Plan (IMP) as an attachment of the Surface Water Management Plan (SWMP). The annual irrigation area monitoring includes an assessment of soil characteristics and vegetation condition with consideration to the irrigation water quality applied.

The irrigation area performance measures and indicators are included in Table 6 of SWMP Section 9. The irrigation performance measure states that irrigation activities would have no significant impact on soil properties or suitability of soil in irrigated areas for future agricultural use (i.e. grazing on native pasture). The irrigation performance indicators relate to pH in the **MWD** being maintained between 6.0 and 8.5; SAR less than 6 and EC less than 2500 µS/cm (2.5 dS/m). If a performance indicator is exceeded an assessment of the performance measure is also included in the irrigation monitoring report.

Irrigation area monitoring was undertaken between 6 June and 2 July 2019 and a summary from the Irrigation Area Monitoring Report (Horizon Environmental, 2019) is provided below:

*"Irrigated water disposal ceased in 2018. The present condition of soils and pastures in the irrigation areas has been investigated to identify whether soil fertility has declined and if so, whether remediation is needed. Specifically, impact of cumulative electrolyte loadings from salts, trace metals and metalloids in irrigated mine water on future grazing land use of irrigated areas at Duralie Coal Mine (**DCM**) was investigated in 2018-19 and reviewed over the life of the monitoring program since 2013 across two reference sites representative of the different soils and geologies; and five mine water irrigation sites. Contamination assessment referred to ANZECC & ARMCANZ guidelines for water quality monitoring and published Australian guidance for soil fertility assessment. The implications of identified soil impacts for longer-term agricultural land use are discussed.*

Irrigation water salinity, sodicity and pH have historically exceeded the irrigation management trigger levels. Metal and metalloid concentrations in the MWD have been below short-term guidelines (irrigation periods up to 20 years). Consequently, cumulative contaminant loadings in the irrigation management system are not considered to be an issue for future land management. However, there has been an upward trend over time in soil sodicity from the annual soil monitoring results. The increase in sodicity has not been accompanied by declines in soil organic carbon that would indicate soil structural degradation. Consequently, soil sodicity is not considered to be detrimental to pasture production in the irrigated areas. Generally, major nutrients (total nitrogen, extractable phosphorus and potassium) and micronutrients (Cu and Zn) in surface soils are limiting to pasture quality and productivity. A fertiliser management program would improve pasture productivity.

We found no detectable adverse impact from irrigation management on pasture cover or composition. Complete ground cover is being maintained on the irrigated pasture. Introducing grazing in the irrigation areas compared with low grazing pressure on reference sites, appears to be changing pasture composition to dominance of paspalum (Paspalum dilatatum) in the irrigated pastures. Observed year to year variation in pasture biomass are likely to be associated with seasonal conditions and applied grazing pressure. There may be a general lack of soil porosity to depth that could promote waterlogging. Low soil porosity at depth may be due to over-clearing for pasture. Deep ripping combined with revegetation or pasture improvement may improve pasture productivity. There does not appear to be a detrimental effect on ground cover or pasture composition in the irrigated pastures compared with the dryland, reference sites.

Recommendation:

> *The former irrigation areas can be decommissioned without detriment to pastureland use. A fertilizer management program for major nutrients and trace metals would improve pasture production generally, inside and outside of former irrigation areas."*

8. REHABILITATION

Rehabilitation of disturbed land at DCM is undertaken in accordance with the Mining Operations Plan and Rehabilitation Management Plan (MOP 2017). The MOP term covers mining operations and rehabilitation activities up to the end of 2019. The MOP is available on the Duralie Coal website.

The new MOP will be prepared for the mine closure phase of operations prior to the end of 2019. The new MOP will reflect the proposed mining and rehabilitation activities for the next 3 year period and also include a detailed Mine Closure Plan.

Condition 55, Schedule 3 of the Project Approval specifies the DCM post mining land use and rehabilitation objectives which are reproduced in **Table 31** below.

Table 31: Rehabilitation Objectives

Feature	Objective
Mine site (as a whole of the disturbed land and water)	Safe, stable and non-polluting, fit for the purpose of the intended post-mining land use(s).
Surface infrastructure	To be decommissioned and removed, unless the Secretary agrees otherwise.
Coal Shaft Creek Diversion	Hydraulically and geomorphologically stable, with riparian vegetation that is the same or better than prior to mining.
Landforms	Final landforms sustain the intended land use for the post-mining domain(s). Final landforms are consistent with and compliment the topography of the surrounding region to minimise the visual prominence of the final landforms in the post-mining landscape. Final landforms incorporate design relief patterns and principles consistent with natural drainage.
Other land affected by the project	Restore ecosystem function, including maintaining or establishing self-sustaining ecosystems comprising: • local native plant species; and • a landform consistent with the surrounding environment
Water Quality	Water retained on site is fit for the intended land use(s) for the post-mining domain(s). Water discharged from site is consistent with the baseline ecological, hydrological and geomorphic conditions of the creeks prior to mining disturbance. Water management is consistent with the regional catchment management strategy.
Native flora and fauna habitat and corridors	Size, locations and species of native tree lots and corridors are established to sustain biodiversity habitats. Species are selected that re-establishes and complements regional and local biodiversity.
Final void	Safe, stable and non-polluting.
Post-mining agricultural pursuits	The land capability classification for the relevant nominated agricultural pursuit for each domain is established and self-sustaining within 5 years of land use establishment (first planting of vegetation).
Community	Minimise the adverse socio-economic effects associated with mine closure.

A summary of the rehabilitation objectives, performance indicators and completion criteria relevant to the DCM rehabilitation domains is provided in the MOP. Plan 4 in the MOP shows the conceptual final landform, relevant primary domains and secondary rehabilitation domains.

8.1 BUILDINGS & INFRASTRUCTURE

Buildings and infrastructure at the DCM have been utilised during the life of the operations. Following the cessation of mining activities in October 2018, some infrastructure has been decommissioned and an assessment has been undertaken for the infrastructure which will still be required. During the previous reporting period the following infrastructure was decommissioned and relocated to the SMC:

- Muster area and bathhouse
- Field crib hut

- Fuel storage tanks
- Oil and grease storage tanks

The remaining infrastructure will be required at the DCM for future activities including rehabilitation work. No other buildings or infrastructure were constructed, demolished or renovated during the reporting period. No decommissioning of infrastructure is schedule during the next reporting period. This will be further addressed during the mine closure planning process.

8.2 REHABILITATION OF DISTURBED LAND

Rehabilitation of disturbed areas is undertaken progressively and concurrently with ongoing mining operations. Rehabilitation planning, management and implementation is described in the MOP. The overburden emplacement is rehabilitated in progressive increments to the final landform so the area of disturbed land is minimised and disturbed water catchment areas are reduced. Stage plans for the Duralie disturbance and rehabilitation areas are provided in the MOP.

Mining and rehabilitation activities follow the general progression below:

- Vegetation is cleared ahead of mine progression. Details are included in the Annual Biodiversity Report included in **Appendix 8**;
- Topsoil is removed ahead of the advancing pit or overburden dump and recovered for rehabilitation;
- Overburden and coal extraction is undertaken:
- Bulk shaping of waste emplacements, drainage works, ground preparation and topsoil placement; and
- Planting of rehabilitation areas following all preparation works. The areas to be rehabilitated will comprise a combination of native forest/woodland and pasture with scattered trees as described in the MOP.

The DCM rehabilitation progress is generally in accordance with the planned activities described in the MOP Plan 3E - Mining and Rehabilitation 2019. The MOP makes provision for 427 hectares of total disturbance area and 215 hectares of rehabilitated area by the end of 2019. The current (June 2019) total disturbance area is 406 hectares and the completed rehabilitation area is 151 hectares (excluding bulk shaping). The difference between proposed and completed rehabilitation is due to 21 hectares less disturbance than proposed and 39 hectares due for completion prior to the end of 2019.

During the reporting period approximately 36 hectares of the Weismantel waste emplacement area was rehabilitated, incorporating ground preparation, spreading with topsoil and planting with pasture species in November 2018.

Prior to the end of 2019, a further 39 hectares of bulk shaping (landform establishment) is scheduled to be finalised on the Western Haul Road, Weismantel waste emplacement and Clareval waste emplacement areas. Of this area 29 hectares will be topsoiled and seeded prior to the end of 2019.

Table 32 presents a summary of the rehabilitation undertaken at the Duralie mine site up to the current reporting period. The current mining areas and rehabilitation as of 30 June 2019 are shown in **Figure 4,** provided in **Appendix 1.**

Table 32 – Rehabilitation status

Mine area type	Previous RP (actual hectares)	Current RP (actual hectares)	Next RP (forecast hectares)
Total Mining Lease	942.8	942.8	942.8
Total mine footprint	406	406	406
Total active disturbance	250	248	218
Land being prepared for rehab (Landform Establishment)	41	7	17
Land under active rehabilitation (Growth Medium Development)	0	0	0
Completed rehabilitation (Ecosystem Establishment & Sustainability)	115	151	180

Note: Landform establishment area is included in the active disturbance total.

Rehabilitation Resources

Topsoil resources are managed in accordance with the MOP Section 3.3.4. No vegetation clearance or topsoil stripping was undertaken during the reporting period. No further disturbance is proposed for mining activities at the DCM

The site topsoil balance is updated annually to track the recovery and usage of topsoil and ensure adequate resources are available for rehabilitation of disturbed areas at the DCM. The latest topsoil balance was updated in July 2019. At the end of the reporting period an estimated 129,000 cubic metres of topsoil was held in various stockpiles. This would provide for rehabilitation of 129 hectares to the nominal topsoil depth of 100mm. The current area of disturbance which will require topsoil (i.e. not including final void of 65ha or water management area of 63ha) is 121 hectares, therefore sufficient topsoil resources are available to complete rehabilitation of the operation.

Topsoil stripping has now been completed up to the northern extent of both the Clareval pit and the Weismantel pit. The DCM topsoil balance will be updated again during the next reporting period.

Rehabilitation Maintenance

Recommendations for maintenance activities on rehabilitated land have been included in the rehabilitation monitoring reports, refer to Section 8.3.

During the reporting period maintenance activities focussed on the improvement of pasture rehabilitation at the DCM. Maintenance works included slashing, aerating and fertiliser application. Maintenance activities also included slashing and clearing of access tracks and weeds spraying. Weed control has been undertaken across the rehabilitation areas targeting lantana, blackberry, wild tobacco and giant parramatta grass.

During the next reporting period work will be undertaken in the young native rehabilitation area via aerating and over-seeding to improve biodiversity and stem density.

8.3 REHABILITATION MONITORING

Monitoring of the DCM rehabilitation areas is described in Section 8 of the MOP. Rehabilitation is monitored on a regular basis to ensure vegetation is establishing in the rehabilitation areas and to determine the need for any maintenance and/or contingency measures (e.g. supplementary plantings, weed or erosion control). The monitoring also aims to demonstrate the effectiveness of the rehabilitation techniques and track the progression towards achieving the performance and completion criteria.

Visual Monitoring

Rehabilitation monitoring includes a visual assessment:

- monitoring of soil erosion status and the effectiveness of erosion control methods;
- assessing germination success and vegetation establishment (diversity and abundance);
- usage of habitat enhancement features;
- the presence of weeds or feral animals; and
- mine landform runoff water quality.

The visual monitoring provides an early identification of areas requiring remedial planting or other maintenance works to maintain rehabilitation progress. A report has been prepared titled "*Duralie Rehabilitation Walkover Report 2017*" and provides a list of maintenance recommendations predominantly relating to erosion control, weeds control and vegetation management and enhancement. The report can be made available on request from the Environmental Department.

Ecosystem Function Analysis

The assessment of rehabilitation quality and ecosystem value is conducted via the use Ecosystem Function analysis (EFA). EFA aims to measure the progression of rehabilitation towards self-sustaining ecosystems. EFA has been incorporated into the overall DCM rehabilitation monitoring program to provide an assessment of landscape functionality.

EFA Analogue Transects have been established in proximal areas to represent the varying landscapes (i.e. slopes and aspects) and target communities planned for each rehabilitation area.

In December 2013, a fixed transect-based Landscape Function Analysis (LFA) and Vegetation Structure monitoring program was established across the DCM Rehabilitation areas. These transects were assessed again in May 2019 as part of the sixth annual round of monitoring in accordance with Section 8 of the MOP. A summary of the findings from the *2019 Duralie Coal Mine Rehabilitation Monitoring Report* (Kleinfelder, 2019) (**Appendix 10**) follows;

Overall, the rehabilitation of the Duralie Spoil Emplacement continues to progress satisfactorily and is on a trajectory towards meeting the performance and completion criteria detailed in the MOP. LFA indices are continuing to achieve or approach the analogue site.

By index:

- *Stability Index – all rehabilitation greater than three years old has achieved Analogue index scores. Younger rehabilitation – 2016 – has improved. This is the first survey of the 2018 rehabilitation area but is relatively stable due to good vegetation cover and flat slope. Overall the soil surface is intact with no active erosion observed.*
- *Infiltration Index – the transects surveyed in 2019 remain below the Analogue benchmark score and require further time for development. The 2008 rehabilitation achieved the highest index score, with the younger rehabilitation achieving progressively lower scores; and*
- *Nutrient Cycling Index – the 2008 rehabilitation achieved the analogue value, with the remaining rehabilitation ages trending upwards. This is termed a lagging index and requires the greatest length of time to achieve analogue values.*

The vegetation structure on the spoil emplacement is still at a relatively early stage of development when compared to remnant vegetation found on the analogue sites.

Stem density is variable across the spoil emplacement, but almost without exception the rehabilitated areas have lower overall numbers of plants than the average analogue values. Stem densities are also variable within each rehabilitation area and reflects both transects surveyed and natural processes at work. Area of 2008 and 2012 rehabilitation are experiencing die-off of Acacia species resulting in more open areas dominated by exotic grasses. Two rehabilitation areas, the 2011 and the 2016 rehabilitation have recorded increase in stem densities.

The distribution of the vegetation by strata is considerably different in the rehabilitated areas when compared to analogue sites, with distribution of stem densities reversed. In the rehabilitation areas,

Eucalypt densities – i.e. canopy – are generally the bulk of the stems, and much higher than the analogue density regardless of age rehabilitation. The only exception to this is the 2013 rehabilitation where canopy numbers are still quite low or non-existent. The shrub stratum on the other hand is largely composed of juvenile Eucalypts and Acacias, whereas analogue sites, the shrub stratum is dominant in terms of numbers. 2010 and some areas of the 2008 rehabilitation have recorded an increase in new native species – particularly in the shrub and forb layers that appear to have established naturally. Earlier surveys noted the establishment of avian spread species, whereas these species are heavier seeded and are spread by other vectors e.g. wind or other fauna.

Canopy volumes have increased across the entire spoil emplacement – as expected – as vegetation matures and increases in size. Weed species, dominated by Lantana, Wild tobacco and Privet were noted in the older rehabilitation areas.

It was concluded that the rehabilitation of the spoil emplacement is progressing satisfactorily, with the following recommendation made:

- *Plant or seed canopy species into the area surrounding Transect 3502.*
- *Improve the overall vegetation structure of the older areas of rehabilitation by implementing a modest seeding and/or planting program of shrub species to better match the structure of the analogue sites, especially where Acacia die-off has occurred.*
- *More generally further introduction of a wider variety of shrub species, especially those that do not spread by avian fauna could be facilitated with a modest seeding and/or planting program.*
- *Leucopogon juniperinus (Prickly Beard-heath) is a common species through the analogue sites but is not provided commercially. It would be beneficial to attempt to collect seed from on site to use in the rehabilitation introducing it to younger rehabilitation areas or where it has not yet colonised. The PAF area and VMU AG both have dense populations of this specie and it may be possible to collect seed from these areas. PlantNET states that seed are mature from August to January.*
- *Woody weed control works should be undertaken in the areas identified above where Lantana and Wild tobacco (and Privet identified during other work undertaken the spoil emplacement) have become established.*
- *As part of the above the drains could be slashed to provide access for weed control works and to provide fire breaks.*

Fauna Monitoring

Fauna usage of the native woodland/forest rehabilitation areas is monitored and documented over time. Fauna surveys are conducted to assess the success of the rehabilitation and revegetation activities in providing habitat for a range of vertebrate fauna. The surveys include an assessment of habitat complexity, species richness and abundance. Fauna monitoring was undertaken during February 2018.

During 2018 AMBS Ecology & Heritage (AMBS) was engaged to undertake a fauna survey within the DCM native rehabilitation areas to assess the success of the rehabilitation areas in providing habitat for a range of vertebrate fauna. The fauna survey undertaken in February 2018 also extended to the Duralie Biodiversity Offset Areas.

The results are provided in the *DCM Fauna Surveys of the Offset and Mine Rehabilitation Areas, February 2018* (AMBS, 2018). An extracted summary is provided below.

"Targeted fauna surveys were undertaken at five sites within the Duralie Offset Area and two sites in the Duralie Mine Rehabilitation Area during February 2018. At most sites survey techniques included pitfall traps, funnel traps, Elliott A traps, harp traps, ultrasonic call recording, spotlighting, diurnal bird surveys and reptile searches. Opportunistic observations of signs of fauna were noted throughout the field survey period, including during transit between surveys sites".

"A total of 124 species of vertebrate were recorded, comprising 8 frogs, 10 reptiles, 56 birds and 30 mammals…, most of which were native. With the exception of reptiles, a similar number of frog, mammal and bird species were recorded at Mine Rehabilitation Area sites compared with Offset Area sites. Five introduced species were recorded during the surveys, including Cattle (Bos taurus), House

Mouse (Mus musculus), European Rabbit (Oryctolagus cuniculus), Black Rat (Rattus rattus) and Red Fox (Vulpes vulpes). Fifteen of the species detected are listed as threatened or migratory on the schedules of the Biodiversity Conservation Act 2016 (NSW) and/or the Environment Protection Biodiversity Conservation Act 1999 (Cth)."

Four of these species have been recorded for the first time during dedicated fauna surveys for the DCM, including the Little Lorikeet, Masked Owl, Long-nosed Potoroo and New Holland Mouse.

The fauna surveys suggest the DCM offset and rehabilitation areas provide habitat for a range of native vertebrate fauna, including birds, mammals, reptiles and frogs. The number of species recorded utilising the rehabilitation area is encouraging, particularly given the relatively young age of the vegetation."

8.3.1 Threats to Rehabilitation Completion

The Duralie MOP Section 9 includes a description of intervention and adaptive management for threats to rehabilitation. DCPL has successfully undertaken rehabilitation activities at the DCM since 2008. The Environmental Risk Assessment identified potential issues and risks associated with rehabilitation at the DCM. These potential risks are identified and risk assessed which leads to improvement of rehabilitation practices and remediation as required.

A trigger, action, response plan (TARP) (MOP Table 13) has been developed based on identified threats to rehabilitation at the DCM.

During the reporting period the rehabilitation monitoring program identified a list of recommendations regarding the existing rehabilitation and future rehabilitation works (**Section 8.3**) (**Appendix 10**). The recommendations mostly related to increasing tree and shrub structure and biodiversity in the native rehabilitation areas, and secondly continuing to manage weeds in both the native and pasture rehabilitation areas.

A review of the threats identified in the rehabilitation TARP (MOP Table 13) indicates the following issues may present a risk to the success of the DCM rehabilitation achieving the relevant rehabilitation completion criteria:

- Species diversity and/or density in rehabilitation areas does not correspond with reference site(s).

The recommendations in the rehabilitation monitoring report (**Section 8.3)** provide recommended maintenance and management measures.

8.4 REHABILITATION TRIALS AND RESEARCH

DCPL has extensive experience in both native woodland/forest revegetation and agricultural pasture rehabilitation, with successful rehabilitation areas completed over the past 20 years at both the Duralie and Stratford mine sites. Learnings from the rehabilitation works undertaken onsite to date along with industry best practice guidelines are employed in the methodology for new rehabilitation areas.

Rehabilitation trials are currently being implemented in the biodiversity offset area in accordance with the Biodiversity Management Plan. The program has trialled several methods for ground preparation, seeding and planting to determine the most suitable and cost effective methods for completing the remaining offset revegetation and mine site rehabilitation. The techniques include both direct seeding and tube stock with inoculated and un-inoculated seed. Refer to Section 6.5 of this report and the Duralie Coal Mine Annual Biodiversity Report (DCPL, 2019) for a summary of works undertaken during the reporting period.

8.5 REHABILITATION TARGETS

The DCM MOP Plan 3E - Mining and Rehabilitation 2019 rehabilitation target for end of 2019 calendar year is a cumulative total of 215 hectares of rehabilitation. To date 151 hectares of rehabilitation has been completed comprising Ecosystem Establishment and Sustainability. A further 7 hectares of Landform Establishment (bulk shaping) has been completed.

The MOP rehabilitation targets for the next reporting period have not yet been submitted to the Resources Regulator. A new MOP will be prepared for the mine closure phase of operations prior to the end of 2019. The new MOP will reflect the proposed mining and rehabilitation activities for the next 3-year period.

DCPL proposes to undertake rehabilitation of approximately 29 hectares to Ecosystem Establishment phase and a further 10 hectares to Landform Establishment phase during the next reporting period.

8.6 DEVELOPMENT OF THE FINAL REHABILITATION PLAN

8.6.1 Mine Closure Planning

A MOP Amendment (Amendment B) was prepared following the issue of a notice under section 240(1)(C) of the *Mining Act 1992* by the Department of Planning and Environment (DP&E) in May 2017. In accordance with the notice, the MOP Amendment included the addition of a mine closure planning program, which includes a schedule of all technical and/or environmental assessments that will be required to undertake final rehabilitation following the cessation of open-cut mining at the DCM. The MOP Amendment was approved by DRG on 11 December 2017.
31 August 2017.

The MOP Section 10 details the mine closure planning program. The planning program is designed to inform the preparation of a detailed Mine Closure Plan, which is required to be prepared and submitted to the DRG prior to the expiry of the MOP term (i.e. prior to 31 December 2019). The Mine Closure Plan would include final rehabilitation measures for all areas including infrastructure areas, water management areas, waste emplacements, final voids and biodiversity offsets.

A new MOP will be prepared for the mine closure phase of operations prior to the end of 2019. The new MOP will reflect the proposed mining and rehabilitation activities for the next 3-year period.

The subsections below provide progressive updates on the key mine closure planning requirements for the DCM and the actions completed during the reporting period.

8.6.2 Final Landform designs

The rehabilitation objectives for the final landforms requires final landform designs which sustain the intended land use for the post-mining domain(s). Final landforms are to be consistent with and complement the topography of the surrounding region to minimize the visual prominence of the final landforms in the postmining landscape. Final landforms are to incorporate design relief patterns and principles consistent with natural drainage.

DCPL have continued to develop the detailed final landform designs consistent with the conceptual rehabilitation strategy in the EIS 2014 and rehabilitation objectives in the Project Approval. The MOP also includes detail regarding the rehabilitation implementation requirements and the conceptual final rehabilitated landform for the DCM.

The final landform design will be included in the new MOP. A stability assessment of the final landform design will also be undertaken and included in the MOP.

8.6.3 Final Void Management

Under the Project Approval, at the cessation of mining, the northern extents of the currently approved DEP include final voids in the Clareval pit and Weismantel pit. A final void water balance and groundwater model was prepared for the DEP EA 2010 and was revised for the Open Pit Modification EA 2014.

The mine closure planning schedule includes several components relating to water management and final voids.

Final Void Design

DCPL is required to rehabilitate the final void to ensure the landform is safe, stable and non-polluting. During the reporting period DCPL engaged an independent consultant to provide advice on the development of a detailed final void design including geotechnical stability and provide recommendations for the reshaping of final highwalls and endwalls. The report provides advice on rehabilitated wall stability and slope design.

The final void design has been revised during the reporting period to minimise the overall extent of the final void as much as is reasonably feasible and within the Project Approval constraints. The final void design will continue to be included in the MOP.

Final Void Water Balance

The final void water balance conducted by Gilbert & Associates (2014) for the DCM indicates the final voids would slowly fill over time and the final water levels in the Clareval open pit and Weismantel open pit would stabilise below the spill levels,

A review of the final void water balance is required to ensure the water balance incorporates the final landform design and surface water inflows and outflows to/from the final void. HEC were engage during the reporting period to revise the site water balance and provide advice on the predicted post-mining final void equilibrium level. This report will be included in the MOP.

Groundwater model

The groundwater model for the post-mining groundwater system is intrinsically related to the final void water balance. In conjunction with the final void water balance review, HydroSimulations has also been engaged the undertake a verification of the site groundwater model in relation to the final landform designs and inform the groundwater seepage rates to the final void. This report will be included in the MOP.

8.6.4 Water Management

The rehabilitation and post-mining water management strategy is described in the DEP EA 2014.

Site Water Balance

A review of the post-mining site water balance is required to ensure the water balance incorporates the detailed final landform design. The site water balance will be included in a revision of the DCM Water Management Plan.

Water Infrastructure

Consistent with the approved DCM, rehabilitation of water management infrastructure would occur in consultation with regulatory authorities and the community, and considering future local and regional water infrastructure needs. Site water dams (e.g. MWD, Auxiliary Dams) and accompanying upstream diversion structures may be retained for future use. Sediment dams would remain pending long-term acceptable water quality and may be kept for stockwater if suitable. Irrigation infrastructure owned by

DCPL would be decommissioned, unless used for post-mining agricultural use.

Further detail regarding the management of the Coal Shaft Creek reconstruction and the Mine Water Dams are included in the sub-sections below.

8.6.5 Coal Shaft Creek Reconstruction Plan

Re-construction of the lower reaches of Coal Shaft Creek is required following the completion of mining activities. The Coal Shaft Creek Reconstruction Plan was prepared in December 2012 and provides a conceptual design for the creek reconstruction. The plan is included as an attachment to the DCM Water Management Plan. The final Coal Shaft Creek design will be included in the mine closure planning process as described in the MOP Section 5.4

The MOP requires an analysis to be conducted into the geotechnical, hydrological and hydraulic design of the final alignment focussing on long-term stability, seepage management and the creation of habitat. The outcomes of these analyses will inform the final detailed design of the post-mining alignment and reconstruction of Coal Shaft Creek.

During the reporting period HEC was commissioned to prepare a detailed final design of the Coal Shaft Creek re-alignment and reconstruction. The Coal Shaft Creek Reconstruction Plan will be prepared in consultation with the relevant authorities and stakeholders. The Coal Shaft Creek Reconstruction Plan will be described in the MOP and included as an attached to the Water Management Plan.

8.6.6 Rehabilitation Resources

Topsoil resources are managed in accordance with the MOP Section 3.3.4. To ensure suitable and adequate topsoil resources are available for final rehabilitation, a site topsoil balance is undertaken annually and the volume compared to the total remaining disturbed area requiring rehabilitation. Annual reporting of the site soil balance and rehabilitation performance is provided in Section 8.2 of this report.

Topsoil stripping has now been completed up to the northern extent of both the Clareval pit and the Weismantel pit.

Clay resources will be required for the construction of clay cut-off walls along the southern end of the toe of the waste rock emplacement to reduce direct seepage out of the waste rock emplacement to negligible
levels. Clay resources would also be required for lining of the reconstructed Coal Shaft Creek. Details are included in the CSC Reconstruction Plan

8.6.7 Infrastructure Decommissioning

The mine closure planning program includes consideration for infrastructure decommissioning including:

- Identify and remove/demolish all non-active infrastructure which is not required for the remainder of processing activities.
- Undertake consultation to confirm any alternative use for retained infrastructure (i.e. rail loop, haul roads, access tracks and dams) post-mining.

A list of the site assets/infrastructure and the decommissioning schedule will be included in the MOP.

Further details regarding decommissioning activities during the reporting period is included in Section 8.1 of his report,

8.6.8 Mine Water Dams Decommissioning

The Main Water Dam, Auxiliary Dam 1 and Auxiliary Dam 2 are all prescribed under the Dams Safety Act 1978. DCPL is required to prepare a strategy for decommissioning of the mine water dams or for integration with the final land use. Additionally, DCPL is required to prepare a strategy for transferring mine water from the prescribed dams back to the final voids following the completion of mining activities.

DCPL has engaged an independent dams engineer to assist with preparing plans for the decommissioning the of the prescribed dams with consideration of future approvals or mine closure requirements in consultation with relevant agencies (e.g. Dam Safety Committee).

During the 2018, AD1 was dewatered to MWD. No water has been pumped from the open cuts and adequate storage is currently available in MWD and AD2. Since the completion of mining in the Clareval Open Cut, the void has become available for water storage. No water has been transferred from the Mine Water Dams as of the end of the reporting period, however water has been transferred from the Weismantel Pit to the Clareval void.

AD2 is planned to be dewatered during the next reporting period. Decommissioning of the prescribed dam structures is expected to be undertaken over the coming years. The decommissioning strategy will be included in the MOP and the Water Management Plan.

9. COMMUNITY RELATIONS

9.1 COMMUNITY ENGAGMENT ACTIVITIES

Yancoal Australia Ltd is committed to making a positive contribution in the areas in which it operates. To help facilitate this commitment Stratford Coal Pty Ltd have established the Community Support Program to provide assistance to local initiatives within the local area in which they operate. The aim of the Community Support Program is to help benefit a diverse range of community needs such as education, environment, health, infrastructure projects, arts, leisure and cultural heritage.

The Stratford Coal Community Support Program has granted over $638,000 since commencing in 2010 and during 2019 a total of $85,950 in grants was distributed between 22 community organisations for a diverse range of community projects and initiatives. The community groups to receive grants in 2019 were:

Community Support Program 2019 Recipients	Project Description
Gloucester Police Department	Gloucester Police & Friends Charity Golf Day
Street Swags for Homeless	Massive Murray River Paddle - Street Swags for Homeless
Gloucester Little Athletics Centre Inc	High Jump Mats
Stroud Neighbourhood Children's Cooperative	Outdoor Space Roof Lining
Gloucester Country Club	Stratford Coal Super Sevens Golf Competition 2019
Stroud Raiders Rugby League Club	Football Goal Post Replacement
Gloucester Pre-School	Kitchen Upgrade
Booral Rural Fire Brigade	Defibrillator for Driver Reviver
NSW Rural Fire Service - MidCoast District	Brigade Capability Enhancement - Hose Washing Devices and Cooler Boxes.
Stroud Rodeo Association	2019 Stroud Rodeo and Campdraft - Major Sponsor
Stroud & District Country Club	Stroud Country Club Family Fun Day
Stroud Show Association	2019 Stroud Show - Major Sponsor
Bucketts Way Neighbourhood Group Inc	Training Room Equipment Upgrade
Gloucester Agricultural, Horticultural & Pastoral Assoc.	Gloucester Show 2019
Gloucester Thunderbolts Swimming Club Inc.	New Laptop for Club Admin and Presentations.
Gloucester Public School P & C Assoc	Oven Upgrade in School Canteen
Stratford Public School	Apple Swivl Camera
Stroud Road Community Hall & Progress Assoc	Stroud Road Spring "Bash 'n Bang" 2019
Gloucester High School	Laptops - Class sets for use in classrooms
Gloucester Mountain Man Triathlon Inc.	2019 Gloucester Mountain Man Tri Challenge
MidCoast Science & Engineering Challenge	MidCoast Science & Engineering Challenge and Discovery Days 2019
Gloucester Pony Club Inc	Gloucester Pony Club Show Jumping Equipment

Stratford Coal Pty Ltd have also continued their commitment to education and training in the Gloucester region through Stratford Coal's Education Support Program, providing much needed

funding for the next generation of young students. The Education Support Program is managed by an independent committee and the funds distributed by MidCoast Council. In 2019, $29,000 has been allocated in funding to help support local students and businesses in university degrees, TAFE courses and apprenticeships.

Since the commencement of mining in 1995, Stratford Coal has contributed more than $731,000 to locally based community and training initiatives via the Education Support Program. During that time, the funding has support over 160 tertiary students, 100 apprentices and 50 businesses.

Yancoal and Stratford Coal have continued their partnership with the Clontarf Foundation Chatham Academy. During 2019 SCPL engaged in several activities with the Chatham Academy students including a site visit to the Stratford Coal mine site. The site visit provided an example of an operational mine site and what goes into running a mine including the rehabilitation of mine land. Following the site visit, Clontarf students spent the afternoon learning how to plant tubestock trees in the Stratford Biodiversity Offset Area.

During the reporting period Stratford Coal have given presentations to Advance Gloucester and the Gloucester Business Chamber.

9.2 COMMUNITY CONSULTATIVE COMMITTEE

The Duralie Community Consultative Committee (CCC) was established in 2003 and operates under the guidance of the NSW Department of Planning & Environment. Meetings are held 6-monthly and provide a forum for open discussion between the community, Council, the Company and other stakeholders on issues relating to the mine's operations, environmental performance and community engagement.

The Community Consultative Committee (CCC) for the Duralie Coal Mine is currently comprised of:

- An independent Chairperson;
- Four (4) local community representatives;
- Two (2) local government representatives (MidCoast Council); and
- Two (2) DCPL representatives.

The CCC was formed in accordance with Schedule 5, Condition 5 of the Project Approval for the Duralie Extension Project. The Committee operates in such a manner as to generally satisfy the *Community Consultative Committees Guidelines for State Significant Projects* (Department of Planning, 2016) and to the satisfaction of the Secretary of the DP&E.

During the reporting period and following the cessation of mining activities at the DCM the CCC have been reduced from quarterly to 6-monthly. Three CCC meetings were held during the reporting period in August and November 2018 and February 2019.

Items raised and/or discussed during the three (3) CCC meetings held during the reporting period include but are not limited to:

- General progress at the mine;
- Mine closure planning;
- Mine rehabilitation and post-mining land use;
- Environmental Management Plans;
- Environmental monitoring, including air quality, noise, surface water and groundwater;
- Environmental Reporting;
- Water management;
- Community complaints;
- Community engagement and Council contributions;
- Karuah River Catchment Management;
- Biodiversity Offset Areas;
- Yancoal land management;

- Agricultural rehabilitation possibilities; and
- Stratford Extension Project updates and transition from Duralie Coal.

The committee has regularly invited guests to present on a variety of subjects that the members express an interest in. Speakers for the reporting period included MidCoast Council representatives; the Chairperson of the Karuah Aboriginal Land Council and Yancoal's Business Optimisation Manager for Stratford and Duralie operations.

Regular site inspections have been undertaken during the CCC meeting including viewing of the rehabilitation area and biodiversity offset area. The CCC meeting agendas, presentations and minutes are available on the Duralie Coal website (www.duraliecoal.com.au).

An additional consultation activity emanating from the CCC was the Duralie Agricultural Rehabilitation Workshop held in September 2018. This was an interactive field day held in the Duralie rehabilitation area and was attended by a cross-section of the local community, Government and industry stakeholders. The focus was on property planning for the long-term layout and operation of agricultural rehabilitation areas and integration with the surrounding lands. Topics of discussion at the workshop included stock rotation, water infrastructure and pasture management.

An Annual Report for the Duralie Coal CCC was prepared by the Chair and submitted to DP&E on 18 February 2019 (**Appendix 7**).

9.3 ENVIRONMENTAL COMPLAINTS

Complaints (by category) received by Duralie Coal Pty Ltd over the last 6 reporting years are shown in Table 33:

Table 33 – Community Complaints Summary

Complaint Category	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19
Noise	26	39	10	3	0	0
Blasting	12	13	3	0	0	0
Air Quality	4	1	1	14	1	4
Water	0	0	0	0	0	0
Lighting	0	0	0	0	0	0
Visual	1	0	0	0	0	0
Train	0	3	0	0	0	0
Other	1	0	0	0	0	0
Total Complaints	**42**	**56**	**14**	**17**	**1**	**4**

Four complaints were received during the 2019 reporting period. All complaints were related to air quality and specifically odours.

Summary comments for complaints received during the reporting period:

- The total number of complaints received during the reporting period was four (4) with the total number of complainants also being 4. All complaints via the EPA hotline.
- Four air quality (odour) complaints were received during the reporting period.
- Overall the total number of complaints received by category during 2018/2019 increased compared to the previous reporting period, although remains very low.
- The reduced noise, blasting and air quality complaints compared to previous years potentially reflect the reduced production (i.e. no weekend work and no night shift), current location of operations and improved management practices.

A full complaints listing is provided in **Appendix 7** and includes details on DCPL's responses to

complaints. A summary of complaints by category is provided in the relevant sections of the report.

9.3.1 Liaison and Complaint Resolution

DCPL aims to inform the community of its activities and consult with the community in an open and honest manner and address complaints/conflicts and consult to achieve mutually acceptable outcomes.

In accordance with the Project Approval Conditions, DCPL is required to establish and maintain a complaint handling and response procedure. DCPL operates a system to receive, handle, respond to and record complaints or information requests relating to operation of the DCM which is described in the Environmental Management Strategy.

DCPL operates a dedicated community information hotline (1300 658 239) 24 hours per day. The number is advertised within the Sensis *White Pages Directory (Newcastle)*, a local telephone directory (*Pink Pages*) and in the local newspapers *(Gloucester Advocate and Dungog Chronicle)* on a six-monthly basis.

Designated DCPL staff, when notified of a complaint, determine an appropriate response on the basis of the nature of the complaint during business hours. This may involve a site visit/inspection, liaison with personnel on site or other appropriate action. After business hours, all complaints and operations are reviewed as soon as practicable by the open cut examiner and responded to by DCPL staff during business hours.

All complaints received and responses taken in relation to each complaint are recorded in a Complaints Register. The Complaints Register is tabled at each Community Consultative Committee meeting for the period covered since the last Committee meeting and is included in **Appendix 7**. The complaints register is also made available on the Duralie Coal website.

9.4 EMPLOYMENT STATUS AND DEMOGRAPHY

At the end of the reporting period (i.e. June 2019), the total number of staff and FTE's employed at the Duralie Coal Mine was **15**, including 15 SCPL employees and 0 contractors. During the reporting period 2 environment & community representatives were employed and shared with the nearby Stratford Mining Complex.

During 2018 DCPL transitioned the workforce from DCM to the SMC to align with the completion of coal mining at the DCM and the recommencement of operations at the SMC. The total FTE numbers above assumes all DCPL operators are now based at Stratford and all Ditchfield contractors are based at Stratford, although some short-term work has been undertaken at Duralie.

In addition to direct permanent employment at the mine, on the basis of a conservative employment multiplier of one mine site job generating one job within the general community, up to 15 (full time equivalent) jobs are expected to have been provided in supporting services. On the basis of a review of employees' living location, 52% of mine employees resided within the greater local area (defined as being bounded by Stroud, Gloucester and Dungog).

9.5 EMPLOYEE ENVIRONMENTAL AWARENESS TRAINING

DCPL recognises the importance of establishing, developing and maintaining a risk-aware, trained, and competent workforce at its operations to ensure a high standard of environment and community management.

DCPL environmental & community management objectives include:

- ensuring employees and contractors are informed about DCPL's policies and are made aware of their environmental and community responsibilities in relation to DCPL's activities;

- providing all employees/contractors with the knowledge, skills and equipment necessary to meet their environmental obligations; and
- promoting an awareness and concern for good environmental management amongst all employees/contractors.

New employees and contractors working at site are provided with information on environmental and community issues as part of Stratford Coal induction training which is updated periodically. This includes elements such as the Pollution Incident Response Management Plan and reporting obligations of personnel and the management of environmental incidents. Ongoing environmental awareness training is also undertaken with staff and employees periodically.

During the reporting period employee and contractor training included presentations on:

- General environmental management and awareness – Training was undertaken across four sessions during July 2018 with all employees and contractors at the Stratford & Duralie operations. This included information on the DCM Pollution Incident Response Management Plan and incident reporting.
- Mining Operations Plan & Rehabilitation Management Plan - A presentation was provided to the site managers and supervisor on the obligations and requirements in regard to rehabilitation and mine closure planning.
- Vegetation Clearance & Ground Disturbance – Toolbox training was undertaken in December 2018 with all employees and contractors regarding the environmental compliance requirements and procedures for vegetation clearance and ground disturbance.

10. INDEPENDENT ENVIRONMENTAL AUDIT

An Independent Environmental Audit (IEA) of the DCM was not required during the reporting period. The next IEA is scheduled to 31 December 2020.

The previous Independent Environmental Audit (IEA) of the DCM was conducted during December 2017. Hansen Bailey was commissioned by DCPL to undertake the audit in accordance with the Project Approval conditions PA 08_0203 Schedule 5 Condition 8. Additionally, it is a requirement under Schedule 5 Conditions 9A to complete a Rail Haulage Audit. This audit was undertaken at the same time as the IEA and included in a single audit report.

The audit team was approved by the Secretary for DP&E and included experts in the areas of rehabilitation, ecology and surface water. The rail audit team included experts in the areas of noise, air quality and logistics. The final IEA report along with DCPL's responses to the recommendations was submitted to DP&E on 26 February 2018. On 25 May 2018 DP&E provided confirmation of acceptance of the IEA 2017 Report.

The IEA identified some non-compliances against conditions of Project Approval PA 08_0203 and other licences and approvals. The audit identified a total of seven non-compliances comprised of five issues. The non-compliances were risk ranked and no high or medium risks were identified during the audit. Five issues were identified as low risk and two issues classified as administrative in nature.

The field inspection revealed that the site was generally well maintained and in good condition, particularly around the administration area. The rail load out facility was well maintained as was the truck maintenance area. Spill kits were observed in the vicinity of the refuelling bay and appropriate bunding and contouring was visible to adequately contain any dirty surface water runoff from the area.

Progressive and high quality rehabilitation of the site was observed, including active final shaping in preparation for rehabilitation. The site has established suitable landforms and successful rehabilitation of forest communities are well underway to achieving final completion criteria. Ecological succession was observed in the older rehabilitation.

Community concerns are well managed and are recorded within the Duralie Community Complaints Register, which was viewed during the site component of the audit. The number of complaints received has decreased substantially during the audit period compared to previous years. This audit has concluded that a good standard of environmental management is being applied in Duralie Coal Mine Operations.

The IEA report also provided a series of recommendations arising from a review of site documentation and identified non-compliances. DP&E have requested an update on the IEA Responses to Recommendations to be included in this Annual Review. Accordingly, the status of actions against each audit recommendations are included in **Appendix 9.**

The full audit report and responses to the recommendations are available on the Duralie Coal website at http://www.duraliecoal.com.au. The next Independent Environmental Audit of the DCM is scheduled to be undertaken prior to the end of 2020.

11. INCIDENTS AND NON-COMPLIANCE

Activities at the DCM continue to be carried out in accordance with the conditions of Project Approval 08_0203, ML 1427, ML 1646 and EPL 11701.

A protocol for managing incidents and non-compliances is included in the DCM Environmental Management Strategy. A statement of compliance is included in **Section 1** of this report.

During the reporting period, there were no identified non-compliances or reportable incidents at the DCM.

No additional actions have been requested by either DP&E, Resource Regulator or EPA.

12. ACTIVITIES PROPOSED IN THE NEXT AR PERIOD

DCPL will continue mining operations in accordance with Project Approval 08_0203 and the relevant EMPs for DCM.

A new MOP will be prepared for the mine closure phase of operations prior to the end of 2019. The new MOP will reflect the proposed mining and rehabilitation activities for the next 3 year period and also include a detailed Mine Closure Plan.

The following environmental targets have been set for the next 12 months:

- Mining and rehabilitation activities will be implemented in accordance with the timing in stage plans in the DCM MOP.
- Continuing developing the detailed Mine Closure Plans in accordance with the mine closure planning schedule in the MOP for the DCM.
- Progress rehabilitation works to satisfy DEP EA and MOP nominated rehabilitation targets;
- Continue to meet the environmental management, monitoring and reporting requirements in accordance with the Project Approval conditions.
- Progress biodiversity offset works in accordance with the BMP including full implementation of the revegetation works.
- Maintain low level of complaints reported to the mine.

13. REFERENCES

- Biosphere Environmental Consultants (2015). *Duralie Coal Mine Giant Barred Frog (Mixophyes iterates) Monitoring Results October 2014 to February 2015*
- Centre for Mined Land Rehabilitation (CMLR) (2019). *Summary Interpretation of Duralie Coal Mine Ecotoxicity Testing Results*, 16 April 2019.
- Department of Planning and Infrastructure (DoPI) (2011). *Land and Environment Court of NSW Order* for *Duralie Extension Project Approval, Duralie Coal Pty Ltd 10 November 2011.*
- Department of Planning and Environment (DPE) (2016). *Community Consultative Committee Guidelines for State Significant Developments for Mining Projects, November 2016.*
- DCPL (2015). *Duralie Coal Mine Air Quality and Greenhouse Gas Management Plan*
- DCPL (2015). *Duralie Coal Mine Heritage Management Plan*
- DCPL (2017*). Duralie Coal Mine Blast Management Plan*
- DCPL (2017). *Duralie Coal Mine Mining Operations Plan & Rehabilitation Management Plan*
- DCPL (2017). *Duralie Coal Mine Water Management Plan*
- DCPL (2017). *Duralie Coal Mine Giant Barred Frog Management Plan*
- DCPL (2018). *Duralie Coal Mine Biodiversity Management Plan*
- DCPL (2018). *Duralie Coal Mine Noise Management Plan*
- DCPL (2019). *Duralie Coal Mine Annual Biodiversity Report 2019*
- Freudenberger (2013). *Baseline Monitoring of Landscape Function and Vegetation Structure for the Duralie Biodiversity Offset.*
- GCL (2010). "Duralie Extension Project Environmental Assessment". Prepared for Gloucester Coal Ltd by Resource Strategies Pty Ltd, January.
- Gilbert and Associates Pty Ltd (2010). *Duralie Extension Project, Surface Water Assessment*
- Hansen Bailey (2017). *Duralie Coal Mine Independent Environmental Audit Report December 2017*.
- Horizon Environmental Soil Survey and Evaluation (2019). *Duralie Coal Mine Irrigation Area Monitoring Report 2019*
- Invertebrate Identification Australasia (2018). September 2018 Survey. *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine for Duralie Coal Pty Ltd*.
- Invertebrate Identification Australasia (2019). February 2019 Survey. *Biological Monitoring of the Streams Adjacent to the Duralie Coal Mine for Duralie Coal Pty Ltd*.
- Kleinfelder (2019). *Duralie Coal Mine Rehabilitation Monitoring Report 2019*
- NSW Trade and Investment, Resources and Energy (2013) *Guidelines to the Mining, Rehabilitation and Environmental Management Process.*
- NSW Government (2015) *Annual Review Guideline*.

Appendix 1:

- **Site Locality Plan**
- **Project General Arrangement**
- **Monitoring Locations**
- **Disturbed and Rehabilitated Land Plan.**

GCL-10-13 EMS 2017_101A

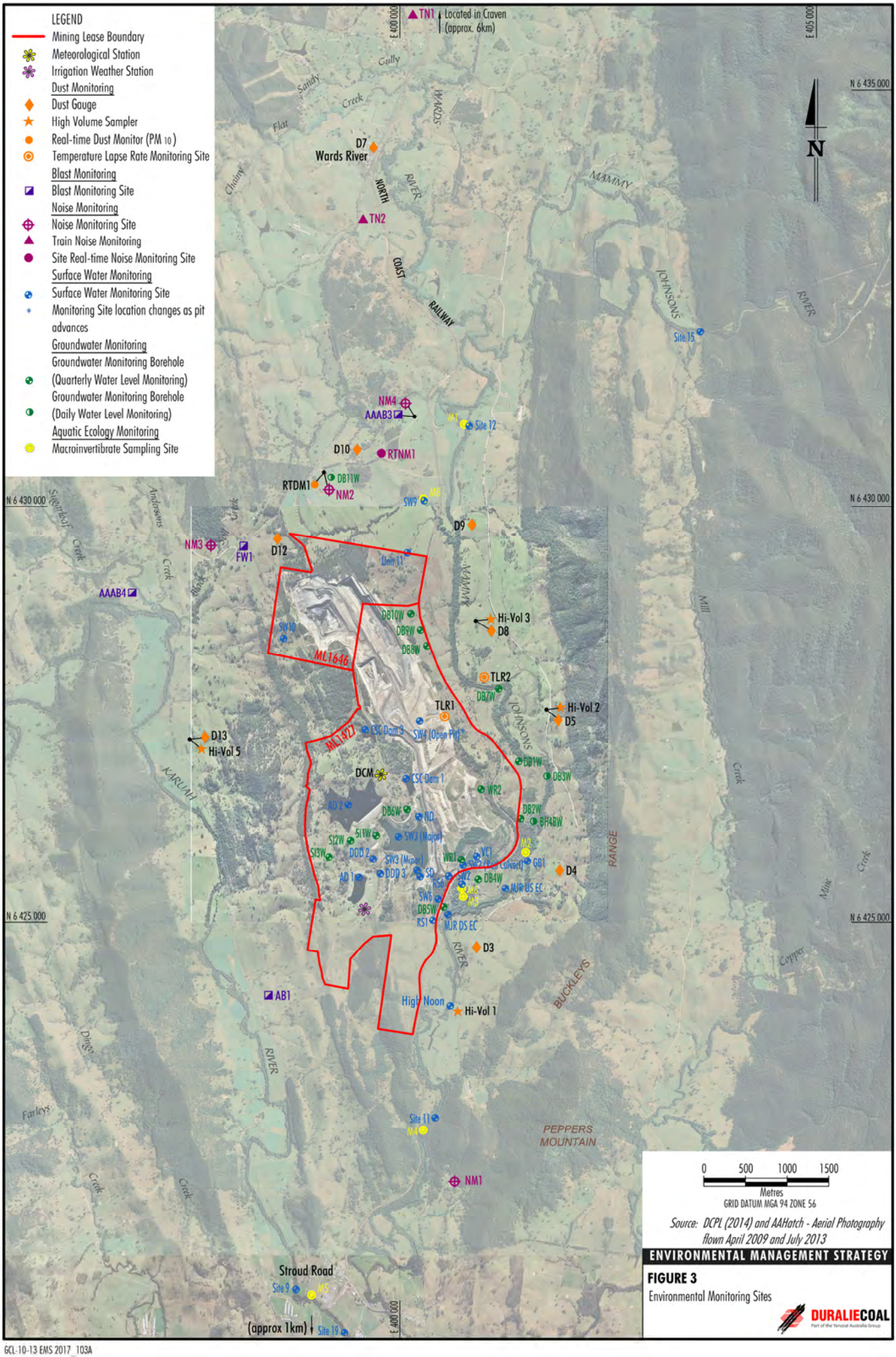
ENVIRONMENTAL MANAGEMENT STRATEGY

FIGURE 2

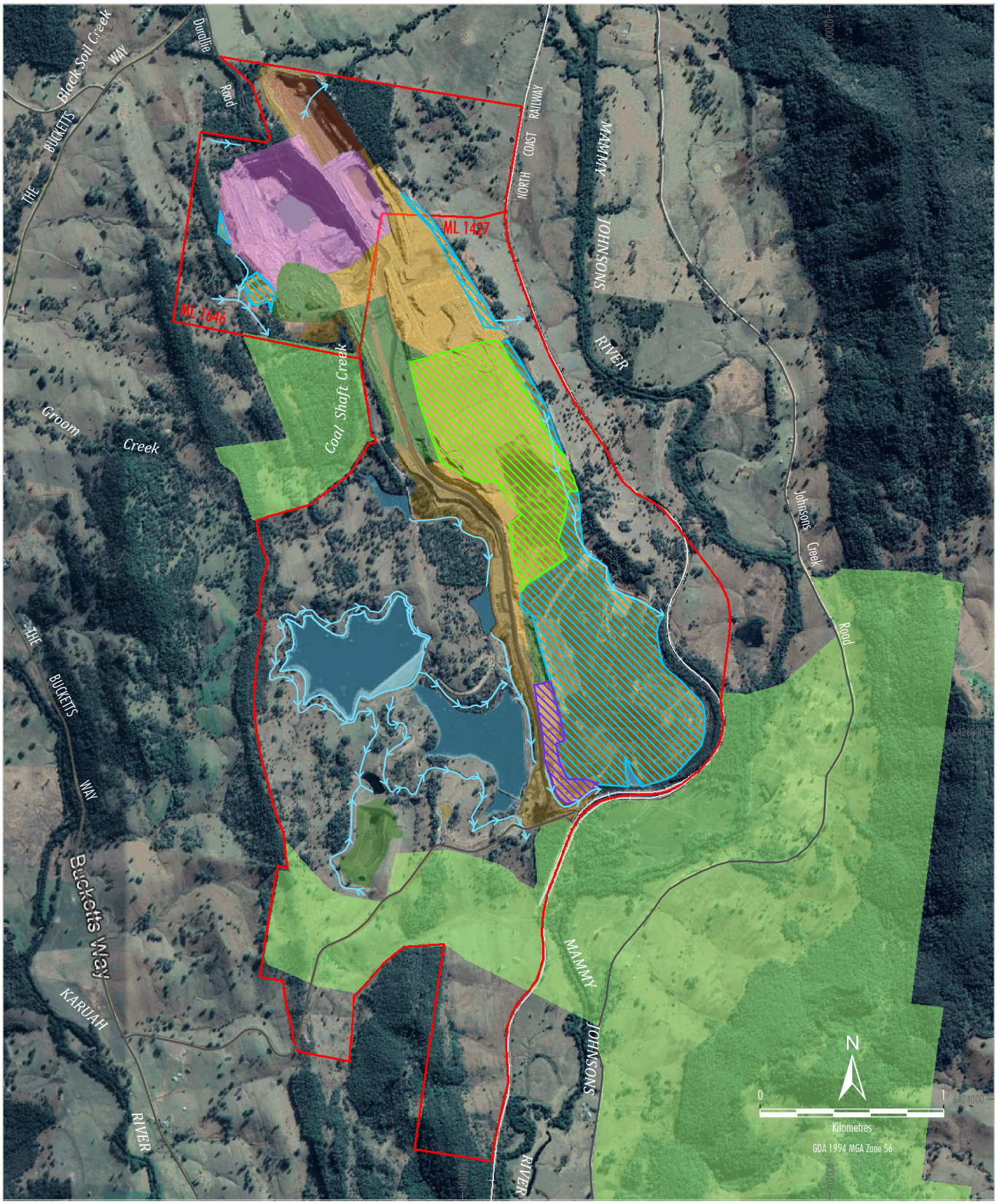
Project General Arrangement

DURALIECOAL

GCL-10-13 EMS 2017_102A



GCL-10-13 EMS 2017_103A



CH_YAN-17-07 DAR19_201A

LEGEND

- TitlesCurrent
- Water Management Drainage
- Expected Mining Area
- Proposed Rehabilitation for 2020

Primary Domains

- Infrastructure Area (1)
- Water Management Area (2)
- Waste Emplacement Area (3)
- Final Void/Open Pit (4)
- Offset Area (5)

Rehabilitation Phase

- Landform Establishment
- Growth Medium Development
- Ecosystem and Land Use Establishment
- Ecosystem and Land Use Sustainability

Source: © State of New South Wales and Department of Planning and Environment (2017); © Department Finance, Services & Innovation (2018); Yancoal (2019)

DURALIECOAL

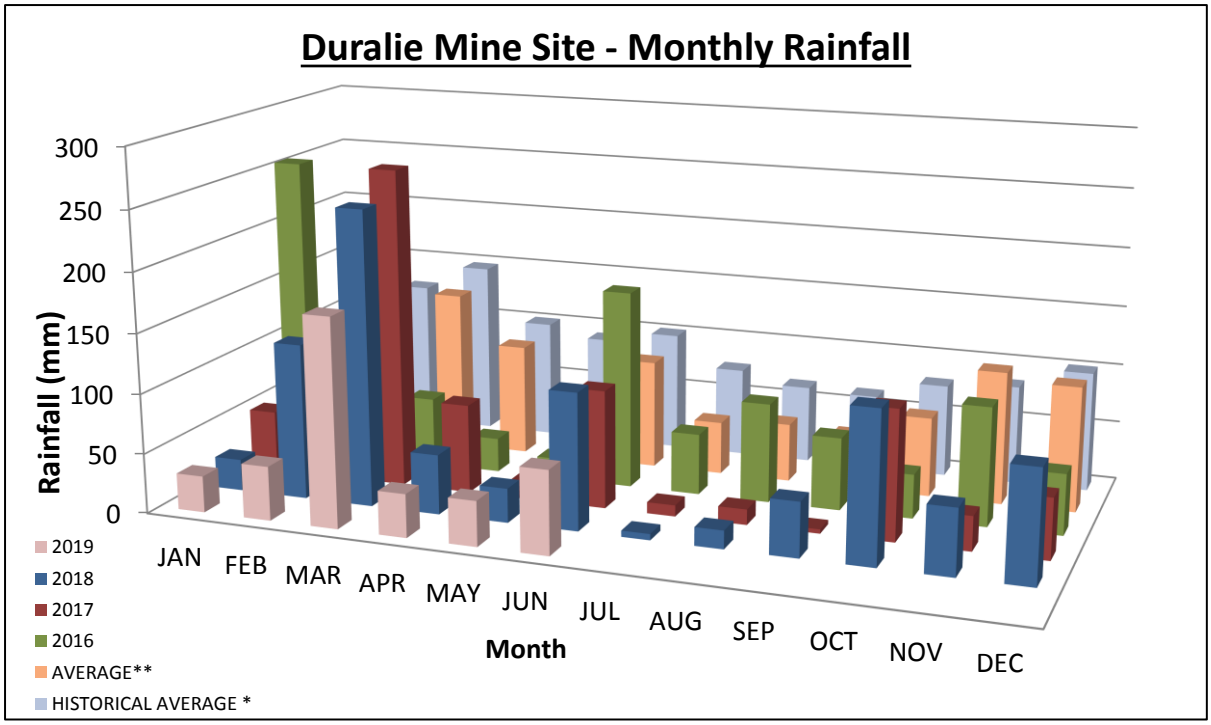
DURALIE COAL MINE REVIEW 2018

Mining and Rehabiltation Areas

Figure 4

Appendix 2:

Meteorological Monitoring



*Stroud + Duralie 1889 to 2010 (inclusive)
**Duralie Mine 2002 – 2019 (inclusive)

Figure 2-1: Monthly Rainfall for 2016 to 2019 and Historical Averages

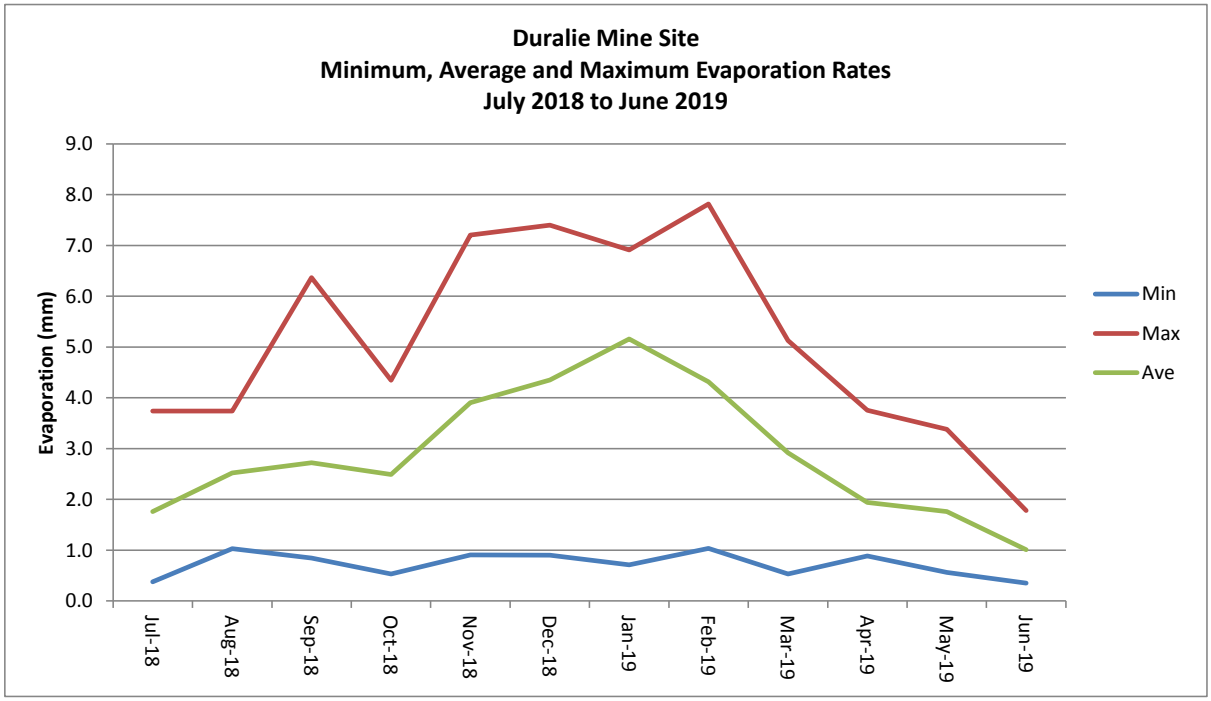


Figure 2-2: Minimum, Maximum and Average Evaporation Rates During the Reporting Period

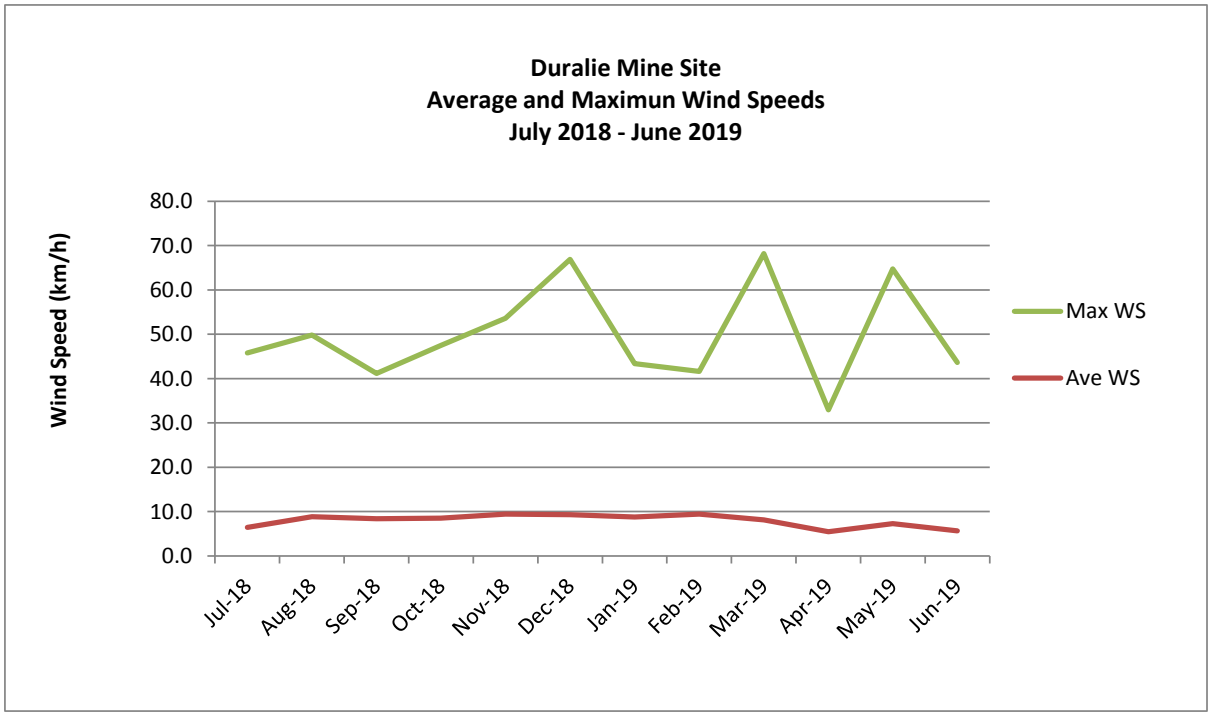


Figure 2-3: Maximum and Average Wind Speeds During the Reporting Period

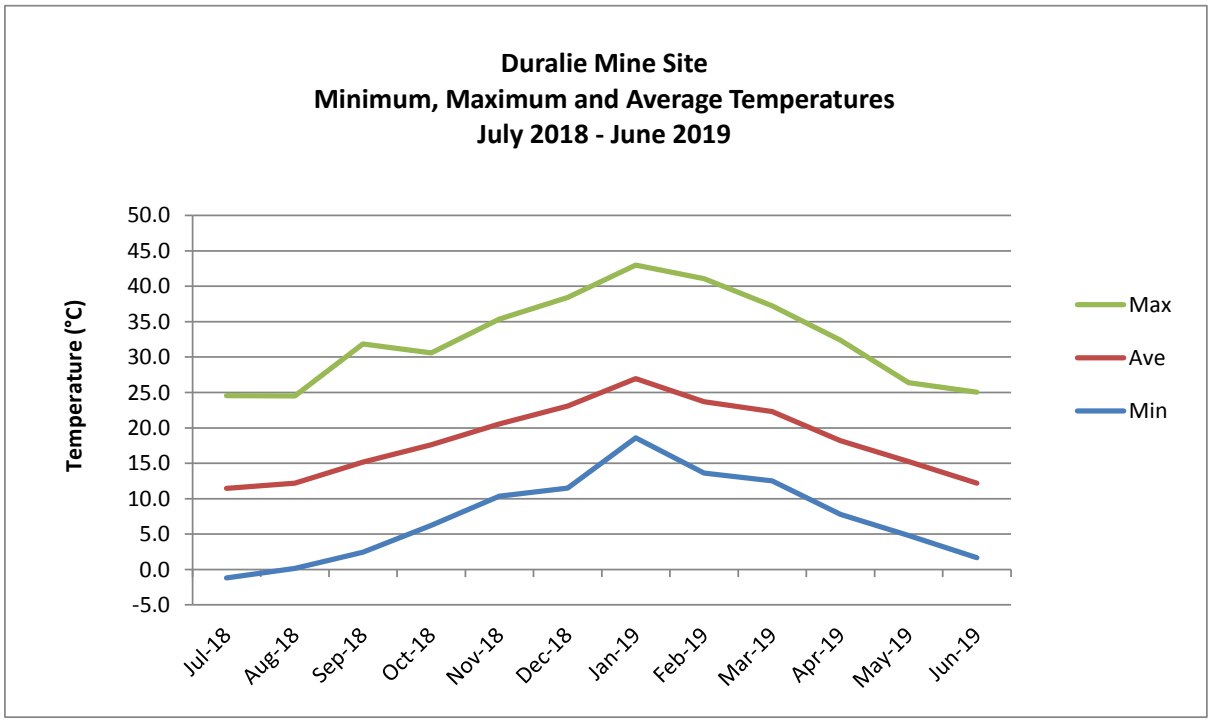
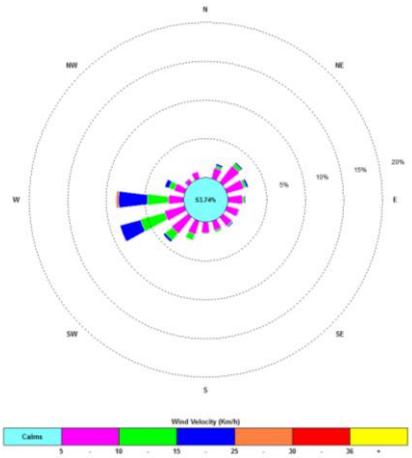
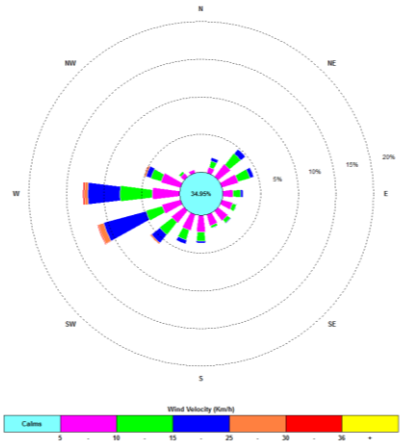


Figure 2-4: Minimum, Maximum and Average Temperatures During the Reporting Period

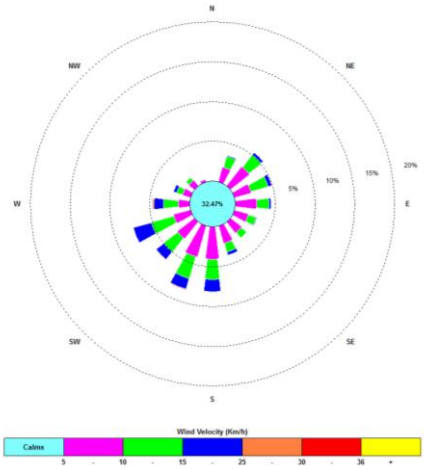
July 2018



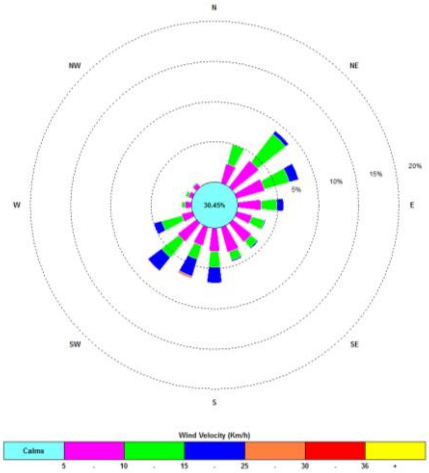
August 2018



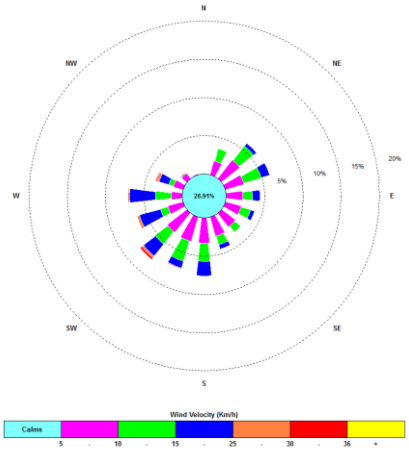
September 2018



October 2018



November 2018



December 2018

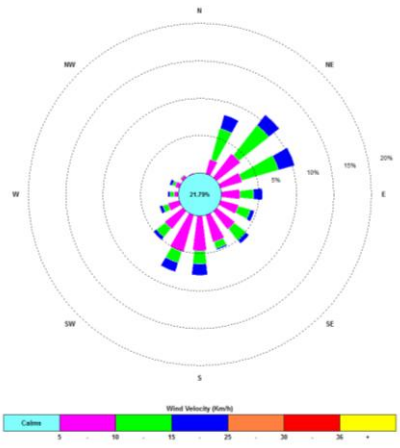
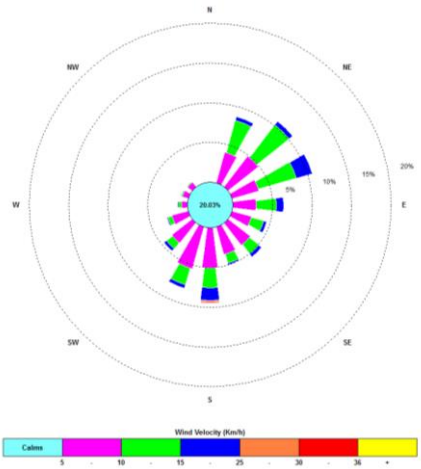
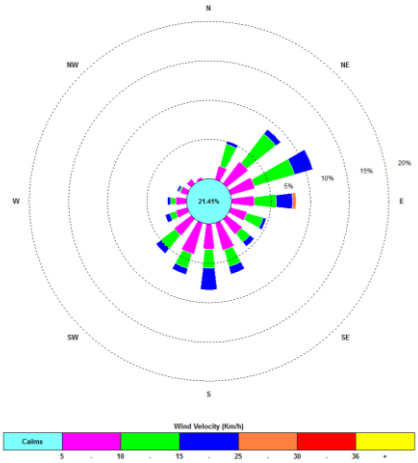


Figure 2-5: Monthly Windroses showing wind direction, speed and frequencies

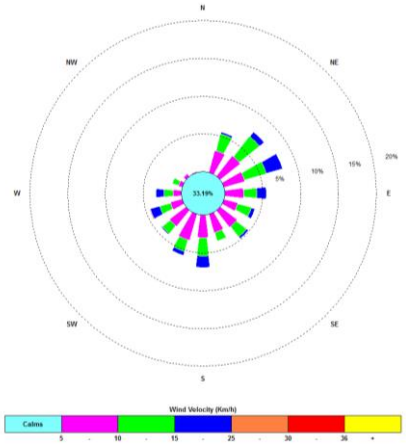
January 2019



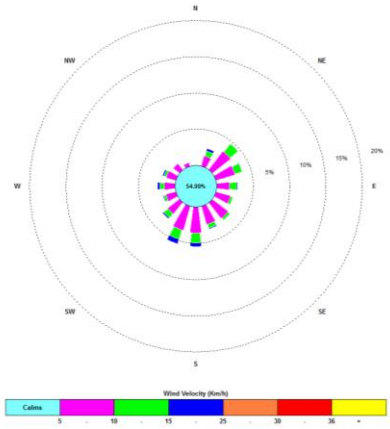
February 2019



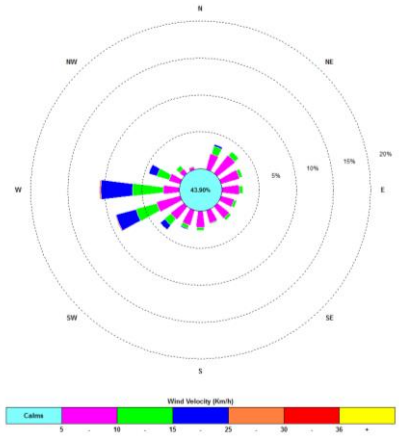
March 2019



April 2019



May 2019



June 2019

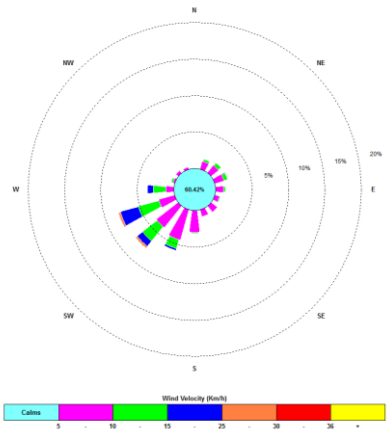


Figure 2-5 (continued): Monthly Windroses showing wind direction, speed and frequencies

Appendix 3:

Air Quality Monitoring Results

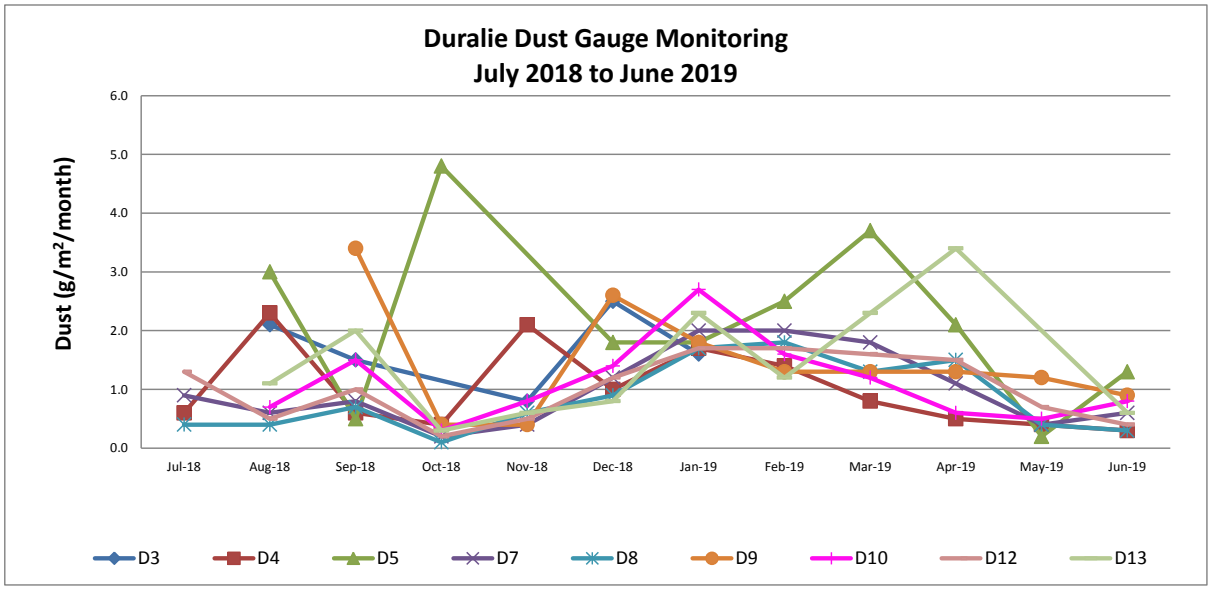


Figure 3-1: Monthly Depositional Dust Monitoring Results (minus contaminated results) during the Reporting Period

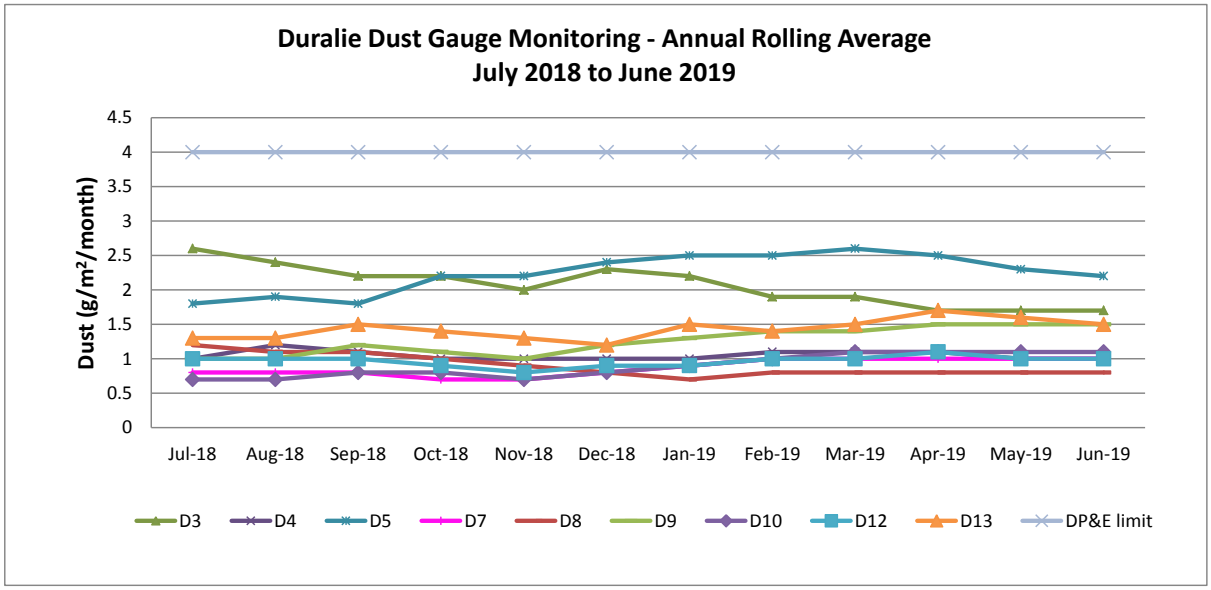


Figure 3-2: Rolling Annual Average Depositional Dust Monitoring Results (minus contaminated results) during the Reporting Period

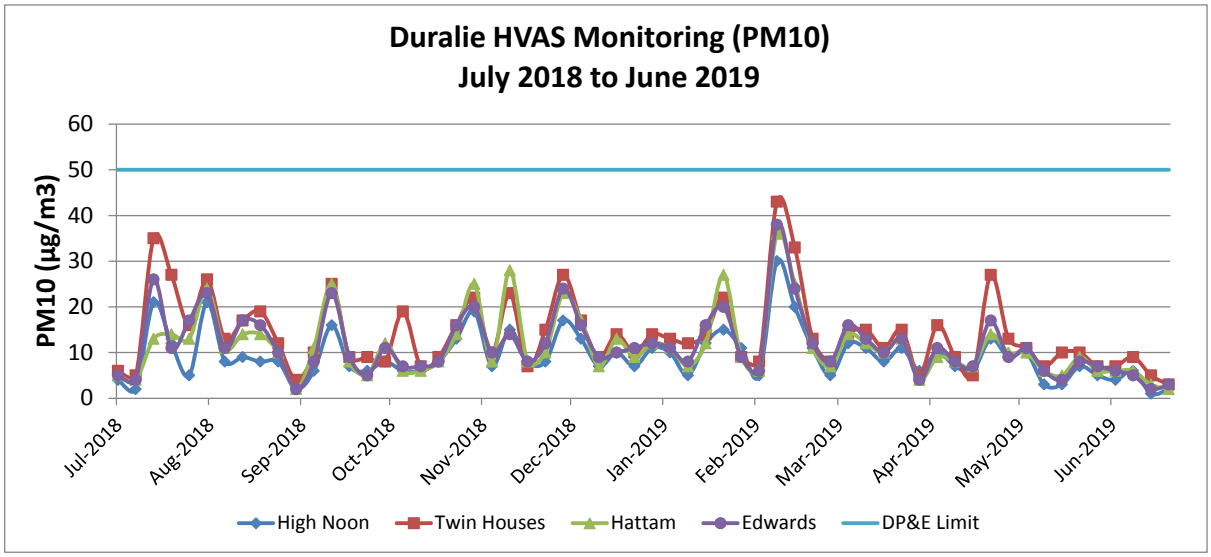


Figure 3-3: High Volume Air Sampling (PM_{10}) Results during the Reporting Period

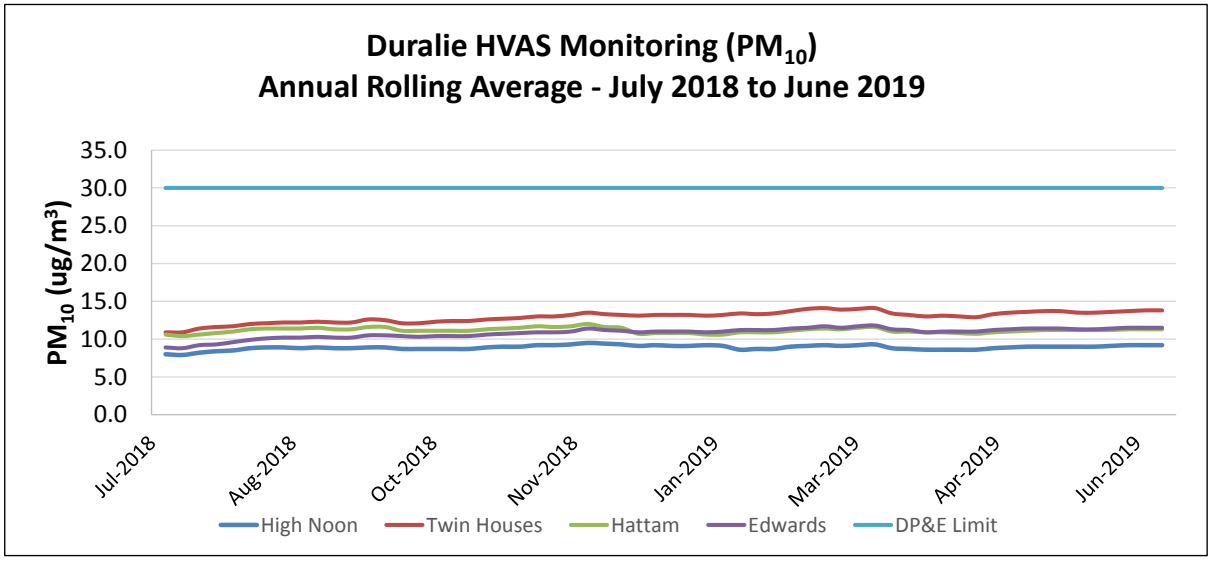


Figure 3-4: Rolling Annual Average HVAS (PM_{10}) Results during the Reporting Period

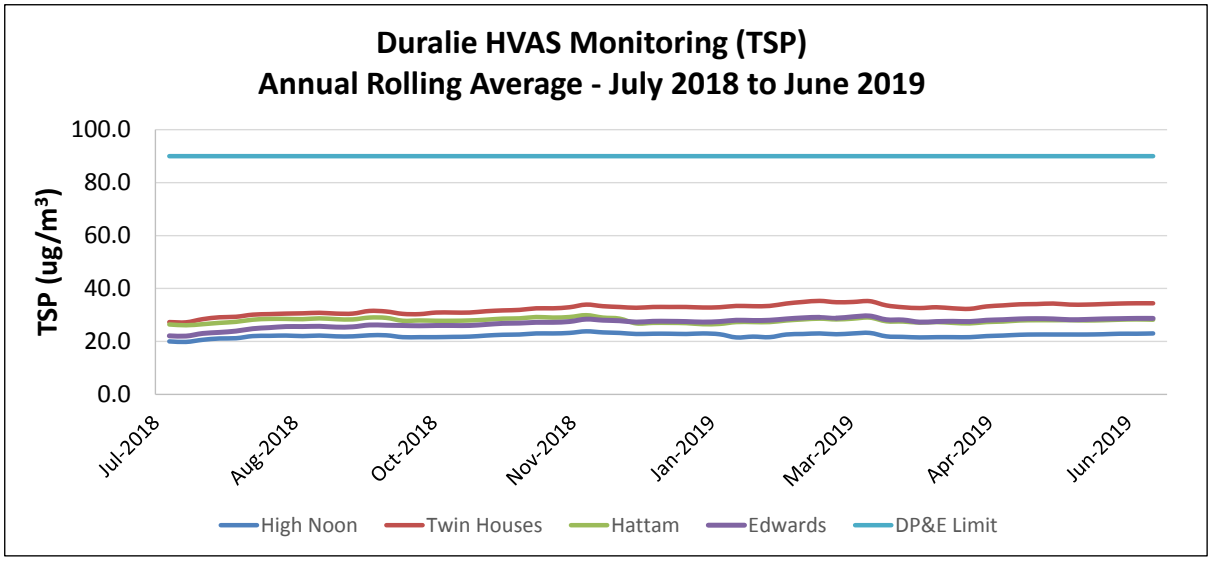


Figure 3-5: Rolling Annual Average HVAS (TSP) Results during the Reporting Period

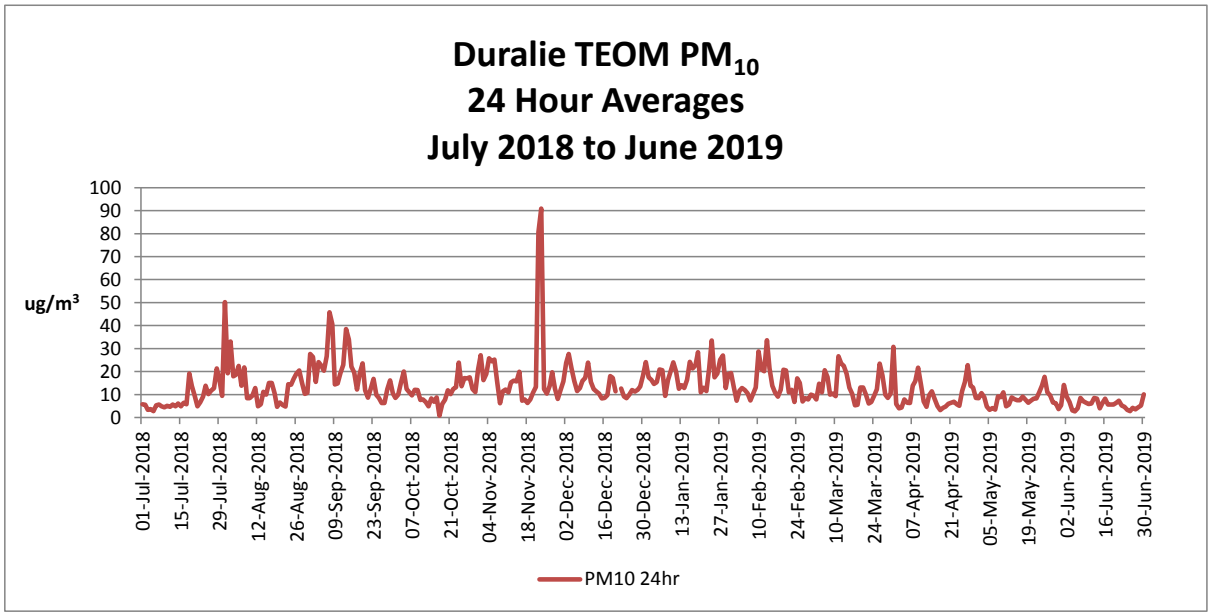


Figure 3-6: Real Time Dust Monitoring (PM_{10}) Results during the Reporting Period

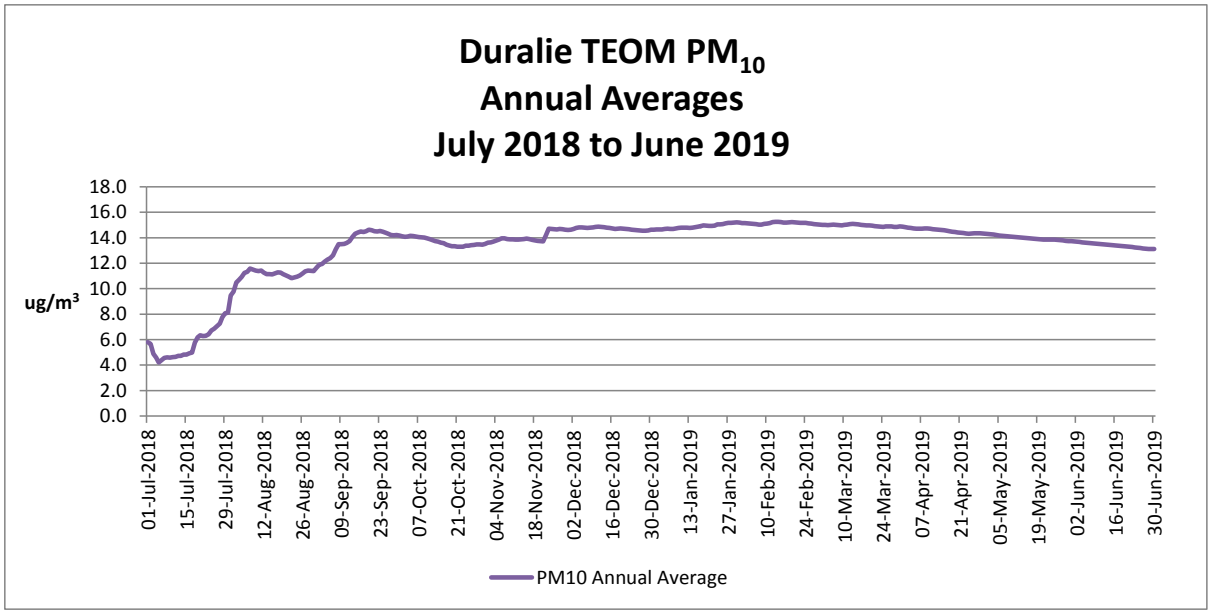


Figure 3-7: Rolling Annual Average TEOM (PM_{10}) Results during the Reporting Period

Real Time Dust Monitoring (PM_{10}) Results during the Reporting Period

	PM10 24hr	PM10 Annual Average		PM10 24hr	PM10 Annual Average		PM10 24hr	PM10 Annual Average		PM10 24hr	PM10 Annual Average		PM10 24hr	PM10 Annual Average		PM10 24hr	PM10 Annual Average
1/07/2018	5.8	5.8	1/09/2017	26.3	11.9	1/11/2018	27.1	13.6	1/01/2019	17.5	14.6	1/03/2019	10.0	15.0	1/05/2019	8.5	14.3
2/07/2018	5.5	5.7	2/09/2017	15.5	11.9	2/11/2018	16.3	13.6	2/01/2019	16.4	14.6	2/03/2019	9.6	15.0	2/05/2019	10.6	14.3
3/07/2018	3.4	4.9	3/09/2017	24.1	12.1	3/11/2018	18.9	13.7	3/01/2019	14.6	14.7	3/03/2019	7.8	15.0	3/05/2019	8.8	14.2
4/07/2018	3.6	4.6	4/09/2017	22.7	12.3	4/11/2018	25.8	13.8	4/01/2019	15.4	14.7	4/03/2019	14.7	15.0	4/05/2019	4.8	14.2
5/07/2018	2.7	4.2	5/09/2017	20.4	12.4	5/11/2018	24.4	13.9	5/01/2019	20.9	14.7	5/03/2019	11.0	15.0	5/05/2019	3.3	14.2
6/07/2018	5.3	4.4	6/09/2017	26.7	12.6	6/11/2018	25.2	13.9	6/01/2019	20.6	14.7	6/03/2019	20.6	15.0	6/05/2019	4.1	14.1
7/07/2018	5.7	4.6	7/09/2017	45.8	13.1	7/11/2018	15.4	14.0	7/01/2019	9.4	14.7	7/03/2019	17.6	15.0	7/05/2019	3.4	14.1
8/07/2018	4.9	4.6	8/09/2017	40.6	13.5	8/11/2018	6.2	13.9	8/01/2019	16.3	14.7	8/03/2019	10.0	15.0	8/05/2019	9.2	14.1
9/07/2018	4.4	4.6	9/09/2017	14.4	13.5	9/11/2018	11.4	13.9	9/01/2019	19.9	14.8	9/03/2019	10.4	15.0	9/05/2019	8.8	14.1
10/07/2018	5.0	4.6	10/09/2017	14.8	13.5	10/11/2018	12.2	13.9	10/01/2019	24.0	14.8	10/03/2019	9.3	15.0	10/05/2019	10.9	14.1
11/07/2018	4.7	4.6	11/09/2017	19.3	13.6	11/11/2018	11.0	13.8	11/01/2019	19.9	14.8	11/03/2019	26.7	15.0	11/05/2019	4.9	14.0
12/07/2018	5.6	4.7	12/09/2017	22.9	13.7	12/11/2018	15.3	13.9	12/01/2019	12.5	14.8	12/03/2019	23.4	15.1	12/05/2019	5.6	14.0
13/07/2018	4.8	4.7	13/09/2017	38.5	14.1	13/11/2018	16.0	13.9	13/01/2019	14.0	14.8	13/03/2019	22.5	15.1	13/05/2019	8.8	14.0
14/07/2018	6.1	4.8	14/09/2017	33.9	14.3	14/11/2018	15.7	13.9	14/01/2019	12.8	14.8	14/03/2019	19.0	15.1	14/05/2019	7.9	14.0
15/07/2018	4.9	4.8	15/09/2017	22.1	14.4	15/11/2018	19.9	13.9	15/01/2019	16.4	14.8	15/03/2019	12.9	15.1	15/05/2019	7.5	14.0
16/07/2018	6.4	4.9	16/09/2017	19.6	14.5	16/11/2018	7.3	13.9	16/01/2019	24.2	14.9	16/03/2019	10.3	15.0	16/05/2019	7.5	14.0
17/07/2018	5.8	5.0	17/09/2017	12.2	14.5	17/11/2018	7.8	13.8	17/01/2019	21.3	14.9	17/03/2019	5.3	15.0	17/05/2019	9.1	13.9
18/07/2018	19.1	5.8	18/09/2017	19.2	14.5	18/11/2018	6.3	13.8	18/01/2019	22.7	15.0	18/03/2019	5.5	15.0	18/05/2019	7.8	13.9
19/07/2018	13.7	6.2	19/09/2017	23.6	14.6	19/11/2018	7.9	13.7	19/01/2019	28.3	14.9	19/03/2019	13.0	15.0	19/05/2019	6.5	13.9
20/07/2018	9.5	6.3	20/09/2017	11.8	14.6	20/11/2018	10.8	13.7	20/01/2019	11.0	14.9	20/03/2019	13.1	14.9	20/05/2019	7.3	13.9
21/07/2018	4.9	6.3	21/09/2017	8.6	14.5	21/11/2018	13.3	13.7	21/01/2019	12.9	14.9	21/03/2019	10.0	14.9	21/05/2019	8.2	13.9
22/07/2018	6.6	6.3	22/09/2017	12.5	14.5	22/11/2018	80.6	14.2	22/01/2019	11.5	15.0	22/03/2019	6.1	14.9	22/05/2019	8.3	13.8
23/07/2018	9.1	6.4	23/09/2017	16.8	14.5	23/11/2018	90.9	14.7	23/01/2019	21.5	15.0	23/03/2019	6.7	14.9	23/05/2019	11.0	13.8
24/07/2018	13.8	6.7	24/09/2017	9.9	14.5	24/11/2018	12.4	14.7	24/01/2019	33.5	15.1	24/03/2019	9.4	14.9	24/05/2019	13.9	13.9
25/07/2018	10.2	6.9	25/09/2017	8.6	14.4	25/11/2018	10.4	14.7	25/01/2019	17.5	15.1	25/03/2019	12.3	14.9	25/05/2019	17.7	13.8
26/07/2018	11.7	7.0	26/09/2017	6.3	14.3	26/11/2018	13.7	14.7	26/01/2019	19.1	15.1	26/03/2019	23.5	14.9	26/05/2019	11.0	13.8
27/07/2018	12.7	7.3	27/09/2017	6.3	14.2	27/11/2018	19.7	14.7	27/01/2019	25.1	15.2	27/03/2019	18.3	14.9	27/05/2019	9.6	13.8
28/07/2018	21.4	7.8	28/09/2017	12.3	14.2	28/11/2018	12.5	14.7	28/01/2019	27.0	15.2	28/03/2019	10.0	14.9	28/05/2019	6.6	13.8
29/07/2018	16.6	8.1	29/09/2017	16.1	14.2	29/11/2018	8.1	14.6	29/01/2019	12.8	15.2	29/03/2019	8.6	14.8	29/05/2019	6.2	13.8
30/07/2018	9.4	8.1	30/09/2017	10.5	14.2	30/11/2018	11.9	14.6	30/01/2019	18.9	15.2	30/03/2019	10.4	14.9	30/05/2019	3.6	13.7
31/07/2018	50.2	9.5	1/10/2017	8.5	14.1	1/12/2018	15.7	14.6	31/01/2019	19.4	15.2	31/03/2019	30.7	14.9	31/05/2019	5.3	13.7
1/08/2018	19.2	9.8	2/10/2017	9.9	14.1	2/12/2018	23.8	14.7	1/02/2019	13.1	15.2	1/04/2019	5.9	14.8	1/06/2019	14.2	13.7
2/08/2018	33.1	10.5	3/10/2017	15.3	14.1	3/12/2018	27.6	14.8	2/02/2019	7.3	15.1	2/04/2019	4.0	14.8	2/06/2019	9.1	13.7
3/08/2018	17.9	10.7	4/10/2017	20.0	14.1	4/12/2018	21.3	14.8	3/02/2019	11.6	15.1	3/04/2019	4.3	14.8	3/06/2019	6.8	13.7
4/08/2018	18.6	10.9	5/10/2017	12.4	14.1	5/12/2018	15.8	14.8	4/02/2019	12.8	15.1	4/04/2019	7.9	14.7	4/06/2019	3.1	13.6
5/08/2018	22.5	11.2	6/10/2017	11.1	14.1	6/12/2018	11.5	14.8	5/02/2019	12.0	15.1	5/04/2019	6.5	14.7	5/06/2019	2.7	13.6
6/08/2018	13.8	11.3	7/10/2017	9.6	14.1	7/12/2018	12.8	14.8	6/02/2019	10.5	15.1	6/04/2019	6.4	14.7	6/06/2019	4.0	13.6
7/08/2018	21.8	11.6	8/10/2017	12.1	14.0	8/12/2018	15.9	14.8	7/02/2019	7.4	15.0	7/04/2019	13.8	14.7	7/06/2019	8.5	13.6
8/08/2018	8.4	11.5	9/10/2017	12.0	14.0	9/12/2018	17.2	14.8	8/02/2019	10.4	15.0	8/04/2019	15.8	14.7	8/06/2019	7.1	13.6
9/08/2018	8.4	11.4	10/10/2017	7.7	13.9	10/12/2018	23.9	14.9	9/02/2019	13.0	15.1	9/04/2019	21.7	14.7	9/06/2019	6.4	13.5
10/08/2018	9.5	11.4	11/10/2017	7.9	13.9	11/12/2018	15.5	14.9	10/02/2019	28.8	15.1	10/04/2019	14.5	14.7	10/06/2019	5.9	13.5
11/08/2018	12.8	11.4	12/10/2017	6.8	13.8	12/12/2018	12.4	14.8	11/02/2019	21.0	15.1	11/04/2019	7.0	14.7	11/06/2019	6.1	13.5
12/08/2018	4.9	11.3	13/10/2017	4.9	13.7	13/12/2018	11.4	14.8	12/02/2019	20.1	15.2	12/04/2019	4.7	14.6	12/06/2019	8.5	13.5
13/08/2018	5.8	11.1	14/10/2017	8.3	13.7	14/12/2018	10.4	14.8	13/02/2019	33.6	15.2	13/04/2019	9.6	14.6	13/06/2019	8.2	13.5
14/08/2018	11.2	11.1	15/10/2017	6.8	13.6	15/12/2018	8.4	14.8	14/02/2019	21.5	15.2	14/04/2019	11.4	14.6	14/06/2019	4.0	13.4
15/08/2018	10.0	11.1	16/10/2017	8.7	13.6	16/12/2018	8.5	14.7	15/02/2019	13.8	15.2	15/04/2019	8.1	14.6	15/06/2019	6.4	13.4
16/08/2018	15.0	11.2	17/10/2017	0.8	13.5	17/12/2018	9.7	14.7	16/02/2019	10.8	15.2	16/04/2019	5.0	14.5	16/06/2019	8.2	13.4
17/08/2018	15.0	11.3	18/10/2017	5.8	13.4	18/12/2018	18.0	14.7	17/02/2019	9.0	15.2	17/04/2019	3.2	14.5	17/06/2019	5.6	13.4
18/08/2018	10.6	11.3	19/10/2017	7.8	13.3	19/12/2018	17.3	14.7	18/02/2019	12.1	15.2	18/04/2019	4.2	14.5	18/06/2019	5.7	13.4
19/08/2018	4.7	11.1	20/10/2017	11.8	13.3	20/12/2018	11.4	14.7	19/02/2019	20.8	15.2	19/04/2019	4.8	14.4	19/06/2019	5.6	13.3
20/08/2018	6.5	11.0	21/10/2017	10.2	13.3	21/12/2018	no data	14.7	20/02/2019	20.5	15.2	20/04/2019	5.9	14.4	20/06/2019	6.4	13.3
21/08/2018	5.4	10.9	22/10/2017	12.4	13.3	22/12/2018	12.6	14.7	21/02/2019	11.0	15.2	21/04/2019	6.4	14.4	21/06/2019	7.3	13.3
22/08/2018	4.7	10.8	23/10/2017	13.2	13.3	23/12/2018	9.2	14.6	22/02/2019	12.1	15.2	22/04/2019	6.9	14.4	22/06/2019	5.2	13.3
23/08/2018	14.5	10.9	24/10/2017	23.9	13.4	24/12/2018	8.4	14.6	23/02/2019	6.8	15.2	23/04/2019	5.8	14.3	23/06/2019	4.6	13.2
24/08/2018	14.3	10.9	25/10/2017	13.6	13.4	25/12/2018	10.0	14.6	24/02/2019	17.0	15.2	24/04/2019	5.1	14.3	24/06/2019	3.3	13.2
25/08/2018	16.8	11.1	26/10/2017	17.1	13.4	26/12/2018	12.0	14.6	25/02/2019	15.0	15.1	25/04/2019	11.5	14.3	25/06/2019	2.8	13.2
26/08/2018	19.1	11.2	27/10/2017	17.0	13.4	27/12/2018	11.3	14.6	26/02/2019	7.0	15.1	26/04/2019	15.5	14.4	26/06/2019	4.2	13.2
27/08/2018	20.5	11.4	28/10/2017	17.5	13.5	28/12/2018	12.1	14.6	27/02/2019	8.4	15.1	27/04/2019	22.8	14.4	27/06/2019	3.5	13.1
28/08/2018	15.0	11.4	29/10/2017	12.4	13.5	29/12/2018	13.5	14.6	28/02/2019	7.8	15.1	28/04/2019	13.8	14.3	28/06/2019	4.4	13.1
29/08/2018	10.3	11.4	30/10/2017	11.1	13.4	30/12/2018	18.2	14.6				29/04/2019	13.1	14.3	29/06/2019	5.2	13.1
30/08/2018	10.7	11.4	31/10/2017	21.0	13.5	31/12/2018	24.1	14.6				30/04/2019	8.5	14.3	30/06/2019	10.1	13.1
31/08/2018	27.6	11.6															

DCPL Real-time Dust Monitoring Response Register

**Note: Alarming operational as of January 2014.*

**Note: For the baseline data from the 12 month period April 2012 to April 2013, no exceedances of the 24-hour average criterion of 50 µg/m³ were recorded.*

Alarm		Validate Data	Source Identification	Management Strategy	Review
Alarm Date/Time	**What Performance Indicator has been exceeded?**	**Assess potential for influence of extreme activities or irregular events non-mine related.**	**Visually assess if excessive dust being generated and identify source?**	**Management measure taken, i.e. Additional mitigation measures applied or ceasing of activities.**	**Review of real-time data to determine whether the management strategy has resulted in a discernible dust reduction.**
2018-07-16,14:37:15	DMC=114271.74M/ug Hi	TEOM calibration being undertaken.	N/A	N/A	N/A
2018-07-19,12:07:19	MED24H=25.64M/ug	Light northerly winds over previous day. PM10 briefly greater than 25. Mine site downwind from monitor. No visible mine contribution.	N/A	N/A	N/A
2018-07-31,05:40:25	PM10>25=25.3 Hi	Light NW wind. High proportion of PM2.5 mostly likely due to woodfire smoke.	No operations at time of alarm.	N/A	N/A
2018-08-02,08:10:02	MED24H=25.50M/ug Hi	Back-burning in the berrico area. High levels of smoke throughout the valley form 31/7 to 3/8.	N/A	N/A	N/A
2018-09-13,09:54:37	PM10>25=25.2 Hi	Bushfire smoke throughout valley.	N/A	N/A	N/A
2018-10-09,12:07:19	PM10>100=73.0 Hi	TEOM calibration being undertaken.	N/A	N/A	N/A
2018-11-04,21:08:23	MED24H=25.25M/ug Hi	Moderate SSE wind on 4/11/18. Hazy conditions from backburning and bushfires.	No operations during 24 hours prior to al	N/A	N/A
2018-11-06,17:44:27	PM10>25=25.1 Hi	Moderate N wind, not in direction of Mine. Very hazy conditions throughout Gloucester Basin due to bushfire smoke and backburning.	N/A	N/A	N/A
2018-11-22,13:36:00	PM10>100=112.8 Hi	Regional dust storm	N/A	N/A	N/A
2018-11-22,14:08:02	DMC=209.17M/ug Hi	Regional dust storm	N/A	N/A	N/A
2018-11-22,14:13:55	MED24H=26.86M/ug Hi	Regional dust storm	N/A	N/A	N/A
2018-11-22,14:29:19	PM10>25=25.9 Hi	Regional dust storm	N/A	N/A	N/A
2018-11-22,19:17:36	PM10>45=65.3 Hi	Regional dust storm	N/A	N/A	N/A
2018-11-23,02:02:38	PM10>100=110.1 Hi	Regional dust storm	N/A	N/A	N/A
2018-11-23,02:44:00	DMC=210.65M/ug Hi	Regional dust storm	N/A	N/A	N/A
2018-12-03,01:08:48	MED24H=25.22M/ug Hi Signal	Moderate SW winds at time of alarm. Strong winds in proceeding 24 hours. Local bushfire smoke present	N/A	N/A	N/A
2018-12-03,03:05:43	PM10>25=25.1 Hi	Moderate SW winds at time of alarm. Strong winds in proceeding 24 hours. Local bushfire smoke present	N/A	N/A	N/A
2019-01-24,02:19:29,	MED24H=25.03M/ug Hi Signal	Region wide poor air quality seen on Duralie, Stratford and Craven TEOMS. Following dry conditions and a Southerly wind change. Outside of	N/A	N/A	N/A
2019-01-24,03:53:01	PM10>25=25.1 Hi Signal	Region wide poor air quality seen on Duralie, Stratford and Craven TEOMS. Following dry conditions and a Southerly wind change. Outside of	N/A	N/A	N/A
2019-02-10,13:08:43	MED24H=25.28M/ug Hi	Southerly change, following a long dry spell. Poor air quality observed throughout valley. Mining not a contributing factor, no operations at time of alarm.	N/A	N/A	N/A
2019-02-10,14:24:39	PM10>25=25.1 Hi	Southerly change, following a long dry spell. Poor air quality observed throughout valley. Mining not a contributing factor, no operations at time of alarm.	N/A	N/A	N/A
2019-02-10,16:56:38	MED24H=27.29M/ug Hi	Southerly change, following a long dry spell. Poor air quality observed throughout valley. Mining not a contributing factor, no operations at time of alarm.	N/A	N/A	N/A

2019-02-10,17:20:54	PM10>25=26.5 Hi	Southerly change, following a long dry spell. Poor air quality observed throughout valley. Mining not a contributing factor, no operations at time of alarm.	N/A	N/A	N/A
2019-02-10,22:56:37	MED24H=29.02M/ug Hi	Southerly change, following a long dry spell. Poor air quality observed throughout valley. Mining not a contributing factor, no operations at time of alarm.	N/A	N/A	N/A
2019-02-10,23:20:52	PM10>25=28.3 Hi	Southerly change, following a long dry spell. Poor air quality observed throughout valley. Mining not a contributing factor, no operations at time of alarm.	N/A	N/A	N/A
2019-02-13,10:09:37	MED24H=25.46M/ug Hi	Regional dust storm	N/A	N/A	N/A
2019-02-13,10:42:51	PM10>25=25.2 Hi	Regional dust storm	N/A	N/A	N/A
2019-02-13,22:11:38	MED24H=33.68M/ug Hi	Regional dust storm	N/A	N/A	N/A
2019-02-13,22:35:56	PM10>25=34.5 Hi	Regional dust storm	N/A	N/A	N/A
2019-02-14,01:56:36	MED24H=33.75M/ug Hi	Regional dust storm	N/A	N/A	N/A
2019-02-14,02:02:30	PM10>25=33.4 Hi	Regional dust storm	N/A	N/A	N/A
2019-02-14,05:11:39	MED24H=34.04M/ug Hi	Regional dust storm	N/A	N/A	N/A
2019-02-14,05:17:32	PM10>25=33.5 Hi	Regional dust storm	N/A	N/A	N/A
2019-02-20,06:34:36	PM10>25=25.0 Hi	Poor air quality observed throughout valley. Mining not a contributing factor. No visible dust originating from site	N/A	N/A	N/A
2019-02-20,13:11:37	MED24H=26.66M/ug Hi	Poor air quality observed throughout valley. Mining not a contributing factor. No visible dust originating from site	N/A	N/A	N/A
2019-02-20,13:17:31	PM10>25=25.6 Hi	Poor air quality observed throughout valley. Mining not a contributing factor. No visible dust originating from site	N/A	N/A	N/A
2019-03-11,21:15:20	MED24H=25.50M/ug Hi	Poor air quality observed throughout valley. Mining not a contributing factor Prevailing wind placing TEOM upwind from mining operations	N/A	N/A	N/A
2019-03-11,22:53:01	PM10>25=25.1 Hi	Poor air quality observed throughout valley. Mining not a contributing factor Prevailing wind placing TEOM upwind from mining operations.	N/A	N/A	N/A
2019-03-27,02:18:28	MED24H=25.31M/ug Hi	Southerly change noted prior to alarm, widespread haze across Gloucester Valley region. Spikes also occurred on Stratford and Craven TEOMS.	N/A	N/A	N/A
2019-03-27,02:41:07	PM10>25=25.0 Hi	Southerly change noted prior to alarm, widespread haze across Gloucester Valley region. Spikes also occurred on Stratford and Craven TEOMS.	N/A	N/A	N/A
2019-03-31,06:19:39	MED24H=26.37M/ug Hi	Wind speed increase observed at time of alarms. Wind direction consistent. Alerts and very similar results seen at Craven Stratford and Duralie indicating a widespread regional air quality issue. No mining operations.	N/A	N/A	N/A
2019-03-31,06:41:33	PM10>25=25.2 Hi	Wind speed increase observed at time of alarms. Wind direction consistent. Alerts and very similar results seen at Craven Stratford and Duralie indicating a widespread regional air quality issue. No mining operations.	N/A	N/A	N/A

Alarms:

Medium

Rolling 24hr Average >25 is: **Duralie TEOM1: PM10>25=25.7 Hi**

5 Minute Average >100 for 3 logs is: **Duralie TEOM1: PM10>100=105.7 Hi**

5 Minute Average >200 is: **Duralie TEOM1: PM10>200=205.7 Hi**

High

Rolling 24hr Average >45 for 3 logs is : **Duralie TEOM1: PM10>45=45.7 Hi**

Notes on Duralie TEOM Data

Start	End	Comment
10/04/2012		Start
13/06/2012		Temporary data loss or comms fault
18/06/2012		Temporary data loss or comms fault
18/07/2012		Temporary data loss or comms fault
5/12/2012	14/12/2012	Data loss. Some PM2.5 data available.
19/12/2012		Temporary data loss or comms fault
8/01/2013	12/03/2013	System failure. Do not use data
24/04/2013		Temporary data loss or comms fault
25/05/2013	27/05/2013	No data
26/07/2013		Temporary data loss or comms fault
13/10/2013		Temporary data loss or comms fault
19/12/2013		Temporary data loss or comms fault
8/01/2014		Temporary data loss or comms fault
3/02/2014	6/02/2014	Corrupt data due to grass fire.
17/03/2014		Temporary data loss or comms fault
9/05/2014	22/05/2014	System failure. Do not use data
9/11/2016	24/11/2016	Water infiltrated system from storm. System repairs.
10/02/2017	12/02/2017	System overheating, air-conditioner fault.
10/04/2017	13/04/2017	System faults.
28/06/2017	29/06/2017	UPS failure. Data lost temporarily.

Appendix 4:

Surface Water and Groundwater Monitoring

Surface Water

SW2 - Coal Shaft Creek **EPL 11701 Point 30**

Date	Category	Comment	ph	EC	Turbidity	DO	TSS	Alkalinity (as $CaCO_3$)	Acidity (as $CaCO_3$)	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	Cu
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	Monthly	brown	7.1	472	9	35	<5	90	6	54	62	21	16	0.09	0.470	0.007	2.42	<0.001
30-Aug-18	Monthly	Trickle, clear	7.7	**709**	5	52	9	99	1	46	161	23	19	0.07	0.214	<0.005	1	<0.001
28-Sep-18	Monthly	No flow																
18-Oct-18	Discharge Event	clear	7.3	400	33.0	79	18	44	6	91	51	18	13	0.37	0.150	0.023	1.25	0.002
21-Oct-18	Discharge	brown. 0.6m above	7.3	307	86.5		40											
29-Nov-18	Monthly	brown	7.3	504	4.2	48	<5	140	7	12	61	21	18	0.06	0.799	<0.005	1.21	0.002
15-Dec-18	Discharge Event	Steady, light brown	**6.8**	312	34.9	6	21	55	6	46	33	13	10	1.14	0.218	0.022	2.03	0.001
30-Jan-19	Monthly	No flow																
28-Feb-19	Monthly	No flow																
17-Mar-19	Discharge Event	No flow																
25-Mar-19	Discharge	No flow																
31-Mar-19	Discharge	No flow																
30-Apr-19	Monthly	No flow																
30-May-19	Monthly	No flow																
26-Jun-19	Monthly	Trickle	**7.0**	**569**	15.0	54	10	46	3	104	70	21	18	0.1	0.170	0.01	2.78	<0.001
Min			6.8	307	4.2	6.0	5	44	1	12	33	13	10	0.06	0.150	0.005	1.00	0.001
Avg			7.2	468	26.8	46.0	15	79	5	59	73	20	16	0.31	0.337	0.012	1.78	0.001
Max			7.7	709	86.5	79.0	40	140	7	104	161	23	19	1.14	0.799	0.023	2.78	0.002
Var			0.1	20746	849.7	576.0	155	1426	5	1124	2020	13	12	0.18	0.065	0.000	0.54	0.000
SD			0.3	144	29.2	24.0	12	38	2	34	45	4	4	0.43	0.254	0.008	0.73	0.001
*Water Quality Trigger			7.1 - 7.9	544	119	85 - 110%	80							3.02		0.064		0.003

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). *"Gilberts & Asscocistes 2011 -* Development of Water Quality Trigger Levels for the Duralie Extension Project".**

SW2 RC - Coal Shaft Creek at Rail Siding Culvert (Entrance)

Date	Category	Comment	ph	EC	Turbidity	DO	TDS	TSS	Hardness	Alkalinity $CaCO_3$	Acidity $CaCO_3$	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	CO3 $CaCO_3$	Bicarb (as $CaCO_3$)	BOD	Na
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	Monthly	Trickle, Clear	7.5	440	6.97	**49**	282	12	122	87	6	67	52	21	17	0.24	0.118	0.029	0.68	<1	87	<2	50
30-Aug-18	Monthly	Trickle, Clear	**8.1**	503	12.22	**71.4**	322	10	131	76	1	93	74	21	19	0.1	0.228	0.028	1.64	<1	76	<2	54
28-Sep-18	Monthly	Trickle, clear	7.2	426	6.46	**71.6**	273	30	109	115	7	46	41	19	15	0.11	0.157	0.016	1.07	<1	115	<2	50
18-Oct-18	Discharge Event	y flow, Slightly turbid, light	7.5	387	51.1	103.9	248	18	97	50	4	110	34	19	12	0.57	0.019	0.039	0.79	<1	50	<2	43
21-Oct-18	Discharge	eady flow, turbid, light brow	7.3	307	86.5		196	40															
29-Nov-18	Monthly	Trickle, Clear	**7.0**	438	22	**77.4**	280	8	113	99	10	47	42	19	16	0.3	0.357	0.021	1.33	<1	99	<2	45
15-Dec-18	Discharge Event	w flow, slightly turbid, bro	7.6	481	**175**	**7.7**	308	74	121	48	2	119	42	22	16	**3.32**	0.055	0.041	3.05	<1	48	24	52
30-Jan-19	Monthly	Nil flow																					
28-Feb-19	Monthly	Nil flow																					
17-Mar-19	Discharge Event	Slow flow and clear	**6.0**	**876**	15.68	**62.8**	561	**<5**	252	13	3	320	107	45	34	0.45	0.136	**0.466**	0.62	<1	13	<2	81
30-Apr-19	Monthly	Nil flow																					
30-May-19	Monthly	Nil flow																					
26-Jun-19	Monthly	Trickle, grey	**6.7**	**696**	18.9	**53.9**	445	14	149	17	2	178	64	25	21	0.24	0.028	**0.085**	0.44	<1	17	<2	75
Min			6.0	307	6.5	8.0	196	<5	97	13	1	46	34	19	12	0.10	0.020	0.016	0.44		13	2	43
Avg			7.2	506	43.9	62.0	324	23	137	63	4	123	57	24	19	0.67	0.140	0.091	1.20		63	5	56
Max			8.1	876	175.0	104.0	561	74	252	115	10	320	107	45	34	3.32	0.360	0.466	3.05		115	24	81
Var			0.4	30347	3090.5	765.0	12441	485	2407	1394	9	8251	585	77	45	1.18	0.010	0.023	0.71		1394	61	195
SD			0.6	174	55.6	28.0	112	22	49	37	3	91	24	9	7	1.08	0.110	0.153	0.85		37	8	14
*Water Quality Trigger			7.1 - 7.9	544	119	85 - 110%		80								3.02		0.064					

Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). *"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

SW2 RC - Coal Shaft Creek at Rail Siding Culvert (Entrance)

Date	As	Ba	Cd	Cr	Cu	Pb	Mo	Ni	Se	Ag	U	B	Hg	F	NH3 (as N)	NO2 (as N)	NO3 (as N)	N	P
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	<0.001	0.033	<0.0001	<0.001	<0.001	<0.001	<0.001	0.002	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	<0.01	0.4	<0.01
30-Aug-18	<0.001	0.032	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.04	<0.01	0.06	0.7	0.01
28-Sep-18	<0.001	0.03	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	0.03	0.7	<0.01
18-Oct-18	<0.001	0.028	<0.0001	<0.001	0.003	<0.001	<0.001	0.002	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.07	0.7	0.02
21-Oct-18																			
29-Nov-18	<0.001	0.031	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.05	0.6	0.01
15-Dec-18	<0.001	0.042	<0.0001	0.002	0.002	0.002	<0.001	0.002	<0.01	<0.001	<0.001	<0.05	<0.0001	0.1	0.02	<0.01	0.04	0.5	<0.01
30-Jan-19																			
28-Feb-19																			
17-Mar-19	<0.001	0.065	0.0001	<0.001	0.002	<0.001	<0.001	0.006	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.17	0.4	<0.01
30-Apr-19																			
30-May-19																			
26-Jun-19	<0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	0.002	<0.01	<0.001	<0.001	<0.05	<0.0001	0.1	0.02	<0.01	0.34	0.6	0.02
Min		0.030	0.0001	0.001	0.001	0.001		0.001						0.1	0.01		0.01	0.4	0.01
Avg		0.040	0.0001	0.001	0.002	0.001		0.002						0.1	0.02		0.10	0.6	0.01
Max		0.070	0.0001	0.002	0.003	0.002		0.006						0.1	0.04		0.34	0.7	0.02
Var		0.000			0.000			0.000							0.00		0.01	0.0	0.00
SD		0.010			0.001			0.002							0.01		0.11	0.1	0.00
*Water Quality Trigger					0.003										0.05			1.2	0.08

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

SW6

Date	Category	Comment	ph	EC	Turbidity	DO	TSS	Alkalinity (as $CaCO_3$)	Acidity (as $CaCO_3$)	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	Cu
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	Monthly	Dry																
30-Aug-18	Monthly	Dry																
28-Sep-18	Monthly	Dry																
18-Oct-18	Discharge Event	Trickle flow, clear	7.2	**809**	18	**76**	15	69	12	213	75	48	34	0.34	0.018	0.007	0.35	0.002
29-Nov-18	Monthly	No flow																
15-Dec-18	Discharge Event	Trickle	**6.4**	**639**	23	**7**								0.91	0.057	0.008	0.79	0.002
30-Jan-19	Monthly	Dry																
28-Feb-19	Monthly	Dry																
17-Mar-19	Discharge Event	Nil flow																
30-Apr-19	Monthly	Nil flow																
30-May-19	Monthly	Nil flow																
26-Jun-19	Monthly	Nil flow																
Min			6.4	639	18	7								0.34	0.018	0.007	0.35	0.002
Avg			6.8	724	21	42								0.63	0.038	0.008	0.57	0.002
Max			7.2	809	23	76								0.91	0.057	0.008	0.79	0.002
Var			0.3	14450	13	2381								0.16	0.001	0.000	0.10	0.000
SD			0.6	120	4	49								0.40	0.028	0.001	0.31	0.000
*Water Quality Trigger			7.1 - 7.9	544	119	85 - 110%	80							3.02		0.064		0.003

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

SW9 - Un-named Tributary (Fisher-Webster)

Date	Category	Comment	ph	EC	Turbidity	DO	TDS	TSS	Hardness	Alkalinity (as $CaCO_3$)	Acidity (as $CaCO_3$)	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	CO3 (as $CaCO_3$)	Bicarb (as $CaCO_3$)	BOD	Na
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	Monthly	Dry																					
30-Aug-18	Monthly	Dry																					
28-Sep-18	Monthly	Nil flow																					
18-Oct-18	Discharge Event	eady flow, light brow	7.0	225	75.4	88.3	144	**75**	38	20	7	22	44	7	5	0.6	0.06	0.018	2.26	<1	20	4	27
29-Nov-18	Monthly	Nil Flow																					
15-Dec-18	Discharge Event	Nil Flow																					
30-Jan-19	Monthly	Dry																					
28-Feb-19	Monthly	Dry																					
17-Mar-19	Discharge Event	Nil flow																					
30-Apr-19	Monthly	Nil flow																					
30-May-19	Monthly	Nil flow																					
26-Jun-19	Monthly	Nil flow																					
Min																							
Avg																							
Max																							
Var																							
SD																							
*Water Quality Trigger			6.4 - 7.1	461	94	85 - 110%		57								2.96		0.024					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

SW9 - Un-named Tributary (Fisher-Webster)

Date	As	Ba	Cd	Cr	Cu	Pb	Mo	Ni	Se	Ag	U	B	Hg	F	NH3 (as N)	NO2 (as N)	NO3	N	P
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	(as N) mg/l	mg/l	mg/l
18-Oct-18	0.003	0.056	<0.0001	<0.001	0.003	0.002	<0.001	0.003	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.11	<0.01	0.07	3.1	0.74
Min																			
Avg																			
Max																			
Var																			
SD																			
*Water Quality Trigger				0.002	0.0040										0.13			2.6	0.68

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

SW10 - Coal Shaft Creek (Holmes Upstream)

Date	Category	Comment	ph	EC uS/cm	Turbidity NTU	DO %	TDS mg/l	TSS mg/l	Hardness mg/l	Alkalinity (as $CaCO_3$) mg/l	Acidity (as $CaCO_3$) mg/l	SO4 mg/l	Cl mg/l	Ca mg/l	Mg mg/l	Al mg/l	Mn mg/l	Zn mg/l	Fe mg/l	CO3 (as $CaCO_3$)	Bicarb (as $CaCO_3$)	Na mg/l	BOD mg/l
31-Jul-18	Monthly	Dry																					
30-Aug-18	Monthly	Dry																					
28-Sep-18	Monthly	Dry																					
18-Oct-18	Discharge Event	Trickle, light brown	7.1	69	111	85	44	24	25	22	7	<1	10	5	3	1.16	0.03	0.008	1.1	<1	22	8	2
29-Nov-18	Monthly	No flow																					
15-Dec-18	Discharge Event	No flow																					
30-Jan-19	Monthly	Dry																					
28-Feb-19	Monthly	Dry																					
17-Mar-19	Discharge Event	No flow																					
30-Apr-19	Monthly	No flow																					
30-May-19	Monthly	No flow																					
26-Jun-19	Monthly	No flow																					
Min																							
Avg																							
Max																							
Var																							
SD																							
*Water Quality Trigger			7.1 - 7.9	544	119	85 - 110%		80								3.02		0.064					

Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). *"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

SW10 - Coal Shaft Creek (Holmes Upstream)

Date	As mg/l	Ba mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Pb mg/l	Mo mg/l	Ni mg/l	Se mg/l	Ag mg/l	U mg/l	B mg/l	Hg mg/l	F mg/l	NH3 (as N) mg/l	NO2 (as N) mg/l	NO3 (as N) mg/l	N mg/l	P mg/l
18-Oct-18	<0.001	0.018	<0.0001	<0.001	0.006	<0.001	<0.001	0.003	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.03	<0.01	0.02	1.8	0.11
*Water Quality Trigger					0.003										0.05			1.2	0.08

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

GB1 - Mammy Johnsons River EPL 11701 Point 31

Date	Category	Comment	ph	EC uS/cm	Turbidity NTU	DO %	TDS mg/l	TSS mg/l	Hardness mg/l	Alkalinity (as $CaCO_3$) mg/l	Acidity (as $CaCO_3$) mg/l	SO4 mg/l	Cl mg/l	Ca mg/l	Mg mg/l	Al mg/l	Mn mg/l	Zn mg/l	Fe mg/l	CO3 (as $CaCO_3$) mg/l	Bicarb (as $CaCO_3$) mg/l	BOD mg/l	Na mg/l
31-Jul-18	Monthly	Steady flow, clear	7.38	274	4	**76**	175	**<5**	65	48	4	11	56	13	8	0.18	0.025	**<0.005**	0.80	<1	48	<2	36
30-Aug-18	Monthly	Slow flow, clear	**7.71**	317	2	**64**	203	**<5**	70	55	<1	8	64	15	8	0.03	0.049	**<0.005**	0.47	<1	55	<2	41
28-Sep-18	Monthly	Slow flow, clear	**7.78**	**397**	1	**69**	254	**<5**	84	66	4	8	70	17	10	0.03	0.056	**<0.005**	0.54	<1	66	<2	48
18-Oct-18	Discharge Event	Fast, Light Brown	7.57	184	**63**	90	118	**41**	36	46	4	8	34	8	4	0.56	0.038	0.008	1.24	<1	46	3	24
21-Oct-18	Discharge	Fast, brown	7.14	147	**83**			**57**															
29-Nov-18	Monthly	Slow, light brown	7.48	294	2	**43**	188	**<5**	61	64	8	<1	42	13	7	0.06	0.365	**<0.005**	1.00	<1	64	<2	30
15-Dec-18	Discharge Event	eady flow, light brow	**6.9**	160	**148**	**63**	102	**107**	25	27	3	3	26	5	3	**3.23**	0.080	0.009	3.54	<1	27	<2	20
30-Jan-19	Monthly	Nil flow																					
28-Feb-19	Monthly	Nil flow																					
17-Mar-19	Discharge Event	Nil flow																					
25-Mar-19	Discharge	Slow flow, clear	**6.96**	362	6			6															
31-Mar-19	Discharge	low flow, light brow	**6.47**	259	**25**			**16**															
30-Apr-19	Monthly	Nil flow																					
30-May-19	Monthly	Trickle, light brown	7.1	323	21	**13**	207	14	61	54	4	7	45	13	7	0.04	0.395	**<0.005**	1.55	<1	54	<2	29
26-Jun-19	Monthly	Slow flow, clear	7.15	304	3	**49**	195	**<5**	63	59	1	10	50	12	8	0.07	0.033	**<0.005**	0.60	<1	59	<2	33
Min			6.5	147	1	13	102	5	25	27	1	1	26	5	3	0.03	0.030	0.005	0.47	1	27	2	20
Avg			7.2	275	33	58	180	24	58	52	4	7	48	12	7	0.53	0.130	0.006	1.22	1	52	2	33
Max			7.8	397	148	90	254	107	84	66	8	11	70	17	10	3.23	0.400	0.009	3.54	1	66	3	48
Var			0.2	6587	2225	551	2425	1056	355	154	5	11	219	15	5	1.23	0.020	0.000	1.02	0	154	0	82
SD			0.4	81	47	23	49	32	19	12	2	3	15	4	2	1.11	0.160	0.002	1.01	0	12	0	9
*Water Quality Trigger			7.1 - 7.6	370	24	85 - 110%		15								1.24		0.011					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

GB1 - Mammy Johnsons River

Date	As mg/l	Ba mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Pb mg/l	Mo mg/l	Ni mg/l	Se mg/l	Ag mg/l	U mg/l	B mg/l	Hg mg/l	F mg/l	NH3 (as N) mg/l	NO2 (as N) mg/l	NO3 (as N) mg/l	N mg/l	P mg/l
31-Jul-18	<0.001	0.04	<0.0001	<0.001	0.017	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	**<0.01**	<0.01	0.03	0.3	<0.01
30-Aug-18	<0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.03	<0.01	0.04	0.3	0.02
28-Sep-18	<0.001	0.05	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	0.02	0.4	0.03
18-Oct-18	<0.001	0.04	<0.0001	<0.001	0.002	<0.001	<0.001	0.002	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.07	1.4	0.15
21-Oct-18																			
29-Nov-18	0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.03	<0.01	0.10	0.7	0.08
15-Dec-18	0.002	0.07	<0.0001	0.001	0.002	0.003	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.15	1.6	0.15
30-Jan-19																			
28-Feb-19																			
17-Mar-19																			
25-Mar-19																			
31-Mar-19																			
30-Apr-19																			
30-May-19	<0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.08	<0.01	0.05	0.6	0.09
26-Jun-19	<0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.03	<0.01	0.08	0.3	0.02
Min	0.001	0.040	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.100	0.010	0.010	0.02	0.3	0.01
Avg	0.001	0.050	0.000	0.001	0.003	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.100	0.030	0.010	0.07	0.7	0.07
Max	0.002	0.070	0.000	0.001	0.017	0.003	0.001	0.002	0.010	0.001	0.001	0.050	0.000	0.100	0.080	0.010	0.15	1.6	0.15
Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.3	0.00
SD	0.000	0.010	0.000	0.000	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.000	0.04	0.5	0.06
*Water Quality Trigger				0.001	0.0020										0.06			0.8	0.15

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

Highnoon - Mammy Johnsons River EPL 11701 Point 35

Date	Category	Comment	ph	EC uS/cm	Turbidity NTU	DO %	TDS mg/l	TSS mg/l	Hardness mg/l	Alkalinity (as $CaCO_3$) mg/l	Acidity (as $CaCO_3$) mg/l	SO4 mg/l	Cl mg/l	Ca mg/l	Mg mg/l	Al mg/l	Mn mg/l	Zn mg/l	Fe mg/l	CO3 (as $CaCO_3$) mg/l	Bicarb (as $CaCO_3$) mg/l	BOD mg/l	Na mg/l
31-Jul-18	Monthly	Steady flow, clear	7.5	276	5	**75**	177	**<5**	59	45	5	11	55	12	7	0.21	0.039	**<0.005**	0.93	<1	45	3	34
30-Aug-18	Monthly	Slow flow, clear	**7.81**	314	2	**52**	201	6	61	50	<1	9	64	13	7	0.05	0.066	**<0.005**	0.60	<1	50	<2	36
28-Sep-18	Monthly	Slow flow, clear	**7.81**	**398**	2	**66**	255	13	86	60	4	11	69	18	10	0.04	0.096	**<0.005**	0.58	<1	60	<2	45
18-Oct-18	Discharge Event	Steady flow, light brown	7.3	188	**61**	**83**	118	**37**	34	36	4	7	38	7	4	0.53	0.033	0.009	1.20	<1	36	2	25
21-Oct-18	Discharge	Fast flow, turbid, brown	7.11	156	**71**		100	**50**															
29-Nov-18	Monthly	Slow flow, Light brown	7.48	290	2	**47**	186	**<5**	59	64	3	1	42	12	7	0.07	0.270	**<0.005**	1.15	<1	64	<2	31
15-Dec-18	Discharge Event	Steady slow, light brown	**6.95**	265	**51**	**74**	170	**56**	52	48	3	4	39	11	6	1.14	0.228	**<0.005**	3.61	<1	48	14	30
30-Jan-19	Monthly	No flow																					
28-Feb-19	Monthly	No flow																					
17-Mar-19	Discharge Event	No flow																					
25-Mar-19	Discharge	No flow																					
31-Mar-19	Discharge	Slow flow, Light brown	**6.64**	**393**	22			**18**															
30-Apr-19	Monthly	Trickle, clear	7.18	364	4	**52**	233	**<5**	77	61	5	10	53	16	9	0.01	0.795	**<0.005**	1.98	<1	61	2	35
30-May-19	Monthly	Slow flow, light brown	7.17	367	6	**31**	235	5	72	58	4	14	48	14	9	0.03	0.182	**<0.005**	1.70	<1	58	<2	34
26-Jun-19	Monthly	Slow flow, Light brown	**6.95**	362	6	**35**	232	6	70	51	2	13	64	13	9	0.15	0.091	**<0.005**	0.94	<1	51	2	39
Min			6.6	156	2	31	100	5	34	36	1	1	38	7	4	0.01	0.030	0.005	0.58	1.0	36	2	25
Avg			7.3	307	21	57	191	19	63	53	3	9	52	13	8	0.25	0.200	0.005	1.41	1.0	53	3	34
Max			7.8	398	71	83	255	56	86	64	5	14	69	18	10	1.14	0.800	0.009	3.61	1.0	64	14	45
Var			0.1	6557	708	335	2650	381	232	81	2	18	133	10	4	0.14	0.060	0.000	0.89	0.0	81	16	32
SD			0.4	81	27	18	51	20	15	9	1	4	12	3	2	0.37	0.240	0.001	0.95	0.0	9	4	6
*Water Quality Trigger			7.1 - 7.6	370	24	85 - 110%		15								1.24		0.011					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

Highnoon - Mammy Johnsons River

Date	As mg/l	Ba mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Pb mg/l	Mo mg/l	Ni mg/l	Se mg/l	Ag mg/l	U mg/l	B mg/l	Hg mg/l	F mg/l	NH3 (as N) mg/l	NO2 (as N) mg/l	NO3 (as N) mg/l	N mg/l	P mg/l
31-Jul-18	<0.001	0.04	<0.0001	<0.001	0.006	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	0.04	0.3	0.02
30-Aug-18	<0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.01	0.3	0.02
28-Sep-18	<0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.03	0.3	0.02
18-Oct-18	<0.001	0.04	<0.0001	<0.001	0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.04	<0.01	0.08	1.3	0.18
29-Nov-18	0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.05	0.6	0.06
15-Dec-18	0.002	0.07	<0.0001	<0.001	0.001	0.002	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.13	**1.6**	0.24
30-Apr-19	0.001	0.06	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.07	<0.01	0.08	0.7	0.08
30-May-19	0.001	0.04	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	<0.01	0.7	0.08
26-Jun-19	<0.001	0.05	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.10	<0.01	0.07	0.5	0.03
Min	0.001	0.04	0.0	0.001	0.001	0.001	0.001	0.001	0.01	0.001	0.001	0.1	0.0	0.1	0.01	0.0	0.01	0.3	0.0
Avg	0.001	0.05	0.0	0.001	0.002	0.001	0.001	0.001	0.01	0.001	0.001	0.1	0.0	0.1	0.03	0.0	0.06	0.7	0.08
Max	0.002	0.07	0.0	0.001	0.006	0.002	0.001	0.001	0.01	0.001	0.001	0.1	0.0	0.1	0.10	0.0	0.13	1.6	0.24
Var	0.000	0.00	0.0	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.0	0.0	0.0	0.00	0.0	0.00	0.2	0.01
SD	0.000	0.01	0.0	0.000	0.002	0.000	0.000	0.000	0.00	0.000	0.000	0.0	0.0	0.0	0.03	0.0	0.04	0.5	0.08
*Water Quality Trigger				0.001	0.0020										0.06			0.8	0.15

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

Site 9 - Karuah River (Near Stroud Road Village)

Date	Category	Comment	ph	EC	Turbidity	DO	TDS	TSS	Hardness	Alkalinity (as $CaCO_3$)	Acidity (as $CaCO_3$)	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	CO3 (as $CaCO_3$)	Bicarb (as $CaCO_3$)	BOD	Na
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l			mg/l	mg/l
31-Jul-18	Monthly	Slow flow, clear	7.8	158	2	11	101	<5	43	43	3	5	28	9	5	0.07	0.008	<0.005	0.25	<1	43	<2	18
30-Aug-18	Monthly	Steady flow, clear	8.2	172	4	88	110	<5	46	46	<1	4	31	10	5	0.05	0.008	<0.005	0.21	<1	46	<2	18
28-Sep-18	Monthly	Fast flow, clear	7.6	182	1	100	116	<5	46	42	2	4	28	10	5	0.05	0.008	<0.005	0.25	<1	42	<2	17
18-Oct-18	Discharge Event	ast flow, light brow	8.0	84	67	97	54	42	18	25	6	<5	16	4	2	0.90	0.023	0.007	0.86	<1	25	2	11
29-Nov-18	Monthly	Fast flow, clear	8.2	178	4	68	114	<5	36	44	2	2	22	8	4	0.14	0.024	<0.005	0.48	<1	44	<2	16
15-Dec-18	Discharge Event	Steady flow, clear	7.1	149	10	7	95.4	8	36	39	2	<1	20	8	4	0.15	0.040	<0.005	0.56	<1	39	<2	14
30-Jan-19	Monthly	Trickle flow, brown	7.4	262	4	37	168	9	66	62	3	<1	34	15	7	0.02	0.168	<0.005	0.47	<1	62	4	23
28-Feb-19	Monthly	ow, clear, brown	7.1	272	2	58	174	<5	64	65	1	2	41	14	7	0.04	0.042	<0.005	0.43	<1	65	2	24
17-Mar-19	Discharge Event	w, clear, light brow	7.3	200	1	71	128	<5	52	56	2	<1	32	11	6	0.06	0.018	<0.005	0.42	<1	56	<2	19
30-Apr-19	Monthly	Steady flow, clear	7.4	189	2	74	121	<5	43	35	2	4	27	9	5	0.05	0.022	<0.005	0.42	<1	35	<2	17
30-May-19	Monthly	Steady flow, clear	7.3	195	2	70	125	<5	46	38	2	4	28	10	5	0.03	0.009	<0.005	0.24	<1	38	<2	17
26-Jun-19	Monthly	Steady flow, clear	7.3	170	1	88	109	<5	43	41	1	11	37	9	5	0.04	0.008	<0.005	0.23	<1	41	2	19
Min			7.1	84	1	7	54	5	18	25	1	1	16	4	2	0.02	0.010	0.005	0.21	1.0	25	2	11
Avg			7.6	184	8	64	118	9	45	45	2	4	29	10	5	0.13	0.030	0.005	0.40	1.0	45	2	18
Max			8.2	272	67	100	174	42	66	65	6	11	41	15	7	0.90	0.170	0.007	0.86	1.0	65	4	24
Var			0.2	2410	348	960	987	112	160	130	2	8	50	8	2	0.06	0.000	0.000	0.04	0.0	130	0	12
SD			0.4	49	19	31	31	11	13	11	1	3	7	3	1	0.25	0.040	0.001	0.19	0.0	11	1	3
*Water Quality Trigger			N/A	N/A	N/A											N/A		N/A					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

Site 9 - Karuah River (Near Stroud Road Village)

Date	As	Ba	Cd	Cr	Cu	Pb	Mo	Ni	Se	Ag	U	B	Hg	F	NH3 (as N)	NO2 (as N)	NO3 (as N)	N	P
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	<0.001	0.015	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.05	0.2	0.01
30-Aug-18	<0.001	0.016	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.04	0.2	0.02
28-Sep-18	<0.001	0.017	<0.0001	0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.04	0.3	0.02
18-Oct-18	<0.001	0.023	<0.0001	<0.001	0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.18	1.0	0.09
29-Nov-18	<0.001	0.018	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.04	0.4	0.04
15-Dec-18	<0.001	0.021	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.05	<0.01	0.08	0.5	0.07
30-Jan-19	0.002	0.026	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.3	<0.01	0.10	1.6	0.18
28-Feb-19	<0.001	0.027	<0.0001	<0.001	0.018	<0.001	<0.001	0.003	<0.01	<0.001	<0.001	<0.05	<0.0001	0.1	0.03	<0.01	0.08	0.5	0.02
17-Mar-19	<0.001	0.019	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	0.1	0.05	<0.01	0.10	0.3	0.02
30-Apr-19	<0.001	0.017	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.13	0.5	0.04
30-May-19	<0.001	0.015	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.09	0.4	0.03
26-Jun-19	<0.001	0.016	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.09	0.3	0.02
Min	0.001	0.020	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.01	0.01	0.04	0.2	0.01
Avg	0.001	0.020	0.000	0.001	0.002	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.05	0.01	0.09	0.5	0.05
Max	0.002	0.030	0.000	0.001	0.018	0.001	0.001	0.003	0.010	0.001	0.001	0.050	0.000	0.1	0.30	0.01	0.18	1.6	0.18
Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.01	0.00	0.00	0.2	0.00
SD	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.0	0.08	0.00	0.04	0.4	0.05

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

Site 11 - Mammy Johnsons - Downstream of High Noon

Date	Category	Comment	ph	EC	Turbidity	DO	TDS	TSS	Hardness	Alkalinity $CaCO_3$	Acidity $CaCO_3$	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	CO3 $CaCO_3$	Bicarb (as $CaCO_3$)	BOD	Na
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	Monthly	ly flow, clear. No RL boards in	**7.9**	290	5	85	186	**<5**	65	50	4	12	57	13	8	0.22	0.041	<0.005	0.95	<1	50	<2	35
30-Aug-18	Monthly	teady flow, clear, No RL record	**7.95**	329	1	**65**	211	**<5**	68	58	<1	9	65	14	8	0.04	0.030	<0.005	0.42	<1	58	<2	37
28-Sep-18	Monthly	Steady flow, clear	**8.26**	**412**	4	**72**	264	14	88	66	3	11	70	17	11	0.04	0.089	<0.005	0.63	<1	66	<2	45
18-Oct-18	Discharge Event	Fast flow, light brown	7.4	204	**67**	85	130	**58**	40	34	6	9	40	8	5	0.53	0.044	0.008	1.20	<1	34	3	26
29-Nov-18	Monthly	Steady flow, clear	**7.66**	305	2	**54**	195	**<5**	65	66	3	2	44	13	8	0.06	0.112	<0.005	1.05	<1	66	<2	32
15-Dec-19	Discharge Event	Fast flow , light brown	**6.73**	295	**55**	**38**	189	**24**	61	57	4	3	43	13	7	0.79	0.286	<0.005	2.94	<1	57	<2	34
30-Jan-19	Monthly	Nil flow																					
28-Feb-19	Monthly	Nil flow																					
17-Mar-19	Discharge Event	Nil flow																					
30-Apr-19	Monthly	Slow flow, clear	7.34	**425**	4	**53**	272	**<5**	88	64	4	13	62	17	11	0.03	0.149	<0.005	1.14	<1	64	<2	39
30-May-19	Monthly	Trickle, clear	7.44	**462**	2	**31**	296	**<5**	90	68	3	14	61	18	11	**<0.01**	0.052	<0.005	0.46	<1	68	<2	39
26-Jun-19	Monthly	Slow flow, clear	7.21	364	4	**61**	233	**<5**	76	49	1	13	67	14	10	0.07	0.041	<0.005	0.67	<1	49	<2	40
Min			6.7	204	1.0	31	130	5	40	34	1	2	40	8	5	0.0	0.0	0.0	0.4	1.0	34.0	2.0	26.0
Avg			7.5	343	16.0	60	220	14	71	57	3	10	57	14	9	0.2	0.1	0.0	1.1	1.0	56.9	2.1	36.3
Max			8.3	462	67.0	85	296	58	90	68	6	14	70	18	11	0.8	0.3	0.0	2.9	1.0	68.0	3.0	45.0
Var			0.2	6520	661.5	354	2688	315	263	122	2	19	128	9	4	0.1	0.0	0.0	0.6	0.0	121.9	0.1	29.5
SD			0.5	81	25.7	19	52	18	16	11	2	4	11	3	2	0.3	0.1	0.0	0.8	0.0	11.0	0.3	5.4
*Water Quality Trigger			7.1 - 7.6	370	24	85 - 110%		15								1.24		0.011					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
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Site 11 - Mammy Johnsons - Downstream of High Noon

Date	As	Ba	Cd	Cr	Cu	Pb	Mo	Ni	Se	Ag	U	B	Hg	F	NH3 (as N)	NO2 (as N)	NO3 (as N)	N	P
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	<0.001	0.036	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.05	0.4	<0.01
30-Aug-18	<0.001	0.037	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.04	<0.01	0.03	**0.2**	0.01
28-Sep-18	<0.001	0.043	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	0.04	0.3	<0.01
18-Oct-18	<0.001	0.045	<0.0001	<0.001	0.002	<0.001	<0.001	0.002	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.04	<0.01	0.1	1.5	0.22
29-Nov-18	<0.001	0.038	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.01	0.6	0.05
15-Dec-18	0.002	0.063	<0.0001	**<0.001**	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	**<0.01**	<0.01	0.32	**1.3**	0.18
30-Jan-19																			
28-Feb-19																			
17-Mar-19																			
30-Apr-19	<0.001	0.043	<0.0001	**<0.001**	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.04	<0.01	0.06	0.5	0.07
30-May-19	<0.001	0.037	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	0.03	0.5	0.06
26-Jun-19	<0.001	0.038	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	**<0.01**	<0.01	0.09	0.4	0.03
Min	0.001	0.040	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.01	0.01	0.01	0.2	0.01
Avg	0.001	0.040	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.02	0.01	0.08	0.6	0.07
Max	0.002	0.060	0.000	0.001	0.002	0.001	0.001	0.002	0.010	0.001	0.001	0.050	0.000	0.1	0.04	0.01	0.32	1.5	0.22
Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.00	0.00	0.01	0.2	0.01
SD	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.01	0.00	0.09	0.5	0.08
*Water Quality Trigger				0.001	0.0020										0.06			0.8	0.15

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). "Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".**

Site 12 - Mammy Johnsons - Relton Property

Date	Category	Comment	ph	EC	Turbidity	DO	TDS	TSS	Hardness	Alkalinity (as $CaCO_3$)	Acidity (as $CaCO_3$)	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	CO3 (as $CaCO_3$)	Bicarb (as $CaCO_3$)	BOD	Na
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	Monthly	Steady flow	7.38	267	3.8	**82**	171	<5	52	47	4	10	54	11	6	0.19	0.021	<0.005	0.78	<1	47	<2	30
30-Aug-18	Monthly	Slow flow, clear	7.66	**269**	0.9	**65**	172	**<5**	55	48	<1	7	55	12	6	0.06	0.031	<0.005	0.42	<1	48	<2	31
28-Sep-18	Monthly	Slow flow, clear	**7.79**	340	1.6	**73**	218	6	77	54	3	8	62	16	9	0.04	0.045	<0.005	0.43	<1	54	<2	39
18-Oct-18	Discharge Event	ady flow, light bro	7.52	**156**	53.4	**90**	100	**28**	34	32	5	1	31	7	4	0.51	0.025	0.005	1.06	<1	32	<2	22
29-Nov-18	Monthly	ow flow, light brow	7.37	290	**1.8**	**48**	186	**<5**	59	61	4	2	40	12	7	**0.07**	0.309	<0.005	1.03	<1	61	<2	28
15-Dec-18	Discharge Event	ast flow, light brow	7.07	194	**81.3**	**72**	124	**46**	36	35	3	4	28	8	4	**2.28**	0.081	0.007	2.78	<1	35	<2	22
30-Jan-19	Monthly	Nil flow																					
28-Feb-19	Monthly	Nil flow																					
17-Mar-19	Discharge Event	Nil flow																					
30-Apr-19	Monthly	Nil flow																					
30-May-19	Monthly	ow flow, light brow	7.08	377	10.7	**41**	241	<5	80	65	4	5	51	17	9	<0.01	0.232	<0.005	1.41	<1	65	9	32
26-Jun-19	Monthly	ow flow, light brow	7.21	264	2.8	**49**	169	8	59	59	2	4	41	12	7	0.09	0.035	<0.005	0.48	<1	59	<2	28
Min			7.1	156	1	41	100	5	34	32	1	1	28	7	4	0.01	0.02	0.005	0.42	1	32	2	22
Avg			7.4	270	20	65	173	14	57	50	3	5	45	12	7	0.41	0.10	0.005	1.05	1	50	3	29
Max			7.8	377	81	90	241	46	80	65	5	10	62	17	9	2.28	0.31	0.007	2.78	1	65	9	39
Var			0.1	5081	936	307	2081	235	276	144	2	9	147	12	4	0.60	0.01	0.000	0.61	0	144	6	31
SD			0.3	71	31	18	46	15	17	12	1	3	12	3	2	0.77	0.11	0.001	0.78	0	12	2	6
*Water Quality Trigger			7.1 - 7.6	370	24	85 - 110%		15								1.24		0.011					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). "Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".**

Site 12 - Mammy Johnsons - Relton Property

Date	As	Ba	Cd	Cr	Cu	Pb	Mo	Ni	Se	Ag	U	B	Hg	F	NH3 (as N)	NO2 (as N)	NO3 (as N)	N	P
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	<0.001	0.037	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	**0.01**	<0.01	0.04	0.2	<0.01
30-Aug-18	<0.001	0.039	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.03	<0.01	0.07	0.3	0.01
28-Sep-18	<0.001	0.040	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	0.04	0.4	0.02
18-Oct-18	<0.001	0.036	<0.0001	<0.001	0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	0.10	0.02	<0.01	0.05	**1.2**	**0.11**
29-Nov-18	<0.001	0.044	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.04	<0.01	0.03	**0.5**	**0.06**
15-Dec-18	0.002	0.062	<0.0001	<0.001	0.001	0.002	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	**<0.01**	<0.01	0.08	**1.4**	**0.12**
30-May-19	<0.001	0.059	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.29	<0.01	0.02	0.6	0.06
26-Jun-19	<0.001	0.041	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.05	<0.01	0.06	0.3	0.02
Min	0.001	0.040	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.100	0.010	0.010	0.02	0.2	0.01
Avg	0.001	0.040	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.100	0.060	0.010	0.05	0.6	0.05
Max	0.002	0.060	0.000	0.001	0.001	0.002	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.100	0.290	0.010	0.08	1.4	0.12
Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.00	0.2	0.00
SD	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.02	0.4	0.04
*Water Quality Trigger				0.001	0.0020										0.06			0.8	0.15

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). "Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".**

Site 15 - Mammy Johnsons - Tereel

Date	Category	Comment	ph	EC	Turbidity	DO	TDS	TSS	Hardness	Alkalinity (as $CaCO_3$)	Acidity (as $CaCO_3$)	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	CO3 (as $CaCO_3$)	Bicarb (as $CaCO_3$)	BOD	Na
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
27-Jul-17	Monthly	Mod flow clear	**7.7**	202	4	**10**	103	<5	40	27	<1	8	62	8	5	0.18	0.010	<0.005	0.62	<1	27	5	24
28-Aug-17	Monthly	Low Flow, clear	7.5	224	2	**77**	114	<5	47	27	<1	7	44	9	6	0.1	0.015	<0.005	0.47	<1	27	2	26
27-Sep-17	Monthly	Trickle	**7.3**	275	3	**5**	141	**6**	47	40	4	6	52	9	6	0.06	0.101	<0.005	0.47	<1	40	<2	29
27-Oct-17	Monthly	Trickle	7.3	245	4	**22**	125	<5	47	37	7	4	46	9	6	0.11	0.358	<0.005	0.46	<1	37	<2	27
27-Nov-17	Monthly	Trickle	7.3	272	2	**44**	139	**<5**	61	46	3	2	46	13	7	**0.07**	0.400	<0.005	0.93	<1	46	<2	27
27-Dec-17	Monthly	Nil flow																					
31-Jan-18	Monthly	No flow																					
26-Feb-18	Monthly	No flow																					
6-Mar-18	Discharge Event	mod flow	7.7	181	17	**86**	116	11	34	23	5	5	33	7	4	0.48	0.027	<0.005	0.85	<1	23	<2	20
26-Apr-18	Monthly	Steady flow, clear	7.6	195	2	**83**	125	<5	36	28	3	8	47	8	4	0.1	0.026	<0.005	0.47	<1	28	<2	23
29-May-18	Monthly	Steady flow, clear	7.2	201	1	**86**	129	<5	43	27	4	7	47	9	5	0.07	0.010	<0.005	0.86	<1	27	<2	26
19-Jun-18	Discharge Event	runoff from road works	**7.7**	141	**1364**	**91**	90	**1070**	31	37	5	3	24	6	4	**20.3**	0.331	0.057	22.70	<1	37	<2	22
Min			7.2	141	1	5	90	<5	31	23	<1	2	24	6	4	0.06	0.010	<0.005	0.46		23	<2	20
Avg			7.5	215	155	56	120	362	43	32	4	6	45	9	5	2.39	0.142		3.09		32		25
Max			7.7	275	1364	91	141	1070	61	46	7	8	62	13	7	20.30	0.400	0.057	22.70		46	5	29
Var			0.0	1903	205422	1277	272	####	82	60	2	5	117	4	1	45.15	0.029		54.10		60		8
SD			0.2	44	453	36	16	613	9	8	1	2	11	2	1	6.72	0.169		7.36		8		3
*Water Quality Trigger			7.1 - 7.6	370	24	85 - 110%		15								1.24		0.011					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project.

Site 15 - Mammy Johnsons - Tereel

Date	As	Ba	Cd	Cr	Cu	Pb	Mo	Ni	Se	Ag	U	B	Hg	F	NH3 (as N)	NO2 (as N)	NO3 (as N)	N	P
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	<0.001	0.030	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	<0.01	0.4	<0.01
30-Aug-18	<0.001	0.028	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.02	0.2	<0.01
28-Sep-18	<0.001	0.034	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.12	0.3	<0.01
18-Oct-18	<0.001	0.027	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	0.04	0.5	0.02
29-Nov-18	<0.001	0.038	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	<0.01	0.5	0.02
15-Dec-18	0.001	0.047	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	**<0.01**	<0.01	0.03	**0.6**	0.03
30-Jan-19																			
28-Feb-19																			
17-Mar-19																			
30-Apr-19	0.001	0.040	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.05	<0.01	0.04	0.3	0.02
30-May-19	0.002	0.058	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.1	<0.01	0.02	0.4	0.04
26-Jun-19	<0.001	0.024	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.03	**0.3**	0.02
Min	0.001	0.020	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.01	0.010	0.01	0.2	0.01
Avg	0.001	0.040	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.03	0.010	0.04	0.4	0.02
Max	0.002	0.060	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.10	0.010	0.12	0.6	0.04
Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.00	0.000	0.00	0.0	0.00
SD	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.03	0.000	0.03	0.1	0.01
*Water Quality Trigger				0.001	0.0020										0.06			0.8	0.15

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project.

Site 19 - Karuah River (Washpool Turnoff)

Date	Category	Comment	ph	EC	Turbidity	DO	TDS	TSS	Hardness	Alkalinity (as $CaCO_3$)	Acidity (as $CaCO_3$)	SO4	Cl	Ca	Mg	Al	Mn	Zn	Fe	CO3 (as $CaCO_3$)	Bicarb (as $CaCO_3$)	BOD	Na
				uS/cm	NTU	%	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	Monthly	Med/low flow, clear	7.8	208	3	**11**	133	<5	55	48	4	7	37	12	6	0.14	0.010	<0.005	0.41	<1	48	<2	24
30-Aug-18	Monthly	Steady flow, clear	**8.14**	208	**1**	**95**	133	**<5**	52	52	<1	5	38	11	6	**0.04**	0.011	**<0.005**	0.19	<1	52	<2	22
28-Sep-18	Monthly	Fast flow, NR	**7.73**	**218**	**1**	**102**	140	**5**	52	48	2	5	35	11	6	**0.04**	0.013	**<0.005**	0.19	<1	48	<2	22
18-Oct-18	Discharge Event	v, light brown, sligh	**7.6**	114	64	**94**	73	40	25	27	6	<5	23	5	3	0.61	0.029	0.009	0.82	<1	27	3	15
29-Nov-18	Monthly	Steady flow, clear	**7.88**	187	**2**	**75**	120	**<5**	43	45	2	2	24	9	5	**0.10**	0.036	<0.005	0.53	<1	45	<2	17
15-Dec-18	Discharge Event	Fast slow, clear	**7.22**	172	**13**	**7**	110	**20**	43	44	3	<1	24	9	5	**0.61**	0.124	<0.005	1.20	<1	44	<2	17
30-Jan-19	Monthly	Slow flow, clear	**7.31**	216	**3**	**67**	138	**<5**	55	61	2	<1	30	12	6	**0.03**	0.115	<0.005	0.57	<1	61	2	20
28-Feb-19	Monthly	w, clear, light brown	**7.29**	254	4	**72**	163	6	64	70	2	1	36	14	7	0.05	0.107	**<0.005**	0.41	<1	70	2	25
17-Mar-19	Discharge Event	w, clear, light brown	**7.48**	238	3	83	152	<5	61	71	2	<1	35	13	7	0.04	0.042	<0.005	0.43	<1	71	<2	23
30-Apr-19	Monthly	Fast flow,clear	7.34	240	2	84	153	<5	52	43	2	7	33	11	6	0.08	0.028	<0.005	0.44	<1	43	<2	22
30-May-19	Monthly	Steady flow, clear	**7.5**	223	3	85	142	<5	50	45	2	6	31	10	6	0.05	0.018	<0.005	0.23	<1	45	<2	20
26-Jun-19	Monthly	Steady flow, clear	**7.55**	230	**2**	**92**	147	**<5**	56	46	1	7	39	11	7	**0.03**	0.016	**<0.005**	0.30	<1	46	2	25
Min			7.2	114	1	7	73	5	25	27	1	1	23	5	3	0.03	0.010	0.005	0.19	1	27	2	15
Avg			7.6	209	8	72	134	9	51	50	2	4	32	11	6	0.15	0.050	0.005	0.48	1	50	2	21
Max			8.1	254	64	102	163	40	64	71	6	7	39	14	7	0.61	0.120	0.009	1.20	1	71	3	25
Var			0.1	1407	316	975	573	112	103	150	2	7	33	5	1	0.05	0.000	0.000	0.08	0	150	0	11
SD			0.3	38	18	31	24	11	10	12	1	3	6	2	1	0.22	0.040	0.001	0.29	0	12	0	3
*Water Quality Trigger			7.1 - 7.6	370	24	85 - 110%		15								1.24		0.011					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
"Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".

Site 19 - Karuah River (Washpool Turnoff)

Date	As	Ba	Cd	Cr	Cu	Pb	Mo	Ni	Se	Ag	U	B	Hg	F	NH3 (as N)	NO2 (as N)	NO3 (as N)	N	P
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
31-Jul-18	<0.001	0.020	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.01	<0.01	0.02	0.4	<0.01
30-Aug-18	<0.001	0.018	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	0.1	0.03	<0.01	<0.01	**0.4**	**0.02**
28-Sep-18	<0.001	0.019	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.02	**0.3**	**0.02**
18-Oct-18	<0.001	0.027	<0.0001	<0.001	0.002	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.14	1	0.13
29-Nov-18	<0.001	0.021	<0.0001	<0.001	0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.02	<0.01	0.03	0.4	0.03
15-Dec-19	0.001	0.028	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	0.04	<0.01	0.20	**0.8**	0.09
30-Jan-19	0.001	0.024	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	0.1	0.05	<0.01	0.03	0.5	0.07
28-Feb-19	0.001	0.032	<0.0001	<0.001	0.013	<0.001	<0.001	0.003	<0.01	<0.001	<0.001	<0.05	<0.0001	0.1	0.02	<0.01	0.03	0.7	0.04
17-Mar-19	<0.001	0.025	<0.0001	<0.001	<0.001	<0.001	<0.001	0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	0.1	0.03	<0.01	0.10	0.4	0.04
30-Apr-19	<0.001	0.020	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.18	0.4	0.03
30-May-19	<0.001	0.018	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	<0.01	0.4	0.03
26-Jun-19	<0.001	0.021	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.05	<0.0001	<0.1	<0.01	<0.01	0.48	**0.7**	**0.02**
Min	0.001	0.020	0.000	0.001	0.001	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.01	0.010	0.01	0.3	0.01
Avg	0.001	0.020	0.000	0.001	0.002	0.001	0.001	0.001	0.010	0.001	0.001	0.050	0.000	0.1	0.02	0.010	0.10	0.5	0.04
Max	0.001	0.030	0.000	0.001	0.013	0.001	0.001	0.003	0.010	0.001	0.001	0.050	0.000	0.1	0.05	0.010	0.48	1.0	0.13
Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0	0.00	0.000	0.02	0.0	0.00
SD	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.0	0.01	0.000	0.14	0.2	0.04
*Water Quality Trigger				0.001	0.0020										0.06			0.8	0.15

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). "Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".**

SW3 - Main Water Dam (Major) EPL11701 Point 3

Date	Category	Storage RL	pH	EC uS/cm	Turbidity NTU	TDS mg/l	TSS mg/l	Hardness mg/l	Alkalinity (as $CaCO_3$)	Acidity (as $CaCO_3$)	SO4 mg/l	Cl mg/l	Ca mg/l	Mg mg/l	Al mg/l	Mn mg/l	Zn mg/l	Fe mg/l	CO3 (as $CaCO_3$) mg/l	Bicarb (as $CaCO_3$) mg/l	BOD mg/l	Na mg/l
5-Jul-18	Weekly	RL 71.00	7.8	2690	2.9																	
12-Jul-18	Weekly	RL 71.02	7.7	2570	1.7																	
17-Jul-18	Weekly	RL 71.03	7.6	2590	0.9																	
24-Jul-18	Weekly	RL 71.03	8.0	2800	0.6																	
31-Jul-18	Monthly	RL 71.014	8.3	2810	0.9	1798	7	1020	166	4	1160	245	207	123	0.03	0.14	<0.005	0.08	<1	166	<2	332
10-Aug-18	Weekly	RL 71.022	8.0	2780	3.2																	
15-Aug-18	Weekly	RL 71.014	8.1	2760	2.9																	
22-Aug-18	Weekly	RL 70.976	7.6	2660	1.3																	
30-Aug-18	Monthly	RL 71.010	8.3	2630	1.5	1683	8	862	143	<1	800	250	167	108	0.02	0.11	<0.005	<0.05	3	140	<2	283
5-Sep-18	Weekly	RL 76.060	8.1	2600	1.6																	
14-Sep-18	Weekly	RL 70.998	8.2	2640	1.7																	
19-Sep-18	Weekly	RL 70.996	8.6	2740	4.0																	
28-Sep-18	Monthly	RL 71.036	8.3	2790	4.5	1786	16	978	131	<1	1060	258	187	124	0.05	0.19	<0.005	0.12	<1	131	<2	326
3-Oct-18	Weekly	RL 71.011	8.2	2680	1.5																	
8-Oct-18	Weekly	RL 71.096	8.2	2770	3.0																	
17-Oct-18	Weekly	RL 71.005	8.2	2630	2.6																	
18-Oct-18	Discharge Event	RL 71.011	8.3	2550	4.0	1632	12	888	154	3	1110	259	171	112	0.09	0.18	<0.005	0.15	<1	154	<2	289
22-Oct-18	Weekly	RL 71.071	8.2	2500	1.5																	
30-Oct-18	Weekly	RL 70.991	8.3	2650	1.2																	
7-Nov-18	Weekly	RL 70.998	8.4	2885	1.7																	
14-Nov-18	Weekly	RL 70.979	8.5	2910	1.6																	
19-Nov-18	Weekly	RL 71.004	8.3	2660	2																	
29-Nov-18	Monthly	RL 71.011	8.2	2570	1	1645	<5	950	138	1	959	259	171	127	0.01	0.22	<0.005	0.05	<1	138	<2	352
4-Dec-18	Weekly	RL 70.996	8.5	2840	1																	
14-Dec-18	Weekly	RL 71.010	8.5	2776	1																	
15-Dec-18	Discharge Event		8.4	2700	2	1728	<5	840	110	<1	905	244	150	113	0.02	0.08	<0.005	<0.05	<1	110	<2	303
20-Dec-18	Weekly	RL 71.029	8.5	2582	1																	
3-Jan-19	Weekly	RL 71.022	8.4	2724	1																	
10-Jan-19	Weekly	RL 71.001	8.5	2850	1																	
17-Jan-19	Weekly	RL 70.099	8.5	2860	1																	
24-Jan-19	Weekly	RL 70.996	8.4	2880	2																	
30-Jan-19	Monthly	RL 70.975	8.4	2600	2	1664	<5	947	116	3	1040	263	165	130	<0.01	0.05	<0.005	<0.05	<1	116	2	315
6-Feb-19	Weekly	RL 70.962	8.5	2920	2																	
14-Feb-19	Weekly	RL 70.956	8.7	2680	1																	
21-Feb-19	Weekly	RL 70.926	8.5	3000	2																	
28-Feb-19	Monthly	RL 70.915	8.6	2830	2	1811	42	914	107	<1	978	289	160	125	<0.01	0.04	<0.005	<0.05	<1	107	<2	315
7-Mar-19	Weekly	RL 70.937	8.3	3010	1																	
14-Mar-19	Weekly	RL 70.937	8.9	3470	3																	
17-Mar-19	Discharge Event	RL 71.021	8.1	3070	1	1965	11	966	128	3	1400	278	169	132	0.01	0.05	<0.005	<0.05	<1	128	<2	320
28-Mar-19	Weekly	RL 71.060	8.2	2960	1																	
4-Apr-19	Weekly	Locked,	8.2	2960	1																	
10-Apr-19	Weekly	RL 70.989	8.0	2950	1																	
18-Apr-19	Weekly	RL 70.993	8.1	3280	1																	
24-Apr-19	Weekly	Locked,	8.4	2780	2																	
30-Apr-19	Monthly	RL 71.014	8.2	2860	3	1830	<5	932	117	2	1150	251	162	128	0.02	0.24	<0.005	<0.05	<1	117	<2	306
9-May-19	Weekly	RL 71.042	8.2	3380	2																	
16-May-19	Weekly	RL 70.977	8.1	3380	1																	
22-May-19	Weekly	RL 71.011	8.3	3380	1																	
30-May-19	Monthly	RL 70.993	8.2	3400	1	2176	<5	962	126	4	952	277	166	133	<0.01	0.34	<0.005	0.06	<1	126	<2	345
6-Jun-19	Weekly	RL 70.982	8.2	3320	1																	
13-Jun-19	Weekly	RL 71.052	8.1	3330	0																	
20-Jun-19	Weekly	RL 71.007	8.2	3270	1																	
26-Jun-19	Monthly	RL 71.085	8.2	3010	1	1926	5	951	135	<1	1060	269	160	134	<0.01	0.15	<0.005	<0.05	<1	135	2	312
Min			7.6	2500	0	1632	5	840	107	1	800	244	150	108	0.01	0.04	0.010	0.05	1	107	2	283
Avg			8.3	2866	2	1804	11	934	131	2	1048	262	170	124	0.02	0.15	0.010	0.07	1	131	2	317
Max			8.9	3470	5	2176	42	1020	166	4	1400	289	207	134	0.09	0.34	0.010	0.15	3	166	2	352
Var			0.1	68343	1	25014	111	2581	312	2	23185	197	216	75	0.00	0.01	0.000	0.00	0	306	0	419
SD			0.3	261	1	158	11	51	18	1	152	14	15	9	0.02	0.09	0.000	0.03	1	18	0	20
*Water Quality Trigger			N/A	N/A	N/A	N/A	N/A								N/A		N/A					

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project.

SW3 - Main Water Dam (Major)

Date	As mg/l	Ba mg/l	Cd mg/l	Cr mg/l	Cu mg/l	Pb mg/l	Mo mg/l	Ni mg/l	Se mg/l	Ag mg/l	U mg/l	B mg/l	Hg mg/l	F mg/l	NH3 (as N) mg/l	NO2 (as N) mg/l	NO3 (as N) mg/l	N mg/l	P mg/l
31-Jul-18	<0.001	0.032	<0.0001	<0.001	<0.001	<0.001	0.003	0.005	<0.01	<0.001	<0.001	<0.05	<0.0001	0.3	0.05	<0.01	0.16	0.6	<0.01
30-Aug-18	<0.001	0.028	<0.0001	<0.001	<0.001	<0.001	0.003	0.004	<0.01	<0.001	<0.001	<0.05	<0.0001	0.3	0.03	<0.01	0.06	0.7	<0.01
28-Sep-18	<0.001	0.029	<0.0001	<0.001	<0.001	<0.001	0.003	0.004	<0.01	<0.001	<0.001	<0.05	<0.0001	0.2	0.02	<0.01	0.02	0.3	<0.01
18-Oct-18	<0.001	0.031	<0.0001	<0.001	<0.001	<0.001	0.003	0.005	<0.01	<0.001	<0.001	<0.05	<0.0001	0.3	0.02	<0.01	0.03	0.2	<0.01
29-Nov-18	<0.001	0.027	<0.0001	<0.001	<0.001	<0.001	0.003	0.004	<0.01	<0.001	<0.001	<0.05	<0.0001	0.3	<0.01	<0.01	<0.01	0.3	<0.01
15-Dec-18	<0.001	0.026	<0.0001	<0.001	<0.001	<0.001	0.003	0.003	<0.01	<0.001	<0.001	<0.05	<0.0001	0.3	<0.01	<0.01	0.03	0.2	<0.01
30-Jan-19	<0.001	0.03	<0.0001	<0.001	<0.001	<0.001	0.003	0.002	<0.01	<0.001	<0.001	0.05	<0.0001	0.3	<0.01	<0.01	0.02	0.3	<0.01
28-Feb-19	<0.001	0.033	<0.0001	<0.001	<0.001	<0.001	0.003	0.002	<0.01	<0.001	<0.001	<0.05	<0.0001	0.3	0.03	<0.01	0.03	0.3	<0.01
17-Mar-19	<0.001	0.034	<0.0001	<0.001	<0.001	<0.001	0.003	0.003	<0.01	<0.001	<0.001	<0.05	<0.0001	0.3	0.06	<0.01	0.02	0.2	<0.01
30-Apr-19	<0.001	0.034	<0.0001	<0.001	<0.001	<0.001	0.003	0.003	<0.01	<0.001	<0.001	<0.05	<0.0001	0.2	<0.01	<0.01	0.04	0.3	0.05
30-May-19	<0.001	0.033	<0.0001	<0.001	<0.001	<0.001	0.002	0.003	<0.01	<0.001	<0.001	<0.05	<0.0001	0.2	0.1	<0.01	0.02	0.5	0.02
26-Jun-19	<0.001	0.033	<0.0001	<0.001	<0.001	<0.001	0.003	0.004	<0.01	<0.001	<0.001	<0.05	<0.0001	0.3	0.03	<0.01	0.04	0.3	0.01
Min	0.001	0.030	0.000	0.001	0.001	0.001	0.002	0.002	0.01	0.00	0.001	0.05	0.00	0.2	0.01	0.01	0.01	0.2	0.01
Avg	0.001	0.030	0.000	0.001	0.001	0.001	0.003	0.004	0.01	0.00	0.001	0.05	0.00	0.3	0.03	0.01	0.04	0.4	0.01
Max	0.001	0.030	0.000	0.001	0.001	0.001	0.003	0.005	0.01	0.00	0.001	0.05	0.00	0.3	0.10	0.01	0.16	0.7	0.05
Var	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00	0.00	0.000	0.00	0.00	0.0	0.00	0.00	0.00	0.0	0.00
SD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.00	0.00	0.000	0.00	0.00	0.0	0.03	0.00	0.04	0.2	0.01

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000).**
Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project.

Site - Northern Arm of MWD Diversion Drain

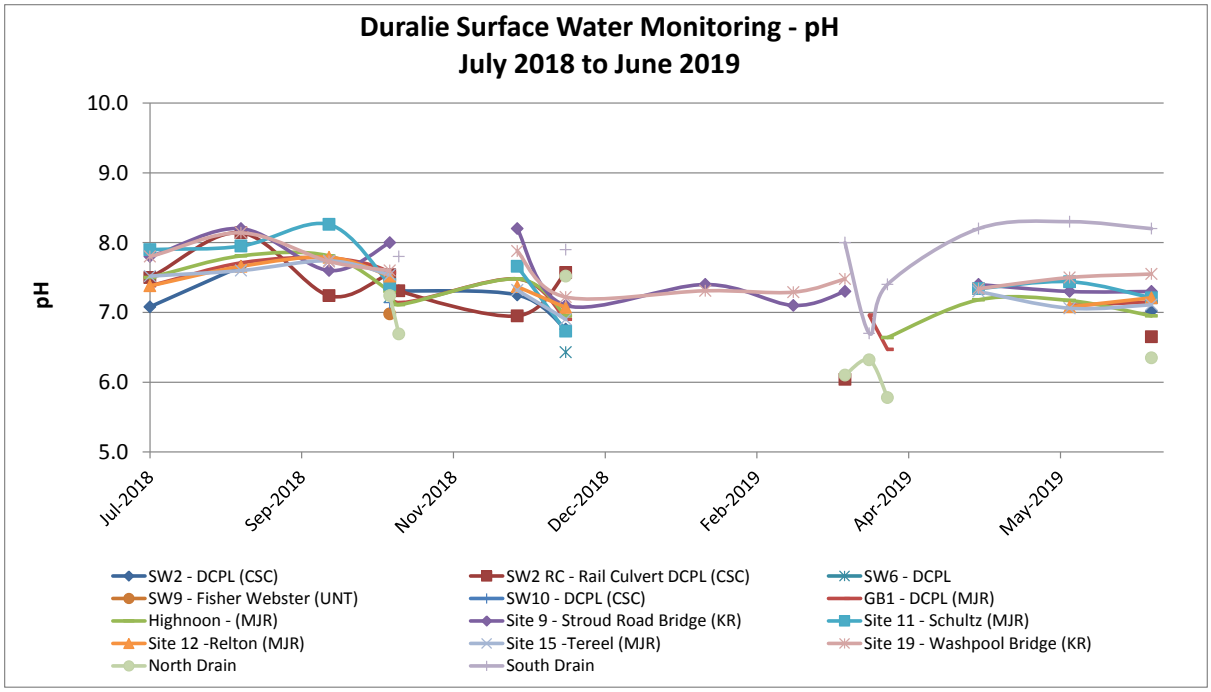
Date	Category	Comment	ph	EC uS/cm	Turbidity NTU	TSS mg/l
31-Jul-18	Monthly	Dry				
30-Aug-18	Monthly	Dry				
28-Sep-18	Monthly	No Flow				
18-Oct-18	Discharge Event	Steady flow, light brown	**7.2**	372	75.1	13
21-Oct-18	Discharge	Steady flow, turbid, light brown. 7cm above invert of V.	**6.7**	258	100	31
29-Nov-18	Monthly	No Flow				
15-Dec-18	Discharge Event	Slow flow, brown	**7.5**	196	227	96
30-Jan-19	Monthly	No flow				
28-Feb-19	Monthly	No flow				
17-Mar-19	Discharge Event	Not flowing into drain or over 'V' notch	6.1	112.5	375	168
25-Mar-19	Discharge	Steady flow, brown and slightly turbid	**6.3**	**141.2**	415	164
31-Mar-19	Discharge	Trickle, light brown. From drain	5.8	**365**	19.2	16
30-Apr-19	Monthly	No flow				
30-May-19	Monthly	No flow				
26-Jun-19	Monthly	Trickle, Orange in colour	6.4	250	67.8	21
Min			5.8	113	19	13
Avg			6.6	242	183	48
Max			7.5	372	415	168
Var			0.4	10233	25209	3233
SD			0.6	101	159	57
*Water Quality Trigger			7.1 - 7.9	544	119	80

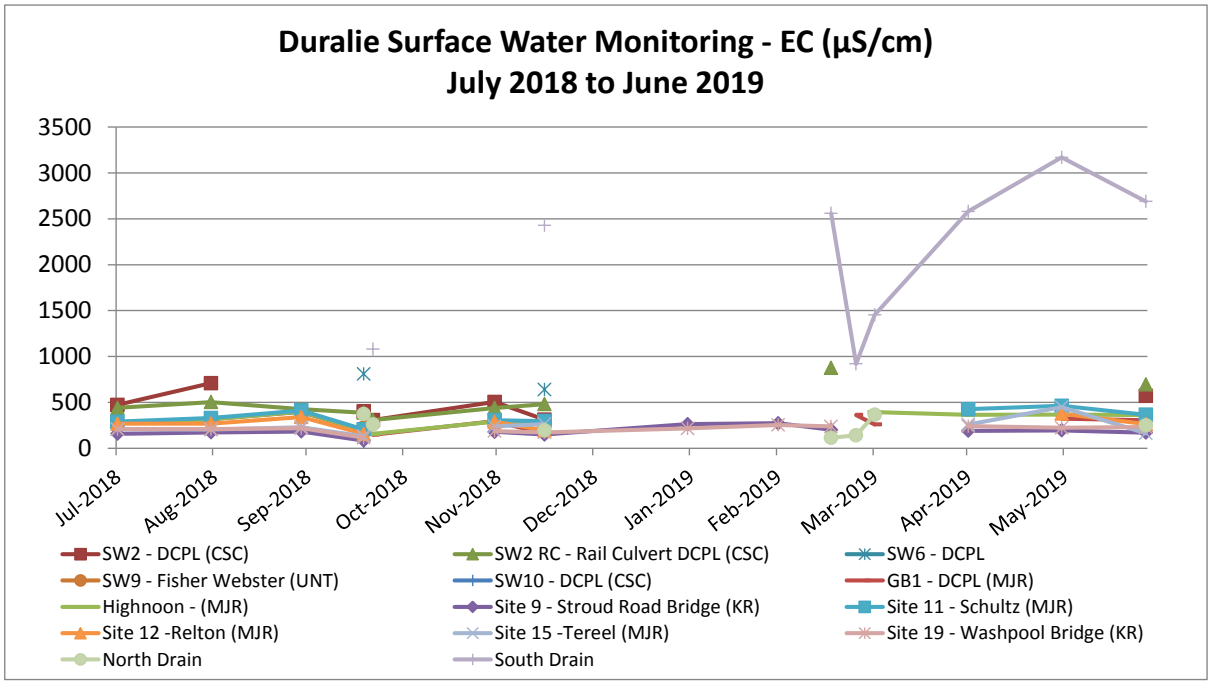
***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). "Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project".**

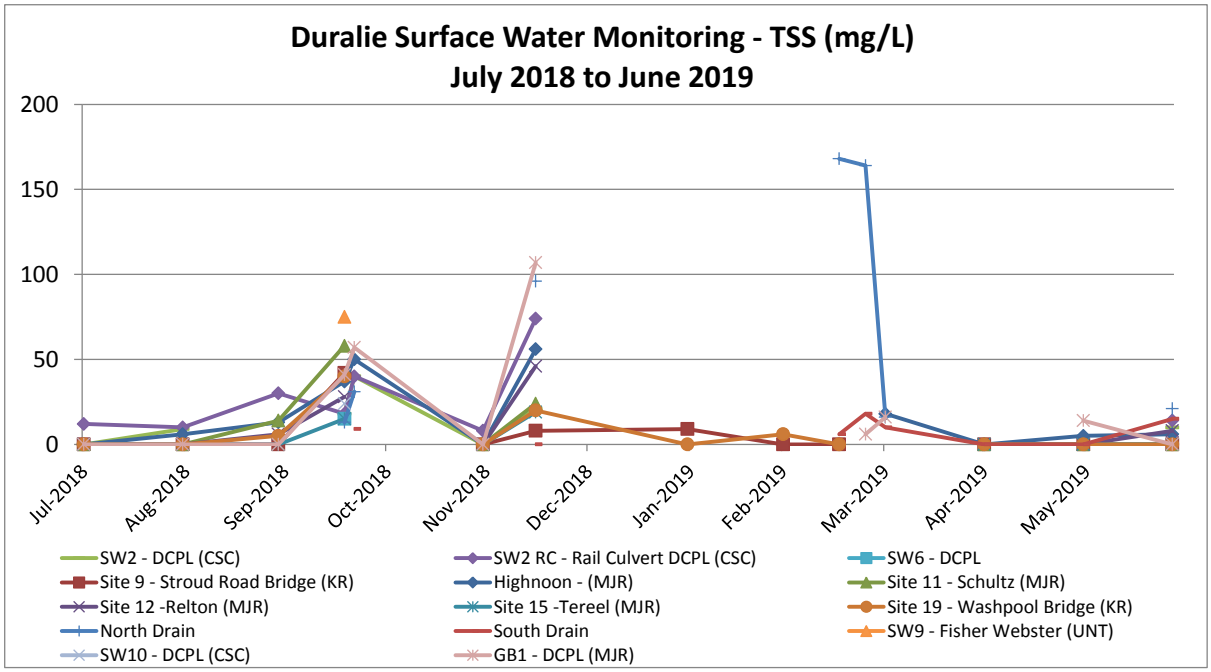
Site - Southern Arm of MWD Diversion Drain

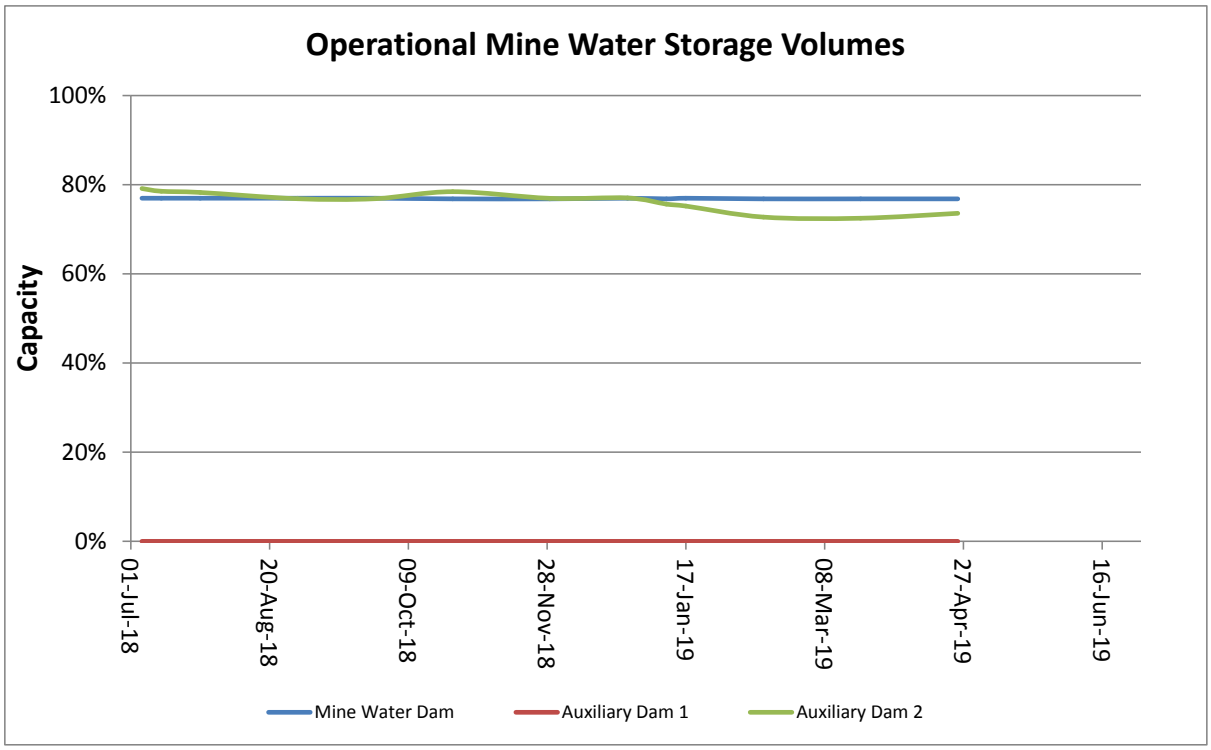
Date	Category	Comment	ph	EC uS/cm	Turbidity NTU	TSS mg/l
31-Jul-18	Monthly	Flowing into Dam not over spillway				
30-Aug-18	Monthly	No Flow				
28-Sep-18	Monthly	No Flow				
18-Oct-18	Discharge Event	No flow				
21-Oct-18	Discharge	No flow at time of sampling. Flow to dam - Sample requested by M. Plain	7.8	**1080**	17.4	9
29-Nov-18	Monthly	No Flow				
15-Dec-18	Discharge Event	Steady flow, clear. Flow was diverted to MWD	**7.9**	**2430**	4.63	<5
30-Jan-19	Monthly	No flow				
28-Feb-19	Monthly	No flow				
17-Mar-19	Discharge Event	Steady flow, clear and light brown in colour. Flow diverted to MWD	**8.0**	2560	4.85	6
25-Mar-19	Discharge	No flow at time of sample- sampled as advised by T.Kirkwood. Sampled from behind the V notch. Light brown	6.7	919	**47.6**	18
31-Mar-19	Discharge	Steady/Fast flow and light brown in colour. Sampled from drain. Flow diverted to MWD	7.4	1453	10.82	10
30-Apr-19	Monthly	Slow, clear. Sampled from Drain. Flow diverted to MWD.	8.2	**2580**	1.27	<5
30-May-19	Monthly	Slow, clear. Sampled from Drain. Flow diverted to MWD.	8.3	**3170**	0.66	<5
26-Jun-19	Monthly	Slow, clear. Sampled from Drain. Flow diverted to MWD.	8.2	**2690**	1.15	15
Min			6.7	919	1	6
Avg			7.8	2110	11	14
Max			8.3	3170	48	18
Var			0.3	699547	251	309
SD			0.5	836	16	18
*Water Quality Trigger			7.1 - 7.9	544	119	80

***Water quality triggers for the Duralie Coal Mine developed in accordance with the methodology in ANZECC/ARMCANZ (2000). Gilberts & Asscocistes 2011 - Development of Water Quality Trigger Levels for the Duralie Extension Project.**


Duralie Surface Water Monitoring - pH
July 2018 to June 2019
pH
10.0
9.0
8.0
7.0
6.0
5.0
Jul-2018
Sep-2018
Nov-2018
Dec-2018
Feb-2019
Apr-2019
May-2019
SW2 - DCPL (CSC)
SW2 RC - Rail Culvert DCPL (CSC)
SW6 - DCPL
SW9 - Fisher Webster (UNT)
SW10 - DCPL (CSC)
GB1 - DCPL (MJR)
Highnoon - (MJR)
Site 9 - Stroud Road Bridge (KR)
Site 11 - Schultz (MJR)
Site 12 -Relton (MJR)
Site 15 -Tereel (MJR)
Site 19 - Washpool Bridge (KR)
North Drain
South Drain


Duralie Surface Water Monitoring - EC (µS/cm)
July 2018 to June 2019
3500
3000
2500
2000
1500
1000
500
0
Jul-2018
Aug-2018
Sep-2018
Oct-2018
Nov-2018
Dec-2018
Jan-2019
Feb-2019
Mar-2019
Apr-2019
May-2019
SW2 - DCPL (CSC)
SW2 RC - Rail Culvert DCPL (CSC)
SW6 - DCPL
SW9 - Fisher Webster (UNT)
SW10 - DCPL (CSC)
GB1 - DCPL (MJR)
Highnoon - (MJR)
Site 9 - Stroud Road Bridge (KR)
Site 11 - Schultz (MJR)
Site 12 -Relton (MJR)
Site 15 -Tereel (MJR)
Site 19 - Washpool Bridge (KR)
North Drain
South Drain


Duralie Surface Water Monitoring - TSS (mg/L)
July 2018 to June 2019
200
150
100
50
0
Jul-2018
Aug-2018
Sep-2018
Oct-2018
Nov-2018
Dec-2018
Jan-2019
Feb-2019
Mar-2019
Apr-2019
May-2019
SW2 - DCPL (CSC)
SW2 RC - Rail Culvert DCPL (CSC)
SW6 - DCPL
Site 9 - Stroud Road Bridge (KR)
Highnoon - (MJR)
Site 11 - Schultz (MJR)
Site 12 -Relton (MJR)
Site 15 -Tereel (MJR)
Site 19 - Washpool Bridge (KR)
North Drain
South Drain
SW9 - Fisher Webster (UNT)
SW10 - DCPL (CSC)
GB1 - DCPL (MJR)


Operational Mine Water Storage Volumes
Capacity
100%
80%
60%
40%
20%
0%
01-Jul-18
20-Aug-18
09-Oct-18
28-Nov-18
17-Jan-19
08-Mar-19
27-Apr-19
16-Jun-19
Mine Water Dam
Auxiliary Dam 1
Auxiliary Dam 2

Groundwater

DB1W

Parameter	Units	17-Aug-18	21-Nov-18	13-Feb-19	23-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	15.90	15.85	16.17	16.07	15.9	16.00	16.17	0.02	0.15
pH		5.8	5.9	6.1	6.0	5.8	6.0	6.1	0.02	0.15
Conductivity @ 25^{0}C	(µS/cm)	3960	3890	3960	4980	3890	4198	4980	273225	523
ORP	(mV)	133	235	99	175	99	161	235	3433	59
Dissolved Oxygen	(%)	29	27	23	27	23	26	29	8	3
TDS	(mg/L)	2770	2700	3120	3190	2700	2945	3190	60433	246
Alkalinity as CaCO3	(mg/L)	132	88	120	105	88	111	132	362	19
Acidity as CaCO3	(mg/L)	89	117	130	91	89	107	130	403	20
Sulphate	(mg/L)	385	345	387	384	345	375	387	408	20
Chloride	(mg/L)	1110	1170	1160	1240	1110	1170	1240	2867	54
Calcium	(mg/L)	235	214	265	286	214	250	286	1014	32
Magnesium	(mg/L)	55	57	64	68	55	61	68	37	6
Sodium	(mg/L)	435	517	500	595	435	512	595	4329	66
Aluminium	(mg/L)	1.44	4.91	5.00	1.16	1.16	3.13	5.00	4.47	2.11
Manganese	(mg/L)	0.9	0.9	1.0	1.1	0.9	0.9	1.1	0.01	0.10
Zinc	(mg/L)	0.09	0.21	0.19	0.09	0.09	0.15	0.21	0.00	0.06
Iron	(mg/L)	25.0	31.0	35.9	39.1	25.0	32.8	39.1	37.79	6.15

DB2W

Parameter	Units	17-Aug-18	21-Nov-18	13-Feb-19	23-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	13.60	13.61	13.80	13.93	13.60	13.74	13.93	0.03	0.16
pH		6.09	6.29	6.37	6.21	6.1	6.2	6.4	0.01	0.12
Conductivity @ 25^{0}C	(µS/cm)	1442	1542	1453	1606	1442	1511	1606	6037	78
ORP	(mV)	28	112	66	73	28	70	112	1184	34
Dissolved Oxygen	(%)	27	24	24	29	24	26	29	5.51	2.35
TDS	(mg/L)	902	948	1030	983	902	966	1030	2935	54
Alkalinity as CaCO3	(mg/L)	179	182	174	150	150	171	182	212	15
Acidity as CaCO3	(mg/L)	61	78	84	39	39	66	84	407	20
Sulphate	(mg/L)	203	192	188	162	162	186	203	302	17
Chloride	(mg/L)	289	276	296	330	276	298	330	531	23
Calcium	(mg/L)	96	100	102	102	96	100	102	8	3
Magnesium	(mg/L)	23	25	23	25	23	24	25	1.33	1.15
Sodium	(mg/L)	139	175	152	181	139	162	181	386	20
Aluminium	(mg/L)	<0.01	0.01	<0.01	0.01	0.01	0.01	0.01	0.00	0.00
Manganese	(mg/L)	0.79	0.79	0.83	0.83	0.79	0.81	0.83	0.00	0.02
Zinc	(mg/L)	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.00	0.00
Iron	(mg/L)	11.8	12.2	13.2	14.5	11.8	12.9	14.5	1.45	1.20

DB3W

Parameter	Units	17-Aug-18	21-Nov-18	13-Feb-19	23-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	3.52	3.42	3.68	3.91	3.42	3.63	3.91	0.05	0.21
pH		6.5	6.2	6.5	6.1	6.1	6.3	6.5	0.04	0.19
Conductivity @ 25^{0}C	(µS/cm)	103	123	140	122	103	122	140	229	15
ORP	(mV)	86	151	181	179	86	149	181	1966	44
Dissolved Oxygen	(%)	63	39	72	30	30	51	72	392	20
TDS	(mg/L)	208	386	538	162	162	324	538	29780	173
Alkalinity as CaCO3	(mg/L)	38	34	35	34	34	35	38	4	2
Acidity as CaCO3	(mg/L)	17	17	12	7	7	13	17	23	5
Sulphate	(mg/L)	4	3	6	4	3	4	6	2	1
Chloride	(mg/L)	13	12	23	12	12	15	23	29	5
Calcium	(mg/L)	2	2	2	2	2	2	2	0	0
Magnesium	(mg/L)	1	2	2	1	1	1	1	0	0
Sodium	(mg/L)	18	22	25	18	18	21	25	12	3
Aluminium	(mg/L)	12	10	108	3	3	33	108	2511	50
Manganese	(mg/L)	0.10	0.12	0.72	0.04	0.04	0.25	0.72	0.10	0.32
Zinc	(mg/L)	0.04	0.07	0.41	0.01	0.01	0.13	0.41	0.03	0.19
Iron	(mg/L)	10.8	23.7	161.0	3.4	3.4	49.7	161.0	5573.53	74.66

DB4W

Parameter	Units	16-Aug-18	21-Nov-18	13-Feb-19	21-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	6.36	6.47	6.54	6.63	6.36	6.50	6.63	0.01	0.11
pH		6.9	6.9	6.9	6.7	6.7	6.8	6.9	0.01	0.11
Conductivity @ 25^{0}C	(µS/cm)	3360	3700	3500	4050	3360	3653	4050	89692	299
ORP	(mV)	-196	-199	-176	-195	-199	-192	-176	110	10
Dissolved Oxygen	(%)	16	12	16	13	12	14	16	4	2
TDS	(mg/L)	2150	2290	2460	2170	2150	2268	2460	20292	142
Alkalinity as CaCO3	(mg/L)	363	300	304	231	231	300	363	2915	54
Acidity as CaCO3	(mg/L)	20	32	38	18	18	27	38	92	10
Sulphate	(mg/L)	46	57	53	82	46	60	82	246	16
Chloride	(mg/L)	1000	892	1060	1010	892	991	1060	5001	71
Calcium	(mg/L)	128	142	145	150	128	141	150	89	9
Magnesium	(mg/L)	49	58	60	63	49	58	63	36	6
Sodium	(mg/L)	425	580	495	587	425	522	587	5909	77
Aluminium	(mg/L)	0.23	0.02	0.03	0.01	0.01	0.07	0.23		
Manganese	(mg/L)	1.1	1.1	1.2	1.2	1.1	1.1	1.2	0.00	0.05
Zinc	(mg/L)	0.04	<0.005	<0.005	<0.005	0.04	0.04	0.04		
Iron	(mg/L)	29.4	0.3	0.5	0.3	0.3	7.6	29.4	210.84	14.52

DB5W

Parameter	Units	16-Aug-18	21-Nov-18	13-Feb-19	23-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	11.74	11.75	12.13	12.22	11.74	11.96	12.22	0.06	0.25
pH		5.9	5.8	5.8	5.6	5.6	5.8	5.9	0.02	0.12
Conductivity @ 25^{0}C	(µS/cm)	2220	2310	2310	2493	2220	2333	2493	13142	115
ORP	(mV)	26	11	28	55	11	30	55	335	18
Dissolved Oxygen	(%)	29	19	25	19	19	23	29	27	5
TDS	(mg/L)	1390	1430	1630	1390	1390	1460	1630	13200	115
Alkalinity as CaCO3	(mg/L)	63	42	48	42	42	49	63	98	10
Acidity as CaCO3	(mg/L)	120	141	162	106	106	132	162	600	25
Sulphate	(mg/L)	209	188	235	198	188	208	235	410	20
Chloride	(mg/L)	631	572	645	628	572	619	645	1037	32
Calcium	(mg/L)	30	31	34	31	30	32	34	3	2
Magnesium	(mg/L)	33	35	38	36	33	36	38	4	2
Sodium	(mg/L)	288	378	335	374	288	344	378	1758	42
Aluminium	(mg/L)	0.60	0.54	0.39	0.54	0.39	0.51	0.60	0.01	0.09
Manganese	(mg/L)	1.2	1.1	1.3	1.2	1.14	1.20	1.29	0.00	0.07
Zinc	(mg/L)	0.122	0.122	0.120	0.152	0.12	0.13	0.15	0.00	0.02
Iron	(mg/L)	45.4	44.8	54.7	53.9	44.8	49.7	54.7	28.38	5.33

DB6W

Parameter	Units	16-Aug-18	22-Nov-18	14-Feb-19	22-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	21.15	21.07	21.19	19.01	19.01	20.61	21.19	1.13	1.06
pH		6.7	6.7	6.8	6.6	6.6	6.7	6.8	0.01	0.07
Conductivity @ 25^{0}C	(µS/cm)	5530	5940	5180	6590	5180	5810	6590	366867	606
ORP	(mV)	57	85	119	15	15	69	119	1939	44
Dissolved Oxygen	(%)	34	29	24	23	23	28	34	23	5
TDS	(mg/L)	3690	3800	4260	4020	3690	3943	4260	63625	252
Alkalinity as CaCO3	(mg/L)	515	581	586	511	511	548	586	1664	41
Acidity as CaCO3	(mg/L)	66	108	108	55	55	84	108	772	28
Sulphate	(mg/L)	104	84	99	97	84	96	104	73	9
Chloride	(mg/L)	1550	1410	1590	1570	1410	1530	1590	6667	82
Calcium	(mg/L)	251	287	279	316	251	283	316	715	27
Magnesium	(mg/L)	167	193	187	200	167	187	200	202	14
Sodium	(mg/L)	512	664	605	685	512	617	685	6000	77
Aluminium	(mg/L)	0.8	0.37	0.82	0.11	0.11	0.53	0.82	0.12	0.35
Manganese	(mg/L)	0.305	0.330	0.336	0.335	0.305	0.327	0.336	0.000	0.015
Zinc	(mg/L)	0.013	0.019	0.015	0.015	0.013	0.016	0.019	0.000	0.003
Iron	(mg/L)	3.8	4.4	4.8	5.0	3.8	4.5	5.0	0.32	0.56

DB7W

Parameter	Units	17-Aug-18	23-Nov-18	13-Feb-19	23-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	10.50	10.64	10.94	11.15	10.50	10.81	11.15	0.09	0.29
pH		6.8	7.0	7.1	6.9	6.8	7.0	7.1	0.02	0.14
Conductivity @ 25^{0}C	(µS/cm)	2710	2920	2532	3080	2532	2811	3080	57428	240
ORP	(mV)	-75	-105	-140	-124	-140	-111	-75	781	28
Dissolved Oxygen	(%)	34	32	24	22	22	28	34	31	6
TDS	(mg/L)	1600	1700	1760	1550	1550	1653	1760	9025	95
Alkalinity as CaCO3	(mg/L)	382	376	384	325	325	367	384	786	28
Acidity as CaCO3	(mg/L)	22	28	38	16	16	26	38	88	9
Sulphate	(mg/L)	73	55	65	55	55	62	73	76	9
Chloride	(mg/L)	688	635	678	696	635	674	696	739	27
Calcium	(mg/L)	138	137	129	143	129	137	143	34	6
Magnesium	(mg/L)	53	54	52	54	52	53	54	1	1
Sodium	(mg/L)	346	414	351	407	346	380	414	1294	36
Aluminium	(mg/L)	0.7	0.3	0.1	0.1	0.1	0.3	0.7	0.09	0.30
Manganese	(mg/L)	0.623	0.650	0.635	0.639	0.623	0.637	0.650	0.000	0.01
Zinc	(mg/L)	0.013	<0.005	<0.005	<0.005	0.013	0.013	0.013		
Iron	(mg/L)	0.82	0.24	0.16	0.15	0.15	0.34	0.82	0.10	0.32

DB8W

Parameter	Units	15-Aug-18	22-Nov-18	14-Feb-19	22-May-19	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	19.68	19.54	19.43	19.31	19.49	19.68	0.02	0.16

DB9W

Parameter	Units	15-Aug-18	22-Nov-18	14-Feb-19	22-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	20.9	20.8	20.92	20.73	20.73	20.84	20.92	0.01	0.09
pH		7.07	7.28	7.26	7.3	7.1	7.2	7.3	0.01	0.11
Conductivity @ 25^{0}C	(µS/cm)	3160	3400	2990	3680	2990	3308	3680	89958	300
ORP	(mV)	142	156	145	11	11	114	156	4706	69
Dissolved Oxygen	(%)	18	21	28	22	18	22	28	15	4
TDS	(mg/L)	1880	1970	2060	1820	1820	1933	2060	11025	105
Alkalinity as CaCO3	(mg/L)	154	122	103	98	98	119	154	644	25
Acidity as CaCO3	(mg/L)	5	9	7	5	5	7	9	4	2
Sulphate	(mg/L)	251	232	257	247	232	247	257	114	11
Chloride	(mg/L)	873	805	872	887	805	859	887	1355	37
Calcium	(mg/L)	144	156	142	154	142	149	156	49	7
Magnesium	(mg/L)	12	15	10	12	10	12	15	4	2
Sodium	(mg/L)	472	589	491	571	472	531	589	3348	58
Aluminium	(mg/L)	0.26	0.06	0.05	0.03	0.0	0.1	0.3	0.01	0.11
Manganese	(mg/L)	0.196	0.195	0.151	0.178	0.151	0.180	0.196	0.00	0.02
Zinc	(mg/L)	0.012	0.019	0.008	0.01	0.008	0.012	0.019	0.00	0.00
Iron	(mg/L)	0.74	0.59	0.52	0.48	0.48	0.58	0.74	0.01	0.11

DB10W

Parameter	Units	15-Aug-18	22-Nov-18	14-Feb-19	22-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	12.56	12.44	12.69	13.41	12.44	12.78	13.41	0.19	0.44
pH		6.29	5.36	5.51	5.25	5.3	5.6	6.3	0.22	0.47
Conductivity @ 25^{0}C	(µS/cm)	3920	4160	3610	4360	3610	4013	4360	104358	323
ORP	(mV)	72	168	255	116	72	153	255	6186	79
Dissolved Oxygen	(%)	8	17	26	30	8	20	30	89	9
TDS	(mg/L)	3280	2510	2530	2450	2450	2693	3280	154558	393
Alkalinity as CaCO3	(mg/L)	180	33	35	22	22	68	180	5658	75
Acidity as CaCO3	(mg/L)	24	109	140	44	24	79	140	2957	54
Sulphate	(mg/L)	460	428	459	424	424	443	460	377	19
Chloride	(mg/L)	1030	952	1040	1020	952	1011	1040	1588	40
Calcium	(mg/L)	154	76	68	70	68	92	154	1720	41
Magnesium	(mg/L)	70	83	77	75	70	76	83	29	5
Sodium	(mg/L)	584	698	596	690	584	642	698	3640	60
Aluminium	(mg/L)	81.5	0.58	0.97	0.27	0.3	20.8	81.5	1636	40
Manganese	(mg/L)	1.84	0.969	0.983	0.863	0.863	1.164	1.840	0.21	0.45
Zinc	(mg/L)	0.346	0.215	0.169	0.2	0.169	0.233	0.346	0.01	0.08
Iron	(mg/L)	53.4	17.9	21.4	12	12.00	26.18	53.40	344.47	18.56

DB11W

Note: Installed 3-Sep-13. E - 399100, N - 6430300

Parameter	Units	16-Aug-18	21-Nov-18	13-Feb-19	23-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL (TOC)	(m)	10.70	10.90	10.89	10.68	10.7	10.79	10.90	0.01	0.12
pH		6.8	7.02	7.06	6.97	6.8	6.96	7.06	0.01	0.11
Conductivity @ 25^{0}C	(µS/cm)	3320	3160	2790	3560	2790	3208	3560	104492	323
ORP	(mV)	-28	-52	-14	-19	-52	-28	-14	284	17
Dissolved Oxygen	(%)	32	27	29	26	26	28	32	8	3
TDS	(mg/L)	2240	2010	1980	2030	1980	2065	2240	14033	118
Alkalinity as CaCO3	(mg/L)	281	291	283	224	224	270	291	949	31
Acidity as CaCO3	(mg/L)	20	26	27	14	14	22	27	36	6
Sulphate	(mg/L)	218	130	196	197	130	185	218	1460	38
Chloride	(mg/L)	900	714	732	821	714	792	900	7396	86
Calcium	(mg/L)	222	203	189	223	189	209	223	267	16
Magnesium	(mg/L)	43	34	30	39	30	37	43	32	6
Sodium	(mg/L)	361	433	349	428	349	393	433	1928	44
Aluminium	(mg/L)	1.50	0.63	1.01	0.30	0.3	0.86	1.50	0.27	0.52
Manganese	(mg/L)	1.100	0.849	0.812	0.952	0.8	0.93	1.10	0.02	0.13
Zinc	(mg/L)	0.022	0.013	0.006	<0.005	0.0	0.01	0.02	0.00	0.01
Iron	(mg/L)	5.29	3.22	3.13	3.95	3.1	3.90	5.29	1.00	1.00

BH4BW

Parameter	Units	17-Aug-18	21-Nov-18	13-Feb-19	23-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	4.93	4.87	5.28	5.24	4.9	5.08	5.28	0.04	0.21
pH		6.2	6.4	6.3	6.1	6.1	6.24	6.40	0.02	0.12
Conductivity @ 25^{0}C	(µS/cm)	273	296	237	244	237	263	296	742	27
ORP	(mV)	113	199	188	163	113	166	199	1464	38
Dissolved Oxygen	(%)	31	28	23	34	23	29	34	20	4
TDS	(mg/L)	394	285	212	97	97	247	394	15593	125
Alkalinity as CaCO3	(mg/L)	114	109	101	68	68	98	114	429	21
Acidity as CaCO3	(mg/L)	23	31	43	17	17	29	43	126	11
Sulphate	(mg/L)	4	4	3	2	2	3	4	1	1
Chloride	(mg/L)	17	16	16	14	14	16	17	2	1
Calcium	(mg/L)	14	16	14	10	10	14	16	6	3
Magnesium	(mg/L)	10	12	9	6	6	9	12	6	3
Sodium	(mg/L)	22	26	20	17	17	21	26	14	4
Aluminium	(mg/L)	17	54	4	6	4	20	54	531.22	23.05
Manganese	(mg/L)	2.0	2.6	1.0	0.6	0.6	1.53	2.55	0.79	0.89
Zinc	(mg/L)	0.1	0.3	0.0	0.0	0.0	0.11	0.26	0.01	0.10
Iron	(mg/L)	27.1	88.4	9.4	14.3	9.4	34.80	88.40	1332.89	36.51

SI1W

Parameter	Units	15-Aug-18	22-Nov-18	14-Feb-19	22-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	9.85	9.80	10.00	9.92	9.80	9.89	10.00	0.01	0.09
pH		7.1	7.2	7.1	7.0	7.0	7.1	7.2	0.01	0.11
Conductivity @ 25^{0}C	(µS/cm)	2720	2930	2610	3140	2610	2850	3140	55000	235
ORP	(mV)	279	199	254	176	176	227	279	2273	48
Dissolved Oxygen	(%)	34	36	33	25	25	32	36	26	5
TDS	(mg/L)	1500	2030	2160	1820	1500	1878	2160	82958	288
Alkalinity as CaCO3	(mg/L)	474	435	444	382	382	434	474	1468	38
Acidity as CaCO3	(mg/L)	24	39	38	19	19	30	39	101	10
Sulphate	(mg/L)	784	641	816	811	641	763	816	6813	83
Chloride	(mg/L)	318	299	301	307	299	306	318	73	9
Calcium	(mg/L)	171	175	170	189	170	176	189	77	9
Magnesium	(mg/L)	141	152	142	160	141	149	160	81	9
Sodium	(mg/L)	242	285	245	296	242	267	296	758	28
Aluminium	(mg/L)	0.22	0.14	0.02	<0.01	0.02	0.13	0.22	0.01	0.10
Manganese	(mg/L)	0.005	0.010	0.002	<0.001	0.0	0.01	0.01	0.00	0.00
Zinc	(mg/L)	0.007	0.027	0.012	0.008	0.0	0.01	0.03		
Iron	(mg/L)	0.35	0.33	0.06	<0.05	0.06	0.25	0.35	0.03	0.16

SI2W

Parameter	Units	15-Aug-18	22-Nov-18	14-Feb-19	22-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	19.27	19.22	19.90	19.61	19.2	19.50	19.90	0.10	0.32
pH		7.2	7.3	7.2	7.2	7.2	7.24	7.29	0.00	0.03
Conductivity @ 25^{0}C	(µS/cm)	3020	3260	2910	3380	2910	3143	3380	46425	215
ORP	(mV)	215	159	201	136	136	178	215	1341	37
Dissolved Oxygen	(%)	22	18	25	25	18	23	25	10	3
TDS	(mg/L)	2320	2420	2420	2280	2280	2360	2420	5067	71
Alkalinity as CaCO3	(mg/L)	320	290	304	233	233	287	320	1434	38
Acidity as CaCO3	(mg/L)	12	16	19	9	9	14	19	19	4
Sulphate	(mg/L)	1190	931	1250	1200	931	1143	1250	20617	144
Chloride	(mg/L)	285	274	282	294	274	284	294	68	8
Calcium	(mg/L)	137	150	152	157	137	149	157	73	9
Magnesium	(mg/L)	150	169	165	172	150	164	172	95	10
Sodium	(mg/L)	325	406	352	412	325	374	412	1784	42
Aluminium	(mg/L)	0.09	0.04	0.05	0.04	0.04	0.06	0.09	0.00	0.02
Manganese	(mg/L)	0.020	0.017	0.017	0.016	0.016	0.018	0.020	0.000	0.002
Zinc	(mg/L)	0.008	0.011	0.018	0.007	0.007	0.011	0.018	0.000	0.005
Iron	(mg/L)	0.27	0.13	0.15	0.11	0.11	0.17	0.27	0.01	0.07

SI3W

Parameter	Units	15-Aug-18	22-Nov-18	14-Feb-19	22-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL	(m)	28.09	28.10	28.12	28.12	28.09	28.11	28.12	0.00	0.02
pH		6.9	6.9	7.0	6.9	6.9	6.9	7.0	0.00	0.05
Conductivity @ 25^{0}C	(µS/cm)	6220	7100	6520	8510	6220	7088	8510	1032758	1016
ORP	(mV)	246	233	263	174	174	229	263	1495	39
Dissolved Oxygen	(%)	67	57	64	67	57	64	67	22	5
TDS	(mg/L)	4040	5160	6150	4140	4040	4873	6150	981425	991
Alkalinity as CaCO3	(mg/L)	289	259	274	238	238	265	289	474	22
Acidity as CaCO3	(mg/L)	22	33	23	15	15	23	33	55	7
Sulphate	(mg/L)	734	622	821	761	622	735	821	6947	83
Chloride	(mg/L)	1690	1500	2060	2220	1500	1868	2220	109292	331
Calcium	(mg/L)	437	510	544	622	437	528	622	5899	77
Magnesium	(mg/L)	128	152	163	172	128	154	172	362	19
Sodium	(mg/L)	680	832	792	863	680	792	863	6395	80
Aluminium	(mg/L)	3.65	0.28	2.66	0.53	0.28	1.78	3.65	2.69	1.64
Manganese	(mg/L)	1.110	0.115	0.647	0.319	0.115	0.548	1.110	0.19	0.43
Zinc	(mg/L)	0.094	0.044	0.088	0.046	0.044	0.068	0.094	0.00	0.03
Iron	(mg/L)	3.64	0.5	3.04	0.99	0.50	2.04	3.64	2.34	1.53

WR1

Note: Installed 3-Sep-13. E - 400776, N - 6425804

Waste Emplacement - South

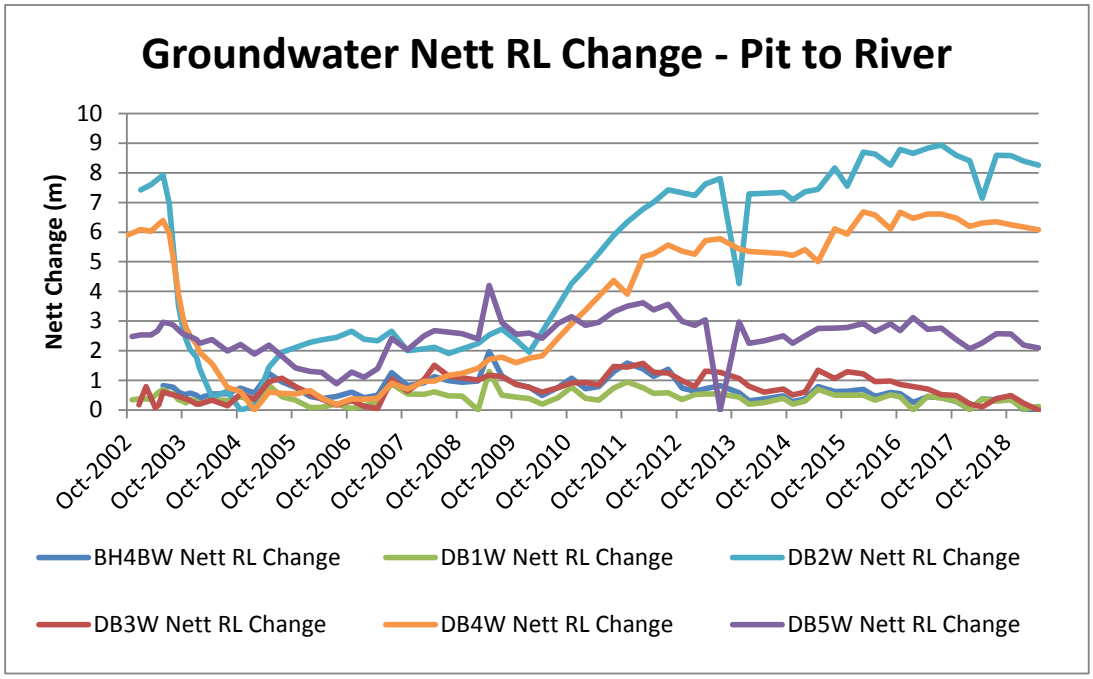
Parameter	Units	16-Aug-18	22-Nov-18	14-Feb-19	23-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL (TOC)	(m)	9.02	9.23	9.95	9.96	9.02	9.54	9.96	0.24	0.49
pH		6.52	6.48	6.56	6.44	6.4	6.5	6.6	0.00	0.05
Conductivity @ 25^{0}C	(µS/cm)	2220	2390	2120	2635	2120	2341	2635	50773	225
ORP	(mV)	172	182	222	149	149	181	222	929	30
Dissolved Oxygen	(%)	57	56	40	77	40	58	77	234	15
TDS	(mg/L)	1400	1520	1540	1380	1380	1460	1540	6667	82
Alkalinity as CaCO3	(mg/L)	328	263	272	224	224	272	328	1840	43
Acidity as CaCO3	(mg/L)	32	51	66	30	30	45	66	290	17
Sulphate	(mg/L)	491	412	446	448	412	449	491	1048	32
Chloride	(mg/L)	358	333	358	387	333	359	387	487	22
Calcium	(mg/L)	149	159	158	172	149	160	172	90	9
Magnesium	(mg/L)	28	30	29	32	28	30	32	3	2
Sodium	(mg/L)	256	340	294	343	256	308	343	1716	41
Aluminium	(mg/L)	3.84	0.9	1.86	1.42	0.9	2.0	3.8	1.65	1.28
Manganese	(mg/L)	0.722	0.678	0.743	0.726	0.678	0.717	0.743	0.00	0.03
Zinc	(mg/L)	0.028	0.024	0.032	<0.005	0.024	0.028	0.032	0.00	0.00
Iron	(mg/L)	3.32	1.82	2.88	2.12	1.82	2.54	3.32	0.47	0.69

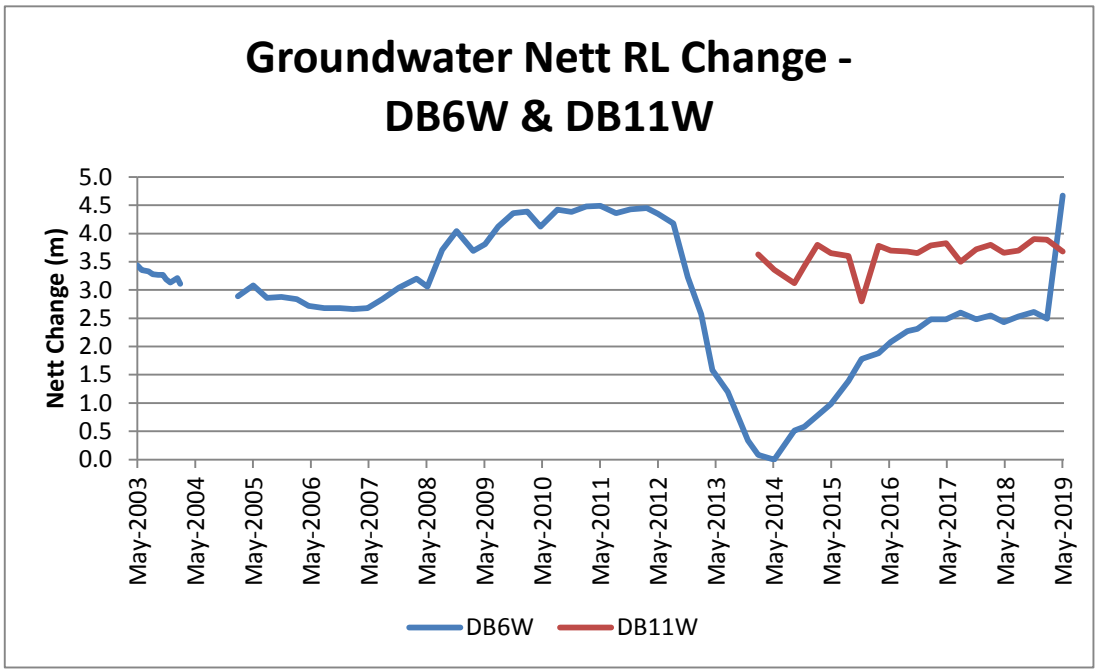
WR2

Note: Installed 3-Sep-13. E - 400990, N - 6426582

Waste Emplacement - East

Parameter	Units	16-Aug-18	22-Nov-18	14-Feb-19	22-May-19	Min	Avg	Max	Variance	Std Dev
Depth to standing WL (TOC)	(m)	69.71	70.4	72.21	69.31	69.31	70.41	72.21	1.65	1.28
pH		7.06	7.28	7.02	6.93	6.9	7.07	7.28	0.02	0.15
Conductivity @ 25^{0}C	(µS/cm)	5510	5980	5250	6830	5250	5893	6830	481892	694
ORP	(mV)	123	109	206	64	64	126	206	3514	59
Dissolved Oxygen	(%)	31	26	32	25	25	29	32	13	4
TDS	(mg/L)	4510	4990	5950	4250	4250	4925	5950	560900	749
Alkalinity as CaCO3	(mg/L)	169	176	182	152	152	170	182	168	13
Acidity as CaCO3	(mg/L)	30	26	29	18	18	26	30	30	5
Sulphate	(mg/L)	1310	994	1290	1270	994	1216	1310	22171	149
Chloride	(mg/L)	1350	1180	1350	1370	1180	1313	1370	7892	89
Calcium	(mg/L)	879	931	944	960	879	929	960	1230	35
Magnesium	(mg/L)	27	30	29	31	27	29	31	3	2
Sodium	(mg/L)	302	354	332	363	302	338	363	738	27
Aluminium	(mg/L)	4.26	4.32	3.46	5.45	3.46	4.37	5.45	0.67	0.82
Manganese	(mg/L)	2.63	2.45	2.46	2.67	2.45	2.55	2.67	0.01	0.11
Zinc	(mg/L)	0.184	0.208	0.099	0.129	0.099	0.155	0.208	0.00	0.05
Iron	(mg/L)	7.84	8.72	6.45	12.8	6.45	8.95	12.80	7.45	2.73


Groundwater Nett RL Change - Pit to River
Nett Change (m)
10
9
8
7
6
5
4
3
2
1
0
Oct-2002
Oct-2003
Oct-2004
Oct-2005
Oct-2006
Oct-2007
Oct-2008
Oct-2009
Oct-2010
Oct-2011
Oct-2012
Oct-2013
Oct-2014
Oct-2015
Oct-2016
Oct-2017
Oct-2018
BH4BW Nett RL Change
DB1W Nett RL Change
DB2W Nett RL Change
DB3W Nett RL Change
DB4W Nett RL Change
DB5W Nett RL Change


Groundwater Nett RL Change -
DB6W & DB11W
Nett Change (m)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
May-2003
May-2004
May-2005
May-2006
May-2007
May-2008
May-2009
May-2010
May-2011
May-2012
May-2013
May-2014
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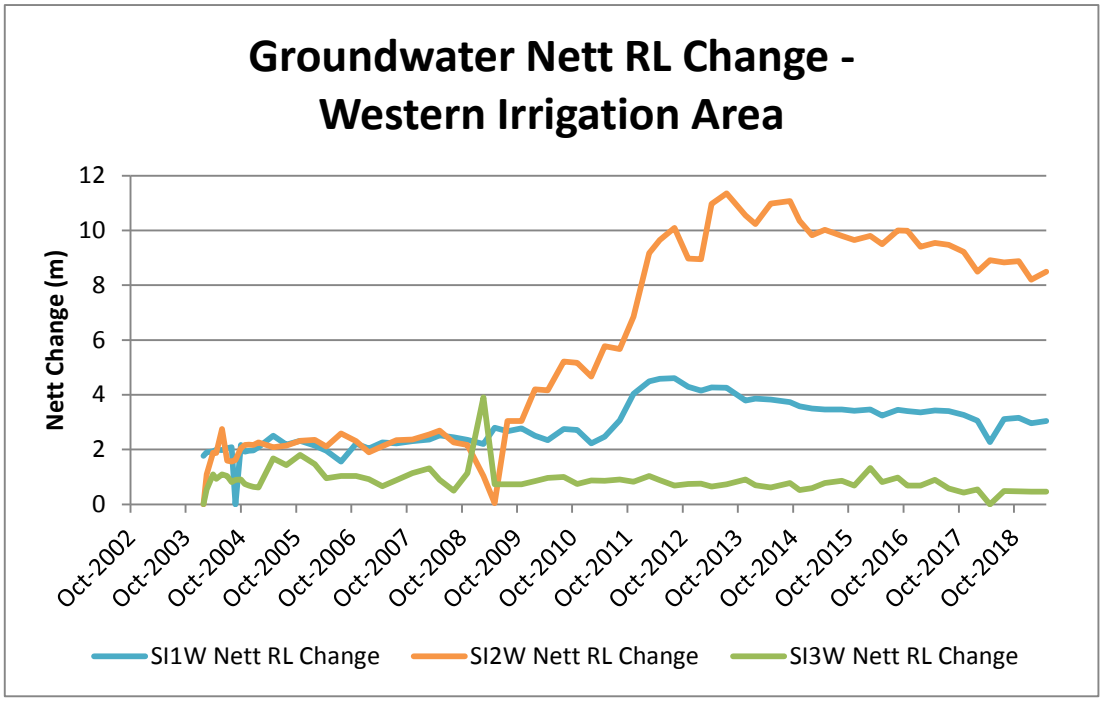
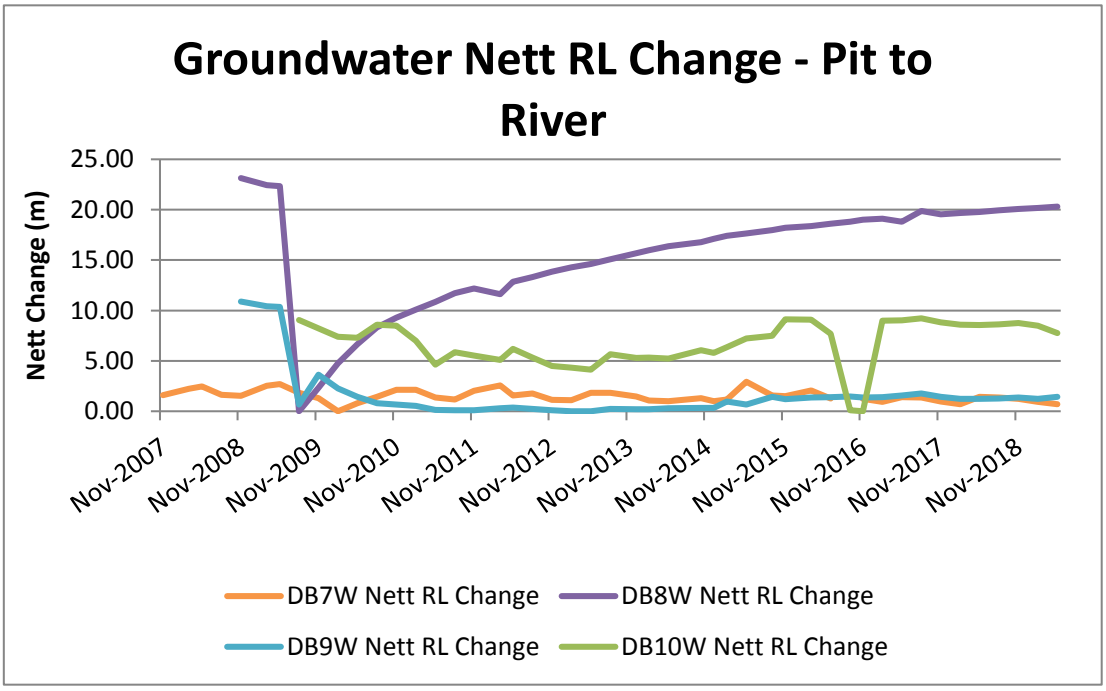
May-2016
May-2017
May-2018
May-2019
DB6W
DB11W


Groundwater Nett RL Change - Western Irrigation Area
Nett Change (m)
12
10
8
6
4
2
0
Oct-2002
Oct-2003
Oct-2004
Oct-2005
Oct-2006
Oct-2007
Oct-2008
Oct-2009
Oct-2010
Oct-2011
Oct-2012
Oct-2013
Oct-2014
Oct-2015
Oct-2016
Oct-2017
Oct-2018
SI1W Nett RL Change
SI2W Nett RL Change
SI3W Nett RL Change


Groundwater Nett RL Change - Pit to River
Nett Change (m)
25.00
20.00
15.00
10.00
5.00
0.00
Nov-2007
Nov-2008
Nov-2009
Nov-2010
Nov-2011
Nov-2012
Nov-2013
Nov-2014
Nov-2015
Nov-2016
Nov-2017
Nov-2018
DB7W Nett RL Change
DB8W Nett RL Change
DB9W Nett RL Change
DB10W Nett RL Change

Appendix 5:

Blast Monitoring

Duralie Coal Mine Blast Monitoring Results

Location	Date	Time	Schultz (AB1)		Fisher-Webster (AAAB3)		Moylan (AAAB4)		Weismantel Inn		Overpressure Site Exceedance [1]	Overpressure "Cumulative Exceedance" [1]	Ground Vibration Site Exceedance [1]	Ground Vibration "Cumulative Exceedance" [1]	Monitored Blasts[1]	Fume Rating
		24hr	mm/s	dBL	mm/s	dBL	mm/s	dBL	mm/s	dBL	%		%			
Weismantel Strip 16	06-Jul-18	11:59:00	<0.22	<110.0	<0.22	<110.0	<0.22	<110.0	<0.22	<110.0	0.0%	0	0.0%	0	1	Nil
Weismantel Strip 16	12-Jul-18	11:48:00	<0.22	<110.0	<0.22	<110.0	<0.22	<110.0	<0.22	<110.0	0.0%	0	0.0%	0	2	Nil
Weismantel Strip 16	02-Aug-17	14:33:00	<0.22	<110.0	<0.22	<110.0	<0.22	<110.0	<0.22	<110.0	0.0%	0	0.0%	0	3	Nil
Weismantel Strip 16	10-Aug-18	13:36:00	<0.22	<110.0	<0.22	<110.0	<0.22	<110.0	0.77	109.6	0.0%	0	0.0%	0	4	Nil
Weismantel Strip 16	17-Aug-18	11:45:00	<0.22	<110.0	<0.22	<110.0	<0.22	<110.0	1.01	111.3	0.0%	0	0.0%	0	5	Nil

Blasting ceased at Duralie

Note 1 Site exceedance, monitored blasts & cumulative exceedances reference blasts between 4/9/17 and most recent blast.

Note 2 Blast exceedance of 115dBL or 5mm/s.

Note 3 Blast exceedance of 120dBL or 10mm/s

**Note: Blast compliance,*

- *No more than 5% of total blasts for annual monitoring period to exceed an overpressure of 115dB(L) or ground vibration of 5mm/s.*
- *No blast is to exceed an overpressure of 120dB(L) or ground vibration of 10mm/s.*
- *Weismantel's Inn – No blast is to exceed 10 mm/s ground vibration. No limit on overpressure.*
- *Mammy Johnson's Grave - No blast is to exceed 5 mm/s ground vibration. No limit on overpressure.*

Appendix 6:

Shuttle Train Performance Summary

DURALIE SHUTTLE TRAIN PERFORMANCE SUMMARY

Notes:

1 - The number of trains is considered to be a full circuit to and from the site.
2- Includes the date/time of each train received between 10pm and midnight.
3 - Includes instances when the shuttle train is operated between midnight and 1

Day / Date	Number of Trains [1]	Trains Received after 10pm [2]	Trains between 12 and 1am [3]
Monday, 1 January 2018	0		
Tuesday, 2 January 2018	0		
Wednesday, 3 January 2018	0		
Thursday, 4 January 2018	0		
Friday, 5 January 2018	0		
Saturday, 6 January 2018	0		
Sunday, 7 January 2018	0		
Monday, 8 January 2018	0		
Tuesday, 9 January 2018	0		
Wednesday, 10 January 2018	0		
Thursday, 11 January 2018	0		
Friday, 12 January 2018	0		
Saturday, 13 January 2018	0		
Sunday, 14 January 2018	0		
Monday, 15 January 2018	0		
Tuesday, 16 January 2018	0		
Wednesday, 17 January 2018	0		
Thursday, 18 January 2018	0		
Friday, 19 January 2018	2		
Saturday, 20 January 2018	0		
Sunday, 21 January 2018	0		
Monday, 22 January 2018	3	22:05	
Tuesday, 23 January 2018	3		
Wednesday, 24 January 2018	3		
Thursday, 25 January 2018	3		
Friday, 26 January 2018	0		
Saturday, 27 January 2018	0		
Sunday, 28 January 2018	0		
Monday, 29 January 2018	0		
Tuesday, 30 January 2018	0		
Wednesday, 31 January 2018	0		
Thursday, 1 February 2018	0		
Friday, 2 February 2018	0		
Saturday, 3 February 2018	0		
Sunday, 4 February 2018	0		
Monday, 5 February 2018	0		

Tuesday, 6 February 2018	0			
Wednesday, 7 February 2018	0			
Thursday, 8 February 2018	0			
Friday, 9 February 2018	0			
Saturday, 10 February 2018	0			
Sunday, 11 February 2018	0			
Monday, 12 February 2018	2			
Tuesday, 13 February 2018	3			
Wednesday, 14 February 2018	3			
Thursday, 15 February 2018	3			
Friday, 16 February 2018	1			
Saturday, 17 February 2018	0			
Sunday, 18 February 2018	0			
Monday, 19 February 2018	3			
Tuesday, 20 February 2018	3			
Wednesday, 21 February 2018	0			
Thursday, 22 February 2018	0			
Friday, 23 February 2018	0			
Saturday, 24 February 2018	0			
Sunday, 25 February 2018	0			
Monday, 26 February 2018	0			
Tuesday, 27 February 2018	0			
Wednesday, 28 February 2018	0			
Thursday, 1 March 2018	0			
Friday, 2 March 2018	0			
Saturday, 3 March 2018	0			
Sunday, 4 March 2018	0			
Monday, 5 March 2018	0			
Tuesday, 6 March 2018	0			
Wednesday, 7 March 2018	0			
Thursday, 8 March 2018	0			
Friday, 9 March 2018	0			
Saturday, 10 March 2018	0			
Sunday, 11 March 2018	0			
Monday, 12 March 2018	0			
Tuesday, 13 March 2018	2	23:05		
Wednesday, 14 March 2018	3			
Thursday, 15 March 2018	2			
Friday, 16 March 2018	2			
Saturday, 17 March 2018	0			
Sunday, 18 March 2018	0			
Monday, 19 March 2018	3			
Tuesday, 20 March 2018	3			
Wednesday, 21 March 2018	1			
Thursday, 22 March 2018	3			
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Saturday, 24 March 2018	0			
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Saturday, 14 April 2018	0			
Sunday, 15 April 2018	0			
Monday, 16 April 2018	0			
Tuesday, 17 April 2018	2	22:15		
Wednesday, 18 April 2018	3			
Thursday, 19 April 2018	3			
Friday, 20 April 2018	1			
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Monday, 23 April 2018	3			
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Wednesday, 25 April 2018	0			
Thursday, 26 April 2018	2			
Friday, 27 April 2018	0			
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Monday, 30 April 2018	0			
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Sunday, 20 May 2018	0			
Monday, 21 May 2018	0			
Tuesday, 22 May 2018	2	23:45		
Wednesday, 23 May 2018	4			
Thursday, 24 May 2018	3			
Friday, 25 May 2018	2			
Saturday, 26 May 2018	0			
Sunday, 27 May 2018	0			
Monday, 28 May 2018	3	23:25		
Tuesday, 29 May 2018	3			
Wednesday, 30 May 2018	3			
Thursday, 31 May 2018	3			
Friday, 1 June 2018	0			
Saturday, 2 June 2018	0			
Sunday, 3 June 2018	0			
Monday, 4 June 2018	0			
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Monday, 18 June 2018	0			
Tuesday, 19 June 2018	1			
Wednesday, 20 June 2018	3			
Thursday, 21 June 2018	3			
Friday, 22 June 2018	1			
Saturday, 23 June 2018	0			
Sunday, 24 June 2018	0			
Monday, 25 June 2018	3			
Tuesday, 26 June 2018	3			
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Friday, 29 June 2018	0			
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Wednesday, 18 July 2018	3			
Thursday, 19 July 2018	3	22:20		
Friday, 20 July 2018	2			
Saturday, 21 July 2018	0			
Sunday, 22 July 2018	0			
Monday, 23 July 2018	3			
Tuesday, 24 July 2018	2			
Wednesday, 25 July 2018	1			
Thursday, 26 July 2018	3	22:40		
Friday, 27 July 2018	2			
Saturday, 28 July 2018	0			
Sunday, 29 July 2018	0			
Monday, 30 July 2018	0			
Tuesday, 31 July 2018	0			
Wednesday, 1 August 2018	0			
Thursday, 2 August 2018	0			
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Monday, 1 October 2018	0			
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Wednesday, 3 October 2018	1			
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Friday, 5 October 2018	0			
Saturday, 6 October 2018	0			
Sunday, 7 October 2018	0			
Monday, 8 October 2018	0			
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Wednesday, 10 October 2018	0			
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Monday, 31 December 2018	0		

Appendix 7:

Complaints & CCC Annual Report

Duralie Complaint Summary

Period: 12 Months to July 2019

Total No. of Complaints: 4 (0 noise, 0 blasting, 4 air quality (inc. odour), 0 other)

Total No. of Complainants: 4

Date/Time of Complaint	Complainant Location	Method of Complaint	Nature of Complaint	Investigation/Outcome
10/10/2018 4:00am	Not advised	EPA hotline	Odours	Description of Incident: The caller is affected by strong offensive odour coming from Duralie mining, on 10/10/2018 at about 4am. The issue is ongoing and happens at night. The odour is strongest before dawn at about 4am. The odour was so strong that it woke up the caller to shut down windows. The odour occurs every week - not every day but often most morning. The caller described the odour as the type of smell that that comes of coal. The wind is still. The caller rated odour at 5/6. • Notification of complaint received from EPA on 25/10/2018. Response to EPA: Refer to response below.
12/10/2018 9:30hrs	Not advised	EPA hotline	Odours	Description of Incident: Caller is reporting of distinct to strong coal like odour coming from the mine which started around 09:30 am and is continuing. Caller lives approximately 2 km from the mine. There is slight breeze. • Notification of complaint received from EPA on 25/10/2018. Response to EPA: Refer to response below.
24/10/2018 8:00hrs	Not advised	EPA hotline	Odours	EPA Hotline Incident Description: *Caller is reporting of strong acrid odour coming from the mine which caller noticed at 8 am today and is continuing. Caller said the odour was stronger on Sunday, 21/10/18 and Monday, 22/10/18. Caller gets the odour when the wind blows from South, South-East direction.* • Response to EPA on 26 Oct 2018: Management of self-heating (potentially acid forming) material on the Weismantel PAF dump has been ongoing in accordance with the Duralie Coal Mine Spontaneous Combustion Principle Mining Hazard Management Plan (PMHMP). Further, DCPL has continued to manage areas with self-heating or spontaneous combustion in accordance with the Duralie Coal Mine Spontaneous Combustion & Hot Material Management Procedure. During August and September 2018 DCPL had identified some areas of increased level of heating and odours on the PAF dump and immediate actions were taken to manage these areas. DCPL has continued to monitor areas with the potential for spontaneous combustion or self-heating. DCPL will continue to treat this matter as a priority and believe appropriate measures have been taken to limit offsite impacts of odours. Additional information on PAF and odour management measures has been provided to the EPA.
7/11/2018 12:00hrs	Not advised	EPA hotline	Odours	EPA Hotline Incident Description: *Complainant would like to know what's happening at Duralie Coal on Bucketts Way near Stroud. They have driven past a number of times in past weeks and guess its their overburden pile that is smouldering and water cannons have been trying to put it out. Complainant would like to know if this safe; what causes it and when should it be under control? How long has it been burning? It is concerning and has many people in the surrounding communities talking* • Response to EPA: The management of self-heating (potentially acid forming) material has been ongoing during mining operations at the Duralie Coal Mine. We have previously undertaken consultation with both neighbours and community members following receipt of any complaints. DCPL has also had ongoing dialogue through our Community Consultative Committee forums. There is currently no spontaneous combustion on the waste emplacements or in the open cut. There are several areas of heating material which DCPL are continuing to manage by dozing and capping. DCPL have also undertaken watering prior to re-handling any hot material to control the potential for spon comm or odours.

Duralie Coal Community Consultative Committee Annual Report for Year 2018

Community Consultative Committee Details

CCC / Project Name:	Duralie Coal Mine	**Reporting Period:**	January - December 2018
Independent Chairperson:	**Margaret MacDonald-Hill**	**Proponent Contact:**	**Michael Plain**

1. Executive Summary

The Duralie Community Consultative Committee was established in 2003 as part of the Duralie Coal Mine Development Consent approval and operates in accordance with the Department of Planning and Environment's 2016 Community Consultative Committee Guidelines for State Significant Projects. The Committee is currently comprised of:

- four local community representatives;
- two - three Mid Coast Council representatives (elected and staff);
- two Duralie Coal representatives, with attendance from other personnel as required;
- one independent Chairperson.

Meetings are held quarterly with regular site tours of places of interest within the mine site and surrounds, nominated by Committee members. Attendance numbers at the meeting are consistently high as all members take a very strong interest in their local community and environment.

Over the last two years and in anticipation of cessation of mining, the committee has had a specific focus on mine closure planning, land rehabilitation and management and future land use. At the committee's behest, these matters have been a regular agenda item at each meeting and as a consequence of such discussions, Duralie Coal has taken the initiative to broadly engage with the local community and CCC members at a specific purpose Agricultural Rehabilitation Planning Workshop held in September 2018. Mining of ROM coal at the Duralie Coal Mine was completed in October 2018 and the dialogue established is timely, relevant and ongoing.

The committee regularly has invited guests to present on a variety of subjects that the members express an interest in. Speakers for the reporting period included MidCoast Council representatives; the Community Coordinator, the Catchment Officer and the Director of Community Spaces and Services, the Chairperson of the Karuah Aboriginal Land Council and Yancoal's Business Optimisation Manager for Stratford and Duralie operations.

Other topics of discussion for the reporting period also included:

- general environmental management & monitoring, including air quality, noise, surface water and groundwater
- water management
- community complaints
- broader community engagement and the CCC's print media articles

- Duralie community enhancement contributions to Council and allocation thereof
- Karuah River Catchment Management
- Biodiversity Offset area
- Yancoal land management
- Agricultural rehabilitation possibilities
- Stratford Extension Project updates and transition from Duralie Mine.

The committee members are an integral part of the local community and as such, the CCC forum is a good example of an effective committee working together to improve community engagement within the mine's area of operation, between the villages of Stroud Road and Wards River and to achieve beneficial outcomes in the MidCoast Council Local Government Area. The committee is fortunate in the amount of information provided by Duralie Coal Pty Ltd in advance of each meeting and in response to committee requests. A clear example of efficient two-way communication and working together between the community representatives, the Council and the company.

My observation is that all members of the committee are very committed to fulfilling their roles and such enthusiasm comes from the broader recognition of finding the balance to a better co-existence. They share a strong community interest and their insights and the ongoing dialogue to building partnerships and social capital in the local community is a valuable ingredient to a competent committee.

2. CCC activities over last 12 months

- Committee meetings were held in the months of February, May, August and November 2018. The committee resumes its meeting schedule in February 2019 and will maintain a similar schedule as in previous years.
- Attendance at meetings is high with mostly a full contingent, excepting apologies due to ill health or unforseen work commitments. Absences are rare as the committee sets its meeting dates at the end of each calendar year for the ensuing year.
- Following the death of a long-term community member in early 2018, a new member was sought and the vacancy filled by a new community representative; a landowner of almost three decades within the local area. His contribution will be a valuable asset to an already effective committee.
- Site visits of the rehabilitation areas and biodiversity offsets were undertaken during May and November 2018.
- No joint Committee meetings were held, although the Duralie Committee maintains an interest in Yancoal's sister operation at Stratford, has held a meeting at the Stratford mine and inspected the site in a previous reporting period. Stratford updates are included on the agenda for each meeting.
- An additional consultation activity emanating from the CCC was the Duralie Agricultural Rehabilitation Workshop held in September 2018. This was an interactive field day held in the Duralie rehabilitation area and was attended by a cross-section of the local community, Government and industry stakeholders. The focus was on property planning for the long-term layout and operation of agricultural rehabilitation areas and integration with the surrounding lands.

Topics of discussion at the workshop included stock rotation, water infrastructure and pasture management.

- Through aligned networks, the committee is kept informed by Duralie Coal and MidCoast Council of other events occurring in the region throughout the year such as Karuah Catchment Landcare group and Land Service field days.
- Two representative of the Duralie CCC were nominated by the CCC and accepted on the Duralie Community Fund Panel under the auspice of MidCoast Council established May 2018.

3. Key issues

The Duralie CCC has been keen to understand the process and distribution of the community enhancement contributions paid to Council each year. This originated from a split of funding between the two Local Government areas of Gloucester and Great Lakes Councils prior to the merge into MidCoast Council. In the past year, Council has provided comprehensive history and reporting, reviewed management practices and financial reporting to the committee to address concerns. Whilst this has taken some time to achieve, the CCC is fully appraised of funding components, key activities and allocations, expenditure and proposed future works. At Council's invitation, two members of the committee are also on Council's Duralie Community Fund Panel.

Issue	Actions Taken	Next Steps
Stratford Coal Education Program	Actively support ongoing success of Stratford Coal Education Program through CCC networks and media	Ongoing
Yancoal Community Support Programs	Disseminate information through CCC networks and media.	Ongoing
Post mining requirements	Planning for post mining landforms	Ongoing interaction through CCC and workshops as required

4. Focus for next 12 months

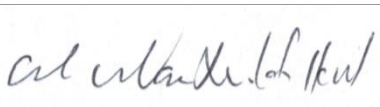
The planned activities for 2019 will be guided by the contributions of the CCC members. These activities are likely to include:

- to investigate potential opportunities to increase agricultural land capability whilst meeting rehabilitation requirements.

- Engage with Yancoal and the broader community on post mining options, including landscape and potential uses and maintaining the committee's presence through local media releases.

To the best of my knowledge, there are no outstanding or emerging issues that have not been addressed or are in the process of being so, to the committee's satisfaction.

Committee Meeting minutes and presentations are available on the website within two weeks of each meeting.

Signature of Chair:	
Date:	February 8 2019

Appendix 8:

Duralie Coal Mine Annual Biodiversity Report 2019

Duralie Coal Mine Annual Biodiversity Report 2019

FOR THE YEAR ENDING 30 JUNE 2019

CONTENTS

List of Appendices

1 INTRODUCTION

The Duralie Coal Mine (**DCM**), located in the Southern part of the Gloucester Basin NSW, is approximately 30 kilometres south of Gloucester and is owned and operated by Duralie Coal Pty Ltd (**DCPL**), a fully owned subsidiary of Yancoal Australia Limited (**YAL**).

1.1 Scope

In accordance with the Duralie Extension Project, Project Approval 08_0203 (as modified December 2014), the proponent (DCPL) is required in accordance with *Schedule 3, condition 43* to prepare and implement a Biodiversity Management Plan (BMP). This Plan must include a:

> *"a program to monitor and report on the effectiveness of the measures in the Biodiversity Management Plan and conditions 33-43 of this approval, and the performance of the Offset Strategy, with summary reporting to be carried out annually and comprehensive reporting every three years following the independent environmental audit".*

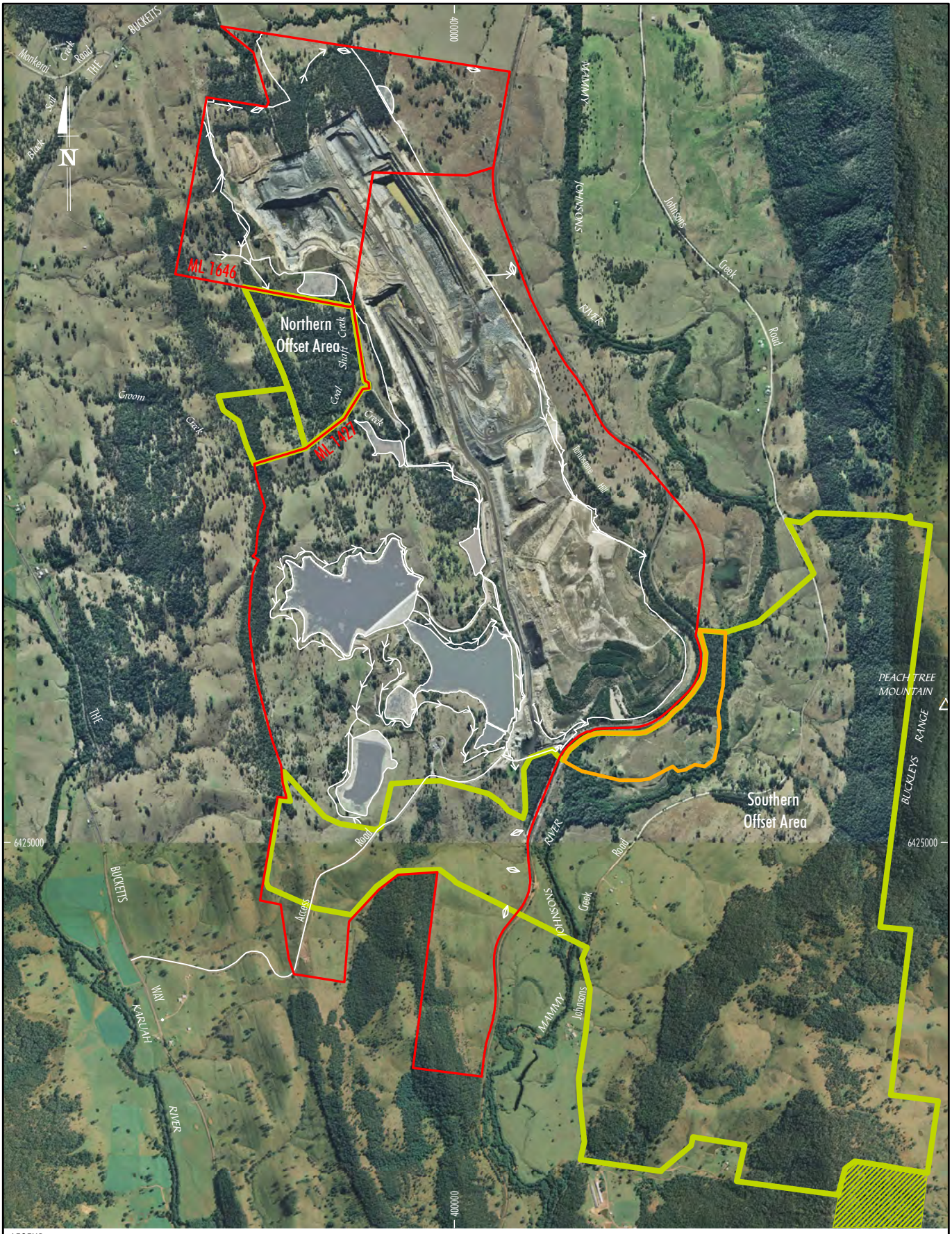
This DCM Annual Biodiversity Report provides a review of the effectiveness of measures in the BMP for the annual year ending 30 June 2019 in accordance with Section 7.2 of the BMP. The scope of the review includes the Mining Lease area ML1427 and ML1646 and Biodiversity Offset areas as indicated on Plan A.

This report (and associated Appendices) is included as an Appendix of the DCM Annual Review which is available on the Duralie Coal website www.duraliecoal.com.au.

During the reporting period a revised BMP was submitted to the NSW Department of Planning and Environment (DP&E) and approved on **25 January 2019 (Appendix A).** Following the DCM Independent Environmental Audit undertaken in **December 2017** a revision of the BMP was prepared for the three year period between August 2018 and July 2021 and includes broader concepts for the longer term (6+ years) management since commencement of the BMP in 2012. The key changes to the BMP include relevant updates to the performance and completion criteria tables with consideration to the works which have been completed to date.

2 STATUS OF BMP PERFORMANCE CRITERIA

Performance criteria as prescribed in the BMP is presented in **Tables 1 to 10**. The performance criteria have been developed to meet the specific objectives for the areas described in Section 2 of the BMP. All performance criteria are linked to the management specifications listed in the BMP Section 5 and Section 6, and monitoring/reporting specifications in the BMP Section 7. The status of BMP performance criteria is provided in the subsequent sections of this report.



LEGEND

- Mining Lease Boundary
- Approximate Extent of Project Major Surface
- Private Land Under Conservation Agreement
- Offset Area
- Bowens Road North Offset Area

0 1000

Metres

GRID DATUM MGA 94 ZONE 56

Source: DCPL (2014); AAHatch - Aerial Photography flown April 2009 and July 2013

BIODIVERSITY MANAGEMENT PLAN

FIGURE 3

Location of the Offset Areas

DURALIECOAL

3 VEGETATION CLEARANCE PROTOCOL

3.1 Vegetation Clearance Report

Vegetation clearance is undertaken in accordance with the BMP Section 5.4 Vegetation Clearance Plan. Prior to any clearance operations a Clearing Plan is prepared, and vegetation pre-clearance surveys are undertaken.

Vegetation clearance for the Duralie Extension Project was finalised in 2017. During the 2018/2019 reporting period no vegetation clearance was undertaken.

The area of disturbance at the end of June 2019 is shown in the DCM Annual Review 2019 Figure 4 (Appendix B).

Information obtained during vegetation clearance activities (i.e. habitat features, hollows cleared and fauna observed) has been used to determine the requirements for nest box replacement in the biodiversity offset areas (refer Section 4).

3.2 Salvaged and Reused Material for Habitat Enhancement

Section 5.8 of the BMP requires salvaged material from vegetation clearance activities to be used for habitat enhancement within the revegetation or rehabilitation areas. Habitat features such as trunks, logs, large rocks, branches, stumps and roots are salvaged and relocated where practicable. As there was no vegetation clearance undertaken during the reporting period, no further habitat materials were salvaged.

During previous reporting periods cleared vegetation was managed as follows:

- Suitable trees and stumps salvaged and stockpiled for reuse.
- Mulched vegetation stored in stockpiles and used on the rehabilitation and incorporated into topsoil.

4 NEST BOX PROGRAM

Nest box management is undertaken in accordance with the BMP Section 6.4. Nest boxes will be installed to provide habitat opportunities in the short to medium-term for a number of arboreal fauna species including the Squirrel Glider.

Table 1: Nest Box Program Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	Completion Criteria
Nest box strategy including target species, habitat trees/feature, nest box designs maintenance and monitoring	Nest box plan developed following habitat assessment and pre-clearance surveys (Section 5.4).		
Nest box installation Includes installation of 18 Squirrel Glider boxes, however may be expanded as required.	Hollow bearing habitat features (nest boxes) installed (Section 6.4).		Nest boxes installed.
Maintenance and monitoring of installed nest boxes. Including monitoring for European bee invasion and repair/replacement	Monitoring in autumn and spring completed. Maintenance undertaken where required (Sections 6.4 and 7.1).	Annual nest box monitoring and maintenance (Sections 6.4 and 7.1).	Nest boxes monitored and maintained, being replaced where required.

Legend	Not commenced	In progress	Completed

AMBS Ecology & Heritage (AMBS) was commissioned to implement the Nest Box Program as described in the BMP Section 5.4.2 and Section 6.4. The Nest Box Program consists of two main components:

- Replacing 18 boxes specifically targeting the Squirrel Glider; and
- Replacing boxes on a like for like basis for any hollow bearing trees cleared during vegetation clearance operations (refer to Section 3).

The installation of nest boxes has occurred over four periods with the final installation in **September 2016**. An annual nest box monitoring report was completed by AMBS in **September 2018** (Appendix C). No further nest box installations were required during the next reporting period. The next monitoring is scheduled for September 2019.

The current program involves:

- 18 nest boxes targeting the Squirrel Glider (*Petaurus norfolcensis*), installed during February 2013;
- 106 nest boxes targeting a variety of hollow-dependent species, installed during August 2013;
- 45 nest boxes targeting a variety of hollow-dependent species, installed during September 2014; and
- 42 nest boxes targeting a variety of hollow-dependent species, installed during September 2016.

The 2017 - 2018 Nest Box Programme for the Duralie Offset Area Report (AMBS June 2019) summarises the work undertaken in relation to the Nest Box Programme for the Duralie Offset Area between October 2017 and September 2018, in accordance with the Duralie Coal Mine Biodiversity Management Plan (BMP). Works undertaken and other milestones that took place during this period included yearly monitoring of 210 nest boxes that have been installed between February 2013 and September 2016. No additional nest boxes were installed in September 2018.

A summary of results from the 2017-2018 report is provided below.

> *"Fourteen species were recorded or shown signs of previous occupation during the current reporting period, including the Squirrel Glider, Sugar Glider, Feathertail Glider, Brush-tailed Phascogale, Brown Antechinus, Common Brushtail Possum, Mountain Brushtail Possum, Common Ringtail Possum, Gould's Wattled Bat, Lesser Long-eared Bat, Australian Wood Duck, Masked Owl, White-throated Treecreeper and Australian Owlet-nightjar. The record of the Mountain Brushtail Possum is the first for the Nest Box Programme. Species recorded previously but not during the current reporting period include the Bush Rat [probable], Gould's Long-eared Bat, a Free-tailed Bat, Australian King-*

Parrot, Eastern Rosella, Peron's Tree Frog, Lace Monitor, Common Tree Snake and Diamond/Carpet Python). Twenty-three vertebrate species have now been recorded within nest boxes during the Nest Box Programme.

Three of the species recorded utilising the nest boxes are listed as vulnerable under the NSW Biodiversity Conservation Act 2016 (BC Act), the Squirrel Glider, Brush-tailed Phascogale and Masked Owl. Other threatened species recorded during the surveys in offset areas but not within nest boxes included the Varied Sittella, Square-tailed Kite, Glossy Black-Cockatoo and Koala. These are listed as vulnerable under the BC Act, while the Koala is also listed as vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

The majority of nest boxes were in good condition, although two nest boxes required replacing during September 2018. This included one Phascogale nest box at C4 and one Feathertail Glider nest box at A45. Minor degradation was noted on several other nest boxes, such as peeling or splitting of the plywood, slight warping of the lid, disintegration of the brace plate, chewing of entrance holes, small cracks on the outside of the nest box, and moisture appearing inside the nest box. One nest box is likely to required replacing during the next monitoring survey.

Overall, a total of 182 out of 210 nest boxes, or approximately 87%, have been occupied or shown signs of occupancy since their installation. This includes 100% of the Squirrel Glider nest boxes installed in February 2013, 76% of the additional nest boxes installed in August 2013, 91% of the additional nest boxes installed in September 2014, and 83% of the additional nest boxes installed in September 2016.

Occupancy of the nest boxes installed in August 2013 is lower than the other nest box groups, mostly due to the low occupation rate of animals within Feathertail Glider nest boxes, and the original single, double and four-chambered Microbat nest boxes. When these nest box designs are removed from the calculations, occupancy of the remaining nest boxes installed in August 2013 is 99%, and overall occupancy is 170 out of 175 nest boxes (approximately 97%). We recommend replacing the existing Feathertail Glider nest boxes with a design that has been demonstrated to be successful within the study area for occupation by fauna, as well as relocating microbat nest boxes that have been installed for 2 or more years and not shown signs of occupancy.

A total of twenty-three vertebrate species have now been recorded within nest boxes during the Nest Box Programme. This includes thirteen species of mammal, six species of bird, one species of frog, and three species of reptile."

Plate 1 - Sugar Gliders (***Petaurus breviceps)***

Plate 2 – Masked Owl at B18 nestbox (***Tyto novaehollandiae***)

5 WEED CONTROL AND MONITORING

Weed control is undertaken in accordance with the BMP Section 5.9 and Section 6.5. The weed control program aims to manage weeds to minimise their impact on native flora and fauna.

Table 2: Weed Control Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	Completion Criteria
Weed Control/treatment program in remnant enhancement and regrowth management VMUs	Primary woody weed control (Sections 5.9 and 6.5). Primary control of priority target weeds described in Sections 5.9 and 6.5 commenced. Follow-up woody and priority weed control undertaken as per Sections 5.9 and 6.5.	Follow-up woody and priority weed control undertaken as per Sections 5.9 and 6.5.	Target/priority weed coverage within offset VMUs reduced by 90%.
Weed control/ management in Installation (revegetation) VMUs	Pre-cultivation spraying in all installation VMUs undertaken including control of exotic Sporobolus and fireweed (Figure 7 and Section 6.11). Second cultivation spray in all installation VMUs undertaken including control of exotic Sporobolus and fireweed where necessary (Section 6.11). Additional pre-planting weed treatment in all installation VMUs undertaken if required (Section 6.11). Control of competitive plants within revegetation areas as detailed in Section 6.11.	Additional pre-planting weed treatment in all installation VMUs undertaken if required (Section 6.11). Control of competitive plants within revegetation areas as detailed in Section 6.11.	Control of competitive plants within revegetation areas until maintenance phase (detailed in Section 6.11) is complete i.e. 90% of canopy and shrub species have survived 12 months after planting including replanting of lost species.
Monitoring and reporting	Monitoring and documentation of weed species, occurrence and densities a per Section 7.1.	Monitoring and documentation of weed species, occurrence and densities as per Section 7.1.	Monitoring and reporting undertaken.

The general procedure for controlling weed involves:

- Monitoring to identify locations and densities of priority weed;
- Identification of suitable control measures;
- Implementation of the selected control measure by a suitable qualified person; and
- Follow-up inspections to evaluate effective of weed control.

Weed spraying activities are generally undertaken between the months of September and April each year. Physical management measures such as mechanical removal, slashing and/or back-burning can be undertaken at other times of the year as required.

Greening Australia were contracted to undertake an initial weed assessment of the offset area in August 2013. The aim of the weed assessment was to assist in setting priorities and developing on-ground actions for weed control and is presented in the form of a mapping survey. The mapping survey provides reference to individual weed infestations within each Vegetation Management Unit (**VMU**) for the biodiversity offset area. Each weed occurrence was allocated a priority ranking based on the species status i.e. noxious or agricultural, and the size and density of the infestation. The survey information contributed to the development of a strategic approach to the control of priority weeds and allow contractors to locate

infestations using the mapping files. Additionally, it will continue to assist in tracking weeds to gauge the effectiveness of control measures and the potential spread and future distribution.

A contractor is engaged at the DCM to undertake weed management activities on an ongoing basis. Follow-up weed treatment of all remnant enhancement and regrowth management VMUs recommenced in **October 2018** and continued through to **May 2019**. Additional weed management activities within the Mining Lease areas recommenced in **September 2018**. The key species targeted included blackberry, lantana, privet, wild tobacco and Giant Parramatta grass. This is the sixth round of weed control activities in the offset areas.

During 2017/2018, the removal of privet and wild tobacco adjacent to Mammy Johnsons River in the Biodiversity Offset areas was undertaken using mechanical removal (slashing), and chemical spraying in accordance with previous advice from the MidCoast Council (MCC) Weeds Officer.

Weeds monitoring to evaluate the effectiveness of control measures is undertaken in conjunction with the annual vegetation monitoring and is documented in the Duralie Coal Mine Biodiversity Offsets Monitoring of Landscape Function and Vegetation Structure, March 2019 (Appendix F).

Monitoring of the VMUs including the effectiveness of weed control will continue to be undertaken in conjunction with the Landscape Function Analysis (LFA) and vegetation monitoring. The 2019 monitoring report indicates that:

> *The installation VMUs generally consisted of exotic grasses and forbs, and observations of weeds were limited to environmental weeds. These included Blackberry, Camphor Laurel, Lantana, Privet and Wild Tobacco. Ongoing weed control works has resulted in only sparse occurrences of these weeds, except for VMU P and the remnant vegetation VMUs where steep slopes and access issues have allowed Lantana to become denser in places.*
>
> *Recommendation:*
>
> - *Targeted weed control in the remnant patches to prevent outcompeting the re-establishing native vegetation, with more widespread control works elsewhere.*

6 FERAL ANIMAL CONTROL AND MONITORING

Feral animal control is undertaken in accordance with the BMP Section 5.10 and Section 6.5. The objective of feral animal control program is to manage feral animals to minimise their impact on native flora and fauna in the Biodiversity Offset Areas or the impact on agricultural production in other surrounding areas.

Table 3: Feral Animal Management Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	Completion Criteria
Feral animal control program	Initial study undertaken.	Feral animal control as required.	Feral animal numbers within offset areas minimised as evidenced through monitoring data.
Monitoring and reporting	Monitoring and documentation of feral animal species undertaken.	Monitoring undertaken.	-

AMBS was commissioned to undertake the initial invasive animal survey, in accordance with Section 5.10 of the BMP in 2013. The objective of the study was to determine the range of invasive animals that occur or are likely to occur within the DCM and offset areas and provide recommendations for invasive animal control.

MDP Vertebrate Pest Management has been engaged by DCPL since 2016 to implement wild dog and fox control programs across property owned by DCPL including both the Stratford & Duralie Mining Leases and the Stratford & Duralie Biodiversity Offset Areas. During the reporting period wild dog control was undertaken between **August 2018** to **September 2018** and in **May 2019**. The program involved a combination of trapping and shooting.

Plate 3 – Wild Dog

Plate 4 – Wild Dog

In accordance with the BMP Section 5.10 a follow-up feral animal monitoring survey was undertaken by AMBS Ecology & Heritage during **April 2017** to monitor the success of control programs and determine priorities for ongoing control measures. The feral animal survey covered the Duralie Mining Lease and Duralie Biodiversity Offset Area.

An extracted summary of the survey results from the *Invasive animal study of the Duralie Coal Mining Lease and Offset areas, Gloucester Valley* (September 2017) is provided below (Appendix D).

> *The results of the current invasive animal survey were similar to those from the initial invasive animal survey in 2013. A total of 14 invasive species have been recorded in the study area in the past or during recent surveys or are considered to have potential to occur. Eleven of these species were either not recorded or were recorded in very low numbers during the current surveys and are of little concern at the current time. These include the Common Starling, House Sparrow, Mallard, Rock Dove, Spotted Turtle-Dove, House Mouse, Black Rat, Brown Hare and Deer. In accordance with the BMP the abundance of these species should be monitored every two years to determine if future controls are necessary.*
>
> *Four species of invasive animal were repeatedly recorded in the study area and are a potential threat to native biodiversity. These are the Fox, Feral Cat, Rabbit and the Common Myna. Wild Dogs were also recorded in the study area. Wild Dogs are mostly seen as an agricultural threat, preying on sheep, calves and other livestock (Fleming et al. 2001). They are not generally considered to have severe negative impacts on biodiversity, although this topic has not been well studied.*

In summary:

• Foxes and Feral Cats may represent a threat to biodiversity within the study area;

• Wild Dogs are present in the study area, and while they may or may not be a threat to biodiversity, are currently a declared pest species;

• The European Rabbit is present at low densities, but its abundance can increase rapidly, particularly if dog, fox and cat numbers decrease, and it is also a declared pest species;

• The abundances of all of the above species within the study area are likely to be inter-related.

It is therefore recommended that if control measures for Wild Dogs and/or European Rabbits are implemented in order to comply with the Pest Control Order, that any such control measures should be implemented together with control measures for Foxes and Feral Cats, in a co-ordinated manner, and the impacts monitored. Pest control in the study area should be considered in the context that the study area represents a small part of a much broader region. Pest control in the study area alone is likely to be of only temporary and limited benefit, unless carried out in a broader area in conjunction with other landholders, and carried out over the medium to long term.

A follow-up feral animal survey of the Duralie Mining Lease and Duralie Biodiversity Offset Area will be undertaken during the next reporting period. Feral animal monitoring will guide the ongoing management efforts for controlling feral animals.

7 CONTROLLING ACCESS AND MANAGING GRAZING

Controlling access and managing grazing is undertaken in accordance with the BMP Section 5.11, 6.6 and 6.7.

Table 4: Managing Grazing and Agriculture Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	Completion Criteria
Managing grazing and agriculture	Livestock excluded from the Offset through installation of gates and fencing illustrated in Figure 9 (Section 6.7).		Livestock excluded from the offset.
Monitoring and maintenance of fencing and gate infrastructure	Monitoring of gates and fencing to exclude livestock. Where required, maintenance undertaken and documented (Section 7.1).	Monitoring of gates and fencing to exclude livestock. Where required, maintenance undertaken and documented (Section 7.1).	Gates and fencing monitored and maintained.

Table 5: Controlling Access Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	CC
Operational Review to facilitate site access for offset management activities including installation, inspection and bushfire management	Operational Review developed. Review includes road, fire trail and culvert construction and requirements for fencing and revegetation cultivation/site preparation[2]. Maintenance activities, particularly track maintenance and slashing have been considered (Section 6.7, plus related Sections 6.9 and 6.5).		Operational Review undertaken and outcomes implemented.

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	CC
Community and stakeholder engagement	Assessment of surrounding landholders and the local community to evaluate opportunities for participation in implementation of this Biodiversity Management Plan undertaken. Local council consultation has commenced regarding placement of signage on the Johnson's Creek Road bisect area of the Offset (see Figure 9 for location) (Section 6.7). Signage has been installed on the Johnson's Creek Road bisect area of the Offset to alert drivers of potential fauna on the roads.		Opportunities for landholder and community participation in the BMP identified. Local council consulting regarding signage. Signage installed on Johnsons Creek Road.
Infrastructure including access tracks, fencing, fire trails and culverts	Access tracks, fire trails, firebreaks, fencing and culverts have been completed as per Figure 9 and the Operational Review[2] (Section 6.7).		Access related infrastructure identified in the Operational Review and completed.
Monitoring and maintenance of infrastructure including tracks, fire trails, signs, culverts and fences.	Monitoring and maintenance of all access tracks and fire trails has been undertaken[2] (Sections 6.7, 6.9 and 7.1).	Monitoring and maintenance of all access tracks, fire trails and warning signs has been undertaken[2] (Sections 6.7, 6.9 and 7.1).	Regular monitoring and maintenance program for roads, tracks, fire trails, signs, fences and culverts.

The implementation of the BMP management measures commenced in 2013. The BMP requires works to be undertaken to exclude livestock and control access to the Biodiversity Offset Areas.

Installation works to control access and manage grazing in the offset areas was completed in 2014. During the reporting period contractors were engaged to undertake maintenance activities on access tracks, culverts, gates and fences. The works included slashing of tracks, firebreaks and repairs to damaged gates and culverts. Additional signage was also installed on the key access points to the Biodiversity Offset Areas.

Livestock continue to be excluded from the Biodiversity Offset areas with the exception of 'crash grazing' programs in preparation for revegetation activities following a field assessment by a qualified consultant. However, during inspections of the Biodiversity Offset area, cattle were identified to have entered through damaged fencing on the eastern and northern boundaries. The cattle were removed and maintenance work was undertaken to repair the fencing.

Roadside Flora and Fauna signage has been installed in accordance with advice from Great Lakes Council and with regard to Australian Standard AS1742.2. Further correspondence was held with GLC Ecologist in 2015 regarding future requirements for traffic controls within the offset areas.

Plate 5 – Biodiversity Offset fencing and signage

8 BUSHFIRE MANAGEMENT

Bushfire management is undertaken in accordance with the BMP Section 5.12 and Section 6.9. The objective of bushfire management in the Biodiversity Areas is to prevent impacts from unplanned bushfire and to use fire to promote biodiversity.

Table 6: Bushfire Management Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	Completion Criteria
Operational Review to facilitate site access for offset management activities including installation, inspection and bushfire management.	Operational Review completed[2]. Areas addressed within the review include road, fire trail and culvert construction along with maintenance activities, particularly track slashing (Sections 5.12 and 6.7).		
Fire excluded from the offset for initial 3 years.	Fire excluded from offset prior to 2015 (Section 6.9).		Fire excluded from offset prior to 2015.
Bushfire management activities through hazard reduction actions installation and maintenance of relevant access infrastructure.	Access tracks, fire trails, firebreaks, fencing and culverts have been completed as per Figure 9 and the Operational Review 2 (Sections 6.7 and 6.9Fire management activities have been undertaken as required, including yearly access trail inspection, maintenance and repair of inaccessible tracks within one month of identification2, hazard reduction burning (Sections 5.12, 6.7 and 6.9).	Fire management activities have been undertaken as required, including yearly access trail inspection, maintenance and repair of inaccessible tracks within one month of identification2, hazard reduction burning (Sections 5.12, 6.7 and 6.9).	Regular bushfire management measures in place.
Monitoring and maintenance	Fuel loads monitored and documented (Sections 6.9 and 7.1). Identified issues incorporated into future management planning	Fuel loads monitored and documented (Sections 6.9 and 7.1). Identified issues incorporated into future management planning.	Fuel loads monitored and maintained. Risks identified and managed as part of part of hazard reduction actions.

Where possible, fire was excluded from the Biodiversity Offset area during the first three years (up to 2015) to assist with native regeneration.

To assist with bushfire management, access tracks and firebreaks have been constructed and maintained as shown in the BMP Figure 9.

DCPL engaged the NSW Rural Fire Service (RFS) in **August 2015** to assist in the development of a burn plan for hazard reduction burning in select areas of the Biodiversity Offset areas and surrounding mine owned properties. The burn plan considered areas where fire was to be excluded for bush regeneration in the Biodiversity Offset areas and areas were burning was required for hazard reduction prior to revegetation activities. A hazard reduction burn was undertaken by the RFS along Johnsons Creek Road on **13 August 2017**.

Continued discussions have been held with the RFS to conduct fire management activities and any such activities will be assessed and implemented to ensure the most appropriate period for ecological burn activities whilst also giving due consideration to personnel and asset safety.

Following the revegetation works, fire would mostly be excluded from the offsets areas for at least 5 years to allow for tubestock and seedlings to establish.

Monitoring of fuel loads to evaluate bushfire risk and guide bushfire hazard reduction activities is undertaken in conjunction with the annual vegetation monitoring. Further detail is included in Section 10 and Appendix F. Bushfire risk will continue to be mitigated through the maintenance of access tracks and fire breaks.

Plate 6 – RFS hazard reduction burning in August 2017

Plate 7 – RFS hazard reduction burning in August 2017

9 REVEGETATION MANAGEMENT

9.1 Seed Collection and Propogation

Seed collection and propagation is undertaken in accordance with the BMP Section 5.7 and 6.10.

Table 7: Seed Collection and Tubestock Supply Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	CC
Collecting and propagating seed	Seed collection (of required species as specified in Section 6.10 and Appendix D) has commenced during vegetation clearance or an alternate seed source has been obtained. (Sections 5.7 and 6.10). Seed collection from cleared vegetation finalised (Section 5.7). Seed collection to obtain required quantities and species for future revegetation continued (Section 6.10, Appendix D).		Seed collection necessary to obtain required quantities and species for future revegetation completed.
Plant propagation/ tubestock supply	Propagation of species required for revegetation work in Offsets commenced. Species and quantity as per guidelines in Section 5.7, 6.10 and Appendix D or adjusted based on additional literature/field trial results.	Propagation of species required for revegetation/supplementary infill planting work in Offsets undertaken as per guidelines in Sections 5.7 and 6.10 and Appendix D.	Plant propagation necessary to obtain quantities and species required for revegetation completed.

Revegetation in the BMP Revegetation Areas has occurred via seed and tubestock. Local endemic species are preferentially used where a seed supply is available, however consideration will be given to the use of a high quality seed sourced further from the site as required.

Where possible, seed required for revegetation activities has been collected from within the Biodiversity Offset area and surrounds. Specific tree and shrub species which have not been available for collection have been sourced through external third-party suppliers. Further seed collection may be undertaken if found necessary to meet the completion criteria of the BMP offset revegetation and mine site rehabilitation.

Kleinfelder and Cumberland Plain Seed have been engaged to assist in the propagation of native plant species with tube-stock grown under controlled nursery conditions and delivered to site as required for revegetation works.

9.2 Revegetation and Regeneration

Revegetation management is undertaken in accordance with the BMP Section 6.11 and 6.12. The aim of revegetation is to establish a range of habitat niches including native canopy, and understorey, with the goal of achieving self-sustaining vegetation communities as well as increasing the resilience to identified risks such as fire, herbivory and future weed invasion. The Revegetation VMUs in the Biodiversity Areas will be revegetated to substantially increase the area of native vegetation and maximise habitat diversity and a range of successional stages.

Table 8: Revegetation Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	Completion Criteria
Operational Review	Operational review including access, tracks and cultivation requirements for implementing revegetation completed (Section 6.7).		Operational Review completed and implemented.
Implementing Revegetation - Weed management and maintenance	Pre-cultivation spraying in all installation VMUs including control of exotic Sporobolus and fireweed undertaken (Sections 6.5 and 6.11). Pre-plant weed treatment in all installation VMUs as per Figure 7 undertaken as required (Sections 6.5 and 6.11). Control of competitive plants within revegetation areas as detailed in Section 6.11. Maintenance including watering and herbivory controls, undertaken as required (Section 6.11).	Pre-plant weed treatment in all installation VMUs as per Figure 7 undertaken as required (Sections 6.5 and 6.11). Control of competitive plants within revegetation areas as detailed in Section 6.11. Maintenance including watering and herbivory controls, undertaken as required (Section 6.11).	Pre-planting weed control undertaken, including control of threatening weeds Sporobolus and Fireweed. Competitive plants controlled during revegetation establishment.
Implementing revegetation	Initial cultivation of all proposed trial installation VMUs commenced (Vegetation Management Units I, S, U and AB.) according to guidelines in Section 6.11. Trial revegetation for VMUs I, S, U and AB completed. Plant palettes adjusted where field trails or research demonstrate alternative species/density (Section 6.10). Propagation of species required for revegetation work in Offsets commenced. Species and quantity as per guidelines in Sections 5.7 and 6.10 and Appendix D.	Revegetation planting finalised. All plants prescribed in Appendix D have been installed. (Section 6.11). Based on learnings from the revegetation trials, planting of tubestock/direct seeding in installation VMUs according to species palette and quantity guidelines in Appendix D and Section 6.1 has been completed	Species type and quantities planted according to threshold guidelines in the species palette or as guided by on site trials. 90% survival of canopy and shrub-layer plants 12 months after installation, including replacement of lost plants to above threshold levels. Revegetation areas have met Assessment Criteria and Completion criteria described in Table 24, Section 8 (e.g. 90% of all initial canopy species rates are present within VMUs).
Monitoring and reporting	Monitoring and reporting of trial revegetation results, changes to plant palette, plant health, establishment success and maintenance activities. (Section 7.1).	Monitoring and reporting of trial revegetation results, changes to plant palette, plant health, establishment success and maintenance activities. (Section 7.1).	Annual Monitoring and reporting completed.

Revegetation Preparation & Trials

Pre-cultivation weed spraying was undertaken in Summer to Autumn 2016 in preparation for the trial revegetation works. Initial revegetation works for VMUs I, S and U commenced in Autumn of 2016. Preparation works were completed including seed collection, inoculation, growing of tube-stock and ground preparations including weed spraying. The trial revegetation program included methods involving both tube-stocking, and direct seeding. Ground preparation was site specific and included weed spraying, crash grazing and back burning as required.

Revegetation works in VMUs AF, AE, AA and Z were undertaken during **December 2016** and included ground preparation and direct seeding of approximately 80 hectares. Due to the inability to undertake controlled burning, slashing was undertaken as an alternative option prior to direct and broadcast seeding.

Plate 8 - Loading seed for revegetation works.

Plate 9 - Spreading native tree and shrub seed.

Revegetation Implementation

Tubestock was propagated during Summer 2016/2017 in preparation for Autumn planting in 2017. VMUs Y, AD and S, (approximately 40 hectares), located on alluvial flats near Mammy Johnsons River were prepared for planting by slashing, spraying for weeds and ripping. This was followed by the planting of approximately 7,200 tube-stock in **April 2017**. The results of the 2017 re-vegetation activities are reported in the *DCM Biodiversity Offsets Revegetation Program Report Spring 2016 - Autumn 2017*.

Following the hazard reduction burning in **August 2017**, revegetation works in VMUs Z, AB and AC were undertaken. In **September 2017**, direct seeding of approximately 52 hectares was completed, followed by harrowing.

Plate 10: Tube-stock being prepared for the biodiversity offset.

Plate 11: Planted tube-stock.

Tube-stock planting of VMUs F, V, W and X was proposed for Autumn 2018 including approximately 16,000 plants over 61 hectares. The native tree seed was propagated over the Summer of 2017/2018 by Cumberland Plain Seeds. However, due to the slower than expected establishment of the tubestock, planting has been postponed during winter and completed in **September 2018**. The results of the 2018 re-vegetation activities are reported in the *DCM Biodiversity Offsets Results of Spring 2018 Planting Report*.

Plate 12: ***Tubestock planted in September 2018.***

Plate 13: ***Tubestock planted in September 2018.***

During Spring 2019, further revegetation works are proposed to reach the required woodland density and species diversity in VMUs F, V, W, X and AH. A total of approximately 14, 400 trees and shrubs over 61 hectares will be planted and the tubestock is currently being grown. Plans showing the area proposed for revegetation in the Biodiversity Areas in 2019 are included in Appendix E.

Monitoring

Following the initial re-vegetation works in 2015, annual vegetation monitoring (including LFA and vegetation dynamics) was undertaken in **January 2017** and continues to be undertaken annually. The results from the biodiversity offset monitoring are shown in Section 10. Results from the annual monitoring will be used to measure revegetation against the performance criteria and completion criteria and to determine future works requirements and maintenance activities.

10 BIODIVERSITY OFFSET MONITORING AND REPORTING

The Biodiversity Offset monitoring and reporting program is prescribed in the BMP Section 7. The program aims to monitor and report on the effectiveness of the BMP management measures and progress against the detailed performance and completion criteria.

Table 9: Monitoring and Reporting Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	CC
Monitoring and reporting	Monitoring and reporting has been undertaken[3] as per requirements in Sections 7.1 and 7.2. Independent Environmental Audit has been supplied to the NSW Secretary of the DP&E for review.	Monitoring and reporting has been undertaken[3] as per requirements in Sections 7.1 and 7.2.	Monitoring requirements completed when all completion criteria are achieved in accordance with Section 8 (e.g. 357.5 ha of revegetated woodland/open woodland habitat areas and 36 ha of revegetated forest habitat areas are a self-sustaining ecosystem).

As described in the Section 7 of the BMP an annual report reviewing DCPL's environmental performance and progress against the requirements of the BMP including monitoring and reporting is prepared annually and appended to the *Duralie Coal Mine Annual Review*. The Annual Biodiversity Report, reports on monitoring for:

- Effectiveness of revegetation in the offset area;
- Usage of the offset areas by fauna;
- Effectiveness of weed control;
- Effectiveness of feral animal control;
- Nest box monitoring program.

10.1 Habitat and Vegetation Condition Monitoring

Habitat and vegetation condition monitoring is undertaken to quantitatively measure the change in habitat and vegetation condition over time. The visual monitoring and photo monitoring programs are undertaken concurrently with the vegetation monitoring to provide additional information on the change of the Biodiversity Offset Areas over time and inform maintenance requirements.

To monitor the effectiveness of revegetation in the Biodiversity Offset areas Greening Australia was commissioned to undertake the baseline monitoring of LFA and vegetation structure within the Biodiversity Offset areas in **February 2013**. The baseline monitoring provides information to track the progression towards meeting the completion criteria of the BMP.

The annual vegetation and landscape function monitoring continues to be undertaken and was repeated in **March 2019.** The results are provided in the *DCM Biodiversity Offset Monitoring of Landscape Function and Vegetation Structure 2019* (Appendix F). An extracted summary is reproduced below. The next round of monitoring is scheduled for 2020.

> *In accordance with Section 7 of the Duralie Coal Mine – Biodiversity Management Plan (2018) monitoring and assessment of the of the effectiveness of the Offsets Area revegetation is required. This assessment will be conducted using the stipulated methodologies (Section 7.1 of the BMP) which include EFA (Ecosystem Functional Analysis) to*

measure the progression of the rehabilitation towards a self-sustaining ecosystem, floristic surveys and walkover surveys to assess the effectiveness of the revegetation efforts and weed control.

This report presents the results of the monitoring undertaken in March 2019. A subset of Vegetation Management Unit (VMU) transects were selected, which were established in the 2013 baseline survey. A total of 15 VMUs were monitored in the Offset Areas – 14 Installation VMUs (where active planting and seeding is required) and one regrowth management VMU (weed and erosion control only). These 14 VMUs had been the subject of active management where biomass reduction through slashing, grazing or ecological burns followed by planting and/or seeding had occurred, whereas the remaining VMU has been the subject of weed control works.

Overall the results of the revegetation effort to date has been partially successful. Tubestock planting has been the most effective with canopy species recorded in all VMUs where this has been undertaken, VMU U being the most successful although this was not necessarily reflected in the data given the placement of the transect. Direct seeding has not been as successful with only one area of the ecological burns undertaken (VMU Z) resulting in successful germination and survival of the seeded species. Negligible regrowth from the revegetation efforts were observed where slashing and then direct seeding was undertaken.

Natural regeneration is occurring throughout the VMUs with remnant patches observed during the walkover surveys recording good floral diversity and recruitment of canopy and shrub species. Recruitment from the edges of the remnant vegetation VMUs where they adjoin the installation VMUs was also observed.

The installation VMUs generally consisted of exotic grasses and forbs, and observations of weeds were limited to environmental weeds. These included Blackberry, Camphor Laurel, Lantana, Privet and Wild Tobacco. Ongoing weed control works has resulted in only sparse occurrences of these weeds, except for VMU P and the remnant vegetation VMUs where steep slopes and access issues have allowed Lantana to become denser in places.

It was concluded that the biophysical processes of the VMUs are operating satisfactorily for the predominant vegetation type currently in existence. Revegetation is still too young and sparse to have measurable effect upon these processes.

Recommendations made included:

- *A more strategic approach to revegetation with targeted tubestock planting of areas that will link up remnant patches within the Offsets Areas. This will allow a more intensive management effort including watering if necessary.*
- *Cool season ecological burns around the patches to stimulate the germination of seeds in the soil seed bank.*
- *Targeted weed control in the remnant patches to prevent outcompeting the re-establishing native vegetation, with more widespread control works elsewhere.*
- *Relocation of the transect in VMU U to a more representative location.*
- *Removal of cattle from the Offsets areas and repair of fencing.*

10.2 Fauna Monitoring

Monitoring of fauna usage within the Biodiversity Areas is conducted every three years to document the fauna species response to improvement in vegetation and habitat in the Biodiversity Areas and assess the performance in providing habitat for a range of vertebrate fauna. The surveys include an assessment of habitat complexity, species richness and abundance.

AMBS was engaged to undertake fauna monitoring within the Biodiversity Offset areas and native mine rehabilitation areas during February 2018. The results are provided in the *DCM Fauna Surveys of the Offset and Mine Rehabilitation Areas, February 2018* (Appendix G). An extracted summary is provided below.

> *"Targeted fauna surveys were undertaken at five sites within the Duralie Offset Area and two sites in the Duralie Mine Rehabilitation Area during February 2018. At most sites survey techniques included pitfall traps, funnel traps, Elliott A traps, harp traps, ultrasonic call recording, spotlighting, diurnal bird surveys and reptile searches. Opportunistic observations of signs of fauna were noted throughout the field survey period, including during transit between surveys sites".*
>
> *"A total of 124 species of vertebrate were recorded, comprising 8 frogs, 10 reptiles, 56 birds and 30 mammals…, most of which were native. With the exception of reptiles, a similar number of frog, mammal and bird species were recorded at Mine Rehabilitation Area sites compared with Offset Area sites. Five introduced species were recorded during the surveys, including Cattle (Bos taurus), House Mouse (Mus musculus), European Rabbit (Oryctolagus cuniculus), Black Rat (Rattus rattus) and Red Fox (Vulpes vulpes). Fifteen of the species detected are listed as threatened or migratory on the schedules of the Biodiversity Conservation Act 2016 (NSW) and/or the Environment Protection Biodiversity Conservation Act 1999 (Cth).*

Plate 14: Koala (***Phascolarctos cinereus***)

Plate 15: Long-nosed Potoroo (***Potorous tridactylus***)

11 MAMMY JOHNSONS RIVER STABILISATION

In accordance with Section 6.8 of the BMP a detailed design for the in-stream rehabilitation of a severely eroded section of Mammy Johnsons River (MJR) has been prepared by Alluvium (2013) (Appendix F). No works on the MJR bank stabilisation have commenced during the reporting period. Further planning is required.

Table 10: MJR Bank Stabilisation Performance Criteria (PC) and Completion Criteria (CC)

Management Action	Completed Activities to June 2018	Annually from June 2018 onwards PC Maintenance Phase	Completion Criteria
River bank stabilisation design	Design for the in-stream rehabilitation of a severely eroded section of Mammy Johnsons River has been prepared. Office of Water engaged regarding plan approval[1] (Section 6.8).		Design of stabilisation plan completed and approved by the Office of Water
River bank in-stream rehabilitation		In-stream rehabilitation works undertaken[1] (Section 6.8).	Rehabilitation of severely eroded section of Mammy Johnsons River completed.

12 LONG TERM SECURITY AND CONSERVATION BOND

12.1 Long Term Security

In accordance with Condition 42, Schedule 3 of Project Approval 08_0203, DCPL is required to make suitable arrangements for the long-term security of the Duralie Extension Project Biodiversity Offset Area. DCPL used the mechanisms available under section 88E(3) of the NSW Conveyancing Act, 1919, namely:

- Registration of a Positive Covenant under section 88E(3) of the NSW Conveyancing Act, 1919; and
- Registration of a Restriction on the Use of Land by a Prescribed Authority under section 88E(3) of the NSW Conveyancing Act, 1919.

Public Positive Covenants and Restrictions on the Use of Land for the Biodiversity Offsets have been registered on title with NSW Land and Property Information (LPI) in **May 2015**.

12.2 Conservation Bond

In accordance with Condition 44, Schedule 3 of Project Approval 08_0203, DCPL is required to lodge a Conservation Bond with the DP&E which covers the cost of implementing the Biodiversity Offset Strategy detailed in the BMP.

The conservation bond for the Biodiversity Offset areas was calculated by Greening Australia and verified by Rider Levett Bucknell in December 2013. The terms of the conservation bond in the form of a Bank Guarantee were approved by NSW Department of Planning & Environment (DP&E) on **12 December 2013**. The Bank Guarantee has been subsequently provided to DP&E.

In December 2017, an Independent Environmental Audit of the DCM was undertaken in accordance with PA 08_0203. A revision of the BMP was approved in January 2019 in accordance with PA 08_0203 Schedule 5 Condition 4. Following this, a revision of the conservation bond will be prepared and lodged with DP&E in accordance with Schedule 3 Condition 45. The revised conservation bond will be lodged in the next reporting period.

13 COMMONWEALTH EPBC APPROVAL COMPLIANCE REPORTS

In accordance with the Commonwealth Approval [**EPBC 2010/5396**], during the reporting period DCPL submitted to the Department of Environment and Energy (DoEE) the following compliance report:

- *Duralie Coal Extension Project Annual Compliance Report 2019, submitted on 12 April 2019 (Condition 20).*

Additionally, the following reports were submitted annually for the first five years following the commencement of the operation:

- *DCM Implementation of the Giant Barred Frog Management Plan Annual Reports (Condition 10);*
- *DCM Implementation of the Biodiversity Management Plan Annual Reports (Condition 14(i)).*

These reports are now required to be submitted every **fifth** (5) year before the anniversary of the commencement of the operations.

14 APPENDICES

Appendix A: DP&E approval of the BMP.

Appendix B: DCM Annual Review 2019 - Disturbance & Rehabilitation Areas Figure 4.

Appendix C: AMBS Ecology & Heritage - Nest Box Programme for the Duralie Offset Area, Annual Report for 2018.

Appendix D: AMBS Ecology & Heritage - Invasive animal study, Duralie Coal Mining Lease and Offset areas, 2017.

Appendix E: Biodiversity Offset Area – Areas proposed for revegetation in 2019.

Appendix F: Kleinfelder - DCM Biodiversity Offset Monitoring of Landscape Function and Vegetation Structure 2019.

Appendix G: AMBS Ecology & Heritage - DCM Fauna Surveys of the Offset and Mine Rehabilitation Areas, 2018.

Appendix H: Alluvium - Mammy Johnson's River – Bank Stabilisation Detailed Design, 2013.

(Appendices available on request)

Appendix 9:

Status Update on DCM Independent Environmental Audit 2017 Responses to Recommendations

DURALIECOAL
Part of the Yancoal Australia Group

Duralie Coal Mine - Independent Environmental Audit 2017
Recommendations and Responses

Audit Recommendations						
Audit Reference	**Condition**	**Management Area**	**Recommendation**	**Stratford Coal Response**	**Due Date**	**Status Update July 2018**
Previous Audit Recommendations						
1	**Table 2**	**Administrative**	Recommend a summary report following analysis of the inversion data is forwarded to EPA/OEH for consideration in any EPL variation.	DCPL accepts the recommendation.		
PA 08-0203 Non-compliance Recommendations						
2	**Sch 3, Con 9**	**Blasting**	Written approval should be obtained from the Secretary for any blasts outside approved hours.	DCPL accepts the recommendation.	Ongoing	No further action at this time.
3	**Sch 3, Con 17**	**Geochemistry**	Strict PAF management must be continued to ensure odour events are minimised.	DCPL accepts the recommendation. PAF management measures have been implemented and are ongoing.	Ongoing	Implementation of PAF and odour management procedures are ongoing.
4	**Sch 3, Con 43**	**Biodiversity**	The BMP should be updated to outline how measures relating to rehabilitation of creeks and drainage lines seek to ensure no net loss of stream length and aquatic habitat.	DCPL accepts the recommendation. Update with next BMP revision.	Q2 2018	The Duralie BMP has been revised during Q2 2018 and resubmitted to DPE on 29 August 2018.
5	**Sch 3, Con 48**	**Administrative**	Times should be recorded and screenshots taken in the future for updating the website on a fortnightly basis to confirm compliance with this condition and request amendment of condition at next modification.	DCPL accepts the recommendation.	Q2 2018	A function has been added to the Duralie website content management system which records the revision history for each page on the website.
PA 08-0203 Continual Improvement Recommendations						
6	**Sch 2, Con 8**	**Trains**	Scheduling of trains should be reviewed to ensure all scheduled train movements occur within the Conditions of Consent. A train was scheduled at 5.50am but did not depart until 6am.	DCPL accepts the recommendation.	Q2 2018	A new shuttle train contract has been established with Genesee Wyoming. Training and familiarisation on the shuttle train conditions and requirements was undertaken in September 2017.
7	**Sch 2, Con 8A**	**Administrative**	Recommend that times are recorded in the future with screenshot taken for updating the website within 12 hours of operating shuttle trains on the North Coast railway between midnight and 1am in exceptional circumstances to confirm compliance with this condition.	DCPL accepts the recommendation.	Q2 2018	A function has been added to the Duralie website content management system which records the revision history for each page on the website.
8	**Sch 3, Con 2**	**Noise**	A review of the NMP is required to ensure that it clearly stipulates internal monitoring sites or where a private Agreement to exceed relevant criteria as advised to DP&E applies; and those sites which are representative of private receivers and as such consent criteria does apply. It needs to be confirmed which noise monitoring sites apply to each closest private receiver. Where noise monitoring sites are representative of private receivers, but the noise monitoring is on mine owned land, the relevant criteria the private house should be stipulated (derived from modelling) and approved by DP&E.	DCPL accepts the recommendation. Revised noise monitoring locations would be proposed in consultation with DP&E to represent private receivers. Update with next NMP revision.	Q2 2018	A revision of the Duralie NMP has been prepared during May 2018. The revised plan includes updated monitoring requirements and locations to reflect landownership and private agreements. The plan has also been updated to reflect the reduced hours of operation at Duralie. The NMP was approved by DPE on 9/05/2018 and is available on the Duralie website.
9	**Sch 3, Con 7**	**Noise**	Consultation with the EPA should be undertaken for future updates of the NMP or DP&E approval, particularly where plans are being updated for closure status.	DCPL accepts the recommendation.	Q2 2018	The EPA advised in correspondence dated 08/03/2018, it supports the development of Environmental Management Plans, however the EPA does not review or provide comment on these documents. This advice has been noted in the EMPs and provided to DPE.
10	**Sch 3, Con 29**	**Water**	Any future updates to the SWMP include additional details on the final void design, Coal Shaft Creek reconstruction, closure objectives and specific performance criteria.	DCPL accepts the recommendation. Update with next WMP revision.		
11	**Sch 3, Con 32**	**Administrative**	Revision status register in the GBFMP to be updated to indicate if the current version is approved by DP&E and evidence of such approval included within the plan.	DCPL accepts the recommendation. Update with next GBFMP revision.	Q3 2018	The GBFMP revision table has been updated with the approval dates included.
12	**Sch 3, Con 39**	**Biodiversity**	Hollow bearing habitat features should be introduced into revegetated areas.	Action included in the BMP. Hollow bearing habitat features would be installed following the establishment of vegetation in the biodiversity offset revegetation areas.	Q2 2018	The Duralie BMP has been revised during Q2 2018 and resubmitted to DPE on 29 August 2018.
13	**Sch 3, Con 43**	**Biodiversity**	The BMP should be updated to outline how measures relating to rehabilitation of creeks and drainage lines seek to ensure no net loss of stream length and aquatic habitat.	DCPL accepts the recommendation. Update with next BMP revision.	Q2 2018	The Duralie BMP has been revised during Q2 2018 and resubmitted to DPE on 29 August 2018.
14	**Sch 3, Con 44**	**Biodiversity**	Conservation bond is reviewed and revised as required, due to update of BMP in 2017.	DCPL accepts the recommendation. The BMP would be revised and the conservation bond reviewed during 2018.	Q4 2018	A revision of the conservation bond is currently being prepared.
15	**Sch 3, Con 48**	**Administrative**	The audit has no means of determining whether the records of exceptional circumstances have been made available on a fortnightly basis on DCPL's website. It is recommended that times and dates are recorded or screenshot taken to demonstrate compliance with this condition.	DCPL accepts the recommendation.	Q2 2018	A function has been added to the Duralie website content management system which records the revision history for each page on the website.
16	**Sch 3, Con 55**	**Rehabilitation**	Recommend Annual Reviews discuss the Rehabilitation objectives in Table 12 of this condition and discuss how each is being met or worked towards.	DCPL accepts the recommendation. Include in next Annual Review.	Q3 2018	A discussion progress towards meeting the DCM rehabilitation objectives has been included in the 2018 DCM Annual Review.
EPL 11701 Continual Improvement Recommendations						
17	**P1**	**Air Quality**	Recommend considering justifying and removal of dust gauges and modify commensurate with closure status. AQMP would also require update for consistency.	DCPL accepts the recommendation. EPL variation to be considered during closure phase.	Next EPL variation	No change.

18	**L4.2**	**Noise**	A discussion with the EPA is recommended with the aim of modifying this condition to permit acoustically equivalent locations to be adopted for the noise compliance measurements to minimise disturbance to residents. NMP would also required update.	DCPL accepts the recommendation. Revised noise monitoring locations would be proposed in consultation with DP&E and EPA to represent private receivers. Update with next NMP revision.	Q2 2018	A revision of the Duralie NMP has been prepared during May 2018. The NMP was approved by DPE on 9/05/2018 and is available on the Duralie website.
19	**O5.1**	**Administrative**	Recommend the last sentence of this condition is removed at next variation request, relating to the development of an emergency response plan as the date has been superseded and is no longer relevant.	DCPL accepts the recommendation. Revise with next EPL variation.	Next EPL variation	No change.
20	**M9**	**Noise**	Recommend this condition is removed. Condition relates to submitting a noise compliance report within 30 days of the completion of quarterly monitoring.	DCPL accepts the recommendation. Revise with next EPL variation.	Next EPL variation	No change.
ML 1646 Non-compliance Recommendations						
21	**5**	**Administrative**	Recommend that any incidents that meet the definition under this condition are reported to DRG in the future	DCPL accepts the recommendation.	Ongoing	No further action at this time.
General Recommendations						
22		**Administration**	All approval and consultation letters are appended to management plans appendices in the future.	DCPL accepts the recommendation.	Ongoing	No further action at this time.
23		**Administration**	It is recommended that consultation is undertaken for any future revisions to management plans or approval from DP&E sought not to consult.	DCPL accepts the recommendation. DCPL will undertake consultation on all management plans and revisions as required by the Development Consent conditions.	Ongoing	No further action at this time.
24		**Air**	Amend sentence in the AQGGMP Section 3.1.1 that states no PM2.5 criteria in NSW to reflect recent legislative changes at next update.	DCPL accepts the recommendation. Update with next AQGGMP revision.	Next AQMP revision	
25		**Consultation**	Recommend that consultation with regulatory departments is undertaken for updates of management plans or approval from DP&E is sought to not consult.	DCPL accepts the recommendation. DCPL will undertake consultation on all management plans and revisions as required by the Development Consent conditions.	Ongoing	No further action at this time.
26		**Ecology**	Table 7 of the BMP contains an incorrect reference to Section 6.13 for a discussion on canopy bridges. This should be updated to Section 6.14 when BMP next revised.	DCPL accepts the recommendation. Update with next BMP revision.	Q2 2018	The Duralie BMP has been revised during Q2 2018 and resubmitted to DPE on 29 August 2018.
27		**Ecology**	It is recommended that the BMP is updated with the following changes when next revised as suggested by KW: • Table 10 of the BMP is updated to include details for the Varied Sittella for consistency. Additionally, given that the BMP addresses multiple offsetting requirements, it is recommended that the BMP includes a summary table indicating the list of threatened fauna species recorded within the surface development area and the areas of habitat (current and future) within each of the different offset areas; • allowance for installation of hollow-bearing habitat features within revegetation areas; • Include clear short, medium and long term measures for the offset areas, or indicate that medium and long term measures have been amalgamated; and • Include the requirement for the submission of records of captured individuals of Threatened species.	DCPL accepts the recommendation. Update with next BMP revision.	Q2 2018	The Duralie BMP has been revised during Q2 2018 and resubmitted to DPE on 29 August 2018.
28		**Rehabilitation**	The following recommendations were made by CR: • Continue rehabilitation techniques along eastern edge of mine area and apply upon the final shaping of the overburden emplacements. Continue to monitor and manage weed species as required; • Continue to monitor and manage weed species and species diversity as required in the mine rehabilitation to forest community; and • Continue same process of rehabilitation as per previous efforts in shaped and topsoiled areas to ensure consistent results (CR, 2018).	DCPL accepts the recommendation.	Ongoing	DCPL will continue to implement rehabilitation procedures described in the Duralie MOP which have been proven to be successful.
29		**Spontaneous Combustion**	Outcomes from the actions in the DCPL response letter (dated 23/09/16) to the Spontaneous Combustion incident on 29 July 2016 should be included in the next Annual Review.	DCPL accepts the recommendation. Include in next Annual Review.	Q3 2018	Comments on spontaneous combustion have been included in the 2018 DCM Annual Review.
30		**Training**	Induction (and log on induction) is improved by adding additional detail such as the general management processes used for dust, noise, water, odour and heritage on site as well as identifying any of the sensitive areas in relation to these.	SCPL accepts the recommendation. Review of the Stratford Coal inductions packages commenced in February 2018.	Q4 2018	Stratford Coal generic induction revised.
31		**Training**	Recommend that the induction package includes PIRMP (list of inclusions in Section 11) and an assessment of competency.	SCPL accepts the recommendation. Review of the Stratford Coal inductions packages commenced in February 2018.	Q4 2018	Stratford Coal generic induction revised.
32		**Waste**	Recommend update contractor to JR Richards in Section 5 of the WaMP.	DCPL accepts the recommendation.	Q2 2018	The Duralie Waste Management Plan has been updated during Q2 2018.
33		**Waste**	Section 7 of the WaMP references a Community Management and separate Coordinator. Recommend this is updated to current.	DCPL accepts the recommendation.	Q2 2018	The Duralie Waste Management Plan has been updated during Q2 2018.
34		**Water**	Actions should be taken to ensure any outstanding actions from the dams compliance audit are addressed.	DCPL accepts the recommendation.	Q2 2018	Follow-up on the Dams Compliance Audit actions has been undertaken with the individual departments (EPA, DPE, DIRR). Refer separately to the audit responses to recommendations and action tracking in Intelex.

Appendix 10:

Rehabilitation Monitoring Report 2019

2019 Duralie Coal Mine Rehabilitation Monitoring Report

Yancoal Pty Ltd

Duralie Coal Pty Ltd

1164 Buckett's Way via Stroud Road
NSW, 2422

2019 Duralie Coal Mine

Rehabilitation Monitoring Report

Duralie Coal Pty Ltd

1164 Buckett's Way via Stroud Road
NSW, 2422

Kleinfelder Document Number: NCA19R98278
Project No: 20200566

Prepared for:

YANCOAL PTY LTD
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EXECUTIVE SUMMARY

The survey of the Duralie Coal Mine Rehabilitation areas conducted in May 2019 was the sixth survey in accordance with the Duralie Coal Mine – Mining Operations Plan & Rehabilitation Management Plan (MOP) (2017) to assess the rehabilitation progress against the project specific performance and completion criteria. Using Landscape Functional Analysis (LFA) and vegetation dynamics the survey provides indicators of rehabilitation success and assessment of landscape processes obtained from measurements at ten 25m transects representing the various ages of rehabilitation summarised below.

Table 1: Summary of transects surveyed in 2019

Year Rehabilitated	No. Transects Surveyed	Transect Designation
2008	2 (Native Woodland)	3045, 3444
2010	1 (Native Woodland)	3454
2011	1 (Native Woodland)	3048
2012	3 (Native Woodland)	3041, 3054, 3466
2013	1 (Native Woodland)	3503
2016	2 (Native Woodland)	3501, 3502
2018 (new this survey)	1 (Pasture)	3504

Processes associated with the soil surface are reported as three main indices;

- *Stability Index - measures the ability of the soil to resist erosion and to reform after disturbances;*
- *Infiltration Index - measures how the soil partitions rainfall into soil-water that is plant available and runoff that is lost from the local system and may also remove nutrients and other materials; and,*
- *Nutrient Cycling Index - how efficiently organic matter is cycled back into the soil.*

The development of the woody vegetation is tracked by measuring the number of plants per hectare and calculating the volume of canopy for each distinct layer of vegetation. This is presented as Vegetation Structure. Observations of weeds and desirable native species are recorded.

The results for the above indices from this year's survey were compared to the average index scores from a subset of six analogue transects established in remnant woodland vegetation communities of the Duralie Biodiversity Offset area and surveyed in January 2017.

Overall, the rehabilitation of the Duralie Spoil Emplacement continues to progress satisfactorily and is on a trajectory towards meeting the performance and completion criteria detailed in the MOP. LFA indices are continuing to achieve or approach the analogue site.

By index:

- *Stability Index – all rehabilitation greater than three years old has achieved Analogue index scores. Younger rehabilitation – 2016 – has improved. This is the first survey of the 2018 rehabilitation area but is relatively stable due to good vegetation cover and flat slope. Overall the soil surface is intact with no active erosion observed.*
- *Infiltration Index – the transects surveyed in 2019 remain below the Analogue benchmark score and require further time for development. The 2008 rehabilitation achieved the highest index score, with the younger rehabilitation achieving progressively lower scores; and*
- *Nutrient Cycling Index – the 2008 rehabilitation achieved the analogue value, with the remaining rehabilitation ages trending upwards. This is termed a lagging index and requires the greatest length of time to achieve analogue values.*

The vegetation structure on the spoil emplacement is still at a relatively early stage of development when compared to remnant vegetation found on the analogue sites.

Stem density is variable across the spoil emplacement, but almost without exception the rehabilitated areas have lower overall numbers of plants than the average analogue values. Stem densities are also variable within each rehabilitation area and reflects both transects surveyed and natural processes at work. Area of 2008 and 2012 rehabilitation are experiencing die-off of Acacia species resulting in more open areas dominated by exotic grasses. Two rehabilitation areas, the 2011 and the 2016 rehabilitation have recorded increase in stem densities.

The distribution of the vegetation by strata is considerably different in the rehabilitated areas when compared to analogue sites, with distribution of stem densities reversed. In the rehabilitation areas, Eucalypt densities – i.e. canopy – are generally the bulk of the stems, and much higher than the analogue density regardless of age rehabilitation. The only exception to this is the 2013 rehabilitation where canopy numbers are still quite low or non-existent. The shrub stratum on the other hand is largely composed of juvenile Eucalypts and Acacias, whereas analogue sites, the shrub stratum is dominant in terms of numbers. 2010 and some areas of the 2008 rehabilitation have recorded an increase in new native species – particularly in the shrub and forb layers that appear to have established naturally. Earlier surveys noted

the establishment of avian spread species, whereas these species are heavier seeded and are spread by other vectors e.g. wind or other fauna.

Canopy volumes have increased across the entire spoil emplacement – as expected – as vegetation matures and increases in size.

Weed species, dominated by Lantana, Wild tobacco and Privet were noted in the older rehabilitation areas.

It was concluded that the rehabilitation of the spoil emplacement is progressing satisfactorily, with the following recommendation made:

- *Plant or seed canopy species into the area surrounding Transect 3502.*
- *Improve the overall vegetation structure of the older areas of rehabilitation by implementing a modest seeding and/or planting program of shrub species to better match the structure of the analogue sites, especially where Acacia die-off has occurred.*
- *More generally further introduction of a wider variety of shrub species, especially those that do not spread by avian fauna could be facilitated with a modest seeding and/or planting program.*
- *Leucopogon juniperinus (Prickly Beard-heath) is a common species through the analogue sites but is not provided commercially. It would be beneficial to attempt to collect seed from on site to use in the rehabilitation introducing it to younger rehabilitation areas or where it has not yet colonised. The PAF area and VMU AG both have dense populations of this specie and it may be possible to collect seed from these areas. PlantNET states that seed are mature from August to January.*
- *Woody weed control works should be undertaken in the areas identified above where Lantana and Wild tobacco (and Privet identified during other work undertaken the spoil emplacement) have become established.*
- *As part of the above the drains could be slashed to provide access for weed control works and to provide fire breaks.*

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Appendices

1. INTRODUCTION

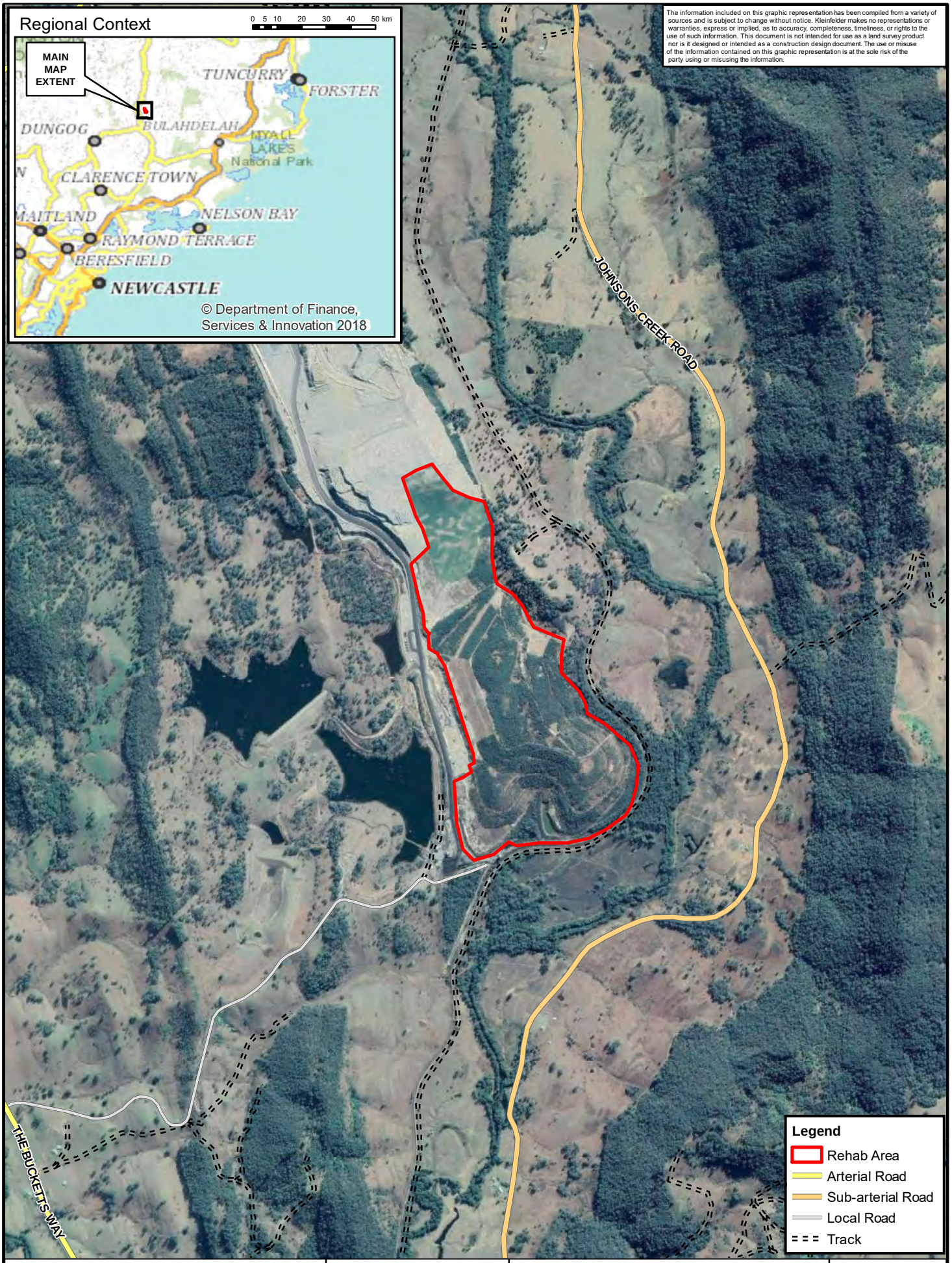
Duralie Coal Pty Ltd (DCPL) is a wholly owned subsidiary of Yancoal Australia Ltd and operates the Duralie Coal Mine (DCM). The DCM is located between the small towns of Stroud Road and Wards River, approximately 80km north of Newcastle in New South Wales (**Figure 1**). Approval for mining was granted in 1997 and coal production commenced in 2003.

The DCM operates under two key approvals, NSW Project Approval (08_0203) and the Commonwealth Approval (EPBC 2010/5396). Both may be viewed at http://www.duraliecoal.com.au.

In accordance with Section 8.1 of the Duralie Coal Mine – Mining Operations Plan & Rehabilitation Management Plan (2017) monitoring and assessment of the quality and ecological value of the woodland rehabilitation will be required. This assessment will be conducted using EFA (Ecosystem Functional Analysis) to measure the progression of the rehabilitation towards a self-sustaining ecosystem. This report is submitted to fulfil this requirement.

1.1 SCOPE AND RATIONALE

Kleinfelder Australia was commissioned by DCPL to conduct LFA and EFA monitoring to ensure compliance with the above stated objectives. As part of the monitoring program, Kleinfelder undertook to conduct LFA and EFA monitoring at transects situated to provide representative data of rehabilitation age, slope and aspect. This, the sixth annual survey (the fourth conducted by Kleinfelder Australia staff) was carried out between the 22nd and the 23rd May 2019.



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PROJECT REFERENCE: 20200566

DATE DRAWN: 2/08/2019 14:32 Version 1

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2018
Google Earth - 2018

Locality

Duralie Coal Pty Ltd
2019 Duralie Coal Mine Rehabilitation Monitoring Report
1164 Buckett's Way via Stroud Road NSW

FIGURE:

1

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2. METHODS

2.1 TRANSECTS SURVEYED

The 2019 survey utilised a combination of a subset of the original 20 Greening Australia transects on the DCM spoil emplacement which were surveyed in 2013 and 2014, and new transects established to monitor more recent rehabilitation. **Table 2** details the transects by age of rehabilitation surveyed in 2019. **Figure 2** shows the location of the transects on the Duralie Spoil Emplacement and the age of rehabilitation monitored.

Table 2: Year of rehabilitation and designation of the transects selected for monitoring in 2019

Designation	Age of Rehabilitation	Rehabilitation Type	Aspect	Transect Bearing
3045	2008	Native Woodland	South	180
3444		Native Woodland	South West	255
3454	2010	Native Woodland	North East	270
3048	2011	Native Woodland	East	72
3041	2012	Native Woodland	South	190
3054		Native Woodland	West	76
3466		Native Woodland	East (Flat)	242
3503	2013	Native Woodland	East	80
3501	2016	Native Woodland	West	260
3502		Native Woodland	South	170
3504	2018	Pasture	North (flat)	350

The 2016 survey (the first undertaken by Kleinfelder) utilised 10 of these previously established transects, having ascertained in conjunction with Yancoal staff that this number satisfied reporting requirements (**Table 3**). The 2017 survey utilised a different set of six established transects with an additional four new transects – two transects in areas of the spoil emplacement rehabilitated in 2016, one transect in 2013 rehabilitation and one transect in an area of 2008 rehabilitation that had not been previously surveyed. This survey, a new transect has been established in a recently rehabilitated area of the spoil emplacement. While data collected from this survey was not from the same transects as surveyed in 2018, all ages of rehabilitation are represented in all surveys. **Table 3** compares the transects used for the 2016 – 2018 surveys to the 2019 survey.

Monitoring photographs were taken looking along transects from the starting peg with the tape measure visible if possible, as well as representative photographs of the query zones of each transect.

Table 3: Comparison of transects surveyed from 2016 – 2019

Year Rehabilitated	2016 Survey	2017 Survey	2018 Survey	2019 Survey
2008	3045			3045
	3443	3444 (new)	3443	3444
	3474	3042		
	3450		3450	
2010	3046	3454	3046	3454
2011	3043	3048	3043	3048
2012	3041	3044	3055	3041
	3049	3052	3056	3054
	3055	3466	3047	3466
2013		3503	3503	3503
2016		3501	3501	3501
		3502	3502	3502
2018 (Pasture)				3504 (new)

2.2 LANDSCAPE FUNCTIONAL ANALYSIS

Landscape Functional Analysis is a monitoring technique that uses eleven soil surface characteristics to determine the functional status of a landscape and is fully described in Tongway and Hindley (2011). These soil surface characteristics correspond to a range of physical, chemical and biological processes that control movement of water, topsoil and organic matter in a landscape. The landscape is divided into a patch and interpatch system along transects where water and nutrients are accumulated or shed respectively. Full data for each transect is provided in **Appendix 1**.

2.3 VEGETATION STRUCTURE

The second component of the monitoring consisted of assessing the vegetation structure at each transect. The “point-centre-quadrat” method as outlined in Tongway and Hindley (2011) was employed to collect density and canopy size of vegetation present at each transect. At 5 x 5m points along transects, the distance to the nearest stem or other important species or

structural component (i.e. largest canopy) was measured and the plant height, canopy density, and dimensions (breadth and width) were recorded. Tallest trees had dimension estimated, whereas smaller stems (<4m) were measured.

2.4 DATA ANALYSIS

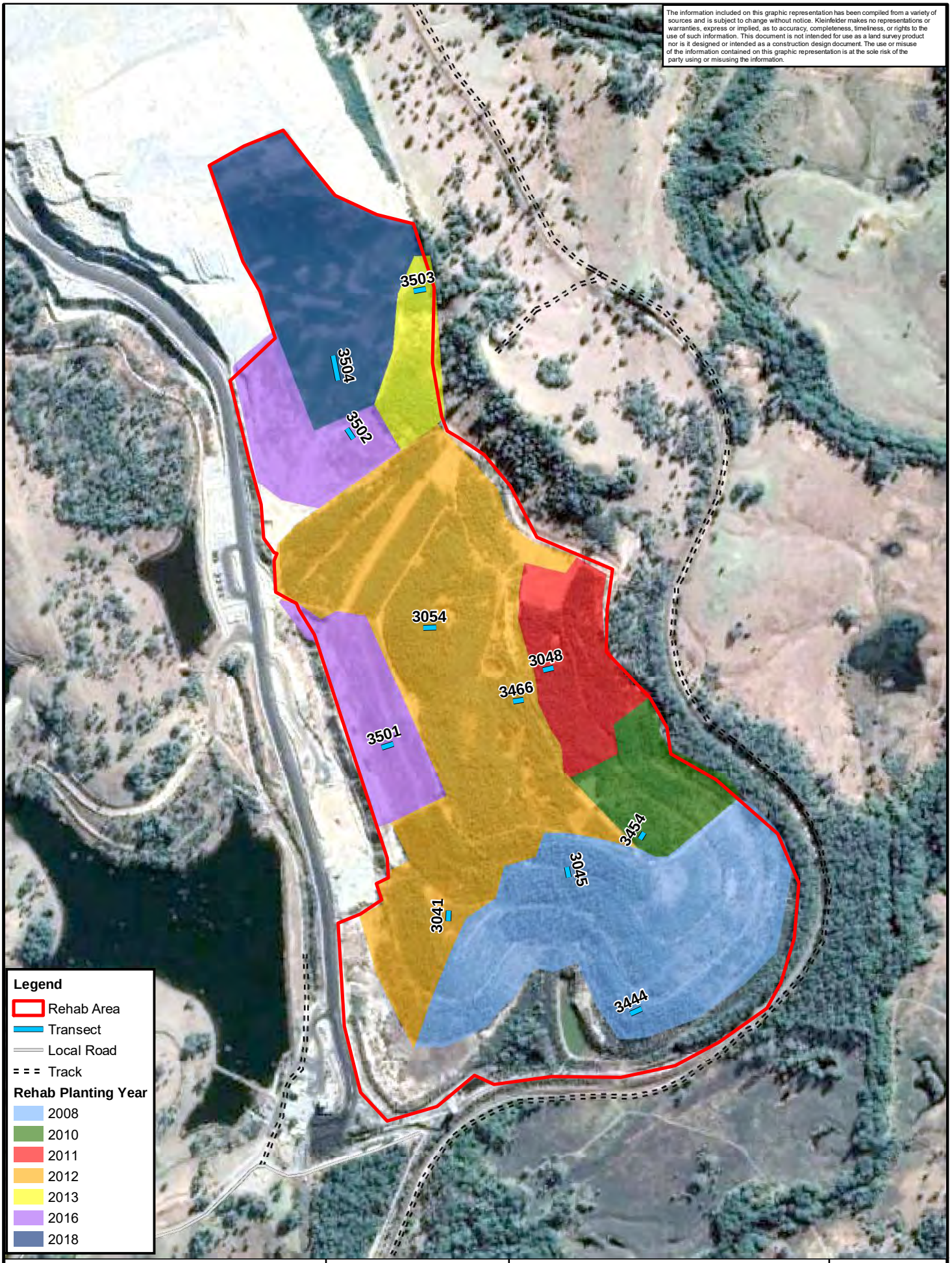
The collected data is input into a software system purpose-designed for LFA where a series of tables are generated providing data on both a hillside and a patch basis. This data can then be used to provide insight into the functional status of the landscape.

Vegetation Structure data is also input into purpose-designed software where woody plant density and vegetative volume on a per hectare basis is calculated. These surveys were conducted in conjunction with the LFA monitoring using the same transects for data collection from the six ages of rehabilitation (**Table 2**). Raw data for each transect is presented in **Appendix 2**.

Analogue data for comparison of monitoring on the spoil emplacement was undertaken in 2017 (Kleinfelder, 2017). Surveys were undertaken in six vegetation management units (VMUs) representing the most common woodland and vegetation communities in the Biodiversity Offset areas. This data is included for comparison to the monitoring results from the 2013 and 2014 surveys for LFA in the Duralie Biodiversity Offset area (**Table 4**).

Table 4: LFA Index results from the six analogue sites (Woodland Remnant Offsets) surveyed in the 2017 Biodiversity Offsets Monitoring Report

Index	Stability Index			Infiltration Index			Nutrient Cycling Index		
Survey Year	2013	2014	2017	2013	2014	2017	2013	2014	2017
Index Score	71.5	69.6	76.9	47.3	51.0	68.9	44.6	44.1	61.7
Standard Error	4.2	7.7	1.9	3.9	5.5	5.5	4.8	5.0	5.1



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DATE DRAWN: 4/09/2019 17:05 Version 1
DRAWN BY: GJoyce
DATA SOURCE:
NSW DFSI - 2018
Google Earth - 2018

2019 Transects

Duralie Coal Pty Ltd
2019 Duralie Coal Mine Rehabilitation Monitoring Report
1164 Buckett's Way via Stroud Road NSW

FIGURE:
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3. 2019 SURVEY RESULTS

3.1 SOIL SURFACE INDICES

3.1.1 Stability Index

Results from the 2019 survey show that the stability index is exceeding benchmark (analogue site) values (76.9 ± 1.9) for all rehabilitation older than 3 years. 2016 rehabilitation is approaching this value at 74.4 ± 3.2 and 2018 rehabilitation with a relatively high initial value, however largely variable at 73.7 ± 10.3 (**Table 5** and **Figure 3**). Several ages of the rehabilitation (2010, 2011, 2012 and 2013) have achieved or exceed the analogue value. 2008 rehabilitation is variable with one transect close to analogue values and far exceeding the analogue value (e.g. Transect 3444), resulting in an average score higher than the previous survey. 2012 rehabilitation shows all transects are exceeding analogue values, with an average stability index of 80.5 ± 3.5 recorded. The more recent areas of the spoil emplacement to be rehabilitated in 2016 have increased grass coverage and litter production compared to the last survey and consequently have recorded increased stability index scores, averaging 74.4 ± 3.2. The initial measurements in 2018 rehabilitation show good stability due to the flat surface that promotes resource capture, however the measurements are still variable with patches of vegetation of litter cover integrated with more sparse areas (**Table 5** and **Figure 3**)**.** All rehabilitation is trending toward increasing levels of stability with no specific areas of concern.

3.1.2 Infiltration Index

A benchmark value of 68.9 ± 5.5 was recorded for this index from the Analogue sites in 2017. Results from this year's survey shows that none of the rehabilitation areas have achieved this benchmark. Transect 3045 (61.1 ± 5.7) in the 2008 rehabilitation was the highest score recorded in this survey, but on average the more recent the rehabilitation, the lower the index score, with one of the 2016 rehabilitation areas recording the lowest score (36.5 ± 6.7) and 2018 showing a similar level at 38.8 ± 9.7 (**Table 5** and **Figure 3**)**.**

3.1.3 Nutrient Cycling Index

With an average index score of 61.7 ± 5.1, the analogue nutrient cycling index has been achieved by the oldest rehabilitation area, with the 2008 scores reaching 61.1 ± 5.59. All other years of rehabilitation are lower than analogue values of nutrient cycling, however, are trending upward with each year of monitoring. The 2016 rehabilitation is relatively young and as expected is not yet achieving analogue levels, however the index is increasing upward, having risen from 29.9 ± 5.85 to 39.0 ± 4.49 since the first year of monitoring.

3.1.4 Other Soil Surface Indicators

Landscape Organisational Index (LOI) (**Table 5**) scores for the transects in the different rehabilitation areas are uniform, with all rehabilitation areas being assessed entirely as “patch”, i.e. areas of nutrient accumulation, thus they have LOI’s of 1.00. Transect 3502 (2016 rehabilitation) recorded an LOI of 0.47 in the previous monitoring round, and this year increased to 1.00, showing an overall increase in cover that has been steadily trending upward since the first year of monitoring.

Average Patch Width measures the cross slope spread of the patches. The Analogue sites recorded an average patch width of 6.63m, with most of the rehabilitation areas recording a width of 10m – the maximum that the LFA system can record. This indicates that the patch system identified in the surveys is very uniform with a minimum of variation as expected for areas seeded with grasses. One area of 2008 rehabilitation (Transect 3045) had a decrease in patch width from 10 to 8.67/10m, due to disturbance by animal movement through the area, resulting in some bare areas of soil. Animal activity such as tracks by macropods or foraging disturbance by bandicoots can have a noticeable if localised effect on the soil surface and the revegetation.

Table 5: **Results of the 2019 Landscape Functional Analysis survey at Duralie Coal Mine spoil emplacement by transect and age of rehabilitation compared to average results from the Analogue sites in the Biodiversity Offsets areas (surveyed 2017).**

Year Rehab	Transect	Stability Index	SE	Infiltration Index	SE	Nutrients Cycling Index	SE	LOI	No Patches /10m	Ave Patch Width (m)
Analogue Average		76.9	1.9	68.9	5.5	61.7	5.1	1	1.9	6.63
2008	3045	75.9	2.5	61.1	5.7	58.2	8.3	1	1.2	8.67
	3444	85.0	2.6	58.8	5.3	63.9	2.9	1	0.4	10
2010	3454	83.9	0.5	45.9	1.7	48.5	2.1	1	1	10
2011	3048	84.4	0.0	51.8	4.2	56.5	3.7	1	0.4	10
2012	3054	77.5	4.1	50.3	7.4	49.1	8.6	1	0.4	10
	3047	84.5	2.3	49.4	4.0	54.7	5.4	1	1	10
	3041	79.4	4.2	52.4	3.9	49.4	7.8	1	0.4	10
2013	3503	79.8	2.8	47.2	2.3	50.5	3.8	1	1.2	10
2016	3501	72.5	3.1	43.4	3.1	40.4	1.3	1	0.4	10
	3502	76.3	3.3	36.5	6.7	37.6	7.7	1	0.5	10
2018	3504	73.7	10.3	38.8	9.7	36.1	14.4	1	0.2	10

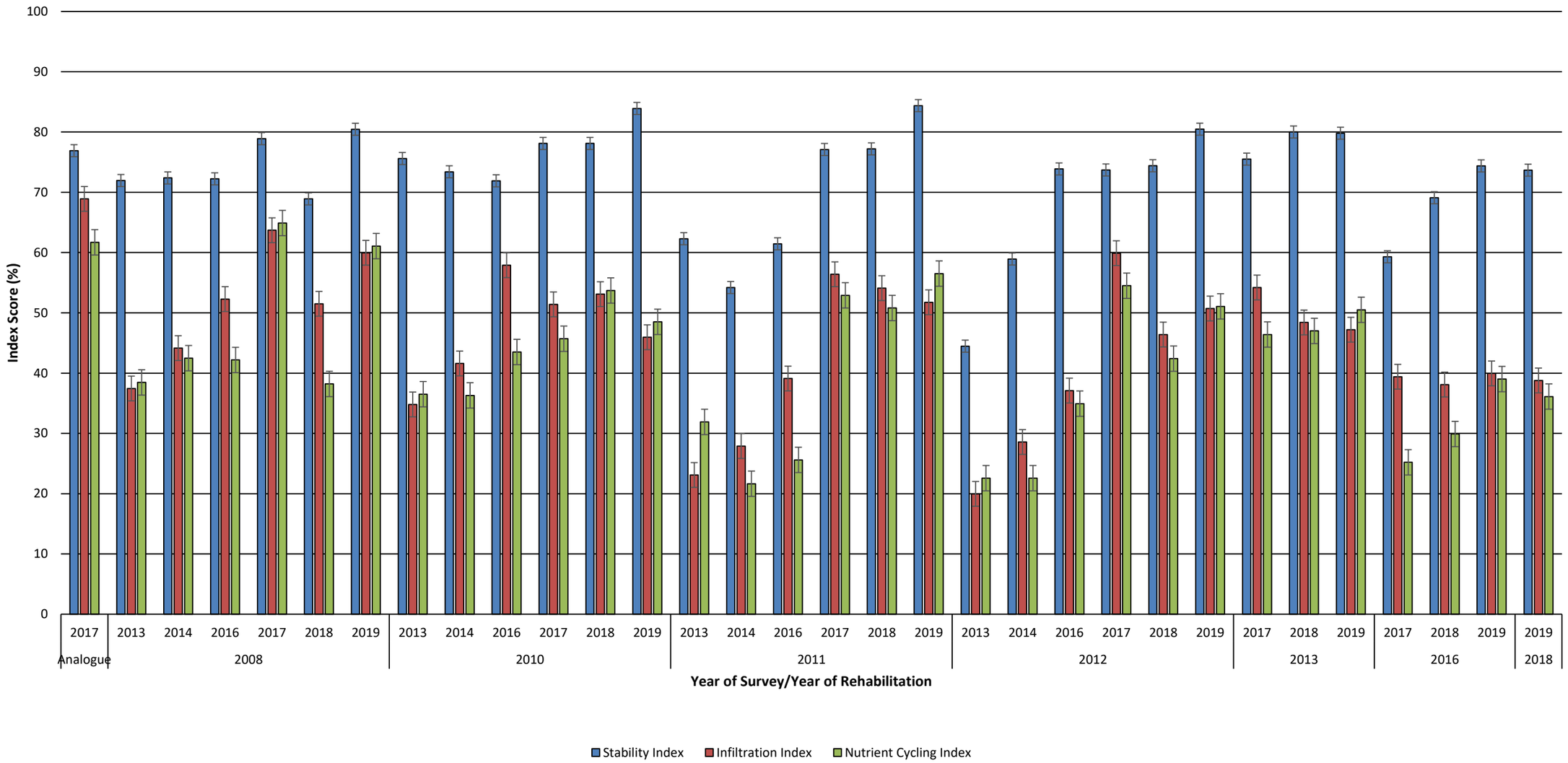


Figure 3: **Landscape Functional Analysis results for the surveys for the different aged rehabilitation areas on the Duralie Coal Mine spoil emplacement and comparison to the 2017 average analogue sites derived from the Biodiversity Offsets Areas. Standard Error bars are shown where statistically valid, i.e. three or more transects in that age cohort for the 2019 survey**

3.2 VEGETATION DENSITY AND STRUCTURE

Vegetation density and structure numerical data from the 2019 survey are presented in **Table 6** with graphical representation of this data in **Figure 4** and **Figure 5.**

3.2.1 2008 Rehabilitation

This survey of the 2008 transects recorded average stem densities at 2068 plants/ha, and woody vegetation volume was 34,924 m^3/ha.

Transect 3045 (**Plate 3**) recorded 1512 plants/ha made up of *Corymbia maculata* and *Eucalyptus punctata* in the canopy (8 - 20m). Many regenerating *E. punctata* and *C. maculata* plants were recorded in the midstory layer with a height range of 1.2m - 7m. The lower layer was made up of "shrubs" 0.8m – 8m in height.

Transect 3444 (**Plate 7**) recorded a total of 7107 stems/ha. This was divided between a canopy stratum composed of *C. maculata, E. punctata* and fewer ironbarks identified as *E. fibrosa* (584 stems/ha) that was between 11m and 15m in height. This secondary stratum was made up of smaller *C. maculata* and Eucalypts between 2.2m and 10m in height (4129 stems/ha). The shrub layer also included Eucalypt saplings as well as *Acacia irrorata* and *A. falcata.*

Transect 3045 recorded 33061m3/ha of woody vegetation, with Eucalypts accounting for 18,778m3/ha and 10,048m3/ha respectively within the canopy and regenerating layers. The woody vegetation volume of Transect 3444 was 48,044 m^3/ha with the canopy stratum accounting for 38516 m^3/ha of this area.

The ground cover in this area is litter dominated, but other native species identified included the shrubs *L. juniperinus, Breynia oblongifolia, Exocarpos cupressiformis* with other species *Lomandra longifolia, Dichondra repens, Glycine spp.,* and *Pratia purpurascens* observed in the in the surrounding area.

Weeds observed in the vicinity of the transect included extensive *Lantana camara* (Lantana) and *Solanum mauritianum* (Wild Tobacco).

3.2.2 2010 Rehabilitation

The 2010 area (Transect 3454) (**Plate 9**) recorded an overall stem density of 5378 stems/ha divided into three distinct strata. The canopy layer of *C. maculata* which was between 6m and 12m in height, recorded 645 stems/ha at an average spacing of 3.94m. The midstory layer consisted of the next generation of Eucalypt species of the same height, yet with smaller canopy size. The shrub layer consisted of *Acacia* species*, Leucopogon juniperinus* and *Pultenaea villosa* <2.5m tall with a density of 1477 stems/ha at an average spacing of 2.03m.

Total woody vegetation volume was calculated at 39,206 m^3/ha. This was divided into the canopy strata with 29,079 m^3/ha, the midstory with 8,650 m^3/ha and the lower shrubby strata with 1477 m^3/ha.

3.2.3 2011 Rehabilitation

The 2011 rehabilitation area (Transect 3048) (**Plate 13**) had a density of 5366 stems/ha consisting of three strata divided by height and species habit. The canopy stratum of *C. maculata* and *E. punctata* ranged in height from 9.0m to 15.0m with a density of 961 stems/ha at an average spacing of 3.23m. The "midstory" strata consisted of a mix of *Acacias* at 2792 stems/ha varying between 2.5 m and 13.0m at an average spacing of 1.89m. The lower stratum consisted of a mix of young Eucalypts 1.0 – 8.0m in height with 1612 stems/ha at an average spacing of 2.49m.

Total woody vegetation volume of 67,445 m^3/ha was divided between the strata with the canopy stratum holding 59,645 m^3/ha, the midstory stratum with 4370 m^3/ha and the shrub stratum holding 3430 m^3/ha.

Observations of the vegetation in this area suggest three generations of *Eucalyptus* and two generations of *Acacia* species. Weeds observed in the vicinity of this included *Lantana camara* (Lantana) and *Solanum mauritianum* (Wild Tobacco).

3.2.4 2012 Rehabilitation

The 2012 rehabilitation area is the largest area on the Duralie Spoil Emplacement and three transects were surveyed this year.

Transect 3041 (**Plate 16**) recorded a "canopy" stratum of *C. maculate* and *E. punctata* between 1.0 and 12m at 419 stems/ha at an average spacing of 4.9m. The lower midstory/shrubby stratum of *Acacia irrorata* and one Eucalypt sapling between 1.2m and 5.5m in height was calculated at 936 stems/ha with an average spacing of 3.27m. Woody vegetation cover had a total of 12,018 m^3/ha with the midstory making up the larger portion of this volume at 2,061 m^3/ha. This area had extensive *Acacia* die-off and was very open with exotic grasses the dominant ground cover.

Transect 3054 (**Plate 18**) recorded an overall stem density of 3290 stems/ha. This consisted of a Eucalypt stratum – predominantly *C. maculata* – that was between 0.8m and 12m in height at 713 stems/ha and an average spacing of 3.75m. The second stratum consisted of *Acacias* (*A. irrorata* and *A. falcata*) that were between 0.5m and 10m and recorded 2577 stems/ha at an average distance of 1.97m.

The volume of woody vegetation cover for Transect 3054 was the highest of all transects, at 77,665 m^3/ha. Eucalypt species accounted for 26,309 m^3/ha of this while *Acacia* spp. recorded a total of 51,356 m^3/ha.

Weeds observed in the vicinity of Transect 3054 included *Lantana camara* (Lantana) and *Solanum mauritianum* (Wild Tobacco).

The final transect in this rehabilitation area, Transect 3466 had Eucalypts (*C. maculata* and *E. punctata*) between 7m and 14m in height at 1032 stems/ha and an average spacing of 3.1m, making up the canopy stratum. The second stratum was much denser at 4444 stems/ha and consisted exclusively of *Acacias* (*A. falcata, A. implexa,* and *A. irrorata*) between 2.5m and 10m in height at an average spacing of 1.5m. The shrub stratum was made up of regenerating Eucalypts, between 0.2m and 7m, with 1859 stems/ha spaced out at 2.32m apart and a total woody vegetation volume of 3,136 m^3/ha. Woody vegetation was recorded at a total of 51,030 m^3/ha for Transect 3466, with Eucalypts in the canopy making up 33,613 m^3/ha, and the midstory calculated at 14,281 m^3/ha.

This transect was very densely covered by the above vegetation and ha d few weeds and very little groundcover, with litter providing 100% cover.

3.2.5 2013 Rehabilitation

The vegetation structure of the 2013 rehabilitation area (transect 3503) (**Plate 24**) was recorded as two strata. The first was composed of Eucalypts – mostly *C. maculata* – varying in height from 0.5m to 9.0m at 345 stems/ha and an average spacing of 5.38m. The second stratum composed of *Acacias* (*A. falcata, A. implexa,* and *A. irrorata*) varied from 1.2m to 8m in height at 3247 stems/ha with an average spacing of 1.76m.

Total woody vegetation volume was 22,373 m^3/ha. The *Eucalyptus* stratum was only 1145 m^3/ha, while the *Acacia* stratum held 21,229 m^3/ha.

3.2.6 2016 Rehabilitation

Two transects were surveyed in the 2016 rehabilitation. Transect 3501 (**Plate 27**) faces west, and while the rehabilitation is young, Eucalypt stems were recorded for the first year (402/ha), however these are still relatively sparse at 4.99m between stems and a canopy volume of 463 m^3/ha. *Acacia* species in the second stratum ranged from 0.3m to 4m in height, with a total of 3,156 stems/ha making up 5,754 m^3 of a total 6,216 m^3/ha for the transect.

Transect 3502 (**Plate 29**) has a southerly aspect and again all stems - *Acacia* and shrub species - were measured. This produced a stem density figure of 9539 stems/ha with all stems recorded being 0.4 – 4m in height. Stem spacing was 2.42m in the midstory and 1.13m for the shrubby layer with a total woody vegetation volume of 16,756 m^3/ha.

3.2.7 2018 Rehabilitation

One new transect (3504) (**Plate 31**) was established in the 2019 monitoring round. However, the age of the rehabilitation is young, and the intended land use is grazing - there were no stems to measure.

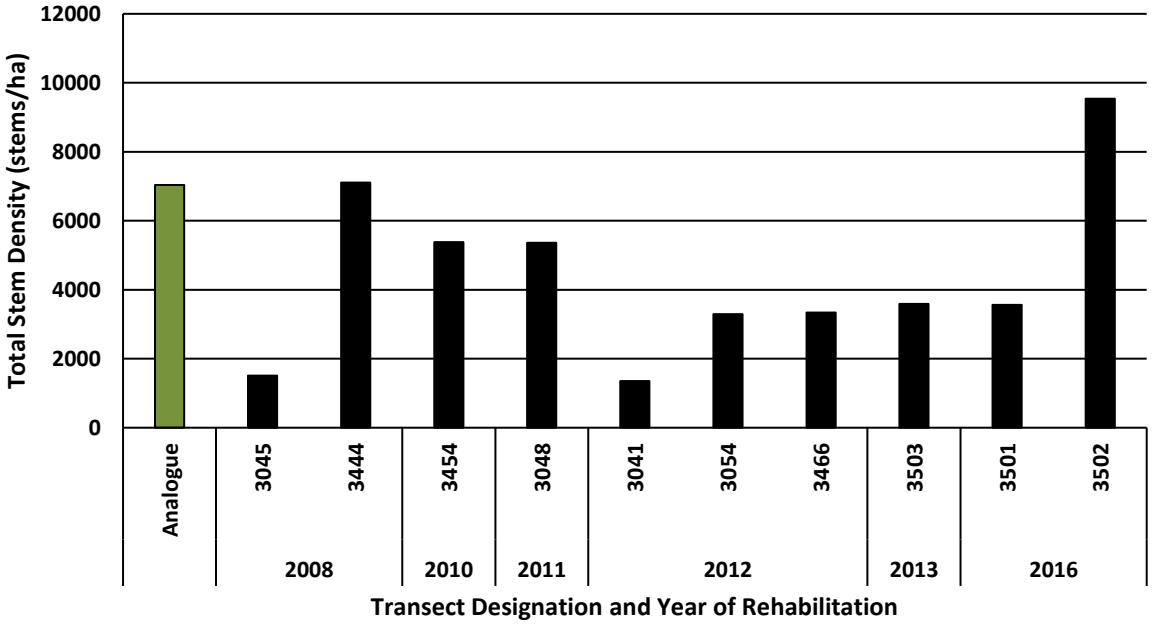


Figure 4: **2019 survey data Total Stem Densities for the Duralie Spoil Emplacement LFA Transects compared to average Analogue data surveyed in 2017**

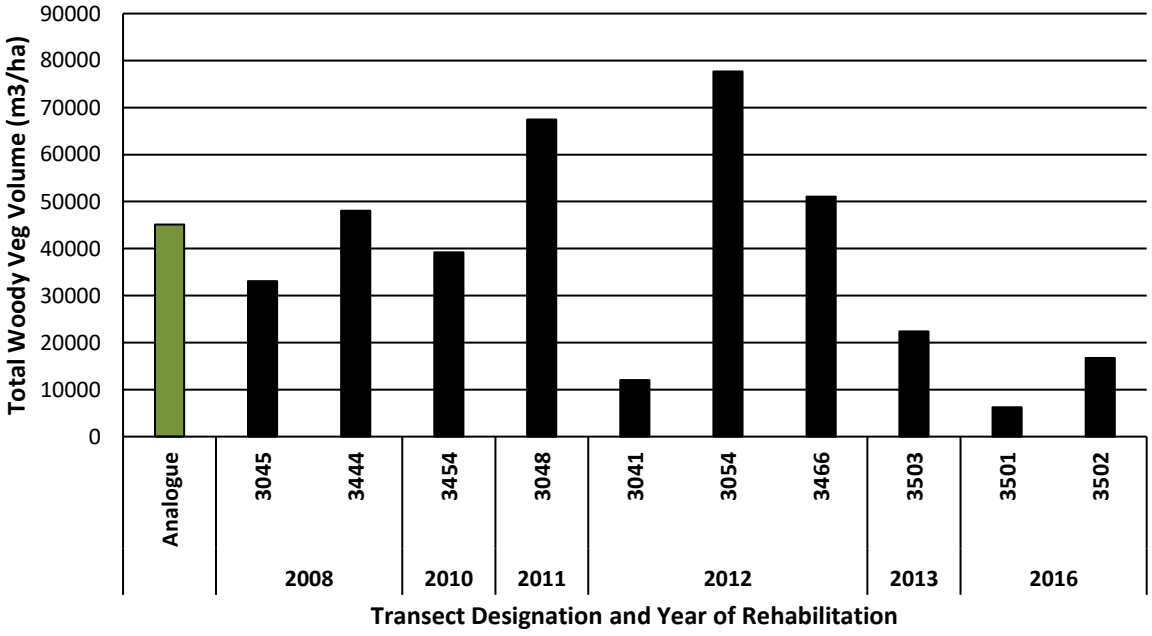


Figure 5: **2019 survey data Total Woody Vegetation Volume for the Duralie Spoil Emplacement LFA Transects compared to average Analogue data surveyed in 2017**

Table 6: 2019 survey stem densities and canopy volume of the woody vegetation for the Duralie Coal Mine spoil emplacement monitoring transects and the Average Analogue site values derived from the Biodiversity Offsets areas

Year Rehab	Transect	Canopy			Midstory			Shrubs			Total	Total	Comments
		Density (stems/ha)	Distance between stems (m)	Canopy Volume (m^3/ha)	Density (stems/ha)	Distance between stems (m)	Canopy Volume (m^3/ha)	Density (stems/ha)	Distance between stems (m)	Canopy Volume (m^3/ha)	Stem Density (stems/ha)	Woody Veg Volume (m^3/ha)	Attributes Measured
Average Analogue (2017)		188.2	7.60		1320.7	3.80		5528.3	2.20		7037.2	45121.2	
2008	3045	258	6.23	18778	777	3.59	4235	476	4.58	10048	1512	33061	*Eucalyptus* spp. (8 - 12m), juvenile *Eucalyptus* spp. (2 - 7m) Acacia spp. & shrubs (<2m)
	3444	584	4.14	38516	4129	1.56	9268	2394	2.04	260	7107	48044	*Eucalyptus* spp./*Corymbia* (11 - 15m), juvenile *Eucalyptus/Corymbia* spp. (2 - 10m), Juvenile Eucalypts *Acacia* spp./, shrubs (>2m)
2010	3454	645	3.94	29079	2295	2.09	8650	2439	2.03	1477	5378	39207	*Corymbia maculata* (7 - 12m*), Corymbia maculata/Eucalyptus* spp (2 - 10m), *Acacia* spp. & shrubs (>2m)
2011	3048	961	3.23	59645	2792	1.89	4370	1613	2.49	3430	5366	67445	*Eucalyptus* spp. (9 - 15m), *Acacia* spp. (2 - 11m), juvenile *Eucalyptus* (1m – 7m)
2012	3041	419	4.89	9957	936	3.27	2061	0	0	0	1355	12018	Canopy/*Eucalyptus* spp. (2 – 12m) and *Acacia irrorata* (1.5 - 5m)
	3054	713	3.75	26309	2577	1.97	51356	0	0	0	3290	77665	Canopy of *Eucalyptus* spp. and Midstorey of Acacias and juvenile *Eucalyptus* spp.
	3466	1032	3.11	33613	4444	1.50	14281	1860	2.32	3136	3337	51030	Canopy of *Eucalyptus* (7 – 14m), Midstorey of *Acacia* spp (>2 – 10 m) and Shrub of juvenile *Eucalyptus* spp (up to 4 m) strata
2013	3503	345	5.38	1145	3247	1.76	21229	0	0	0	3592	22373	Potential Canopy of juvenile *Eucalyptus* spp. (1 – 4m), Mid story of *Acacia* spp (2 – 7m),
2016	3501	402	4.99	463	0	0	0	3156	1.78	5754	3558	6216	Potential Canopy of juvenile *Eucalyptus* spp. and Shrub strata
	3502	0	0.00	0	1708	2.42	15508	7831	1.13	1248	9539	16756	Midstory of *Acacia* spp (>2m) and Shrub and *Acacia* spp. (< 2m) strata
2018	3504	0	0	0	0	0	0	0	0	0	0	0	No woody plants present

3.2.8 Historical Comparison

The results of the 2019 survey are compared to the previous surveys in **Figure 6** for Average Stem Densities and **Figure 7** for Average Woody Vegetation Volume.

The 2008 rehabilitation has rebounded somewhat from the figures recorded last survey (**Figure 6**) increasing from an average of only 850 stems/ha in the 2018 survey to an average of 4309 stems/ha. This level is comparable with the 2013 – 2016 surveys. Average Woody vegetation volume has however, increased dramatically to levels comparable with 2016 and 2017 surveys with 46, 082 m^3/ha (**Figure 7**).

The 2010 rehabilitation also recorded a substantial increase in stem density this survey compared to the previous survey but has not recovered to previous levels. The 2018 survey recorded 1860 stems/ha – the lowest recorded for this area – compared to 5378 stems/ha this survey. Average wood vegetation volume has substantially increased over the period of the surveys and is now at its highest recorded level of 39, 206 m^3/ha.

The 2011 rehabilitation area recorded a substantial decrease in stem density with 5,366 stems/ha measured this year compared to 22,531stems/ha for the previous year. This apparent discrepancy will be discussed further in Section 4. Canopy volume has continued to increase over the course of the surveys, with a substantial increase recorded this survey. Canopy volume 67,444 m^3/ha compared to 20, 317 m^3/ha last survey.

The 2012 rehabilitation has recorded a steady decline in stem densities over the period of the surveys with this survey recording the least – 2660 stems/ha. Canopy volume has, as with other rehabilitation areas increased with each survey to reach the highest volume recorded of 46, 904 m^3/ha.

The 2013 rehabilitation recorded a small decrease in stem density from 4146 stems/ha to 3592 stems/ha, continuing the downward trend over the three monitoring events. Average woody vegetation volume has increased substantially to 22,373 m^3/ha compared to 5613 m^3/ha recorded the previous survey, and slightly higher than the volume of 17,800 m^3/ha recorded in 2017.

The 2016 rehabilitation has increased the average stem density from the 2018 survey (4988 stems/ha) with 6548 stems/ha in 2019 and continues the upward trend. Canopy volume has also continued to increase, recording a substantial jump to 11,486 m^3/ha compared to 2168 m^3/ha for 2018.

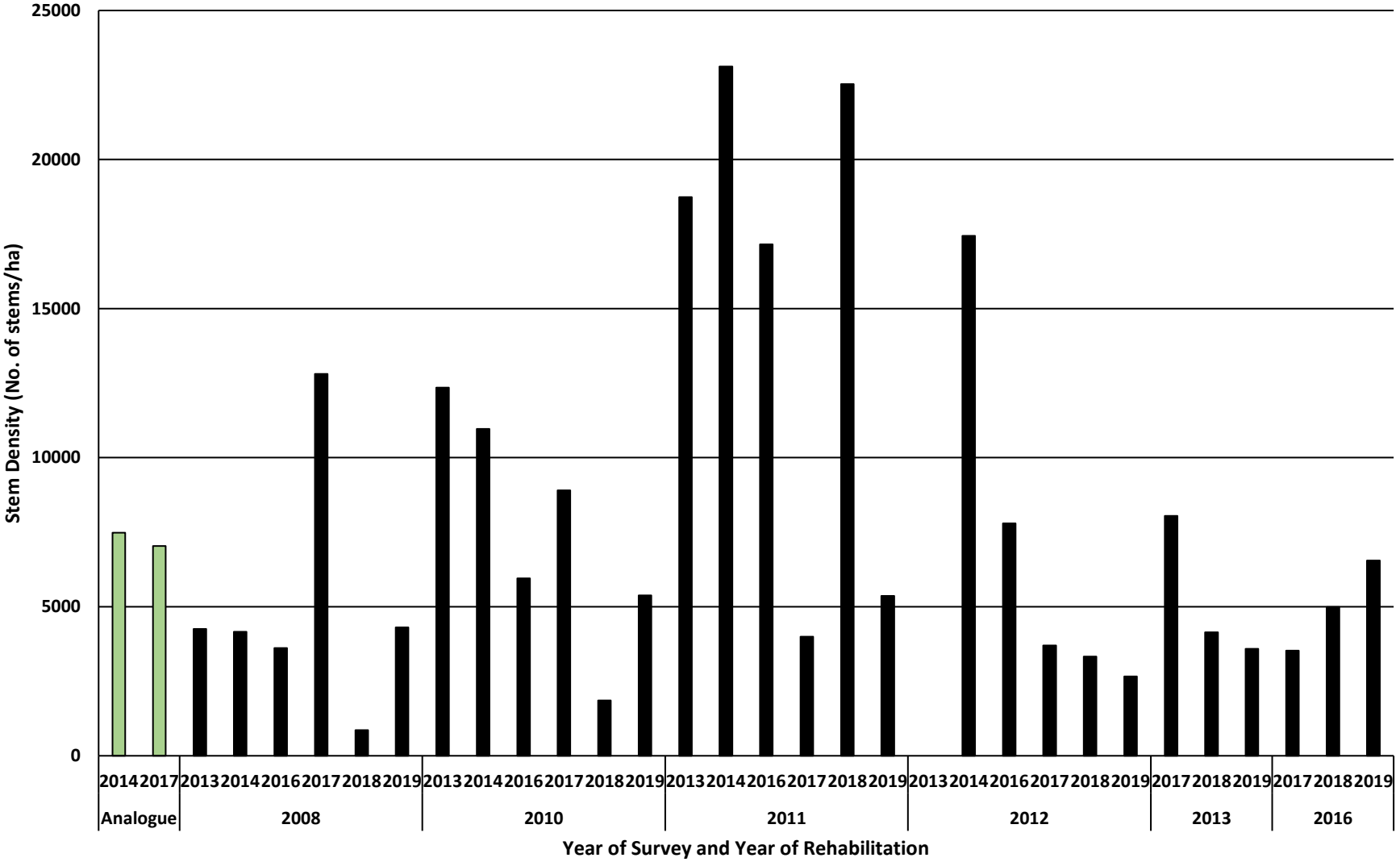


Figure 6: **Average Total Stem Density (stems/ha) values recorded from the 2019 survey, comparison to previous surveys and the 2017 Average Analogue values derived from the Biodiversity Offsets Areas**

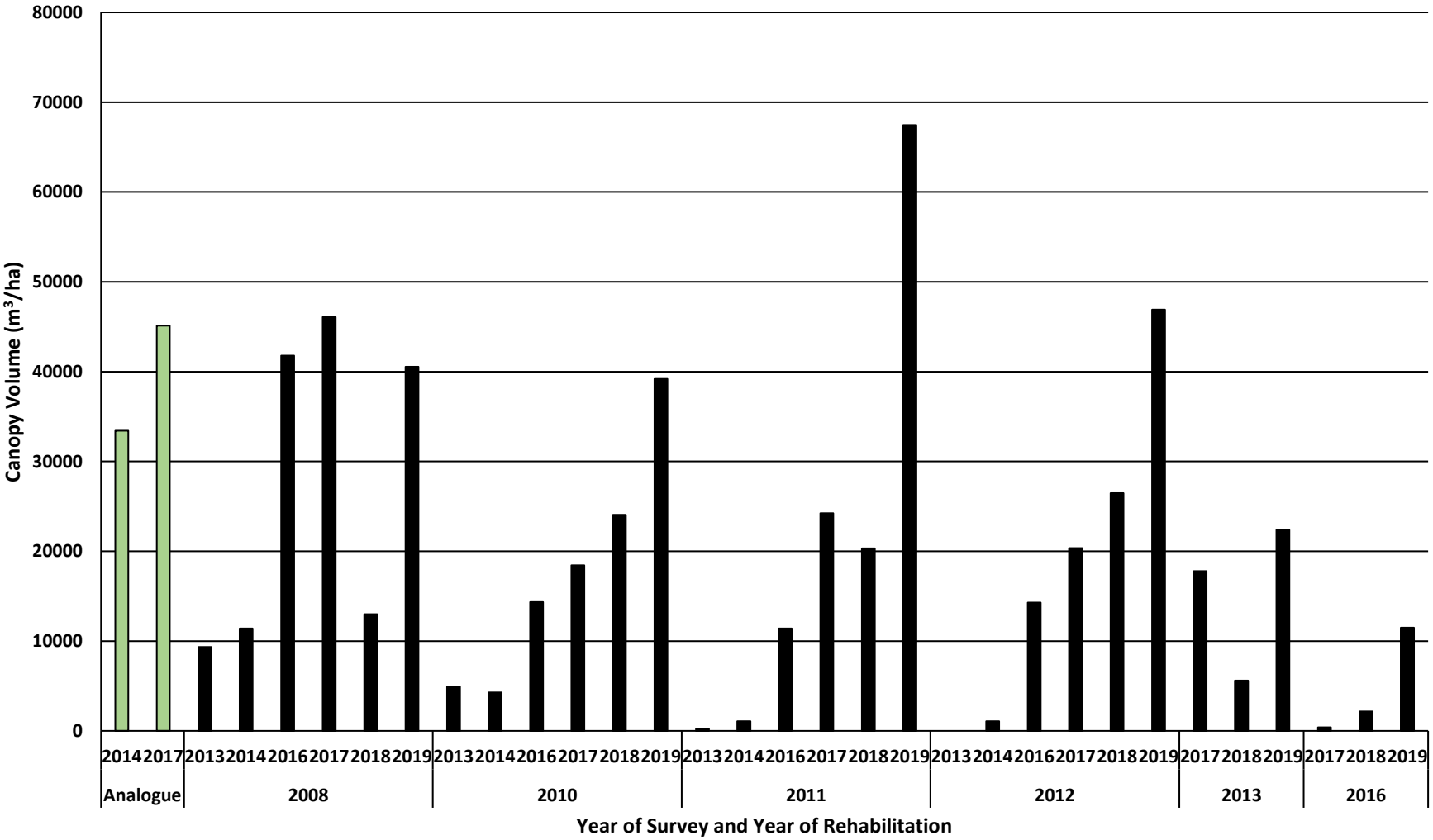


Figure 7: **Average Total Woody Vegetation Volume (m^3) values recorded from the 2019 survey, comparison to previous surveys and the 2014 and 2017 Average Analogue values derived from the Biodiversity Offsets Areas**

4. DISCUSSION AND RECOMMENDATIONS

Soil surface indicators for the various ages of rehabilitation are overall positive and indicate progression towards sustainable ecosystem functions. There are variations for some of the indicators for some of the ages of the rehabilitation (discussed below) but since the commencement of monitoring, the trend has been towards the analogue values.

The LFA indices continue to trend in the direction of the of analogue values, a feature that has been noted in previous reports. The Stability Index scores for the older rehabilitation areas have achieved or exceeded Analogue values, with the most recent rehabilitation areas approaching these values. This again highlights that the composition of the underlying spoil, the construction of the spoil emplacements themselves combined with the topsoil treatment contributes significantly to the stability. Further increases in the Stability Index will come from the build-up of litter and maturation of the vegetation itself. It is therefore pleasing to see that the Landscape Organisation Index scores – the arrangement of the soil surface into nutrient accumulating and shedding "patches" and "interpatches"– have become uniformly even across the rehabilitation areas. All LOI's were recorded as 1.00, indicating that the soil surfaces of the transect areas were not shedding resources, but accumulating nutrients and able to limit rain run-off. Within the rehabilitation areas, there tends to be two main patch types identified. Where the canopy has thinned out due to *Acacia* die-off, grassy sward dominates (**Plate 1**), whereas under the dense plantings – especially dense *Eucalyptus* – litter is the dominant ground covering (**Plate 2**). Either type of patch serves to stabilise the soil surface and traps and recycles nutrients.

Despite some of the issues that are associated with the monitoring methodology – alternate/different transects monitored each year - the data recorded shows that the biophysical processes are on track for successful rehabilitation and no recommendation are made to attempt improvement or accelerate development.

The vegetation structure of the rehabilitation areas continues to develop with time as expected with young rehabilitation. While the data can be "noisy" due to the different transects selected for monitoring, some trends can be discerned from the data.

Plate 1: **Transect 3041 (2008 rehab) – looking down LFA transect. Note the open nature of the woody vegetation due to *Acacia* species die-off and the dense exotic groundcover**

Plate 2: **Photograph of Transect 3444 LFA in the 2008 rehabilitation area. Note the dense Eucalypts, litter layer and sparser groundcover**

Stem densities are variable across many of the rehabilitation areas (**Figure 6**). Partly this is an artefact of the transects monitored from year to year, but some direct comparisons can be made. The 2008 rehabilitation has recorded large swings in stem densities between surveys. The very low number of stems in the 2018 survey indicates that these two areas had a relatively

large proportion of *Acacia* species in the seed mix and these are now starting to senesce and die-off. The relatively sparser numbers of Eucalypts have not compensated for this die-off. In 2019 the areas surveyed both have a greater proportion of Eucalypts, especially the area represented by Transect 3444 located at the southern extremity of the emplacement as shown in **Plate 2**. The 2010 rehabilitation area has recorded a steady decrease in stem densities over the course of the monitoring and comparison to previous surveys shows that this has occurred regardless of the transect surveyed. This age of rehabilitation still has far greater numbers of canopy stems when compared to the Analogue values and less than half the number of shrub sized plants in that stratum (**Table 6**). The overlap in the size ranges of the Eucalypts indicates that natural regeneration is occurring. The stem densities in the 2011 rehabilitation area are on the increase and given the locations of the monitoring transects in this area, it can be seen that the lower bench area (Transect 3046) surveyed in 2016 and 2018 has a much higher stem density than the upper bench area (Transect 3454) surveyed in 2017 and 2019. The height ranges of the Eucalyptus again suggest that there has been successful recruitment from the planted species. The 2012 rehabilitation appears to have steadily decreasing stem numbers over the surveys.

The 2013 rehabilitation area is dominated by *Acacia* species of varying ages, with a sparser number of Eucalypts, although as is common throughout the rehabilitation, at 345 stems/ha this is still much higher than the average Analogue values. The 2016 rehabilitation areas have a much greater density of true shrub species (as opposed to juveniles of species that will mature into small and large trees) that were included in the original seed mix. Both areas have low numbers of Eucalypts, with Transect 3502 recording no Eucalypt species at all. Transect 3501 canopy (Eucalypt) stem numbers are much lower the calculated 402 stems/ha (**Table 6**) as the numbers recorded in the field were below the statistically required number to accurately calculate. However, this may improve as the young Eucalypts grow taller and are able to be seen above the grasses.

A major point of difference between the Analogue sites and the rehabilitation areas is the distribution of the vegetation strata, with higher canopy species densities recorded in all rehabilitation areas except for the 2016 rehabilitation surrounding Transect 3502 where no canopy species were recorded. These high densities of Eucalypts and faster growing *Acacia* species do result in a less dense shrub stratum. When compared to the Analogue site data (**Table 6**) the rehabilitation areas have a fewer numbers of these “true” shrub plants, i.e. species that will not grow beyond 1-2m in height. At present most of the stems measured in the shrub category are younger examples of species that will form canopy or midstory, and once they reached maturity the vegetation structure may not have the structure of the Analogue

sites. In these sites most of the stems are in the shrub stratum (approximately 550 stems/ha) with relatively few canopy stems (188 stems/ha) and a moderately dense 1321 stems/ha for the midstory. The 2016 rehabilitation has rectified this to a major degree with a higher proportion of true shrub species, and a lower density of canopy plants that will more closely resemble analogue conditions. While the shrub numbers are low, it is pleasing to report that shrubs species are beginning to appear in the older rehabilitation areas. As noted in Sections **3.2.1** and **3.2.2** observations of native species show that a few additional species have become established including *Leucopogon juniperinus* and *Lomandra longifolia.* The *Leucopogon* is a very good result as this was seeded and given that it has only appeared in the 2008 and 2010 rehabilitation areas, it is presumed to have been naturally dispersed from the adjacent PAF area where it has been observed to be very common. The appearance of native ground covers in the 2008 rehabilitation, under dense canopy where litter is the dominate ground cover bodes well for the establishment of more natural native vegetation at all strata. Comparison to the 2016 rehabilitation areas once the canopy develops in these areas will provide insight into which approach results in better native revegetation.

4.1 RECOMMENDATIONS

Recommendations suggested for the 2019 rehabilitation report include:

- The area represented by Transect 3502 requires seeding or planting with canopy – this area recorded no canopy species in the vicinity of the transect.
- Older areas of the rehabilitation where *Acacia* die back has occurred and opened-up the area to sunlight (becoming dominated by exotic grasses) could be seeded with shrub species not included in the original seed mix to increase diversity.
- More generally further introduction of a wider variety of shrub species, especially those that do not spread by avian fauna could be facilitated with a modest seeding and/or planting program.
- *Leucopogon juniperinus* (Prickly Beard-heath) is a common species through the analogue sites but is not provided commercially. It would be beneficial to attempt to collect seed from on site to use in the rehabilitation introducing it to younger rehabilitation areas or where it has not yet colonised. The PAF area and VMU AG both have dense populations of this specie and it may be possible to collect seed from these areas. PlantNET states that seed are mature from August to January.
- Woody weed control works should be undertaken in the areas identified above where Lantana and Wild tobacco (and Privet identified during other work undertaken the spoil emplacement) have become established.

- As part of the above the drains could be slashed to provide access for weed control works and to provide fire breaks.

4.2 CONCLUSIONS

The rehabilitation of the Duralie spoil emplacement continues to be on track for successful re-establishment of native woodland and pasture. The Landscape Functional Analysis indices have either achieved analogue or on track to achieve analogue values. Vegetation will take much longer to achieve “natural” woodland vegetation structure and composition, but indications from the older rehabilitation areas show that this is occurring. Species diversity is improving and seeding with further shrub species would increase the rate of diversification.

5. REFERENCES

Duralie Coal Mine – Biodiversity Offset Monitoring of Landscape Function and Vegetation Structure (2014). Report prepared by Greening Australia for Yancoal Pty Ltd

Duralie Coal Mine – Biodiversity Offset Monitoring of Landscape Function and Vegetation Structure (2017). Report prepared by Kleinfelder Australia for Yancoal Pty Ltd

Duralie Coal Mine - Biodiversity Management Plan 2017. Report prepared by Greening Australia for Yancoal Pty Ltd

Duralie Coal Mine – Mining and Operations Plan and Rehabilitation Management Plan (2017). Report prepared by Yancoal Pty Ltd

Duralie Coal Mine – 2016 Duralie Rehabilitation Monitoring Report (2016). Report prepared by Kleinfelder for Yancoal Pty Ltd

Duralie Coal Mine – 2017 Duralie Coal Mine Rehabilitation Monitoring Report (2017). Report prepared by Kleinfelder for Yancoal Pty Ltd

Duralie Coal Mine – 2018 Duralie Coal Mine Rehabilitation Monitoring Report (2018). Report prepared by Kleinfelder for Yancoal Pty Ltd

Landscape Function and Vegetation Structure Monitoring Report of Mine Site Rehabilitation at the *Duralie Coal Mine* December 2014. Report prepared by Greening Australia for Yancoal Pty Ltd

Tongway, D. and Hindley, N. (2004b) *Landscape Function Analysis: Procedures for Monitoring and Assessing Landscapes with special reference to Mine sites and Rangelands.* CSIRO Publishing, Canberra.

Tongway, D.J. and Ludwig, J.A. (2011). *Restoring Disturbed Landscapes: Putting Principles into Practice*. Island Press, Washington

APPENDIX 1. LANDSCAPE FUNCTIONAL ANALYSIS (LFA) AND VEGETATION STRUCTURE TRANSECT DATA

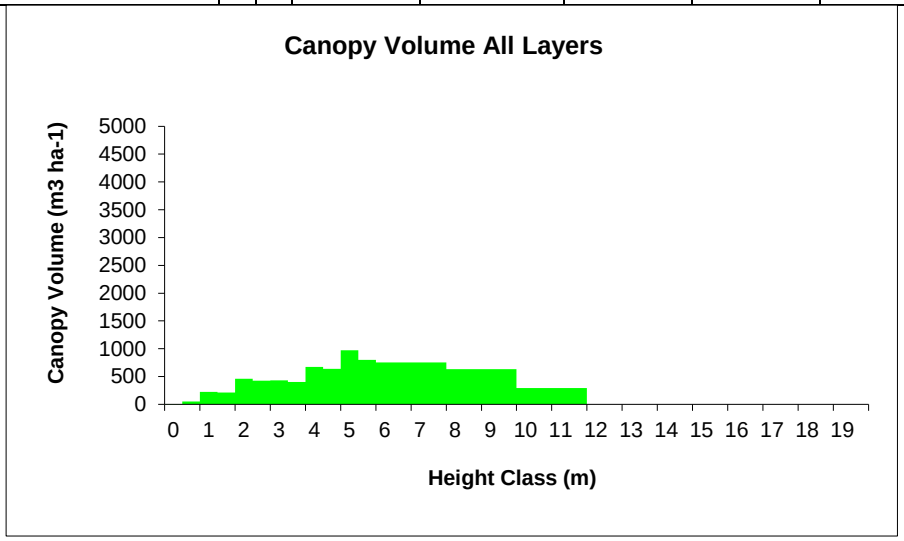
Table 7: Soil Surface Indicators for the LFA transects for the monitoring conducted to date. Transects are grouped by year of rehabilitation.

Year of Rehabilitation (No. of transects surveyed 2017)		Stability Index				Infiltration Index				Nutrient Cycling Index				Ave Distance Between Patches (m)				Ave Patch Width (m)			
		2013	2014	2016	2017	2013	2014	2016	2017	2013	2014	2016	2017	2013	2014	2016	2017	2013	2014	2016	2017
Analogue	Mean	71.7	73.2	-	76.9	46.4	53.5	-	68.9	40.6	47.1	-	61.7	5.8	0.7	-	0	-	-	-	6.63
(6)	SE	2.32	3.92		1.9	2.03	2.73		5.5	2.71	2.62		5.1	0.94	0.17						
2008	Mean	71.95	72.83	72.23	78.9	37.45	44.15	52.28	63.7	38.45	42.48	42.18	64.85	19.15	0.96	0.36	0	0.13	0.51	0.75	10
(2)	SE	2.31	3.61	3.34	0.8	3.96	2.97	5.09	0.9	4.72	3.39	4.52	5.56	5.85	0.58	0.36		0.13	0.25	0.21	
2010	Mean	76.5	73.4	71.9	78.1	34.8	41.6	57.9	51.4	36.5	36.3	43.5	45.7	25	0	0	0	0	1	1	10
(1)	SE	Not applicable																			
2011	Mean	62.3	54.2	61.45	77.1	23.1	27.9	39.1	56.4	31.9	21.65	25.6	52.9	13	7.98	1.54	0	1	0.9	0.89	10
(1)	SE	Not applicable																			
2012	Mean	44.47	58.93	73.87	73.7	19.97	28.57	37.1	59.9	12.2	22.57	34.93	54.5	0	3.16	0.4	0	0.00	0.32	0.76	0.67
(3)	SE	0.67	6.08	6.82	4.38	1.88	2.62	5.23	1.79	0.92	2.64	7.42	5.3	0	0.66	0.4		0	0.02	0.24	
2013	Mean				75.5				54.2				46.4				0				10
(1)	SE	Not applicable																			
2016	Mean				59.25				39.65				25.2				1.3				1.99
(2)	SE				1.75				3.65				6.4				0.3				

Vegetation Structure Data from 2019 Transects

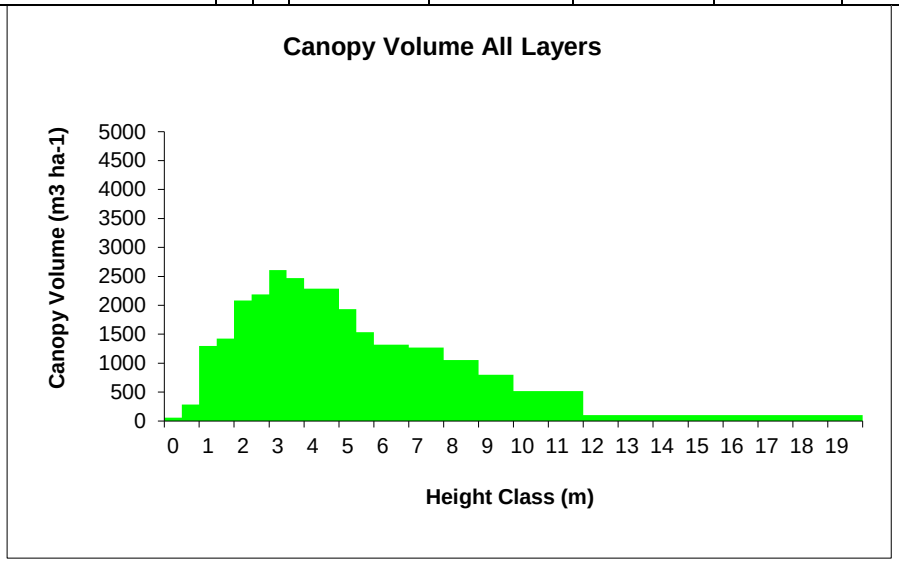
Transect 3041 - 2012 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	418.63	935.92	0.00	0.00	1354.54
Mean Distance /b/ plants	4.89	3.27	0.00	0.00	n/a
Canopy Volume/hectare	9957.15	2060.96	0.00	0.00	12018.11



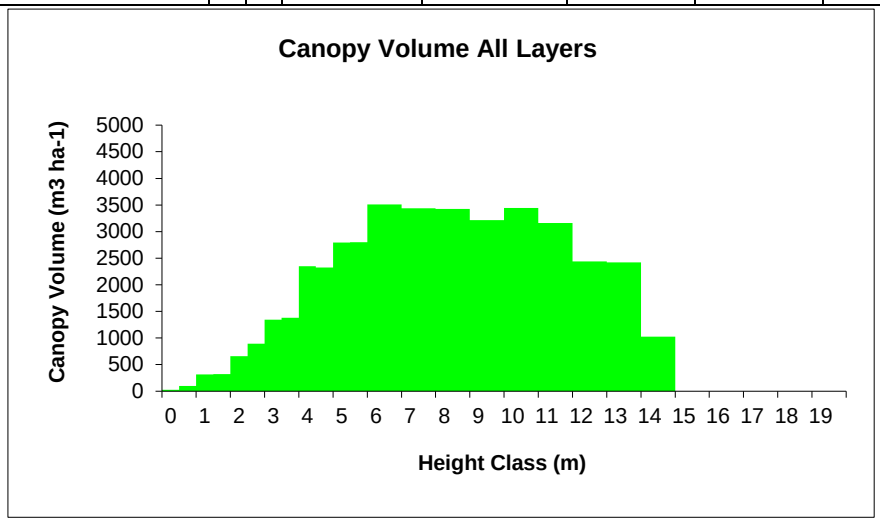
Transect 3045 - 2008 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	258.06	776.99	476.47	0.00	1511.52
Mean Distance /b/ plants	6.23	3.59	4.58	0.00	n/a
Canopy Volume/hectare	18778.35	4234.99	10048.12	0.00	33061.46



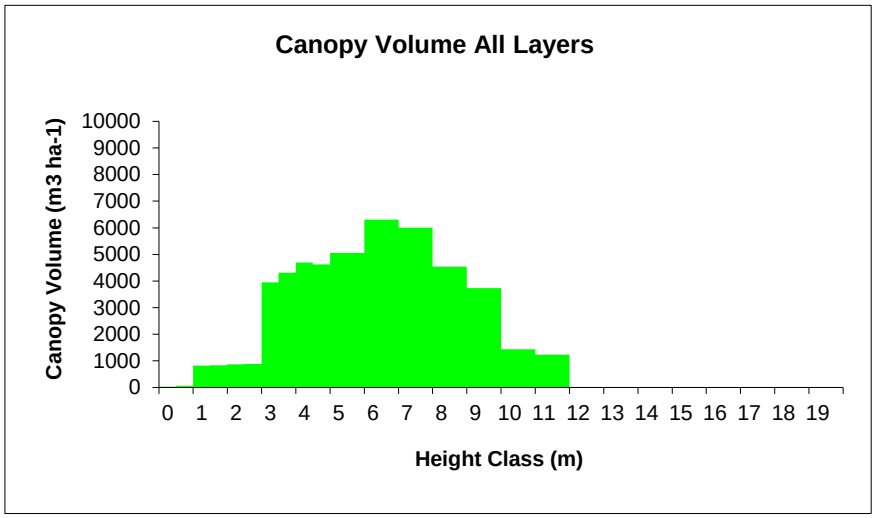
Transect 3048 - 2011 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	961.48	2792.08	1612.88	0.00	5366.44
Mean Distance /b/ plants	3.23	1.89	2.49	0.00	n/a
Canopy Volume/hectare	59644.71	4369.82	3430.44	0.00	67444.98



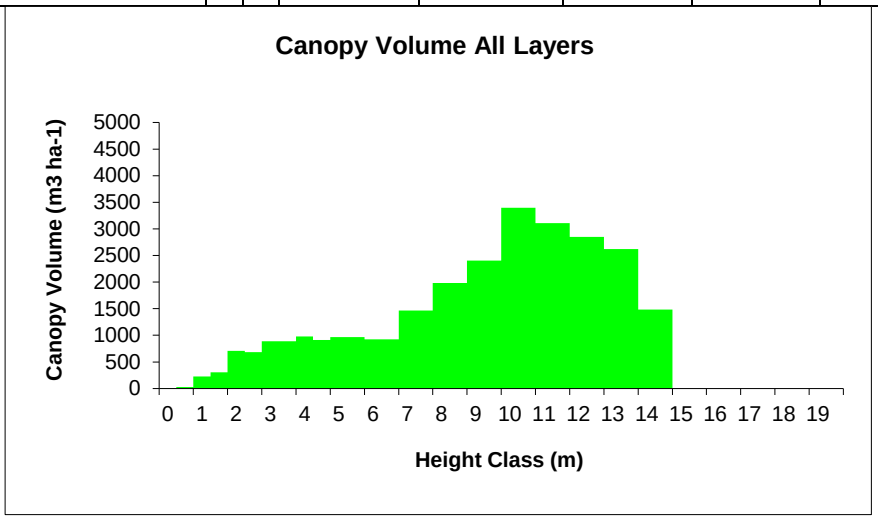
Transect 3054 - 2012 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	0.00	2576.72	713.01	0.00	3289.73
Mean Distance /b/ plants	0.00	1.97	3.75	0.00	n/a
Canopy Volume/hectare	0.00	51356.18	26309.25	0.00	77665.44



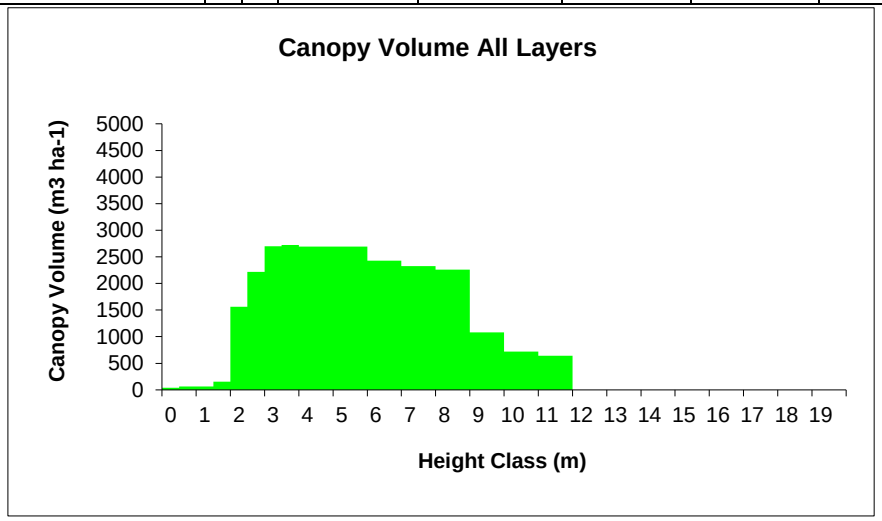
Transect 3444 – 2008 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	584.15	4128.97	2394.11	0.00	7107.23
Mean Distance /b/ plants	4.14	1.56	2.04	0.00	n/a
Canopy Volume/hectare	38516.04	9267.83	260.43	0.00	48044.30



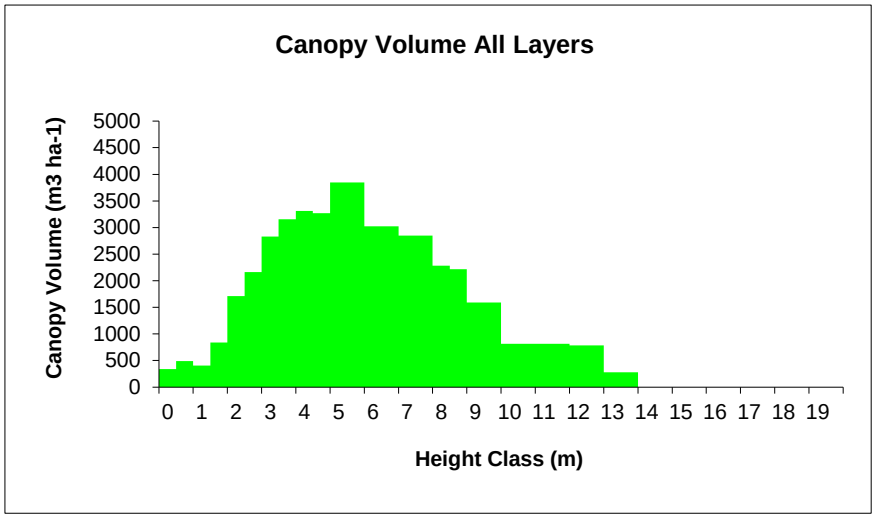
Transect 3454 – 2010 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	645.00	2294.81	2438.65	0.00	5378.46
Mean Distance /b/ plants	3.94	2.09	2.03	0.00	n/a
Canopy Volume/hectare	29078.97	8650.35	1477.45	0.00	39206.78



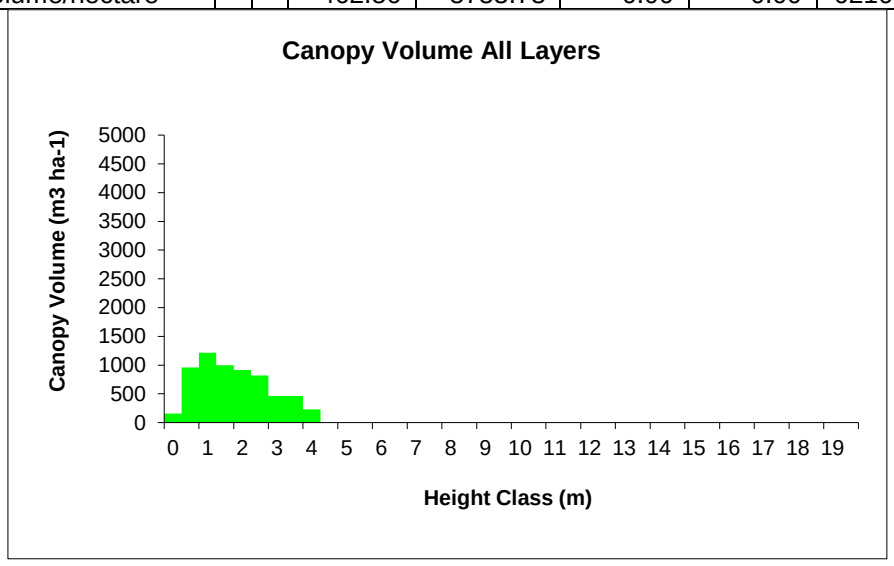
Transect 3466 – 2012 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	1032.24	4444.44	1859.91	0.00	7336.60
Mean Distance /b/ plants	3.11	1.50	2.32	0.00	n/a
Canopy Volume/hectare	33612.98	14280.74	3136.10	0.00	51029.82



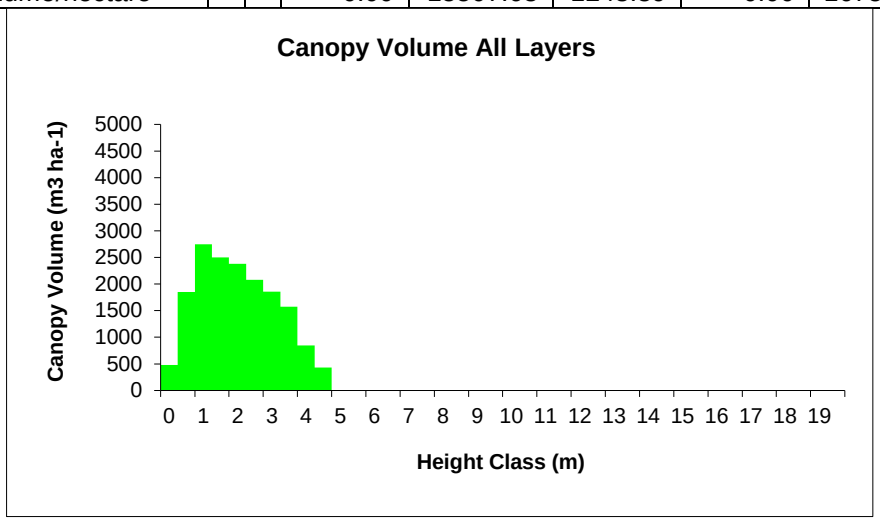
Transect 3501 – 2016 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	402.01	3156.17	0.00	0.00	3558.17
Mean Distance /b/ plants	4.99	1.78	0.00	0.00	n/a
Canopy Volume/hectare	462.56	5753.73	0.00	0.00	6216.29



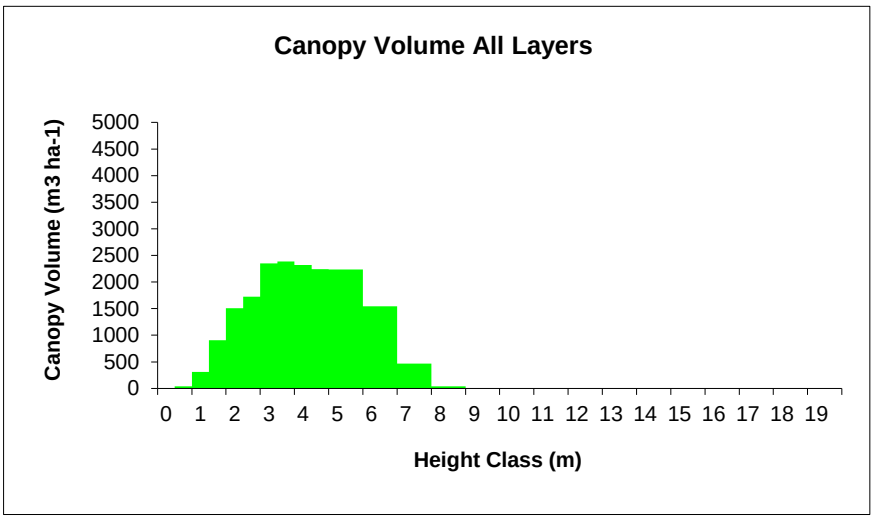
Transect 3502 - 2016 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	0.00	1707.53	7831.47	0.00	9539.00
Mean Distance /b/ plants	0.00	2.42	1.13	0.00	n/a
Canopy Volume/hectare	0.00	15507.68	1248.39	0.00	16756.07



Transect 3053 – 2016 Rehabilitation

Stratum	Canopy	Midstorey	Shrubs	Layer4	Total
No Plants/hectare	0.00	3246.73	345.49	0.00	3592.22
Mean Distance /b/ plants	0.00	1.76	5.38	0.00	n/a
Canopy Volume/hectare	0.00	21228.70	1144.75	0.00	22373.45



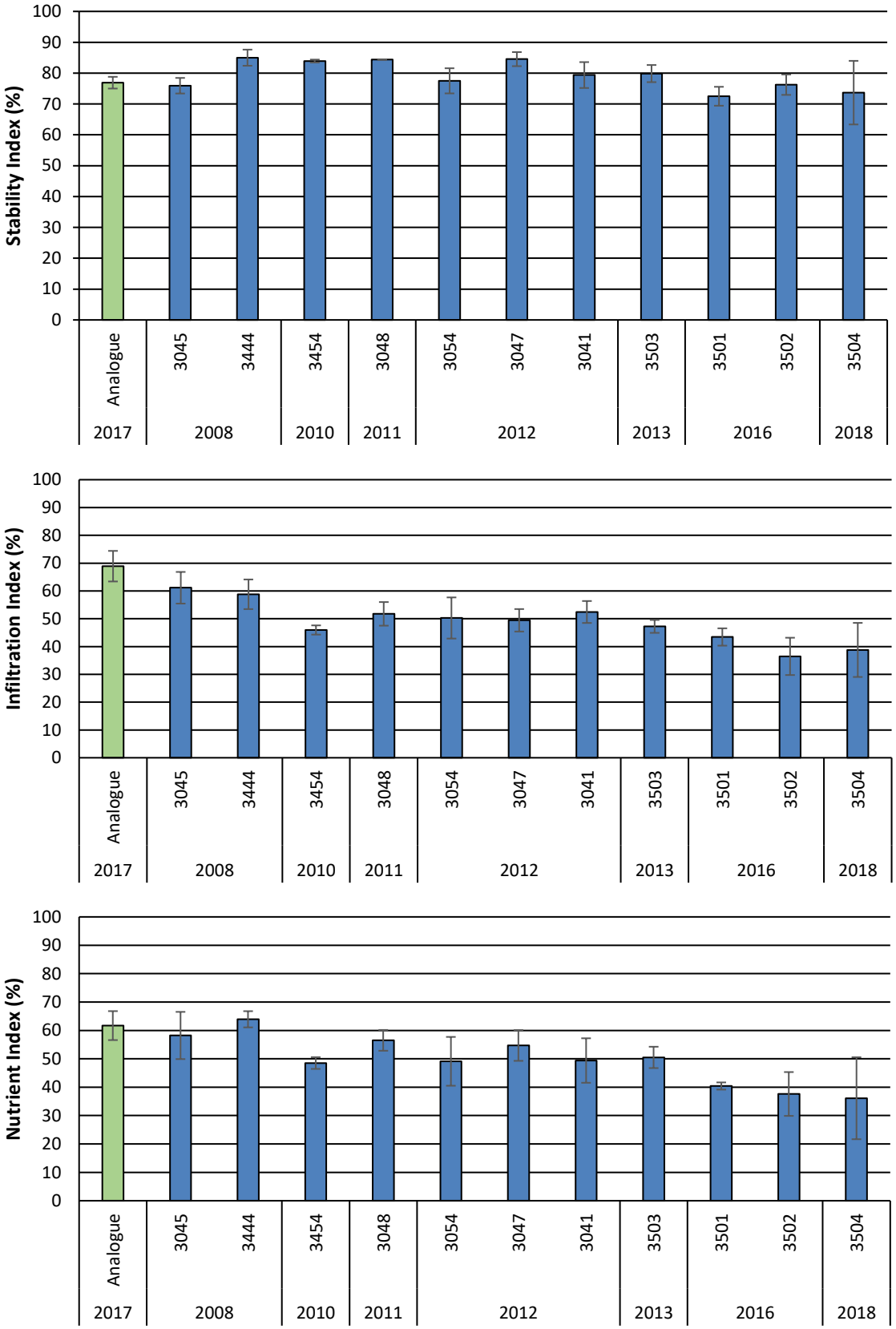


Figure 8: **Individual transect scores for the three LFA indices from the 2019 survey. Error bars are SE generated by the LFA software**

APPENDIX 2. TRANSECT MONITORING PHOTOGRAPHS

Plate 3: **Transect 3045 (2008 rehabilitation) looking down LFA transect.**

Plate 4: **Transect 3045 – view of typical groundcover taken at the 21-22m point on the LFA transect. Grassy sward and sparse litter cover.**

Plate 5: **Transect 3045 – view of typical groundcover taken at the 14.5-15.5m point on the LFA transect. Bare ground and sparse litter cover.**

Plate 6: **Transect 3045 showing groundcover at the 10-11m point**

Plate 7: **Top of Transect 3444 (2008 rehab) looking down LFA transect. Vegetation density increases down the transect.**

Plate 8: **Transect 3444 showing typical groundcover of dense litter at the 3-4m point on the LFA transect**

Plate 9: **Start of Transect 3454 (2010 rehabilitation) looking down LFA transect. Note the proliferation of saplings**

Plate 10: **Transect 3454 showing typical ground cover at the 1.5 – 2.5m point on transect**

Plate 11: **Transect 3454 groundcover at the 29-30m point**

Plate 12: **Transect 3454 showing litter under canopy groundcover on this transect**

Plate 13: **Top of Transect 3048 (2011 rehabilitation) looking down the LFA transect**

Plate 14: **Transect 3048 at the 15-16m point showing typical groundcover towards the middle of the transect**

Plate 15: Transect 3048 showing typical groundcover at the 10-11m point

Plate 16: **Start of Transect 3041 (2012 rehabilitation area) looking down the LFA transect**

Plate 17: **Transect 3041 showing typical grassy sward groundcover at 13-14m**

Plate 18: **Start of Transect 3054 (2012 rehabilitation area) looking down the LFA transect. This area is largely flat with the initial few metres regenerating from slashing**

Plate 19: **Transect 3054 at the 22-23m point showing typical groundcover pd litter and sparse grass**

Plate 20: **Start of Transect 3466 (2012 rehabilitation area) looking down the LFA transect**

Plate 21: **Transect 3466 at the 3m point showing the clumped nature of the grassy groundcover and grassy litter**

Plate 22: **Transect 3466 at the 21-22m point showing litter cover**

Plate 23: **Transect 3466 at the 30m point showing ground cover of sparse grass and litter**

Plate 24: **Start of transect 3503 (2013 rehabilitation) looking down the LFA transect**

Plate 25: **Transect 3503 groundcover at 15-16m**

Plate 26: Transect 3503 groundcover at 21 - 22m

Plate 27: **Start of Transect 3501 (2016 rehabilitation) looking down the LFA transect. Note the tall exotic grasses with native shrubs and canopy beginning to emerge**

Plate 28: **Transect 3501 groundcover at 17m along the transect**

Plate 29: **Start of Transect 3502 (2016 rehabilitation area) looking down the LFA transect. Native shrubs are increasing in size**

Plate 30: **Transect 3502 at the 8m point showing typical exotic grassy groundcover**

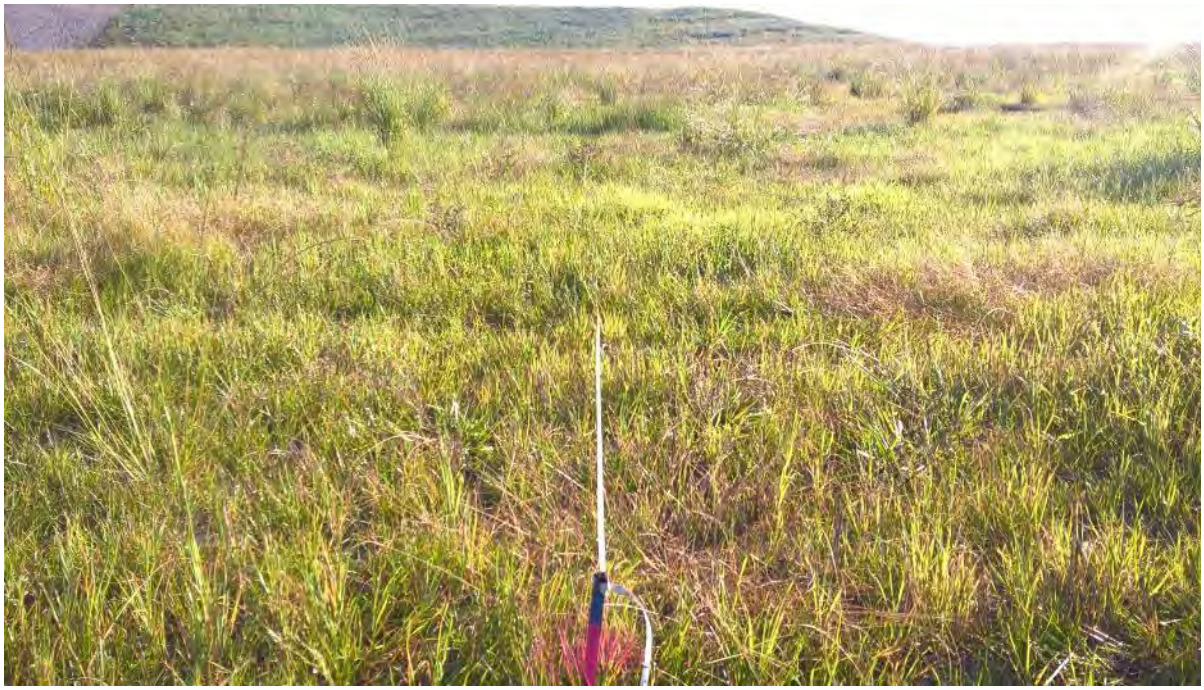


Plate 31: **Start of Transect 3504 (2018 rehab) looking along the transect**

Plate 32: **Transect 3504 at 4-5m showing typical groundcover for the transect**

APPENDIX 3. STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Gayle Joyce	BSc (Forestry) (Hons)	GIS Specialist	GIS & Mapping
Ashley Owen	DipSc. BEnvSc (In progress)	Ecologist	Field Work & Report Writing
Nigel Fisher	BSc (Hons) PhD	Senior Soil Microecologist and Project Supervisor	Field Work, Report Writing and Review